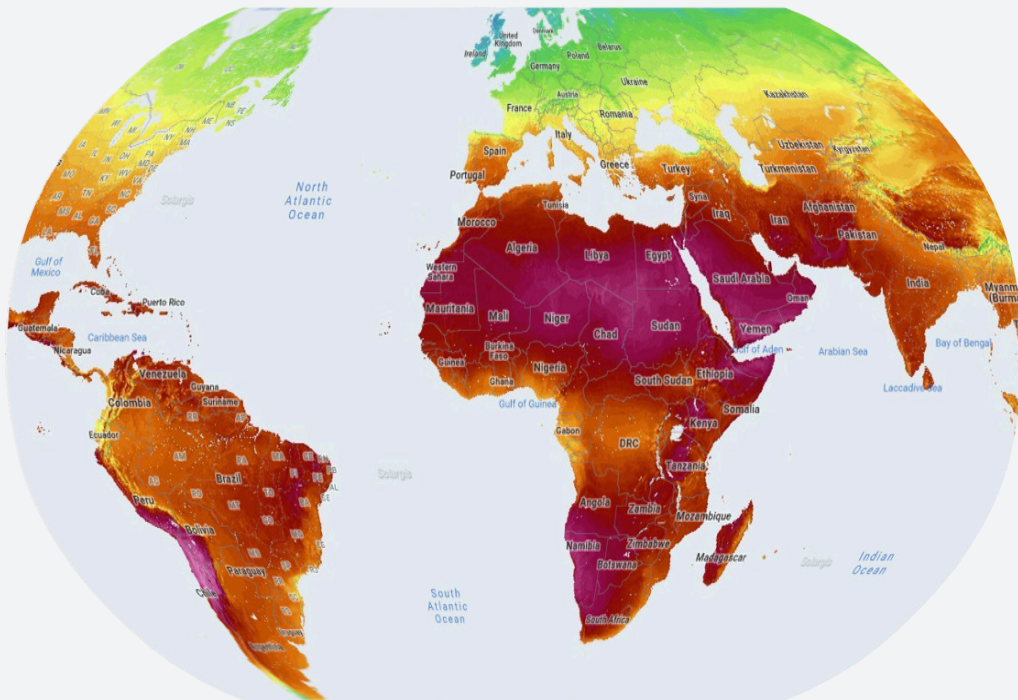


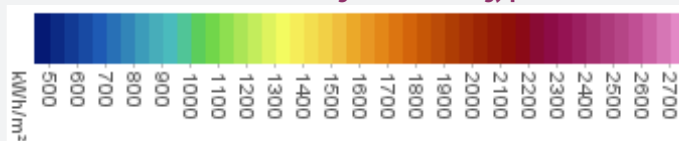
Transforming lives through renewable energy access in Africa UNDP's Contributions



*Empowered lives.
Resilient nations.*



Global irradiance: Africa's great solar energy potential



UNDP Regional Bureau for Africa (RBA)

Acknowledgments

The policy brief was approved for distribution by Tegegnetwork Gettu, OIC and Associate Administrator. The preparation of this policy brief was led by Ayodele Odusola, UNDP Africa Chief Economist. Much appreciation goes to Noura Hamladji, RBA Deputy Director, for initiating the thematic focus of this knowledge product. Special thanks goes to Frederick Mugisha (Economic Advisor, UNDP South Sudan), Marcel Alers (Head of Energy, BPPS) and James Neuhaus for design and production logistics. Inputs from colleagues listed from countries in Annex 1 are also acknowledged.

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May 2018

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Transforming lives through renewable energy access in Africa

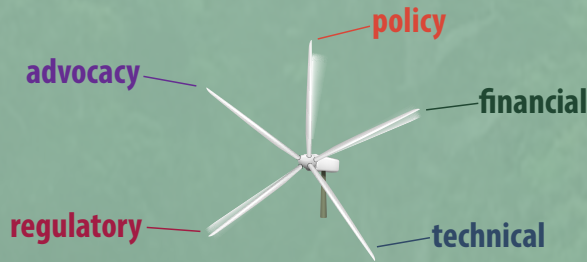
UNDP's interventions transformed at least 3,472 communities – reaching at least 3.35 million Africans

 **Four of ten Africans**  have access to electricity compared to about **nine of ten people globally** 

 sub-Saharan Africa accounts for **57%** of the **global deficit of electricity access** translating to **609 million Africans without electricity** in 2014

Unless something urgent is done an **additional 45 million Africans** may be **added to the deficit by 2030**

UNDP Africa's measures to promote renewable energy access include



UNDP is catalytic in helping countries with

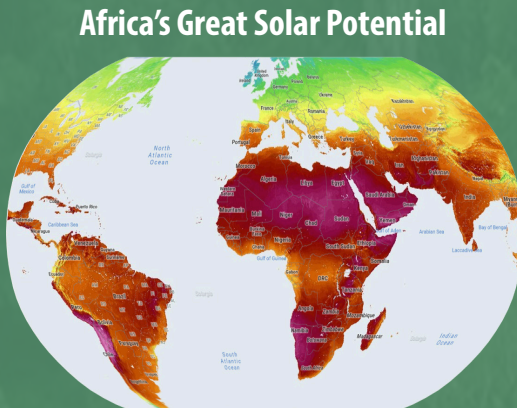
- quality standards
- knowledge transfer
- infrastructure
- rolling out renewable energy products and services
- Promoting technology transfer

Global share of solar installed capacity

Germany 13.7%
Africa 0.8%

Annual average surface solar irradiance:

Africa 260W/m²
Germany 125W/m²



GLOBAL HORIZONTAL SOLAR RADIATION

UNDP Africa solar power pilot programmes include

- solar irrigation
- solar lamps
- solar kits
- solar pumping
- solar streetlights
- solar centres
- guaranteed funds
- GEF small grants

Africa's Biomass Potential

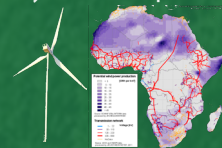


UNDP is deploying biomass gasifiers in a mini-grid project in Benin in combination with sustainable forest management practices

Stimulating universal access to renewable energy is essential to human and economic development, and catalytic to achieving all SDGs in Africa, **yet renewable energy in Africa remains virtually untapped**

Africa's Wind Energy Potential

Africa's global share of the installed wind turbine capacity is very low, at 0.8 per cent



Yet, the average wind speed in Africa is 6.47 m/s, surpassing the minimum (6 m/s) for constructing utility-scale wind power plants

UNDP's role and mandate to support access to energy in Africa is clear to meet the Agenda 2030 Goals, **strong policy and partnership efforts must be implemented urgently.**

How UNDP IS USING RENEWABLE ENERGY TO ACHIEVE THE SDGs IN AFRICA

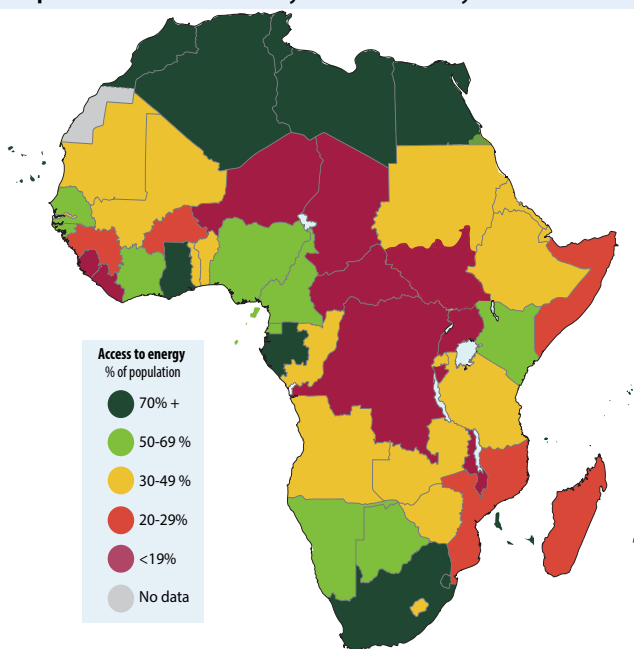


1 CONTEXT: ENERGY ACCESS IN AFRICA

1. **Access to energy is critical to Africa's development and growth.** Energy is the sustenance of all economies and an enabler of better welfare; where there is a deficit in supply, this cripples economic growth and destroys livelihoods. Due to the urgent need to rapidly reduce carbon emissions and respond to the highly negative impact of climate change, there is a strong push towards promoting economic diversification and value chain development, accelerating access to energy in remote areas, and addressing the challenge of geographically complex terrain, all of which make expansion of access to renewable energy sources a development imperative.
2. Sustainable Development Goal (SDG) 7 of the 2030 Agenda for Sustainable Development emphasizes the imperatives of achieving universal energy access through increases in access to renewable energy and improvement in energy efficiency.¹ This is also a critical component of the Sustainable Energy for All (SE4ALL) initiative of the United Nations Secretary-General, which was established in 2011. This target is premised on the understanding that energy access² is critical to accelerate rapid economic growth, empower women, reduce poverty and improve living conditions.

Map 1: Access to electricity in Africa is very low

3. **Access to energy in Africa is too low to meet development objectives.** As of 2016, four out of ten people in sub-Saharan Africa (SSA) have access to electricity, compared to about nine out of ten globally. Also, 16 of the world's 20 largest energy-deficit countries in 2016 are in SSA.³ Furthermore, SSA accounts for 57 per cent of the global electricity access deficit, affecting 609 million people. Unless urgent actions are taken, this may increase to 654 million Africans without energy by 2030.



Source: Author's compilation from IEA 2017

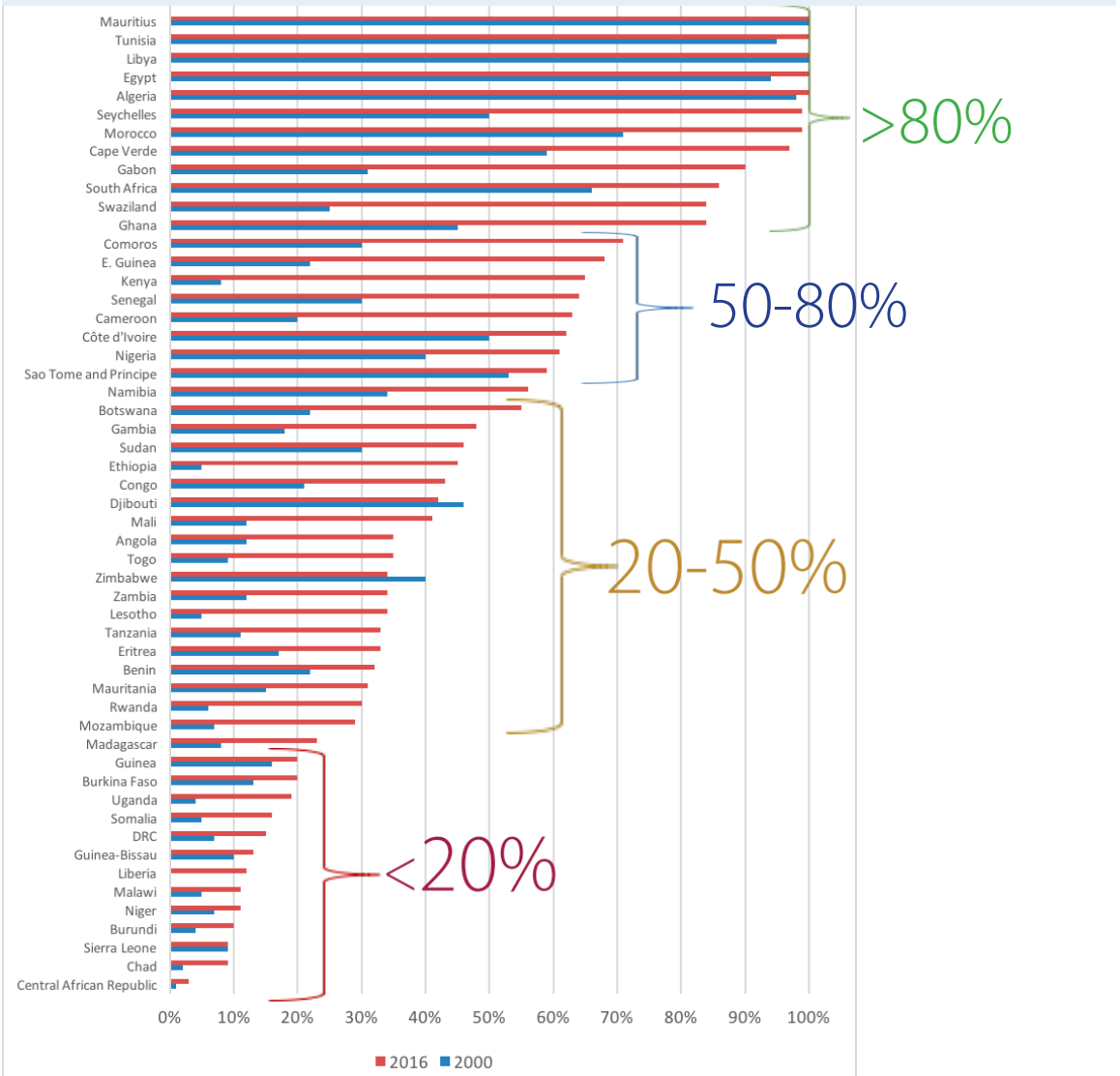
4. Regional averages can mask a country's specific context. Globally, North African countries rank among countries with the highest levels of access to electricity. In all other African countries (except Mauritius, Seychelles, Gabon, South Africa, Ghana, and Cabo Verde), less than 80 per cent

¹ Goal 7 of the SDGs is to be achieved through the following three targets: Target 7.1, "By 2030, ensure universal access to affordable, reliable and modern energy services"; Target 7.2, "By 2030, increase substantially the share of renewable energy in the global energy mix"; and Target 7.3, "By 2030, double the global rate of improvement in energy efficiency."

² As defined by the International Energy Agency (IEA), energy access is a household having access to electricity and to a relatively clean, safe means of cooking.

³ In descending order, these countries are Nigeria, Ethiopia, Democratic Republic of the Congo, Tanzania, Uganda, Kenya, Sudan, Mozambique, Madagascar, Angola, Malawi, Burkina Faso, Chad, Mali and South Sudan. The non-African countries are India, Bangladesh and Democratic People's Republic of Korea. See World Bank (2017) and Africa Progress Panel (2017).

Figure 1. Access to electricity in Africa, 2000-2016 (%)

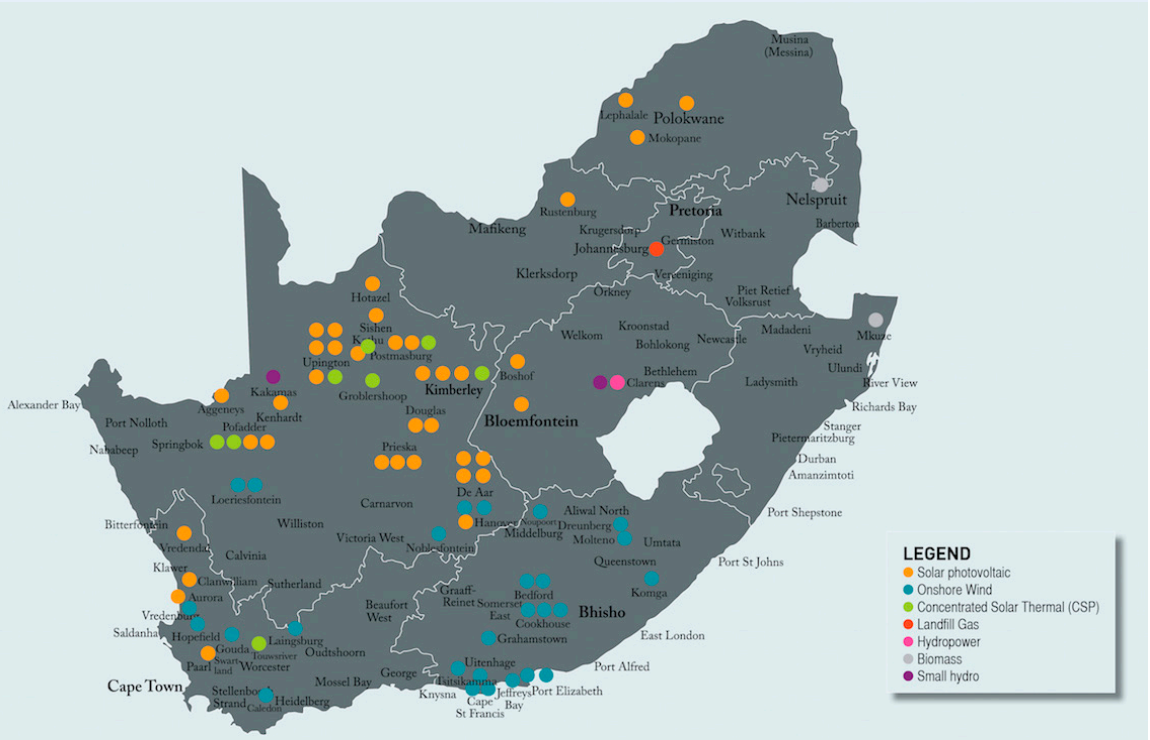


Source: Author's compilation from IEA

of the population have access to electricity. In at least 14 African countries, less than 20 per cent of the population have access to electricity (see Figure 1). This notwithstanding, six of the ten African countries experiencing the fastest rates of growth in electricity access between 1990 and 2014 are Morocco, Cabo Verde, Botswana, Republic of the Congo, Ghana and Comoros. However, between 2000 and 2016, the seven fastest growing countries are Ethiopia, Kenya, Rwanda, Lesotho, Mozambique, Uganda and Chad while Djibouti and Zimbabwe regressed.

5. **There are real challenges to increasing energy access, but opportunities abound.** The energy challenge in Africa is not limited to access, but also includes its quality, reliability, affordability and duration. The prohibitive cost of electricity is an impediment to access. Access to electricity is also concentrated in urban areas; most hard-to-reach rural communities are excluded, and urban slums often experience intermittent supply. For instance, only about 1 per cent of the rural populations, in ten African countries had

Map 2. Renewable energy power plants in South Africa



By many measures, South Africa leads sub-Saharan Africa in generating renewable energy, yet dramatic increases must be made for the continent to meet the Agenda 2030 goals. Source: Energy Intelligence

access to electricity in 2016.⁴ Overall, the shortage of energy is costing African economies an annual average of up to 4 per cent of its GDP (APP, 2017), i.e. about US\$60.52 billion in 2016 current market prices. The inability of countries to keep up with population growth and limited political commitment to investment in the energy sector are among the factors explaining why SSA is experiencing a large energy deficit. The challenge of using energy access to mitigate climate change underpins the imperatives of renewable energy in closing Africa’s energy gap.

6. Unless urgent actions are taken to scale up access to energy, it may become an overwhelming challenge to achieve SDG 7. This Policy Brief showcases UNDP’s efforts with national partners to facilitate and increase access to renewable energy. It also shows the potential for scaling up off-grid initiatives across the continent.

2 AFRICA’S RENEWABLE ENERGY POTENTIAL

7. **Africa has unique potential to scale up energy access to modernize agriculture; rekindle industrialization; increase jobs; and reduce poverty and reduce exclusion.** Due to the geographic landscape of African countries, particularly rural communities, access to the national grid is very difficult and expensive. Cost-effective renewable energy therefore becomes the most effective solution to rural electrification in Africa. This solution unleashes the productive capacity of around two-thirds of the population of many African

⁴ These countries are Central African Republic, Chad, Democratic Republic of the Congo, Djibouti, South Sudan, Burkina Faso, Guinea, Guinea Bissau, Liberia and Niger (IEA, 2017).

countries, including South Africa, Nigeria, Ethiopia, Democratic Republic of the Congo and Kenya. For example, the recently signed Renewable Energy Independent Power Producer Programme in South Africa is expected to create 61,600 jobs.⁵

8. Good news: Over the past decade, the cost of providing electricity through renewable energy has decreased considerably and is becoming competitive with conventional energy sources such as coal, gas and oil. For instance, the cost of a solar home system dropped from \$1,000 to \$350 over the past five years.⁶ This emerging trend offers African countries real opportunities to be creative when increasing access to affordable and reliable energy; utilizing decentralized energy sources will play a critical role. Further, forming partnerships with the private sector to identify and use optimal business models that help achieve affordable and reliable energy access will also be critical to achieving SDG 7 in Africa.
9. Despite the declining cost of producing renewable energy, these renewable energy resources remain largely untapped in Africa. The potential for renewable energy cuts across most African countries. (Box 1 presents the potential for Nigeria; Box 2 for Ghana; and Box 3 for Chad and Madagascar.) Yet, their potential is enormous for transforming lives and livelihoods, and facilitating the achievement of the SDGs. Renewable energy offers the potential to quickly transform agricultural value addition, create decent jobs, mitigate the impact of climate change, improve the delivery of education and health care services, as well as transform livelihoods and living conditions in remote and rural communities. If access increases sufficiently, it will provide affordable, reliable and sustainable energy for all, thus helping to address poverty and leaving no one behind in the energy revolution. As the United Nations Secretary-General noted recently, “Energy is vital to our lives [...] Access to energy helps children to study at night, farmers to grow more crops and hospitals to provide better care.”⁷
10. **Africa’s population growth is creating imbalances between electricity demand and supply, leading to a rising energy deficit.** SSA has not been able to keep up with an increased demand for access to electricity that has resulted from population growth. The number of people without electricity rose from about 500 million in 2000 to 609 million in 2014 (World Bank, 2017). Good news: the pace of electrification tripled since 2012. This made the population without access to electricity to fall to 588 million in 2016. However, unless this effort is sustained and improved, this may rise to 645 million by 2030. The recent improvement is based on increased investment and the realization that the traditional on-grid system does not work in Africa due to its topography and low population density and the remoteness of most of its villages and rural communities. Poor capacities for transmission and distribution make rural access to electricity very challenging. SSA has the highest number of countries with connection charges higher than \$100 per customer at the lowest connection service rating (World Bank, 2017:31). Therefore, since most of the poor people live in rural areas, demand for electricity is very low due to low income and thus the supply of on-grid infrastructure is not commercially viable. Leveraging the opportunities of renewable energy in the context of geographically challenging areas and rising population rates is an imperative.

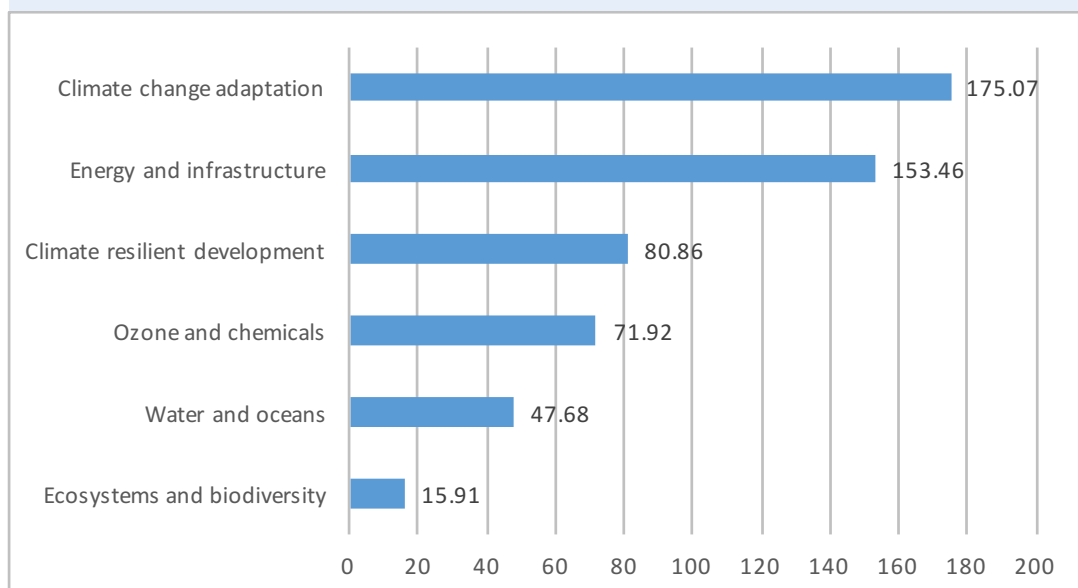
⁵ See Radebe (2018) for the provincial distribution of jobs to be created.

⁶ The home solar system includes a television, a radio and two LED lights (see ODI, 2016).

⁷ United Nations Chief Guterres highlights the importance of sustainable energy in his Expo 2017 message, see <https://goo.gl/RrCkbY>

11. **UNDP, through the Regional Bureau for Africa (RBA) is well positioned to play a leading role in helping to increase access to energy.** RBA is operating in 46 countries on the African continent, more than 65 per cent of which have ongoing programmes in renewable energy – biomass, solar and/or wind (Annex). Partnerships between UNDP and the Global Environmental Facility (GEF) have contributed immensely towards these programmes; for example, between 2014 and March 2018, \$544.9 million was mobilized through them. Climate change adaptation as well as energy and infrastructure have the largest share of the resources (Figure 2). Through these partnerships, 13 projects, totaling about \$484 million, are being developed for submission for funding in 2018 to the Green Climate Fund and 11 other projects are at the early stage of development, totaling about \$220 million.⁸

Figure 2. Resources mobilized for Africa through UNDP-GEF partnership, 2014-2018 (US \$million)



Source: Author's compilation from UNDP (2018b)

12. UNDP's engagement in the energy sector in Africa covers the three main targets of SDG 7: renewable energy, energy access and energy efficiency. Given indoor pollution, which accounts for about 4.3 million deaths every year on the continent, about 20 per cent of UNDP's energy portfolio between 2012 and 2015 was invested in energy-efficient cookstove projects. UNDP's portfolio in Africa covers 3,472 communities and 3.35 million people, ranging from 24,000 in Lesotho to 879,162 in the Democratic Republic of the Congo. It is also contributing to a reduction in carbon emissions of 23 million ton (ibid).⁹
13. In Africa, the installed capacity of power plants and other installations that use renewable energy to produce electricity is low, at less than 2 per cent of the global total, compared to 4 per cent in Asia. However, there is a significant annual increase (12.2 per cent), which is comparable to Asia (13.0 per cent) and well above the global average (8.8 per cent). The areas on which UNDP focuses are catalytic, including: helping countries establish and enforce quality standards; creating platforms to transfer knowledge, for learning and for incubation;

⁸ See UNDP (2018) for the countries involved.

⁹ See UNDP (2017) for detailed information on the coverage and dimensions of the energy portfolio in Africa.

Box 1: UNDP's efforts to help resolve the renewable energy paradox in Nigeria

Nigeria's energy access presents a paradox. In 2016, the country flared 6.9 billion standard cubic meters (scm) of natural gas (about 9.5 per cent of daily production), translating to between US\$700 million and US\$1.00 billion during 2014-2016. Moreover, in Nigeria, the daily average of solar radiation is 19.8 MJ/m²/day¹, which is untapped for solar energy, which the Government projected to be as high as 6,000 MW. The country also has capacity to generate at least 1,100 MW of electricity from biomass and 800 MW from wind by 2030. Yet, less than 60 percent of the population have access to electricity. Irregular energy supply leads to the proliferation of small diesel generators, which are more expensive than renewable energy and lead to noise and air pollution as well as health hazards.

UNDP contributes to harnessing untapped biomass and solar resources for energy access in many ways. Regarding biomass, UNDP efforts include supporting forestry management to balance demand for firewood, scaled up improved cookstoves to reduce deforestation in Delta and Kaduna States, and manufacturing efficient cookstoves in Bwari Local Government in Abuja. This partnership motivated the governments to distribute 750,000 clean cook stoves and 18,000 wonderbags in 2014 alone (FGN, 2016). To address ecological problems such as deforestation and desertification, the National Clean Cooking Scheme (NCCS) aims to distribute over 20 millions of clean cook stoves by 2020.

Regarding solar energy, UNDP supported the following activities: the preparation of the National Energy Master Plan; the development of off-grid solar-PV for homes, street lighting and health delivery in 12 communities in North Eastern Nigeria and 14 villages in Bwari Local Government in Abuja; the fabrication of solar-powered agro-processing machines for women in Ebonyi, Nassarawa, Benue, Jigawa, Ogun and Kano States; solar electrification in Edo State (Odighi and Ofetebe communities) and in Nasarawa State (Roguwa community). This includes training of youths for installation and maintenance of solar facilities.

Opportunities and lessons for transformation abound. These include: providing affordable market-based solutions; de-risking the environment through matching grants; strengthening the participation of value chain market-based actors; hands-on training; adopting to fit local technology and practices; promoting demand-driven initiatives, ensuring that renewable energy initiatives open up businesses for small- and medium-sized enterprises (SMEs); and putting in place exit strategies. There is enormous opportunity for renewable energy in Nigeria due to a population of around 73 million without access to electricity and the abundance of untapped renewable energy resources including surface solar irradiance averaging about 1,700 kWh/m² in the northern part of the country. The Government's SE4ALL Action Agenda aims at developing new biomass energy sources such as pellets, briquettes, biogas and liquid fuels (e.g. ethanol) and create self-sustaining entrepreneurial network of rural micro-entrepreneurs for achieving this. UNDP is ready to accompany the Federal and State Governments and the private sector to achieve these goals.

Source: UNDP Nigeria Office Case study; Federal Government of Nigeria (FGN, 2016); World Bank (2016).

¹ MJ/m²/day means megajoules per square meter per day



In Swaziland, bi-products of refining sugar are used to generate electricity

and setting up infrastructure and other mechanisms to roll out renewable energy products and services where governments and/or the private sector are unable to do so, mainly on a pilot basis.

3 UNDP'S LIFE-TRANSFORMING ENGAGEMENTS AND EMERGING OPPORTUNITIES

14. **More countries are prioritizing renewable energy.** The 2015 Paris Climate Agreement has rekindled interest in investing in renewable energy. Further, as stated in the State of Electricity Access Report 2017, global investment in renewable energy has more than doubled the investments in conventional energy sources since 2015, and investment in developing countries outpaced those of developed countries. Indeed, 147 out of the 189 countries that submitted intended nationally determined contributions (INDCs) emphasized the importance of renewable energy.
15. **The ambition from Sub-Saharan African countries, if backed up by actions, is very promising.** For instance, Nigeria is targeting 100% electricity access by 2030, using both grid extension and 13 gigawatts (GW) of off-grid solar photovoltaic (PV); Sudan is planning to provide 1.1 million solar home installations by 2030; and Ghana aims to provide 2 million households with solar lanterns (IEA, 2017).
16. **RBA advocates for least-cost energy solutions that mitigate risks and offer business opportunities.** With predictable financing mechanisms, better planning, regulatory frameworks, enhanced coordination and enhanced technical skills, the cost of energy access can be affordable to the poor. UNDP's approach is to advocate and promote the least-cost solutions that mitigate risks and offer viable business opportunities. In

particular, in Africa, UNDP's role is to advocate and promote the practices that could make universal energy achievable by 2030 (including building capacities of small and medium enterprises).

17. In addition to hydropower mini-grids deployed in several African countries (e.g. Democratic Republic of the Congo¹⁰, Republic of the Congo, Central African Republic, Guinea, Lesotho and Malawi), UNDP also supported energy efficiency in several countries, (e.g. the support to 140 people in Rochama and Achada Church in Santa Cruz Municipality, Cabo Verde). UNDP's measures to promote renewable energy access in Africa cover the following areas:
- **Advocacy:** Piloting mini-schemes for stakeholders to appreciate the value of renewable energy and how imperative it is to help people build better lives. These schemes involve biomass, solar and wind energy.
 - **Policy:** Facilitating the development of a mixed national energy policy that emphasizes renewable energy, especially in countries with large, untapped renewable energy resources. This also entails contributing to the establishment of simple and clear rules for scaling up renewable energy including risk mitigation, and fiscal and market incentives that lead to win-win situations for beneficiaries, entrepreneurs and governments. This applies to most countries in which UNDP operates (e.g. Chad, Cameroon, Côte d'Ivoire, Ghana and Senegal). The engagement in these countries includes supporting governments to prepare national strategies and action plans on renewable energy.
 - **Regulatory:** Helping to facilitate non-obstructive and simple regulatory frameworks that guarantee standards and quality (products and services) that protect all segments of renewable value chains, including customers. Rwanda's regulatory framework offers a good example¹¹; the payment for environmental service scheme in Madagascar incentivizing the conservation of threatened species; working with governments to prepare SE4ALL implementation plan (e.g. Tanzania, and Nigeria); and working with the Government of the Democratic Republic of the Congo on legal and regulatory framework on the energy sector.
 - **Technical:** Ensuring the transfer of technology to local operators, which is a panacea for sustainability. Technical skills that help provide quality power and meet future energy needs are key to success. Facilitating the training of local people to maintain and produce renewable energy helps develop entrepreneurship and job opportunities. UNDP's operations in Angola, Chad, Kenya, Niger, and Nigeria offer good examples of this.
 - **Financial:** Ensuring commercial viability of renewable energy, especially among rural dwellers is vital to achieve universal energy access. Working with partners to promote long-term financial support in the form of loans, grants and subsidies incentivize private firms to invest in renewable energy and rural electrification. It is also important to promote low-cost solutions. To this end, the UNDP Nigeria – Bank of Industry, the Rwanda-Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and the Government of Tanzania-Tanzania Investment Bank Renewable Energy Fund partnerships were established.¹²

¹⁰ UNDP helped implement three micro-hydropower electricity plants between 2016 and 2017 (Idjwi, Bitale, and Masisi); developed electricity legal and regulatory framework and improved cook stove and biogas fuel. UNDP's interventions in the country (e.g. North Kivu, South Kivu, Tshopo, etc) benefited 10,000 households.

¹¹ The Rwanda Utilities Regulatory Agency (RURA) offers a 70 per cent subsidy on investments in privately owned and operated mini-grids of up to 100 kW installed capacity, and those on isolated grids under 50 kW are exempted from licensing (see World Bank, 2017).

¹² The Renewable Energy Fund of \$500 per mini-grid household connection, managed by the Tanzania Investment Bank is another

Box 2: UNDP's efforts to promote access to renewable energy in Ghana

Ghana is one of the few African countries with successful stories on electricity access. Between 2000 and 2016, its electricity access rate increased from 45 percent to 84 percent – thanks to the committed implementation of the 1989 National Electrification Scheme and policies focused on rural communities.

Ghana has a high electricity access rate of over 80 per cent of the population. In the recent past, however, low water levels caused by droughts and unstable gas supply have led to load shedding. The policy goal is to increase the total installed capacity from 3,200 MW to 5,000 MW, and to increase share of renewable energy from 0.1 now to 10 per cent by 2020 with a view to leveraging the country's renewable energy potential. This is to be achieved through: 150-300 MW of small and medium hydro power plants; two million solar lanterns; 30,000 solar home systems; 20-26 MW of utility-scale biomass and waste energy capacity; 150-250 MW of utility-scale wind; and 50-150 MW of utility-scale solar capacity.

The potential for renewable energy is high. For instance, the country is estimated to have about 2,700 m³ of biomass, which could generate over 110 megawatts (MW) of power. This source alone could create more than 26,000 direct jobs along the value chain (KNUST, 2015). Despite this robust opportunity, biomass co-generation plants, which use sawmill residue and oil palm waste, have a total capacity of over 6 MW (Africa-EU RECP, n.d.). About 13,000 Ghanaians died annually from air pollution mostly due to 71 percent of the population relying on solid biomass for cooking (IEA, 2017). This among others revamped Government interest to accelerate access to improved cooking facilities.

The potential for wind and solar is even more. For instance, the average annual wind speed above 50 m is 8 m/s and could be as high as 9.9 m/s in certain locations. The monthly average solar radiation is between 4.4 and 5.6 kWh/m²/day with sunshine duration between 1,800 and 3,000 hours per year (RVO, 2016). Several companies have started to leverage this potential for investment and business opportunities.

UNDP has worked with the Government in many areas to facilitate the achievement of its renewable energy target. The first area is helping to establish the regulatory framework that focuses on standards of efficiency and performance of cook stoves. The second is helping to promote technology transfer including the establishment of the renewable energy centre at the Kwame Nkrumah University of Science and Technology. The third is piloting solar irrigation systems in deprived communities. And finally, UNDP has established the small grants mechanism to promote renewable energy technology transfer.

Regulations and standards, and their enforcement continue to be important lessons to be learned. An important opportunity for Ghana is solar energy, especially in the northern part of the country, which has a photovoltaic power potential of up to 1,600 kWh/kWP. The implementation of a rooftop solar programme will be particularly useful. The development of mini-grids – using a tested, optimally affordable business model – would be desirable, particularly for rural dwellers. Fiscal incentives include: exemption from import duties; a feed-in-tariff system; access to a power purchase agreement; and the establishment of a renewable energy fund.

Sources: UNDP Ghana Office Case study; KNUST (2015); RVO (2016); and Africa-EU RECP (n.d.).

3.1 BIOMASS

18. **Turning waste into energy increases access to electricity, stimulates small-scale business growth, and propels economic transformation.** Based on available data, over 60 per cent of country offices in RBA countries with renewable energy programmes focus on improving biomass value chains. Notable examples include: transferring technology and delivering energy-efficient technologies; improving legislation and standards; and sourcing of biomass (e.g. forestry and landfills). Examples of UNDP projects include: small-scale bioenergy woodlots in Port Loko and Moyamba in Sierra Leone; briquette technology in Kenya; community-based forest management in Angola; the piloted biogas plant in Sengerema District in the United Republic of Tanzania ; the bio-coal Typha valorization project in Senegal; and the cookstove testing and expertise lab in Ghana. See Box 2 on biomass potential in Ghana.
19. There are enormous opportunities to significantly scale up biomass initiatives in most African countries. Rapid urbanization accompanied with serious shortages of effective and modern waste infrastructure in SSA makes the case more appealing for waste-to-energy or wealth initiatives. The presence of landfills in most cities and agricultural waste in rural areas creates further opportunities for similar initiatives.
20. There are emerging opportunities to use waste feedstock to generate energy in Africa in commercial quantities. Some examples are: the Landfill Gas to Energy Project in, Johannesburg, South Africa; Municipal Solid Waste Composting Project in Ikorodu and the Ketu Ikosi Biogas Project in Lagos, Nigeria; the biogas plant at Kumasi Abattoir in Kumasi, Ghana; the Pilot Biogas Initiative in Ferlo, Senegal; the Gorge farm anaerobic digestion (AD) power plant in Naivasha, Kenya; and the Koshe Waste to Energy Project in Addis Ababa, Ethiopia.
21. UNDP is committed to maximizing opportunities for turning waste into energy in order to increase access to electricity, stimulate small-scale enterprise growth in the energy sector, and propel economic diversification and transformation. However, critical efforts must be undertaken to commercialize associated technologies in an affordable manner and ensure standardization for quality and safety.

de-risking efforts to promote renewable energy in Africa. Moreover, the Government of Tanzania in partnership with the African Development Bank is developing a Renewable Energy Investment Facility to further de-risk the investment climate for renewable energy (UNDP Tanzania Country Office Case Study).



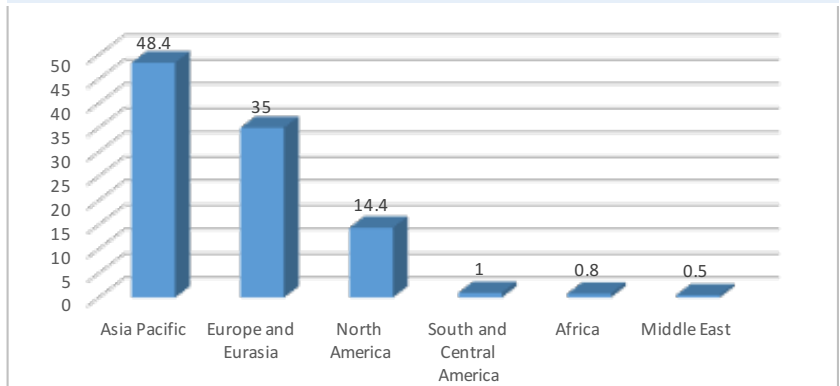
In Naivasha, Kenya, a biomass plant generates electricity and produces rich fertilizer as a bi-product

3.2 SOLAR

22. Africa is one of the most richly endowed regions with the highest global surface solar radiation, yet the continent's share of the world's generated solar energy is less than 1 per cent.

Globally, solar energy **Figure 3. Cumulative installed solar energy capacity, 2016 (%)** is one of the most untapped clean energy sources.

In 2016, the share of solar power generation was 1.3 per cent, more than tripling in four years. In the same year, it increased by 29.6 per cent.¹³ Despite Africa's large share of

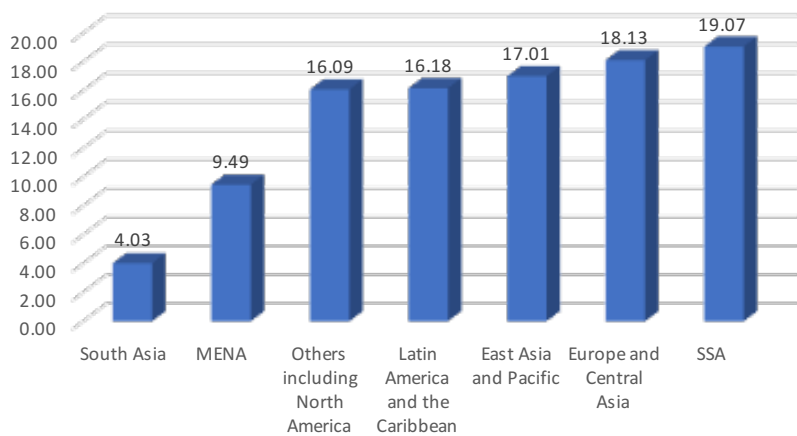


Source: Author's compilation from BP (2016b).

the global population (16.5 per cent) and even though Africa will account for over 80 per cent of the net global population by 2100, its 2016 share of the cumulative installed capacity of solar energy was too low (Figure 3). Africa's installed capacity falls short of its potential. Sub-Saharan Africa (SSA) alone accounted for about 19 percent of global potential PV electricity output (1994-2015) (Figure 4). This lack of investment is disproportional to Africa's natural endowment of potential solar energy. For instance, in 2016, Germany's share of the global solar energy installed capacity was 13.7 per cent, yet it has an annual average of irradiance of 125 W/m² compared to Africa's 0.8 per cent share of installed capacity, which boasts an annual average of irradiance of between 220-300 W/m².¹⁴ The Sahel and the Horn of Africa are even more advantaged, with irradiance (surface solar radiation) of over 280 W/m².¹⁵ The cover page presents the potential for Africa relative to the rest of the world and boxes 1-3 present for Nigeria, Ghana, Chad, and Madagascar.

Figure 4: Potential PV electricity output (1994-2015)

23. UNDP is working with partners on innovative pilot programmes for scaling up renewable energy in Africa such as: a solar irrigation system in northern Ghana; solar lamps for primary schools, health centres



Source: Author's computation from <http://globalsolaratlas.info/downloads/sub-saharan-africa;> Landmass compiled from WDI.

¹³ Countries leading the cumulative installed capacity are: China (78.1 GW), Japan (42.8 GW), Germany (41.3 GW) and the United States of America (40.3 GW) (see BP, 2016).

¹⁴ See BP Statistical Review of World Energy June 2017 for each country's breakdown.

¹⁵ For surface solar radiation, see <https://goo.gl/HfPjrh>



An 8.5 Megawatt solar field at the Agahozo-Shalom Youth Village in Rwanda, a country where less than 15 per cent of the population has access to power. With the solar project, the East African nation's generating capacity surged by six per cent.

Box 3: Renewable energy opportunities in Chad and Madagascar

Madagascar: In 2015, energy access reached 15 per cent of the population, of whom 54 per cent in the urban areas and 6 per cent in rural areas. The high-level of deficit presents opportunities for expansion. The Government has set a target of 70 per cent energy access by 2030 with solar and wind rising from about 1 to 10 per cent. The country is endowed with over 350 potential sites of small hydroelectric plants with a cumulative capacity of 1,350 MW; an annual average of 2,000 kWh/m² of solar radiation (photovoltaic potential); and wind power of 7-8 m/s. To attract investors, the Government introduced a tax reduction of 50 per cent for renewable energy investments and exemption from duties and taxes on various renewable energy equipment (e.g. PV panels, solar kits and 2V batteries). To promote climate change mitigation, the environmental service scheme was introduced. This payment for environmental services, which is community based, helps to incentivize the conservation of threatened species.

Chad: Electricity in Chad is scarce, expensive and erratic in supply. As of 2012, only 6.4 per cent of Chadians had access to electricity. The State of Electricity Report 2017 rated Chad as the 18th largest electricity access deficit globally. The per capita electricity consumption is one of the lowest in the world and tariffs are among the highest. Yet the photovoltaic power potential ranges from 1,680 to 2,045 kWh/kWp annually from the south to the north. This can play a strong role in bridging the electricity deficit with solar alone having the potential to generate more than 10 per cent by 2030 (World Bank, 2017). The wind potential in the Central Region, for instance, could reach as high as 7-7.5 m/s. UNDP's engagement consists in strengthening regulatory frameworks (e.g. helping to prepare the national strategy on renewable energy, energy coordination), facilitating access (e.g. distributing cookstoves to 9,500 households) and promoting technology transfer and diffusion (e.g. at least 25,000 people have learned better techniques for the use and manufacture of solar cookers). The opportunities for expanding solar energy production are significantly untapped, together with other renewable energy sources, such as biomass and wind. Enabling policy instruments to partner with the private sector provides the greatest opportunity to expand renewable energy in Chad.

Sources: UNDP Madagascar and Chad Offices Case studies.



A solar home in Rwanda demonstrates that energy from the sun can be harnessed at the village level

Box 4: Solar lights up new hope for the remote Nyatsato Primary School, Zimbabwe and for health centres in Zambia

Zimbabwe: Nyatsato Primary School is in Rushinga District, Mashonaland Central, about 240 km away from Harare- few kilometers from Mozambique’s border. The lack of electricity in the school caused hardship for students and teachers alike. The installation of 4.08 kW power systems for lighting two school blocks, powering computer lab, as well as lighting, information sharing and entertainment (e.g. TV and radio) for six teachers houses brought hope in 2015. The school teaching and management staff were trained to be able to use and maintain the equipment.

The students use the classrooms at nights to read and have the privilege of being taught computer lessons while teachers complemented their studies using the light to study after school hours. The community has also expressed interest in taking literacy lessons after their children’s lessons are finished. The savings from non-purchase of paraffin and candles because of the solar system is being contemplated for buying communal refrigerator and television.

Zambia: In cooperation with Innovation Norway and four private sector companies, UNDP led a pilot project to demonstrate how renewable energy improves quality and delivery of healthcare by installing solar power systems in 13 health facilities and Central Medical Store in Zambia. As a priority, the solar systems distributed energy to the most critical parts of the hospitals including emergency rooms, surgery, pharmacies, labs, vaccine refrigerators, and delivery rooms. Maternity wards received electricity 24 hours, seven days per week; vaccines remained available and cold. A hybrid battery system, using lead-lithium ion batteries, provides efficient storage, competitive unit costs, and an eight-year lifespan. The performance and usage of the system can be monitored off-site. For repairs, a “remote repair” scheme uses phone or Skype to provide technical assistance.

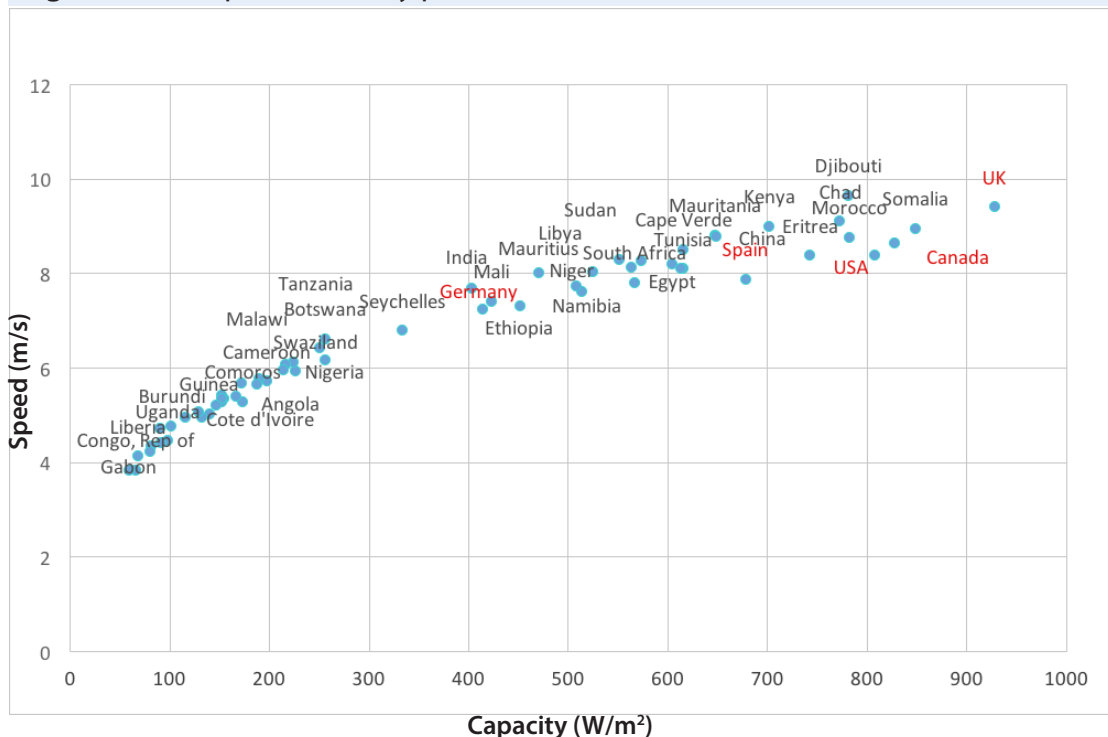
85,000 beneficiaries – half of whom are children or women of child bearing age – received higher quality, reliable healthcare; the number of consultations increased sharply (by between 80-100%) as did access to vaccines, which are now stored on-site. Since the health facilities could now be open and operating during the night, the number of deliveries and emergency services increased dramatically as well.

Sources: UNDP Zimbabwe and Zambia Office Case studies

and vocational training centres in Cameroon; the establishment of a guaranteed fund in Ethiopia; the distribution of solar kits in the west and north regions of Côte d'Ivoire; the solar-based multifunctional platforms and rural streetlights in Togo; the solar pumping system for market gardens in Niger; the multi-functional solar platforms in Burkina Faso; the rural electrification in the Damara province of the Central African Republic; solar electrification access in Kayes, Koulikoro, Segou, Sikasso, Mopti and Gao regions in Mali; the GEF Small Grants Programme implemented by UNDP, which resulted in 24,634 people having access to clean energy in Guinea-Bissau; the rent-to-buy purchase scheme in Botswana; the establishment of a solar centre at the University of Zambia; and the UNDP-GEF solar cooker project in South Africa. UNDP also provided technical and financial support to the manufacturing and distribution of solar stoves, including in Chad and Nigeria. In Chad, for instance, solar stoves were distributed to 9,500 households (See Box 3) while in Zimbabwe, it brought hope to the remote Nyatsato Primary School (See Box 4).

24. Solar energy is a potential driver of economic diversification and growth in Africa. Opportunities lie in expanding investments to scale. This growth will require supporting quality standards in solar equipment, investing in training, removing bottlenecks for the private sector, and actively pushing for partnerships. UNDP has been working with stakeholders to deliver solar technologies, deepen market penetration, and promote technology transfer including through incubation.

Figure 5: Wind power density potential



Source: author's creation from https://s3-eu-west-1.amazonaws.com/globalwindatlas/posters/AFR_PD.png

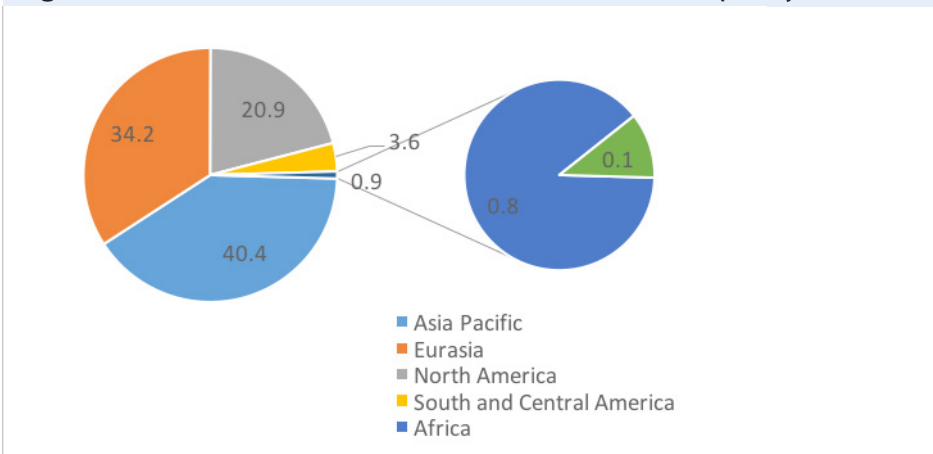


3.3 WIND ENERGY

25. **Africa is endowed with on-shore and off-shore wind energy.** The wind capacity requirement for electricity generation varies from an annual average wind speeds greater than 4 meters per second (m/s) (9 mph) for small wind turbines and a minimum of 6 m/s (13 mph) for utility-scale wind power plants (Tiyou, 2016). The African average is 6.47 m/s. This ranges from below 4 m/s (Gabon and Congo, Rep. of) to above 9 m/s (Djibouti, Chad, and Kenya). See Figure 5 for wind power density potential for selected African countries compared to global leaders in installed capacities (UK, Canada, USA, China, Spain, Germany, and India).
26. Africa’s investment in wind energy is low, yet the potential benefits are high. Africa’s global share of the installed wind turbine capacity is very low, at 0.8 per cent compared to 40.4 per cent in Asia and the Pacific, 34.2 per cent in Europe and Eurasia, and 20.9 per cent in North America (Figure 6). In spite of the high potential, the continent of Africa’s installed wind energy capacity is less than 5.0 per cent of China’s, 6.0 per cent of the United States, 12 per cent of Germany’s and 40 per cent of Brazil’s installed capacities¹⁶.

¹⁶ Author’s computation from Wind Energy Market Intelligence

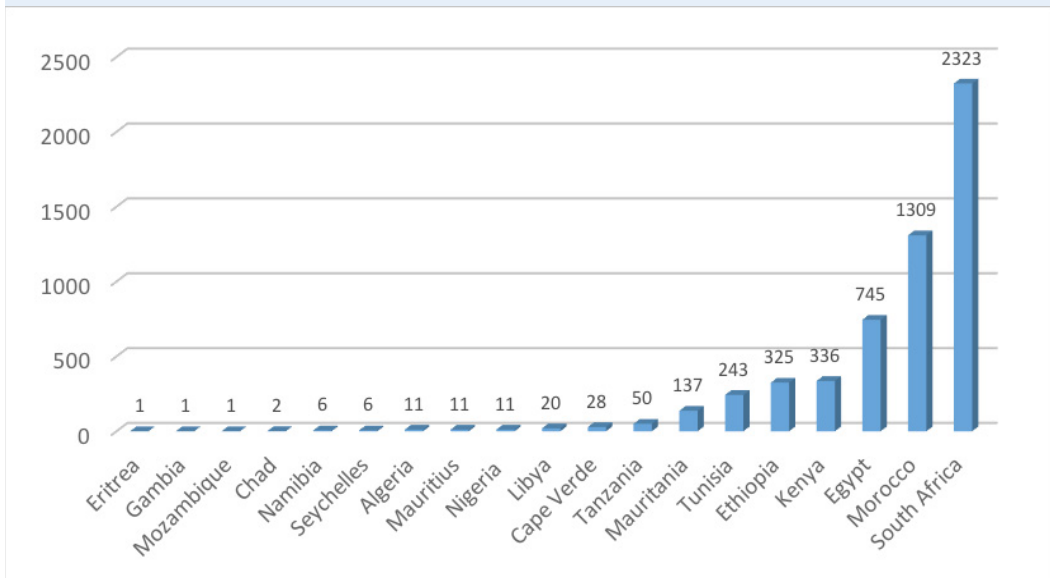
Figure 6: Global cumulative installed wind turbine capacity, 2016 (%)



Source: Author’s compilation from BP (2016a).

27. South Africa, the African country with the largest installed wind energy capacity, offers some lessons. Based on the objective of using renewable energy to further transform the economy structurally, wind projects were selected based on key criteria: pricing, job creation, local content policy and black economic empowerment. Wind energy project in South Africa is based on Public Private Partnership and has been adjudged as one of the best practices globally.¹⁷ Figure 7 presents wind energy installed capacity in Africa. When the ongoing constructions are completed in Africa's leading countries (South Africa, Morocco, Egypt, Ethiopia, and Kenya), the collective installed capacity will reach 4.3 GW. The momentum to accelerate progress is high. For instance, Morocco is aiming 2.0 GW by 2020 and Egypt targets 2.0 GW by 2022 (Tiyou, 2016). As is the case for solar, the gradual decrease of the cost of wind power generation is making it increasingly competitive relative to fossil fuels.
28. UNDP support in wind energy is still nascent (see Annex 1). Kenya is one of the African countries boasting huge commercial wind energy production. In addition to the Ngong wind farm project, which contributes 25.5 MW to the national grid, the country is developing the largest wind power farm on the continent – the Lake Turkana wind farm. The South African Wind Energy Programme (SAWEP) is one of the ongoing wind projects on the continent. The Darling Wind Farm (5.2 MW) and the Klipheuwel Wind Farm (3.2 MW) are among the success stories in generating wind power on the continent.¹⁸ Other countries with wind energy potential should emulate Kenya's and South Africa's giant strides. This is an area where UNDP needs to consider scaling up capacity in line with emerging demand.

Figure 7: African countries' wind energy installed capacity (MW)



Source: Author's computation from Wind Energy Market Intelligence: https://www.thewindpower.net/country_list_en.php

¹⁷ As of 2016, it had a total installed wind turbine capacity of 1,170 MW with another 840 MW in the pipeline and a target of 8,400 MW of wind capacity by 2030 (Tiyou, 2016).

¹⁸ See http://www.energy.gov.za/files/esources/renewables/r_wind.html

3.4 MICRO, SMALL AND MEDIUM ENTERPRISES

29. **UNDP is using renewable energy to drive innovation and entrepreneurial development in Africa.** The renewable energy sector is creating opportunities for entrepreneurial development that could accelerate Africa's economic expansion and transformation. Biomass, solar and wind power highlighted above provide opportunities for youth and women to develop skills and generate employment and livelihoods on the continent.
30. Developing skills of local actors in renewable energy provides a critical component of the sustainability of renewable energy on the continent. Localization of renewable energy technology through adaptation, diffusion and maintenance is central for sustainability. These aspects create great opportunities for entrepreneurship. Even when such technologies are affordable, ensuring local maintenance of such facilities makes a substantial difference.
31. UNDP is using emerging renewable energy to drive innovation on entrepreneurial development in Africa. Some illuminating examples are as follows:
- (a) In Kenya, in partnership with the Department for International Development (DfID) of the United Kingdom, UNDP is promoting the incubation of private firms through the Strengthening Adaptation and Resilience to Climate Change in Kenya Plus (StARCK+) and through the Africa Enterprise Challenge Fund, which is helping to promote competition in the energy market.
 - (b) In Ghana, the provision of subsidies to solar companies to derisk the renewable energy market is promoting the involvement of small-scale enterprises.
 - (c) In Ethiopia, promoting technology roadshows, facilitating competitive schemes on rural energy technology, and providing business advisory services are the focus of partnerships with other actors.
 - (d) In Togo, through the Emergency Community Programme (PUDC), entrepreneurs from micro and small enterprises are being trained to maintain and repair solar energy equipment.
 - (e) In the Democratic Republic of the Congo, UNDP facilitated the construction of three micro-hydropower plants in Idjwi, Bitale and Masisi, and mobilized the private sector in the construction of mini- and micro-hydropower plants.
 - (f) In Nigeria, through the build-own-operate-transfer (BOOT) business model, value chain actors (mostly youth and women) were trained, empowered, and certified as micro, small and medium enterprises (MSMEs); training focused on technical, financial, business and marketing skills to scale-up renewable energy.
 - (g) In Chad, more than 25,000 people were trained on the techniques for manufacturing solar cookers and improved metal stoves.
 - (h) In South Africa, emphasizing local content policy and the black economic empowerment as important criteria for selecting renewable energy projects is creating opportunities for entrepreneurial development.

4 LESSONS LEARNED

32. **Regular access to electricity, especially in rural areas, enhances welfare.** The experience in Africa has shown that energy access is a life-transforming intervention. It enhances rural access to ICTs (e.g. mobile phones and TV), life-comforting appliances (e.g. heating systems), refrigeration (including foods, drugs and vaccines), modern agriculture (solar pumping irrigation), direct and indirect income generating activities (repair and maintenance of equipment), and acts as a catalyst for value chain development (e.g. multifunctional platform and industrialization). Energy also has developmental impacts. The use of fuel wood (which is as high as over 90 percent in the Gambia and Burundi) is a major cause of deforestation and a serious source of health hazards and deaths in Africa. Replacing this with improved cookstoves and lighting systems saves the continent from deforestation, reduces pollution and decreases health hazards. Improved energy access generates multiplier effects on the achievement of the SDGs.
33. **Affordability, scalability and sustainability are interlinked and need to be addressed together to produce synergistic results and impact.** Lessons can be drawn from UNDP's experience over the past decades in partnerships and support to renewable energy in Africa. Although affordability of renewable technologies remains a challenge in most parts of Africa, there has been a declining trend of renewable energy costs over the past five years. In addition, increasing economies of scale could further decrease prices considerably. Based on country experiences, upfront payment for renewable energy services is a good model for business continuity in rural areas.
34. Scalability is limited because solar technologies are imported rather than developed in Africa. Investment in developing and assembling these technologies on the continent will enable opportunities to scale production and availability. It will also ensure that renewable energy becomes affordable and sustainable. UNDP's partnership with domestic and external stakeholders will explore the possibility of facilitating production and assembling renewable energy infrastructure on the continent.
35. Sustainability is key to achieving renewable energy's maximum impact. Several factors contribute to the sustainability of renewable energy in Africa. The first is having national capacity for domesticating appropriate policy instruments, standards and regulations. These regulatory frameworks must be simple and clear, guarantee the quality of products and services, and protect all segments of renewable value chains, especially the customers. Second, community participation in the choice of business model and type of products not only ensures sustainability but also creates affordability. In Nigeria, lessons drawn from the cookstove initiative show that new tools must match cooking practices carried out at community level for successful outcomes. Indeed, sustainability is strengthened when the new tools align with local practices. Involving local actors in the design and management of renewable energy products matters. The joint venture approach imbedded in the recently signed Independent Power Purchase Agreement with South Africa provides illuminating examples– South Africans hold 57.8 per cent of shares and local communities hold 7.1 per cent of shares (Radebe, 2018).

36. **UNDP must encourage MSME investments in renewable energy through effective financing schemes and helpful business strategies.** Five key lessons emerge from UNDP's experience in facilitating renewable energy-based MSMEs in Africa. First, support to MSMEs must have a clear exit strategy (with clear roles and responsibilities in the form of a social contract) to avoid a dependency and entitlement syndrome. Second, ensuring access to competitive financial products and services is key. However, in rural areas, such products could be complemented with matching loans, funds, or partial money guarantees. The term 'subsidy' should be avoided because of past experiences, which tend to perpetuate dependency syndrome. Third, organizing MSMEs into platforms, networks and cooperatives to share experiences, knowledge, and lessons learned is vital for sustainability. Fourth, recognizing and rewarding successful entrepreneurs (including using innovative entrepreneurs as champions) help promote innovation and productivity. Finally, promoting technical partnerships between foreign and local firms will help develop entrepreneurship and skills that are suitable for transferring and diffusing technologies.

5 CONCLUSIONS AND OPPORTUNITIES FOR RENEWABLE ENERGY PARTNERSHIPS

37. **Stimulating universal access to renewable energy is essential to human and economic development, and catalytic to achieving all SDGs in Africa, yet renewable energy in Africa remains virtually untapped.** Promoting energy access in Africa is not only beneficial to the continent but also an imperative for global growth and stability. For instance, efforts to reduce deforestation help to mitigate climate change globally; boosting food production through solar irrigation systems, food refrigeration and reductions in food wastage help improve food security globally. Mobilizing global actors (governments, private sectors, foundations and international financial institutions) creates a win-win situation for Africa and the world. Accelerating access to renewable energy on the continent is not only an investment in Africa's development, but also a global public good.
38. Stimulating universal access to renewable energy will not only contribute to the achievement of SDG 7, but will also catalyse the achievement of all SDGs. In addition to helping transform lives through education and health services (e.g. in Cameroon, Tanzania and Côte d'Ivoire) and agricultural transformation (e.g. solar irrigation in Ghana and Ethiopia), it contributes to creating jobs for youth and women (e.g. Chad and Nigeria) and diversifying economies (e.g. Kenya and South Africa). Yet, renewable energy in Africa remains virtually untapped. A similar trend pertains to biomass and wind energy. Helping build demand and increase installed capacities for renewable energy in Africa are imperatives for achieving the SDGs and Africa's development agenda. The rising momentum to expand wind energy in South Africa, Morocco, Egypt, Ethiopia, and Kenya is commendable. UNDP and other development partners must help governments and other stakeholders to increase installed capacities of renewable energy in Africa.
39. **UNDP's role and mandate to support access to energy in Africa is clear: to meet the Agenda 2030 Goals, strong policy and partnership efforts must be implemented urgently.** The alignment between UNDP's Strategic Plan (2018-2021) (with energy as one of the six signature solutions) and the focus on renewable energy by 147 out of the 189 countries that submitted INDCs shows a harmonization of priorities. A coordinated

partnership with UNDP offers opportunities to achieve synergy on SE4ALL, the Climate Agreement and the SDGs.

40. UNDP is committed to work with stakeholders to facilitate the development of practical solutions to close the electricity gap in Africa. Supporting stakeholders is important to create an enabling environment for reliable, affordable and sustainable access to energy. Such an environment must have the right policies, regulations and incentives for universal and sustainable access to achieve SDG 7 by 2030.

41. UNDP's contribution to renewable energy access in Africa is multi-dimensional (Annex and Boxes 1-4). First, facilitating partnerships, including public-private sector engagement and bilateral and multilateral collaboration on renewable energy in Africa is essential to UNDP's mission. Specifically, partnering with the private sector to promote the development of optimal business models for affordable and reliable energy access is critical. Second, connecting domestic and foreign investors and promoting small-scale development, mentorship and entrepreneurship are important entry points. Third, it is important to work with various actors to identify and ensure viable business models on rural access to electricity and to ensure affordability, scalability and sustainability. Fourth, promoting social entrepreneurs, building local capacity for maintenance and repair of renewable equipment connects the renewable sub-sector to the rest of the economy. Fifth, UNDP is recognized for working with partners to develop policies, plans and strategies on renewable energy and in developing regulatory standards. Finally, working with African governments is needed to bridge the financing gaps through blended financing mechanisms – grants, market-based loans and philanthropy.

Annex 1. Summary of UNDP interventions on renewable energy in Africa

Country	Biomass		Solar		Wind		MSMEs	
Angola	Charcoal value chain; 5 pilot communities to benefit from charcoal technology; training of staff of the Institute of Forestry Development on sustainable charcoal production		300 sets of solar storage systems; photovoltaic panels for solar home system, solar lanterns and advanced cook stoves.				Renewable energy gap analysis conducted to establish investment opportunities.	
Benin	Biomass for green energy for on and off grid including biomass gasifiers; 200 ha of reforestation; and bio energy woodlots benefiting 4,818 people.		Energy services (lighting, recharging, freezing, street lamps) for 41 municipalities benefiting 93,964 people		Analysis to help identify feasible investment in wind energy conducted.		Solar power plants providing energy services MSMEs	
Botswana	Uptake of biogas digesters through public-private partnership with farmers and businesses.		Rent-to-buy purchase scheme for solar products and 1 5.7 kW solar PV mini-grids for 4 villages in Central District; distribution of lanterns				Community organization Training for service Rent to own financial mechanism; use of public- private-partnership	
Burkina Faso			Provision of solar lighting and installation of Multifunctional solar platforms.					
Burundi			Institutional support and strategic analysis conducted.					
Cameroon			108 lamps for schools, 84 lamps for vocational schools and 24 lamps for health centres.					
Central Africa Republic	Community-based tree planting and afforestation.		Supported development of regulatory framework; initiated electrification in 7 pilot villages in Damara area				Standards and regulations.	
Chad	Distribution of cookstoves to 9,500 households.		Helped in preparing national strategy on renewable energy.				Trained 25,000 people on solar cookers technology.	
Côte d'Ivoire	Assisted several small-scale projects on biomass including mangroves rehabilitation, protection of 170 ha of mangroves, anmnd distribution of 5000 cook stoves and 70 ovens. .		Distribution of solar kits including 12 community cocoa dryers.				Trained technicians and agents to repair and manufacture stoves, ovens and solar cocoa dryers.	

Country	Biomass		Solar		Wind		MSMEs
	Supporting national programme to improve cook stoves and biomass fuel.		Interventions in 4 provinces and feasibility carried out.	Installation of solar panels.	Feasibility studies in 4 provinces.	Micro hydro plants.	
Democratic Republic of the Congo+							
Equatorial Guinea							
Eritrea							
Ethiopia		National standards and advocacy on biomass and improved cook stoves.		Standards for solar technologies awareness raising; and installation of solar kits for 211,950 households (benefiting about 1.0 million people).			Provision of credit risk guarantee fund; technical skill training and support to business incubation benefitting 1,038 businesses. .
Gambia				Solar kits and solar powered MPF installed in 6 communities (e.g. Mamuda) benefiting 3,750.			
Ghana		Regulatory framework and Standards (improved cook stoves); Cook stove testing and expertise lab established, standards).		Solar irrigation systems in 4 communities in Northern Ghana; promoted exchange with China on RE; plan to support the National Rooftop Solar Programme.			Facilitated SWITCH Africa Green; supported Ghana Alliance for Clean Cookstove.
Guinea		Installation domestic bio digesters in 44 communities benefiting 1,548 people.		Installation of solar kits in town halls, places of worship, and health centers.			
Guinea Bissau		Bio digesters in 4 communities for electricity and cooking gas benefiting 850 households.		Helped 10,000 families have access to solar energy benefiting 24,634 people.			
Kenya		Revision of charcoal regulation, investment in briquette technology, reforestation and charcoal commercialization.		Provision of equipment, training of technicians (866); developed solar water heating system.		Wind power farms (Turkana and Ngong).	Established and trained National Association of Charcoal Producers (and in 3 counties), training of PV technicians; promoted incubation centres. And supported RE Fund
Liberia				18,000 benefitted from solar electrification of health centres in Bong, Salala, Jundu and St. Timothy.			
Lesotho				Subsidized 1537 solar home systems and solar PV system to 1 business centre and 7 income generating activities.			Establishment of Lesotho Solar Energy Society; training of 165 technicians, 5 instructors, and mainstreaming solar PV in vocational training programmes in the National University of Lesotho. .

Country		Biomass		Solar		Wind		MSMEs	
Madagascar+	Identification of feasible investment.	Supported 50% tax reduction for renewable energy especially solar energy and helping to identify feasible investment.	Identifying feasible investment.	Promotion of fiscal incentives on renewable energy equipment (e.g. PV panel, solar kits and 2V batteries).					
Mali	About 18,000 ha of 2.0 million jatropha planted and 14 local nurseries established benefiting 1,000 farmers in 50 villages; 5 villages electrified through jatropha oil run generators.	309 villages (31,531 people) benefited from hybrid multifunctional platforms.		390 facilitators; 63 photovoltaic installers; and 70 artisans' manufacturer and repairer trained.					
Mauritania		Solar-based multifunctional platforms for refrigeration, television, battery charges, and grain mills in rural communities benefiting about 16,000 in 40 villages.	Electrification of 4 coastal communities by hybrid wind/diesel generation benefitting 2,000 people.	Public-private partnership regulatory framework.					
Niger	Five villages and 10,000 households change to biogas from diesel to run multi-functional platform	Assisted with 252 solar pumps and 392 agricultural units (1 AU=0.25 ha).252 producers and 70,000 inhabitants benefited from solar pumping of 65 garden sites (98 ha) in 2017 alone.		Platform for over 40 solar businesses.					
Nigeria	Sustainable fuelwood supply and woodlot management developed; improved cook stoves manufactured and distributed; biogas rural electricity generation piloted .	Supported renewable energy strategy and master plan; Clean energy policy instruments and capacity piloted in several communities; off-grip solar PV for street lightening, borehole, health delivery supported in north east Nigeria including solar.		Design, fabrication and installation of solar-powered agro-industries (e.g. rice and cassava) supported; local technicians trained on installation and maintenance of renewable equipment and manufacture of improved cookstoves; etc.					
Senegal	Production of bio-coals (e.g. Typha valorization project).	Supported national renewable energy strategy; capacity building of National Agency for RE; and electrification of 420 villages through solar PV; supported women association with solar lamp..		Platform for solar companies supported; advocated for subsidies on renewable energy equipment. .					
Sierra Leone	Charcoal (land refill).			-					

Country	Biomass		Solar		Wind		MSMEs
South Africa		UNDP-GEF solar cooker project completed in 2006.	UNDP-GEF South African Wind Energy Project (SAWEP) – Darling wind farm.		The Fast Track High Resolution Wind Map and the establishment of wind data bank are to level playing fields for small scale actors.		
South Sudan	Framework for renewable energy developed.	Hybrid grid system developed; installation of solar system done.	Framework for clean energy, including solar developed.				
Swaziland	Framework for clean energy, including biomass developed.	Framework for clean energy, including solar developed.	Framework for clean energy, including wind developed.				
Tanzania	Biogas energy plants in Mount Rungwe and Sengerema Districts for pipes, stoves, and lighting system.	More than 20 micro projects supported (e.g. Kegara); solar water pumps; and solar power electricity in 6 hospitals for refrigeration of vaccines and theater operations.			Renewable energy fund established; investment prospectus developed and Renewable investment facility being developed.		
Togo	–	10,000 solar street lights in rural Togo; 40 multifunctional solar platforms. Eco-village initiated to benefit 1,022 million when completed.			Small enterprises to maintain and repair solar energy equipment.		
Uganda	Development of National Biomass Strategy; supported technology for sustainable charcoal production.						
Zambia	Sustainable biomass use through forest regeneration.	A solar centre established at Zambia University for learning and ensuring quality; installed solar system in 13 health facilities in Lusaka Province and the central Medical Store benefiting 85,000 people.			Partnership with four private companies.		
Zimbabwe	Biogas digester for schools	Renewable energy and data analysis tools Pilot project for solar systems for schools (Nyatsato Primary School) Gwanda solar plant with support from GEF and EU			Stakeholders' consultations on renewable energy		

Note: APAUS is the Agency for the Promotion of Universal Access to Services in Mauritania. GEF is Global Environment Facility. EU is European Union.

+UNDP's engagement in Madagascar is more on hydropower plant, e.g. in Amberivy that served two communities that benefitted 213 households. It also supported the development of payment for environmental services scheme. It is also focusing on a hydropower project in the Democratic Republic of the Congo. And in Cabo Verde, the focus is on energy efficiency.

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SUSTAINABLE DEVELOPMENT GOALS





*Empowered lives.
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