RENEWABLE ENERGY IN AFRICA

An opportunity in a time of crisis

WoMin
AFRICAN WOMEN UNITE AGAINST DESTRUCTIVE RESOURCE EXTRACTION

WE FIGHT CLIMATE CHANGE

350Africa.org

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Acronyms

AfDB	African Development Bank
BXC	Beijing Xiaocheng Company
BNEF	Bloomberg's New Energy Finance
BOCRA	Botswana Communications Regulatory Authority
BPC	Botswana Power Corporation
BOO	build-own-operate
CBN	Central Bank of Nigeria
CERC	Clean Energy Research Centre
CSP	Concentrated Solar Plant
DRC	Democratic Republic of Congo
DBSA	Development Bank of Southern Africa
ECOWAS	Economic Community of West African States
EETC	Egypt Electricity Transmission Company
EEHC	Egyptian Electricity Holding Company
ECG	Electricity Company of Ghana
EDC	electricity distribution companies
EGISA	Electricity Governance Initiative of South Africa
ERC	Energy Research Centre at the University of Cape Town
EPC	engineering, procurement and construction
ERIL	Electrification Rurale d'Initiative Locale
FiT	feed-in tariff
AFD	French Development Agency
GIZ	German Society for international Cooperation
GEF	Global Environment Facility
GGGI	Global Green Growth Institute
GW	gigawatt
IPP	independent power producer
IDC	Industrial Development Corporation
ISES	Integrated Sustainable Energy Strategy
IEA	International Energy Agency
IFC	International Finance Corporation
IRP	Integrated Resource Plan
JICA	Japan International Cooperation Agency
KenGen	Kenya Electricity Generation Company
KPLC	Kenya Power and Lighting Company
KEREA	Kenyan Renewable Energy Association
KITE	Kumasi Institute for Technology, Energy and Environment
kWh	kilowatt-hour
MW	megawatts
MDA	Ministries, Departments and Agencies
MOEP	Ministry of Energy and Petroleum
NREA	National Renewable Energy Association
NHES	New Household Electrification Strategy
NBET	Nigerian Bulk Electricity Trading Company
NGO	non-governmental organisation
ORE	Oasis Renewable Energy
PPA	power purchase agreements
PPI	Private Participation in Infrastructure
PIC	Public Investment Corporation
PCOA	put-call option agreement
PV	photovoltaic
R&D	Research and Development
REEEP	Renewable Energy and Energy Efficiency Partnership
REFiT	renewable energy feed-in tariff
REIPPPP	Renewable Energy Independent Power Producer Procurement Program
RENAC	Renewables Academy
REA	Rural Electrification Authority
SREP	Scaling up Renewable Energy Program
SME	small-to-medium size enterprise
SNEL	Societe Nationale d'Electricite
SHS	solar home system
SWH	solar water heater
SAPP	Southern Africa Power Pool
SPS	Strategic Power Solutions
UNIDP	United Nations Industrial Development Organisation
UECCC	Uganda Energy Credit Capitalisation Company
UNT	unified national tariff
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
US	United States of America
USAID	US Agency for International Development
VAT	Value Added Tax

Glossary

Biogas is produced from decomposing organic waste. When food and animal waste break down they release gases like methane and carbon dioxide. Biogas can be converted to create electricity.

Biomass is the solid material that comes from plants and animals. It can be used to create biogas. The chemical energy in biomass can be burned and released as heat. Biomass is a renewable source of energy.

Build Own Operate describes a way in which a government project can be delivered. Government allows a private company to construct a project according to certain design specifications and then run it for a specified time.

Co-generation is the process of producing electricity from steam (or other hot gases) and using the waste heat as steam in chemical processes. In contrast, a stand-alone power-producing plant typically converts less than 40% of the heat energy of fuel (coal, natural gas, nuclear, etc.) to electricity.

Concentrated Solar Plant (CSP) uses mirrors and lenses to concentrate a large amount of sunlight onto the receiver and generates electricity when the heat produced is converted.

Diesel generator generates electricity from a diesel engine combined with an electric generator. It is usually designed to run on diesel fuel, but some types are adapted for other liquid fuels or natural gas. Diesel generators can vary in size from small household units to large plants that feed electricity into national grids.

EGYSOL is an Egyptian Government and United Nations Environmental Programme (UNEP) project, funded by the Italian Government for the rollout of solar water heaters in Red Sea and Sinai hotels and resorts.

Electricity access is defined by the International Energy Agency as a household having access to sufficient electricity to power a basic bundle of energy services – at a minimum, several lightbulbs, task lighting (such as a flashlight), phone charging and a radio – with the option of increasing the number of services over time.

Electricity generation is the process of creating electrical power from renewable and non-renewable sources of power. This stage precedes transmission and finally distribution of electricity.

Electricity supply auction is a mechanism to procure electricity. An entity (usually the government or national utility) will issue a tender for the procurement of electricity, and other entities will bid to supply the energy, usually resulting in the cheapest source being selected.

Feed-in tariff is a payment made to individual households and businesses for excess energy that they generate on their own that then goes back into the grid. It is designed as a policy incentive to advance renewable energy.

Geothermal energy is heat that is produced from under the surface of the earth. This energy is carried by water and/or steam to the earth's surface, where it can be used to generate electricity. Geothermal energy is considered a renewable source of energy.

Localisation in our context is used to describe the process of manufacturing, installing and maintaining renewable energy components like solar PV panels domestically. This can be used as a policy intervention to provide more jobs to citizens of a country and create a fledgling industry in that country.

Market seeding refers to the process of creating a particular need for a good or product in a certain population or group of customers which can encourage a faster adoption of the product to the entire population.

Micro-grid operates as a larger (than mini-grid) decentralised grid usually between 1 and 50 kW and acts as a single controllable entity with its own distributed energy. It can connect and disconnect to the main utility grid.

Mini-grid is a type of distribution network that involves small-scale electricity generation between 50kW and 1 MW[1] to a localised group of customers. It is an isolated, small-scale network that is not connected to utility-scale grids.

Net metering is a billing mechanism that pays or credits home and business solar energy system owners for the electricity they add to the grid.

Non-renewable energy comes from finite sources such as coal, natural gas and petroleum. They can only be replenished again by natural planetary processes over millions of years. These sources of energy are also called fossil fuels.

Off-grid is when a person or entity no longer uses power supplied by the national grid. They can instead generate their own electricity.

Power grid is a network of lines carrying electricity used to transmit and distribute electricity over an area. A power grid can be created to have electricity travel both from a utility to a local consumer and from the consumer back to the grid.

Power Purchase Agreement is a contract between two parties, one who generates electricity and one who is looking to purchase electricity.

Power Pooling is a term for the interchange of power between two or more utilities usually across country borders. This usually involves a contract for power sharing or a power-sharing agreement between the countries. The Southern Africa Power Pool is an example of a power pool operating over several countries across the Southern African region.

Power Africa is a US-led initiative that aims to increase energy access in certain African countries. It involves a partnership between technical and legal experts, the private sector and governments.

Renewable energy is created from natural resources that are infinite, such as the wind and sunlight. It is an alternative to fossil fuel-based energy and is therefore generally described as clean energy.

Solar photovoltaic (solar PV) is a technology that converts light from the sun into electricity by using semiconductors. The technology is generally used on a panel, hence 'solar panels'.

Take or pay power purchase agreement guarantees the seller a minimum portion of the agreed-on payment if the buyer does not follow through with taking the full agreed amount of power. Take or pay provisions are commonly found in the energy sector, where overhead costs are high.

Transmission is the bulk movement of electrical energy from a generating site, such as a power plant, to an electrical substation. The interconnected lines form a transmission network.

Utility scale renewable energy projects are typically defined as those 10 megawatts or larger.

Wheeling is the process of transmission of electricity through transmission lines and often refers to the scheduling of the energy transfer.

World Bank Lighting Africa Program is an initiative of the World Bank which aims to expand access to clean, affordable, off-grid lighting to people currently living without electricity in sub-Saharan Africa.

1. These figures from https://www.ee.co.za/article/development-renewable-energy-based-mini-micro-nano-grids.html

Introduction

Africa is at grave risk from climate change

It is warming faster than the rest of the world, and the impacts of this warming are already being felt. From Cyclones Idai and Kenneth sweeping through parts of southern Africa, to the droughts in Kenya and Namibia, and sea-level rise in Senegal, the continent is already reeling from catastrophic impacts. Fifty-two countries across Africa, barring Nigeria and South Africa, have collectively contributed only 5.7% to total accumulated greenhouse gas emissions since 1850[2], yet these same countries carry a significant burden of climate change impacts.

Africans also live in some of the least developed countries in the world. Of all the global regions, Africa has the least adequate, reliable and affordable electricity. Electrification rates vary widely across the continent with rural areas having the lowest access. Each country situation is unique, in terms of resources, history and political economy, but what they do have in common is a need for energy infrastructure.

Energy deprivation profoundly impacts African women who, by virtue of their socially-ascribed responsibilities for household care, predominantly provide for energy needs. Where energy is being generated through harmful fossil fuels and destructive mega hydro, it is peasant and working-class women and other frontline communities whose livelihoods are destroyed and their lives cut short and degraded with little or no benefit.

There is an urgent need to address the nexus of unfolding climate and ecological crisis, energy access and the state of development in African countries. A key step globally is to urgently move away from the use of fossil fuels as a source of energy by stopping the expansion of fossil fuel infrastructure and implementing a managed closure of existing infrastructure. The benefits of this would be seen in dramatically reduced emissions and pollution and protecting the land and livelihoods of frontline communities. Africa is not as locked into fossil fuels, such as coal, as compared with other parts of the world.

The shift to renewable energy as an alternative cleaner source of energy is therefore proposed. Renewable energy such as solar, wind, and small hydro produce less, if not zero emissions, and can be implemented without needing connections to the national grid in rural areas where communities need the energy. Renewable energy which is just and equitable in form and output, has the potential to unlock great potential in African citizens and their ability to work, deepen livelihood and advance well-being, as well as supporting a home-grown development agenda set on African terms. It will at the same time ensure that the continent leapfrogs polluting fossil fuels as a source of energy.

Renewable energy alone is not a panacea to all of Africa's energy and developmental challenges. Renewable energy can come with its own problems, particularly if it is implemented using the same profit-oriented logic that has guided the development of fossil fuels.

This includes implementation of projects without the free, prior and informed consent of affected communities, and big industries and urban elites being given priority access to electricity produced. Where corporations lead the rollout of renewable energy projects, the profit imperative can result in human and environmental rights violations as costs are externalised to communities and nature. Some forms of renewable energy require the mining of rare earth and other minerals, which is often associated with land and resource grabs affecting marginalised and indigenous communities around the world. These issues are often more prevalent in large-scale renewable energy projects.

350Africa.org and WoMin recognise the interconnected energy and climate crises and the impact and opportunity a just and fair energy transition to renewable energy presents for people across Africa, and women in particular. Both organisations support localised, decentralised, clean, renewable energy alternatives which benefit poor communities and women specifically. As this report shows, there is currently a heavy emphasis on the private sector. We need to widen our understanding, imagination and proposals for scaled-up, just, renewable energy systems.

Our aim in embarking on this research is to provide a snapshot of the status and trends of renewable energy across ten African countries: Botswana, Democratic Republic of Congo, Egypt, Ghana, Côte d'Ivoire (Ivory Coast), Kenya, Nigeria, Senegal, South Africa, and Uganda. From this, we can extrapolate some general comments on overarching regional trends. As part of this research project, we also commissioned a handful of case studies of renewable energy projects in the countries studied, to gain a better understanding of how these projects were being implemented, how accessible and affordable the energy generated was, who was benefiting, and who was carrying the costs. The study also aims to explore whether the very nascent transition to renewable energy has been characterised by a shift away from the traditional centralised control and ownership of energy systems that favours large corporates and their profit-driven motives.

The research provides a baseline for further enquiry and offers 350Africa.org, WoMin and energy and climate justice activists in the countries researched a sense of the emerging outlook of renewable energy. Importantly, the research is intended to support country-level activists in identifying the gaps and pressure points for advocacy in their countries, and to provide examples from other African countries where renewable energy is more advanced. The case studies aim to help activists gain awareness about the costs and benefits of renewable energy projects being rolled out and to shape a view of more socially and environmentally just projects, which benefit communities and women in particular.

2. https://www.pbl.nl/en/publications/countries-contributions-to-climate-change

Method for the ten country analyses

The research on the status and trends of renewable energy in 10 countries was largely desktop based and undertaken by the Energy Research Centre on behalf of 350Africa.org and WoMin. The case studies were conducted by in- country activists and researchers who conducted field visits to the sites to research how the project was implemented and what the socio-economic impacts were locally. The countries were selected largely because of their political centrality and ability to influence energy trends in Africa, and also because of 350Africa.org and WoMin's existing work with organisations and activists in the countries.

A critical note for the reader:

The country cases mainly feature private sector projects and developments, but this is largely determined by the availability of data. This should therefore not be seen as an indication of bias towards private sector development.

Projects that are grant-funded, state-funded or non-profit funded are relevant and of interest, especially for any insights that non-private investment projects might reveal about benefits for local communities and for the environment.

Since private sector development usually links to larger projects with substantive financial investments, information about these projects is usually more readily available in the media and company websites.

Arguably, the more benefit that the developers or stakeholders are likely to derive from publicising the project, the more motivation there might be to make information publicly available that enables tracking of the project.

More in-depth, in-country and field research could help reveal community-based projects and community experiences of private development, information which is largely not visible and publicly available.

The research for this report started in late 2018 with the first datasets available in December 2018. Since then, the research has been updated a few times, with the last update completed in November 2019. The University of Cape Town's Energy Research Centre (ERC) made additions to the overview section in early 2020 and the commissioning organisations have made further additions and edits in May 2020. The call for case studies of country projects went out in early 2019 and this process concluded by late 2019, after an initial selection process, review and final selection of draft reports, and a final editing and inclusion in to the report by November 2019.

We assume that there have been changes to each country's context since the last update, but that these may not be hugely significant because of the redirection of efforts and resources from business as usual to support responses to the COVID-19 health crisis.

Presentation of the findings

In this short report you will find:

- The introduction
- The key findings of the research drawing on the country analysis and the in-depth project case studies
- Conclusions and next steps.

Country Contexts

Analysis related to the ten selected countries is available online. It follows a standardised structure that includes the state of electricity supply and the resources available for energy generation in each of the ten countries.

Five in-depth case studies are included in the relevant country sections.

The country by country analysis was undertaken by the Energy Research Centre (ERC) at the University of Cape Town, South Africa. The individual in-depth project case studies were undertaken by researchers and activists schooled in the energy question in country.

The country cases are reproduced as presented by the ERC and form the basis for the analysis in the introduction and conclusion. The analytical frame and conclusions in the report are provided by both WoMin and 350Africa.org.

The reports can be accessed here:

Botswana

Democratic Republic of Congo

Egypt

Ghana

Cote d' Ivoire

Kenya

Nigeria

Senegal

South Africa

Uganda

Overview of renewable energy in ten African countries

This section draws on the ten country cases and in-depth case studies of renewable energy projects commissioned by 350Africa.org and WoMin. The commissioning organisations reviewed the role of the private sector versus the state, looking at some trends across the countries and concerns for a just transition. It provides inferences from the information presented in the country studies.

Renewable energy versus fossil fuels and mega-hydroelectric dams

The installed capacity for renewable energy technologies is probably the simplest measure of the provision of modern, clean and low carbon electricity infrastructure. This measure is useful for a broad overview of the level of uptake of renewable energy as compared with fossil fuel technologies. This simple measure does not instruct us much on who is accessing this energy and what the costs to society are, which is of great concern to 350Africa.org and WoMin.

Across Africa, the uptake of renewable energy technologies in the form of geothermal, solar, ocean wave, wind and small hydro technologies up to 10 MW falls far short of that of fossil fuel electricity supply, specifically of coal, diesel and natural gas installations. Fossil fuel or hydroelectric power dominates electricity supply in all of the countries in this study, except for Kenya, where geothermal is the main source of electricity generation, followed by hydroelectricity, then oil.

Botswana and South Africa rely mainly on coal, Egypt and Ghana on oil and gas, and Senegal on oil. Electricity supplies in both Côte d'Ivoire and Nigeria are powered mainly by natural gas, followed by hydroelectricity. Uganda and the DRC's electricity supply are dominated by hydroelectricity, but mostly from big hydroelectric dams which we do not characterise as a just source of renewable energy, involving as it does, so many negative social, environmental and climate impacts.

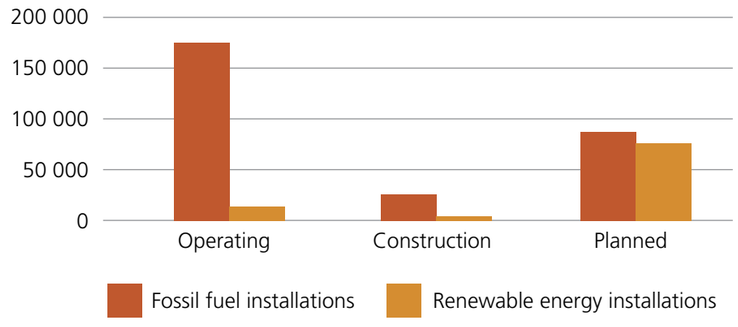
Across the other countries, renewables contribute less than 5%. This includes South Africa, Côte d'Ivoire and Botswana.

A more optimistic perspective is that, however uncertain, the sum capacity of prospective renewable energy technology installations is significantly greater than installations that are under construction or operating.

Overview of capacity of energy technologies operating, under construction and planned in Africa (in MW)[3]

	OPERATING	UNDER CONSTRUCTION	PLANNED
FOSSIL FUEL INSTALLATIONS	**173 737**	**26 859**	**88 816**
coal	49 861	6 522	33 694
diesel	13 031	279	4 592
natural gas	110 845	20 058	50 530
RENEWABLE ENERGY INSTALLATIONS	**14 454**	**3 647**	**77 032**
BIOGAS	95	11	223
BIOMASS	900	402	3 274
GEOTHERMAL	835	83	3 789
hydro (=<10 mw)	569	117	806
ocean	0	6	105
solar	6 024	1 042	52 202
wind	6 031	1 986	16 633

Aggregate capacity of installations across Africa in 2019 (in MW)[4]



3. Source: African Energy Live data, estimates from November 2019 (installed capacity in MW).The overview data for energy installations across Africa is disaggregated by the status of development of the projects. 'Operating' installations are generating energy, those 'under construction' are formally approved with necessary authorisations and licences and their financing has been approved by the lending institutions they rely on. The projects within the 'planned' phase have been publicly announced or have made applications, or started feasibility studies. They are not ready to start construction because an essential approval of the project is outstanding. This approval could be by the authorities, by the power off-taker, or by the lending institution(s). Policy that provide for implementation of projects may change. Not all planned projects will proceed, and the lead time for those that do proceed is also uncertain. Capacity that is described in national energy plans are included only where some implementation action has been taken, for example an announcement launching a tender process to seek a project developer.

4. Source: African Energy: Live data, https://www.africa-energy.com/database.

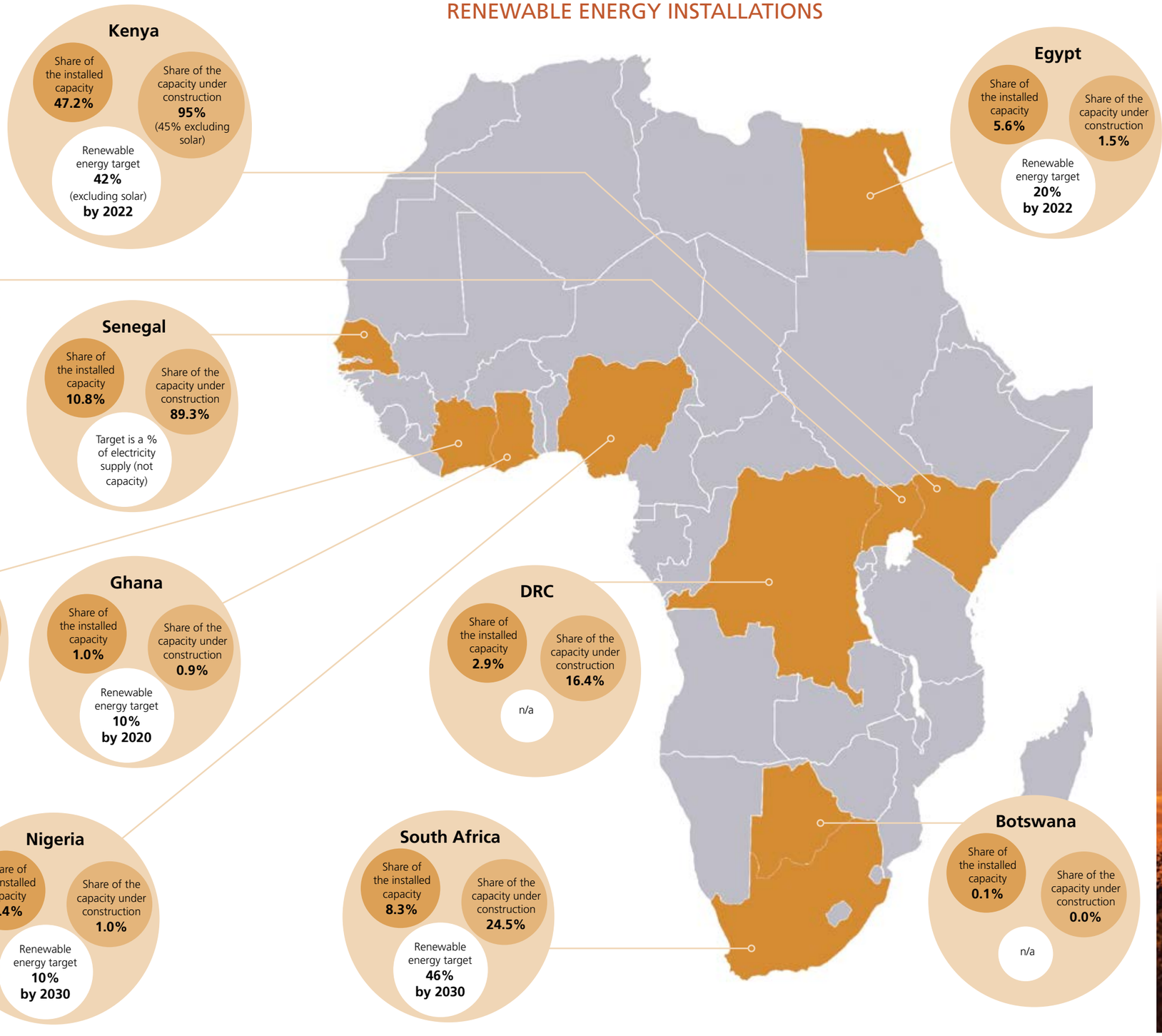
Across the ten selected countries, Kenya leads with the highest share of renewable technologies (47.2%) in electricity generation capacity. The country with the highest share of renewables of all the projects under construction is also Kenya (95%), with solar accounting for 40.1% and wind for 25.4% of the capacity under construction. Kenya's renewable energy is dominated by geothermal capacity (28.8% of the total), and then wind (11.7%). This is explained by their abundant geothermal resources, which has made Kenya the ninth largest producer of geothermal energy in the world. The country has also developed various policies and regulations promoting renewable energy, including most importantly the Kenya Vision 2030 which serves to increase people's access to electricity by renewable energy sources.

Despite having one of Africa's poorest electrification rates, Uganda follows Kenya with the second highest share of renewables in total installed capacity at 20.7%, mainly biomass (8.2%) and small hydro up to 10 MW (7%). Uganda credits its high renewable energy capacity to incentive schemes including a generous renewable energy feed in tariff and other tax incentives. The country generates more than 90% of its power from renewable energy sources.

Senegal has the second highest volume of renewable energy projects under construction, with 89.3% coming from wind power. This is largely attributable to the country's target of universal access to electricity by 2025, with a 20% renewable energy generation capacity goal being achieved by end 2017. The country also aims to meet 15% of primary energy supply from renewable sources (excluding biomass) by 2025. Despite this ambition, by 2017 oil still dominated the national energy supply, with it accounting for 53% of total energy by source.

Botswana lies at the other end of the spectrum. The country has the least amount of renewable energy capacity installed and in construction, with most of its energy imported from the Southern Africa Power Pool (SAPP). For new build it is relying on the exploitation of massive coal reserves which have only been discovered in the last few years. Solar appears to hold the most promise, with wind and biomass emerging as least favourable.

RENEWABLE ENERGY INSTALLATIONS



Electricity access

Electricity access is typically used as a measure of 'development' for countries to indicate the percentage of people in an area that have a connection to electricity, usually to the national grid. Furthermore, according to the International Energy Agency (IEA), electricity access is defined as a household having access to sufficient electricity to power a basic bundle of energy services – at a minimum, several lightbulbs, task lighting (such as a flashlight), phone charging and a radio – with the option of increasing the number of services over time. An important point to highlight here is that people need to be able to afford and use the electricity provided. Simply put, a connection does not imply that a household is able to use power.

> People need to be able to afford and use the elctricity provided

More than half of the total population in eight out of the ten of the countries, including Botswana, Egypt, Côte d'Ivoire, Ghana, Kenya, Nigeria, Senegal, and South Africa have access to electricity. Sixteen percent of the population have electricity access in the DRC and in Uganda just over twenty percent have access. Overwhelming numbers of people are without electricity access: 76.8 million in Nigeria, 68.8 million in the DRC and 31 million in Uganda. Electricity access is typically less common in rural than in urban areas. The countries with the highest levels of overall electricity access are the ones where the level of electricity access is the same in rural and urban areas. These are Egypt (99.8%) and South Africa (84.2%). These countries also have relatively high uptake of renewables as compared with the other countries under study. Egypt, South Africa, Ghana and Kenya have used or are moving to electricity supply auction schemes, rather than feed-in tariffs, to drive investment in renewables connected to national electricity supply grids.

Again, these estimates of access belie very real concerns about affordability, particularly in low to least 'developed' countries. In South Africa, for example, while access to electricity appears to be high, poor people in urban and peri-urban areas are not able to afford electricity and are cut off from supply by Eskom, the national electricity utility. Whilst a minimum source of free basic electricity is supplied, this is not enough to power a household's needs. Many poor people have resorted to illegally reconnecting electricity, which is dangerous and results in criminal prosecutions. Households that are connected to the grid often confront exorbitant electricity bills which they may not be able to pay. This further condemns them to poverty and increases inequality. In the early 1990s, the South African government started installing pay-as-you-go electricity meters in poor homes which, superficially, counts as household connectivity. This process was not uncontested and saw extensive protest and civil disobedience as communities in townships across the country bypassed meters to access power. However, if the household is poor and cannot afford to service its account, they are cut off from power. This tool, from the tool-box of privatisation, is most likely replicated in other countries across the region.

Renewable energy policy, targets and potential

With the exception of Botswana and the DRC, the other eight countries addressed in this research have renewable energy targets, which are generally included in electricity policies. Most of the targets describe an increase in renewable energy technology generating capacity in megawatts or as a percentage of total generating capacity. Senegal targets a percentage of electricity supply (rather than generating capacity), and Uganda targets a percentage of energy consumption. Uganda has achieved its energy target: more than 90% of its supply is hydroelectric, with a significant proportion of this coming from large-scale hydroelectricity, which we critique as unjust, having negative impact on people, the environment and the climate. Kenya aims to install 5 GW more power-generating capacity by end-2016, of which 1.6 GW will be geothermal, 630 MW will be onshore wind, and 18 MW will be cogeneration. Egypt aims to supply 20% of its generated electricity from renewable sources by 2022, with plans to install 3.5 GW of solar by 2027 and 7.2 GW of wind by 2020.

In 2011 in Ghana, 10% renewable energy share of generation (500 MW) was targeted to be achieved by the year 2020.30 Of this, 200 MW is meant to be in the form of rooftop solar. In July 2018, the Côte d'Ivoire released its renewable energy roadmap which set out to achieve a 42% renewable energy share in the country's energy mix by 2030. In this, it targets 150 MW of solar by 2020. Nigeria has a target of 30 GW of overall power generation capacity by 2030 of which 30% is expected to come from renewables, as set out in the Nigeria Vision 30-30-30 energy policy. By 2030, the country plans to have 5.3 GW of mini-grids and 2.8 GW of solar home systems, up from 1 MW and 30 MW in 2015, respectively. In South Africa, the electricity plan, the Integrated Resource Plan 2019 (IRP 2019), includes wind (14.4 GW to be added by 2030) and solar PV (6 GW).

Ngong Hills windfarm, Kenya

The growth of grid-connected renewable energy

Where renewable generating capacity is starting off at a low base, the rate of growth is relatively high. Ghana went from 3 MW of renewable generating capacity in 2013 to 43 MW in 2015 and Uganda added 50 MW of solar PV generating capacity to the grid between 2016 and 2019. Senegal added 100 MW of solar PV in the 2017 to 2018 period. In other countries, such as Botswana, renewables' growth is low or non-existent. In Côte d'Ivoire, renewable energy projects are scheduled be brought on grid by 2022 only, and include solar and biomass projects which accounts for less than 2% of the energy mix combined. Utility-scale solar plants are currently being developed by a Chinese-Canadian manufacturer. Kenya already starts off from a high base because of the percentage of geothermal it already has in place.

In the DRC, plans for renewable energy development are negligible. This is because of the dominance of large hydroelectric power and the lack of policy and incentives to promote the growth of renewable energy.

Despite Nigeria's ambitious plans for renewable energy and the signing of 14 solar PPAs, the rate of growth has been low. This can perhaps be explained by the insolvency within the energy sector.

The rate of growth in Egypt has been high, owing to the feed-in tariff scheme adopted in 2014, and subsequently revised down from 2016. The large-scale renewable energy projects under development include the Benban Solar Park in Aswan, costing USD 4 billion, and consisting of a 1.65 GW PV plant on a site of approximately 37.2km2. Construction of the plant started in the first quarter of 2018 and was completed by the end of 2019.

The relatively high rate of growth of renewable energy in South Africa has been attributed to the Renewable Energy Independent Power Producer Procurement Program (REIPPPP) which was launched in 2011 and progressed over several phases. The programme has been hailed for bringing down the price of renewable energy and attracting a range of private investors, from multinational private companies and wind turbine and PV cell manufacturers to local private banks. The programme has however substantially failed to benefit local communities and create significant sustainable employment, extending beyond the construction period. There has also been a failure to industrialise through manufacturing and this is largely attributed to the lack of state commitment to a just renewable energy transition. Research by the Electricity Governance Initiative of South Africa (EGISA) found that the share benefit scheme only supports profit sharing once most of the project debt had been paid off, and that the failure of renewable energy companies to coordinate with local government has created a parallel track in local social and economic development.[4]

Ngong Hills windfarm, Kenya

Biogas and biomass

Biogas and biomass are renewable sources of energy, typically referred to as biofuels.

Biogas is produced from decomposing organic waste in an oxygen-free environment. When food and animal waste break down they release gases like methane and carbon dioxide, and small quantities of other gases. Biogas is produced in biodigesters, landfill recovery systems or in wastewater treatment plants. Biodigesters are containers or tanks in which the organic matter is diluted in water and broken down by naturally occurring bacteria. Biodigesters can be made in a range of sizes, for example, for use by households to large slaughterhouses, but they must have regular feedstock to operate well. Landfill gas recovery systems capture biogas using pipes and extraction wells. They tend to be medium to large-scale installations. Wastewater treatment plants use sewage sludge as feedstock in an anaerobic digester.

> Biogas and biomass projects have attracted attention in recent years as an alternative source of renewable energy

Biomass is the solid material derived from plants and animals. The energy stored in biomass can be released to produce electricity or heat, through combustion or gasification of dry biomass or biogas. It can be used to create biomethane by a process of thermal gasification at high pressure and high temperature in a low-oxygen environment, followed by the removal of acidic or corrosive components in the gas, and a process of methanisation. The chemical energy in biomass can be burned and released as heat.

Biogas and biomethane can be used directly to create electricity and heat or as an energy source for cooking. Biogas needs to be processed to remove contaminants ('upgraded') to create biomethane which can then be supplied in a piped gas network or used in electric vehicles.

Biogas and biomass projects have attracted attention in recent years as an alternative source of renewable energy. Proponents argue that trees, for example, can be cut down for woodchips to create energy which produce less harmful emissions than fossil fuels. Similarly, other crops such as wheat, corn, soybeans and sugarcane can be diverted to biofuel production. The environmental impacts of biofuels are well documented and include inter alia the degradation of soil, the release of CO2 due to the clearing of land and the burning of carbon stores in trees and vegetation, and the destruction of natural forests for biofuel monocrops, to name a few. An important critique from a food sovereignty perspective is that these crops replace food crops that feed people contributing to rising hunger.[5] The logic that permits this practice is connected to the search by the market for quick wins because these crops can be low cost and low maintenance, or 'greenwashing', which serves the interests of large profit-seeking corporates.

A source of biofuels, which genuinely uses the by-products and waste of food producing processes may be considered a clean and renewable source of energy. Anaerobic biodigesters can produce fertiliser as a by-product and this may be a suitable energy choice in some agricultural communities.

Across the countries studied, potential for biogas energy generating capacity is emerging. There are reportedly about 500 functioning biogas plants in Uganda. Waste-to-energy projects are found in Ghana, Côte d'Ivoire, Kenya, Nigeria, South Africa and Uganda.

4. http://aidc.org.za/renewable-energy-benefits/

5. https://www.scientificamerican.com/article/biofuels-bad-for-people-and-climate/; http://www.thecropsite.com/articles/1771/environmental-impacts-of-biofuels/; http://www.fao.org/3/i0100e/i0100e05.pdf

There is significant potential for agricultural waste gasification in some agricultural communities. In Kenya, biogas using agricultural waste is gaining momentum with over 200,000 biogas systems installed by 2018. The potential for biogas has reportedly not adequately been exploited and contractors were not able to advise farmers about how to use the energy to greatest effect, with the exception of using it for household cooking. The United Nations Industrial Development Organisation (UNIDO) is supporting projects to convert agricultural by-products to electricity.

> There is significant potential for agricultural waste gasification in some agricultural communities

A handful of large-scale biogas plants are operating and also under development, from landfill waste projects and from lumbar, sugar and cocoa plantation waste. Co-generation systems are also being applied on a small scale, for example, for energy supply at sugar-processing plants.[6]

Anaerobic biodigesters are producing biogas at businesses and buildings, such as in Ghana at abattoirs, education facilities, hospitals and hotels. The biogas installations can be dedicated to a single type of feedstock or a combination (for example, faecal matter, slaughter waste and organic waste) provided the supply is consistent in feedstock type and amount.

Landfill waste to energy installations can be found in South Africa, and there are plans for plants in Ghana and Côte d'Ivoire. Wastewater treatment biodigester technologies are planned for Egypt and Uganda. These should deliberately be separated from carbon trading mechanisms, the source of significant contention in the Bisasar Road methane electricity conversion project affecting a poor black working class community in Kwazulu-Natal, South Africa.

Côte d'Ivoire is promoting investment in biomass projects through a project tender system. Large biogas installations (>20 MW) are planned for Ghana, Côte d'Ivoire and Kenya.

Fiscal incentives, standards and localisation

Renewable energy components enjoy relief from import duties or Value Added Tax (VAT) in some countries. Exceptions include the DRC where companies face import duties on off-grid solar products, unless they are granted an exemption, and Senegal where 25% import tax and 18% VAT make off-grid product prices relatively high. High prices reportedly drive the market toward cheaper and inferior quality products. Negative experiences with inferior products or the lack of maintenance are said to undermine consumer confidence in the off-grid sector in general; this is the experience in Botswana, the DRC, Senegal and South Africa.

Ghana is the only country with evidence of a localised supply chain; it has a PV manufacturing plant that will reportedly produce crystalline PV modules at a rate of 30 MW per year. Of the ten countries, Egypt reportedly has the highest potential to meet more than 80% of local manufacturing content for renewable energy and has a localisation target of 70% for renewable energy plants by 2020, 50% for concentrated solar power (CSP) plants and 60% for solar PV including in construction works, mounting structures, cabling, etc.16 Egypt has also localised 30% of overall wind farm requirements. It is said that Egypt can leverage its mature steel, glass and cable industries to produce solar and wind components locally.

Off-grid potential

The off-grid sector is enjoying promising growth in Côte d'Ivoire, Ghana, Nigeria, Senegal, South Africa and Uganda. The DRC has growth potential in off-grid lighting in a few regions. In South Africa this growth is likely driven by low reliability in electricity supply and in Uganda, poor electricity infrastructure may play a role in the shift to off-grid options. In Nigeria, electrification targets and a drive to reduce the use of diesel generators is propelling the electrification agency's support for micro-grids.

Pay-as-you-go and mobile money models have had significant success. The Kenyan market for off-grid pay-as-you-go solar home systems is the best established in Africa. An estimated 300,000 rural households in Kenya have solar home systems. In Côte d'Ivoire, the off-grid market is reportedly growing with companies agreeing in 2016 to enter the market and sell solar home systems via mobile money payments. In June 2018, the African Development Bank (AfDB) approved a proposal worth USD 28 million loan for a project which pilots a small loans facility for 100,000 rural households to purchase pay-as-you-go solar home systems by 2020.

Mini-grids are being considered as a long-term alternative to grid connection for the population without electricity access in Ghana. Botswana has commissioned a pilot project to implement 20 solar PV off-grid installations in isolated rural villages, starting in 2018. Mini-grids can be clean energy and hybrid mini-grids; Senegal, for example, has solar-PV only, solar-PV-diesel, and PV-wind-diesel set-ups.

Solar panels on stalls of Sabon Gari Market, Nigeria

6. https://www.usaid.gov/sites/default/files/documents/1860/Kenya-_November_2018_Country_Fact_Sheet.pdf

Role of the private sector versus the state: Trends across countries and concerns for a just transition

Country experience tells us that private sector-led grid-tied renewables development is relatively lengthy, often taking two to four years, and is subject to high transaction cost and high transaction risk. Reasons given by industry specialists include low expertise in energy sector financing and due diligence, and a lack of capacity of local companies, as has been the experience in Ghana. In Nigeria, Ghana, South Africa and Senegal, the finalisation of power purchase agreements and concessions took many months. These constraints tie, in large measure, to the dominant model of renewable energy rollout in which the private sector plays the leading role, with the state assigned the bit part of facilitating investments. The state builds the policy and legislative framework, 'regulates' the private sector, and may put in place incentives to offer certainty and facilitate profit for private investors. Where the state enables the development of renewable energy projects through a privatised tender system model, called power purchase agreements, it hands over the area of expertise and type of power to the private sector.

> Wide citizen access to safe renewable energy will largely be achieved through decentralised, community-owned, off-grid projects

Equipment costs for renewable energy are also high. Uganda imports components via overland shipping from the port of Mombasa, Kenya, which is an expensive and time-consuming endeavour. In Côte d'Ivoire energy storage prices remain prohibitive for low-density areas' off-grid solutions. Low-quality products, and poor workmanship in installation and maintenance undermine the credibility of renewable energy solutions and social perceptions of off-grid energy supply. This points to the need for the state to take a leading role in a wide-ranging rollout of renewable energy and in this process to plan for, and support, the creation of decent work in the spheres of manufacturing, implementation and maintenance.

Given significant poverty and income inequality, the objective of wide citizen access to safe renewable energy across most African countries will largely be achieved through decentralised, community-owned, off-grid projects. Such projects are characterised by full consultation of and consent by benefiting communities, through design adapted to suit local needs and priorities, implemented using quality components produced by national manufacturers receiving state support and subsidy, and rolled out and maintained by well-trained and trusted local artisans. This model will be counter balanced by larger-scale renewable energy projects, most likely with significant private sector involvement, for on-grid utility-scale electricity generation.

Governance of the power sector tends to be an overarching issue in most of the countries studied. The dominance of large fossil fuel and other mega-energy projects that come with massive costs and high risks of corruption often contribute to a pervasive problem of solvency levels in the energy sector. Large coal plants, for example, are newcomers to many countries in Africa such as Botswana, Egypt, Ivory Coast, Kenya, and Senegal and demand high loan uptake, with inadequate local markets, hence sinking countries deeper into debt.

Using the same large-scale model for renewable energy rollout at a prohibitively high cost, a pathway being attempted by many of the countries studied, can further expose vulnerable energy sectors. These risks then get passed on to the offtakers – where there is a failure to pay the electricity generating organisations for supply. This risk is perceived to be high in Botswana and the DRC, for example. In Ghana and Nigeria, the energy sectors have generally failed to effectively collect revenues. Electricity tariffs also tend to be relatively high because of the costs which are passed on to consumers, and which hurt the poor the most, as they face cut offs, greater household indebtedness, and risks to informal livelihoods, education and general well-being. This is a significant problem in South Africa. In Ghana, the high electricity price is due to an inefficient transmission system with high losses and a failure to effectively collect revenue. In Nigeria, however, the tariffs are too low to cover the national electricity system operator's operational costs.

Where the private sector plays a key role in renewable energy rollout, perceptions of political and economic stability are critical. Of the countries in this study, Ghana is considered to be a relatively good investment option in terms of political and economic stability, despite the national electricity utility's recent rescue from insolvency. The DRC's political instability and currency volatility drive low investor confidence.

> Many countries across Africa are increasingly implementing and interested in renewable energy

The in-depth case studies in this study contain reports on land displacements for energy projects in Ghana and Kenya.

In Kenya, the Olikaria geothermal project developers have been accused of grabbing land from the Masaai people without consulting and fairly compensating them. The Masaai also complained that the resettlement plan promises were not honoured. This can be contrasted against a micro-hydro project, the Tungu-Kabri Project, which was also implemented in Kenya. The non-governmental organisation (NGO) Practical Action collaborated with the Kenyan Ministry of Energy to pilot the micro-hydro system to address the disproportionate use of kerosene, wood and dung by the community. The electricity generated supports up to 200 households and approximately 1,000 people via the charging and distribution of batteries.

A large-scale 20 MW solar plant in Ghana, the Meinenergy PV Plant, has attracted similar controversy because of land grabs from the local community. In this case, the traditional leader in the area made a deal with the company to take over the land of farmers in the area. Fifty farmers lost 120 acres of land in this unfair process.

There is some similarity in Egypt, where state-owned land is offered to renewables developers at discounted prices or free of charge. Here again, the state enables the private sector to take over and grab lands from local communities, favouring big projects that provide profits for corporations and power mostly to wealthier, urban-based communities.

Many countries across Africa are increasingly implementing and interested in renewable energy, but as ever, the devil is in the detail. Where there is great ambition and strides in the development of renewable energy, there is often a focus on large projects and involvement of big corporate sector players which tend to result in negative impacts on affected communities, such as land grabs, and production of clean energy for profit and electricity, exclusively for the benefit of urban elites and industry.

Whilst this section provides a sense of these overall trends, read from a political and technical perspective, the country case studies that follow provide a more in-depth understanding of each context, and provides an indication of the actual and potential opportunity for renewable energy in a time of climate, energy and ecological crisis.

Conclusion

Given the extraordinary challenges facing Africa including the interconnected climate, ecological, economic and social crises, the region must be visionary and act with urgency to bring about an energy revolution. Moving to renewable energy has the potential to dramatically increase access to energy for Africans whilst curtailing carbon emissions.

> The region must be visionary and act with urgency to bring about an energy revolution

The ten country analyses show varying degrees to which the potential of what is possible matches up with the ambition. The project case studies selected focus particular attention on renewable projects in Kenya, because it is where renewable energy is being most vigorously pursued, with a stated ambition of 100% renewables by 2030. However, it also shows the nuance in the implementation of projects, from more controversial large geothermal projects that can cause a lot of harm, as compared to mini hydro which impacts least on, and offers most rewards for, the environment and communities.

The country case studies generally point to a limited role of the state in the rollout of renewable energy up until now. The state's role appears to be to facilitate the private sector by providing an enabling environment and providing incentives such as subsidies and other contributions. The private sector, motivated by profit, implements mostly large-scale renewable energy projects, in which the power is usually sold back to the state at a profit. The state is also less invested and directive in building a local manufacturing sector and creating jobs which can benefit their citizens. This approach is conducive to a neo-liberal economic approach which most African states have been following. We are critical of this approach and think that the state should intervene more to ensure a just transition and that renewable energy serves the poor and most vulnerable.

Renewable energy is already well suited to Africa. Many people live out of reach of centralised power grids, which usually serve to connect urban consumers to big coal and nuclear power plants. In a continent like ours with abundant wind, hydro and solar resources energy generation can be deployed close to where it will be used, particularly in rural areas. It is also easily scalable, unlike fossil fuel plants where economies of scale play a much bigger role. Of course, renewable energy also vastly reduces our greenhouse gas emissions.

There are many technology types classed as renewable energy, the four main ones being solar, wind, hydro and geothermal energy. For the communities in which these technologies are installed, large hydroelectric dams can have significant harmful impacts. Using run-of-river hydropower (often referred to as small or micro-hydro) can reduce negative impacts on communities and the environment when compared to large dams built for hydropower. Large dams can also lead to the displacement of communities at the site of construction and to other resource grabs, such as water and forests. The electricity produced from big dams is usually not intended for the affected communities and is typically transmitted to cities, large mines and other industrial areas. These negative impacts mimic in some ways the destructive features of fossil fuel projects.

> Renewable energy vastly reduces our greenhouse gas emissions

Similarly, geothermal energy is employed in Africa, particularly in Kenya, along the Rift Valley. While it is a very low carbon form of energy generation, and therefore vastly preferable to fossil fuel energy generation, it can have detrimental effects on local communities, particularly through the release of sulphur dioxide. It is important to note that coal-fired power plants release up to 30 times more sulphur dioxide than geothermal plants. Some of the negative impacts of a geothermal plant can be addressed through the introduction of appropriate technology and sound plant management.

Large-scale projects in every technology type generally have negative impacts on communities (as the project case studies well illustrate).

The construction of solar and wind technologies also require the extraction of rare earth and other minerals, such as cobalt, copper, lithium, aluminium etc., mostly extracted in poor and excluded communities around the world, many of whom are already bearing the costs of the climate crisis over and above the damages wrought by large-scale resource extraction.

In many cases, the installation of renewable energy faces the same problems as any infrastructure project, and can therefore be done well or badly. Where there have been issues with renewable energy, and where these have been indicated in the case studies presented, they are almost exclusively to do with the implementation of the project.

It is important that renewable energy is given the best chance to reduce our carbon emissions and provide energy access to Africa. In order to do so, the following needs to be taken into account:

- Affected community(ies') involvement in the project process, in particular full respect for their free, prior and informed consent (FPIC). The right of communities, and women within them specifically, to withhold their consent from a project must be emphasised.
- Environmental and social impacts (with a very particular focus on women) to be assessed, made public in an accessible language and through appropriate forums for full consultation with affected people, before final approval by government. If impacts are considered to be grave, particularly for excluded groups like women, projects should not be authorised to proceed.
- Renewable energy should be sited and constructed in a way that reduces negative impacts. In constructing renewable energy infrastructure, we need to be sensitive to the ecological and community impacts, and ensure the benefits are shared equitably.
- Cost benefit analyses are needed and should be conducted by independent and multi-sector teams. The analyses should also address other options for how to deliver the stated project goals. Climate and ecology should be included in any cost benefit analysis.
- That community(ies) have the opportunity and ability to to collectively own all or part of the project and benefit from the energy produced. Women and young people in the community should be supported to participate in socialised ownership schemes.

Solar distributor, Sabon Gari Market, Nigeria

This research has opened up new questions which require additional research. They include the following:

- What is the role of the African Union and international financial institutions such as the African Development Bank in renewable energy promotion across the region?
- What is the scale of new fossil fuel and big hydro projects that crowd out renewable energy and what is the potential for lock-in of these technologies?
- Are small, off-grid/micro-grid, community-owned renewable energy projects taking off and what is the extent to which these are being prioritised? What are the impediments and opportunities?
- Are there more examples of 'good' renewable energy projects that can be replicated across the region?
- What are the policy and other tools that are being used, and can be used, to aid the rollout of renewable energy?
- Can the state be placed front and centre as facilitator and actor in the promotion and rollout of renewable energy for the majority of citizens? What examples are there to draw from and be inspired by?
- What forms of technology, project process and ownership models give peasant, poor and working-class women better access to energy? In particular, is decentralised, localised renewable energy potentially transformative for Africa's women? Across the region, women experience the gender-prescribed role of subsistence farmers, carers and providers of energy. Traditionally, women go out in search of wood for heat energy and to buy kerosene for lighting at night. Will these tasks no longer be required if access to renewable energy is possible? We assume this would also have an important co-benefit of greater safety because women would be saved from attacks by predatory men on their long walks out. Are there similar positive impacts for working class women in peri-urban settings? The time saved from not having to do these activities could perhaps be spent on more time for other kinds of care like helping children with schoolwork, and their own leisure and education.

WoMin and 350Africa.org support well-implemented renewable energy as the best solution to increasing energy access while responding to the climate emergency. We need to move to 100% clean energy and while doing so, we have an opportunity to ensure we do not replicate old models of energy generation that have denied people access to energy and have resulted in land grabs, environmental destruction, pollution and other forms of harm and exploitation.

We hope this research report will help to create a knowledge base that will empower energy and climate justice activists to advance a campaign for the transformative uptake of renewable energy in Africa.

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WoMin
AFRICAN WOMEN UNITE AGAINST DESTRUCTIVE RESOURCE EXTRACTION

WoMin African Alliance

Main mission

WoMin's main mission is to:

- support the building of women's movements to challenge destructive extractivism
- propose development alternatives that respond to the majority of African women's needs.

Our approach

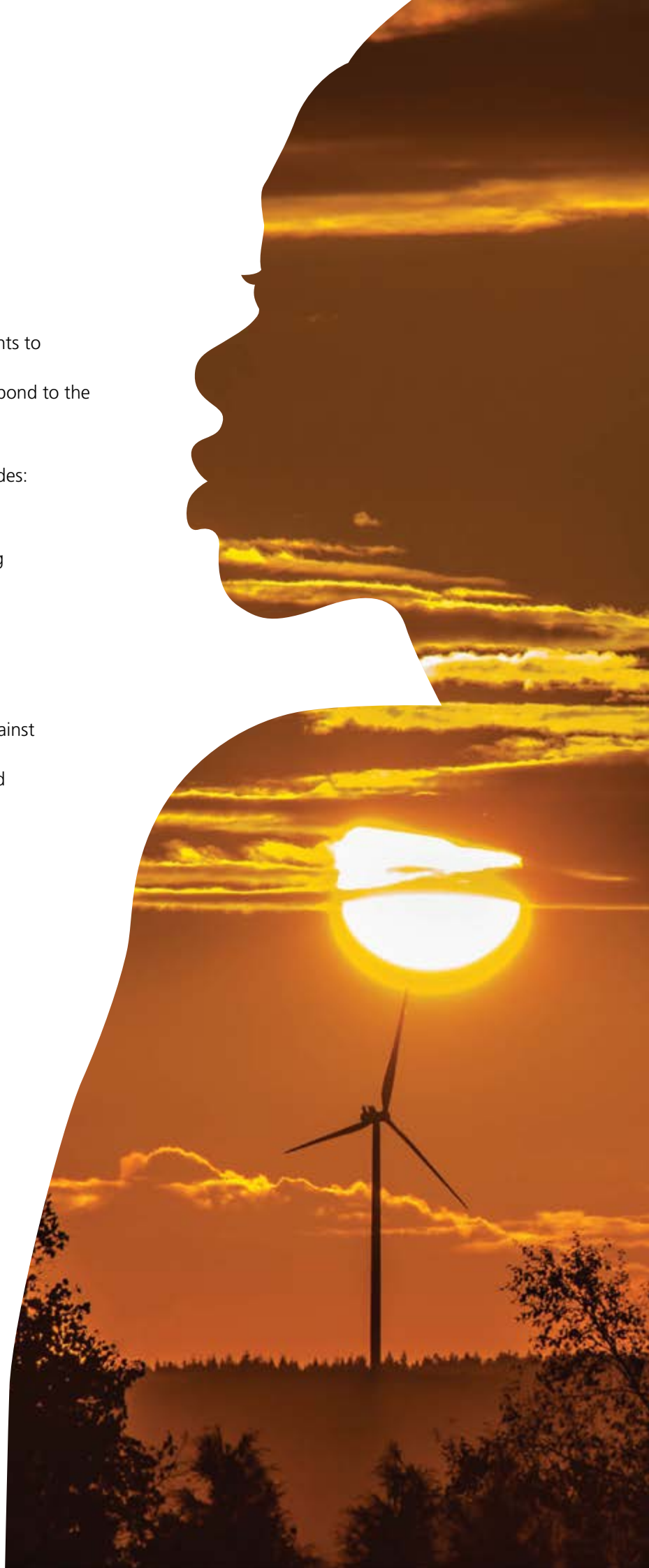
Our approach to making change happen includes:

- Political education
- Participatory research
- Women-led grassroots-driven campaigning
- Alliance and women's movement building
- Solidarity.

Our focus

Our focus areas are:

- Fossil fuels energy and climate justice
- Extractivism, militarisation and violence against women
- Women's rights, consent and democratised socioeconomic decision-making.



WE FIGHT CLIMATE CHANGE

350Africa.org

350Africa.org works to stop the climate crisis by ending the age of fossil fuels in Africa.

Through the Afrika Vuka (www.afrikavuka.org) platform 350Africa.org is supporting climate activists: groups of volunteers, community-based organisations and non-governmental organisations in their work. This support is through the amplification of groups' work, fostering solidarity and cohesive work between different groups so that their actions resonate beyond their own regions and country, and bringing activists together to learn from and support each other in building a fossil fuel-free Africa.