

AFRICA'S FUTURE COUNTS.



AFRICA'S FUTURE COUNTS

RENEWABLES & THE WATER-ENERGY-FOOD
NEXUS IN AFRICA



ABOUT

OUR FLAGSHIP PUBLICATION

Following RES4Africa Foundation's mission to *"create enabling environments for renewable energy investments in Africa"*, the publication serves as an institutional tool for dialogue and raising awareness at international level on a theme key to Africa's renewables market development. Each year, in close collaboration with Enel Foundation, the publication seeks to:

- shed light on a specific issue to raise awareness on a theme of convergence between the international development community and renewable energy business leaders;
- convey a high-level understanding of the topic for decision-makers to follow RES4Africa Foundation's call for action on the way forward;
- contribute to the rapidly evolving international renewable energy scene and accelerate progress to achieve universal energy access in Africa by 2030, in line with the Sustainable Development Goals (SDGs).

Following the publication of the first edition in 2018, "Unlocking Value from Sustainable Renewable Ener-

gy", RES4Africa Foundation leads the publication of the second edition for release during the 2019 Annual Conference in Addis Ababa. The report is developed in collaboration with Enel Foundation.





PREFACE

ENEL FOUNDATION

Dear Reader,

It gives me great pleasure to preface the second edition of RES4Africa Foundation's flagship publication, developed with the support of Enel Foundation.

The Enel Foundation is strongly committed to accelerate Africa's clean energy transition through knowledge and research partnerships as well as capacity-building and scholarship programs in the scientific, business and institutional areas.

After the launch of last year's first flagship publication, Enel Foundation and RES4Africa Foundation have continued to join forces on leading dialogue and raising awareness on key priorities and relevant themes to drive Africa's sustainable energy future.

Indeed, accelerating Africa's universal access to energy is key to unlocking its bright future. With a little more than 10 years to reach the SDGs by 2030, achieving SDG 7 in Africa has never been more urgent. At the same time, renewable energy solutions have never been better suited to make it happen. Not only do they electrify in a sustainable, affordable and reliable manner, but they enable access to other vital resources such as water and food the continent needs to flourish towards prosperity.

The RES4Africa Foundation's annual flagship publication represents a platform to explore innovative ideas and initiatives to reach a common objective: an electrified and prosperous Africa, driven by initiatives that we can push forward in collaboration with our expanding network of partners. Building on the success of last year's first edition, this 2019 flagship publication is dedicated to exploring the enabling role of renewable energy access, the Water-Energy-Food (WEF) Nexus in Africa and its central contribution to achieving the SDGs.

We are committed with partnership and believe in leadership and openness of ideas as a path to achieving ambitious goals. Enel Foundation and RES4Africa Foundation remain committed to push for sustained change in Africa's renewable energy transition.

I hope you will continue to join us on this journey.

Francesco Starace
President, Enel Foundation
& CEO, Enel Group





PREFACE

RES4AFRICA FOUNDATION

The African continent stands at a new dawn of empowerment. Its future prosperity will be unimaginable without access by all its citizens to affordable, reliable and sustainable energy.

Access to sustainable energy does more than just bring power – it enables the pursuit of human rights and creates opportunities for sustainable development. Energy empowers individuals, communities and economies by providing lighting, heating, transport, communications and mechanical power, all key to satisfy basic energy needs, drive productive uses and create industrial development.

Energy is deeply woven with other sectors that are fundamental to Africa's human and industrial development, such as water and food. Water, energy and food are the building blocks of development and essential for human wellbeing, poverty reduction and sustainable development in Africa. Indeed, Africa's future counts on ensuring access to water, energy and food resources, with a tremendous role therein for renewables. We see the nexus of Water-Energy-Food as a strategy to accelerate access to clean energy as a foundation for inclusive, sustainable development in Africa.

Africa is changing, and so must the energy sector. Along with increasing generation capacity and expanding grids, overcoming Africa's energy access gap requires a paradigm shift: from energy as a com-

modity, to energy as an enabler of services that drive sustainable development. Innovative and integrated Water-Energy-Food Nexus approaches provide a framework for new business models and partnerships that can unlock energy access markets and achieve significant development impact.

RES4Africa Foundation has chosen this theme for its 2019 flagship publication and its Annual Conference, organized for the first time in Africa, in light of the vast opportunities the Water-Energy-Food Nexus approach presents to achieve SDG 7 in Africa. Our relentless commitment with an inclusive, clean energy transition in Africa urges us to explore these topics, identify priorities and propose calls for action.

We invite everyone to partner with us.

Antonio Cammisecra
President, RES4Africa Foundation
& CEO, Enel Green Power



EDITORIAL

AFRICA'S FUTURE COUNTS

Access to clean, affordable and reliable energy is a foundational pillar for the African continent to achieve its aspirations of prosperity, wellbeing, and inclusive sustainable development – today and for its future generations. Energy is the engine of industrialization and of value chains; it is the base upon which business and income-generation activities and jobs can flourish.

Africa's prosperous future lies in the varied and abundant sources of renewable energy the continent is blessed with. These resources offer real opportunities to deliver electricity to millions of Africans living in darkness and can offer complementary clean cooking solutions. Thanks to the rise of cost-effective renewable energy technologies, they can accelerate Africa's socio-economic transformation, matching prosperity with quality of life, while facilitating a path towards sustainable growth.

Overcoming Africa's energy access gap will require a

paradigm shift from energy as a commodity to energy as an enabler of productive uses and services. In other words, energy access that can not only power households and service customers but drive local and national business, generate employment and deliver overall development.

The interlinkages captured by the “Water-Energy-Food (WEF) Nexus” approach offer a groundbreaking perspective to increase access to clean energy combined with water and food. As such, the WEF Nexus approach presents opportunities to enable productive uses of energy that can help pave the way for Africa's long-term sustainable economic growth.

Indeed, energy can become truly transformative when it endows other pillars of sustainable development, such as water and food: renewable energy can play a significant role in leading the water and food sectors towards greater sustainability. The benefits of implement-

ing the WEF Nexus are widespread at all society levels, but they can reach even further in African peri-urban and rural areas. The deployment of cross-sectoral solutions linking energy with water, and a key sector for the continent's economy and development such as agriculture and food, can catalyze new markets and attract a broad range of investments.

Companies engaged in the renewable energy value chain are increasingly seeking innovative and viable strategies to grow African markets. In this regard, the WEF Nexus approach represents an opportunity also for investors seeking to close the energy gap in Africa and maximize development impact. Investment at scale, however, requires viable and sustainable business models that help foster local demand growth, open new market possibilities and increase private sector's willingness to invest in African markets.

To devise such viable business models and to turn priority into action, effective and results-oriented partnerships are necessary. Working across sectors, industries and institutions engaged in the fields of water, energy and food is essential for breaking silo-based thinking and to create inter-sectoral collaboration. Replicability and scalability of viable WEF business models can only be possible by combining resources, know-how and will. By joining forces and value propositions, energy, water, and agri-food sector investors can innovate and define new paths for socio-economic growth.

This analysis is RES4Africa Foundation's contribution to a discussion that has, at heart, the certainty of the untapped opportunities of the African continent to build prosperity and achieve sustainable development. Throughout the next three chapters, the publication reflects on energy and energy investments as a definitive lever of local development; and on the positive, multiplying effects that energy access can have when combined with investments in water and

food and their value chains. In part one, we identify what the WEF Nexus means for advancing energy access in Africa and the fundamental role played by renewables. Throughout part two we explore how the WEF Nexus can create sustainable development impact at scale by fostering business models that open new markets, while making a case for scaling-up. Part three closes with a call for action and identifies how players including private sector, governments, financiers, development actors and local communities can add value by engaging in cross-sectoral partnerships to scale WEF Nexus business models.

This book aims to set forth a mission for public-private and multi-stakeholder partnerships on adopting a WEF Nexus approach as a path to accelerate widespread energy access in Africa. Building on the foundation's mission to create enabling environments for renewable energy investments in Africa, we argue that a WEF Nexus approach is of strategic value to expanding access to energy in Africa by 2030 and beyond. The book speaks to all actors involved in this quest to align on the needs and opportunities, and embark on a joint strategy to empower African countries, their communities and citizens through increased access to energy.

Roberto Vigotti

Secretary General, RES4Africa Foundation

Ana Rovzar

Editor, RES4Africa Foundation

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VISIONARY STATEMENT

PAVE THE WAY FOR AFRICA'S BRIGHT FUTURE

AMANI ABOU-ZEID, COMMISSIONER FOR INFRASTRUCTURE AND ENERGY,
AFRICAN UNION COMMISSION



The African continent is leaping towards new horizons of growth. The continent is abounding with resources, talent, dynamism and ambition, ready to realize its full potential. As anchored by the AU's Agenda 2063, we should aim for nothing less than a prosperous and peaceful Africa, based on inclusive growth and sustainable development.

For us to get there, few areas are as strategic to ensure Africa's socio-economic transformation as energy and infrastructure. They are the foundational and enabling pillars for sustainable growth and healthy development that once achieved can ensure a future and legacy for generations to come.

And those generations are coming. Africa is not only the fastest urbanizing continent in the world, but also the youngest, with over 65% of the population under 35 years old. This means we have to imagine sustainable and smart urban, peri-urban and rural spaces that are viable and conducive to live, produce and prosper.

Moreover, energy and infrastructure lie at the core of all value chains that will guarantee Africa's future prosperity. Growing African societies will see their demand for water, energy and food multiply in coming years. Ensuring that Africa's value chains can expand to meet demand increases in a sustainable way is, therefore, key. After all, energy and infrastructure are interconnectors to enhance trade, increase productivity, grow exchange of goods and services, and make value chains more sustainable, both within and between countries and regions; and

in the process create decent jobs for the youth as well as promote inclusive participation by women and girls.

The opportunities are tremendous. Renewable energy has become a crucial solution to scale up Africa's energy infrastructure, to leapfrog towards clean energy systems, as well as a strategy for greater sustainability. It can provide a real answer to electrifying rural Africa, where many still lack access to electricity, and provide the means for productive uses of energy that will in turn power African businesses and communities.

Growth and development go hand in hand and should be inclusive, generating opportunities for all and bridging across communities and livelihoods. In parallel, digitalization is promising new and innovative solutions for energy access and models for energy transmission.

Capacity building is central for the design and application of enabling policies and regulations that make the energy and infrastructure sector flourish. Education is the cornerstone to make this happen. We need to ensure that youth and women are present in a cross-sectoral and holistic manner to harness their potential and be present actors in building the continent we all want.

Delivering on the continent's infrastructure potential will need significant investment, requiring the participation of all players, including private sector.

We have to prioritize an environment that is conducive to these investments, so that entrepreneurship of all kinds, sizes, technologies and services can take root.

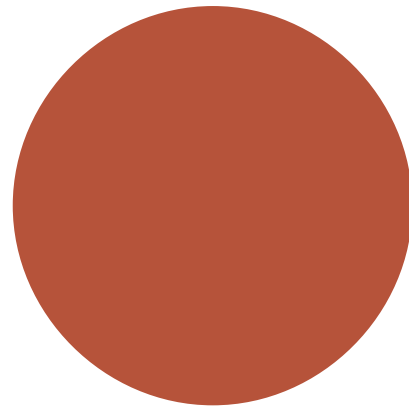
None of this will be achieved without partnerships, the motor behind all international action. More than ever, we need to increase dialogue, scale up

initiatives for cooperation, and learn from African and world best practices.

With these clear priorities in mind, we will pave the way for the bright future we know Africa deserves.



**CLOSING
AFRICA'S
ENERGY
GAP:**



RENEWABLES AND THE WATER-ENERGY-FOOD NEXUS



**WHAT OPPORTUNITIES
DOES THE
WATER-ENERGY-FOOD
NEXUS PRESENT
TO ACHIEVE UNIVERSAL
ENERGY ACCESS
IN AFRICA**

INTRODUCTION

Africa faces a myriad of opportunities to achieve long-term sustainable economic growth. A major barrier to this path of growth remains the lack of widespread access to energy across the continent. Access to energy sustains economic growth, transforms societies and changes millions of African livelihoods. Africa's energy future lies in renewable energy, which can deliver affordable, reliable and clean energy as well as create new markets. As African societies grow and urbanize, so the demand for basic resources is set to multiply. Overcoming Africa's energy access gap will rely on a diversified strategy complementary to the continent's growing demand for resources. The Water-Energy-Food (WEF) Nexus offers an innovative perspective on bridging the energy access gap by considering energy as an enabler for development, and by emphasizing the interdependencies between water, energy and food supply systems. In fact, the WEF Nexus can reveal business models that look at how energy can connect with water and food to respond to essential development needs, thereby improving access to resources, increasing economic productive capacities and driving socio-economic welfare in Africa. Not only can a proliferation of these applications help to close Africa's energy access gap, it also spurs market development that set African communities and economies on a path towards sustainable development.

DELIVERING AFRICA'S ENERGY FUTURE

THE CONTEXT

Africa is transforming into a continent of opportunity and growth. Though individually diverse, many African countries are experiencing promising macro-economic trends including dynamic economic and population growth, rapid urbanization and an expanding middle class with changing lifestyles. Since 2000, Africa's GDP growth has averaged 5% p.a., a trend expected to continue in coming years¹. Economic activity is accelerating with Africa already counting more than 400 companies earning revenues over \$1 billion, while 6 out of the 10 fastest growing economies in 2018 were in Africa². By mid-century, 1 in 4 people on earth will be African, as today's African population of 1.2 billion expands to 1.7 billion in 2030, reaching well beyond 2 billion by 2050^{3,4}. Meanwhile, Africans will continue to migrate from rural to urban areas as the continent becomes the fastest-urbanizing in the world⁵. Most Africans will be living in mega-cities like Lagos, Cairo and Kinshasa, adopting consumer preferences and spending habits of urban consumers⁶.

Moreover, with half of its population younger than 25 years old, Africa's working population is expected to surpass that of China by 2035⁷. Africa is not only fast-growing and urbanizing, but is also highly endowed with vast indigenous resources including fossil fuel and renewable energy, water, land, commodities and agricultural produce.

¹ IMF forecasting expects continued GDP growth of around 6% p.a. from 2017 to 2023. By 2023 most of African economies will experience a GDP growth above 4% (Brookings Institute, 2019b), (OECD, 2013).

² Showing GDP growth rates of 6, 7 and 8% (Brookings Institute, 2019a, p. 78).

³ Africa's population has grown rapidly by about 3% p.a. between 2000 and 2017. Despite an expected slowdown, demographic growth will continue at steady rate of 2% p.a. up to 2050 (UN DESA, 2019), (McKinsey, 2018a).

⁴ Brookings Institute, 2019b.

⁵ Incomes are rising across much of the continent, fueling markets, generating new business opportunities, and increasing annual spending. Africa's household final consumption expenditure has increased by over 4% p.a. on average between 2010 and 2017 (World Bank, 2018).

⁶ McKinsey, 2018a.

⁷ McKinsey, 2018b.

Figure 1:

AFRICA'S MACRO-ECONOMIC TRENDS

Sources: IMF (2019), UN DESA (2018), World Bank (2019c), McKinsey (2018a), AfDB (2018)

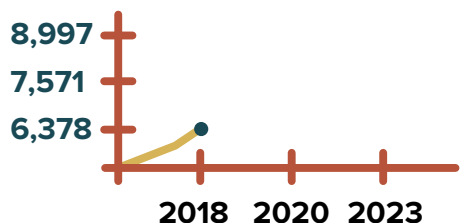
ECONOMIC GROWTH 2018

FINAL CONSUMPTION EXPENDITURE OF AFRICANS HAS GROWN BY 4.1% PER YEAR SINCE 2010

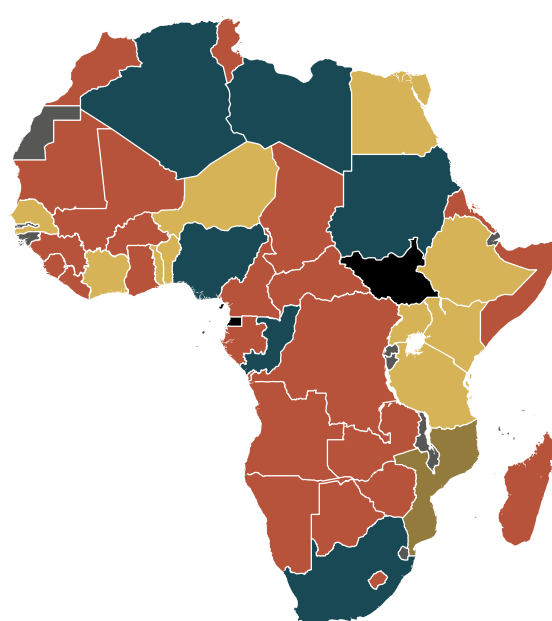
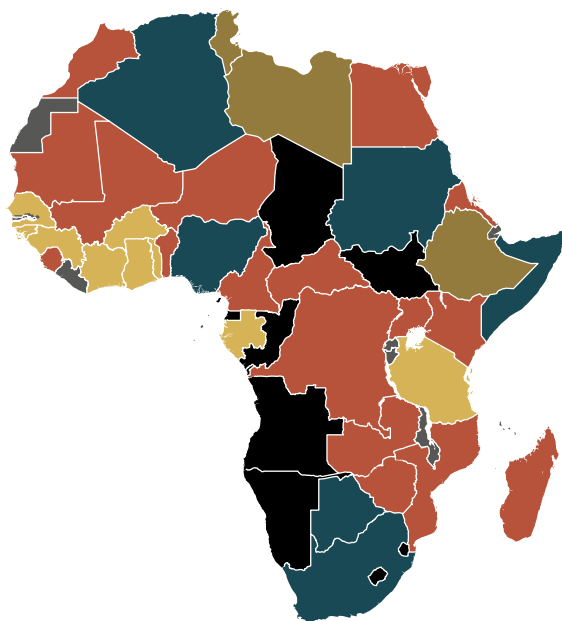
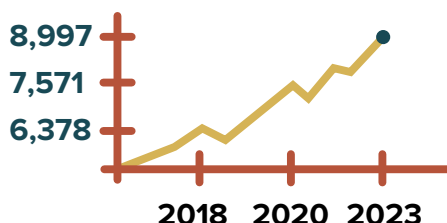
ECONOMIC GROWTH 2023

13 AFRICAN ECONOMIES WILL EXPERIENCE A GDP GROWTH RATE > 6% BY 2023

GDP bn \$ (PPP, current prices)



GDP bn \$ (PPP, current prices)



■ 10% or more ■ 6% - 10% ■ 3% - 6% ■ 0% - 3% ■ less than 0% ■ no data

URBANIZATION AND CITIES 2015

AFRICAN COUNTRIES ARE EXPERIENCING SOME OF THE WORLD'S HIGHEST URBANIZATION RATES

AFRICAN POPULATION LIVING IN CITIES:

12% = 5 - 10 million or more
 23% = 1 - 5 million
 65% = fewer than 1 million

NUMBER OF CITIES:

54 > 1 million
 6 > 5 million
 3 > 10 million



● 5 - 10 MILLION PEOPLE

URBANIZATION AND CITIES 2030

BY 2050 1 PERSON IN 4 IN THE WORLD WILL BE AFRICAN

AFRICAN POPULATION LIVING IN CITIES:

21% = 5 - 10 million or more ▲
 20% = 1 - 5 million ▼
 59% = fewer than 1 million ▼

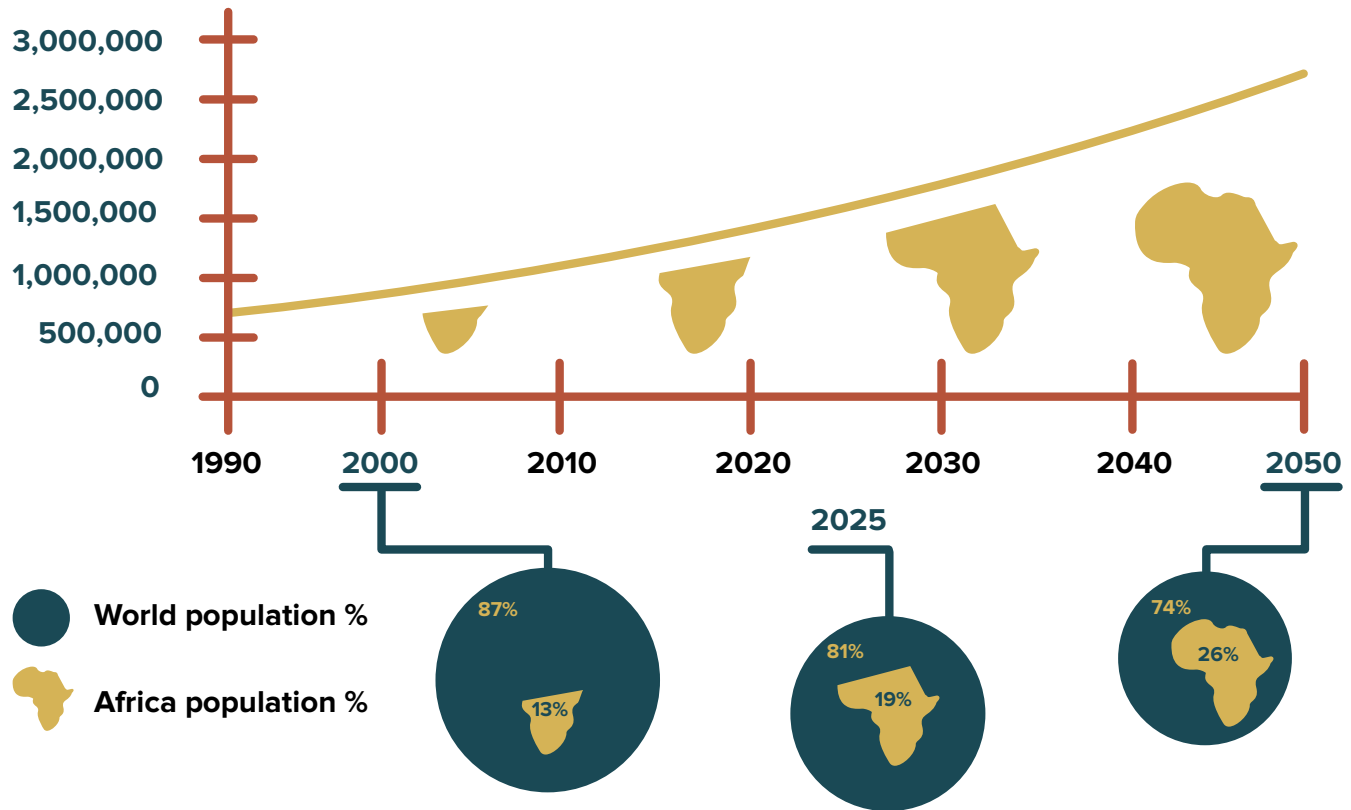
NUMBER OF CITIES:

89 > 1 million ▲
 17 > 5 million ▲
 5 > 10 million ▲



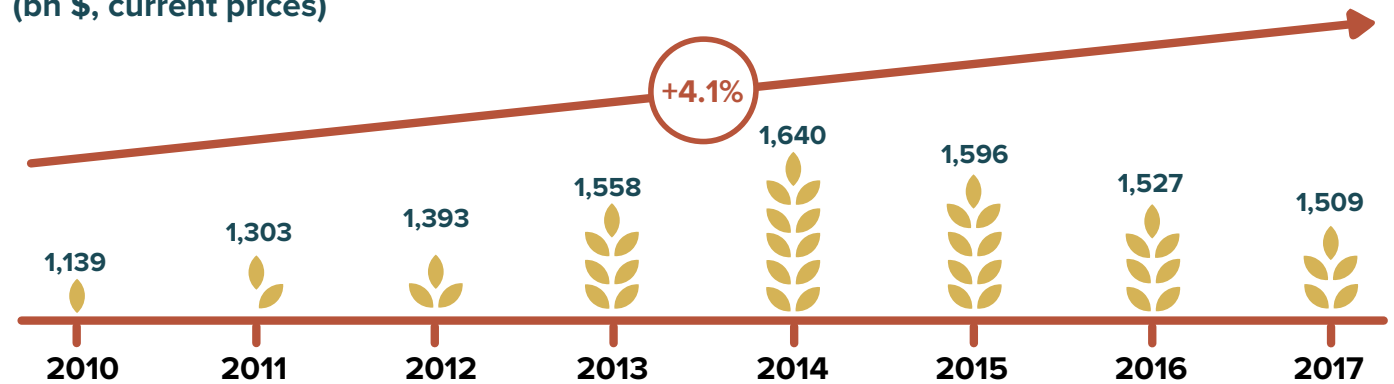
● > 10 MILLION PEOPLE

POPULATION GROWTH

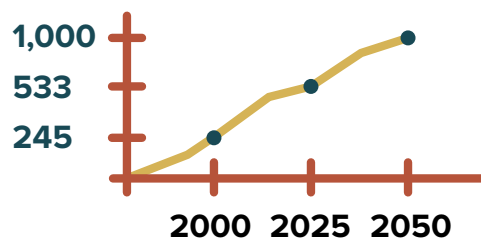


MIDDLE CLASS GROWTH

HOUSEHOLD FINAL CONSUMPTION EXPENDITURE
(bn \$, current prices)



AFRICAN MIDDLE CLASS:
(million people)



In addition to being resource-abundant, Africa counts on a vibrant start-up scene including digitally native users⁸ and talented entrepreneurs thanks to the fast uptake of mobile and platform technologies such as cellphone banking and prepaid solar power⁹. Africa has tremendous potential for growth and is becoming a continent ripe for opportunity, innovation and entrepreneurship.

Simultaneously, African countries still face complex challenges such as widespread poverty and unemployment, persistent food and water insecurity, lacking infrastructure and industrial capabilities, as well as economic and political instability. Expanding populations and economies will add stress on the current infrastructure and supply systems of African countries, leading also to a surge in demand over basic resources such as water, food and energy in coming years. Moreover, this hike in demand for resources risks to be exacerbated by potential effects of climate change¹⁰ to which Africa is particularly vulnerable. Taken together, these

trends and risk factors form bottlenecks that continue to slow down Africa’s socio-economic development in urban, peri-urban and rural zones, and may undermine the continent’s growth perspectives, slowing down the encouraging leaps forward observed in the past few years. While improvements take place every day, efforts are still needed to solve these issues and make Africa a stable and attractive market for investors to speed-up socio-economic development.

⁸ Africans are strong digital adopters, with around 122 million active users of mobile financial services. Smartphone connections are expected to double from 315 million in 2015 to 636 million by 2020, twice the projected numbers of North America. Mobile data traffic expected to increase sevenfold (McKinsey, 2019).

⁹ For example, “M-Pesa” mobile banking systems, and “M-Kopa” prepaid solar power platforms.

¹⁰ Africa is among the most vulnerable continents to the impacts of climate change in terms of drought, extreme weather events, rising sea levels, flooding and resilience issues, expected to impact livelihoods, economic development and security, in particular to weather-dependent agriculture and established agricultural practices (IPCC, 2014).

Figure 2:

AFRICA’S GROWING RESOURCES DEMAND

Sources: IEA (2018b), FAO (2018c), UNEP and IRP (2016)



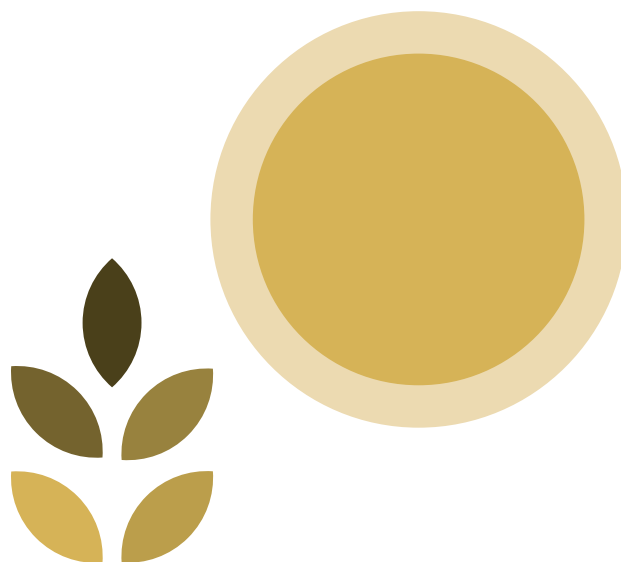
Figure 3:

AFRICA'S VULNERABILITIES TO CLIMATE CHANGE

Source: IPCC (2014)

AFRICA IS THE MOST VULNERABLE CONTINENT TO CLIMATE CHANGE IMPACT

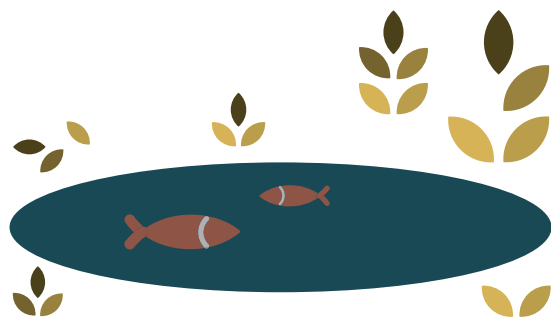
Climate change is very likely to have an overall negative effect on yields of major cereal crops across Africa, with possible yield reduction ranging from 2% for sorghum to 35% for wheat by 2050. The intensification of climate change impacts could become more important in the future in terms of exerting upward pressure on food prices of basic cereals which would have serious implications for Africa's food security.



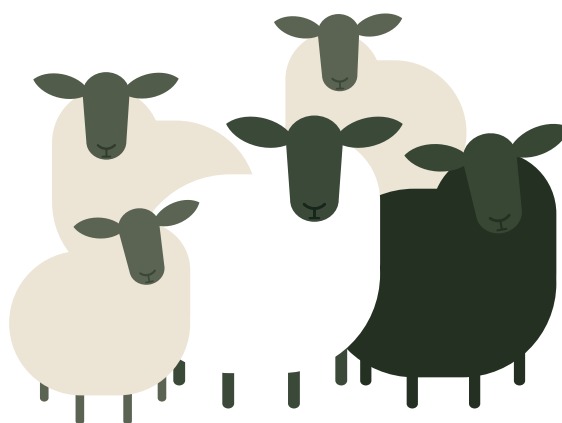
Freshwater ecosystems in Africa are at risk from anthropogenic land use change, overextraction of water and diversions from rivers and lakes, and increased pollution and sedimentation loading in water bodies. Water stressed regions, as North-African countries, may be affected by the decrease in rains.



Climate change will increase challenges from existing stressors on coastal and ocean systems, such as overexploitation of resources, habitat degradation, loss of biodiversity, salinization, pollution, and coastal erosion. Coastal countries will experience a significant negative impact on fisheries due to the impact on coral reefs and coastal upwelling, endangering 50% of fisheries-related employment in West Africa.



Livestock systems in Africa face multiple stressors that can interact with climate change and variability to amplify the vulnerability of livestock-keeping communities, as for rangeland degradation, increased variability in access to water, fragmentation of grazing areas, and changes in land tenure. Loss of livestock under prolonged drought conditions is a critical risk given the extensive rangeland in Africa that is prone to drought.



Africa currently experiences high burdens of health outcomes whose incidence and geographic range could be affected by changing temperature and precipitation patterns, including malnutrition, diarrheal diseases, and malaria and other vector-borne diseases, with most of the impact on women and children.



Finding sustainable and long-term solutions that address development barriers in urban, peri-urban and rural zones is key to instill market confidence and increase investors' appetite for African markets so as to improve living conditions and create an enabling environment for socio-economic growth.

One of the most important barriers to Africa's long-term economic and social development is the lack of universal access to energy. Over 600 million people mostly located in rural Sub-Saharan Africa still do not have access to reliable and affordable energy, reflected by an electrification rate at just over 40% – the world's lowest. Energy poverty is widespread across the continent, while Africa's expanding urban and peri-urban zones require reliable and affordable energy supply to prosper¹¹. For those with access to electricity, average per capita electricity consumption in Sub-Saharan African countries is around 180 kWh¹², among the lowest in the world, compared to about 8,000 kWh per capita in the OECD members and about 6,000 kWh in European Union¹³. If business-as-usual continues, the number of people without access to modern energy is even expected to increase by 2030 mainly due to population growth, the only continent in the world facing this risk.

Energy access gaps hinder Africa's social and economic growth. Today, Africans still rely mostly on traditional biomass for their energy needs¹⁴, while electricity generation is mainly fossil fuel-based. Many countries face a lack of sufficient and reliable generation infrastructure, while transmission and distribution networks are outdated or underdeveloped, resulting in high losses, frequent blackouts and load-shedding. Expensive and polluting diesel generators are among the most common back-up solutions to guarantee continuous power supply in Africa's urban and rural zones. This energy insecurity not only affects human development but also hampers business growth. To illustrate, between 2006 and 2017, "79% of firms in

Sub-Saharan Africa experienced power outages – on average 8.6 power outages a month, with an average duration of 5.7 hours, or 90.9 days a year of electrical outages"¹⁵, while "60% of firms operating in Africa consider infrastructure, such as power shortages, costs, transport bottlenecks, as the most binding constraint they face in their daily operation"¹⁶. As a result, businesses cannot grow and local economies cannot flourish, while Africans pay among the highest electricity tariffs around the globe for unreliable and polluting power supply¹⁷.

¹¹ Urban access to electricity is around 72%, vs. 33% in rural areas in Africa (AfDB, 2018).

¹² Excluding South Africa.

¹³ World Bank, 2018.

¹⁴ Counting for about 50% of the continent's primary energy demand (IEA, 2017).

¹⁵ AfDB, 2018, pp. 73, 76.

¹⁶ AfDB, 2018, p. 74.

¹⁷ World Bank, 2016.

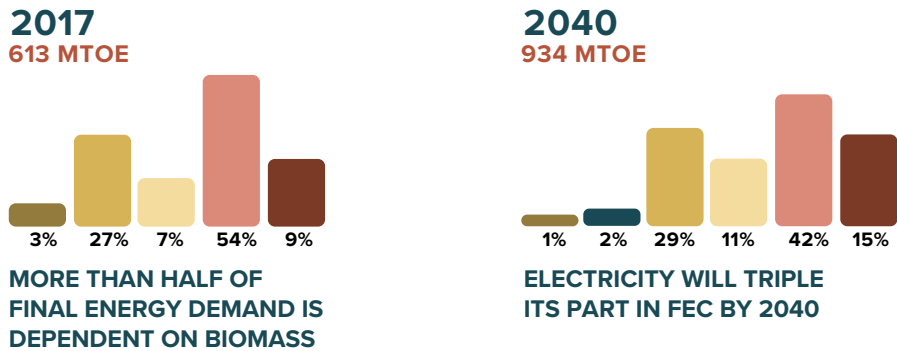
Figure 4:

AFRICA'S ENERGY LANDSCAPE

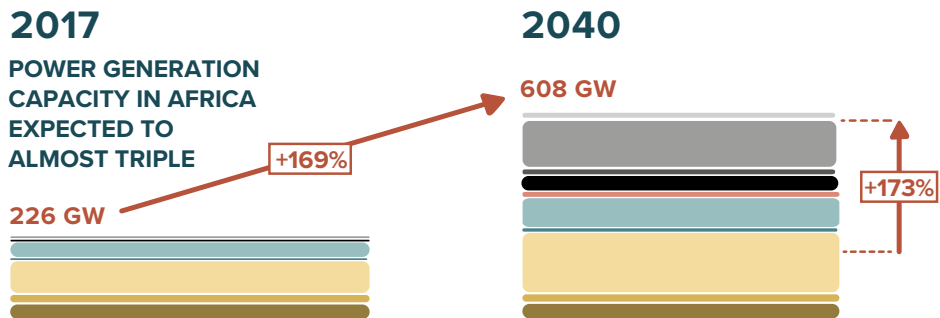
Sources: IEA, World Energy Outlook 2018 – New Policies Scenario (2018b), World Bank (2019c), RES4Africa Foundation (2019)

- COAL
- OIL
- GAS
- ELECTRICITY
- HEAT
- BIOENERGY
- OTHER RENEWABLES
- NUCLEAR
- HYDRO
- WIND
- GEOTHERMAL
- SOLAR PV
- CSP

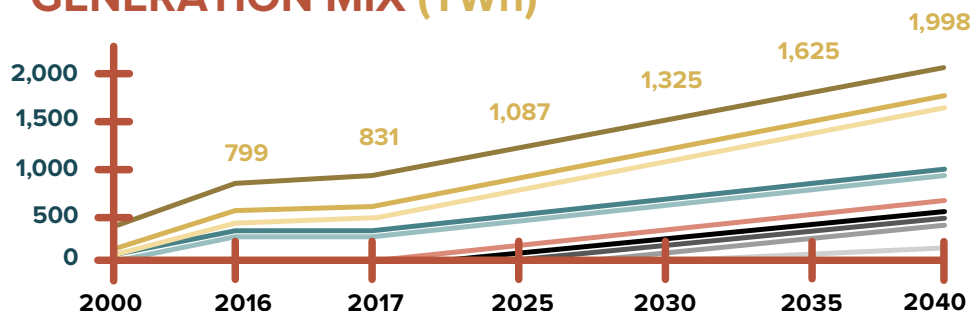
AFRICA'S FINAL ENERGY CONSUMPTION (MTOE)



EVOLUTION OF AFRICA'S POWER GENERATION MIX (GW)



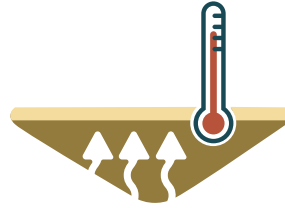
EVOLUTION OF AFRICA'S POWER GENERATION MIX (TWh)



RE POTENTIAL IN AFRICA



On average 2,000 kWh/m² of irradiance level for more than 320 d/y



15 GW of geothermal energy (mainly in the Rift Valley)

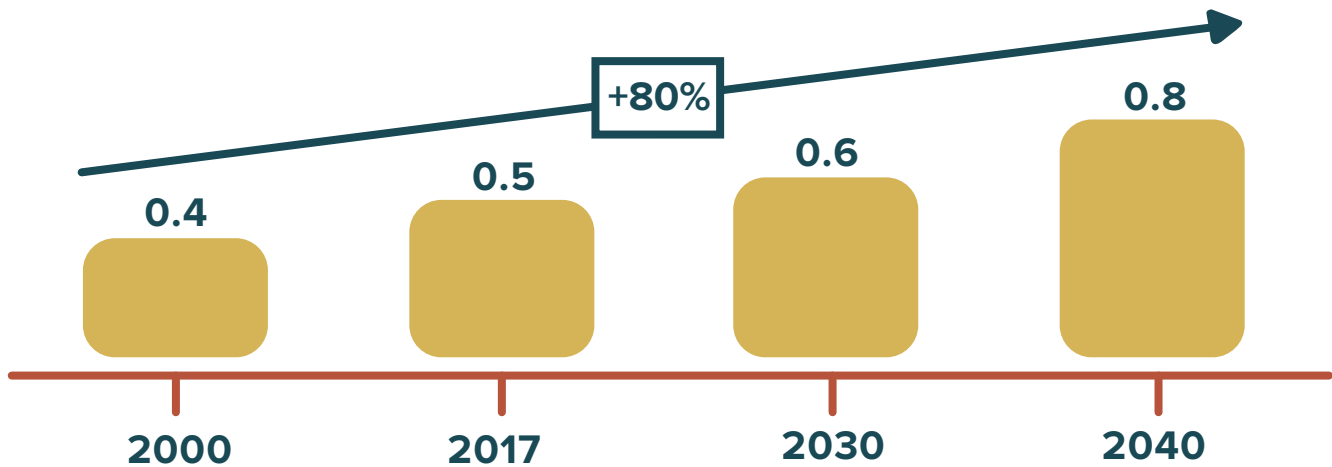


1,300 GW of wind energy onshore and offshore



283 GW of hydropower energy

AFRICA'S ELECTRICITY CONSUMPTION PER CAPITA (GWh/cap per year)



Widespread access to energy is a precondition to unlock Africa's potential for sustainable economic growth and make a difference in hundreds of millions of African lives. Access to energy is a pillar of human development and economic growth. It em-

powers individuals, communities and economies by providing lighting, heating, transport, communications and mechanical power, all key to satisfy basic vital needs, drive economic processes and foster socio-economic development. Electrification acts as an

enabler for impact in education, healthcare, gender equality, employment, business creation and poverty reduction for Africans. Children are able to remain in school and study after sunset, women and girls have time freed from chores, entrepreneurs can start businesses, and people can gain more access to health services, food, and water. Indeed, access to reliable, affordable and modern energy does more than just bring power: it enables the pursuit of basic human rights.

Africa's energy future lies in the renewable energy resources they have been blessed with.

Capitalizing on the continent's huge RE potential to provide reliable, affordable and sustainable energy plays a key role in achieving universal access to energy in Africa¹⁸ with many benefits. Renewables present a unique opportunity to bypass fossil-fuel based electrification solutions and leapfrog towards sustainable energy systems for Africa. Electrical renewables rely on indigenous and clean resources, represent cost-competitive modular technologies, and are easily scalable to adapt to a fast-changing context. Moreover, renewables help limit and reduce the energy sector's GHG emissions, shrink fossil-fuel dependency as well as the carbon footprint of African economies, and bolster climate change resilience. Today, RE technologies offer concrete solutions to electrify Africa while also opening the door to promising new economic sectors. As a result, renewables have the potential to transform African economies and societies and provide the foundations for long-term sustainable economic development.

Achieving universal access to energy in Africa requires a holistic, diversified and polyvalent electrification strategy. Given the scale of the challenge, electrification should rely on a combination of technological solutions such as large-scale on-grid applications, decentralized off-grid solutions, hybridation of different RE technologies (e.g. wind, solar and hydro combined with electricity storage), as well as grid expansion. These are all necessary to deliver com-

petitive and reliable energy to urban, peri-urban and rural areas. Hybrid renewables (e.g. wind, solar, hydro and storage) are amongst the most efficient electricity generation systems and are crucial both for on-grid and for off-grid-distributed generation. On-grid systems will obtain more affordable energy with a much lower operations and maintenance (O&M) cost, allowing for countries to reduce dependency on fossil fuels. On the other hand, hybrids are also critical to off-grid-distributed generation systems as they will enable to produce clean energy at the appropriate scale and price.

Scenarios show that universal energy access in Africa can be within reach in the near future.

According to the IEA's Energy for All Case (see Box 1), by 2030, around half of Africa's unelectrified may gain access to electricity from new and mostly renewable on-grid power generation systems, while the other half may become electrified through decentralized solutions such as mini-grids and off-grid stand-alone applications for remote and rural areas, complemented by the strengthening of grids, the enhancement of Transmission & Distribution (T&D) lines and the expansion of regional grid interconnections.

¹⁸ UNECA, RES4Med&Africa 2018.



BOX 1

A PATHWAY TO ACHIEVING ENERGY FOR ALL BY 2030

(IEA)



The IEA's World Energy Outlook's (WEO) most recent data delivered some promising news: in 2017 over 120 million people worldwide gained access to electricity. As a result, the total number of people without access fell below 1 billion for the first time. The data for access to clean cooking is less rosy: 2.7 billion people — half the population in developing countries — still relies primarily on biomass, coal and kerosene for their cooking needs, which has a detrimental effect on health. It is clear that without modern energy for all, other development objectives — such as improving economic development, gender equality, health and access to clean drinking water and sanitation — become much harder and perhaps impossible to meet. Universal energy access is an essential part of the African Union's 2063 Agenda goal to harness all African energy resources to ensure modern, efficient, reliable, cost-effective, renewable and environmentally-friendly energy to all African households. Today, Sub-Saharan Africa accounts for 60% of those without access to electricity and over 30% of those without access to clean cooking. While electrification rates outpaced population growth for the first time in 2014, leading to an overall decrease in the number of people without access to electricity in the region, progress has been uneven. More than half of those who have gained access since 2011 are concentrated in just four countries: Kenya, Ethiopia, Tanzania and Nigeria. The challenge is even greater when it comes to clean cooking: 83% of the population (890 million) doesn't have access, a majority of which rely on gathering biomass for cooking.

Based on today's trends and access policies, the WEO's New Policies Scenario finds that we are far from on track to reaching SDG 7.1. By 2030 those without access are increasingly concentrated in Sub-Saharan Africa, where around 600 million people lack access to electricity. There are some bright spots however as the population with access to electricity in that region more than doubles from today's level and several countries are on track to reach universal electricity access by 2030 — including Gabon, Gambia, Kenya and Ethiopia. A majority of those who gain access in Sub-Saharan Africa in the New Policies Scenario do so through a grid connection, two-thirds of which is renewables-based (see Figure 5). However, cost reductions in renewables and energy-efficient lighting and appliances mean that almost a third of those who gain access in Sub-Saharan Africa do so via decentralized renewable technologies. This has been aided by the emergence of new business models in Africa that tap into the widespread





availability of mobile phones to facilitate payments and manage decentralized technologies. The challenge of access to clean cooking remains deeply entrenched, as the number of people without access rises to 900 million in 2030.

Given that energy is essential for humanity to develop and thrive and that under current policies we are well off the mark of modern energy for all by 2030, the IEA mapped out a path to universal access to modern, sustainable energy for all by 2030. In its Energy for All Case, RE sources are the least expensive way to achieve universal electricity access. This is thanks to the declining costs of small-scale solar photovoltaic (PV) for off-grid and mini-grid electricity and the increasing use of renewables for grid-connected electricity. Our analysis underscores that decentralized solutions, mainly solar PV, are the least cost solution for around 450 million people as many of the 600 million who remain unconnected reside in the most remote, rural locations in Sub-Saharan Africa (see Figure 6). Grid extensions provide access to the remainder, with hydropower accounting for the lion's share. Universal access to clean cooking is achieved primarily through increased supply and use of LPG (liquefied petroleum gas), especially in urban areas and improved energy-efficient biomass cookstoves, primarily in rural areas.

However, providing universal energy access to households is not enough to ensure economic and social development. Energy will also need to be available for productive uses such as agricultural production, industry and the provision of water to help achieve the SDG goal on poverty and ensure that no one is left behind.



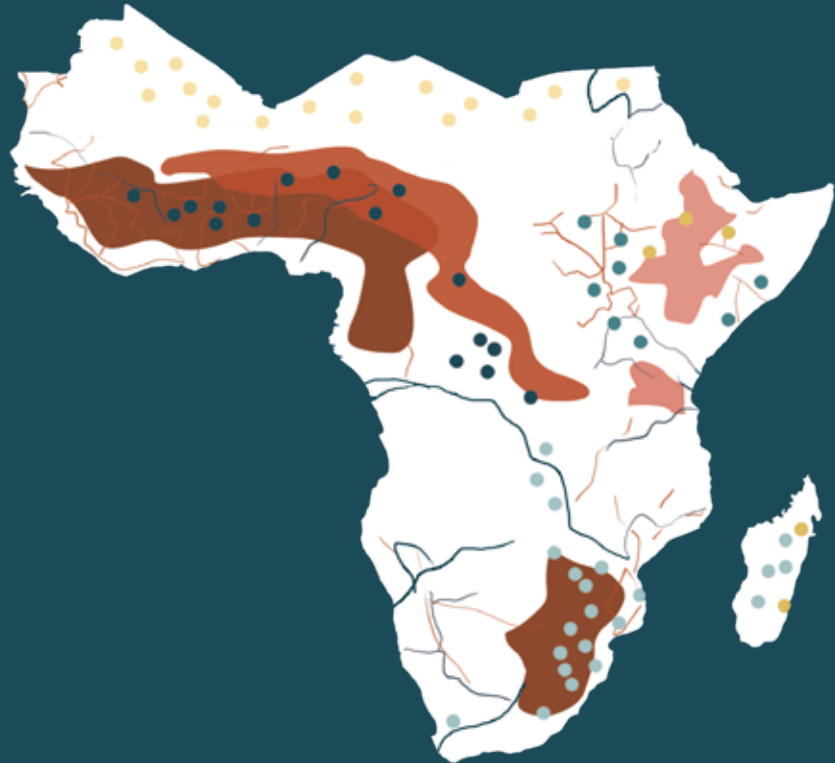


FIGURE 5:

NEW CONNECTIONS AND POWER GENERATION FOR ELECTRICITY ACCESS IN SUB-SAHARAN AFRICA IN THE NEW POLICIES SCENARIO, 2017-2030



Grid extension remains the main pathway to electrification and renewables account for an ever increasing share of new access



ELECTRICITY GENERATION FOR ACCESS, 2017-2030 325 TWh

BY CONNECTION TYPE

- ON-GRID 73%
- MINI-GRID 9%
- OFF-GRID 18%

BY FUEL ENERGY

- SOLAR PV 30%
- OTHER RENEWABLES 6%
- COAL 15%
- OIL 8%
- GAS 9%
- HYDRO 32%

TRANSMISSION LINES (> 69 kV)

- EXISTING
- PLANNED

NEW CONNECTION TYPE

- ON-GRID
- MINI-GRID
- OFF-GRID

Note: Other includes CSP, wind, geothermal, biomass, marine and nuclear.

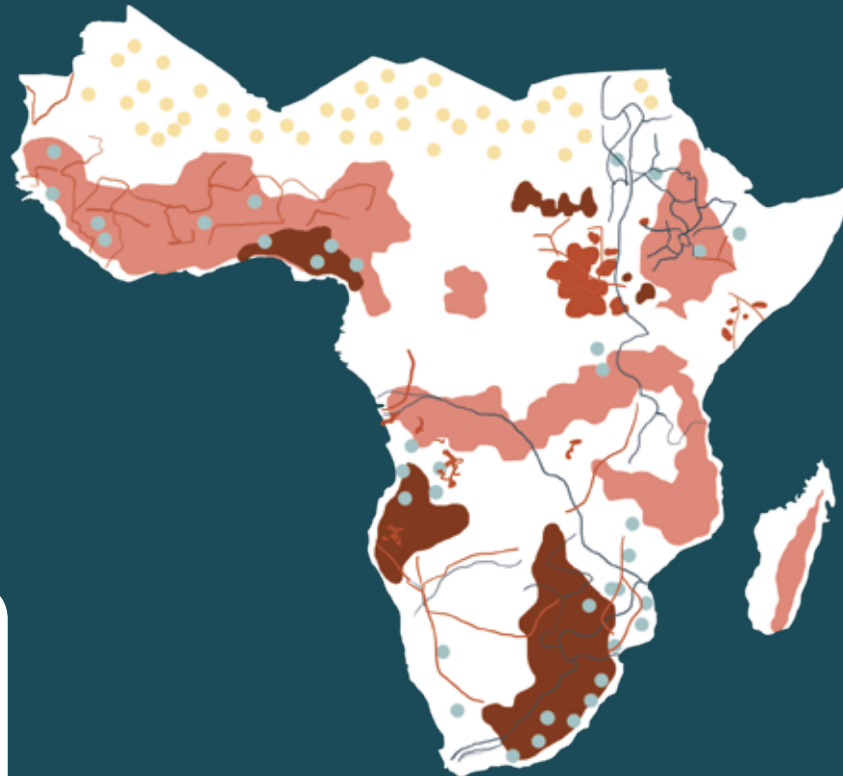
Sources: KTH-dESA; IEA analysis



FIGURE 6:

NEW CONNECTIONS AND POWER GENERATION FOR ELECTRICITY ACCESS IN SUB-SAHARAN AFRICA IN THE ENERGY FOR ALL CASE, 2017-2030

More than half of those who gain access in the Energy for All Case do so through decentralized systems



ELECTRICITY GENERATION FOR ACCESS, 2017-2030
749 TWh

BY CONNECTION TYPE

- ON-GRID 46%
- MINI-GRID 30%
- OFF-GRID 24%

BY FUEL ENERGY

- SOLAR PV 58%
- OTHER RENEWABLES 4%
- COAL 7%
- OIL 5%
- GAS 6%
- HYDRO 20%

TRANSMISSION LINES (> 69 kV)

- EXISTING
- PLANNED

NEW CONNECTION TYPE

- ON-GRID
- MINI-GRID
- OFF-GRID

Note: Other includes CSP, wind, geothermal, biomass, marine and nuclear.

Sources: KTH-dESA; IEA analysis

Authors: Laura Cozzi and Molly A. Walton, World Energy Outlook, International Energy Agency. The IEA provides country-by-country data on energy access in addition to serving as one of the custodian agencies for SDG 7.2 on renewables and 7.3 on energy efficiency. The IEA is chairing the next edition of the Tracking SDG 7 report due in May 2019, a joint work of the SDG 7 co-custodian agencies namely (IEA, IRENA, UN Statistics Division, WHO, and World Bank).

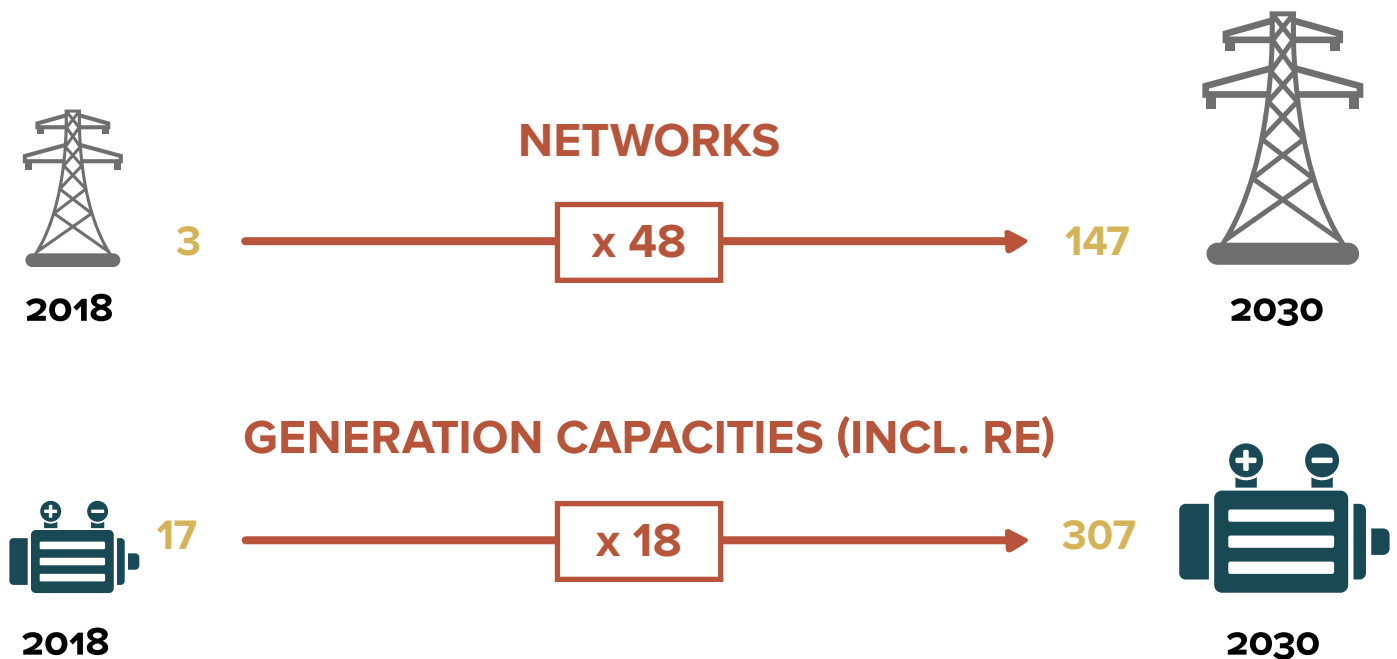
Widespread access to electricity requires scaling up investments in Africa's power sector. Achieving universal access to energy by 2030 in Africa necessitates around \$30 billion p.a. for energy infrastructure between 2017 until 2030¹⁹ according to the IEA²⁰, against the current levels of \$20 billion in 2017²¹. Bridging this financing gap will necessitate private, public and development financing actors to mobilize additional investment capital. While the opportunities are significant, and investors seem to recognize the potential of unlocking new African markets, investment barriers remain in place. The perceived risk environment is still high with consequential effects on

the cost of financing. As a result, efforts are needed to instill market confidence and increase investors' appetite for African infrastructure markets, through regulatory reforms, de-risking measures, as well as new and innovative business ideas that can help unlock Africa's potential for growth.

¹⁹ According to the IEA New Policies Scenario, \$84 billion cumulative investment is needed in Africa to provide electricity access to around 200 billion Africans over the 2017-2030 period. The Energy for All Case, instead, estimates that an additional \$370 billion is needed between 2017 and 2030 to achieve universal access to energy in Africa (IEA, 2017, pp. 89-90).
²⁰ IEA, 2017.
²¹ IEA, 2018a.

Figure 7: AFRICA'S POWER SECTOR INVESTMENT NEEDS

Sources: IEA (2018a), RES4Africa Foundation (2019)
 (bn \$, current prices)



Scaling up investments requires new and sustainable business models that help foster local demand growth, open new market possibilities, and increase private sector's willingness to invest in African markets.

One such strategy regards the conceptual shift away from the dominant commodity-centered approach to service-provider thinking. In this view, electricity in African countries, especially in rural areas, should no longer be seen as an end product but rather as a means to enable services and value creation. After all, electricity powers appliances, equipment, machinery, and has lighting and thermal applications²²; it enables income-generating activities such as services provision (for example, mobile phone recharging, food storage, etc.), industrial productive uses (water supplies and irrigation, mechanization of agricultural and agri-food processes, etc.), and can power entire value chains. In turn, these activities yield socio-economic development spillover effects that empower people and communities, multiply businesses, reduce poverty, and grow healthy African societies. From this perspective, access to electricity represents an instrumental lever that enables the main pillars of sustainable socio-economic development in Africa.

Energy becomes truly transformative when it empowers other pillars of sustainable development, such as water and food. The energy sector is indeed deeply interwoven with the water and food sectors. The 2030 Agenda and the UN Sustainable Development Goals (SDGs) recognize the interlinkages across economic, human and environmental development, emphasizing the need to achieve those targets in a sustainable manner. In this regard, Ensuring Access to Affordable, Reliable, Sustainable and Modern Energy or SDG 7 is instrumental to achieve all other SDGs, yet connects strongly with the two other building blocks of sustainable development: “End Hunger and Achieve Food Security” or SDG 2 and “Clean Water and Sanitation” or SDG 6. As demand for these three resources in Africa is set to increase, it is relevant to

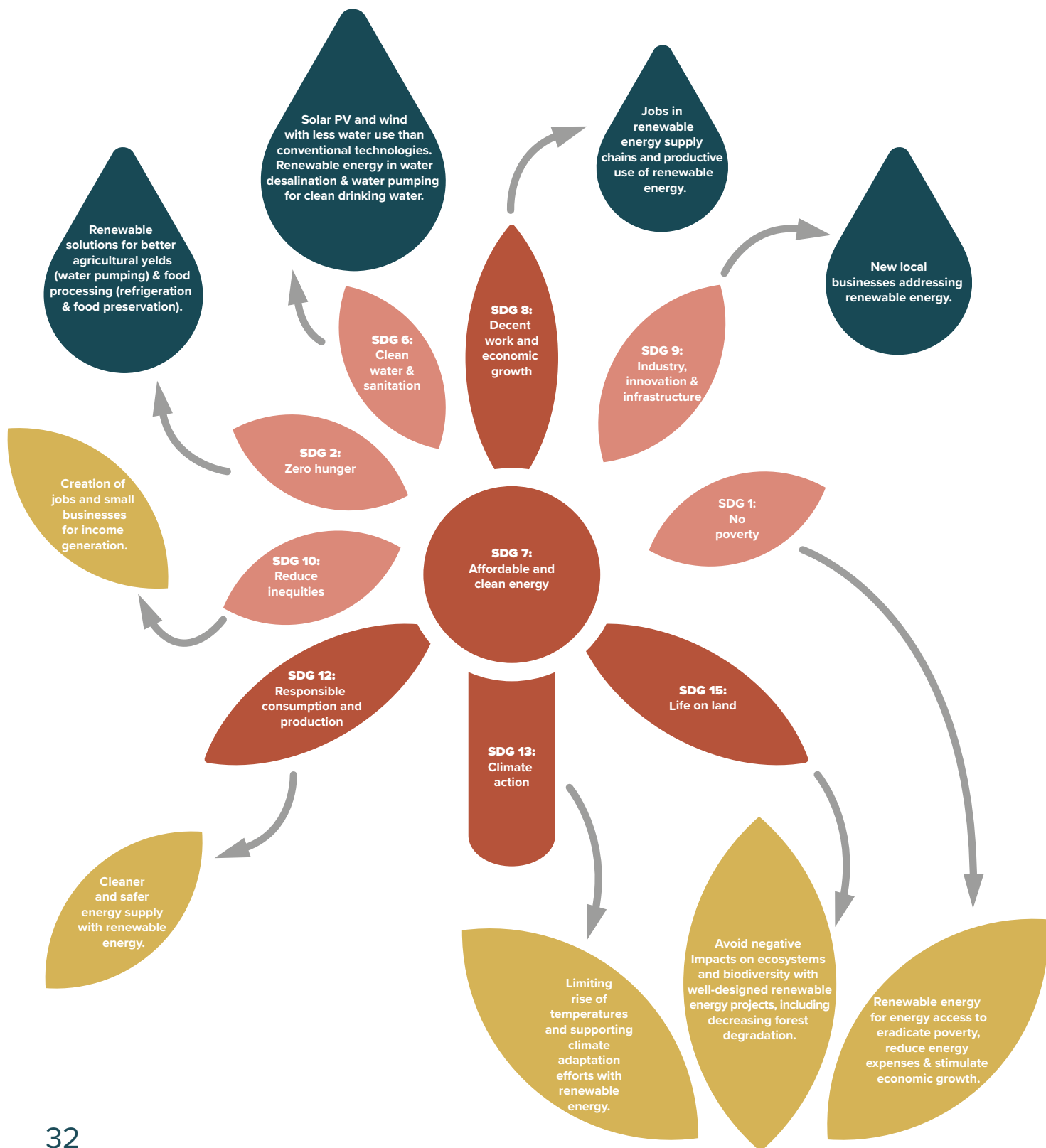
consider how they interact and whether approaching them together as a strategy can reveal further opportunities to accelerate energy access in Africa.

²² UNDP, 2018.

Figure 8:

INTERLINKAGES SDG 7 AND SDGs

Source: UNECE (2017)



CONNECTING THE DOTS:

THE WATER-ENERGY-FOOD NEXUS

Securing access to water, energy and food is vital for human wellbeing and sustainable development. The interactions between the water, energy and food supply systems are manifold:

- **Energy** is required to extract, process and distribute water, as well as power agricultural and agribusiness processes;
- **Water** is central to all forms of energy generation, human needs, and all agricultural production; and
- **Food** requires vast amounts of water and energy for production, processing, distribution, storage and disposal of food products.

There is relevant data showing how the energy access gap (SDG 7) overlaps with access to clean drinking water and sanitation (SDG 6) as well as access to food (SDG 2). Indeed, IEA and FAO data show that *“almost two-thirds of those without access to clean drinking water in rural areas also lack access to electricity,*

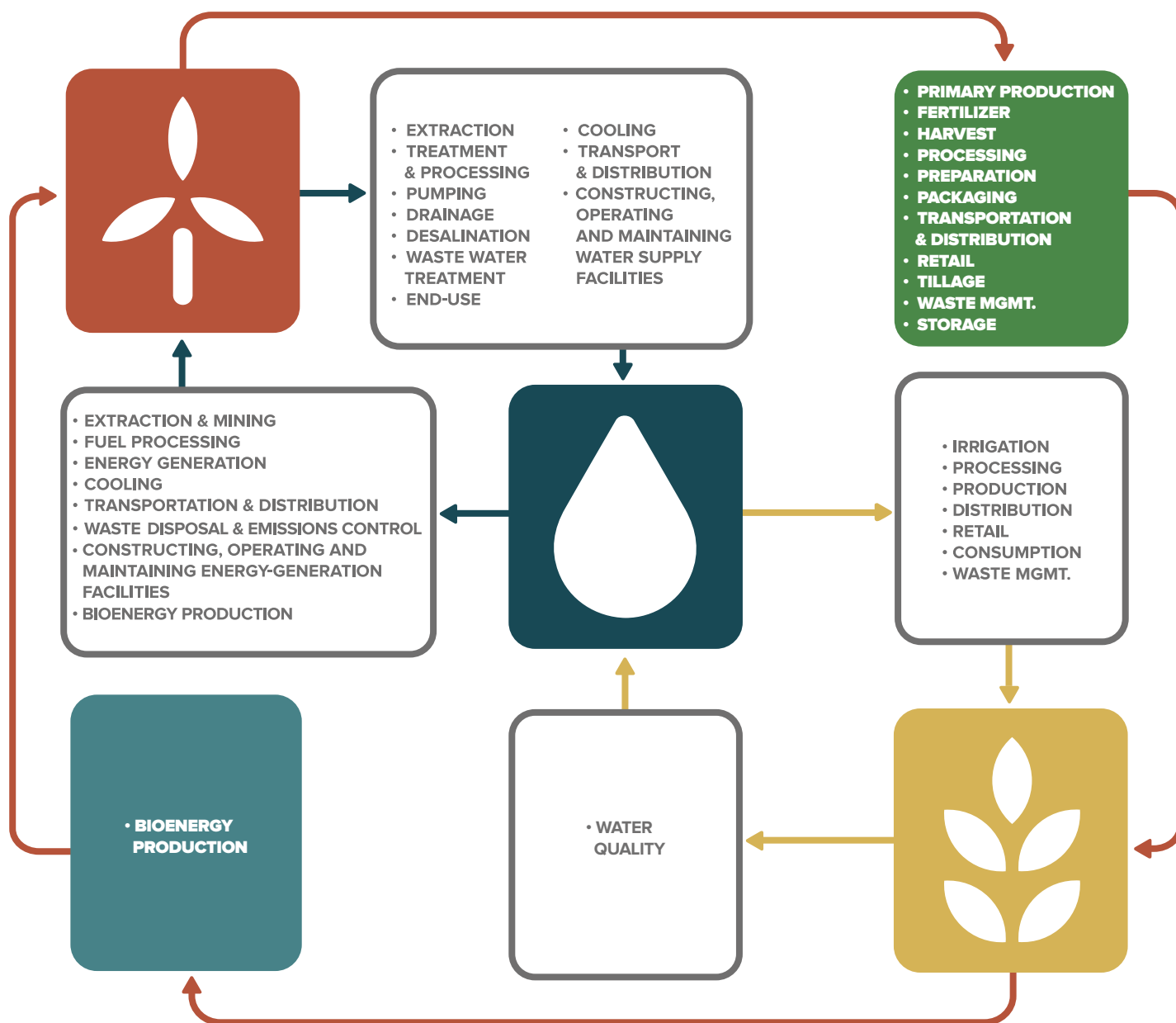
*opening opportunities to coordinate solutions”*²³ (see Box 2). The water-energy-food ecosystems and supply chains are so deeply embedded and connected that actions in one sector impact the others. All three sectors shape a complex and interlinked “Nexus”, representing many trade-offs, resource management and security issues.

²³ IEA (2018b), p. 125.

Figure 9:

WATER-ENERGY-FOOD SUPPLY CHAINS AND INTERLINKAGES

Source: IRENA (2015)



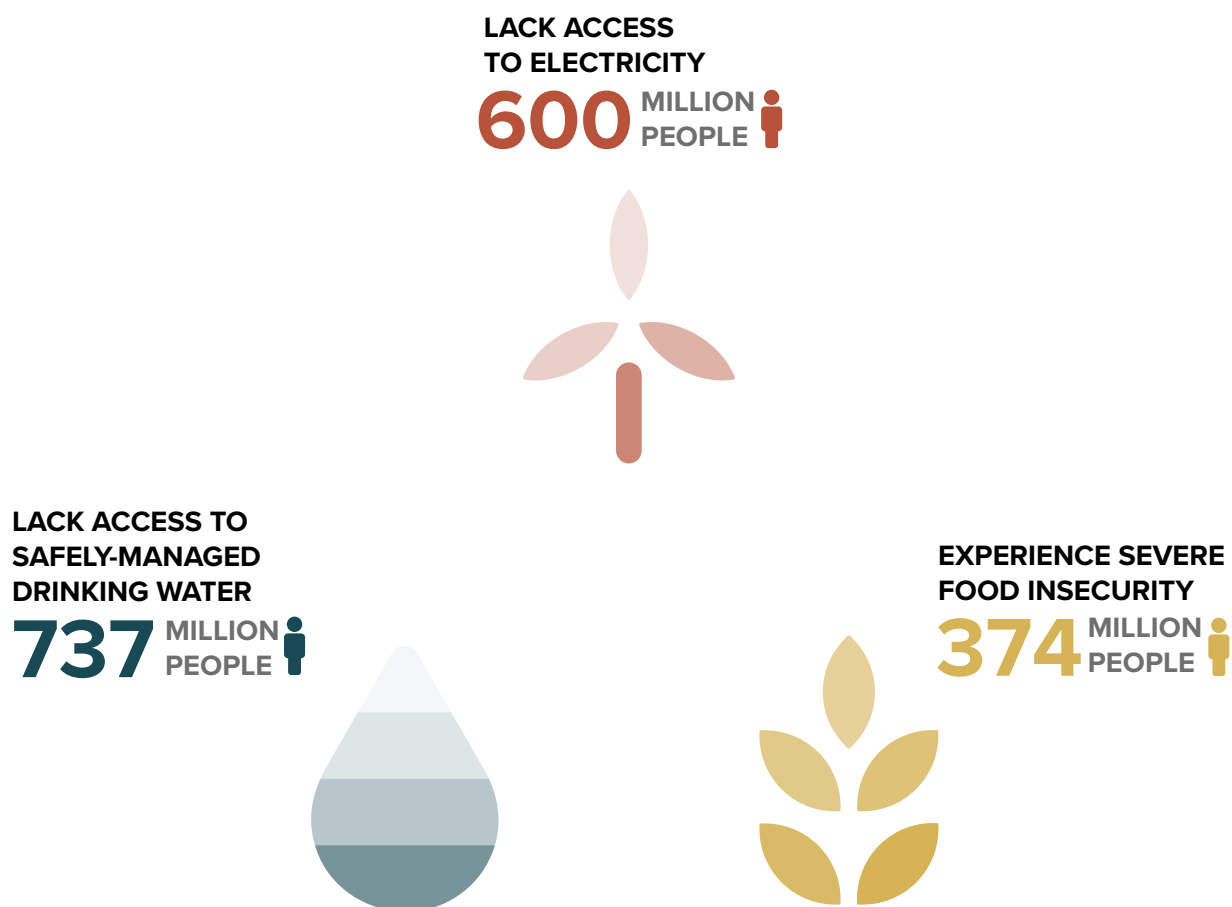
The Water-Energy-Food (WEF) Nexus approach illustrates the inherent relationships and interlinkages between water, energy and food supply chains and systems. Expected stress on access to water, energy and food in coming decades can further hamper Africa’s sustainable development. The WEF Nexus approach has emerged as a conceptual framework and decision-making tool in resource management and sustainable development strategies. Contrary to a “silo approach”, a Nexus-understanding departs

from the interconnections between water, energy and food systems to find new solutions for securing access to basic needs and services. The WEF Nexus leads to systemic thinking and can reveal opportunities for new business services and roles for business actors.

Figure 10:

SUB-SAHARAN AFRICANS LACK ACCESS TO BASIC RESOURCES

Sources: IEA (2017), FAO (2018a), UN SDG indicators (2019)





BOX 2

SYNERGIES BETWEEN SDG 7 AND SDG 6

(IEA)



Energy has a critical role to play in the attainment of a range of SDGs. In particular, given that water and energy are inextricably interlinked it should come as no surprise that new analysis from the IEA highlights a range of potential synergies between SDG 7 on energy access and SDG 6 on clean water and sanitation. In rural areas, considering water supply needs when planning electricity provision can open different pathways for both, which can in turn bring down the cost of electricity for households. The production of biogas from waste can facilitate cleaner cooking in households that currently rely on wood and charcoal for cooking. When wastewater management in urban areas requires new infrastructure, integrating energy efficiency from the start can have a significant impact on the energy and GHG emissions footprint of the wastewater sector.

Taking a deep dive on the intersection between providing access to electricity and clean drinking water provides an illustrative example of how energy can act as an enabler for other SDGs. While many of the solutions available to provide clean drinking water do not require energy, there is significant overlap between those who lack access to both (see Figure 11). As a result, in the IEA's Sustainable Development Scenario (SDS) – an integrated approach focused on delivering energy for all, reducing the impacts of air pollution and tackling climate change – almost two-thirds of those who gain access in rural areas to safely-managed drinking water do so through electrified solutions, primarily via decentralized renewable technologies.

For areas where it is too expensive for the main grid to reach, community solar-powered water pumps are one option to replace labor-intensive hand pumps or more expensive diesel pumps. While there are many water filtration solutions available that require no or minimal energy, the use of energy can help increase their reliability and the amount of clean water available at a given point in time. For example, mini-grids – which provide electricity to almost 45% of those who gain access in rural areas in the SDS – can be used to power filtration technologies to produce clean drinking water.

Reverse osmosis systems are another promising solution: they are efficient even at a small scale and are increasingly economic when paired with mini-grids. For Sub-Saharan Africa, where just a quarter of its population has access to safely-managed drinking water and just



over 40% of the population has access to electricity, this could be a promising path forward. As with energy access, providing access to clean water is just a start. Ensuring it is reliable, affordable and able to scale up to meet continued demand from rising standards of living and population growth is another challenge. Off-grid solutions tend to be more cost-effective for areas of low population density, and they provide almost a third of all new electricity access in rural areas. However, growing household water demand is likely in time to require a higher energy load than can be met by many of today's off-grid systems²⁴. Approaching water and electricity access in an integrated way may shift the emphasis away from off-grid solutions towards mini-grid or grid-connected solutions, especially where water services can provide an "anchor load" for power generation and assist with balancing and storage.

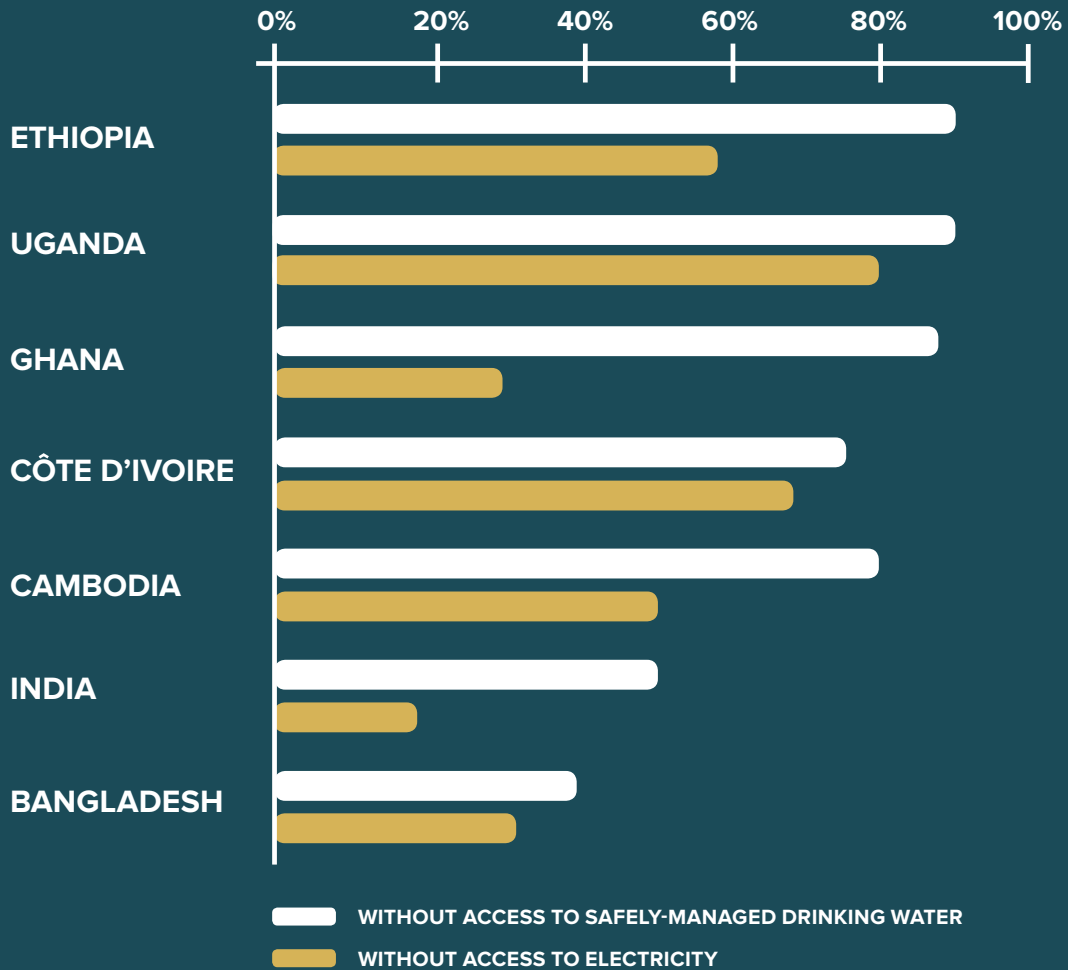
Additionally, beyond just the household level, the provision of energy for productive uses such as agriculture can help foster economic opportunities. As with access to water, an integrated approach creates a stronger business case for entities to invest in electricity-related infrastructure as these productive uses can serve as further anchor loads for power generation, which generate cash flow and provide return on investment, and can bring down the cost of electricity to households. This will require not only a well-designed regulatory framework that allows for the integration of decentralized solutions into the grid, should it arrive, but also cross-sectoral planning, co-ordination and financing to ensure that the necessary infrastructure, technical and financial knowledge and capacity, and access to markets are in place.

²⁴ Such as the off-grid systems that provide a basic bundle of energy services, including several lightbulbs, task lighting, phone charging and a radio.



FIGURE 11:

SHARE OF POPULATION WITHOUT ACCESS TO ELECTRICITY OR WATER



ALMOST TWO-THIRDS OF THOSE WITHOUT ACCESS TO CLEAN DRINKING WATER IN RURAL AREAS ALSO LACK ACCESS TO ELECTRICITY, OPENING OPPORTUNITIES TO CO-ORDINATE SOLUTIONS



Author: Molly A. Walton, World Energy Outlook, IEA (2019)
Sources: IEA Analysis; WHO/UNICEF JMP



The WEF Nexus offers an innovative approach to simultaneously address water, energy and food security in Africa. The benefits of its implementation are widespread at all society levels, but they can reach even further in African rural areas, considering the relevance of agriculture to the continent²⁵. Indeed, the agricultural sector is at the heart of Africa's economy, which relies on agricultural production both as a source of employment and income generation for most of its population. To ensure the continent's long-term economic growth and eradicate poverty will depend in part on the ability to industrialize this sector, increase its productivity, and advance development of rural areas (see Box 3). Agriculture and related industries cannot exist without secured energy and water resources. Here again, energy acts as the enabler of increased food security, agricultural productivity and improved access and management of water resources for both human and agricultural uses.

²⁵ Around 60% of all workers in Sub-Saharan Africa are employed in primary agriculture and the number of farmers will continue to grow in many of those countries with consequent opportunities for agribusiness sector growth in terms of size and employment creation (World Bank, 2019).



BOX 3

IFAD'S APPROACH TO THE WATER-ENERGY-FOOD NEXUS (IFAD)



One of the greatest challenges the world faces is that of feeding a growing population that is rapidly urbanizing, and whose diets are changing as incomes increase – in a context of increasingly difficult climatic conditions. In many developing countries the future of the agricultural sector will be determined by whether smallholder farmers can step productivity to meet this demand.

Access to energy and water are critical factors for growing food and achieving food security. In the context of climate change, water scarcity is expected to become an ever-greater concern for many smallholder farmers as seasonal droughts, interspersed by heavy rainfall with high levels of run-off, increasingly undermine their natural resource base. Extreme climate shocks not only constrain the capacity of smallholders to farm productively and raise livestock, they also threaten to push poor farmers deeper into poverty, making them less able and willing to invest in their production systems. This is particularly true for Africa, where 80% of farmland is under rainfed production.

Emerging food value chains provide an important stimulus to growth in Africa's agricultural productivity. Yet in most Sub-Saharan African countries, access to clean fuels for farm operations or crop processing is limited and costly. When farmers have access to affordable energy – particularly clean, renewable sources such as solar – they can power pumps for water supplies and irrigation and thus reduce the risks associated with being entirely dependent on rainfall.

The International Fund for Agricultural Development's (IFAD) approach to the Water-Energy-Food Nexus (WEF) reflects the complex reality facing smallholder farmers dependent on rainfed agriculture as their main source of income – and particularly those of women producers. The basis of the WEF Nexus remains access to energy for productive uses at farm level such as pumping water, operating labour-saving small-scale machinery, raising poultry and producing fodder (chaff cutters), etc., as well as for value-addition processes (grinding, rice milling, drying, packaging, threshing, and ensuring effective cold storage facilities for storing perishable goods).



An example of IFAD's approach is in Northern Benin where since 2010 IFAD has been working with the Government of Benin and the Solar Electric Light Fund (SELF) to support Solar Market Gardens for horticultural production. During the dry season in Kalalé District, water scarcity is a systematic challenge for smallholder farmers, making it impossible to irrigate fields and severely limiting access to potable drinking water. Solar drip irrigation combines a renewable energy source with an efficient way of cultivating crops (conservation of soil moisture and better water retention). This technology has not only increased the adaptive capacity of smallholder farmers, but has also resulted in greater gender empowerment, nutrition and youth employment. The adoption of the technology has enabled women farmers to break their dependence on seasonal rainfall, which typically limits them to a three to six month growing season; while the provision of water for small productive activities, such as home gardens and high-value small off-season vegetable plots, has had a positive impact on the nutrition and health of the rural communities. Not only have households, on average, earned an additional \$7-8 per week from selling fresh produce, they have also consumed, on average, 1-2 kg of their own production (including tomatoes, amaranth, okra, and carrots) per week. This holistic approach motivates farmers to engage in market-oriented agri-business activities, and can ultimately have a transformative impact on local rural economies.

Author: International Fund for Agricultural Development (IFAD)

Figure 12:

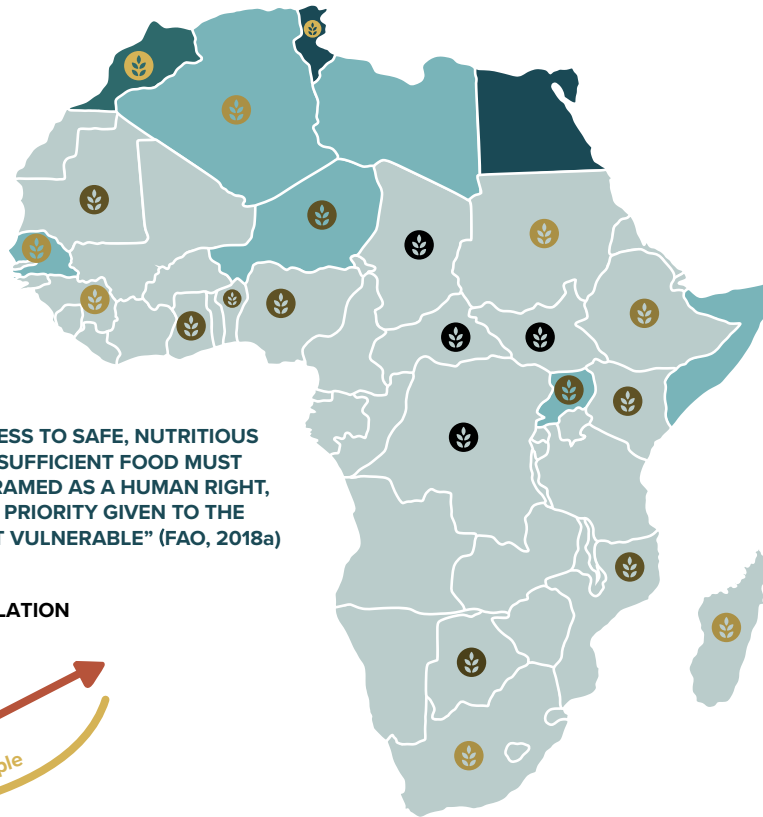
WATER-ENERGY-FOOD ACCESS CHALLENGES IN AFRICA

Sources: UN Stats (SDG indicators) (2019), World Bank (2016, 2019c), FAO (2018c), IndexMundi (2019)

AGRICULTURE 🌾

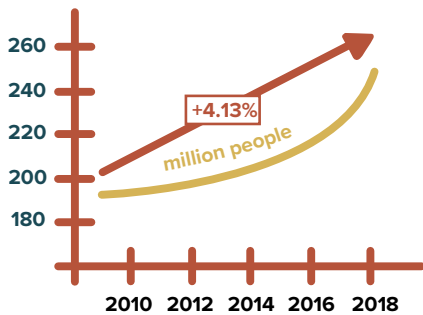
PORTION OF IRRIGATION LAND IN AFRICAN COUNTRIES

- 🌾 0.01 - 0.03
- 🌾 0.03 - 0.07
- 🌾 0.07 - 0.20
- 🌾 0.20 - 0.53
- 🌾 0.53 - 1.3
- 🌾 1.3 - 3.2
- 🌾 3.2 - 7.9
- 🌾 7.9 - 20



“ACCESS TO SAFE, NUTRITIOUS AND SUFFICIENT FOOD MUST BE FRAMED AS A HUMAN RIGHT, WITH PRIORITY GIVEN TO THE MOST VULNERABLE” (FAO, 2018a)

UNDERNOURISHED POPULATION



WATER 💧

PORTION OF SAFELY-TREATED WASTEWATER FLOWS FROM HOUSEHOLDS

- 💧 76% - 100%
- 💧 51% - 75%
- 💧 26% - 50%
- 💧 25% or less
- 💧 insufficient data

“IN AFRICA, ESPECIALLY SUB-SAHARAN AFRICA, MORE THAN A QUARTER OF THE POPULATION SPENDS OVER HALF AN HOUR PER ROUND TRIP TO COLLECT WATER” (UN, 2014)

💧 PORTION OF POPULATION HAVING ACCESS TO SAFELY-MANAGED DRINKING WATER SERVICES

💧 PORTION OF POPULATION HAVING ACCESS TO BASIC DRINKING WATER SERVICES

Central and Southern Asia	💧 57.14%	💧 31.28% = 88.42%
Eastern and South-Eastern Asia	💧 0.00%	💧 94.18% = 94.18%
Sub-Saharan Africa	💧 23.70%	💧 33.94% = 57.64%
Northern Africa and Western Asia	💧 0.00%	💧 90.56% = 90.56%
Least developed countries	💧 33.40%	💧 28.53% = 61.93%

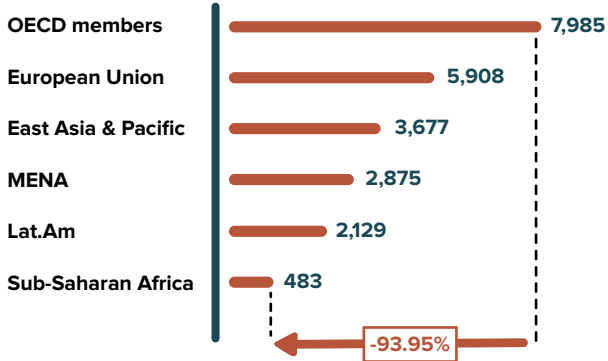
💧 NUMBER OF WATER INSUFFICIENCIES IN A TYPICAL MONTH

💧 PERCENTAGE OF FIRMS EXPERIENCING WATER INSUFFICIENCIES

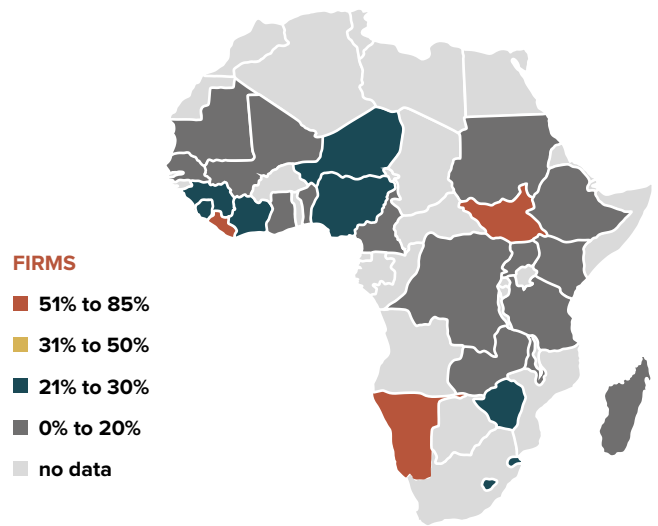
Sub-Saharan Africa	💧 1.9	💧 22.9
Middle East & North Africa	💧 2.3	💧 19.0
Latin America & Caribbean	💧 1.0	💧 16.5
East Asia & Pacific	💧 0.3	💧 10.2

ENERGY

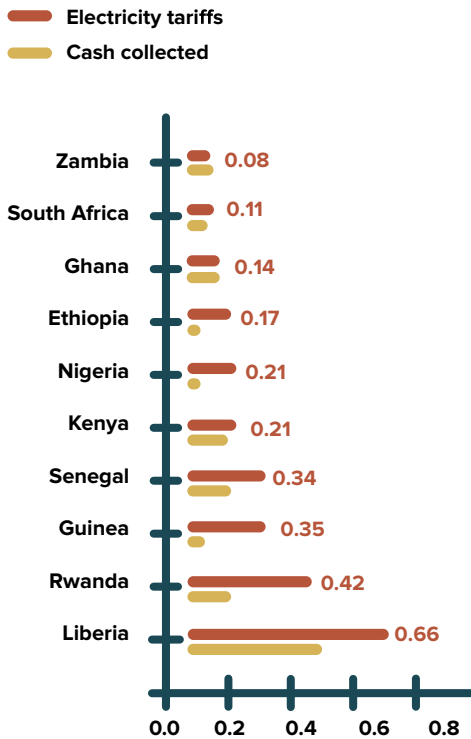
AVERAGE ELECTRICITY CONSUMPTION (kWh/hab, 2016)



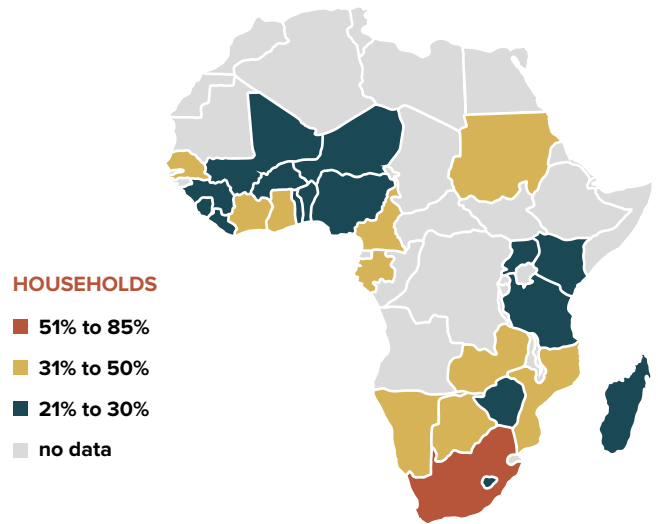
ELECTRICITY RELIABILITY FOR FIRMS AND HOUSEHOLDS (2015)



ELECTRICITY TARIFFS AND CASH COLLECTED IN SELECTED SSA COUNTRIES (\$/kWh, 2016)



“60% OF FIRMS OPERATING IN AFRICA CONSIDER INFRASTRUCTURE (POWER SHORTAGES, COSTS, TRANSPORT BOTTLENECKS) AS THE MOST BINDING CONSTRAINT THEY FACE IN THEIR DAILY OPERATION” (AfDB, 2018)



RENEWABLE ENERGY

FOR A SUSTAINABLE WEF NEXUS APPROACH IN AFRICA

Renewable energies help meet Africa's need for resources in a sustainable way. Thanks to its inherent characteristics, RE technologies offer sustainable solutions to leverage synergies between water, energy and food sectors to enhance resource optimization, foster economic development, and benefit communities²⁶. RE technologies can impact water, energy and food sectors in many ways (see Box 4):

- reduce dependency on fossil fuels, which increases energy security and improves reliability and safety of the water, energy, and food supply chains;
- decrease services costs, raising the affordability of water, energy and food supply chains;
- enable more efficient and better resource management;
- improve access to water and energy in remote areas generating positive impacts across entire economic value-chains;
- allow improved access to modern energy services;
- reduce carbon footprint across all sectors;

- open new opportunities for agricultural economies, when embedded into integrated strategies across WEF sectors.

²⁶ IRENA, 2015.



BOX 4



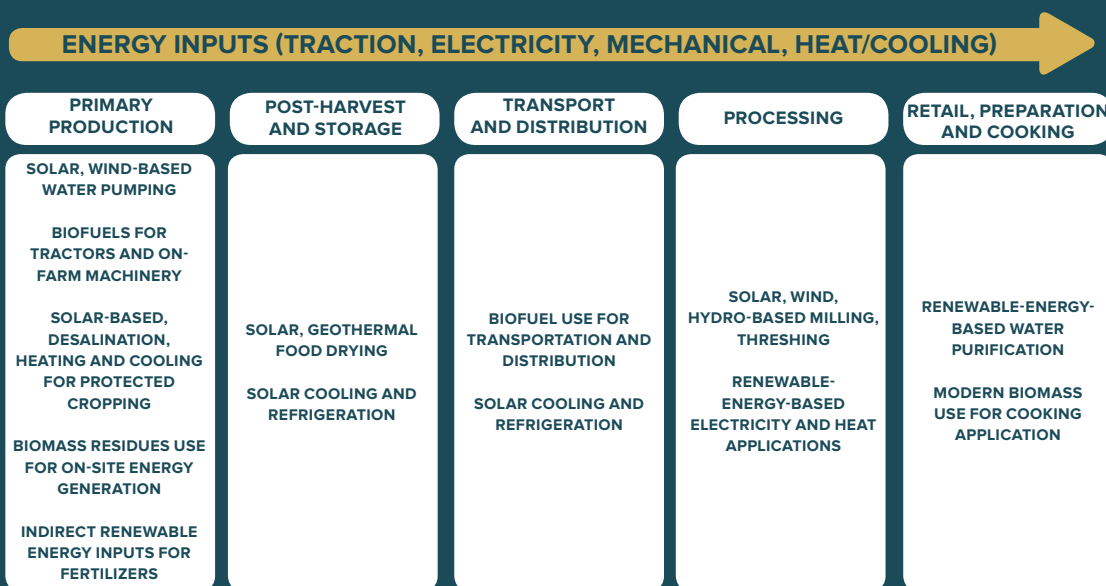
OPPORTUNITIES FROM RENEWABLE ENERGY IN THE WATER-ENERGY-FOOD NEXUS (IRENA)

A nexus approach is essential to identify many opportunities renewable energy can offer to the interlinkages between water, energy and food, thereby guiding policy and addressing potential trade-offs. These strong interdependencies are briefly illustrated here through examples in the agricultural sector and in the power sector.

The agri-food chain. The energy sector relies heavily on water for nearly all forms of traditional energy production processes. Meanwhile, access to affordable, reliable energy is crucial for the delivery of water services and for improving productivity and resilience in the agriculture sector. In the agriculture sector, where nearly 30% of the global energy consumption takes place, cost-effective, secure and environmentally-sustainable supply of energy is crucial along different segments of the agri-food value chain to reduce drudgery, improve yields and productivity, and resilience. There is growing evidence of off-grid renewable energy solutions meeting diverse energy needs along different segments of the value chain with several socio-economic and environmental co-benefits (see Figure 13) (IRENA, 2016a).

**FIGURE 13:
ENTRY POINTS FOR RENEWABLE ENERGY ALONG
DIFFERENT SEGMENTS OF THE AGRI-FOOD CHAIN**

SOURCE: IRENA (2016a)

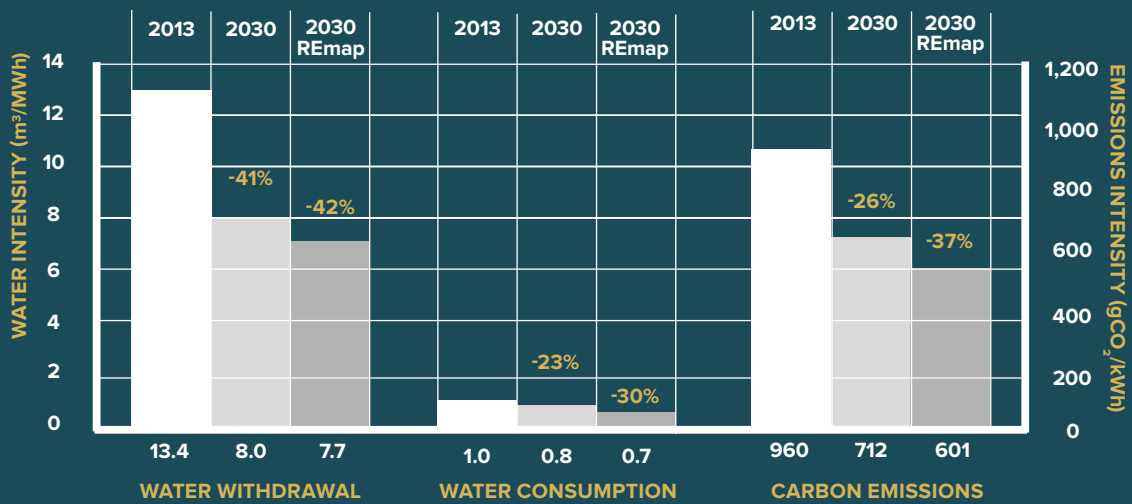




Solar irrigation solutions, for instance, are increasingly being deployed to improve access to water for agricultural uses enabling multiple crop rotations annually, improving yields and incomes, reducing drudgery especially for women, enhancing resilience and food security. A diversity of delivery models is being adopted to support deployment of such solutions and a nexus approach is important to address possible trade-offs (for example, coupling with drip irrigation to limit over water withdrawal) (IRENA, 2016b).

The power sector. Another key opportunity offered by renewables in the water- energy nexus relates to easing the water-dependence of the power sector. Compared to thermal power generation solutions, some renewable energy technologies, such as solar PV and wind, require significantly less water to generate electricity. An IRENA study conducted with China Water Risk found that raising the share of renewables in line with the national climate mitigation objectives, coupled with water-efficient cooling technologies, could reduce the water intensity of power generation by as much as 42% by 2030 and the carbon

FIGURE 14:
WATER AND CARBON INTENSITY OF POWER GENERATION IN CHINA, 2013-2030
 SOURCE: IRENA (2016c)



Sources: China Water Risk based on IRENA's RE mappations
 MWh = megawatt-hours; gCO₂ = grams of carbon-dioxide; kWh = kilowatt-hours

intensity by up to 37% (IRENA, 2016c) (see Figure 14). Another study focusing on India undertaken by IRENA and World Resources Institute (WRI), finds that raising the share of renewables in power generation (in line with the nationally determined contribution)

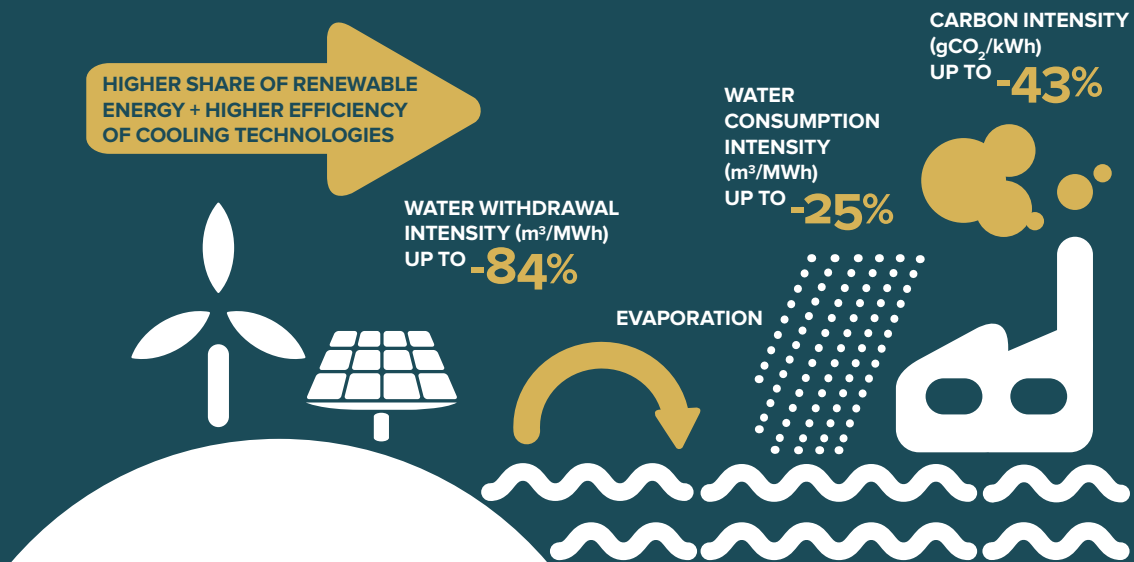


and changing to more efficient cooling technologies could reduce the water withdrawal intensity of electricity generation by up to 84%, consumption intensity by up to 25%, and carbon-intensity by up to 43% by 2030 (IRENA, 2018) (see Figure 15). The analysis demonstrates the value of integrating water perspectives in energy sector planning and co-benefits offered by renewables, such as solar PV and wind, to reduce competition between end uses for limited freshwater resources and to increase resilience to climate-change-related impacts.

The examples presented here showcase some of the opportunities offered by renewables for the Water-Energy-Food Nexus. Indeed, a nexus approach to the energy transition will help to further accelerate deployment in end-use sectors (for example, in agriculture, water) and guide policy making towards greater sustainability and socio-economic development.

FIGURE 15:

IMPACT OF RENEWABLE ENERGY AND EFFICIENT COOLING TECHNOLOGIES ON WATER AND CARBON INTENSITY IN INDIA
SOURCE: IRENA (2018)



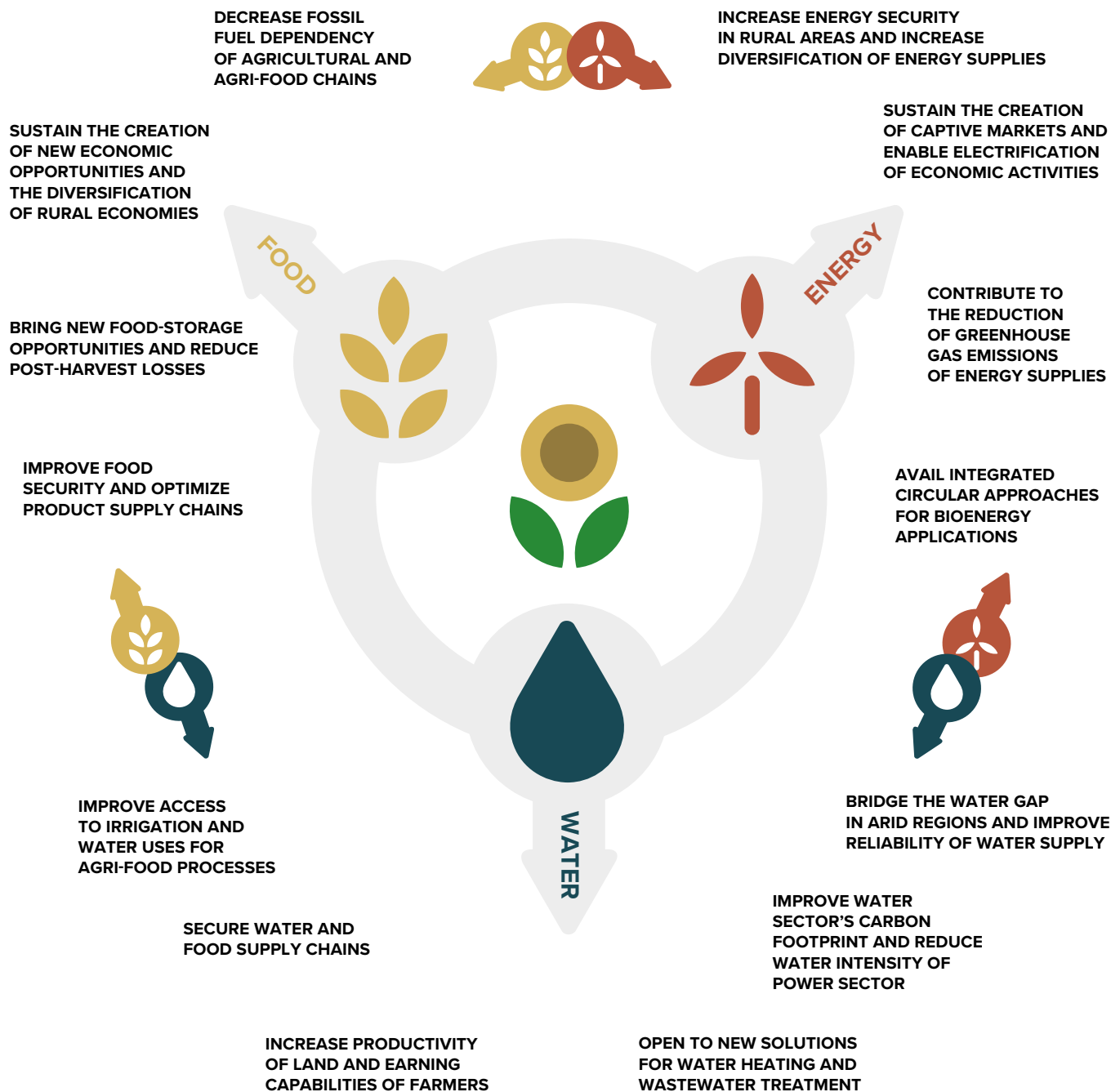
Authors: Divyam Nagpal, Associate Programme Officer, IRENA. Verena Ommer, Associate Programme Officer, IRENA. Rabia Ferroukhi, Deputy Director, Knowledge Policy and Finance Center, IRENA

Sources: IRENA (2015), Renewable Energy in the Water, Energy & Food Nexus, www.irena.org/publications/2015/Jan/Renewable-Energy-in-the-Water-Energy--Food-Nexus. IRENA (2016a), Renewable Energy Benefits: Decentralised solutions in the agri-food chain, www.irena.org/publications/2016/Sep/Renewable-Energy-Benefits-Decentralised-solutions-in-agri-food-chain. IRENA (2016b), Solar Pumping for Irrigation: Improving livelihoods and sustainability, www.irena.org/publications/2016/Jun/Solar-Pumping-for-Irrigation-Improving-livelihoods-and-sustainability. IRENA and China Water Risk (2016c), Water Use in China's Power Sector: Impact of Renewables and Cooling Technologies to 2030, www.irena.org/publications/2016/Feb/Water-Use-in-Chinas-Power-Sector-Impact-of-Renewables-and-Cooling-Technologies-to-2030. IRENA and WRI (2018), Water Use in India's Power Generation: Impact of renewables and improved cooling technologies to 2030, www.irena.org/publications/2018/Jan/Water-Use-in-India-Power-Impact-of-renewables-to-2030

Figure 16:

RENEWABLE ENERGY OPPORTUNITIES IN THE WATER-ENERGY-FOOD NEXUS

Source: RES4Africa Foundation (2019)



Renewable energy solutions are the most suitable power generation technologies to power energy access solutions within the WEF Nexus. Different renewables-powered energy access solutions can be adopted by energy providers to deliver needs-based services for local beneficiaries and consumers. This variety in technologies allows the inclusion of the energy access component into wider WEF Nexus projects, adapting the energy investment components to the needs of local communities. Currently, three main solutions are considered by energy access providers in Africa (see Figure 17):

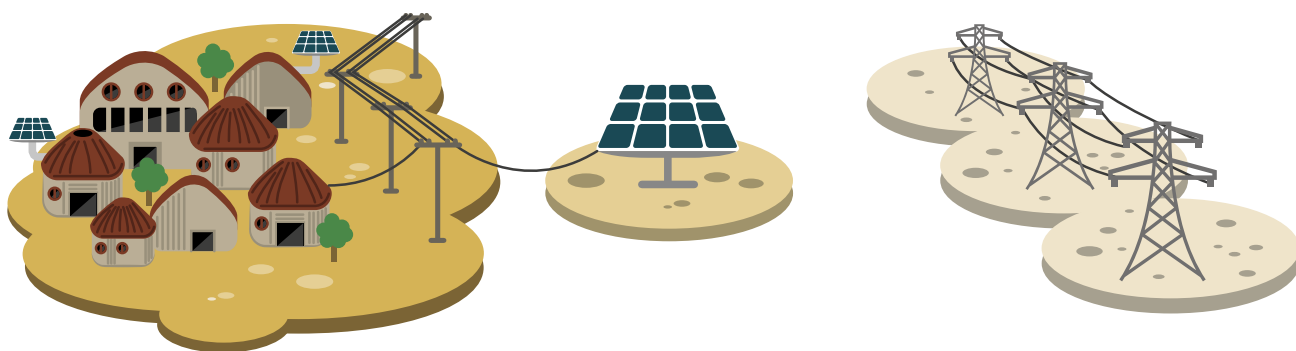
- **Hybrid stand-alone renewable energy mini-grids:** if the target community is far removed from the grid or plants, energy providers can invest in an independent mini-grid operated as an integrated mini-utility. Mini-grids serving local clients can be powered from renewable-based power plants, coupled either with storage solutions or diesel generators to ensure continuous and reliable energy supply and reduce exposure to weather variability.
- **Smart extension:** if the target community is in proximity of an existing large-scale grid connected RE plant, an energy company may implement an extension of the plant to serve surrounding communities (see pages 72-73). This reduces new connection costs for local communities, and can help to better manage power plant energy production, as well as dispatch for the plant owner and the grid operator.
- **Grid expansion:** if the target community is close to the national grid, access to energy could be provided through the extension of national transmission and distribution grids, powered by national renewable or conventional power generation capacity.

Figure 17:

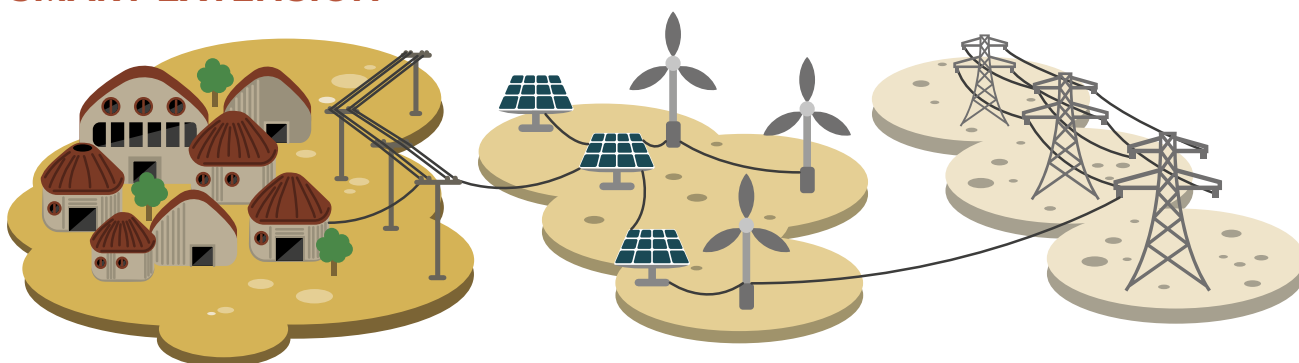
RENEWABLE ENERGY OPTIONS TO SUPPORT LOCAL ENERGY ACCESS AND DEVELOPMENT IMPACT

Source: RES4Africa Foundation (2019)

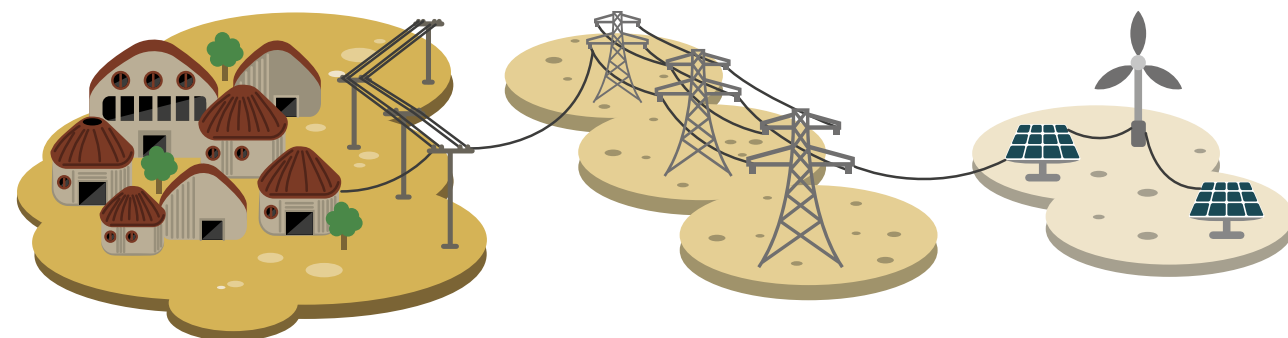
MINI GRID + OFF-GRID SOLUTIONS



SMART EXTENSION



GRID EXTENSION



RENEWABLE ENERGY IS CENTRAL TO ALL APPROACHES

RE-BASED WEF NEXUS APPROACHES

CAN OVERCOME ENERGY ACCESS GAPS

RE based WEF Nexus approaches can be instrumental to achieve universal access to energy. Today, companies seeking to explore opportunities in the energy access markets and bottom-of-the-pyramid consumer segments are confronted with three main bottlenecks:

- How to ensure sufficient and stable consumer demand to cover investment costs in energy generation capacity and distribution services?
- How to find the right business and operating model that can reach scale?
- How to guarantee affordable energy supply aligned with consumers' spending capabilities?

From the perspective of an energy access provider integrated WEF Nexus approaches powered by RE sources help to bridge those gaps by:

- **Providing a market entry point or “anchor client” with stable and reliable power consumption levels:** the integration of energy supply, water supply and agri-food services (with the latter often representing the main sources of commercial and productive energy demand in rural regions) help to secure stable and reliable anchor loads, reduce investors' risk exposure to variability of consumers' energy demand, strengthen the business case of the energy investment component and reinforce the commercial viability of the integrated business model.
- **Securing energy sources that provide affordable supply to low-income and bottom-of-pyramid customers:** the integration of renewable energy solutions within WEF approaches allows to rely on cost-competitive, indigenous and sustainable energy sources which today offer the most economical, reliable and convenient avenue to provide energy supply

to low-income and bottom-of-the-pyramid consumers and adapt project sizing to concrete local needs, thanks to technology modularity of renewables.

- **Strengthening economic impact of investments and paving the way to opportunities for scale:**

multi-service approaches focusing on supporting productive uses and stimulating economic activity maximize socio-economic impact and engender multiple spillover effects that reinforce business models' economic viability and open to new opportunities to replicate and scale most successful cases elsewhere.

The WEF Nexus approach can reveal business opportunities for private sector and development opportunities for local communities. RE-based WEF Nexus

approaches not only open to new business possibilities by bridging energy access market gaps benefiting investors, but also deliver greater sustainability and generate positive socio-economic development in Africa for both investors and beneficiaries. The interconnection between the three sectors makes them act on each other with multiplier effects on development of local communities and project areas, as well as on economic returns of investments. Part two explores how the WEF Nexus can create sustainable development impact at scale by fostering business models that open new markets and focus on what concrete development impact can be set in motion, while making a case for scaling up such business models.



VISIONARY STATEMENT

DELIVERING WATER, FOOD AND ENERGY SECURITY FOR ALL

KOFI ANNAN, FOUNDER AND CHAIR, KOFI ANNAN FOUNDATION,
FORMER SECRETARY-GENERAL, UNITED NATIONS



It is a moral outrage that 30% of food produced for human consumption is spoiled or squandered every year. Even if just one-fourth of it could be saved, it would be enough to feed the 870 million hungry people in the world. Hundreds of millions of our fellow human beings also lack access to both water and energy, which are cornerstones of economic progress and poverty alleviation. The growing impact of climate change is exacerbating these challenges and risks pushing millions more into abject poverty and hunger. And as always, it

is the world's poorest who are paying the highest price.

The challenges we are facing are huge, but fortunately we are not starting from scratch. With the Sustainable Development Goals and the Paris Agreement on Climate Change, world leaders have adopted a compelling vision with ambitious goals. The role of governments is vital in implementing those commitments. But it is not governments' responsibility alone. It requires cooperation and partnership between every sector of society. No one has all the answers, but let me set out a few priorities as I see them.

First, the complexities of today's challenges call for a holistic systems-approach rather than siloed approaches. Too often policies to manage water, food and energy resources are developed and implemented in isolation when we know that they are

interlinked. Decision-makers have to foster policy coherence, and enhance coordination and collaboration among diverse actors to ensure that co-benefits and trade-offs are considered and that appropriate safeguards are put in place.

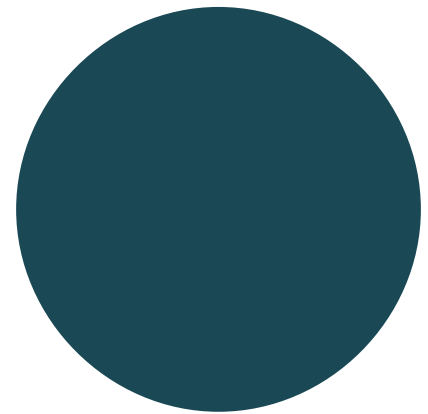
Second, we must seize this moment to change the way we produce and consume energy. As a global community, we have the technology, finance and ingenuity to embark on a low-carbon transition. Shifting towards renewable energy sources is not only helping to avert climate catastrophe, but also creating new opportunities for investment, growth and employment. It is also the most promising way to provide access to modern energy services to the over 1.2 billion people worldwide who lack access to electricity. Another advantage is that clean energy contributes to preserving our water ecosystems. Unlike fossil fuels, most renewables such as solar, wind, or geothermal energy consume very little to no water. Both governments and businesses have to accelerate the transition to low-carbon energy systems by investing in renewables, prioritizing energy efficient practices, and developing and deploying clean technologies and related infrastructure.

Third, we need to explore how the water, food and energy nexus can support agricultural development and food and nutrition security. Agriculture accounts for 70% of the global freshwater withdrawals, and more than one-quarter of the energy used globally is expended on food production and supply systems. Especially in water-scarce regions, we need robust strategies to end wasteful water use and protect water availability to maintain agricultural production and avoid food price volatility. As the global demand for food keeps growing, we need smarter policies and greater investment in sustainable agriculture to increase productivity, particularly


in the Global South, and promote innovation across the entire value chain to contribute to more efficient resource use.

But allow me to stress that, by its very nature, climate change is a cause that should unite us all – governments, businesses, investors, science and civil society. We clearly have an ambitious agenda ahead of us, but I am confident that we can turn aspiration into action and build a more prosperous and sustainable world. Your leadership, actions and ideas must play an important role in this effort.

**THE
WATER-
ENERGY-
FOOD
NEXUS
APPLIED:**



OPPORTUNITIES FOR SHARED VALUE



**HOW CAN THE
WEF NEXUS
APPROACH
CREATE IMPACT AND
HOW CAN THAT
IMPACT BE SCALED UP**

INTRODUCTION

Private sector actors and investors can play a key role in capturing the potential of the WEF Nexus, which presents opportunities not only for profitable investment but also to achieve wide socio-economic impact. Rolling out innovative and integrated business models can help solve unmet social needs, generate new demand, unlock new markets and accelerate virtuous socio-economic development cycles in Africa through renewable energy-enabled local communities. For these virtuous cycles to materialize, private sector needs to develop WEF business models in a way that can be applied at scale. To this end, diverse approaches should be applied incrementally and sequentially in order to reach transformational impact. If specific barriers to scaling up these business models are overcome, the potential to achieve energy access in Africa and its development impact can be within reach. In this way, a paradigm shift towards RE-based WEF Nexus business models presents companies and investors with new opportunities for growth that will effectively contribute to achieving access to energy in Africa.

SUSTAINABILITY IS BUSINESS STRATEGY

Sustainability has become a strategy for business transformation. Across various economic sectors, companies are considering sustainability²⁷ as a new opportunity for long-term growth. The management of environmental, social and governance issues has entered C-section boardrooms as instrumental to ensure businesses success. Indeed, customers, institutional investors and public opinion worldwide are increasingly claiming for companies to serve a wider social purpose beyond financial performance and maximizing shareholder value. As expectations rise, business companies start to take leadership on environmental and social issues by reshaping their investment strategies and finding new opportunities for sustainable growth.

Companies are pivotal for addressing social needs and creating shared value for society. Rethinking the connection between corporate success and societal progress is captured by the “Creating Shared Value”

(CSV) management theory, originated by Michael E. Porter and Mark R. Kramer (2011). The CSV theory is built around the idea that business actors “*can create economic value in a way that also creates value for society by addressing its needs and challenges*”²⁸. CSV reorients the role of private sector as actors of positive change in the communities where they operate along their value chain.

²⁷ Sustainability can be pursued as the management of environmental issues (for example, focus on reducing greenhouse gas emissions, increasing energy efficiency, waste management, green-product development, water conservation, etc.) the management of governance issues (for example, regulation compliance, ethical practices, and meeting industry standards) and that of social issues (working conditions, labor standards, etc.).

²⁸ Porter, M. & Kramer, M. (2011) The Big Idea: Creating Shared Value, p. 3.

Given their nature to procure, transform and sell goods and services, private sector can play a prominent role in offering sustainable and innovative solutions that meet social needs and maximize positive socio-economic impact, while finding new opportunities for growth. The integration of sustainability practices in private sector business strategies can reap value by²⁹:

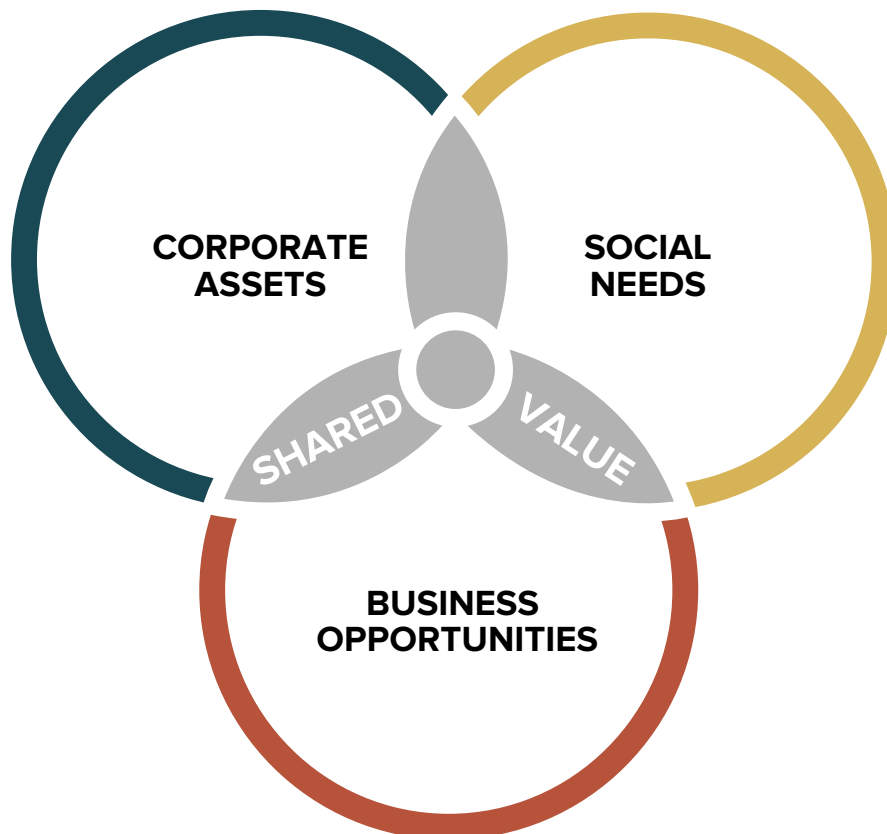
- aligning companies' value propositions with social needs and consumer expectations;
- enhancing productivity, operational efficiency and cost-optimization of existing value chains;
- benefitting from market discovery serving social needs and sustainability-conscious stakeholders.

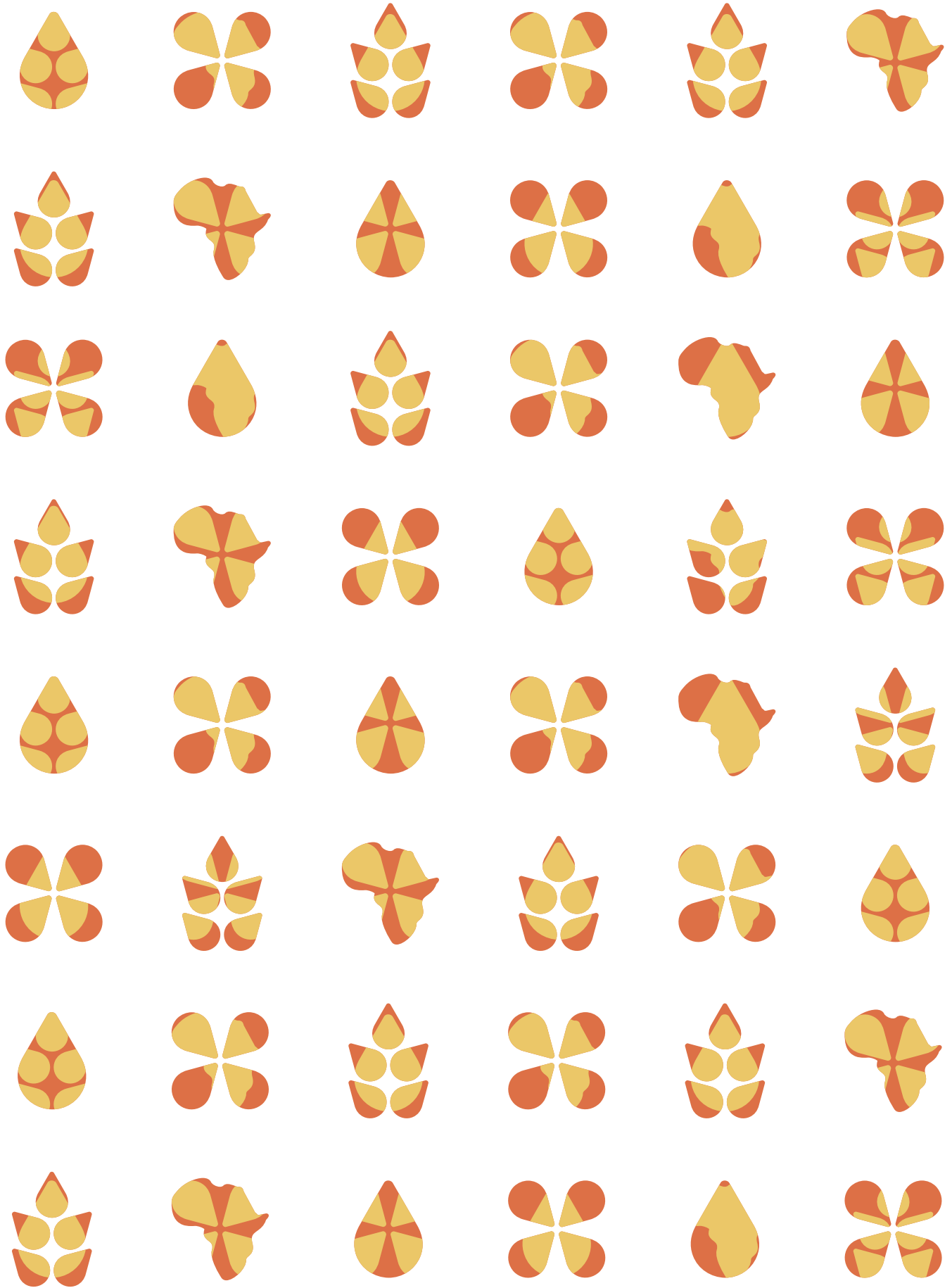
These benefits in turn strengthen a business' ecosystem of stakeholders, increase corporate revenues and margins, and help achieve greater social impact. There is growing evidence that companies having integrated a CSV approach in their value chains and service offerings strengthen their business ecosystem both in terms of economic returns and socio-economic impact in related communities. Doing good is indeed becoming a strategy for companies to do well³⁰.

²⁹ Porter, M. & Kramer, M. (2011) The Big Idea: Creating Shared Value.
³⁰ Porter, M. & Kramer, M. (2011) The Big Idea: Creating Shared Value.

Figure 18: **THE INTERSECTION OF CREATING SHARED VALUE**

Source: Porter, M. & Kramer, M. (2011) The Big Idea: Creating Shared Value





THE WEF NEXUS:

OPPORTUNITIES FOR GROWTH AND IMPACT

The WEF Nexus represents opportunities for companies to create shared value. Conform to CSV theory, WEF Nexus approaches enable the creation of business models based on multi-service approaches leading companies to adopt sustainable business solutions that help meet Africa's water, food and energy access challenges. By acting on the interlinkages between these value chains, the WEF Nexus approach can help solve concrete social needs through sustainable approaches and targeted solutions able also to increase value for business, when compared to single service-oriented approaches.

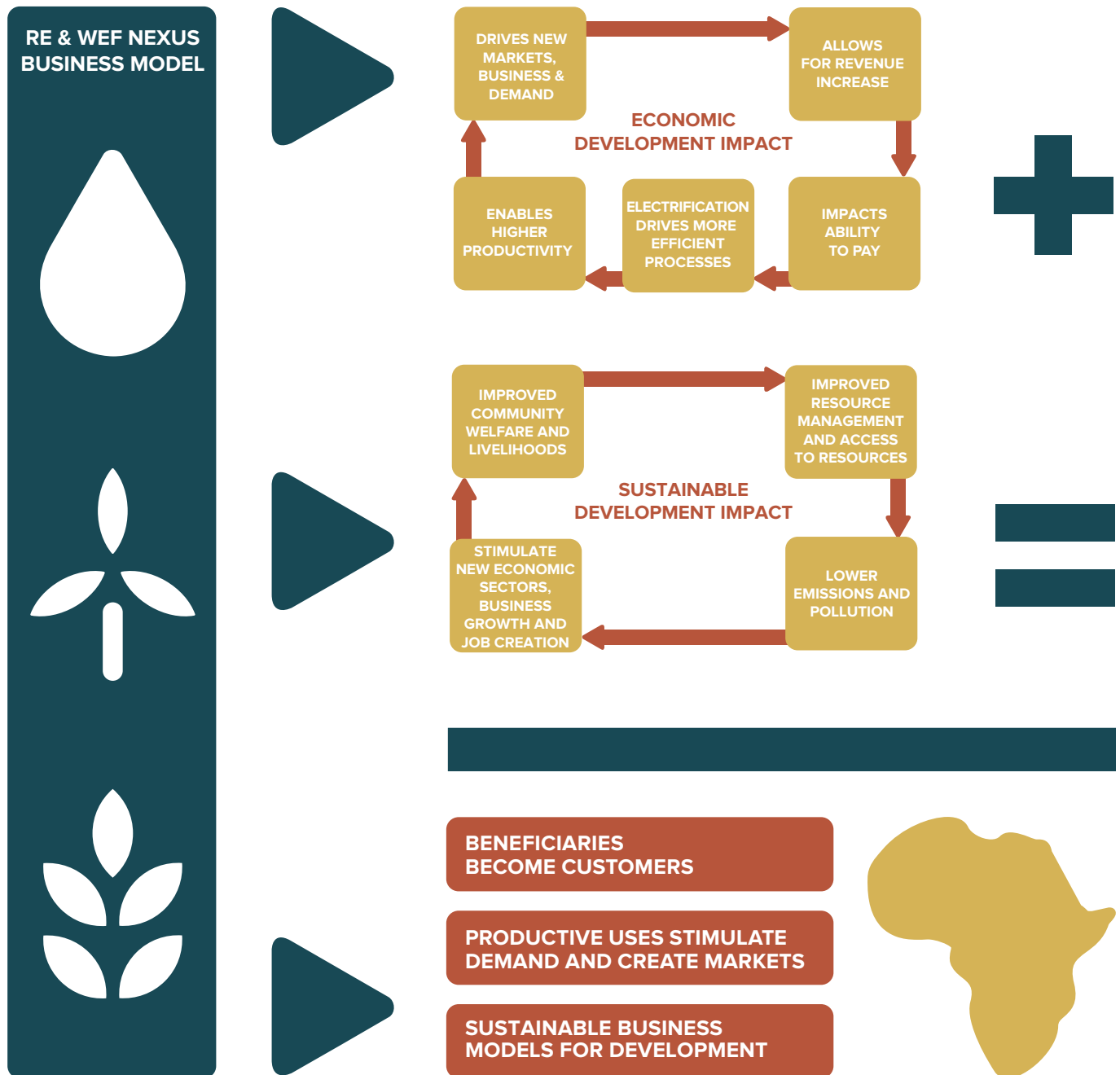
WEF Nexus business models can unlock virtuous cycles for socio-economic growth in Africa. Currently, the lack of access to basic resources and services such as water, energy and food in Africa's urban, peri-urban and rural areas limits income-generating capabilities, thereby reducing

purchasing power, limiting job creation, and keeping overall local economic growth in check. RE-based WEF Nexus business models can turn that limiting cycle around. Cross-sectoral and multi-service approaches that focus on productive uses to support income generating activities enhance business creation and employment opportunities. This in turn boosts local demand for services, thereby creating new markets and strengthening the business case of projects. Simultaneously, thanks to renewable-powered infrastructure, sustainability of value chains is increased, GHG emissions are reduced and resource management is improved. In the end, this not only raises communities' socio-economic welfare but also increases market attractiveness and scalability opportunities for businesses. This results in virtuous cycles of economic and sustainable development for both investors and local communities (see Figure 19).

Figure 19:

VIRTUOUS CYCLES FROM ELECTRIFICATION THROUGH RE-BASED WEF MODELS

Source: RES4Africa Foundation (2019)



WEF Nexus approaches include multiple economic and sustainable development benefits:

- contribute to the expansion of agricultural and agri-food production cycles (for example, farming, poultry and fishing value chains) that create economic added value for countries;
- deliver Africa's unmet energy needs thanks to sustainable, cost-competitive and local renewable energy sources, create customers out of beneficiaries, and catalyze the take-off of new markets while reducing emissions;
- enable new productivity improvements across sectors impacting industrialization;
- enhance resource and operational efficiencies across value chains by optimizing primary resources consumption, minimize waste and reduce imports;
- foster environmental and socio-economic impact, and contribute to achieving progress on the SDGs by 2030.

WEF Nexus approaches can help overcome the limits of electrification strategies in Africa. As argued in part one, access to affordable, reliable and sustainable electricity greatly enhances people's and communities' quality of life. It accelerates local economic growth and enables business creation, improves conditions in education and health services, and supports communities' socio-economic development. Nevertheless, electrification programs in Sub-Saharan Africa, notably in rural areas, have pursued these benefits with limited results. The reliability and affordability of electricity services remains an issue, leading to stagnating levels of power consumption, with limited uptake of appliances by households and Micro and Small-to-Medium Enterprises (MSMEs) and lower socio-economic benefits than expected, especially when compared to other developing regions as South-East Asia or Central and South-America. These moderate results demonstrate how strategies based on providing access to electricity alone are insufficient to drive sustained socio-economic development. Instead, as

the WEF Nexus approach suggests, a complementary and integrated strategy should be pursued based on:

- a comprehensive development strategy that considers accompanying infrastructure needs for access to basic goods and services, access to finance and access to market for transformed and processed final goods;
- the promotion of combined grid and off-grid energy access solutions through a variety of RE technologies; and
- the support and promotion of local economic activities and productive uses.

THE WEF NEXUS IN PRACTICE: MODELS FOR SCALE

The WEF Nexus opens to innovative and scalable business models that can close Africa's energy access gap. It is important to understand how WEF Nexus approaches could be adopted by companies seeking viable investment opportunities in energy access and bottom-of-pyramid market segments. As a niche field, it is clear that the implementation of projects is still being tested around the world and a complementary strategy of multiple approaches will be necessary to achieve scale. From the analysis of different projects currently under implementation in African countries³¹, WEF Nexus approaches are being implemented under two main models:

- **sustainability models** that seek to incrementally integrate WEF Nexus thinking and approaches by embedding them in companies' sustainability efforts related to existing value chains, service offerings and operations;
- **commercial models** that seek to apply the WEF Nexus in a transformational manner as part of ser-

vice offerings, by integrating water, energy and/or food-related services into a new value proposition of goods or services.

While each model carries different characteristics, opportunities, limitations, and ranges for impact, it is possible that investments initiated with the purpose to build corporate sustainability end up demonstrating commercial potential and replicability, and become part of companies' standard portfolio of service offerings. WEF Nexus business models are being tested across countries, which shows how the WEF narrative is gaining attention to the interest of investors and companies. In order to better estimate the characteristics and preliminary benefits among these models, the following pages illustrate them through a high-level overview and a Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis. Relevant case studies are presented to briefly illustrate these models at work and how they relate to each other.

³¹ RES4Africa Foundation (2019).



MODEL 1: SUSTAINABILITY MODEL

Main Characteristics:

This model is linked with responsible business strategies where companies seek to reduce possible negative externalities within their value chains through cross-sectoral interlinkages and communities' activities to identify room for efficiencies and maximize positive spill-over effects.

As a starting point, a company looks at all environmental and social issues related to its operations and value chain that may present risks or opportunity losses. Issues typically regard use of water and energy resources, use of land, CO₂ emissions, impact on local workers' conditions and on local economic activities. By relying on improved technologies, optimized operation procedures and by promoting ancillary services linked to their main business, companies are often able to reduce their impact on resources consumption (for example, water and energy), mitigate GHG emissions, increase health and safety and conditions of workers and local communities, and empower local communities, thereby reducing costs and externalities.

Sustainability-driven models do not directly aim to add new WEF-based revenue streams to a determined investment or project but the implementation of WEF-related activities and services open to cost-saving and efficiency opportunities, thus contributing to business margin increases.

Positive spill-over effects on resource efficiencies and local communities resulting from sustainability-driven action may enlarge the available customer base with positive effects on sales and revenues opening to opportunities to reach scale at an incremental pace.

Different actions taken by companies within this approach are already ascribable to a WEF Nexus integration strategy, for example:

- reducing drinkable water uses and recycling of wastewater;
- building renewable energy-powered water pumps for water supply of project sites and surrounding communities;
- supplying public lights to communities from on-site renewable energy-powered generators.

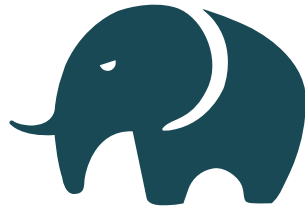
**FIGURE 20:
SWOT ANALYSIS SUSTAINABILITY MODEL**

Source: RES4Africa Foundation (2019)

SWOT Analysis:

STRENGTHS

- Strengthen company sustainability policy and targets
- Improve use of resources (water withdrawals, generation of waste, CO₂ emissions, use of land)
- Allow cost-savings
- Enable consequent increase of margins
- Support company branding
- No relevant risk to the existing business model



WEAKNESSES

- Single-actor approach with limited scope
- Increase of both project Capex and Opex
- No additional revenue streams
- Limited scalability of implemented approaches
- Investment capabilities remain limited
- Require acquisition of new skills and competencies



**SW
OT**



OPPORTUNITIES

- Possibility to access new sources of funding for sustainability improvements
- Allow strategic positioning on sustainability
- Possible increase of customer base
- Favors acceptability from surrounding communities
- Opportunity to test new technologies and business models

THREATS

- Reduction of available budgets for sustainability actions
- Lack of understanding of needs, wants and specifics of local communities
- Lack of long-term impact



CASE STUDY: ENEL GREEN POWER

Organization & case study introduction:

Enel Green Power (EGP) is the Enel Group business line dedicated to the development and management of energy production from all renewable energy technologies across 30 countries worldwide. The Enel Group started its CSV journey in 2014 by integrating social and environmental factors into business processes throughout the entire value chain, making sustainability a fundamental driver for competitiveness. In doing so, it became the world's first utility that publicly committed to achieve carbon neutrality by 2050.

Key points of the case study:

One of EGP's applications of the CSV model is the "Sustainable Construction Site". All EGP plants around the world are sustainable from their inception long before renewable energy flows into the grid. During each construction site, context-specific needs are identified and actions are implemented to mitigate impact on 4 priority areas: Emissions Reduction, Waste Management, Water Savings and People Protection. Starting with the initial phases of a plant's construction, the host land area is analyzed using all technologies available. Data collection is managed from construction to operations allowing to measure the plant's impact and performance. During the construction, management and maintenance phases EGP adopts context-specific solutions to mitigate impact on local communities from the plant's presence. The sustainable construction performance indicators are all based on the 17 SDGs and seek to measure and mitigate emissions, water and waste. EGP seeks to maximize positive economic impact on local communities by training and hiring local workforce and supporting the local supply chain.

Context assessment:

Water quantity and quality is important, especially considering its scarcity in Africa. Local water withdrawals and other environmental risks mean the owner of the plant needs to factor water usage into its construction activities (i.e. cement production, dust abatement, site activities, etc.). EGP seeks to guarantee that the construction site's environmental footprint is minimal by reducing fresh water consumption and avoiding possible water contamination.

Partnership:

EGP prioritizes the definition of strong relations and partnerships with stakeholders including the main contractors in an attempt to merge visions on sustainability, mitigate the construction site's environmental footprint, maximize the positive impact on local communities, and cooperate to make the construction site more sustainable.

Description of solution or application:

An example of a sustainable construction site in Africa applies to a 180 MW wind energy plant in Midelt, Morocco. The Midelt project is part of the 850 MW tender (part of the Integrated Wind Program) launched by the Office National de l'Electricité et de l'Eau Potable (ONEE) and was awarded to the consortium of Nareva Holding, EGP and Siemens Wind Power (SWP). The project supports the government to achieve its goal of increasing the share of RE to 52% of the country's installed capacity. The plant will include 50 wind turbines, guaranteeing an annual average production of 600 GWh and its construction will last about 18 months. The vast majority of the area's rural community works in mining or subsistence farming, with agriculture and livestock farming as the main economic activities. Agriculture in the region remains difficult because of harsh climatic conditions, lack of water resources and fertile land. Considering Midelt's context, water savings have been prioritized. Several actions are implemented to mitigate the impact on water consumption in order to preserve local water availability used by agriculture and pastoral activities:

- implement small dams to recover and reuse rain water;

- install a system to recycle truck washing water;
- perform dust abatement by recycled rain and washing water instead of potable fresh water;
- recycle wastewater via authorized companies to avoid fresh water contamination;
- increase local water availability due to borehole restoration and installation of a solar PV-powered water extraction pumps system.

Action has also been taken on the other priority areas of Emissions Reduction, Waste Management and People Protection:

- reduce CO₂ emissions by using solar PV plant installation to power the construction site;
- maximize waste management through a strategy of waste recycling and reuse;
- local development as local hiring and training, local SME development and inclusion;
- renovation of slopes and creation of new access roads and bridges used also by the community;
- health services on site with ambulance and health workers to enhance people's health and safety aspects.

Value proposition (results and impact):

Sustainable construction sites bring about several positive impacts. At the time of writing the Midelt plant is still under construction so its impact quantification will need to be confirmed but estimates can already be made:

- the “restauration of existing well” activities are expected to benefit local community activities due to the increased availability of potable and cooking water;
- “small dams for rainwater” will recover a considerable quantity of water during the rainy season avoiding consumption of fresh water. During the first construction months 1,635 m³ of rainwater was collected and reused;
- a recycling system for washing water will help recover used water during the washing process of trucks avoiding fresh water consumption;
- as a rule 0% of local potable water is consumed for industrial uses;
- CO₂ emissions will be avoided due to solar PV panel installations to power the camp with a capacity of +30 kW;
- CO₂ emissions are further reduced by an independent lighting system combining a small wind turbine and solar PV panels used in the site's main entrance and at the base camp with storage batteries for nighttime lighting of the site;
- up to 100% of the produced waste will be recycled and reused;
- local value creation with local capacity building, hiring and SME development and inclusion is foreseen. Up to 250 people, half of which from local communities, will be hired for site activities as cementing, transport, cleaning, and site security, while local SME's will benefit from transport, hotels, restaurants, cleaning, etc.

Lessons learned:

The sustainable construction site model is a practical application of CSV that reduces negative impacts on local environments and communities, while maximizing positive impact on value creation. When embedded within the RE value chain, sustainability approaches like these enhance the capability of RE to be a flywheel for local sustainable development. Conceiving the deployment of renewables under a sustainable value-creation model and considering the WEF Nexus permits further unlocking value for local development. The intervention creates shared value at a local level by sensibly decreasing water consumption and other resources, reducing emissions and providing local populations with infrastructure, jobs, training and knowledge transfer. Simultaneously, this approach reduces costs and maximizes competitiveness for the company. EGP prioritizes people and local community development by considering energy as an instrument of sustainable development. That is why EGP considers innovative RE-based productive uses of energy that see sustainable, affordable and reliable energy as a means for food production, processing and water availability.



CASE STUDY: SMART EXTENSION

Background:

Since 2009-2010 Enel Green Power has built renewable power plants in developed and developing countries. Many of these projects that are located in poor and fragile contexts in for example Africa where most of the surrounding population is not grid-connected and consequently have no access to reliable and affordable energy. Thanks to its sustainability vision inspired by the concept of Creating Shared Value (CSV), EGP started to develop activities to reduce the projects' environmental impact during the construction phase and, at the same time, to involve the local communities and create added value for

their economic development and livelihoods. As one of the largest renewable energy producers worldwide, EGP ensures the procurement of vast amounts of reliable and renewable energy around the globe. The power that EGP feeds into grids spans wide distances and reaches cities, industries, ports and airports, enabling millions of people to lead their lives. Yet the communities surrounding EGP plants should be reached, too. A full immersion of the communities' lives and needs made it possible to identify the main elements that contribute in creating positive impact for livelihoods: lighting, education services, health services, water for drinking and irrigation, agriculture products' treatment and food conservation. All these services cannot be provided without reliable and affordable electric power.

Key points of the case study:

The Smart Extension conceptualizes an existing RE plant where an amount of generated energy is spilled out through "a cable pulled" in low voltage to supply the main productive uses of the surrounding communities. Conversely, when it comes to impact on the local community's economy this sudden injection of access to energy could have a positive and disruptive effect. A trigger to business and commercial activities; the possibility to improve education and health; a way to increase agriculture productivity and to reduce food waste; in sum, a "redefinition of productivity in the value chain".

Only a small portion of the energy produced by EGP's plants is needed to deliver a transition from an un-electrified to an electrified community. Thus, the Smart Extension concept presents a win-win process in which the people living close to the power plants, involved in the operation and management, gain a direct benefit from the electricity produced by the plant itself. It's an inclusive business approach in which all stakeholders dialogue and recognize each other as key players of the same ecosystem, sharing the same resources and contributing to a sustainable development.

Value proposition (results and impact):

The Smart Extension is a way to create shared value; managing this electrification transition will enable the development of local clusters of businesses, organizations and institutions, enhancing local productivity and socio-economic development, with an important potential for growth in the communities' including the creation of new businesses, jobs and wellbeing benefits.

Applicability and scalability

The Smart Extension represents a significant opportunity for scale. By tapping into a marginal portion of the energy produced by EGP's plants in order to procure energy to surrounding communities and beneficiaries reveals an opportunity for socio-economic development. In a few years a modular growth of economic activities can generate an increase in energy demand. Those who were, at first, benefitting from energy supply could turn into entrepreneurs

that can suddenly run businesses thanks to sustainable energy. Rural electrification is delivered based on access to affordable, reliable, sustainable and modern energy, while bypassing risks typically related to off-grid development. A financially sustainable electrification process is found based on providing a solution to the main needs of the communities surrounding EGP's plants. Smart Extension can boost the served community's energy provision, creating an energy gap that would require, for example, the extension of the power plant or the installation of a new plant in another location.





MODEL 2: COMMERCIAL MODEL

Main Characteristics:

Within this model the WEF Nexus is adopted by investors as a proper market-based business strategy, defining a new integrated value proposition based on multi-sectoral services and products tailored to customer needs.

Offerings are diversified, increasing the addressable customer base and opening new sources of revenues, as well as the possibility for a company to become a multi-utility actor. In this model, typically energy provision becomes the catalyst of needed productive uses and services within new business offerings and product lines.

Companies are able to share risks among the activities and maximize spill-over effects, while also increasing consumer expenditure capabilities in the medium-to-long term. Local communities are expected to benefit not only from direct access to energy but also from the wider impacts of enabled economic activities and consequent job creation, increased income, improvements in health, education, gender equality, food and water consumption and reduced environmental impact.

This model is more transformational in nature by tapping into new markets and customers to strengthen investment business cases, and may provide a scalable and replicable base for business models to have impact on a larger scale. Within this model energy provision can become the catalyst to enable:

- RE-based agri-business and productive uses such as water pumping and sanitation, cooling, grinding and milling, food processing and transformation;
- RE-based services such as phone charging, irrigation, cold storage, ice production, milk pasteurization, etc.;
- RE-powered cold storage technologies that prevent post-harvesting food waste and reduce food imports;
- RE-based agri-food production cycles (for example, farming, poultry and fishing value chains).

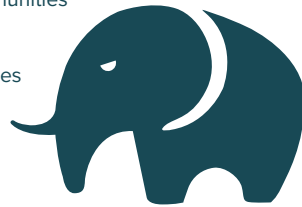
FIGURE 21: SWOT ANALYSIS COMMERCIAL MODEL

Source: RES4Africa Foundation (2019)

SWOT Analysis:

STRENGTHS

- Market-based business model with possibility to scale up
- Integrate and diversify business offerings based on consumer needs
- Increase revenue diversification
- Increase consumer base
- Increase risk-sharing
- Maximize socio-economic impact in target communities
- Improve customers' expenditure capabilities



WEAKNESSES

- Increase in capital expenses for both project Capex and Opex
- Rise in project development and implementation complexity
- Need of new and cross-sectoral competencies for project management and operations



SW
OT



OPPORTUNITIES

- Flexibility to benefit from a multi-services approach
- Opportunity to create partnerships with other players
- Possibility to access new sources of funding dedicated to sustainability
- Favor acceptability from surrounding communities
- Opportunity to test new technologies and business models

THREATS

- Increase in possible competitors
- Risk exposure due to the switch from commodity to service provider business model
- Lack of information and data about market opportunities



CASE STUDY: INSPIRAFARMS

Organization & case study introduction:

InspiraFarms supports growing agribusinesses to be more competitive and sustainable by offering energy-efficient cooling and aggregation spaces to significantly reduce postharvest losses and to cut energy costs, as well as market analytics, asset finance, and remote performance monitoring. InspiraFarms was created to fill the technology and information gap between the point of production and the start of the cold chain (i.e. “First Mile Distribution”). It does this by producing sustainable cold-chain solutions and food-safe spaces for agribusinesses and food distributors. Currently, only 10% of the world’s fresh

produce is refrigerated and usually much less than 5% in developing and emerging markets. This creates billions of kilograms of annual losses, lost income and loss in nutrition in global supply chains. Without cold chains, farmers at the first mile of distribution struggle to aggregate sufficient volumes or reach the quality standards required to access higher value markets, comply with the increasingly strict food safety standards of export markets, and cut energy and logistic cost per unit of product.

Key points of the case study:

InspiraFarms’ technology solution provides a 30-1,200 m² of 2-14 °C, automated, controlled and remotely monitored cold storage and food processing space that can grow modularly up to 2,000 m². Both products can be adapted in size and specific layout to suit needs. The technology ensures compliance with international food-safety standards, making it easier for agribusinesses to leapfrog into higher value markets and chains. It is suitable for both tropical and temperate climate produce and can be fully solar PV-powered. Data services support customers with specific configuration and optimization of their facility, improved performance and undertake predictive maintenance. Asset finance securitized on the technology allows agribusinesses to access the technology with small Capex contributions, allowing the deployment of infrastructure in otherwise challenging cases such as on leased land.

Context assessment:

With the world’s population expected to reach 9.1 billion by 2050, securing growing food demand will require an increase of 70% in food availability. Each year roughly 30% of global food produced for human consumption – approximately 1.3 billion tonnes – is lost or wasted, of which 45-50% is fresh produce (fruits and vegetables). Establishing an unbroken chain of temperature-controlled storage from the point of harvest to the marketplace is required in order to avoid produce spoilage and to connect farmers with higher value market options. Furthermore, considering that the food sector accounts for around 30% of the world’s total energy consumption and around 22% of total GHG emissions, cooling solutions should provide technologies that bring energy efficiency and autonomy, accessible for farmers and agribusiness in developing countries.

Partnership:

InspiraFarms has raised investment from six impact-oriented firms and funds focusing on energy and agriculture. The firm has received support as well from non-profit organizations such as Andrews Charitable Trust, Grand Challenges Canada, DOEN Foundation, in early stage R&D, and by the Shell Foundation for the scale-up of its capabilities and operations.

Description of solution or application:

InspiraFarms deploys its “First Mile Distribution” cooling and aggregation technology in different regions. It currently has over 50 units in operation in Kenya, Rwanda, Guatemala, and over 50 new units under delivery to be installed

and operated this year in Ethiopia, South Africa, Mexico, Colombia and India. During 2018 InspiraFarms reached €1.5 million in sales, with a growing pipeline of over €5 million. Thanks to its partnership and alliances InspiraFarms was able to raise investment as growth capital for the company and for asset finance to its clients. By mid-2018 InspiraFarms raised over €4 million of equity investment from Factor(e) Ventures, Energy Access Ventures, Pymwymic, and the DOEN Foundation, with some investors having participated in more than one round. From 2017 InspiraFarms has raised and been deploying over €3 million of asset finance to finance its customers in accessing “First Mile Distribution” technology. The asset finance solutions are supported and funded by the Montpelier Foundation and SunFunder. In partnership with the Shell Foundation and the InterAmerican Development Bank, InspiraFarms is testing an on-demand model, or pay-as-you-chill service in Mexico.

Value proposition (results and impact):

InspiraFarms is designed to respond to the needs of agribusinesses operating in emerging markets. A modular approach enables customers to grow capacity without having to make risky leaps into large-scale facilities. Solar PV-powered and energy-efficient cold rooms eliminate the use of highly polluting energy sources. Positive changes generated by InspiraFarms over the last 12 months include:

- InspiraFarms clients have reported a reduction of produce losses of 20-40% saving over 3,000,000 kg of food in one year only and 30% of energy;
- asset finance with six-monthly payments, and a variable 2-5 years repayment schedule, allows customers to incrementally shift from Capex to Opex to have strategic infrastructure;
- 60% of InspiraFarms’ clients have integrated solar systems into their cooling operations. This means that so far over 800,000 kWh were generated by InspiraFarms solar systems and used for highly productive loads;
- the use of solar systems and efficient energy consumption has allowed to reduce GHG emissions;
- InspiraFarms’ refrigerated units deployed have generated more than 205 jobs in 12 months, in fresh produce (fruits & vegetables) supply chains;
- about 60% of new jobs created by InspiraFarms are positions taken by women (administrative, processing activities).

Lessons learned:

Asset finance is key to unlock the potential for first mile distribution. Careful due diligence of clients’ business, financial and technical capabilities is crucial to ensure optimal results. Modular design and alignment of technical features and business models enable responding to clients that could only use bespoke solutions before. Data that enables a first point of control along the supply chain allows reducing claims and liability for the clients, and keeping servicing of technology affordable. Alliances with off-takers, logistics partners and investors allow the creation of business models for enabling cold chain in areas where this was previously unfeasible.



CASE STUDY: CEFA ONLUS “THE IKONDO-MATEMBWE INTEGRATED MINI-GRID”

Organization & case study introduction:

CEFA (European Committee for Training and Agriculture) is an Italian NGO specialized in integrated rural development. Founded in 1972 by a group of agricultural cooperatives based in Bologna, CEFA is currently operating in North and East Africa and in Latin America. Active in Tanzania since 1976, CEFA promotes interventions in the fields of Rural Electrification, Water Supply, Sustainable Agriculture, Agro-Processing and Urban Poverty Alleviation. In Tanzania, and

in almost all Sub-Saharan Africa, small and hard-to-reach rural villages are considered as marginal markets and often ignored by energy companies. Where modern energy services are available, potential customers often struggle to afford the connection costs for a mini-grid or to purchase a solar PV system. Thus, the success of a rural electrification programme, especially for a mini-grid, depends on the capacity to develop a conducive surrounding ecosystem and on enabling local rural communities to take full advantage of the energy access opportunities.

Key points of the case study:

The Ikondo-Matembe integrated mini-grid is the result of a development initiative led by CEFA currently serving 8 villages and approximately 1,200 users. It consists of 2 community-scale hydro-powered energy access interventions implemented in rural Tanzania. Besides power supply, the project includes an animal feed factory, a poultry hatchery powered and water supply procured by the energy from the mini-grid plant.

Context assessment:

Increasing demand for electrification and modern energy services are stretching Tanzania's limited energy supply. About 70% of the population lives in the rural areas of the country. Of these, only 16.9% has access to electricity, resulting in an overall national electrification rate lower than 33% and forcing many rural communities to rely on biomass, small solar power systems, diesel generators or other highly polluting fuels, such as kerosene and traditional biomass, for lighting, cooking and heating.

Partnership:

The Ikondo-Matembe integrated mini-grid is owned and managed by the Matembwe Village Company Ltd. (MVC). Founded in 1989 by CEFA and its local partners, MVC was gradually entrusted with all CEFA's rural development activities in Tanzania. The Ikondo Saving and Credit Cooperative Organization (SACCOS) is the leading micro-credit institution operating in the Lupembe Division. Founded in 2011, the Ikondo SACCOS together with MVC and CEFA developed a financial instrument (with longer payback period, lower interest rate and tailored payment scheme) to help local communities meet the connection costs.

Description of solution or application:

The Ikondo-Matembe integrated mini-grid is the result of a development initiative led by CEFA which, with its hydro power plants and more than 60 km of network, is currently serving 8 villages and approximately 1,200 users. Whereas funding came from grants and donations, the project and the MVC have succeeded to manage its activities in an efficient and financially sustainable manner. Initially energy generation was considered only as instrumental to the functioning of the other economic activities of the MVC, which started as an animal feed production facility. Energy distribution was then developed as a social service for the communities of the area and later integrated with water supply systems. After the interconnection of the Ikondo-Matembe mini-grid to the national grid, MVC's energy sec-

tor has become the company's main source of revenue, turning TANESCO, Tanzania's public utility company, into the MVC's main anchor client, and MVC itself into the second client with its animal-feed factory and hatchery. The following are the main development stages of the Ikondo-Matembwe integrated mini-grid:

- Matembwe (1989). Construction of the Matembwe Small Hydro Power Plant (SHPP - 120 kW) which supplies 3 villages: Matembwe, Iyembela and Image;
- MVC Ltd (1989). Establishment of the Matembwe Village Company Ltd;
- Ikondo I (2005). Construction of Ikondo SHPP (83 kW) which supplies Ikondo village;
- Ikondo II (2015). Upgrading of the Ikondo SHPP (80 + 350 kW) and expansion of the mini-grid (50 km of new distribution lines in the villages of Nyave, Ukalawa, Kanikelele and Isoliwaya);
- Ikondo-Matembwe (2016). Interconnection between the Ikondo and Matembwe mini-grids and interconnection with TANESCO's national grid.

Value proposition (results and impact):

MVC is a rural-based multi-utility operating in the sectors of energy and water provision, agro-forestry, animal-feed and livestock production. Focusing on the energy sector, MVC provides reliable and affordable clean energy to 3 groups of local users: households, private enterprises and public service providers. In terms of governance, the model adopted is an indirect community-based enterprise. The shareholders of the company are the Njombe Roman Catholic Diocese, the Village Councils of Matembwe, Iyembela and Ikondo, the Njombe District Council and the association of the workers of the company – all expressions of the local community served by the company. As per statute, MVC has to reinvest 25% of its profits in the realization of social initiatives to be implemented within the territory in which it operates. Results and impact achieved over 30 years of operations include:

- 3 business sectors (animal-feed and livestock production, agro-forestry, electricity generation and distribution);
- 36 employees;
- 540,000 chickens reared per year;
- 210 tons of animal feed produced per year;
- 550 kW of electric capacity installed;
- 1,191 mini-grid's users (938 households, 203 businesses, 50 public service providers).

Lessons learned:

Electrification projects are more likely to secure customers and consumption levels when infrastructure interventions are combined with complementary socio-economic activities, an effective management of the local utility, sustainable tariff schemes and effective partnerships with local financial institutions and communities. In CEFA's experience, common denominators for successful projects are: (i) integrated rural development; (ii) community-based approach; (iii) support to productive uses of electricity; (iv) sensitization campaigns; and (v) multi-stakeholder engagement. Other lessons learned include that community involvement pays off. Not only does it respond to CEFA's mandate as an NGO; it also makes sense from an economic point of view. For example, CEFA never had to pay compensations for rights of way and, whenever damage to infrastructure occurs, communities actively contribute to find out those responsible and, when possible, make sure they pay for the damage caused. Another lesson learned is that rural communities pay, as far as tariffs are reasonable. The real obstacle are connection costs, that can be overcome including the connections in the costs borne by the developer and establishing collaborations with local micro-credit institutions. Last, productive uses of electricity need to be supported and stimulated. If left to the sole initiative of the local communities served, it will not happen or very slowly. Developers need to ensure that supportive measures are in place to foster the process. This can be achieved in many ways, for example by organizing vocational training courses or by partnering with local micro-credit institutions.

THE WEF NEXUS IN PRACTICE:

GAUGING THE POTENTIAL FOR IMPACT

Demonstrating the added value of RE-based WEF Nexus projects is key to make a case for scalability.

How does the integration of water, energy and food services powered by renewable energy increase the Net-Present-Value (NPV) of an investment compared to a single-service project? And how can integrated projects achieve greater socio-economic impact to the benefit of surrounding communities? To answer these questions and identify a path towards scalability, RES4Africa Foundation and OpenEconomics conducted a preliminary impact study³² that sought to quantify and evaluate what positive development impact a RE-based WEF Nexus project can engender in a local community. Econometric assessments are useful for governments to identify and target the areas of intervention with a higher potential for impact, as well as for investors that may rely on such results to advocate for the right level of public support to incentivize these investments. The results allow to make a case for scalability, advocate action to policymakers, and promote sustainable institutional programs and poli-

cies, all to drive Africa's renewable-energy transition. The study included a qualitative and quantitative impact assessment³³ of the benefits and challenges that might arise from an integrated project, based on a micro-economic³⁴ and macro-economic analysis. The analysis looks at the hydro-powered mini-grid "Ikondo-Matembwe" project in rural Tanzania serving an agri-business company as anchor client that includes an animal-feed factory and a poultry hatcher, as well as distributing electricity and water to surrounding households.

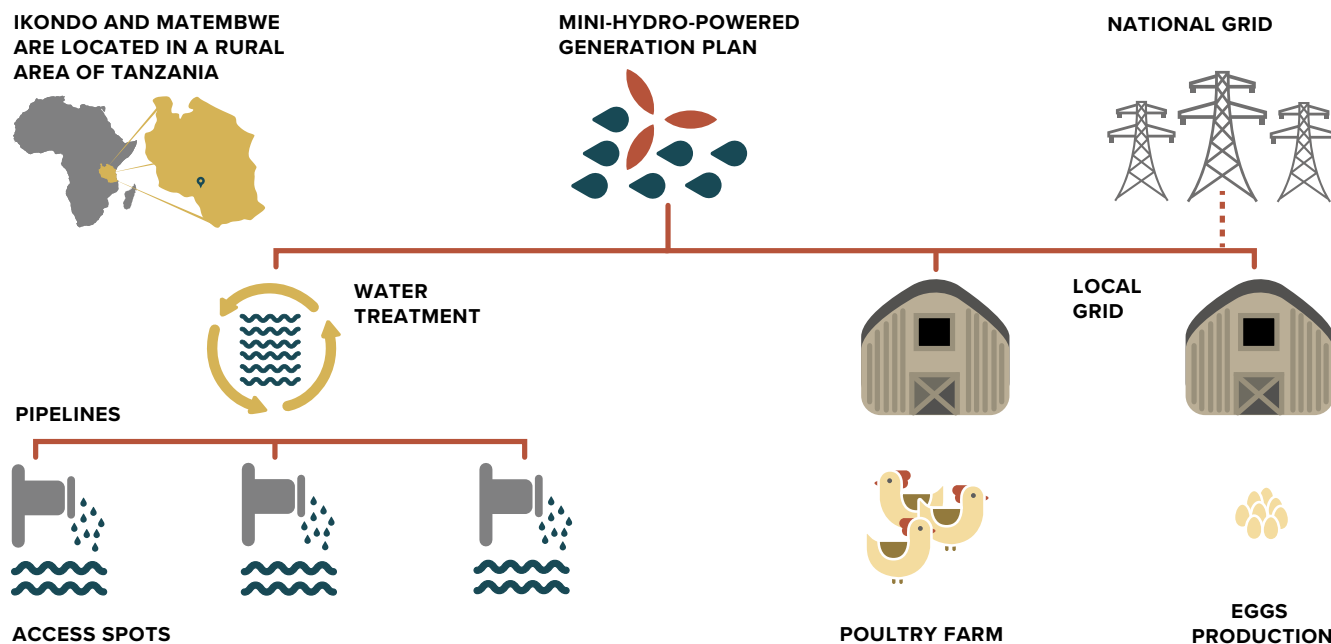
In this case, a cost-benefit analysis was based on the project's investment data³⁵ to assess what direct, indirect and induced impact the surrounding community could experience from the implementation of a single or integrated services model. Benefits in single and multi-service scenarios were identified and compared, against various scenarios: single-service (Energy-only), and integrated (Water, Energy, Food; Energy-Food; and Energy-Water scenarios). Each scenario was then com-

Figure 22:

THE IKONDO-MATEMBWE PROJECT STRUCTURE

Source: OpenEconomics (2019)

A CASE STUDY APPLICATION OF THE WEF TRANSFORMATION APPROACH



pared in terms of Economic Net-Present-Value (ENPV), Economic Internal Rate of Return (EIRR) and Cost-Benefits Ratio (CBR), to highlight their level of attractiveness in the eyes of business investors as well as beneficiaries.

The modelling exercise confirms that an integrated multi-service business approach achieves impact that is larger than the sum of its parts. The analysis results show that integrated WEF Nexus project models bring about greater development impact on local communities than single-sector approaches. In terms of economic impact, the modelling exercise confirm the role of affordable, reliable and sustainable energy supply as a key enabler of socio-economic development for local communities and as an engine of the dynamic mecha-

nism that powers up the supply of other basic services, as water access, and increased productivity of the agri-food businesses. The study also revealed micro-economic results across impact areas including favorable benefits for local communities.

³² Scandizzo, P. Calvosa, G. Ferrarese, C. Nardone, R. Cufari, D. Denaro, R. (2019), The Water Energy-Food Projects in Africa. Applying the WEF Nexus approach to catalyse transformational change, OpenEconomics.

³³ The OpenEconomics study looks at the impacts from a selected water-energy-food project. Its methodology applied a combination of an Economic Cost-Benefit Analysis (CBA) model, a Computable General Equilibrium model, and a Social Accounting matrix, and determined three types of economic impacts (direct, indirect and induced) - OpenEconomics (2019).

³⁴ Within the micro-economic impact assessment, a Cost-Benefit Analysis (CBA) divided into a Financial (FCBA) and Economic (ECBA) analysis was used; within the macro-economic impact assessment, a scale-up of the business model has been assessed to estimate the potential contributions of the project's development at a regional level - OpenEconomics (2019).

³⁵ The model was run on the CEFA case-study as highlighted on pp. 78-79. The case-study used Capex and Opex data assembled across 30 years of the mini-grid.

TABLE 1:

MICRO-ECONOMIC DEVELOPMENT BENEFITS FROM THE IKONDO-MATEMBWE PROJECT³⁷

ACCESS TO EDUCATION:

Improvement in the quality of school facilities, more time for study, more teachers appealed to teach, higher teaching quality, students stay in school longer, and higher future income.

HEALTH IMPROVEMENTS:

Improved sanitary facilities, enhanced family health, better indoor air quality, greater health knowledge and nutrition information, improved health knowledge by women and contraceptive usage.

IMPROVED PRODUCTIVITY:

Rural electrification provides better means of working and can boost productivity of small businesses in the target area. When electricity is available from RE resources production costs are lower and the service is more efficient, raising profits for businesses in the area.

COST SAVINGS:

A shift from fossil fuel-powered energy to RE sources leads to a cost saving due to improvement in energy efficiency.

AVOIDED TIME LOSS:

Improved access to water and sanitation can help populations in developing a better time-efficient daily life. One of the benefits linked to water and sanitation activities is time savings.

REDUCED EMISSIONS:

A shift from conventional fossil fuel sources to clean energy allows a consistent reduction of climate-change causing CO₂ emissions.

IMPROVED ACCESS TO FOOD:

Improved farmers income from crop production benefits, as well as from poultry and egg production.

IMPROVED ACCESS TO WATER:

Assuming that water collection is a daily activity with at least two trips per day, a household on average devotes more than eight hours per week to collecting water in Tanzania, for urban and rural areas alike. Especially women must travel long distances to retrieve water for domestic use diverting valuable time from productive activities. Improved access to water also brings health benefits, better time use, and the opportunity cost of absenteeism. Efforts to improve water, sanitation and hygiene interact with each other to boost overall health benefits. Access to sanitation, such as simple latrines in communities, prevents drinking water contamination from human waste and reduces infections.

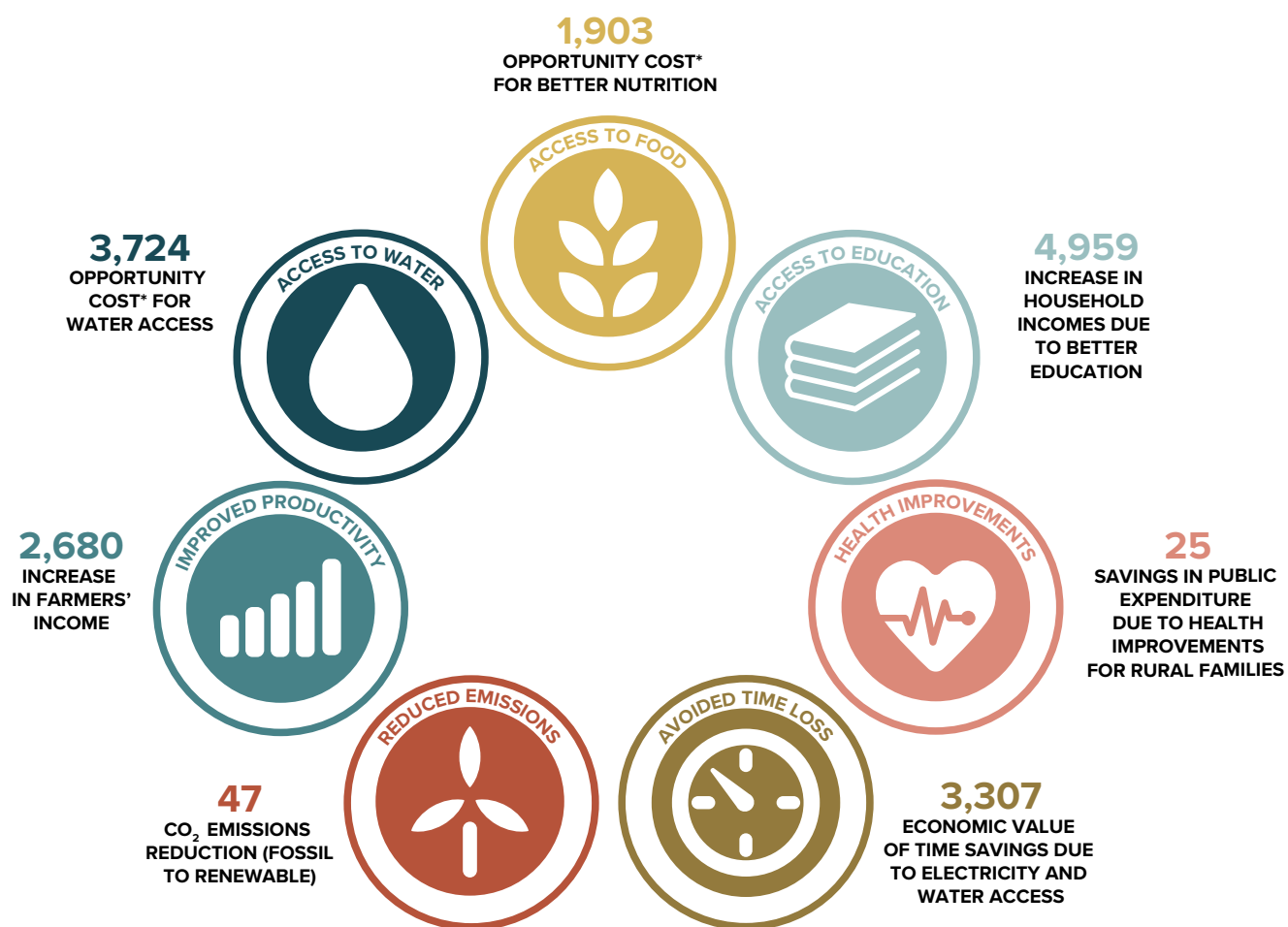
³⁷ Scandizzo, P. Calvosa, G. Ferrarese, C. Nardone, R. Cufari, D. Denaro, R. (2019), The Water-Energy-Food Projects in Africa. Applying the WEF Nexus approach to catalyse transformational change. OpenEconomics, p. 6.

Figure 23:

ECONOMIC BENEFITS OF THE IKONDO-MATEMBWE PROJECT

Source: OpenEconomics (2019)

ESTIMATION OF BENEFITS FROM AN INTEGRATED WEF NEXUS BUSINESS MODEL ECONOMIC VALUE EXPRESSED IN ,000 USD IN PRESENT VALUE FOR 20 YEARS PROJECT LIFESPAN



*OPPORTUNITY COST IS THE BENEFIT THAT IS MISSED OR GIVEN UP DUE TO DIFFERENT CONTINGENT SCENARIOS. ACCORDING TO UN STANDARDS, IT IS CALCULATED AS THE MISSED INCOME VALUE

Figure 24:

HEALTH BENEFITS CYCLE FROM RURAL ELECTRIFICATION

Source: OpenEconomics (2019)

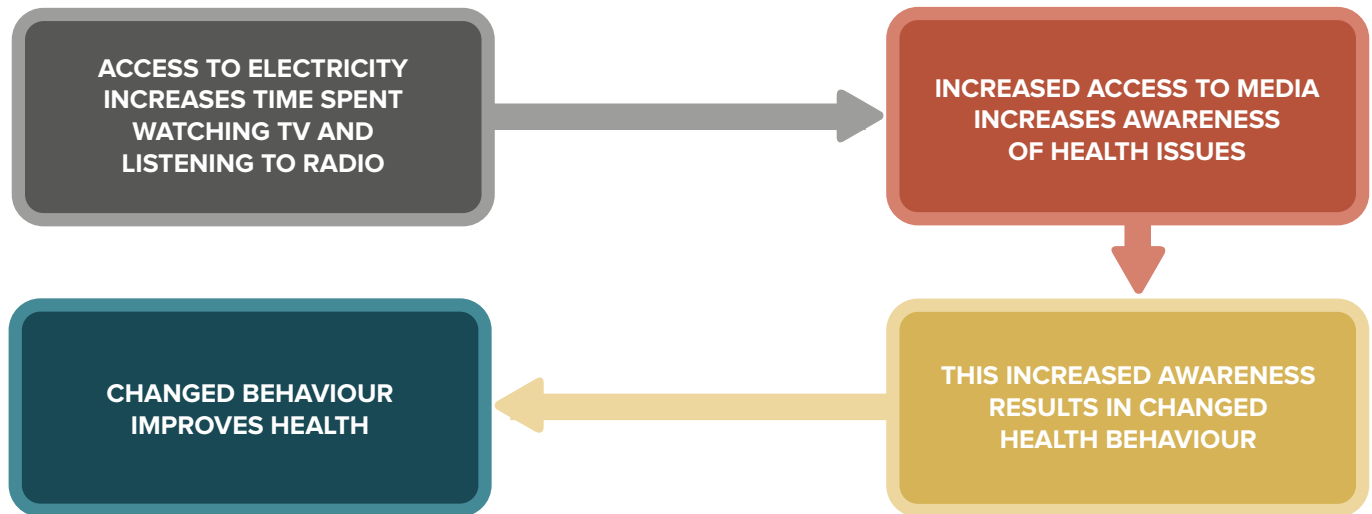


Figure 25:

TIME USE BENEFITS FROM RURAL ELECTRIFICATION

Sources: OpenEconomics (2019)



GREATER PARTICIPATION IN COMMUNITY ACTIVITIES



INCREASE TIME SPENT READING



REDUCE TIME SPENT ON HOUSEHOLD WORK OR SHIFT IT TO THE EVENING



INCREASE TIME DOING HOMEWORK



INCREASE EXTENDING HOURS OF HOUSEHOLD BUSINESS

As a result, the model shows that the economic NPV of the fully integrated approach is double that of a single-energy scenario³⁸. Moreover, results show that investing in all three water, energy and food components renders better results in terms of direct, indirect and induced benefits. This is mainly because the multiplier effects of the WEF Nexus integrated project

significantly increases the purchasing power for targeted stakeholders compared to all other single-service approaches with consequent positive effects in other socio-economic areas.

³⁸ The ENPV of the integrated business model scenario was double that of the ENPV containing an energy-only component. The EIRR was even 6% higher comparatively.

BOX 5

WHERE ARE THE WOMEN AT THE NEXUS OF WATER, ENERGY AND FOOD IN AFRICA?

Africa is indeed rising. Its social and economic transformation is progressing rapidly as the world strategically positions and repositions itself to keep pace with the 'waking lion'. Africa's population is also growing rapidly, with multiplying demand for water, food and energy. To keep up with these rapid changes, Africa will need to innovate swiftly and adopt sustainable models to ensure that no one is left behind, especially the most vulnerable in its communities. Policies and models must strategically integrate the roles of women in the Water, Food and Energy Nexus to ensure shared growth and prosperity.

For too long, African women, especially many in Sub-Saharan Africa, have been disproportionately affected when communities lack basic life-sustaining resources. In many cases, it is women who bear the burden for providing water, food and energy (especially thermal energy for cooking and home space heating). Despite considerable progress made in the last few decades, women in Africa are still 'beasts of burden'. For instance, when communities lack easy and reliable access to clean water, women and children (rarely men) walk long distances to access this vital resource. The picture is similar when it comes to providing cooked food for the household, beginning with agricultural production, where women often bear the primary responsibility of growing food, toiling many hours as small-holder farmers, using rudimentary tools. Many of us are inured to pictures of rural women walking several kilometers carrying



heavy loads of woodfuel on their heads and backs. When they arrive home exhausted, they endure the drudgery of spending hours lighting the fire and cooking in a smoky, toxic kitchen. Urban and peri-urban women are not exempt from this drudgery or unhealthy environment, as the lack of affordable, accessible, safe, and clean fuel, forces them to rely on charcoal and kerosene as their primary or secondary fuel. Sadly, according to the WHO, indoor house pollution caused by cooking with these dirty fuels is responsible for over 4 million deaths globally each year with Africa representing over 860 million people (70% of Africa's population) of those impacted. Moreover, woodfuels especially charcoal are key drivers of deforestation, with its consequent impact on food security and water. Furthermore, black carbon produced by these fuels is a major contributor to greenhouse gases, which impact climate change.

Renewable energy is promising as it plays an increasingly central role in powering Africa's growth. However, it is disheartening that many prominent energy access initiatives only consider electrification. At the household level, energy requirements are two-fold, involving both lighting and heating. Due to its high cost, electricity is rarely a heating solution, especially for cooking. It is not enough to only provide electricity for lighting and charging cellphones. To be effective, energy access models and policies must also consider clean, safe, efficient and affordable cooking and space-heating solutions. This will ensure that women are provided with a chance to participate fully in delivering on Africa's promise of economic growth.



Author: Linda Davis, Ph. D., CEO Giraffe Bioenergy



RE-powered WEF Nexus approaches offer businesses new avenues to explore how to expand energy access markets and help bottom-of-the-pyramid consumers access basic services. The modelling results allow to state that WEF-integrated investments result in better performances in terms of economic results for both operating companies, maximizing NPV, economic IRR and Benefit/Cost ratio of the investment, as well as support local communities with high results in terms of socio-economic impact. With an extra investment effort in order to enable also the water and food components, compared to an investment focused only on energy-related projects, it is possible to boost local population

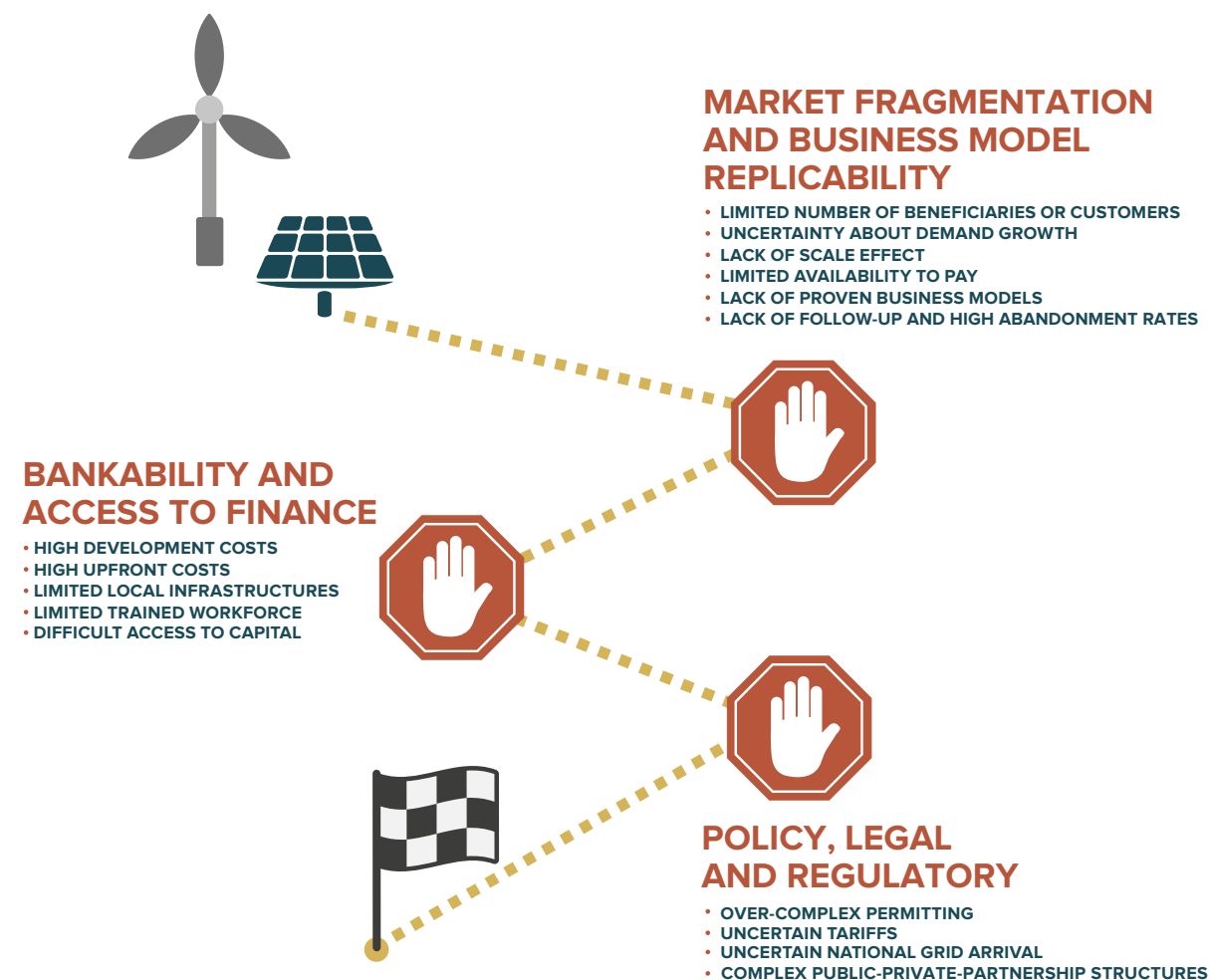
quality of life by achieving significant results in food security, health, productivity increment, and poverty reduction. But to reach scale and transform this market in a financially viable, adequately profitable and attractive for commercial actors, some barriers still need to be overcome:

- **the lack of sound cross-sectoral policy and regulations;**
- **a high-risk investment environment and lack of bankability and competitive financing;**

Figure 26:

MAIN BARRIERS TO ENERGY ACCESS INVESTMENTS IN AFRICA

Source: RES4Africa Foundation (2019)



- **market fragmentation and high customer acquisition costs, impeding scale-up and replicability of business models.**

Scaling up WEF Nexus approaches will be best achieved through innovative partnerships. The economic benefits of integrated WEF projects and the potential development impact make a case for scaling up projects at regional and national level to maximize

impact. RES4Africa Foundation aims to identify strategies to overcome current barriers and unleash opportunities to scale up for business actors and investors. Particularly innovative cross-sectoral partnerships offer a possible solution to facilitate integrated investments for the roll-out of such projects and to create more shared value. The next part will present a call for action and propose recommendations to make the WEF Nexus go mainstream.

VISIONARY STATEMENT

DEVELOPING AFRICA FOR THE NEXT HORIZON OF GROWTH

AKINWUMI ADESINA, **PRESIDENT**, AFRICAN DEVELOPMENT BANK



I'm excited that, this year, growth has picked up – to 4.1%, we project. But the topic really on my mind is, yes, I like that, but it still seems to me like survival growth. The kind of growth I want is prosperity growth. And prosperity growth really means that we must be growing in Africa at double digits. That's what we need to be able to draw millions and millions of people out of poverty.

CHALLENGES IN AFRICA'S GROWTH STORY

When I look at Africa's growth and economic picture, one concern that I have is the nature of the growth process – that it's not been able to create a lot of jobs.

We have a lot of joblessness on the continent. A third of Africa's youth is unemployed. Another third is underemployed and unhappy. If you have a lot of young people who are unhappy, that's going to create or worsen political, economic, and social fragility.

The second one that I think is very important is the link that I see between this joblessness and terrorism. I see in Africa what I call a "disaster triangle" that feeds this. Anywhere you have these three factors, you have terrorists operating. First is a high level of rural unemployment. Second is extreme poverty, especially in rural areas. Third is areas where you have high levels of climate and environmental devaluation.

As we look at Africa's growth story, we have to make sure that these underbelly things are addressed: [creating] jobs for Africa's youth; making sure we deal with rural poverty, because there's quite a lot; and also making sure that we allow African economies to be more resilient and therefore able to adapt to climate change that is impacting the continent.

AGRICULTURAL DEVELOPMENT

Africa today has a huge opportunity. By 2030, the size of the food and agriculture industry is going to be worth over \$1 trillion. This is going to be the new wealth for Africa.

I want to get young people into agriculture as a business, because agriculture is the biggest money-making market globally. Nobody drinks oil. Nobody smokes gas, right? But everybody eats food. And you've got a population of 1.2 billion people you have to feed.

The continent is spending \$35 billion a year importing food. If you don't change that, it's going to grow to \$110 billion by [2025]. It has a real implication for how we maintain macroeconomic stability of Africa. The best way is [that] Africa should produce what it eats, and Africa should add value to what it produces.

ENERGY INCLUSION

When I became president of the bank, I couldn't think of anything more important: one of my first five priorities is just to give universal access to electricity in Africa. We're in the 21st century, for crying out loud. The African Development Bank is putting \$12 billion of our money into the power sector over the next five years. We're going to leverage \$45 billion to \$50 billion to drive universal access to electricity in Africa.

If you take a look at it today, the numbers aren't encouraging, because 645 million don't have access to electricity. I want to make sure that we get all that done within 10 years. Now, we've already started massively. Last year at the bank, we supported over [3.8 million] people having access to electricity. And in the next two years, we expect to raise that to 29 million people.

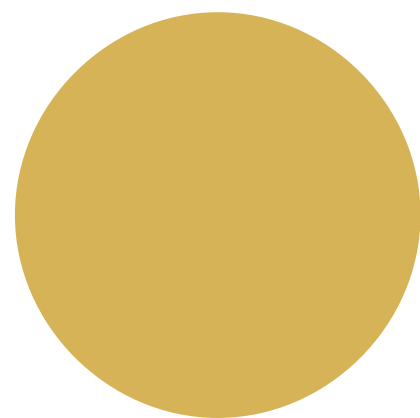
INFRASTRUCTURE

Africa's infrastructure gap is still a lot: about \$68 billion to \$108 billion a year. But I believe that the money can be found in Africa. That's why I launched the Africa Investment Forum. It's going to be Africa's largest-ever investment platform. We're trying to leverage global pension funds, sovereign wealth funds, and institutional investors into Africa – into power, into water, into sanitation, into urban infrastructure – to support the momentous growth that Africa needs to be able to drive millions of people out of poverty.


If we get infrastructure right, if we get energy right, and if we create a lot of jobs for Africa's youthful population, I think we'll have a new dynamism, a new growth process. Not just in GDP, because people don't eat GDP. But one that's actually impacting the lives of people and can lift hundreds of millions of people out of poverty.

**P
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**AFRICA'S
FUTURE
COUNTS:**



A CALL FOR ACTION



**HOW CAN WE
TURN THE WEF
NEXUS INTO
REALITY**

INTRODUCTION

Partnerships and cooperation are key to turn priority into action. For Africa to achieve sustainable economic growth and universal access to energy, electricity has to be closely linked to economic and productive activities. This can transform rural, urban and peri-urban economies, power value chains, create jobs, cut down emissions and food waste, reduce poverty and generate wealth at the local, national and regional level. RES4Africa Foundation calls on actors to scale up WEF-Nexus investments through innovative and result-oriented collaboration. Effective partnerships across sectors, industries and institutions working on water, energy and food can go a long way to reach replicability and scalability of WEF Nexus investments in Africa.

GOING FORWARD

As reflected in the previous chapter of this book it is useful to highlight a few key messages:

- water, energy and food are the building blocks of development and essential for human wellbeing, poverty reduction and sustainable development in Africa. Indeed, Africa's future counts on ensuring sustainable, reliable and affordable access to water, energy and food resources, with a tremendous role therein for renewables;
- electricity plays a truly transformative role when it empowers sustainable economic development by supporting productive uses of energy in high-potential economic sectors in African countries, such as in the water and agri-business sectors;
- a paradigm shift towards business models based on an integrated Water-Energy-Food Nexus approach can unlock virtuous cycles for sustainable socio-economic development in Africa and unleash new opportunities for growth that can contribute to achieving the SDGs in Africa by 2030;
- renewables are suitable power generation technologies to provide energy access solutions within the WEF Nexus approach. In addition to new generation capacity and grid extension, renewable energy-based WEF Nexus approaches can help close Africa's energy access gap, foster local demand growth, open new market possibilities, and encourage private sector to invest in African markets;
- investing in integrated water, energy and food projects bring greater development impact for local communities than single-sector energy-only business models by boosting local population's quality of life, improving food security and access to health and education, increasing productivity, and reducing poverty;
- the multiplier effects of the integrated WEF Nexus approach significantly increase the purchasing power for targeted beneficiaries compared to all other single-service approaches with consequent positive effects in other socio-economic areas;
- companies play a central role in addressing social needs and creating shared value for society. The WEF Nexus can provide business opportunities for private sector and development opportunities for local communities;
- concrete applications are starting to emerge and the WEF Nexus narrative is spreading. However, more efforts are needed to bridge the current disconnect across sectors and actors, mobilize finance, foster knowledge and best practices exchange, and mainstream the WEF Nexus approach.

To exploit these opportunities and accelerate progress on achieving the SDGs in Africa by 2030, action is needed: inclusive collaboration and cross-sectoral partnerships can offer the possibility to bring WEF Nexus business models towards scalability and replicability.

CALL FOR ACTION:

SCALING UP THE WATER-ENERGY-FOOD NEXUS THROUGH PARTNERSHIPS

RES4Africa Foundation calls on energy actors to explore and engage in innovative cross-sectoral partnerships to scale up WEF Nexus investments in Africa. Result-oriented collaboration is needed to enable WEF-induced virtuous development cycles. The partnership model to make that happen would be composed of investors within the energy access, water and agri-food industries joining forces and capital to invest in integrated projects and define successful business models that address access to basic needs. Partnership structures would involve a constellation of stakeholders, from governments, private sector and not-for-profits to international development organizations and financial institutions who will each play a key role in building up a supportive ecosystem for WEF Nexus investments. Cross-sectoral dialogue among all actors involved is needed to identify and act on synergies, as well as contribute with best skills and experience. Policy-makers and investors should work in

tandem on the design and implementation of projects and initiatives that interconnect approaches, objectives, programs and business models to achieve greater impact. Sharing of financial and technical capabilities and knowledge will be key to maximize respective skills and track records, share risks and enhance efficiency.

The partnership proposal is based on complementarity of objectives, know-how, and comparative advantages of all actors involved. WEF-Nexus partnerships should seek to gather those stakeholders that are active in the field and have complementary objectives, but that may not yet engage fully with one another. All actors should have an interest in cooperating to strengthen their presence and operations in African markets, and to achieve the potential socio-economic spillover effects in local communities and national economies. There are multiple benefits from partnering on WEF Nexus projects:

- share Capex: sharing investment capital reduces the high up-front costs of infrastructure sectors and reduces market-entry costs for public and private investors;
- reduce Opex: combining management and operation capacities according to each actor's ability allows for economies of scale and increases efficiencies, ensuring optimal allocation of resources;
- de-risking investments: shared Capex and reduced Opex minimize the risk exposure of investors in financially risky environments;
- maximize margins: higher profitability is achieved when the risk of sunk costs or stranded assets are minimized;
- share market information and best practices: market and business knowledge sharing help to define targeted value propositions and reduce customer acquisition costs;
- increase scalability and profitability: all above points improve the profitability of business cases, thereby opening the path to their scalability and replicability engendering further opportunities for economies of scale;
- enhance influential power and possibility for impact: WEF Nexus partnerships allow for more straightforward advocacy efforts.

Figure 27 shows how such a partnership could work looking both at the investor and ecosystem level, as well as at the concrete application of an integrated WEF business model.

TABLE 2:

PARTNERSHIP MODEL AND KEY STAKEHOLDERS

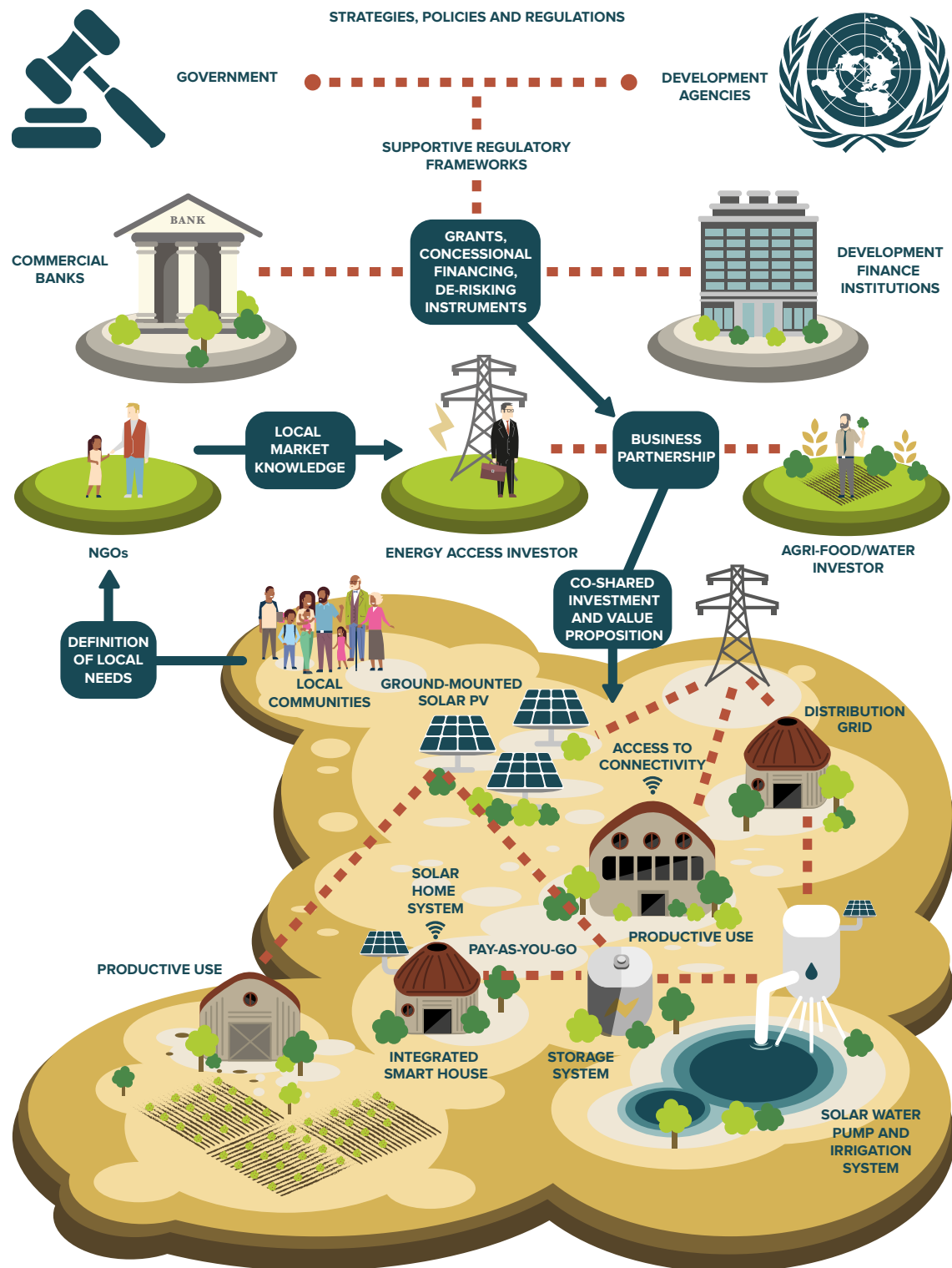
ACTOR	MOTIVATIONS AND CONTRIBUTIONS TO THE WEF APPROACH
Energy actors and investors:	<p>Motivation:</p> <ul style="list-style-type: none"> • seek viable business and investment opportunities as well as market entry points or “anchor clients”³⁹ that provide stable and reliable energy demand to ensure financial sustainability and investment returns; • stimulate the growth of energy markets based on reliable local power demand and diversify client portfolios in Africa; • seek strategies to reduce their carbon footprints, increase their sustainability and social impact. <p>Contribution:</p> <ul style="list-style-type: none"> • assess energy needs, commit resources, technologies and funding, and implement energy projects or services.
Agriculture, water, and agri-business investors:	<p>Motivation:</p> <ul style="list-style-type: none"> • increase productivity and provide stable supply of water, food and agriculture goods and services to local, national and international markets; • secure affordable and reliable energy supply to increase their productivity and expand their operations; • seek strategies to reduce their carbon footprints, increase their sustainability and social impact. <p>Contribution:</p> <ul style="list-style-type: none"> • produce, transform and sell water or agri-food products and services, commit resources, technologies and funding to implement water or agribusiness projects or services and expand its business.
Government:	<p>Motivation:</p> <ul style="list-style-type: none"> • define national development objectives, conduct strategic planning, monitor and evaluate policy implementations, all to engender inclusive economic growth, positive socio-economic and environmental development impact for communities; • maximize impact in terms of economic growth, job creation, health, education. <p>Contribution:</p> <ul style="list-style-type: none"> • define and implement conducive policies and regulations able to reach development objectives.
Development agencies:	<p>Motivation:</p> <ul style="list-style-type: none"> • support governments in designing and implementing sustainable development strategies to achieve development objectives; • provide technical and financial assistance, international know-how and best practices. <p>Contribution:</p> <ul style="list-style-type: none"> • support governments with creating and implementing innovative WEF approaches in collaboration with the private sector.
Development banks (DFIs, IFIs):	<p>Motivation:</p> <ul style="list-style-type: none"> • support high-impact development and infrastructure projects with a potential to reach scale. <p>Contribution:</p> <ul style="list-style-type: none"> • design and implement appropriate development-financing and de-risking instruments that support the implementation at scale of WEF-related programs and projects.
Local and international commercial banks:	<p>Motivation:</p> <ul style="list-style-type: none"> • support the development of new profitable markets with opportunities to reach scale; • support business model replicability and scalability and leverage available market capital. <p>Contribution:</p> <ul style="list-style-type: none"> • achieve greater bankability of projects by creating commercially viable financial instruments for WEF-related projects.
NGOs:	<p>Motivation:</p> <ul style="list-style-type: none"> • partner on the implementation of projects seeking socio-economic impact for local communities and beneficiaries. <p>Contribution:</p> <ul style="list-style-type: none"> • support creation of local capacities and support local communities’ engagement and empowerment.
Local community:	<p>Motivation:</p> <ul style="list-style-type: none"> • identify local needs regarding sustainable, reliable and affordable access to basic water, energy and food services. <p>Contribution:</p> <ul style="list-style-type: none"> • participate in and define decision-making processes in local development initiatives and projects opportunities.

³⁹ “Anchor clients” have a base load demand for energy or agriculture such as telecommunication infrastructure (tower base stations), agriculture (water pumping), mining and metals (extraction, operations), fast moving consumer goods (cooling), food industry (processing, cooling), or local small and medium-sized enterprises (productive uses).

Figure 27:

WEF NEXUS PARTNERSHIP MODEL

Source: RES4Africa Foundation (2019)



RECOMMENDATIONS FOR ACTION

Concrete recommendations for action can be made to turn the opportunities of the WEF approach into reality.

RECOMMENDATION 1: Break the silo mentality and embrace a Water-Energy-Food Nexus strategy

The WEF Nexus needs to gain momentum and become strongly anchored into the development and energy access business agenda as a strategy for impact. More efforts are needed to bridge a disconnect among sectors and actors as well as within their strategies and operations. WEF Nexus thinking should be considered and adopted by all actors according to their means, capacity, mandate and expertise, including through the following actions:

- endorse the WEF Nexus as a strategy to achieve sustainable access to basic water, energy and food services supporting socio-economic development;
- mainstream WEF Nexus thinking into international and national policy-making and planning processes;

- involve private sector actors in strategic dialogue and policy-making processes to acknowledge their fundamental role in closing access gaps to basic services;
- create dedicated cooperation platforms and forums at international and national level to enable institutional coordination and sharing of strategies and experiences.

RECOMMENDATION 2: Walk the Water-Energy-Food Nexus talk and facilitate financing

The mainstreaming of WEF Nexus approaches needs to be complemented with adequate and dedicated financing schemes for implementation and scale-up. For example, agri-food and water sector actors mobilize annually large resources and funds for projects, yet renewable energy supply is still not recognized as a component for operations, while renewable energy investors lack access to those financing sources.

The cross-sectoral interlinkages between water, energy and food sectors need to be recognized and addressed in financing programs and support instruments.

Concrete recommendations include:

- keep the investment mandates of concessional financing providers as broad as possible to direct financial resources towards initiatives and projects presenting the highest impact opportunities;
- define appropriate financial instruments for WEF Nexus projects and match them with the needs of investors and companies by considering long-term debt needs and equity contributions to support both business' start-ups and growth;
- explore the creation of dedicated WEF Nexus financing windows within existing development assistance instruments and programs, including the provision of technical assistance support to countries.

RECOMMENDATION 3: Build an inclusive and supportive Water-Energy-Food Nexus business environment

Supportive policy and regulatory frameworks are fundamental to attract investment and support project implementation. National governments supported by international organizations must ensure that private actors can operate within reliable and enabling business environments in order for WEF Nexus approaches to take root. Areas for improvement include:

- ensure continuous political support to accompany and establish WEF-Nexus friendly legislative and regulatory frameworks;
- avoid give-away programs to achieve unrealistic promises and focus on achievable targets based on real demand-side needs and supply-side capabilities;
- untap business innovation potential by removing discriminatory rules and regulations, such as distortive subsidies as well as duties and taxes;
- simplify bureaucracy, licensing and permitting procedures to speed up project implementation and

reduce administrative burdens on private actors;

- guarantee necessary long-term stability and predictability of policies and regulations to acquire business actors' trust and consolidate their willingness to invest.

RECOMMENDATION 4: Dedicate efforts to capacity building on the Water-Energy-Food Nexus

Capacity building is a fundamental piece of any successful development strategy. The WEF Nexus should be integrated into training programs in order to raise awareness and anchor Nexus thinking into future development strategies. Actors engaged in capacity building programs should consider the WEF Nexus in ongoing capacity building strategies for advancing energy access and sustainable socio-economic development in Africa. Other recommendations are:

- support capacity building activities for public actors in order to enhance program implementation and monitoring capacities by international and national civil servants;
- build a next generation of professional WEF Nexus managers with the creation of dedicated university trainings, professional formations and other education activities;
- support private initiatives and private enterprise development by angel-investor programs, dedicated WEF Nexus incubators, R&D support and dedicated business events.

RECOMMENDATION 5: Fill the Water-Energy-Food Nexus information gap

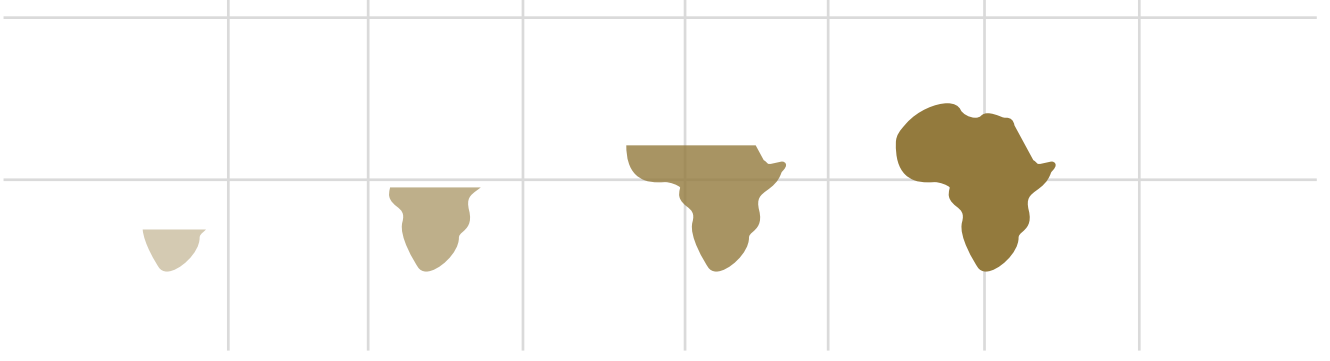
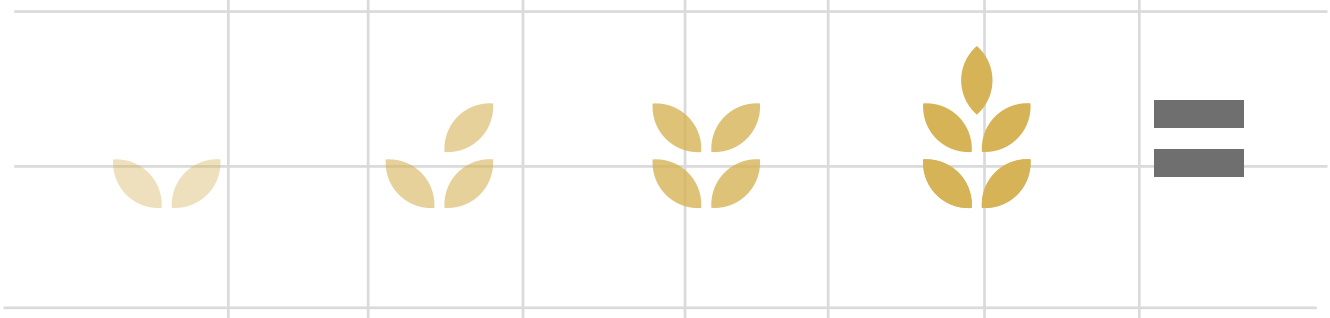
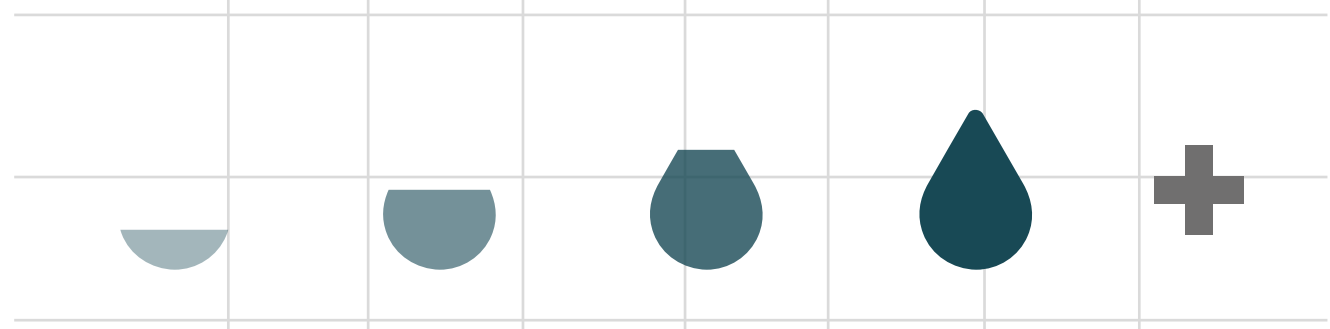
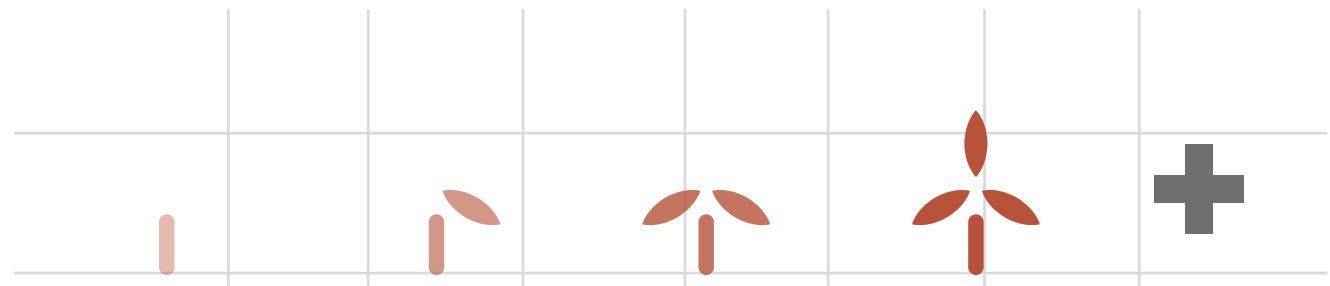
Important information gaps still impede further development and implementation of WEF Nexus business models. Scaling WEF Nexus business models requires access to reliable market and customer information as well as case studies and best practices for learning. This experience-based knowledge is key to serve as examples and support the refinement of business

models. More specifically, it is necessary to:

- improve data availability and accessibility in order to allow private actors to understand local market needs and expectations and improve business planning accordingly;
- identify success stories and share knowledge and experiences to adapt operating rules and procedures to their successful factors;
- foster multi-stakeholder dialogues and knowledge platforms, able to include a diversity perspective to ensure that benefits are reaching concrete expectations and needs of local beneficiaries including women and youth.

RECOMMENDATION 6: Innovate business models by exploring partnership potentials

The WEF Nexus presents actors with an opportunity to think and act outside the box to achieve significant progress on Africa's energy and economic development needs. The UN 2030 Agenda and its SDGs reflect the international community's commitment to consider the interlinkages within Africa's most important development challenges. WEF Nexus projects adopt this interlinkages approach by proposing new infrastructure solutions based on integrated service offerings to deliver access to basic services, rather than separate single-service models. Hence, thinking beyond and across individual sectors is essential to realize the transformative development benefits that the WEF Nexus brings. Following CSV theory, private sector actors should embrace these new avenues for sustainable business and to create shared impact in developing contexts. Cross-sectoral partnerships between energy-access investors and water and agriculture investors in Africa can help achieve Africa's sustainable energy transition as well as its SDG targets. Such solutions will enable business actors to explore new strategies, business models and operating procedures, while playing to the proper strengths of each actor.



VISIONARY STATEMENT

CAPITALIZING ON THE WATER, ENERGY AND FOOD NEXUS FOR AFRICA'S TRANSFORMATION

VERA SONGWE, EXECUTIVE SECRETARY, UNITED NATIONS ECONOMIC COMMISSION FOR AFRICA



Transforming African economies towards attaining the continent's development aspirations as encapsulated in the African Union's Agenda 2063 and the UN 2030 Agenda for Sustainable Development requires massive transformations in energy, agricultural production and use of water resources. This is particularly so because various megatrends on the continent, including population growth, increasing middle-class population, rapid urbanization, industrialization, climate change and the imminent coming into force of the Africa Continental Free Trade Area

(AfCFTA) will have profound impacts on the demand for energy, water and food. Yet these megatrends present opportunities for a holistic approach to how the continent configures its means of production and consumption – a nexus approach towards safer, inclusive and resilient economic growth. The nexus approach provides us with a viable strategy for addressing complex and dynamic interactions that characterize energy access, agricultural productivity and food security, and effective use of water resources in a changing climate. This approach enables us to understand direct benefits, co-benefits, trade-offs and spill-over impacts across system interactions over time and space.

Water is important, among others, for energy generation, including for hydropower generation, steam and cooling in thermal power plants and water treatment. The Ethiopian Renaissance Dam, for instance, aims at generating power with the expected

capacity of 6,000 MW. On the other hand, energy is a crucial input for agriculture and food production, including water pumping for irrigation, as well as food processing and preservation, thereby extending agricultural value chains which African countries can use to industrialize and strengthen their position in regional and global markets. Take cocoa production for example. Four of the top five producers of cocoa in the world are African countries. These countries could capitalise on the water, energy and food nexus by using residues from cocoa processing to fuel small combined heat and power (CHP) units in cocoa processing cooperatives or agro-processing parks. The electricity produced can be used to power the parks, pump and treat water, supply neighbouring communities, and the excess sold to the grid if possible. The heat can be used for controlled drying of the cocoa beans, thereby enhancing the quality of the beans for better export earnings, while the ash can be used to improve soil fertility for better crop yield.

Exploiting Africa's enormous renewable energy potential for productive activities holds the key to this capitalization on agricultural value chains. The continent has solar power potential in the order of thousands of gigawatt, hydropower of over 350 GW, over 100 GW of wind power, about 15 GW of geothermal, as well as abundant bioenergy and even some marine energy. The continuing fall in the cost of renewable energy technologies makes the use of clean energy sources competitive and amenable to both small- and large-scale farming. Thus, African countries can use renewable energy technologies to power a new agricultural revolution that underpins cleaner production agro industries. However, doing so requires radical policy shifts that ensure coherence, capacity development and institutional coordination across sectors. That is why the ECA, in partnership with the United Nations Department for Economic and Social Affairs and UNDP are support-

ing African countries – through pilots in Cameroon, Ethiopia and Senegal – to (i) strengthen national capacity to clearly identify the specific synergies, trade-offs and complexities of the water, energy, food and climate change nexus; (ii) enhance capacity of government officials in various ministries to work in a collaborative and integrated way in implementing policies across these sectors; and (iii) support countries with enhanced technical capacity to use methodologies and modelling tools (focussed on integrated climate, land, energy and water systems) to inform sustainable development. The ECA is also conducting studies on climate risks in the AfCFTA and how the AfCFTA can in turn provide solutions to energy and food insecurity on the continent. To ensure that energy plays a strong anchoring role in the water, energy and food nexus, key issues need to be resolved, including: improved planning of energy supply (grid vs off-grid electrification); strong legal, regulatory and institutional frameworks to facilitate deployment of renewable energy technologies; and innovative financing of renewable energy infrastructure, among others.

CLOSING STATEMENT

RES4AFRICA FOUNDATION AND ENEL FOUNDATION

ROBERTO VIGOTTI, SECRETARY GENERAL, RES4AFRICA FOUNDATION

CARLO PAPA, DIRECTOR, ENEL FOUNDATION

RES4Africa Foundation and Enel Foundation are committed to accelerate Africa's renewable-energy transition. The annual flagship publication represents a platform to explore innovative approaches to reach a common goal: an electrified and prosperous Africa, driven by the belief that electricity would play an essential role in sustainable development and that converging is the name of the game to moving forward at a faster pace. After the launch of the first flagship publication one year ago, we continue to join efforts on leading dialogue, raising awareness, sharing knowledge and defining action points on key priorities to drive Africa's renewable energy future.

Overcoming Africa's energy access gap requires innovative approaches and action. The 2019 flagship publication is dedicated to exploring the Water-Energy-Food Nexus as a novel perspective on achieving widespread electrification in Africa, defining new mar-

kets and business opportunities while enabling sustainable economic growth and development impact.

This book aims to set forth a mission for public-private and multi-stakeholder partnerships on adopting a WEF Nexus approach as a path to accelerate widespread energy access resulting in sustainable development for Africa. Our call for action to pursue inclusive and effective WEF Nexus partnerships speaks to all actors involved in this quest to align on needs and opportunities, design paths for growth and set development milestones relying on and implementing, from the beginning, scalable solutions to accommodate growing water, food and energy needs of Africa in a sustainable and resilient setting.

Going forward, we will continue to co-design new initiatives enabling the WEF Nexus to further unfold into opportunities for change, together with our partners.

**PARTNERSHIP AND COOPERATION ARE
KEY TO TURN PRIORITY INTO ACTION.
WE CALL ON ALL ACTORS TO SCALE UP
WEF NEXUS INVESTMENTS THROUGH
INNOVATIVE AND RESULT-ORIENTED
COLLABORATION.**



ABOUT

RES4AFRICA FOUNDATION

Who we are: RES4Africa Foundation, active as RES4Med&Africa since 2012, promotes the deployment of large-scale and decentralized renewable energy in Africa to meet local energy needs. The foundation gathers the perspectives and expertise of a member network from across the sustainable energy value chain.

Our work: RES4Africa Foundation functions as a platform for members and partners of emerging markets to foster dialogue and partnerships, share knowledge and build capacity to advance sustainable energy investments in African countries.

Our mission: RES4Africa Foundation aims to create an enabling environment for renewable energy investments in emerging markets through three work streams:

- acting as a connecting platform for dialogue & strategic partnerships between members and partners to exchange perspectives and foster cooperation;

- providing technical support & market intelligence through dedicated studies and recommendations based on members' know-how to advance sustainable energy markets;
- leading capacity building & training efforts based on members' expertise to enable skills and knowledge transfer that supports long-term sustainable energy market creation.

Members: RES4Africa Foundation gathers a network of members from across the sustainable energy value chain including industries, agencies, utilities, manufacturers, financing institutions, consultancies, legal and technical services providers, research institutes, and academia.

Partners: RES4Africa Foundation works with local, regional and international partners, agencies and organizations to pursue its mission and promote renewable energy deployment in the region of focus.

ABOUT

ENEL FOUNDATION

Enel Foundation: Knowledge platform for a clean energy future.

We focus on the crucial role of clean energy to ensure a sustainable future for all.

By envisioning a sustainable future – resilient and equal – boosted by quality education and an enlightened self-interest by the business community. The future we want is powered by affordable, reliable, sustainable and modern electricity, smartly distributed to all.

We focus on research and education.

By developing partnerships with pre-eminent experts and institutions across the globe, leveraging on the vast knowledge of our founders. We conduct research to explore the implications of global challenges in the energy domain, develop scenario analysis, define policy and regulation opportunities and design capacity-building programs to the benefit of scientific and institutional realms.

We operate at the intersection of business and society.

By engaging institutions and governmental bodies, thought leaders and civil society representatives, industry experts and academia. We are a non-profit organization seeking to converge with likeminded actors determined to solve global challenges ensuring a sustainable future for all.

ABBREVIATIONS

AfDB: African Development Bank
CAGR: Compound Annual Growth Rate
Capex: Capital Expenditures
CBA: Cost-Benefit Analysis
CSP: Concentrated Solar Power
CSV: Creating Shared Value
E&C: Engineering & Construction
EIRR: Economic Internal Rate of Return
FAO: Food and Agriculture Organization
FEC: Final Energy Consumption
GHG: Green-House Gas Emissions
IEA: International Energy Agency
IFAD: International Fund for Agricultural Development
IRENA: International Renewable Energy Agency
MGMT: Management
MSMEs: Micro and Small-to-Medium Enterprises
NPV: Net Present Value
OECD: Organization for Economic Cooperation and Development
O&M: Operations & Maintenance
OPEX: Operational Expenditures
RE: Renewable Energy
RES: Renewable Energy Solutions
SDG: Sustainable Development Goal
SDS: Sustainable Development Scenario
SSA: Sub-Saharan Africa
T&D: Transmission and Distribution
WEF Nexus: Water-Energy-Food Nexus
WHO: World Health Organization
WRI: World Resources Institute

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