Unlocking Value from Sustainable Renewable Energy

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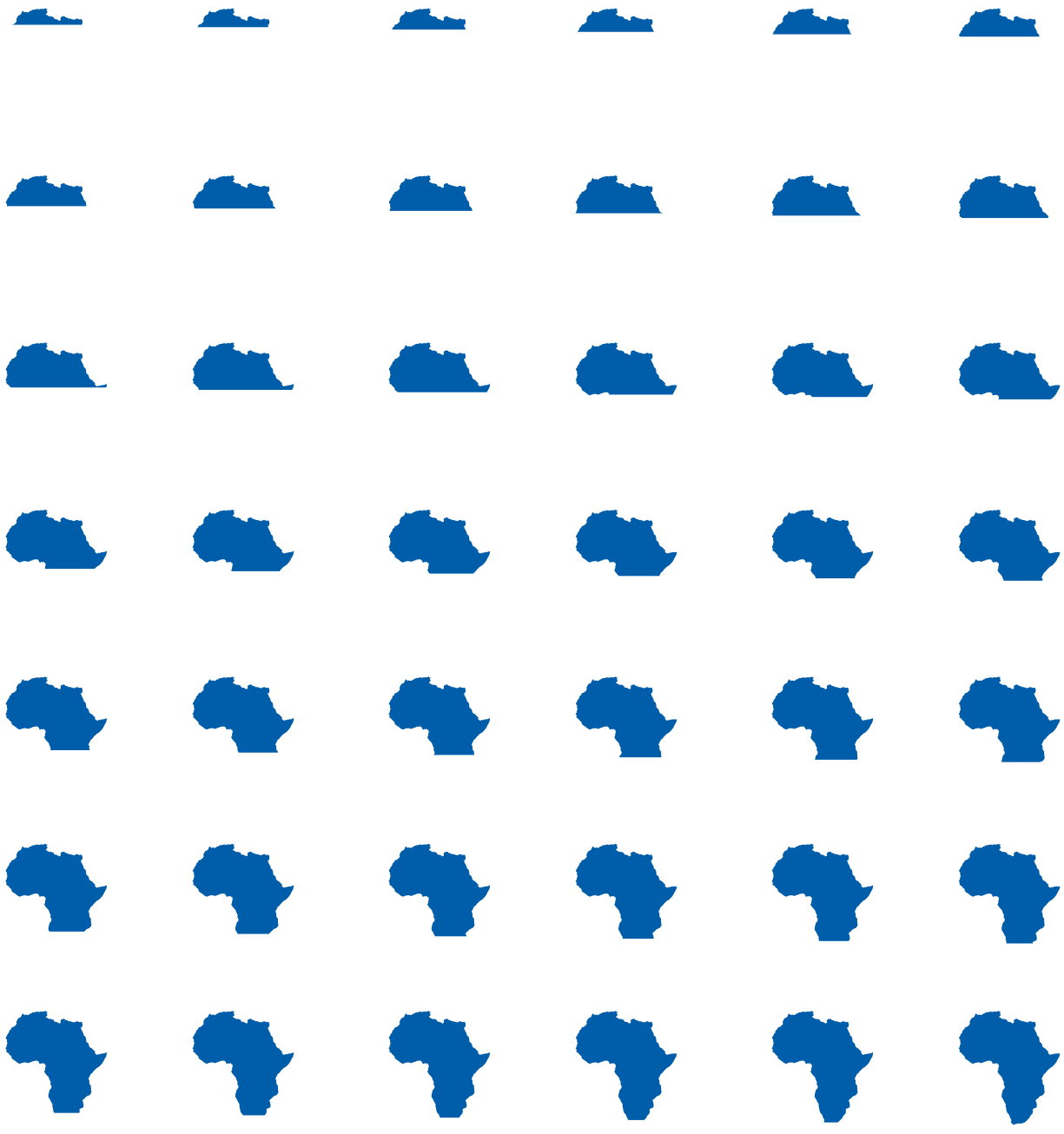

Unlocking Value from Sustainable Renewable Energy

ROBERTO VIGOTTI | Secretary General, RES4MED&Africa

Foreword

Sustainability and Bankability of Renewables - The Contribution of RES4MED&Africa

Access to clean, affordable and reliable energy is fundamental to drive sustainable economic growth in Africa, where a fast growing and populated economy and resulting increasing electricity demand can be met with renewable energy; not only by the traditional hydro and geothermal technologies, but today with solar and wind energy, that have become cost-effective in these last five years.

The private sector plays a vital role for the smooth deployment of renewable energy in African countries. Creating public-private stakeholder networks is important to gain deeper understanding of local needs to propose the right solutions. Private sector actors are encouraged to make a real strategic investment in Africa that fosters impact including human resource development, increased competitiveness, and innovative business creation. Private sector energy actors underline the need to identify bankable projects with good fundamentals as the next move forward.

When we started, back in 2012, renewable energy solutions for the Mediterranean and Africa were still ineffective and above all uncompetitive. At the time, a strongly Eurocentric perspective produced a wealth of analysis, roadmaps and recommendations to be proposed for adoption to African countries.

Since its inception, RES4MED&Africa adopted an "upside down" view: for us, the priority to deploying clean energy solutions was to understand and respond to local needs. Only shared policy dialogue and strategic partnerships could shape favorable business environments for investments in emerging and developing markets.

A distinctive feature that we also adopted from the start is capacity building to foster local project ownership and develop much-needed institutional and local skills that benefit project sustainability, contribute to local industrialization and job market creation and share knowledge all the while adapting to the sector's rapid developments.

This publication collects the views of specific actors of our public-private partnerships and network of over 35 international partners on the topic of our 2018 annual conference. The dialogue experience and resulting visibility has helped turn RES4MED&Africa into a successful connecting platform for renewable energy business. And this first book wants simply to underline that story.

Renewables have become one of the world's most dynamic sectors thanks to an unexpected evolution as the cost of solar and wind energy technologies are dropping dramatically turning them into the most cost-effective option in a growing number of countries. Today, the story of renewables is expanding towards further decentralization, decarbonization, and digitalization, creating new challenges and opportunities and revealing new markets. With this in mind, RES4MED&Africa is excited to head into a future that will be even more disruptive than imagined. Together with our members, partners and African stakeholders, we look forward to continue accelerating the renewable energy transition.

Roberto Vigotti
Secretary General, RES4MED&Africa

Editorial
Unlocking Value from Sustainable Renewable Energy

RES4MED&Africa's first flagship publication focuses on how renewable energy can unlock Africa's sustainable development and growth. Africa's sustainable development is unimaginable without renewable energy. In addition to the continent's natural resource abundance, renewables have never been more cost-effective, efficient, and suitable, with the potential to achieve universal energy access, ensure energy security, match energy demand, and foster economic development all at once. As the business case for renewables is going mainstream, the next frontier is to enable Africa's renewable energy transition that lays the foundation for the continent's sustainable economic development. The challenges are vast but the opportunities even greater – and this publication seeks to gather different views on what is needed to move forward.

Promoting Africa's renewable energy transition is a dynamic field that brings together many different actors, each with their experience and insights. This publication aims to reflect those

various points of views through multiple articles from selected RES4MED&Africa members and partners, including high-level authors from international financial institutions (IFIs), international organizations, academia, and private sector actors. Taken together, the articles represent a comprehensive multi-stakeholder and pluri-disciplinary overview on what is needed to scale renewables in Africa, argued from each actor's angle.

In every article, the authors take the reader on a deep dive into their perspective. Topics include sustainability strategies of energy companies, the international community's pursuit of progress on SDG 7[1], how sustainable energy can foster industrial development in Africa, which innovative policies can boost renewables in sectors beyond power, and what is needed to scale up renewables investments in emerging markets. We receive an overview of the expected role of renewables in Africa's energy infrastructure development, and in what ways sustainable energy development finance can make a difference. The challenge and opportunity of energy access in Sub-Saharan Africa is highlighted, as well as the relevance of integrating a water-food-nexus approach, and what kind of policy and regulatory frameworks are needed for renewables to take off in Africa. The role of frugal innovation to create home-grown solutions is explored, as well as best environmental, social and governance practices for renewable energy projects in African countries, lessons learnt from energy poverty for decentralized renewable energy solutions in Sub-Saharan Africa, and the role of innovative and inclusive capacity building. To conclude, the publication looks at much-needed climate-resilient infrastructure in Africa, the role of Italian renewable energy investments in the continent, and how renewable energy can be considered as a turnkey to achieve the United Nations Sustainable Development Goals by 2030.

Partnerships and cooperation are key to scale up renewable energy investments and to achieve the SDGs, especially as the UN tracks progress on SDG 7 in 2018. As a platform for dialogue, knowledge exchange and capacity building, RES4MED&Africa launches its first flagship publication as an example of such partnership at work. RES4MED&Africa is committed to creating an enabling environment for investments that can make renewables in Africa a reality. Scaling up investments in renewable energy technologies is a central strategy to attain Africa's sustainable development and to achieve progress on SDG 7 by 2030. The viewpoints that follow reflect the current state of a continuously evolving discussion and serves as input for alignment and action to drive Africa's clean energy transition.

[1] SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all. Agenda 2030, United Nations, 2015.

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FRANCESCO STARACE | President, Enel Foundation & CEO, Enel Group

Introduction

Dear Reader,

It is my pleasure to open the first RES4MED&Africa flagship publication on unlocking value from renewable energy in Africa developed in partnership with Enel Foundation.

In just over a decade, sustainable energy has become the centerpiece for Africa's economic and social development. Access to renewable energy – from large-scale power plants to mini-grids and decentralized solutions – is fundamental to accelerate Africa's socioeconomic transformation, enabling poverty reduction, environmental protection, action on climate change, improvement in health and living standards, whilst creating opportunities for entrepreneurship, empowering women and improving education.

This report is the first in a series of annual publications that will focus on specific key priorities and relevant themes about Africa's sustainable energy future. This edition, with support of the Enel Foundation, gathers insights from RES4MED&Africa's members and partners, and shows how renewable energy projects can create a real value in the African context. The authors share their points of view based on their areas of expertise, giving a comprehensive overview of the main challenges and opportunities.

For the upcoming editions, Enel Foundation and RES4MED&Africa will keep cooperating and the Annual Conference will be the occasion to share findings and key recommendations, aiming to create a fecund environment for renewable energy investments in Africa.

In the year when the United Nations takes stock of progress on energy access (SDG 7), the launch of this report during the 2018 Annual Conference witnesses RES4MED&Africa members' engagement to increase awareness on the role of renewable energy in order to ensure access to affordable, reliable, sustainable and modern energy for all.

We look forward to launching the next edition together with you,

Francesco Starace
President, Enel Foundation & CEO, Enel Group

Sustainability along the Value Chain – Creating Shared Value from Renewable Energy

There are many areas where energy and sustainability come together as energy is a key factor in guaranteeing fundamental human rights. By applying a systemic approach not only to the internal value chain of a company but also to suppliers, customers, and grass-roots organizations, it is possible to bolster productivity and define a company as an agent for social change. When all the actors of the economic ecosystem play an active role in reaching corporate goals that ultimately improve the environment and the quality of life, this collective effort will help foster a large-scale change for good.

ANTONIO CAMMISECRA
CEO, Enel Green Power

Energy is a right

Energy and sustainability are intertwined in multiple dimensions.
The first calls for a recognition of the energy sector's role at the forefront of global development and, as such, the United Nations acknowledged this effort with the signing of the Sustainable Development Goal 7, dedicated to energy access.
On September 2015, the 193 members of the United Nations approved the 2030 Agenda. Agenda 2030 is a far-reaching action plan based on "five critical domains for humanity and the planet" (people, planet, prosperity, peace, partnership) that builds on the original 17 Objectives for Sustainable Development to reach a tally of 169 targets. The Enel Group has publicly committed to four SDGs, namely the aforementioned SDG 7, as well as SDG 4 covering education, SDG 8 focused on the promotion of inclusive economic development, and SDG 13 tackling climate change.
Specifically, SDG 7 defines energy as the key factor in achieving long-term inclusive development and eradicating global poverty. This will be accomplished through a series of goals encom-

passing the universal access to energy, the spreading of renewables, the enhancement of energy efficiency and the procurement of cutting-edge, sustainable energy services, all of this, within a comprehensive long-term vision.
Energy is an instrumental right, or a prerequisite for clean water access, healthcare systems, education and industry for developing nations. In other words, energy is a key factor in guaranteeing fundamental human rights.
Hence, the possibility to solve once and for all the global subject of a "development divide" derives solely from the quality and quantity of accessed energy.
In order to measure life quality in member states, the UN has developed an alternative to GDP. The Human Development Index has a three-fold approach, measuring health, education and the general standard of living. Much research has proved how energy plays a pivotal role in determining how these indicators are affected.
Among all of them, the standard of living is definitely the most researched indicator and there is evidence aplenty to support how a correlation exists between a significant rise in family earnings and energy consumption. As far as education is concerned, energy offsets a positive trend on schooling levels and the access to technological tools like computers. The benefits connected to healthcare derive from the gradual phase out of kerosene and the ailments connected to its exposure as well as the availability of power for medical equipment to work properly, like sterilizing machines and cooling devices for medicines.

Renewable energy: where sustainability and competitiveness find common ground

The second dimension where energy and sustainability are close knit regards renewables. In this case, SDG 13 – promoting actions to tackle climate change – provides us with an operational framework emphasizing the central role renewables have undertaken in reducing greenhouse gas emissions.
Enel was the world's first utility to set the ambitious task of reaching carbon neutrality by 2050. Enel is blazing the path of energy transition as it bases its business strategy on three pillars: the development of renewables, a push for digitalization and the mitigation of climate change. So far, this journey has led Enel to generate close to 50% of its energy from zero-emission sources.
Another important factor to consider is that Enel's current business strategy, so centered on energy efficiency, network digitalization and renewables, is sustainable in its essence. This is a far cry from a decontextualized business approach that only considers sustainability as mere green-washing for the negative impacts of lucrative industrial activities. Instead, Enel's underlying principle is that today's sustainability is the way to gain tomorrow's competitive advantage. Sustainability becomes a strategic asset, for it represents the key to our competitive edge.
When renewables come under the spotlight, we can't overlook one of their main characteristics, that is, their intrinsic economic sustainability. Green energy has already proven to save greenbacks compared to conventional energy sources in Germany, Brazil, Mexico and Chile.
In a ten-year timespan, the Megawatt/hour (MWh) price of solar photovoltaic (PV) has decreased ten-fold from a subsidized price of 490 €/MWh to less than 40 $/MWh as certified by the latest price auctions in many world markets. The same trend played out for wind power where the auctioned price slumped from 180 €/MWh to less than 30 $/MWh.
Solar PV and wind are first of all a source of positive energy, but foremost, one of the most important linchpins of economic development.
Not only are they competitive from an economic standpoint, but their carbon footprint is sensibly lower than other energy sources because they don't emit any CO_2 during their service life and, due to their flexible nature, benefit from a lighter infrastructure in place. Their competitive advantage relies on a very short "time to market", enabling utilities to quickly ramp them up in response to a surge in energy demand. Simply put, they're more scalable.

Also, due to their inherently local nature, hydro, solar, wind and geothermal are more physically spread out and less delocalized. This characteristic, coupled with a greater technological flexibility, is bound to offset local development opportunities in the form of new jobs and inclusive growth. IRENA's latest research on renewables and employment estimates that in 2016 the sector generated 9.8 million direct jobs.
Bringing energy to those unable to gain access to it unravels new possibilities in terms of education, health and employment. The access to clean energy does the trick by setting the foundations for an inclusive development that works in favor of the environment and for its dwellers. Understanding the social and economic ramifications of a successful development model is the biggest testament to the push for an affordable, clean and competitive energy source for all.

Sustainability and value chain: the communities

As previously hinted, sustainability must be an integral part of business and not simply the mitigation effort on past actions of an economic cycle. That's why the private sector has shifted its vision by embracing the physical context it operates in, starting from the assumption that, in order to change the world, a company must be compelled to first change the way it operates in its local turf.
Companies were accustomed to conceive their strategic thinking based on activities they could control directly. Today, the game is about adjusting and recognizing the importance of a much wider market ecosystem where the corporate value chain is open to many new stakeholders, such as governments, grassroots organizations, suppliers and clients.
In order to turn all this into reality, at Enel Green Power we've adopted the "Creating Shared Value" (CSV) model, which enables us to seize business opportunities while catering to human and environmental needs. A major step in making sure this process has sustainability at its core is by scrutinizing various indicators of the value chain like the planning, building and development of each industrial plant. This is to guarantee that, at the end of the day, the company as well as the local territory and its dwellers can benefit from the shared value created by this process. Our journey towards the creation of a holistic ecosystem started by tailoring our value chain to each local context.
At Enel Green Power, since the first business planning stages, we've introduced a "materiality matrix", that handles on equal terms the demands and requirements of our business interests as well as those of the stakeholders that revolve around our industrial plants. Our sustainability plans stem from a joint analysis of these demands as they respond to social, economic and environmental issues arising from the local territories where we're operating in. What's more, this is the milieu where mitigation actions are planned to take effect, starting from the construction site, right to the completed plant with the ultimate goal of reducing negative aspects while maximizing positive outcomes.
The fundamental premise is that the whole CSV process gets under way before an actual decision on whether to invest in a specific project is made. A systemic and shared vision is the guarantee for the long-term sustainability of each business venture.
After the development stage, we've set out to reconsider the building phase as a whole. By using our CSV model as a primer, and abiding by the rules of a circular economy, we strive to combine our business interests with the legitimate interests of the territory where our energy circulates, starting from the time and place where the community feels the heaviest impact: the construction site. We measure how the works affect some of the most relevant domains for our sector like emissions, water, waste and people. Right from the preliminary planning stages we anticipate any possible critical aspects, thus offsetting plans for the mitigation of negative environmental outputs, while working to improve life quality through the enhancement of existing infrastructures, capacity building and job creation.

Sustainability and value chain: the suppliers

An outward-looking mentality is the stepping stone to create a virtuous ecosystem conjointly with our business partners and with this framework in mind, we engage proactively in fruitful conversations with local communities and suppliers that partner with us in building our industrial plants. This is the time to plan and implement policies that spur a positive effect on the local economy, leading to direct employment in our industrial plants and satellite activities. By addressing the objectives outlined by SDG 8 – promoting decent work and economic growth – we hit two birds with one stone by also resolving some of the issues brought to light by SDG 4 – achieving quality education. Our training courses often partner with NGOs and local social enterprises to develop the necessary know-how and techniques for the local workforce to effectively operate and manage our renewable power plants. In other instances, we foster the setting up of local SMEs with South Africa as a glaring example. In the African country, wood from the pallets where PV panels are shipped becomes the source material for sustainable furniture. All around our Adams plant, in the Northern Cape region, 4 business ventures entirely run by women are now working with wood, giving a new lease of life to what was once considered a waste product. Now, it's the raw material from which new furniture takes shape, proudly showcased in a local school housing more than 200 pupils.

Our value chain extends its reach from the mere development, building and management of industrial plants, to embrace the local communities, grassroots organizations and ultimately, our suppliers.

Since they're the actual builders of our industrial plants, we've taken them onboard from the onset of our CSV process in order to minimize our carbon footprint, water consumption and waste production. This partnership goes so far as to put in place filtering and recycling systems for gray waters, solar PV systems for camps and offices in lieu of diesel generators, as well as waste and pallet recycling projects.

Another poster child of the collaboration with our suppliers sits in the Mato Grosso, one of Brazil's Amazonian states plagued by widespread deforestation. Construction of the Apiacás hydroelectric power plant was the result of a sustainable building strategy, drawn up from the start to reduce the impact construction works would inevitably have on the local community and surrounding environment. During its construction, the Apiacás complex managed to reuse 14 t of wood and recycle 50 types of metals and other waste byproducts from the building site. Based on the sustainable construction site model, Apiacás was the first Brazilian power plant where building machinery was powered by a purpose-built solar PV system. The 1.2 MW system was instrumental in reducing emissions during the construction phase and when the hydroelectric plant finally went online, the solar PV system added its own energy to the renewable tally. Furthermore, we're currently in the midst of a conservation effort spanning 2,000 hectares of Amazonian rainforest adjacent to the plant, where more than 500 indigenous species have been identified and catalogued in the university scientific collection for the benefit of local researchers.

This demonstrates how onboarding both suppliers and grassroots organizations bolsters productivity and defines the company as an agent for social change as it strives to operate in an integrated fashion.

When all actors of the economic ecosystem play an active role in reaching corporate goals that ultimately improve the environment and the quality of life, this collective effort will help foster a large-scale change for good.

Another big step in this direction was achieved through the electrification of an Ethiopian hospital. This is the case in which the partnership with specialized companies has led to something greater than a simple business endeavor, but, rather, an endeavor to sustain one of humankind's fundamental rights: health.

Ethiopia is the country which saw us win a tender for a 100 MW solar PV plant, located more than 100 miles outside Addis Ababa. Unfortunately, the East African country' hospitals aren't

immune to frequent blackouts which render some medical procedures like surgery very complex to carry out. Our first task was the set-up of a PV-battery mini-grid in one of the medical structures belonging to the local NGO CUAMM which provides healthcare services for over 100,000 patients.
That was just the beginning, and since then we have another big Ethiopian project in the cards. Together with a selected pool of suppliers we aim to electrify Hewo hospital in the town of Qwiha, in the northern corner of the country. Inverters and the containerization will be provided by FIMER and SIEL, respectively. While Neosia, a company which has already been tasked with the building of a solar PV plant near Metehara, volunteered to provide the hospital with a 50 kW solar mini-grid.

Sustainability and value chain: our clients

In recent years, Enel Green Power's value chain has gradually opened to the so-called commercial and industrial customers. Enel Green Power's business model isn't restricted to the mere selling of energy to other utilities but has expanded instead to reach other major industrial and commercial corporations through the signing of PPA's – bilateral contracts that call for global synergies.
These new market opportunities have unraveled and are currently burgeoning thanks to the inherent sustainability of renewable energy.
All this, since sustainability is inherently twofold. It's economic, because green energy has demonstrated its competitiveness over conventional sources. It is environmental as well: RE100 is the consortium of global corporations that have publicly committed to meet their energy requirements by using only renewable sources. As of today, over 100 corporations, featuring household names such as Coca Cola, Ikea, Google, Microsoft, Nestlé, Nike and P&G, have signed up to this initiative.
In 2016, PPAs totaled 19 MW of renewable energy supply worldwide, with the US emerging as a leading nation. Our clean energy is already powering corporations like Google, Facebook, Coca Cola, FEMSA, GM and Adobe.
These companies weren't just looking for a renewable energy supplier. They were looking for a vision, one of sustainability embracing the multiple facets of the energy business: from sustainable construction works and power plants to the energy supply for primary services such as hospitals, from the creation of local employment opportunities to capacity building, from investments in education to the conservation of precious resources like water and the Amazon's biodiversity.
In other words, we can proudly reaffirm our status as the suppliers of choice for large global corporations by combining our competitive edge to a wide value chain. Ultimately, this chain creates an ecosystem where the economic value plays out in protecting the environment and in guaranteeing a long-term and inclusive human development.

Ground mounted solar power plants in Zimbabwe.

A Better Path for Africa's Energy Future

At the heart of the SDGs and the Paris Agreement of 2015 was a commitment that we would "leave no one behind". The evidence shows that without urgent action by governments and communities, and an urgent response from investors and businesses, we risk, in Africa in particular, of many being left behind. Yet at the same time, much of the creativity and the disruption of new technology applications, new business models and fresh ways of thinking about energy services is on display in Africa. A better path for Africa's energy future is possible. This then is the time for bold and brave leadership to ensure significant improvements in energy efficiency, accelerated progress on electricity access using centralized and decentralized sources, and to push forward quickly the ever-increasing role for renewable energy. By embracing a viable, clean energy future, Africa can leapfrog into a new economic future, one more equitable and more secure, for all.

RACHEL KYTE
CEO, SEforALL

In 2015, the international community agreed on a set of Sustainable Development Goals (SDGs). Goal 7 of 17 calls for universal access to affordable, reliable, sustainable and modern energy for all. At the same time the world came together in Paris to agree to the pollution-cutting objectives of the Paris Climate Agreement, which calls for limiting average global temperature increases to "well below" 2 °C.

Neither of these landmark agreements would have been possible without African leadership. Put together, these agreements mean that we have set course for decarbonized energy systems that serve everyone's needs.

Today, a billion people still lack access to electricity and three billion lack access to clean cooking. At the same time, few countries have energy systems that are efficient and the energy mix, while shifting rapidly in some parts of the world, is not yet on track for the clean air and emissions reduction we need.

At the heart of the SDGs and the Paris Agreement was a commitment that we would "leave no one behind". The evidence shows that without ur-

gent action by governments and communities, and an urgent response from investors and businesses, we risk, in Africa in particular, of many being left behind. Yet at the same time, much of the creativity and the disruption of new technology applications, new business models and fresh ways of thinking about energy services is on display in Africa.

So much opportunity, so little time.

This then is the time for bold and brave leadership to ensure significant improvements in energy efficiency, accelerated progress on electricity access using centralized and decentralized sources, and to push forward quickly the ever-increasing role for renewable energy.

These are the components of an energy transition that reaches the rural household, the home-based business in an informal settlement in one of Africa's rapidly growing cities, the agri-processor just getting started in landlocked Africa, the university, the regional health center, the government building.

To be sure, a lot of good things are happening around the world and in Africa.

Solar and wind energy costs are plummeting, as are the costs of storage, which opens up more opportunities to deploy these technologies together.

Across the continent, we're seeing low auction prices for renewable energy projects. The World Bank Group-backed Scaling Solar program helped Zambia secure construction of a large-scale solar power plant at six cents per kWh, the lowest solar price at the time in Africa.

By setting ambitious goals and developing an integrated system of policies, regulations, and investment, countries such as Morocco and Kenya are enabling grid-scale and decentralized renewable efforts to flourish.

Financial innovation is taking place supporting clean energy growth, such as Nigeria's issuance of the first ever green bond in Sub-Saharan Africa and the African Development Bank's support for renewable energy, including off-grid systems.

Governments such as Rwanda's, which have begun to make clean cooking a priority, are showing the benefits of collaborative partnerships that are scaling the use of clean fuels.

And more commitments are being made by African leaders, including in Ethiopia, Ghana, Rwanda, Senegal, Zambia, and other places to prioritize making reliable, affordable and clean energy available to all, especially for remote and marginalized populations.

But it's not enough.

Recent data from the third edition of the Global Tracking Framework released in the spring of 2017 shows significant shortfalls in progress on electricity access, clean cooking access, energy efficiency and renewables. In nearly a dozen Sub-Saharan African countries, national electrification rates were below 20% in 2014. Rural electrification rates are substantially lower. Access to clean cooking fuels and technologies across the region are at dangerously low levels for people's health and the environment, averaging well under 5% in many countries.

Every year of delay in providing affordable, reliable sustainable energy access is a lost year, a lost opportunity, for millions of children and their families. Countries cannot afford to forsake these missed opportunities. They cannot afford to leave entire generations behind when solutions that deliver affordable clean energy services exist today.

A recent study commissioned by Sustainable Energy for All and Power for All, "Why Wait – Seizing the Energy Access Dividend", highlights the dividends of early electrification for households and broader economies, including significant financial savings, educational and environmental benefits. It concludes that in many cases electricity access can be delivered more quickly and affordably with decentralized renewable energy solutions rather than waiting years and sometimes decades for conventional grid-based service.

Why are governments and other decision-makers waiting? We can look at policies and lack of finance as the cause, but also look to both as the opportunities.

Opportunities for a better energy path

Last year the World Bank published, with the

support of SEforALL, the "Regulatory Indicators for Sustainable Energy (RISE)" report, which examines national policies and regulatory frameworks for sustainable energy in 111 developed and developing countries. The RISE scores of Sub-Saharan African countries suggest that significant opportunities exist to strengthen the policy and regulatory framework to close the gaps in access to electricity and clean cooking, but to also stimulate the uptake of renewable energy further and implement energy efficiency measures required for increased productivity.

On finance, our groundbreaking "Energizing Finance" report series, a collaboration of SEforALL and a half-dozen partners, shows that finance commitments to improve electricity and clean cooking access were substantially lower than levels needed to achieve global goals for delivering universal access to sustainable energy by 2030. The research showed that financial commitments for electricity in 20 key countries in Africa and Asia – representing 80% of those without electricity globally – averaged about $19.4 billion a year. That's less than half the estimated $45 billion or more of annual investment needed. Less than one third of these commitments – just over $6 billion a year – went to 13 Sub-Saharan African countries that account for over half of the one billion people globally living without electricity.

Another key finding was that only a miniscule amount of financing commitments in 2013-14 – just 1%, or $200 million a year – went to decentralized renewable energy solutions, such as household solar systems and mini-grid systems, which hold great promise to deliver basic electricity more quickly and affordably to hard-to-reach populations. Even in Kenya, Tanzania and Uganda, which have stronger policy frameworks, only 2% of energy access investments went to decentralized renewables.

But positive changes are underway in scaling up renewables, with much of it happening in East Africa. Millions of households in the region have gained access to household solar systems, much of it made possible with financing through the region's strong mobile money ecosystem. According to a recent Off-Grid Solar Market Trends report by Global Off-Grid Lighting Association (GOGLA), 57% of the financing for pay-as-you-go solar systems was to companies operating in East Africa. This trend ties closely to policy and business environments: countries with high ease-of-doing-business, a strong payments ecosystem, an enabling regulatory environment and a digitally connected customer base are faring better in attracting companies – and investors in those companies – during the early days of this promising sector.

The challenges on clean cooking access in Africa are bigger, but opportunities still exist. Financial commitments for clean cooking solutions in the 20 countries analyzed in our "Energizing Finance" research were extraordinarily low – averaging just $32 million a year, a fraction of the $4.4 billion estimated annual investment needed. But we are beginning to see some increases in spending, beginning in East Africa where there are strong advances in business models and technologies for clean cooking solutions. What is needed is a focus on making clean fuels affordable as well as continued advances in cook stove technology. Those countries outside Africa that have made quick and lasting progress in clean cooking have done so by setting priorities at the top and focusing on affordability of clean fuels.

Immediate action to seize on big-market solutions is critical to meet 2030 clean cooking goals.

What next?

Governments, business leaders, mayors and city leaders, community leaders, development partners and other key decision-makers need to find a higher level of urgency to get on track to meet our common goals.

With all this in mind, here are four priorities for moving down a better path toward a sustainable energy future for all.

• **Energy efficiency first:** Even for those countries whose economy is not energy intensive today, putting energy efficiency first in energy planning will change the shape of the energy system, reduce demand as incomes grow, save many from the effects of filthy air and reduce energy costs for consumers. Energy efficiency

has to be on an equal footing with other types of energy infrastructure planning in national policymaking. Conversations about energy security, energy access, renewables and modernization must include energy efficiency as a form of infrastructure. And how energy efficiency is integrated and financed must be as important a topic as renewable energy project financing.

• **Accelerate national electrification planning and implementation:** While every country has different needs when it comes to their energy transition, all countries need much greater integrated electrification planning and implementation. Government leaders across Africa have a golden opportunity to re-think their national electrification strategies. Embracing integrated strategies, using both centralized and decentralized energy sources, will allow for a speedier and cheaper pathway to close energy access gaps, especially in rural areas where grids are still a distant prospect. This planning must be wrapped in transparent rules and regulations that provide confidence to private investors. And, critically, utilities need to be at the table.

• **Leave no one behind:** In order to leave no one behind, governments, development finance institutions and other financiers have to increase support in countries with significant gaps in electricity access and clean cooking access. Grant support for technical assistance to help in market development, and equity and debt financing – especially local currency financing – are needed to move the needle on sustainable energy. Governments will have to invest more of their own resources to support those at the bottom of the pyramid, and through better enabling environments support the private sector, domestic and foreign, big and small to fill the gap.

• **Think thermal:** There is much focus on electrification as the way forward in the energy transition. And while clean electricity will provide the way forward for energy generation, transportation and many other uses, we have to be smarter in how we think about heating and cooling, especially on a warming planet inhabited by more people.

Across Africa, refrigeration and other cooling solutions are and will be critical to human health and prosperity. Yet access to sustainable and affordable cooling technologies is limited, especially for the poorest people and communities. Lacking cooling access in a hotter world means productivity losses, as well as adverse impacts on public health and food security due to lack of a secure cold chain. Cooling needs will increase as temperatures rise due to climate change and as economies grow and urbanize. Meeting this fast-growing demand in more efficient and sustainable ways is critical to achieving the SDGs, the Paris Climate Agreement goals, and the Kigali Amendment to the Montreal Protocol.

The path best taken

Africa is at a crossroads on energy. For many decades, the path of choice for closing energy access gaps was centralized fossil fuel projects and distributed and expensive diesel and kerosene for household needs. Yet, after all that investment, Africa's energy is not reliable or affordable enough – with far too many people still without access to affordable, reliable, sustainable and modern energy.

But advances in technology, business models and a broadening of the spectrum of financiers put solutions in the hands of many.

Leaders are needed to put in place the policy, regulatory, business and education policies that will enable sustainable energy solutions so that people and industries can access the energy services they want.

By embracing a viable, clean energy future, Africa can leapfrog into a new economic future, one more equitable and more secure, for all.

Transformation towards Sustainable and Resilient Societies: Using Synergies of Sustainable Energy Systems for Inclusive, Sustainable Industrial Development that Leaves No One behind

TAREQ EMTAIRAH
Director of Department of Energy,
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Over the last 15 years UNIDO has delivered technical cooperation services at the interfaces of energy, climate action and industrial development in developing countries, especially in Africa. If industrial development is to be sustainable, the role of renewable energy in the industrial sector has to be strengthened. UNIDO's Energy Programme promotes sustainable energy solutions by looking at integrated energy approaches, decentralized energy systems that bring electricity and productive uses to the bottom of the pyramid, and energy management systems in developing countries. Technology development and transfer policies need to be developed according to domestic needs for countries to achieve their respective economic and social development goals. Interlinkages among energy, climate and economic transformation are a necessary prerequisite to create the needed benefits to members states. Strengthening regulatory frameworks, facilitating technology transfer and linking energy solutions to productive activities and creating the necessary public and private partnerships are at the essence for technical cooperation activities in sustainable energy.

UNIDO has been pursuing an active role in shaping the global debate on sustainable development. As a specialized agency of the United Nations, UNIDO has the mandate to support its member states in achieving Inclusive and Sustainable Industrial Development, or "ISID". This mandate is also reflected in the organization's four strategic priorities, which are to create shared prosperity, advance economic competitiveness, safeguard the environment, and strengthen knowledge and institutions. In this context, the UNIDO Energy Programme is uniquely placed to promote sustainable energy solutions for productive capacities, industrial competitiveness and job creation, and mitigating climate change caused by industrial activity. With this focus in mind, UNIDO's technical cooperation activities in the energy field evolved to respond to specific needs and demands from our beneficiary countries at the intersection of three Sustainable Development Goals: SDG 7 (affordable and clean energy), SDG 9 (industry, innovation and infrastructure) and SDG 13 (climate action).

While the interlinkages are self-evident, the articulation of a coherent and effective development agenda linking multiple development goals is not always straightforward. In this article we want to share brief accounts, drawing from our energy cooperation portfolio of over 110 projects in 47 countries, where we made progress, some lessons learnt and where we can do more together with partners from the public, private and development sectors.

Programmatic approaches

Over the last 15 years, UNIDO worked with three programmatic approaches to deliver technical cooperation services at the interfaces of energy, climate action and industrial development. The first is the industry climate change mitigation program anchored around industrial energy efficiency. It focuses on increasing energy efficiency through the wide-scale deployment of Energy Management Systems (EnMS), Energy Systems Optimization (ESO) and the adoption of ISO 50001 standards within industrial as well as commercial and public enterprises. Implemented in close to 20 countries, we have seen very promising results and data sets to demonstrate cost-effective deployment of efficiency measures within industries of varied sizes in both developing and emerging economy contexts.

The second programmatic approach focuses on building local manufacturing capacity through decentralized energy systems, especially through the implementation of renewable-energy-based mini-grid projects in Africa's rural areas. The aim is to support the local economy's shift away from relying on international donors or government subsidies in the long-term. In the case of solar and small hydro, local manufacturing capacity can be used and strengthened in the areas of design, manufacture and assembly of system components in support of sustainable industrial development. Renewable energy technology centers, such as the SHP technology centre in Tanzania, or a network of trained local subcontractors such as electricians in Chad and Ivory Coast, are able to support renewable-energy mini-grid communities and encourage their uptake in further settlements. The key is to have a critical number of projects, such as in Ivory Coast, which include several villages that are in close proximity of each other and are supported by the same foundation, making the mini-grid a viable business for local contractors. Linked to this is the strengthening of appropriate regulatory frameworks. Existing frameworks need to be redesigned to allow for adequate off-grid solutions. The case of Ivory Coast depicts that, even though many viable mini-grid sites can be identified, the regulatory and financing framework lacks incentives for their development. The financial sector only lends to projects if risks are minimized, and policymakers need to provide incentives and instruments to reduce these risks. In Chad, it has been advised to phase out fossil fuel subsidies and dedicate a minimum level of infrastructure procurement to renewables to encourage the creation of local production facilities and reduce risks for private investors. The capacity of national regulators, utilities and renewable energy agencies to develop rural energy markets can be increased in terms of technical knowledge, as in the case of The Gambia, where the project enabled the national water utility to realize the economic benefits of replacing gasoil gen-sets with solar photovoltaic systems.

These experiences have shown that there are many interlinkages between regulatory, technical, financial and community objectives. An adequate regulatory framework should be able to leverage private investment, support capacity to oversee projects on the ground and to thus encourage community participation. The replication of these demonstration projects bring the development of mini-grids to the next level and can only be realized if investments move away from reliance on donor funds. For this to happen, governments need to enact specific provisions for mini-grids that allow investors to have clarity on the regulatory environment for the foreseeable future in order to be able to design projects in a way that brings returns on investment.

Integrated energy approaches

The integration of renewable energy into exi-

sting energy systems, and their development into integrated energy systems (also known as Smart Energy Systems) are central elements for a decarbonization of the energy sector and a key focus area of UNIDO's work in Africa. If industrial development is to be sustainable, the role of renewable energy in the industrial sector needs to be strengthened. Although many countries will depend on fossil fuels in the foreseeable future, efforts need to be in place to make available adaptive and affordable technology aimed at reducing greenhouse-gas (GHG) emissions. The term "integrated energy approaches" refers to an approach in which electricity, thermal and gas grids are combined with storage technologies and digitally coordinated to identify synergies between them enabling improved solutions for each individual sector and the overall energy system. Technology to support integrated energy has yet to mature fully and is still being explored. However, it is anticipated that it will be increasingly applied and tested in industrialized countries, with the aim to further reduce their GHG emissions. Integrated energy solutions could also be promising for developing countries and emerging economies.

Energy Management Systems

UNIDO's climate change mitigation programme focuses on increasing energy efficiency through the wide-scale deployment of EnMS, ESO and the adoption of ISO 50001 within industrial (as well as commercial and public) enterprises. The digitalization of manufacturing industries opens up new opportunities to monitor and evaluate EnMS based on the increased availability of process-related data. Integrating these solutions into industrial environments could create more transparency for the actual ecological achievements of industry. Examples of UNIDO activities in this field include establishing a sustainable mechanism to provide a response (i.e. training and skills development) to the existing lack of personnel qualified in implementing EnMS in line with ISO 50001, enriching the service industry of the local Industrial Energy Efficiency (IEE) market and promoting certification programs that enable the legal requirement for obligated organizations to deliver tangible benefits that improve energy/cost savings as well as enhanced overall performance. Over the last decade, UNIDO has continually refined and evolved its EnMS/ESO/ISO 50001 services and packages to the point where UNIDO is now regarded as the global leader and centre of excellence in regard to the cost-effective deployment of these IEE methodologies within industries of varied sizes in developing and emerging economy countries. A regional focus of this approach is also on Africa through UNIDO's network of regional sustainable energy centers in Sub-Saharan Africa. The centers contribute to the creation of an enabling environment for regional renewable energy and energy efficiency markets by mitigating existing barriers. They execute cross-border activities in the areas of policy and regulatory frameworks, capacity development, and knowledge management. They help raise awareness, and are important for business and investment promotion.

Facilitating effective and sustainable technology co-operation

Climate technologies to mitigate and adapt to climate change help to lower emissions, increase resilience, and generally develop more sustainably. Technology development and transfer of such climate technologies are central conditions to ensure that economic growth happens in a sustainable and inclusive manner. Therefore, technology development and transfer policies need to be localized and developed accordingly to domestic needs, so that developing countries will be better equipped to achieve their respective economic and social development goals. However, expertise with regard to climate technologies in technology development, deployment, capacity building, finance, investment and policy are urgently needed in many regions. Effective and sustainable transfers of climate technologies through global partnerships as well as home grown innovation can support in addressing these gaps. An illustration can be seen via the Climate Technology Centre and Network (CTCN). The CTCN, co-hosted by UN Environ-

ment and UNIDO, promotes the accelerated transfer of environmentally sound technologies for low-carbon and climate-resilient development at the request of developing countries. Our work in the area has recently been greatly expanded with the relaunching of the Private Financing Advisory Network (PFAN) under a new hosting arrangement with UNIDO and the Renewable Energy & Energy Efficiency Partnership (REEEP). PFAN works with energy efficiency and renewable energy projects to provide assistance in areas such as business-plan development, investment pitching and growth plan and strategy development as well as investor matching in order to facilitate the securing of financial capital.

Policies to encourage innovative climate technologies for inclusive and sustainable industrialization

Innovation and development in environment- and climate-friendly technologies should be fostered by public policy and financing that focus on the development of local solutions for local challenges in particular in developing countries. This is why the UNIDO Energy Programme gathers multi-stakeholder forums that incorporate views from international organizations, governments, the business sector and academia, to discuss the latest challenges and opportunities in the energy sphere, and that is able to offer insightful and innovative policy solutions to promote innovative climate technologies. The Vienna Energy Forum is one such example, which is a biennial forum designed to tackle the latest challenges in sustainable energy. The Forum provides a platform for the exchange of knowledge and experiences to address the challenges of sustainable energy.

Conclusion

Evolved over the last 15 years of technical supports services, we are more convinced than ever that the interlinkages among energy, climate and economic transformation are a necessary pre-requisite to create the needed benefits to our member states. The strengthening of regulatory frameworks, facilitating technology transfer and linking the energy solutions to productive activities, and creating the necessary public and private partnerships is at the essence of UNIDO's technical cooperation activities in the area of sustainable energy.

Renewable Energy Policies in a Time of Transition

Renewables have achieved massive technology improvements and cost reductions in recent years. However, progress is not homogeneous across countries and sectors. Solar photovoltaic and wind have been deploying faster than any other energy technologies, but renewables are lagging behind for applications in heating & cooling and transport. Several barriers still hamper renewables deployment in developing countries. The rapid expansion of variable renewables requires more flexible energy systems in order to ensure a reliable and cost-effective system integration. In general, the mainstreaming of renewables calls for more holistic and sophisticated policy approaches. The report "RE Policies in a Time of Transition", prepared jointly by IRENA, the IEA and REN21 aims to provide policymakers with a comprehensive understanding of the diverse policy options to support the development of renewables across sectors, technologies, country contexts, energy market structures, and policy objectives[1].

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Spurred by innovation, increased competition, and policy support in a growing number of countries, renewable energy technologies have achieved massive technological advances and sharp cost reductions in recent years. With nearly every country in the world adopting a renewable energy target, renewables are now considered a technologically mature, secure, cost-effective and environmentally-sustainable energy supply option to underpin continued socio-economic development, while simultaneously combating climate change and local air pollution. However, progress so far has not been homogenous across countries and sectors. Several key barriers still hamper renewable energy deployment, ranging from technology and financial risks in new markets to integration challenges in markets with high shares of variable renewables. Moreover, despite significant progress in the power sector, renewables are lagging behind for heating and cooling and transport applications, with fewer countries implementing regulatory measures for those end-uses, as shown in ● **Figure 1.** (See Infographic Section).

As renewable technologies mature, policymakers are confronted with new challenges. The rapid expansion of variable renewables, such as solar PV and wind power, requires more flexible energy systems to ensure reliable and cost-effective system integration. Moving forward, renewable energy policy approaches will have to be more holistic and sophisticated to reflect the transformative changes induced by the energy transition on the energy sector, society and economy.

Renewable heating & cooling

Heating is the largest energy end-use, accounting for over 50% of total final energy consumption in 2015, with over 70% of that met by fossil fuels. Modern renewable heating & cooling technologies, including modern bioenergy, solar heat and geothermal, currently only provide 7% of total global heat demand, while renewable electricity supplies another 2%. Unsustainable, traditional use of biomass is estimated at around 14% of total demand and should be phased out as rapidly as possible.

While the potential of renewables for space and water heating in buildings, cooking and various industrial heat uses – in particular at low-medium temperatures – is significant, dedicated policies and measures are crucial to drive this until now rather neglected aspect of the energy transition. As shown in ● Figure 2. (See Infographic Section), the vast majority of countries in the world, including almost the entire African continent, still do not have dedicated policies for renewable heating & cooling.

Multiple barriers call for a range of policy instruments, often in combination. Policy approaches vary according to differences in heat demand, infrastructure and other contextual factors and they can be clustered around i) support for renewables for district heating and cooling, ii) industrial heating and hot water, iii) clean cooking, and iv) renewables competing with extensive individual natural gas heating. The most commonly used policies are mandates and financial and fiscal incentives.

Mandates and obligations, such as those for solar water heaters in some countries, offer greater certainty of increased deployment. Building codes can also implicitly support renewable heating and cooling from renewables by setting energy performance requirements. Fiscal and financial incentives are often used to reduce the capital costs of renewable-based heating, and to create a level playing field with fossil fuels. Most recently, heat generation-based incentives are being applied, providing support over longer periods. Carbon or energy taxes can also provide important price signals and reduce externalities, but design and implementation challenges remain, especially in contexts where energy-intensive industries are subject to strong international competition and may ask for exemptions.

Much more effort at the policy level is needed in a larger number of countries. Approaches to renewable heat policy will have to vary between countries, reflecting different circumstances (for example, building stock, industrial heat demand, resource potential) and specific barriers that need to be overcome. While there is no one-size-fits-all solution, all countries should set themselves targets for renewables in the heating and cooling sector and develop strategies to achieve them, coupled with measures for energy efficiency.

Renewable transport

Transport is the second largest energy end-use sector, accounting for 29% of total final energy consumption in 2015. It remains heavily reliant on fossil fuels, with 96% of the sector's energy use coming from petroleum products. Conversely, transport accounts for 64.7% of world oil consumption in 2015. With the exception of biofuels, there is little practical experience of fostering renewables in transport; policies aimed at developing electric-power transport based on renewables have only recently begun to emerge.

A large uptake of renewable energy in transport requires simultaneous and integrated changes in three main areas: 1) the availability of energy carriers and fuels produced from renewable sources; 2) the deployment of vehicles that can

use renewable fuels; and 3) the development of energy and fuel distribution infrastructure. Policies and planning should aim at overcoming key barriers, such as the immaturity or high cost of certain technologies, inadequate energy infrastructure, sustainability considerations and slow acceptance among users as new technologies and systems are introduced. They should also foster improved understanding between decision makers in the energy and transport sectors, so as to enable integrated planning and policy design. Considering the high dependence of the transport sector on fossil fuel, removal of fossil fuel subsidies is essential for decarbonizing the transport sector. This is particularly true for shipping and aviation as both sectors currently benefit from fuel tax benefits and exemptions. In this context, a price on carbon would be a key tool to stimulate the decarbonization of the transport sector, although implementation could be politically challenging and much work remains to reach a global consensus. Also, low carbon-fuel standards that include life-cycle GHG emission reduction and sustainability criteria are a useful measure to facilitate decarbonization of transport. In general, decarbonization of the transport sector remains a huge task that requires a fundamental change in the nature and structure of transport demand, improvements in efficiency and changes in the energy mix, which all require major policy push.

Renewable electricity

Although the power sector consumed only about a fifth of total final energy consumption in 2015, it has so far received the most attention in terms of renewable energy support policy. Renewable generation increased at an annual average rate of 6.4% between 2009 and 2014, outpacing growth in electricity demand and in generation from non-renewables. In 2015, renewables provided about 23.5% of all electricity generated, the bulk of which came from hydropower, followed by wind, bioenergy and solar PV. These developments have been driven mainly by falling technology costs and support policies, which are expected to continue fostering deployment in the coming years.

Multiple policy instruments have been applied – often in combination – for supporting renewable electricity technologies. In general, there is no single policy that can serve as the preferred one in all contexts. The choice of policy instruments should depend on the specific country conditions, state of the energy market, technology, and objectives to achieve. Moreover, success (or failure) of policies strongly depend on their detailed design.

For example, quotas and mandates enable targets to cascade down to electricity producers and consumers. They are generally supported by tradable renewable energy certificates and sometimes accompanied by fiscal incentives. To ensure the effectiveness of quotas and certificates, a robust framework to monitor and penalize non-compliance is needed. Administratively set pricing policies (feed-in tariffs and premiums) need to continuously adapt to changing market conditions and regular tariff-level adjustment is one example of measures needed to reflect the falling cost of technology. In this context, auctions are being increasingly adopted, given their ability for real-price discovery. Auctions have resulted in electricity prices from solar PV in 2016 equal to almost a fifth of what they were in 2010, reflecting developments in the sector. Prices for onshore wind were almost halved in that period. Notably, however, the success of an auction in achieving policy deployment and development objectives relies on its design. In many contexts, auctions are used for large-scale projects and feed-in tariffs and premiums for small-scale installations. Distributed generation can be supported through net metering and net billing. However, careful consideration is needed to avoid jeopardizing the system's cost recovery and prevent cross-subsidization among those customers who self-consume and those who do not.

System integration

With strongly decreasing costs of solar PV and wind, system integration of variable renewables (VRE) has emerged as an increasingly important

issue in several countries. The amount of VRE that can be integrated in reliable and cost-effective manner in a given country or market critically depends on the flexibility of the overall power system, be it in terms of other dispatchable supply, storage, demand-side response, or strength of grid and interconnections. All power systems have a certain level of flexibility, in order to cope with differences in demand (both daily and seasonal).

Challenges emerge progressively as VRE shares grow in the power system. The increasing impact of VRE on the power system can be categorized by phases and, consequently, the system's ability to deal with VRE should be enhanced gradually. In most countries in the world – including the quasi-totality of Africa – solar and wind supply only few percentages of total electricity generation. In this first phase ● Figure 3. (See Infographic Section) there are no relevant impacts: the flexibility used to respond to demand variations is widely enough to cope with the variability of such a small share of solar and wind.

As the presence of VRE begins to be evident to system operators (Phase 2 – solar and wind change net load over time), new or revised grid codes, improved system operations, and coordinated grid and VRE deployment may be necessary for system integration. At higher shares of VRE – notably above 10% – flexibility becomes an increasingly valuable characteristic in the power systems. A number of European countries, markets in the US, Asian provinces and Latin American countries are in this Phase 3 – demonstrating that integration of high shares of solar and wind is possible in a reliable and cost-effective way. Only three power systems worldwide are today in Phase 4 – in which short-term stability issues emerge.

As the share of increasingly inexpensive solar and wind will expand, policies will need to adapt to the changing system conditions. Coordination of VRE deployment and system integration measures is crucial to operate the system in a cost-effective, reliable and safe manner. Technical, economic and institutional policy layers mutually influence each other and have to be addressed in a consistent way.

Energy access

Decentralized renewable energy solutions (stand-alone and mini-grids) will play a key role in achieving universal access to modern energy services by 2030 – a target within the Sustainable Development Goal (SDG) 7 on energy. These solutions also have the potential to contribute to other SDGs related to livelihoods, education, health, water, employment and gender equality. To realize these benefits, tailored policies are needed to support the deployment of decentralized renewables to accelerate the pace of energy access. National energy access plans should consider both on- and off-grid solutions to reach universal access in a timely manner. Targets for electrification using stand-alone systems and mini-grids have been adopted by many developing countries. In the specific case of mini-grids, enabling regulatory measures are needed related to the right to generate and sell electricity, tariff-setting and main grid connection, and fiscal and financial incentives such as subsidies, grants and tax breaks. Equally important are quality assurance frameworks, measures to facilitate access to finance, capacity building and linking energy services to livelihoods. Greater attention is needed to reduce the use of traditional fuels for heating and cooking. Energy access plans should prioritize the adoption of clean-cooking systems and fuel switching towards modern fuels. Quality and standards, awareness raising and capacity building are key components for the delivery of clean-cooking solutions and should be integrated into energy access plans.

Conclusion - The way forward

Despite the significant progress made over the past decade and the growth in policy support, renewables have yet to reach their full potential and key barriers still inhibit further development. These relate to technology, awareness and capacity, cost, finance, infrastructure and public acceptance, in addition to policy, regulatory, institutional and administrative barriers. Unless renewable energy and energy efficiency are scaled up more rapidly, international climate

objectives will not be met. To this end, a combination of policy measures are needed, focusing on direct support, integration and enabling environments.

Despite recent progress and cost reductions, direct policy support for renewable energy has to be increased, in particular in the building, industry and transport end-use sectors, which both account for large shares in final energy consumption as well as energy related CO_2 emissions. Meanwhile, enabling policies are needed to ensure effective operating conditions for renewables in energy systems and markets, also reminding that in many countries renewables continue to face competition from subsidized fossil fuel options. As such, policy makers should make sure that renewable energy technologies can operate on a level playing field with other technologies, through appropriate market design and regulatory frameworks that facilitate innovation, supply and consumption of renewable energy in all end-uses. Finally, renewable energy needs to be integrated into the daily life of consumers and prosumers, to allow them to be part of the overall energy transition. Integrating policies, in this context, are those measures to encourage behavioral change and policies to couple renewable energy technologies with livelihoods in the access context.

In general, no single policy instrument can fulfill all country objectives. Policies must be selected with care and designed and adapted to reflect specific national and local circumstances. The long-term stability of targets and policies is key to ensuring investor confidence and sustained growth. At the same time, policies need to continuously adapt to changing market conditions, to achieve greater cost-competitiveness and improve integration of renewables into the system. Finally, greater attention must be paid to the transformative impact on society, institutions, financing, ownership structures and the wider economy. This requires supporting effective participation by all stakeholders.

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[1] The present article is adapted from the report "Renewable Energy Policies in a Time of Transition" by the International Renewable Energy Agency (IRENA), the International Energy Agency (IEA) and the Renewable Energy Policy Network for the 21st century (REN21), 2018.

Fig.1

Number of countries with renewable energy regulatory incentives and mandates by type, 2014-2016.

Source: REN21 (2017), Renewables 2017 Global Status Report, Paris.

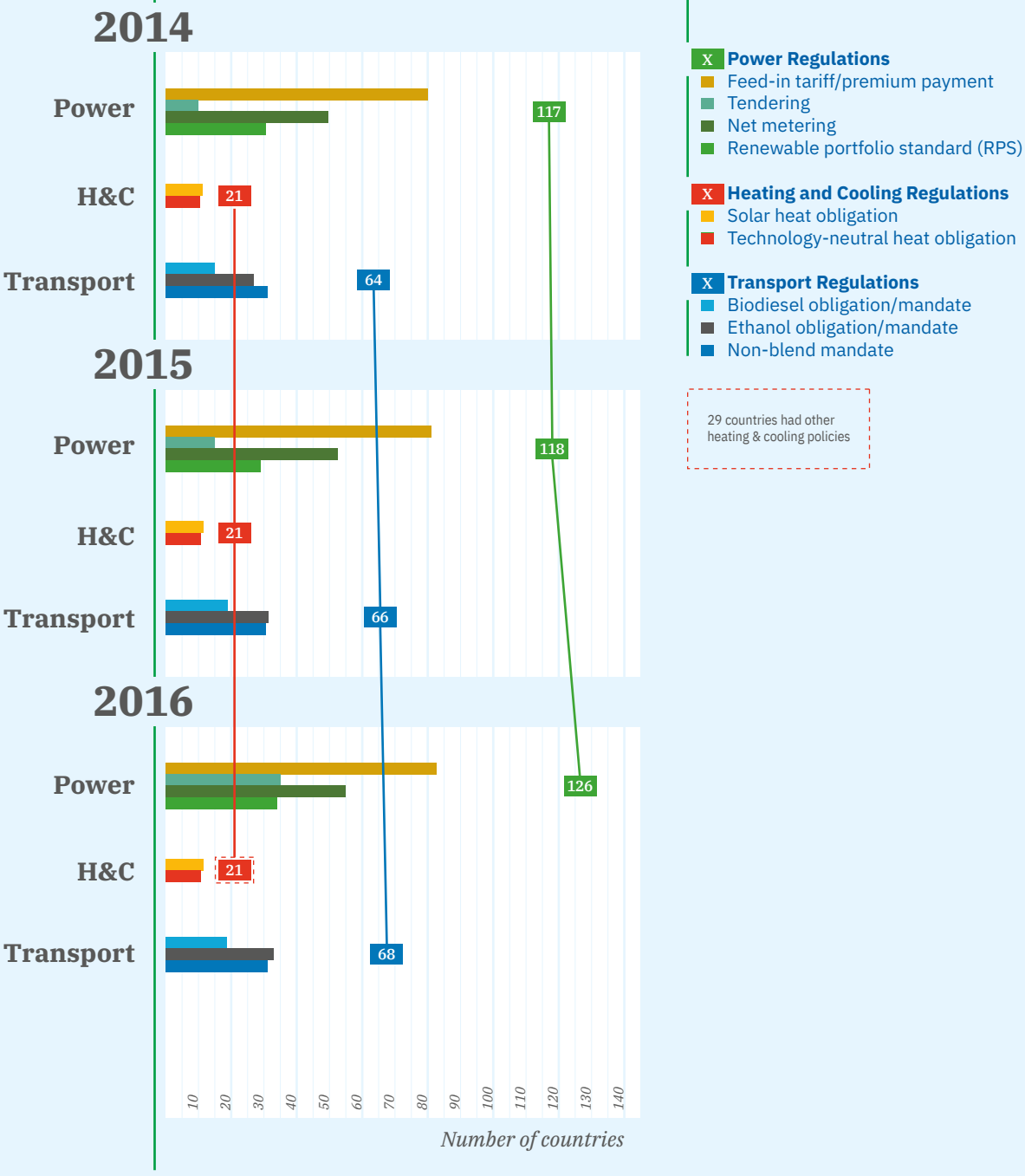
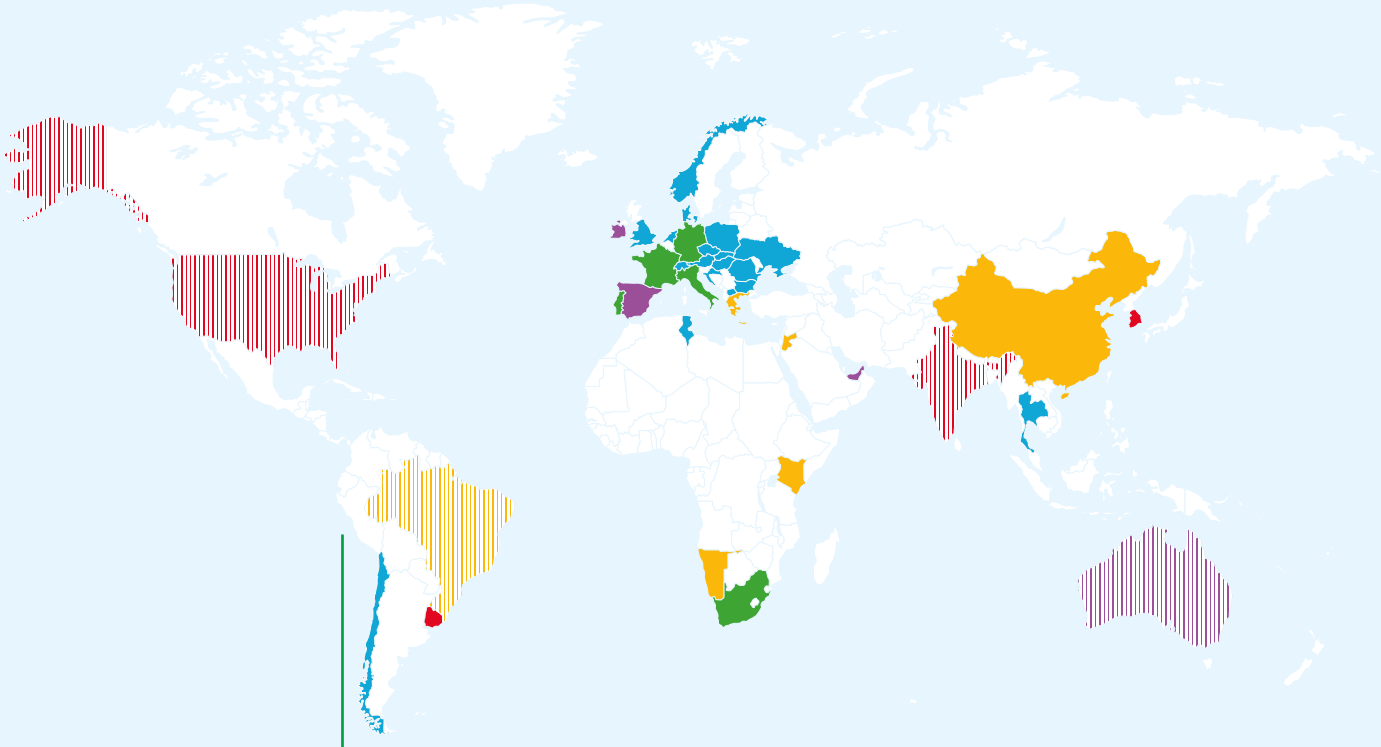


Fig.2

Countries with renewable heating policies, 2016.

Source: REN21 (2017), Renewables 2017 Global Status Report, Paris.



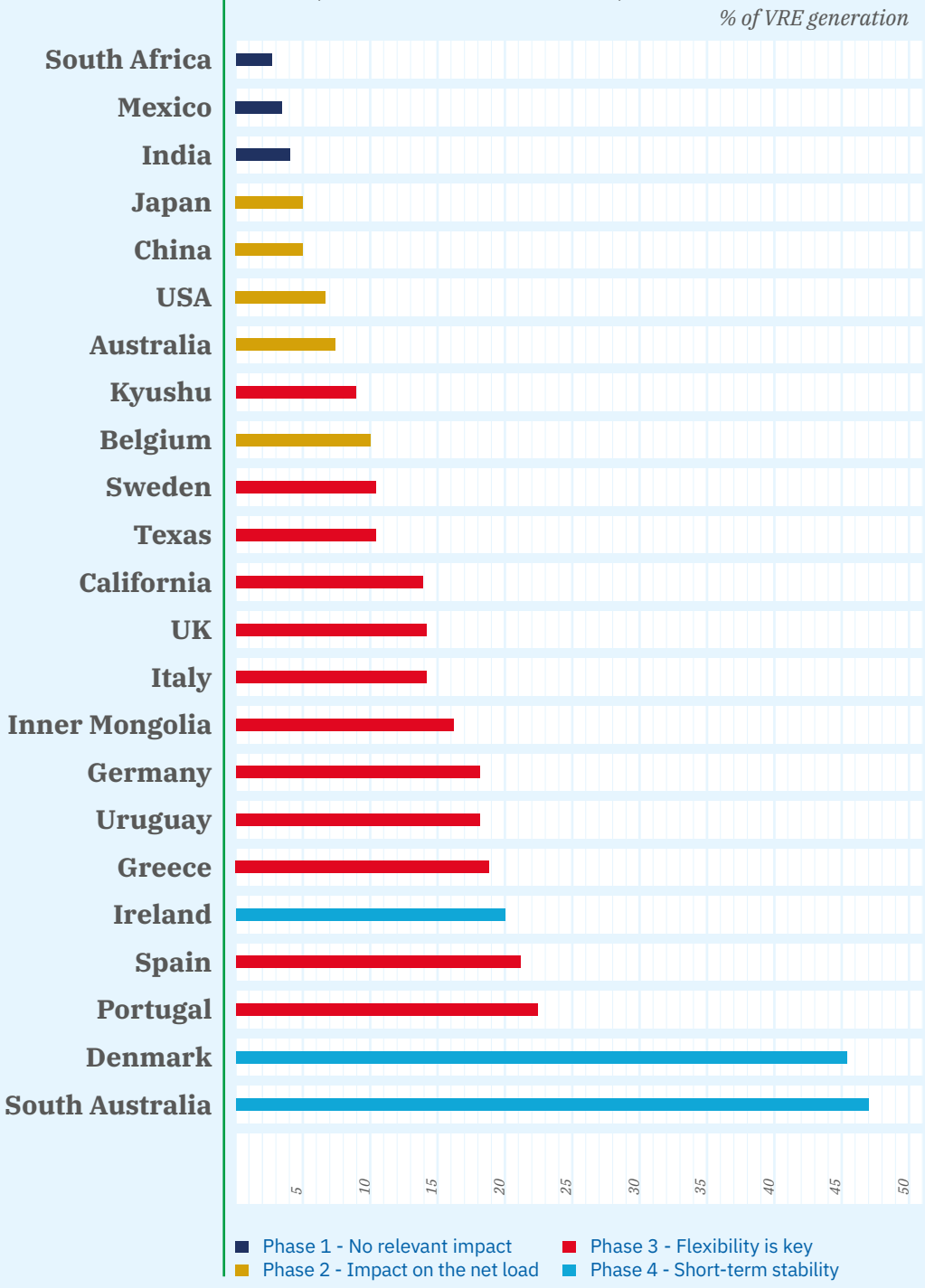
- Countries with solar obligation
- Countries with solar obligation and other policy/policies
- Countries with technology-neutral obligation
- Countries with technology-neutral obligation and other policy/policies
- Countries with other direct support policies*
- Countries with no policiy or no data
- State/provincial (not national) policy/policies

*Indicates countries with other policies that directly support renewable heating and cooling technologies, including rebates, tax credits, FITs, tenders, etc.

Fig.3

Annual shares of variable renewables on electricity generation, 2016.

Source: Adapted from IEA, Renewables 2017 Market Report.



Scaling up Renewable Energy Investment in Emerging Markets: Challenges, Risks and Solutions

Despite impressive cost reductions and market growth, renewable energy investment levels are still far removed from what is needed to decarbonize the energy sector. Significant finance & bankability, administrative & capacity and policy & regulatory challenges prevent accelerated renewables investments, especially in emerging markets. The IRENA Coalition for Action Business & Investors Group[1] produced a white paper[2] for policymakers that identifies key challenges, risks and solutions for scaling up renewable energy investment in emerging markets. Highlighting these issues represents an effort to foster a public-private dialogue that engages all relevant actors on creating the right investment climate to rapidly upscale renewable energy across new markets.

We find ourselves at a time where investing in renewable energy has never made more sense. With the last decade's remarkable cost reductions and maturing policy landscape, renewable energy is now the most cost-competitive source of energy in many parts of the world. Yet, investment levels in renewable energy are still far from what is needed to decarbonize the energy sector, in particular for emerging markets. Investors and developers face significant challenges that complicate the scale-up of renewable investment and development. Progress is needed on de-risking finance and bankability challenges, administrative and capacity challenges, as well as policy and regulatory issues. Clear bankability criteria should be established, together with an eye for strong social, financial and environmental sustainability indicators. A white paper was produced by the IRENA Coalition for Action Business & Investors Group consolidating previous analyses and on the ground experiences of some of the leading private sector players in the renewable energy field, all in an effort to foster public-private dialogue on how to address key

risks and opportunities for scaling up renewable energy investments in emerging markets.
● Figure 4. (See Infographic Section).

1. Key challenges

There are currently a few key challenges to rapid upscaling of renewable energy in emerging markets in general terms.

1.1 Finance and bankability challenges

A key concern for any investment is whether a given project is bankable (i.e., banks or an internal investment committee must be convinced the project will be profitable and perform as proposed over the financing period). In today's competitive renewable energy environment, margins are increasingly narrow, and therefore risk must be minimized in every way possible. In this context, the power purchase agreement (PPA: the agreement with the off-taker as to how much will be paid for each unit of power produced) is critical. The financial health of the off-taker or buyer of power needs to be strong enough to convince lenders/investors to take the risk over the term of financing. Another risk to be mitigated is currency risk, i.e., where the capital purchase, financing/debt service is made in one currency but the revenue stream or operating expenses are in another, usually local currency.

1.2 Administrative and capacity challenges

The adage "time is money" holds true for the development of renewable energy projects. Delays in project development timelines, whatever the source, can make the difference between a viable project and one that is not.

The clarity and timeliness of procedures and decision-making processes are critical to creating a good investment environment. Decisions do not have to be favourable to one party or another; it is just necessary for there to be clarity regarding who is going to make them, when they are to be made and what the decision-making criteria are. Having too many agencies or regulatory bodies involved in the process can create significant delay as well as a lack of clarity pertaining to permitting and regulatory procedures.

One of the most difficult issues faced by renewable energy projects in many parts of the world is land tenure. Lack of clarity regarding the law and rules of land control can be a complex and terminal challenge in project development. The renewable energy industry should not be put in the position of attempting to resolve decades- or centuries-old land disputes.

1.3 Policy and regulatory challenges

Beyond risks associated with unfavourable policy landscape and power market design choices, the main regulatory risk is primarily associated with rapid and/or unexpected changes in energy policies, procedures, market design, grid access or plant dispatch during the project development and plant operations phase.

At the same time, lack of clarity on medium- to long-term planning for demand growth, capacity additions, grid and infrastructure build-out, and environmental goals (either climate- or air pollution-related) will tend to discourage investors.

The ability of the local grid infrastructure to manage the output from renewable energy projects is a critical element for developers. Rules for acquiring grid connections, grid codes, dispatch priority and curtailment compensation are a few of the many issues that often plague early projects in the development of a national renewable energy programme.

Likewise, the payment mechanism – if it involves a feed-in tariff (FIT), a feed-in premium or some form of certificate – often generates regulatory issues in the sense that when new procedures are developed, there can often be a significant delay in payment. Regulatory changes during the project operational phase, which is designed to be 20 years or more in most cases, can have negative impacts on the cash flow streams of the project and therefore the ability to service debt and investors' returns. Any retroactive changes

may also negatively impact the country's ability to later attract project sponsors or lenders for further projects.

For all aspects of project development and execution, it is necessary to be able to take agreements to the bank and to include clearly defined and effective dispute resolution mechanisms. For all parties involved, rule of law and transparency is of utmost importance.

2. Key solutions

Governments can take steps to mitigate the various risks businesses are exposed to in renewable energy project development. While some risks are a normal part of assessing and undertaking new business opportunities, others are unique to new markets and can be mitigated through smart policy adaptations and tools.

2.1 Tools and policies to overcome finance and bankability challenges

The recent trends in renewable energy development are clearly diversifying the investor base and lowering the cost of funding. While those are positive developments, there are still challenges to overcome in order to scale up renewable energy deployment. Addressing finance and bankability challenges with the right tools and policies in place enables governments to effectively translate national and global goals into local implementation. A range of risk mitigation tools can be proposed, particularly related to off-taker and currency risks, that can increase the confidence of investors and the mobilisation of financing in renewable energy projects.

Off-taker risk mitigation

Off-taking parties (i.e., investor-owned, municipal or national utilities) to whom an independent power producer (IPP) is selling electricity do not always have a balance sheet strong enough to satisfy investors. If the off-taker is not creditworthy, a state guarantee can be used to mitigate the payment risk, and in some cases the regulatory risk, to make the PPA bankable enough to be accepted by lenders and investors. If the state itself does not have a high credit rating, development banks or export credit agencies can step in and provide guarantees, which should lower the cost of projects by lowering their risk profile. In markets where traditional off-taking parties (municipalities and national utilities) have limited capacity to satisfy investors, permitting third-party sales, allowing IPPs to sign direct PPAs with large corporate off-takers could be a way to further stimulate investment.

Currency risk mitigation

Currency risk is a significant obstacle for financing projects in emerging markets. A significant portion of capital expenditures, spare parts and overseas workers' salaries and expenses are often in one or more foreign currencies, while the revenue stream, operating expenditures and local workers' salaries are in the local currency. While in the long run, if it is a significant market, most expenditure will be localized, there is an element of currency risk associated with investing in an emerging market. Various commercial risk mitigation instruments are available for purchase. Also, several public finance institutions offer currency hedges (IRENA, 2016a). But these are generally considered quite expensive, adding considerably to overall project costs. The most common mitigation strategy is to offer the PPAs in foreign currency, usually US dollars. International financial institutions can play some role in providing hedging instruments, and/or underwriting some or all of the risk that is transferred from the project developer to the off-taker when PPAs are tied to "hard" currencies such as the US dollar or the euro (IRENA, 2016a).

Standardized contracts for PPAs

Another measure that can help mitigate both the administrative and financing risks is the reduction of transaction costs resulting from the complex nature of contractual arrangements supporting a renewable energy project. Governments and developers can tackle this challenge through the support and use of standardized contracts. The process of standardizing contracts and/or contract components has

been used in other related sectors and could in the case of renewable energy projects be used to establish, among other things, ownership structures, service requirements and PPAs.

2.2 Tools and policies to overcome administrative and capacity challenges

Another category of barriers includes a lack of capacity within governments to develop and operate the administrative framework required to enable investment in, and delivery of, these projects. One of the main barriers is a lack of experience regarding the nature and requirements of a renewable energy power plant. While governmental power and energy departments, and often finance departments, may be focused on renewable energy, colleagues in other departments may have very limited experience of, or interaction with, IPPs or the broad mechanics of renewable energy. This has implications for large swathes of government policy, from environmental and land-use permitting to aviation and transport.

Centralize, strengthen and streamline administrative and permitting institutions

The establishment of "one-stop shops" for infrastructure investors can assist in the coordination of administrative and permitting requirements and encourage investment. This can help to work around the barriers of inertia and lack of experience while collaborating with other governments to build the needed capacity over the medium term. Zambia's Public Private Partnership Unit (Zambia Development Agency, 2014), Morocco's MASEN agency, and, to an extent, South Africa's IPP Office (IPP Projects, 2018), are good examples of such shops. The government of the Philippines recently committed to an intensive programme of infrastructure investment, which included a commitment to guarantee project permitting within 30 days (Philippines, 2017). Projects not permitted within this period are to be deemed to have consent to proceed. This is a bold initiative, and may not suit all countries, but it is an example of "outside the box" thinking that will enable investment in infrastructure, including new power plants.

Mitigate/resolve land tenure issues

In many countries, land use and ownership records are limited, and patterns of land ownership are complex, involving post-colonial structures, unresolved indigenous land claims and/or communal patterns of land use, among others. Often, government departments with responsibility for land reform, land registration or land-use planning are distant from government departments in energy policy. They may have their own priorities, which may not be fully aligned or share the same energy policy focus. As a result, applications for land use for energy projects are often delayed or deprioritized. Thus, introducing some level of government guarantee in the event of land disputes, or, alternatively, for a government to designate zones suitable for renewable energy development, could have a tremendously positive impact on renewable energy development.

Another way to proactively deal with land tenure issues and social acceptance of renewables is through dialogue and proactive engagement with landowners and communities. Following years of land disputes in Mexico, renewable energy developers are now working to promote a good relationship with landowners and communities close to wind and solar farms. A strategy used by a leading developer operating in the Oaxaca region has been to conduct an annual socio-economic community study. This study serves as a guideline to continuously reinforce the company's Social Management Plan, considering local interests and allowing it to address risks and opportunities that arise.

2.3 Tools and policies to overcome policy and regulatory challenges

Addressing regulatory challenges requires building a sound regulatory system and an effective legal framework that establishes long-term, sound renewable energy policies and market conditions. While predictability is of the highest importance, flexibility needs to be recognized as a key element to adjust to a rapidly evolving market environment and technology development.

Comprehensive and holistic energy strategy and policies
Policy makers and regulators should consider delivering an energy strategy and policies focused on the implementation and growth of renewables that are coherent with three main principles: environmental sustainability, security of supply and economic affordability. Failure to address those adequately could result in an unbalanced policy design, increased policy risks and damaged public acceptance – all of which are likely to have negative impacts on the renewable energy investment process.

Policy risk mitigation
Policy risk is a barrier in mature markets. The most useful things governments can do to mitigate policy risk are to establish and maintain clear policies over the long term and to make only gradual policy changes, announced well in advance. Such steps will establish a clear track record and build confidence in the market. Some of the worst policy steps governments can make are the so-called "retroactive changes" that have been experienced recently in some markets. These have the effect of killing investment for a period of time, with confidence in the market returning only very slowly, if at all. These should be avoided at all costs. The tools and policies available to overcome those should cover institutional, economic, legal and technical aspects that will affect renewable energy projects.

Rule of law and dispute resolution
The rule of law is crucial to provide comfort to all parties involved. Law and rule production mechanisms should be open, transparent and non-discriminatory. Voluntary dispute resolution systems and independent judiciary systems are necessary to provide fair and non-discriminatory decisions.

Grid regulation
The process of acquiring grid connections, the establishment and enforcement of grid codes, transparent arrangements for dispatch priority, grid services (low-voltage ride through, reactive power, etc.) requirements and curtailment compensatory schemes should be each under the responsibility of a single regulatory body, and clarified up front before the first projects are connected, and modified/upgraded periodically on a non-retroactive basis in response to both consultation with stakeholders and the evolution of the power system as a whole.

Payment mechanisms
Regardless of whether the payment mechanism is a result of participation in the energy market, a PPA, a FIT system, a feed-in premium system, a system based on clean energy certificates, tax benefits or something else, it is necessary for one body to be fiscally responsible to ensure a stable and predictable revenue stream. In the case of renewable electricity provision, long-term predictability in terms of revenue is crucial to lower the cost of capital. A mechanism designed to provide revenue stability is required.

International policy standards and comparability
Participation in multilateral and/or international agreements, such as international trade promotion, investment protection or intellectual property rights, is crucial to deliver political and economic stability and produce positive effects on investment. Equally, collaboration in political and economic integration projects will limit the risk perception that might hinder investment flow, particularly at the international level. Such an approach will deliver benefits in terms of institutional design, policy definition, rule production, market supervision and best practices sharing.

3. Conclusion

The increasing competitiveness of renewable technologies is driving the energy transition across the globe, with huge untapped potential in the smaller emerging markets in Africa. The benefits are clear: renewable energy technologies are low-cost, by definition indigenous, sources of energy that do not pollute and do not contribute to the climate change problem. In addition, they can attract billions of dollars of investment,

help create jobs and grow local economies, while insulating local economies from the vagaries of the international commodity markets and improving their foreign exchange position. But the market alone, despite record low prices for wind and solar, has as yet proved insufficient to spread the benefits of renewables beyond the larger established markets.

These recommendations were presented and discussed with industry, government representatives and over 50 legislators in the first-ever public-private dialogue during the Eighth Session of the IRENA's Assembly in Abu Dhabi in January 2018. There was a broad consensus that there is not a lack of investment finance or capital in the marketplace for good projects. There is, however, a lack of bankable projects to attract investment and fulfill today's appetite for renewable energy projects (compounded by political and market barriers), to attract investment and scale up renewables to meet the Paris targets and the Sustainable Development Goals. The public-private dialogue led to the following conclusions:

- Political will, clear targets and long-term policy frameworks that ensures a broad and just participation in the energy transformation are crucial to successfully scale up investment.
- Public finance institutions need to move away from direct financing to focus on risk mitigation including off-taker guarantees and currency risk hedging mechanisms, which in turn is critical to reduce financial costs.
- Standardized contract templates are an important tool for reducing transaction costs and in allowing the aggregation of projects to create larger financial deals.
- Non-discriminatory market access is needed, allowing for both private and community-based investors to engage effectively in the energy transition.
- Importance of maximizing socio-economic benefits at all levels, especially the local community level including local job creation.
- There is strong support for long-term and effective carbon pricing and the removal of existing subsidies to fossil fuels.

As we move forward with the energy transformation, the need to cooperate in identifying and sharing experience and good practices will only continue to grow. Indeed, intervention by governments, international financing institutions, working in partnership with the relevant industry and investment sectors can help increase the pace and scale of investment. Industry knows how to site and build solar plants, wind farms and other renewable energy installations, and both public- and private-sector financial institutions know how to finance them. The most important element is for governments to send clear signals that they are eager to attract investments and to do so in a way that is beneficial to all concerned.

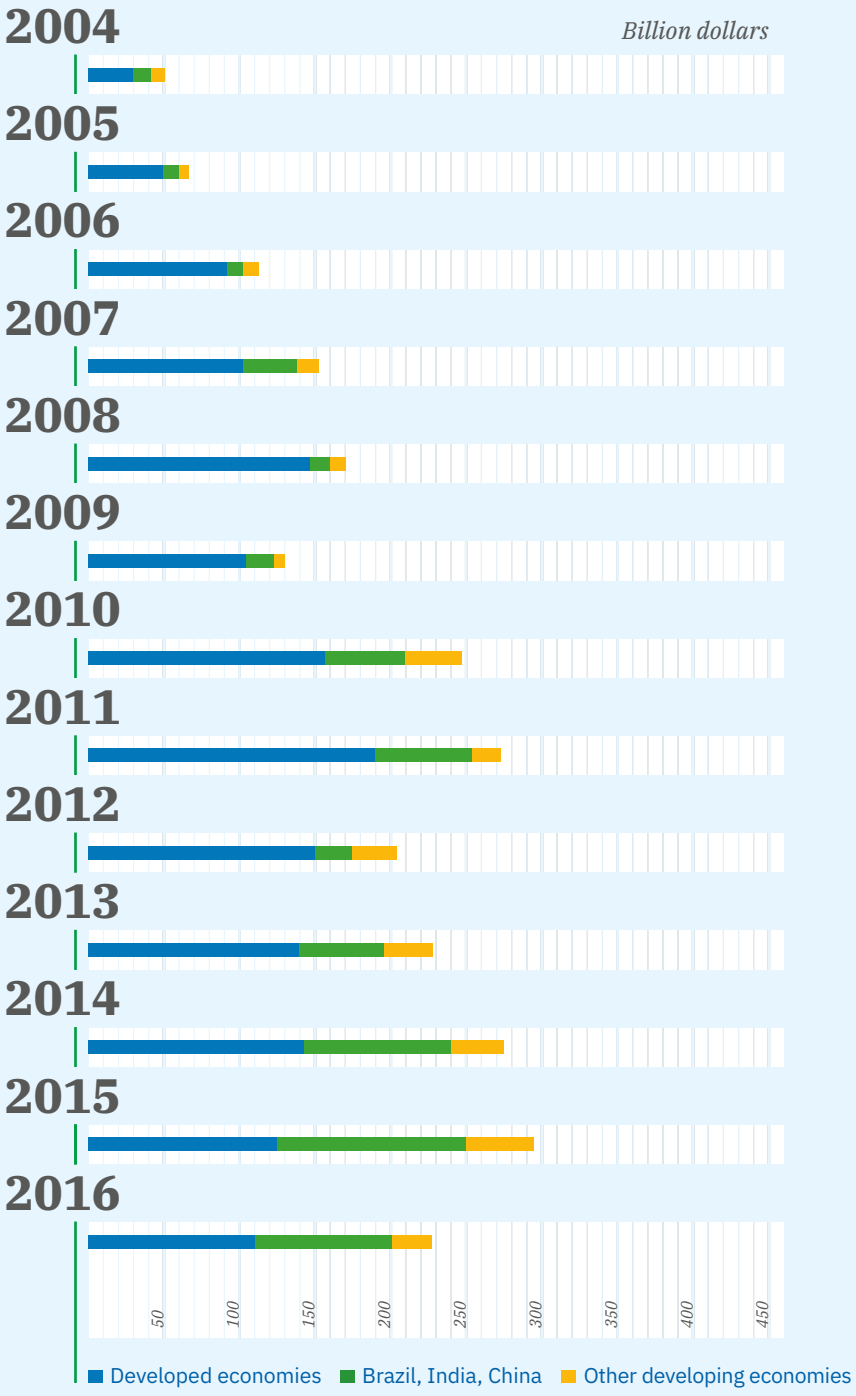
[1] The IRENA Coalition for Action (Coalition) is an international network with a vision for its members to work together to advance renewable energy in order to drive the global energy transition in line with the Sustainable Development Goal on energy. Within the Coalition, the Business and Investors Group is a Working Group chaired by the Global Solar Council (GSC) and the Global Wind Energy Council (GWEC) aiming to provide a platform for renewable energy businesses and investors to discuss current challenges and agree upon solutions to put forward to policymakers.

[2] This article is an edited version of the white paper developed by the IRENA Coalition for Action Business & Investors Group. The full version can be downloaded on the IRENA website.

Fig.4

Global annual investments in renewable energy in developed and developing countries, 2004-2016.

Source: Frankfurt School - UNEP/BNEF (2017).



The winelands near Stellenbosch, South Africa, outside of Cape Town.

Sustainable Renewable Energy Finance and the Role of CDP

The approval of the UN 2030 Agenda and the ratification of the Paris Climate Agreement have shown, more clearly than ever, a broad consensus on the non-sustainability of current development models. A global effort is needed to achieve sustainable growth and political stability. To this end, there is a need to leverage inadequate national and European public resources that maximize private finance involvement in development finance. It is widely held that we need to pass "from billions to trillions" in order to support the 2030 Agenda ambitions. Achieving the SDGs requires an estimated global investment of $3.9 trillion per year for the next 12 years. Bridging the current 'financial gap' needs an 'incremental' approach based on a medium-long term strategy, able to leverage scarce public resources to maximize crowding-in of private financing. The CDP Group, with its unique business model, is the ideal vehicle to pursue sustainable finance, implementing public-private partnerships to set a wide range of financial instruments aimed at directly supporting action on climate change and the development of sustainable energy projects.

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CDP'S development cooperation policies

Since its establishment, the traditional mission of Cassa depositi e prestiti (CDP) has been to support Italian economic development and growth acting as a long-term investor with a public mandate. CDP uses private resources, mainly postal savings, to finance initiatives of general economic interest, transforming short-term funding into investments in the real economy.
As a national promotion institution, having a long-term strategy implies following a systemic approach that is focused in its scope on sustainable development.

If in the past years, like many of its European counterparts, the main focus of CDP's activities was on the domestic dimension, nowadays CDP is increasingly multiplying its efforts also on the international front. Indeed, in recent years CDP has developed and strengthened its business lines aimed at supporting exports and internationalization of Italian companies and, more generally, all activities aimed at promoting the country. Recently, with Law 125/2014 CDP has also assumed the role of financial institution for development cooperation.

There are several challenges that Italy and Europe must deal with such as demography, climate change and energy, to name but a few. To face these challenges, Italy must consider a braver concept of cooperation. A new identity focused on the concept of co-development, in which the development of other countries is increasingly crucial for national development.

It is fundamental that both public and private sectors work effectively to support such a change of approach. The approval of the 2030 United Nations Agenda and the ratification of the Paris Climate Agreements have shown, more clearly than ever, a broad consensus at global level on the non-sustainability of the current development models. According to this, therefore, we need an integrated 360° global effort to allow sustainable growth and political stability.

It is for this reason that cooperation becomes strategic for International Financial Institutions (IFIs), as well as for the European Commission (EC), which has, in fact, strengthened its support tools with the launch of the External Investment Plan (EIP).

However, the fundamental problem, and also the main reason for the role of the National Promotional Banks being strengthened across Europe, is to convey additional resources from the private sector to development projects. To this end, the need arises to leverage increasingly scarce public national and European resources in order to maximize the involvement of private finance in the area of development finance.

In this scenario, the world is facing an enormous financial challenge for global development and it has been commonly agreed that we need to move "from billions to trillions" with an estimated $3.9 trillion every year for the next 12 years required to successfully bring about the achievement of the SDGs.

Bridging the current financial gap needs an incremental approach based on a medium-long term strategy that focuses on two priorities: the development of asset classes and calibrated mechanisms for risk allocation between the public and the private sector.

First, in order to effectively identify viable new financial models and innovative instruments to reduce the cost of financing for the public sector, a systematic approach in building project pipelines is needed. This is a key factor for developing a proper asset class capable of attracting private long-term investors. At the same time this requires a strong capacity for structuring and managing complex projects and investment programs; likewise, greater efforts to implement technical assistance are required.

Secondly, it is necessary to identify a new balance between the public and the private sectors, between the donor logic and the market player logic: donors and public resources must be strategically focused on planning and designing financially sustainable initiatives and mitigating non-marketable risks. With a correct financial allocation of risk – in a context of political and regulatory stability – the private sector will be able to play a central role in financing initiatives aimed at maximizing the leverage effect of those limited public resources available.

The tool that is increasingly used to meet these needs is "blending": a sort of bridge between public and private intervention, between general interests and the risk appetite of market players, and a mix of public resources with private finance invested at market rates.

Blending, however, is not only the mechanism through which it is possible to mix forms of funding that come from different sources. Blending – or blended finance – is the process that allows the correct identification of market distortions and leads to a balanced allocation of risks between subjects. Indeed, blended finance can be used to capture positive externalities that are not usually commercially capturable (for example, utilities or other public services in the poorest areas of the planet where the level of demand would be insufficient to produce adequate remuneration for private investors). At the same time, blending should be dedicated to risk mitigation through a range of possible financial structures, from a *pari passu* risk sharing approach to first-loss guarantee schemes, in order to promote credit enhancement of the financial structures designed to support development initiatives.

Furthermore, the concept of blending could also be more widely applied, within a strategy integrating international cooperation and develop-

ment finance activities with export and trade finance instruments. Traditional financial instruments of export credit increasingly need to be reshaped in order to match sustainable development targets with greater strategic, long-term attention paid to social and environmental impact. This is a crucial condition to promote a convergence among different financial instruments that range from cooperation to development finance, to export, trade and project finance. A convergence of targets and an integration of financial approaches can represent a fundamental pillar of a new development strategy, aimed at promoting sound financial leverage and, therefore, helping to reach the ambitious targets of the 2030 Agenda, both in Least Developed Countries (LDCs) and in developed countries.

This holistic approach is consistent with the strategy followed by the European Commission, in particular with the EIP, but it is also consistent with the mission and historical experience of CDP acquired on national and international markets.

Regarding its international activities, the CDP business model is unique as it combines different but complementary functions into one group: from export credit, to foreign investment support, to international cooperation and development finance.

In this context, CDP can play a fundamental role to optimize the financial resources dedicated to the cooperation and promotion of Italy abroad. This is possible thanks to the complementarity of the public funds that are already managed through the Revolving Fund for Development Cooperation (RFDC) with funds managed by CDP, including those of SACE and Simest, and funds that come from Europe in the envisaged windows of the EIP.

The CDP Group for Africa.

In recent years, the CDP Group has strengthened its international vocation, following the integration of SACE and Simest into the perimeter of the Group and the creation of an integrated financial system dedicated to the promotion of the country abroad, also in the regions and in target countries of development cooperation. The CDP Group's exposure to these countries is already significant:

- SACE[1] has a total exposure of approximately €12.7 billion, of which €4.5 billion in Sub-Saharan Africa;
- Simest has holdings in its portfolio of over €200 million;
- CDP financed interventions by Italian companies abroad for about €800 million, of which €550 million in Africa, concentrated in energy, infrastructure and state-defense.

Moreover, since January 2016, CDP manages the Revolving Fund for Development Cooperation (RFDC). In particular, as regards African countries, in 2016-2017 CDP signed 11 financial agreements with local governments on behalf of the government of Italy for a total value of approximately €230 million.

The strategic approach of CDP

Innovative financing is key to enabling bankable and sustainable renewable energy projects. As renewables become competitive in emerging economies such as Africa, there is an increasing need for innovative financing tools able to leverage the insufficient public resources available to maximize private intervention.
CDP's ambition is, therefore, to leverage the experience gained with the "Juncker Plan" where important results have been achieved in terms of promoted initiatives and volumes of resources mobilized, in synergy with Italian and other European Development Financial Institutions and the experience gained from previous actions in Africa.
Regarding the new European EIP, CDP is currently engaged in the drafting of investment program proposals on all five sectoral windows of the Plan, i.e. "Micro, Small and Medium-Sized Enterprises Financing", "Sustainable Energy and Connectivity", "Digitalization for Sustainable Development", "Sustainable Cities" and "Sustainable Agriculture, Rural Entrepreneurs and Agroindustry".
Moreover, CDP is collaborating with the Italian Ministry of the Environment and Land and Sea Protection (Ministero dell'ambiente e della tutela del territorio e del mare - MATTM) to define the modalities of intervention within the 2018-2019 program of international cooperation focusing on environmental issues.

EIP and the Sustainable Energy Window

CDP is developing a strategy for the promotion of sustainable energy as well as for action to combat climate change. In addition to its own initiatives, CDP is also collaborating with other European and International Financial Institutions. To this end, CDP has joined an initiative promoted by the European Investment Bank (EIB) and the Agence Française de Développement (AFD), for the implementation of renewable energy projects.
EIB and AFD are presenting to the European Commission a common proposal for a "European Platform for Renewable Energy" under the "Sustainable Energy and Connectivity Window" of the EIP. This initiative is a risk-sharing platform aimed at providing a guarantee to foster the financing of small renewable energy development projects for local private beneficiaries.
CDP is actively involved in presenting other initiatives under the EIP across all the five investment windows with particular attention to Sustainable Development and Climate Change.

Sustainable Development Green Platforms with MATTM

Through the activities of the General Directorate for Sustainable Development, Environmental Damage and Relations with the European Union and International Organizations, MATTM carries out international cooperation activities, both bilaterally and multilaterally, to implement the commitments set by the agendas of the main international environmental processes.
Multilateral action, complementary to what is carried out at bilateral level, proposes the ambitious challenge of combining innovation, development and competitiveness, through the promotion of clean technologies, energy savings, the use of renewable energy and fostering the synergy between research and industry.
In terms of bilateral cooperation, the entering into force of the Paris Climate Agreement states that industrialized countries must provide financial resources to assist developing countries, both in terms of mitigation and adaptation to climate change, to ensure technical assistance for the identification of the most effective practices and actions.
CDP and MATTM jointly defined the guidelines for interventions within the 2018-2019 program of international cooperation focusing on environmental issues. The main themes covered regard sustainable economy, renewable energy, energy efficiency, mitigation and adaptation measures. Moreover, the strategic areas are identified in the Mediterranean basin and Southern Africa, but also in Small Islands and South-East Asia. In this context, CDP and MATTM consider the development of renewable

energy in Africa one of the priority areas of intervention. MATTM and CDP are currently identifying countries where the platform will be implemented as a pilot.

In conclusion, CDP is ready to play its part in this ambitious agenda to tackle climate change and to spur the change towards a more sustainable and inclusive society, sharing its experience as financial institution dedicated to the promotion of economic development and growth.

This article was developed with the support of Martina Colombo, Head of Sovereign, Multilateral Financing and Blending Partnerships and Alberto Carriero, Head of Climate Change and Sustainable Development, Cassa depositi e prestiti SpA.

[1] SACE is a joint-stock company wholly owned by Cassa depositi e prestiti that offers a wide range of insurance and financial products: export credit, investment protection, financial guarantees, surety bonds and factoring. SACE is enriched with Simest products, ranging from investments in equity capital of companies to subsidized loans and export credit.

Enabling the Green Power Transformation for the Africa We Want

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Africa's energy situation is a paradox of scarcity in plenty – being highly endowed with all forms of energy resources but the least energized region in the world with about 590 million people still lacking access to electricity. This paradox must be addressed urgently to attain the continent's development goals as encapsulated in the UN 2030 Agenda and the continent's wider 2063 Agenda. This requires countries to frame appropriate blueprints and strategies for transformative policies to unlock and catalyze public private partnerships, domestic resources, foreign direct investment and climate finance to unleash the continent's abundant renewable energy resources. As such, a dramatic shift in rethinking energy on the continent is required, capitalizing on new opportunities such as the Africa Continental Free Trade Area and the need to leverage limited public resources to mobilize private sector investments. The good news is that this is indeed possible and already happening on the continent as demonstrated by recent developments in countries such as Ethiopia, Kenya, South Africa and Zambia, among others.

Africa's energy paradox

Africa's energy situation is a classic paradox of scarcity in plenty. Despite of the continent's huge energy resource potential, there are still 590 million people (just over 45% of the population) without access to electricity. However, there has been good progress made in many African countries since 1990 to increase access to energy. Based on data by the International Energy Agency (IEA) the electrification rate increased from 34% in 2000 to 52% in 2016, compared to 64%-86% on average for developing countries, 87%-97% for the Central and South America region, and close to 100% in North African countries over the same period (IEA, 2017). For those with access to electricity, the average per capita consumption of 200 kWh per year in Sub-Saharan Africa remains the lowest in the world. This compares unfavorably to 1,600 kWh in the European Union, 1,075 kWh in India and 4,066 kWh in China.

Although the energy resource potential and demand in Africa are high, the current total active electricity installed capacity on the continent – mostly from fossil fuels (coal, oil and gas) – is only around 173 GW[1], as shown in Figure 5. (See

Infographic Section). This represents an increase from about 168 GW in 2016 (AfDB, 2017), with renewable power reaching a share of 23%, driven mainly by developments in wind, solar photovoltaic (PV), geothermal and large hydropower in South Africa, Ethiopia and Kenya, among others. South Africa has an installed capacity of the same order of magnitude as the rest of Africa (excluding North African countries), which compares to the 53 GW of solar PV capacity addition in China in 2017 alone. The electricity supply mix of current and soon to be online capacity, as shown in ● Figure 6. (See Infographic Section), is dominated by gas and coal. However, a detailed analysis of existing power plants shows that over 50% of the coal plant units are more than 40 years old and therefore could be retired early and their capacities replaced with a resilient mix of renewable technologies. Despite its huge potential, hydropower still represents less than 20% of electricity installed capacity and approximately 16% of generation at 119 TWh in 2015.

A renewable future for Africa's transformation

The continent is highly endowed with all forms of fossil and renewable energy resources. Yet, the total installed capacity from renewable sources is only about 40 GW (including partially active plants), representing less than 2% of global renewable power capacity in 2017[2]. ● Figure 7. (See Infographic Section) shows that the global renewable energy revolution – that saw new capacity additions from renewable sources exceed those from other sources since 2013 – is yet to be felt significantly in Africa. However, as shown in ● Figure 8. (See Infographic Section) the momentum for renewables on the continent has been increasing since 2014 with transformative actions in Morocco, South Africa, Ethiopia, Kenya and Zambia, among others.

Capitalizing on the continent's huge renewable energy potential to provide reliable, affordable clean energy has a key role to play in achieving the structural transformation and inclusive green growth that underpin the UN 2030 Agenda for Sustainable Development bringing tangible benefits such as improved health[3] and the creation of sustainable, green jobs. According to IRENA's 2017 renewable energy and jobs review (IRENA, 2017), the sector included 9.8 million jobs in 2016, with 62,000 of these in Africa (mainly South Africa and North African countries). Ethiopia's Grand Renaissance Dam, for example, is expected to create around 12,000[4] new jobs while generating 6,000 MW of electricity. In addition to jobs and health benefits, Africa's rich green energy resources can contribute to global efforts to reduce emissions in the long term and prevent dangerous and irreversible global warming. However, to better tap the continent's renewable power potential, it is essential to invest in very strong grids that can ensure stability with increasing penetration of variable power from wind and solar sources. In this regard, integrating the power pools of Africa could ensure that renewable power is generated where the potential is highest and used where the demand is highest.

A huge investment opportunity ahead

Analysis by Economic Commission for Africa (ECA) of announced, financed and under construction renewable energy projects in Africa to 2030 shows a pipeline of at least 183 GW as of March 2018 ● Figure 9. (See Infographic Section), dominated by projects in Democratic Republic of Congo (particularly the Inga), Ethiopia, South Africa, Egypt, Kenya, Morocco and Nigeria, with most of the projects being hydropower, solar PV and wind power. At an average cost of $2 million per MW, this pipeline represents investments of close to $370 billion.

Leveraging limited public resource to mobilize private sector and domestic resource for the transformation

Public finance will not be sufficient to meet the huge capital flows needed to unlock Africa's renewable energy potential. Yet, the current level of private sector engagement in the energy sector in Africa is still far from sufficient. The Frankfurt School, UNEP Centre and BNEF 2017 report on global trends in renewable energy in-

vestment shows that of the $242 billion invested globally in renewables in 2016, only about $3.5 billion was in Africa (Frankfurt School-UNEP Centre/BNEF, 2017) – e.g. $894 million in South Africa, $660 million in Morocco, $648 million in Kenya and $745 million in Egypt.

With regard to domestic resources, most African countries are not tapping the huge potential of domestic resource mobilization to finance their energy transformation, even though there have been some cases of great success. South Africa's Renewable Energy Independent Power Producer Procurement (REIPPP) program presents a leading example of what investment transformation can happen from private and domestic sources when the political will and right polices are in place. The bulk of the financing required for investments in the renewable energy procurement program is sourced domestically. Over $14 billion in investments so far are committed to renewable energy procurement in the country. Already, over 6 GW of renewable electricity capacity has been procured, with 3,773 MW dispatched to the grid in 2017. Ethiopia's $4.7 billion Grand Renaissance Dam is being constructed using public, as well as domestic and diaspora bonds.

The World Bank/IFC Scaling Solar program[5] is already making positive impacts on enhancing the confidence of countries to take measures to promote the development of their solar power potential. For example, the Industrial Development Board of Zambia has used this program in a 2016 auction to procure 72 MW of solar capacity at so far the cheapest prices in Africa ($0.06 per kWh). Other countries, including Senegal, Nigeria and Madagascar are now also embarking on the program.

With a number of African countries now already leading the way with ambitious and transformative actions, turning them into renewable energy beacons for other African countries, key questions remain to be addressed. For example: what will it take for these transformations to happen across the board on the continent and where would the investments come from? These are the critical questions that African countries need help with to unleash their clean energy potential for transformed and enhanced livelihoods to ensure no one is left behind towards the Africa we want.

Robust policies and regulatory frameworks for enabling the transformation

The heavy underinvestment in Africa's renewables is due to a combination of factors, including lack of appropriate policy and regulatory frameworks to signal and stimulate investments. Countries must take transformative and concerted measures to instill market confidence in order to attract the levels of private investment needed. Strong political will is the most important ingredient in creating the enabling environment to drive private sector investment.

While many African countries have in place policies and incentives to support renewables, these in themselves are not sufficient. To send clear signal to investors, policies must indicate a country's strong political commitment to develop its renewable energy sector. Such policies are characterized by the "three Cs": clarity, coherence and certainty beyond election cycles. Furthermore, issues of bankability of project off-takers, ease of doing business, enforcement of contracts, and ensuring quality standards and certification are equally important.

Choosing the right incentive mechanisms

Private sector investors need assurance that their investments will generate stable and attractive returns. Policymakers can use different financial instruments such as feed-in-tariffs (FITs) and public tenders to increase generation of dependable energy, building the market and attracting the interest of the private sector. The auction system has proved very effective and reduced costs tremendously. Elements of success with the South African auction system include standardized non-negotiable Power Purchase Agreements (PPAs) denominated in local currency, guaranteed by the government and supported by an enabling environment. This

worked because of careful design and a well thought-out approach that stimulated investor confidence, resulting in over-subscription in fourth bid round and a 68% drop in the average procured price (wind and solar power). For off-grid rural communities, FiTs are necessary to ensure investor interest in addressing energy poverty.

Building credible institutions and human capacity for the energy transformation

Whichever instrument is used, whether a FiT or auction, PPAs are needed. However, the credibility of the PPA is determined by the bankability of the utility and governments involved. National governments, development banks and development partners have an essential role to play in building the capacity and financial health of utilities in order to make them bankable and ready to engage with investors. Furthermore, there is very limited human and institutional capacity on the continent for energy modeling and investment planning. Against a background of increased energy demand for structural transformation, rising population, the need for sustainable livelihoods, as well as the adverse impacts of climate change on the continent, many African countries are discovering new reserves of fossil fuels on a continent endowed with abundant renewable energy resources. This calls for urgent action to support African countries to strengthen their capacities in energy planning so as to be able to optimize investments in energy production and services. That is why ECA has built a partnership to launch the Energy Modeling Platform for Africa and is developing a modular training program on energy supply and demand management and planning through its African Institute for Economic Development and Planning (IDEP). The private sector also needs to support such programs since this will, in the medium term, help reduce transaction costs locally through readily available personal and strengthened institutions that can speed up informed decision making.

Addressing real and perceived risks

Africa has suffered for too long from unnecessary high cost of capital owing to high perceived investment risks, which do not correspond with the reality on the ground. That reality shows that Africa has a track record as good source of return on investment. In fact, Moody's 2016 Investors Service report on defaults and recovery rates for project finance bank loans (based on projects from 1983 to 2014) shows that while North America, Europe and Southeast Asia accounted for 76.9% of defaults, Africa only accounted for at most 3.1%. The high cost of capital in Africa must come down and development banks must play a key role in ensuring that accelerated investments flow into Africa to support its transformation agenda. Policymakers need to play an active role in tackling perceived risks by making market information more accessible to investors as well as proactively sharing success stories around engagement with the private sector in their countries.

Leveraging climate change for resilient investments

Hydropower has a major role in the current and future energy mix of African countries. Against a background of climate change and uncertainties, it is important to ensure that hydropower systems will perform and provide the services needed, as well as return on investment into the future. A 2015 study by the World Bank and the African Climate Policy Centre of the ECA on Enhancing the Climate Resilience of Africa's Infrastructure (ECRAI)[6] found that failure to integrate climate change in the planning and design of power and water infrastructure could entail – in the driest climate scenarios – losses of hydropower revenues of between 5% and 60% (depending on the basin) and increases in consumer expenditure on energy up to 3 times the corresponding baseline values. There is also a growing requirement for organizations to disclose the climate risks to their investments. It is therefore vital that the huge investments that will flow into the energy sector over the next

few decades perform and deliver returns in future climate. That is why the ECA, together with the World Bank, the African Union Commission and the African Development Bank – with initial funding from the Nordic Development Fund – have established the Africa Climate Resilient Investment Facility (AFRI-RES) aimed at strengthening the capacity of African institutions and project developers to integrate climate information and services into the planning, design, and implementation of infrastructure investments to enhance their resilience to climate variability and change in selected sectors.

Conclusion

Africa is in a unique position to achieve its development goals through a transformation of its energy system. Energy strategies adopted by African countries are fundamental to how the continent responds to climate change while transforming its economies for inclusive green growth towards resilient socio-economic transformation that leaves no one behind as the continent strives to reach the development objectives encapsulated in the UN 2030 Agenda for Sustainable Development and the wider African Union's 2063 Agenda. With limited public resources, countries will have to leverage private and domestic resources to unleash their renewable energy potential to energize national development agenda. For this to happen, policy coherence, certainty and clarity are essential as they boost investor confidence. Notwithstanding tremendous progress and pathbreaking renewable energy developments in some countries such as South Africa, Ethiopia, Kenya, Zambia, among others, so much work still needs to be done to ensure that the much-needed investments can flow not only from the private sector but also from domestic resources and other innovative sources of finance. But transformative leadership and political will are needed to also structure energy markets on the continent, integral to national development plans. Starting from a high deficit, African countries have the opportunity today to design their energy options in ways that assure long-term performance and optimize the continent's abundant renewable energy resources for enhanced livelihoods, green industrialization, strong regional integration and enhanced trade, capitalizing on the framework of the African Continental Free Trade Area.

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[1] Based on ECA estimates from the GlobalData's power plants database (www.globaldata.com).

[2] See IRENA's resource gateway at http://resourceirena.irena.org/gateway/dashboard/?topic=4&subTopic=17.

[3] Access to modern energy forms and services could cut the number of premature deaths from indoor smoke and air quality by up to 500,000 according estimates by the IEA (IEA, 2017a).

[4] http://www.water-technology.net/projects/grand-ethiopian-renaissance-dam-africa/.

[5] The program aims to support countries overcome the challenges institutional capacity, lack of scale, lack of competition, high transaction costs and high perceived risks towards scaling up investments in solar energy (https://www.scalingsolar.org/).

[6] Two studies have been produced: one on the power and water sectors and one on the roads and bridges sector. These are accessible online at: https://openknowledge.worldbank.org/handle/10986/21875 and http://documents.worldbank.org/curated/en/270671478809724744/pdf/110137-WP-PUBLIC-ECRAI-Transport-CLEAN-WEB.pdf.

Electricians working on high-voltage power lines. Johannesburg, South Africa.

Fig.5

Cumulative installed electricity capacity in Africa by source.

Source: ECA estimates from the GlobalData's power plants database (www.globaldata.com).

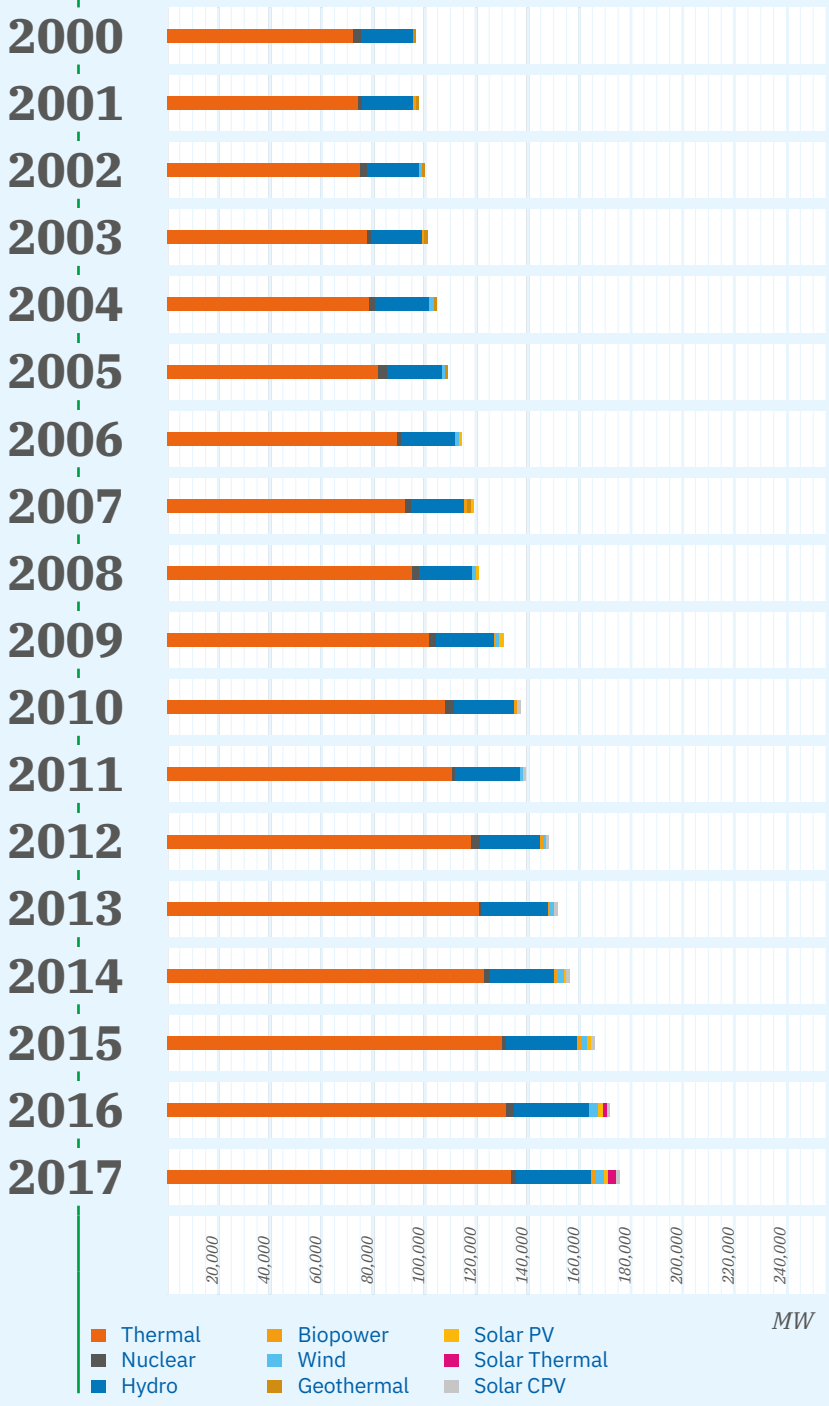


Fig.6

Share of total installed electricity capacity in Africa.

Source: ECA estimates from the GlobalData's power plants database (www.globaldata.com).

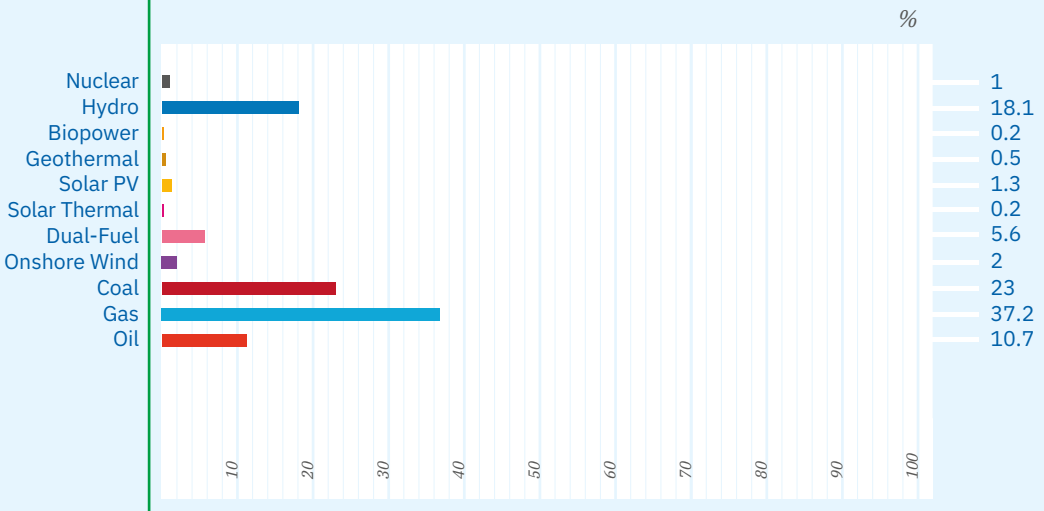


Fig.7

Cumulative renewable electricity capacity in Africa.

Source: ECA estimates from the GlobalData's power plants database (www.globaldata.com).

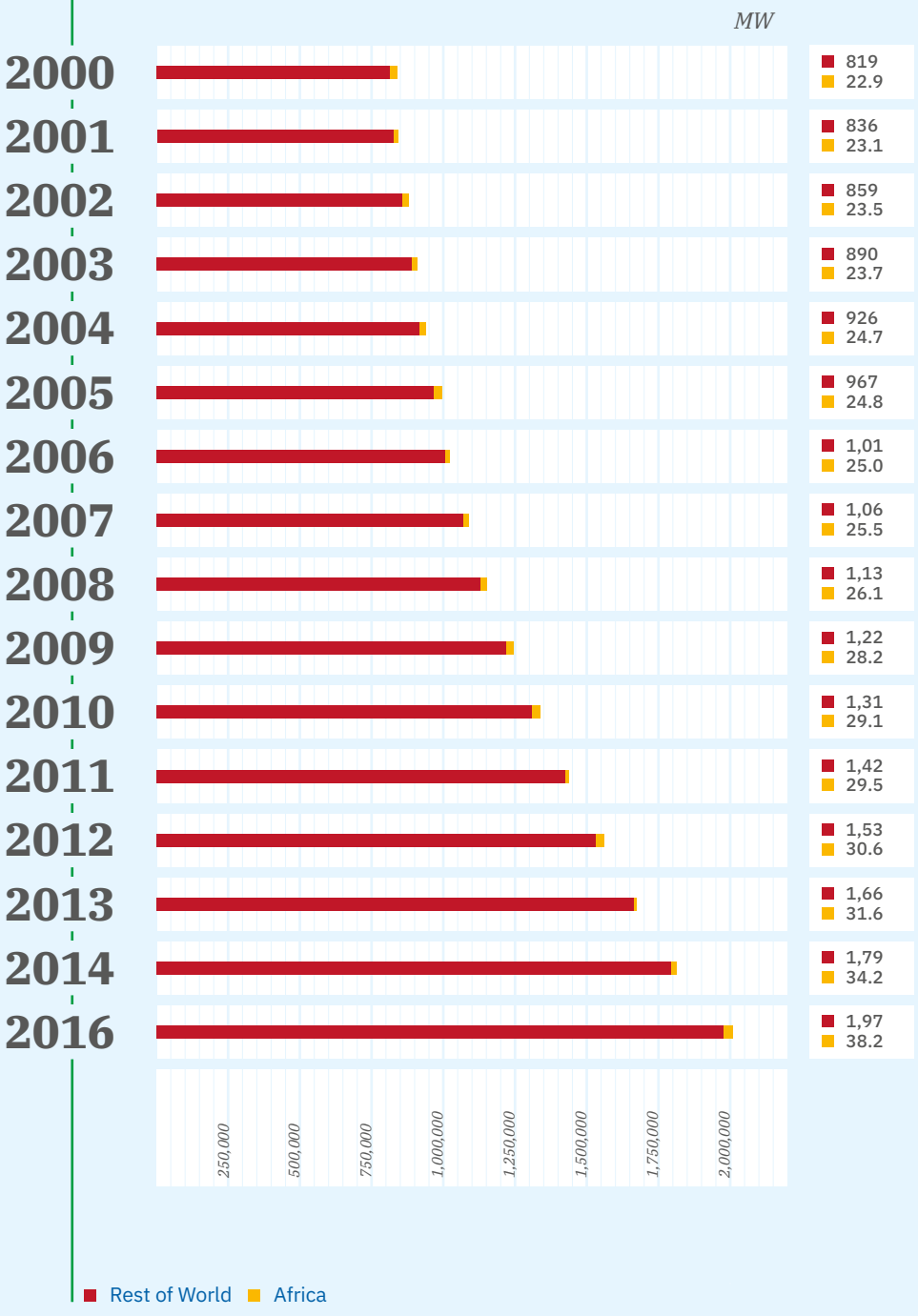


Fig.8

Cumulative active renewable power installed capacity in Africa.

Source: ECA, compiled from GlobalData's power plants database (www.globaldata.com).

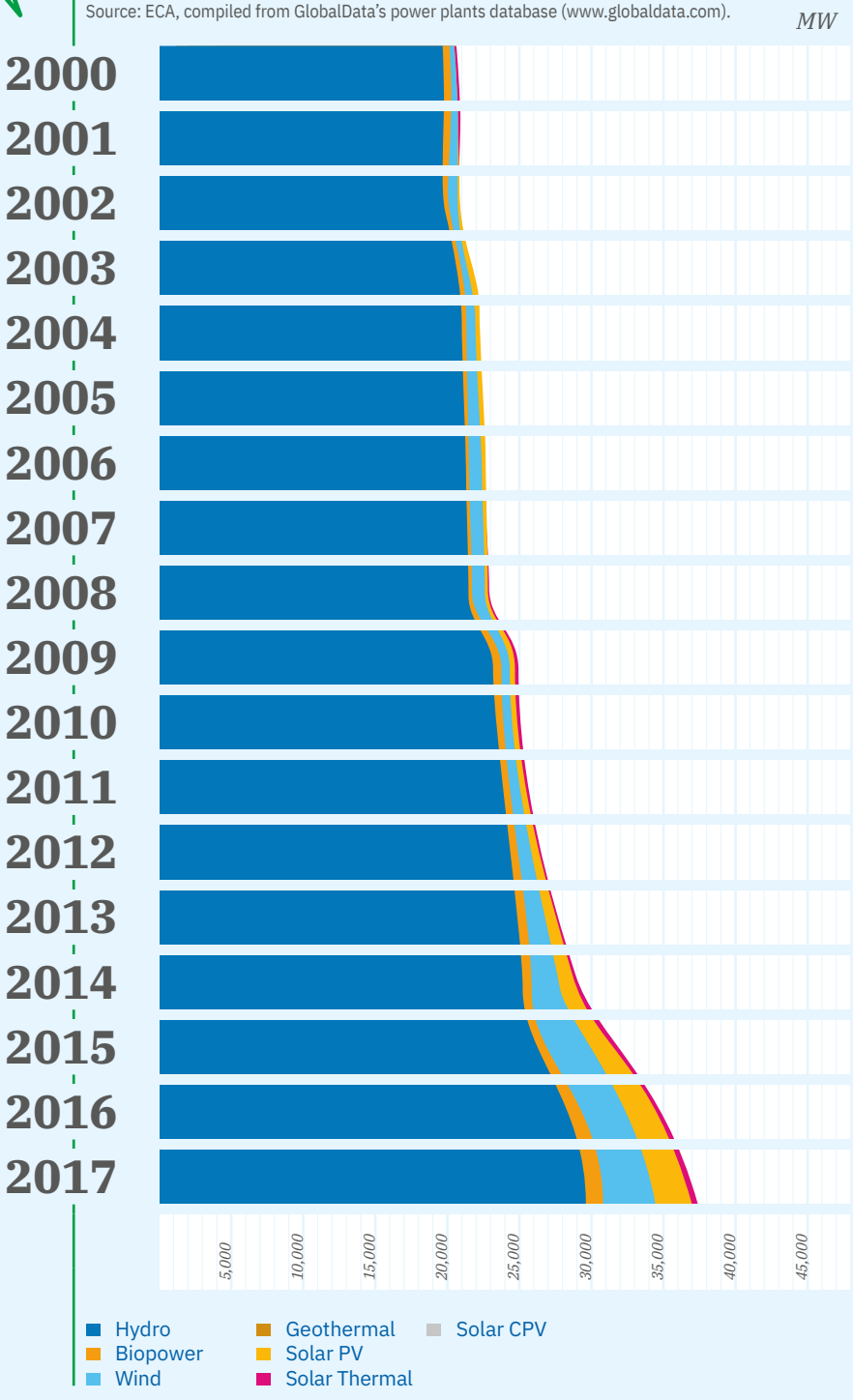
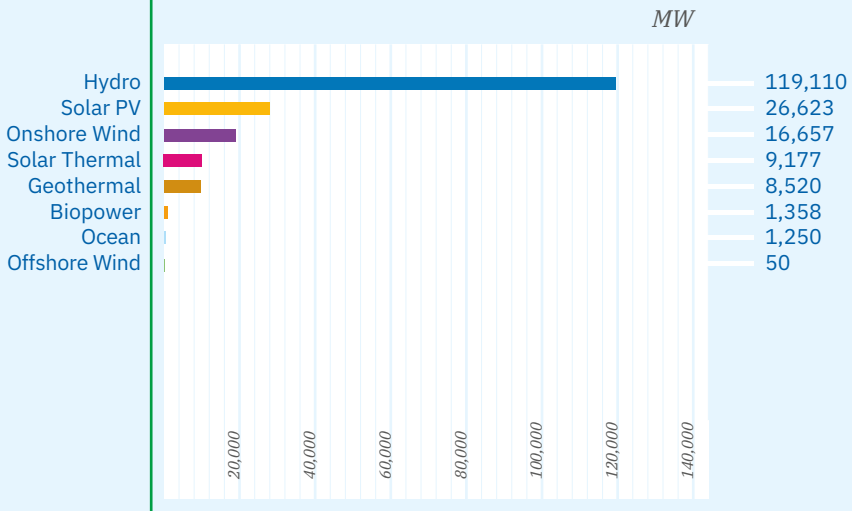


Fig.9

Pipeline of announced, financed or under construction renewable power projects in Africa to 2030.

Source: ECA, compiled from GlobalData's power plants database (www.globaldata.com).



Midmar dam wall overflowing in 2009, Howick, KwaZulu-Natal, South Africa.

Making an Impact in the Mediterranean and Africa by Supporting Renewable Energy Projects

The "raison d'être" of the European Investment Bank (EIB) is to make a tangible positive impact on society and on the economy through the projects it finances. This is even more true for its operations outside the EU including the Mediterranean (Med) region and Africa, in the latter of which two-thirds of the population is estimated not to have access to electricity, and existing generation capacity is dominated by aged, inefficient and polluting fossil fuel plants. In this context renewable energies (RE), either utility scale or off-grid, are increasingly an essential part of the solution as they represent a sustainable and competitive choice improving also the countries' security of supply and independence from fuel imports. The EIB has committed to dedicate 35% of its lending in support of climate-related investment in developing countries by 2020 and has already reached this goal in 2017 with RE playing a prominent role. The EU bank also supports the EU's commitment to implement the 2030 Agenda and the SDGs and the results of the EIB supported projects can be linked clearly to many SDGs.

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Founded in 1958 by the Treaty of Rome, the EIB is the largest supranational borrower and lender in the world, and the only international financial institution owned by and representing the interests of the European Union Member States. The EIB works closely with other EU institutions and the Member States to implement EU policies.

As the bank of the European Union, the EIB also has a special role to play outside the Union, supporting the common efforts of EU Member States towards advancing EU external policy objectives. Among EU institutions, the EIB has a unique ability to mobilize financial resources for economically sound projects around the world, whilst our technical expertise helps to ensure that these resources achieve high environmental, social and economic returns. EIB loans can be blended with grants from the European Commission and Member States to provide the right financing mix for projects that could not otherwise go ahead. At the same time, our advisory role ensures that projects are well designed and successfully implemented – often becoming

demonstration projects that can catalyze even greater investments.

The EIB's External Lending Mandate (ELM) covers 68 countries and/or territories in five regions: Pre-Accession countries; the EU's Southern Neighbourhood (South), the Eastern Neighbourhood and Russia (East); Asia and Latin America (ALA); and the Republic of South Africa. In addition, the EIB lends at its own risk for investment grade operations in Pre-Accession and Neighbourhood countries, and globally in support of climate and strategic investments. The Cotonou Partnership Agreement covers operations in the 78 African, Caribbean and Pacific (ACP) states. The overarching objective of the Cotonou Agreement is to reduce and eventually eradicate poverty, in line with the objectives of sustainable development and increased integration of the ACP countries into the global economy.

EIB and climate action

With dramatic climate changes already affecting many ecosystems around the world, large-scale investments in climate change mitigation and adaptation are becoming ever more urgent. The EIB has already stepped up its climate action lending to respond to this challenge. As part of the joint efforts of EU Member States and institutions to tackle climate change, the EIB committed to increasing the proportion of its lending in support of climate-related investment in developing countries from 25% to 35% by 2020.

● Figure 10. (See Infographic Section).

In 2017 we achieved this goal, with 38% of total finance contract signatures outside the EU (and 36% of approved new project lending) supporting climate action. At €2.6 billion, approved climate action lending for new projects in 2017 substantially exceeded that of 2016 in absolute terms. Moreover, as the world's largest multilateral provider of climate finance in volume terms, we play a critical role not only in mobilizing climate finance but also in building on our extensive technical and financial experience with climate finance within and outside the EU.

Contributing to the SDGs

The EU is committed to implementing the 2030 Agenda and the Sustainable Development Goals. As the bank of the EU, the EIB plays a vital role in the EU's efforts to do this beyond its borders, as well as within the EU. The results of the EIB supported projects may be linked clearly to many SDGs, both in their direct effects and wider development impacts.

The 17 SDGs are intended to inspire and guide work towards greater human dignity, a healthy planet, fair and resilient societies and prosperous economies. They call for a new global partnership between the public sector, the private sector and civil society to mobilize enhanced efforts and resources to make this vision a reality. As part of that partnership, International Financial Institutions (IFIs) play an important role, and the EIB is fully committed to doing its part to catalyze the acceleration in investment finance and knowledge sharing that is needed to achieve the goals.

We can link many of the project outputs and outcomes we track directly to the achievement of different SDGs. In 2017 for example we enabled the connection of 297,000 new households to electricity networks (SDG 7 – Affordable and Clean Energy) and contributed towards supplying 6 million households with green electricity (SDG 13 – Climate Action). The EIB continues to work alongside other development partners to develop the best possible ways to assess our contribution to the SDGs.

Renewable energy in the Med and Africa

Countries in the Med region and Africa are endowed with abundant renewable energy resources (for example, solar, wind, hydro) and the costs of these technologies have significantly decreased (particularly solar photovoltaic - PV) over the last years. Therefore, renewable energies have become more and more a sustainable and competitive choice improving also the countries' security of supply and independence from fossil fuel imports. Initiatives like Scaling Solar

by the World Bank are showing that with the appropriate institutional and regulatory support and proper tendering practices RE projects can also achieve the best possible outcomes in terms of tariff levels and overall project quality, for the benefit of the local consumer.
Renewable energy sources are also essential to improving access to energy in Africa, especially in more remote non-interconnected areas, since they can be deployed as off-grid solutions both in the form of solar-based mini-grids serving communities or solar home systems. These systems allow families to move away for example from oil-based lanterns and stoves that are more costly, unhealthy and hazardous. In this domain, the EIB recently signed a $25 million financing plan (D. Light) for the installation of off-grid solar systems in Sub-Saharan Africa. This financing will enable the installation of solar kits, including the panels and lamps, as well as low-energy equipment such as radios and TVs, with the ambitious goal of reaching 10 million solar installations within five years.

More in general, in 2017 the EIB signed financing contracts for 100 new projects outside the EU and EFTA (European Free Trade Association countries), and approved a total financing amount of €7.2 billion for the region. This will enable total investments of €22.9 billion to take place. As far as renewable energy is concerned the Bank signed loan agreements worth just under €1.0 billion out of which €270 million went to projects in Southern Neighborhood countries and Sub-Saharan Africa. These projects included a wind farm in Egypt, a geothermal power plant in Kenya and the launch of the Africa Energy Guarantee Facility, a risk-sharing platform aimed at boosting investment insurance availability for RE projects.

Cleaner energy for all – Backing Kenya's ambitious plans

As part of its development plans for the country, KenyaVision 2030, the Kenyan government is aiming for universal electricity access for the country's population. The plan is to achieve this through both a comprehensive electrification program and the expansion of generation from renewables. The EIB supported these efforts in 2017 through two new projects: the Last Mile Connectivity Program and a further increase in capacity at the Olkaria geothermal facility. The EIB is co-financing Last Mile alongside the Agence française de développement (AFD) and a grant from the European Union under the EU-Africa Infrastructure Trust Fund, without which a project of this kind could not go ahead. The program will see power lines extended into rural areas in 32 of the 47 counties in Kenya. It is set to connect some 300,000 households to the grid, thus bringing power to around 1.5 million Kenyans. This is the equivalent to more than the population of Mombasa, the country's second largest city. Using industry standard equipment, the program is aiming for completion in 2020.

To support the generation of clean power, the Bank has also invested in an extension to the Olkaria I geothermal plant. The installation of an additional turbine will add 70 MW to the facility's total capacity, enabling the plant to supply electricity to an additional 530,000 households. Geothermal power is renewable and clean as it harnesses the immense heat energy within the Earth's crust. Compared to the likely alternative sources of power, the project represents a reduction in annual greenhouse gas emissions equivalent to around 179,000 t of carbon dioxide. The EIB has now worked with KenGen, Kenya's largest energy producer, on five projects over three decades. Part of this fruitful partnership is learning lessons on best practices for carrying out power projects, and the Bank and KenGen are working together to ensure the highest of environmental and social standards are implemented. For the Olkaria extension project, KenGen is working with the Kenyan Wildlife Service to minimize any impacts on the diverse wildlife of the Hell's Gate National Park, where the Olkaria geothermal resource is located. Geothermal power is a key strategic part of Kenya's energy mix. It can also be sustainable and beneficial to all.

De-risking green energy investments in Africa

The 48 countries of Sub-Saharan Africa, with a combined population of 800 million, together generate roughly the same amount of electricity as Spain. According to the Sustainable Energy for All (SE4ALL) Global Tracking Framework, less than 38% of the Sub-Saharan African population has access to main electricity; and this is despite the enormous potential that exists in Africa for the development of renewable energy resources.

One of the many reasons behind this gap is that energy projects in the region often face high real or perceived public counterparty risks that deter private sector investments. Insurance offers a way to hedge against such risks, making investments more attractive. However, effective insurance of this kind is rarely available in this context. The Africa Energy Guarantee Facility responds to this gap. It is an innovative, first-of-its-kind guarantee initiative, expected to play a catalytic role in unlocking private sector investment in Africa. It will support an EU-based reinsurer, Munich Re, in the provision of political and (sub) sovereign risk insurance services for the energy sector in the region, working through local primary insurers.

The operation was initiated by the EIB and forms part of the Bank's response under the UN initiative SE4ALL. The EIB's leading role and its $50 million investment have been critical in attracting other partners and are on track to catalyze up to $1 billion in reinsurance capacity to support the financing of green energy projects. Based on the preliminary pipeline of eligible energy projects, the facility could support the installation of 360 MW of generation capacity from renewables, enough to serve the typical consumption of some 876,000 households, or just over 4 million people.

Tafila wind farm – A completed project

The Tafila wind farm is the first in Jordan. It has contributed towards achieving the country's renewable energy targets, and paved the way and built expertise for the deployment of more renewable power plants and related grid infrastructure in the country in the future. Approved by the EIB in 2013, the wind farm went into operation in 2016. In line with expectations, the 117 MW plant is producing around 350 GWh annually, which is estimated as enough to supply some 78,600 households in the country. This is important for a number of reasons. It is helping to reduce Jordan's very heavy dependence on energy imports, saving the country's budget around €200 million a year. At the same time, it is reducing the country's dependence on fossil fuels. At the time the project was initiated, renewable energy sources accounted for a mere 0.1% of electricity generation in the country. By providing about 3% of generation needs in Jordan, the project constitutes a major contribution to meeting the country's target of 10% electricity generation from renewables by 2020. The reduction in CO_2 emissions from the project relative to the likely alternative of generation from fossil fuels is estimated at 175,000 t of CO_2 per year.

The EIB was involved in this project in a technical capacity from the start and contributed significantly to its preparation, notably with regard to technical analysis of the project design, setting standards for the environmental and social impact assessment, ensuring high procurement standards and supporting negotiations with the contractor for the project. The project has led to greater awareness of the need to assess risks to migratory birds and has helped to build expertise on the type of assessments that need to be carried out when constructing wind farms in this region.

Conclusion

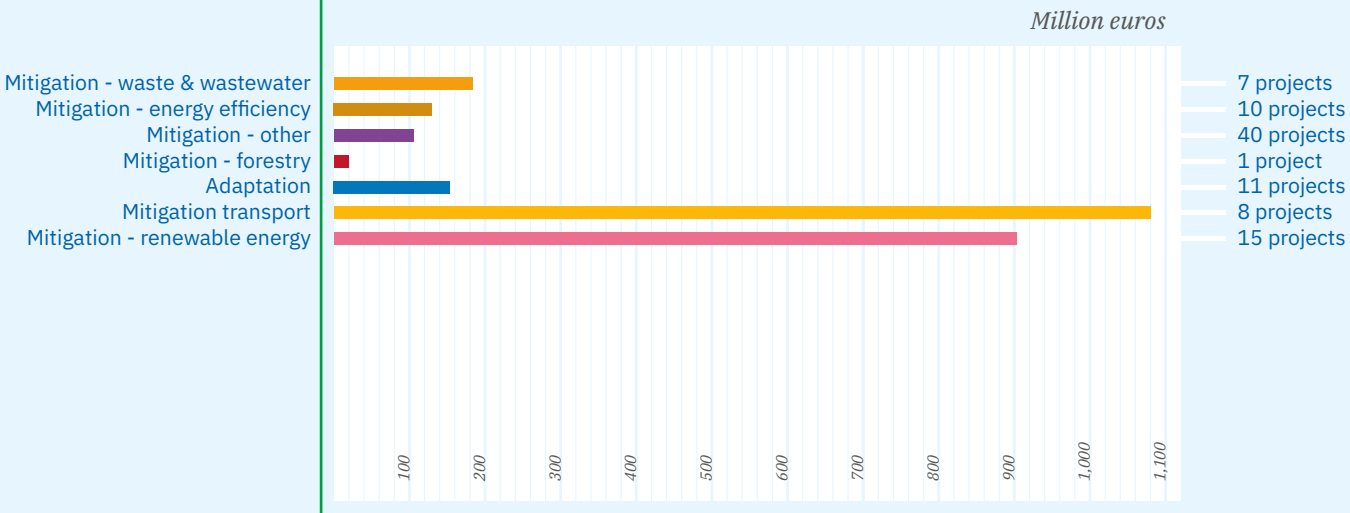
Renewable energy in the Mediterranean countries and in Africa has an immense growth potential due to underdeveloped and underserved markets combined with strong economic and social dynamics. The EIB has placed climate change and sustainable development at the core of its strategy in these regions. It is committed therefore to continue providing its contribu-

tion to such growth by supporting projects that have tangible impacts on peoples' lives. It is by focusing on such impacts that we will really be able to unlock value from sustainable renewable energy projects in the Mediterranean countries and in Africa.

Fig.10

Climate action lending for new projects in 2017.

Source: The EIB outside the EU 2017 Report.



Lukonga, Democratic Republic of Congo.

Access to Energy: Empowering People through Sustainable Energy

LAURA COZZI

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Energy access is a golden thread that weaves together human development, economic growth, and environmental sustainability. Working towards Sustainable Development Goal 7.1 of universal access to electricity and clean cooking by 2030 would allow Sub-Saharan Africa to unlock important synergies with other important areas of development including economic growth, health, gender equality, and climate action. The time is ripe for action, as technological innovations, creative business models, and political momentum offer new opportunities for making significant progress on electricity access. However, many challenges remain, particularly for clean cooking. Further policy commitment and increased co-operation across all stakeholders will be needed for the region to achieve universal access by 2030 and lay groundwork for making the 21st century the "African century."

A new chapter in energy and development - the Sustainable Development Goals

With the adoption of the Sustainable Development Goals (SDGs) by 193 countries in 2015, access to affordable, reliable, sustainable and modern energy for all was concretized as a central pillar of development, with energy being highlighted in a separate goal (SDG 7) for the first time. This step holds great significance for the future of Sub-Saharan Africa, a region which is showing clear signs to unfold a new paradigm of energy access. The SDGs underscore a new way of looking at development, where "gender equality and women empowerment" (SDG 5) or "quality education" (SDG 4) go hand-in-hand with sustainable energy. The agreement underlines universal acceptance that we cannot continue to accept a world where women miss out on potential economic opportunities because of the time they spend each day collecting fuel, or where people living in rural areas lack adequate light to secure their communities at night or allow children to do their schoolwork, or where the act of preparing food can itself be a cause of illness or death due to the use of dirty fuels. African countries have also echoed the political commitment

of the SDGs through their respective Nationally Determined Contributions (NDCs), submitted as part of the Paris Agreement, many of which include specific targets and plans for achieving universal electricity access and access to clean cooking fuels and technologies. This attention is essential – energy access is the "golden thread" that weaves together human development, economic growth, and environmental sustainability – and it is timely – as the continent is poised to see immense economic growth which can only be fed through energy. Technological innovations, creative business models and political momentum are carving out the opportunity for Africa to achieve universal access and reap the myriad related benefits ranging from gender equality to health, agricultural productivity, business growth, education, and biodiversity protection.

First and foremost, energy is essential for economic growth and needs to be available for productive uses such as agriculture and industry.
For the primary industry of agriculture, which accounts for a significant proportion of the active population in many Sub-Saharan African countries, access to energy greatly helps to boost productivity. Energy can fuel processes such as tilling the land and crop drying, and by freeing up labor, create more flexibility for farmers to spend money and manpower on irrigation networks and other infrastructure projects that bolster output.
Urban economic activity also benefits from more reliable electricity supply. A World Bank Enterprise Survey found that half of all African firms perceive electricity to be a significant constraint in their work. About 48% of the firms rely on a back-up generator during outages, but, still, 4% of losses in annual sales are reportedly due to electrical outages.

Energy is also essential for the very foundations of human capital, by providing electricity to schools. Only 35% of schools in Sub-Saharan Africa have electricity, meaning that over 90 million primary children attend schools without electricity (UNESCO Institute for Statistics). Education has been shown to be an important driver of poverty reduction and income generation. Providing electricity – to illuminate and ventilate classrooms, print and copy learning materials, even access electronic learning resources and teach computing skills essential for future generations – is a powerful investment in future economic growth.

Modern energy also moves us closer to SDG 3: good health and wellbeing. Living without clean cooking fuels has deadly health consequences: the smoky air from the incomplete combustion of dirty fuels for cooking is linked to the premature deaths of approximately 600,000 Africans per year, higher than the number of deaths from malaria. Reliance on dirty fuels is especially consequential because people mostly cook indoors, in enclosed spaces lacking proper ventilation. At the minimum, modern energy entails improved biomass cookstoves that can achieve more complete combustion, or chimneys which channel emissions out of the living space, changes which save lives.

Access to electricity also contributes to health in important ways. On average, just 34% of hospitals and 28% of health facilities in Sub-Saharan Africa have reliable electricity access (WHO and World Bank, 2014). A lack of electricity means medics often have to work with flashlights or kerosene lamps. An estimated 60% of refrigerators used in health clinics in Africa have unreliable electricity resulting in a loss of almost half of vaccines while 70% of electrical medical devices used in developing countries fail largely due to poor power quality (UNEP, 2017; WHO, 2010). More reliable electricity access will provide adequate lighting for doctors' work, reliable cold storage for vaccines, and power for medical devices.

A change in paradigm in electricity access

Electricity remains a challenge for Sub-Saharan Africa, more so than for other parts of the world, and the region will need a unique set of so-

lutions for its geography, economy, and population. While near-universal electricity access has been achieved in all countries in North Africa, Sub-Saharan Africa is lagging behind. Although the overall access rate grew to 43% in 2016 in the region, from 23% in 2000, the population grew by around 360 million people over the same time period. This means that overall there are more people without electricity now than there were at the turn of the millennium. The persistence of this problem is not only due to issues of affordability, but also caused by inadequate policy and infrastructure: currently in Sub-Saharan Africa, at least 120 million people live above the poverty line but remain without electricity access.

However, there are signs of promise – electrification efforts in Sub-Saharan Africa outpaced population growth for the first time in 2014. This was mainly due to tremendous progress in some countries including Kenya and Ethiopia, where policies and investments have enabled the roll-out of the electricity grid and an increase in power generation. This resulted in the connection of around a million households each year since 2012, a ground-breaking trend which suggests that more widespread progress can be achieved yet. Globally, technology developments have led to rapidly declining costs of solar photovoltaic cells, efficient end-user appliances, light-emitting diodes (LEDs), etc. Simultaneously, new business models are emerging in Africa that tap into the widespread availability of mobile phones to facilitate payments, meaning that more households than ever before can afford off-grid access. Efforts such as those in Kenya and Ethiopia have enabled an incredible tripling of the rate of additional connections, from 9 million people per year between 2000 and 2012, to 26 million per year from 2012 to 2016. Looking ahead until 2030, the population of Sub-Saharan Africa is expected to grow at an average annual rate of 31 million people per year, meaning that yearly connections will need to be increased yet and maintained above this number in order to achieve access for all.

● Figure 11. (See Infographic Section).

Thus, commitments and successes similar will need to be spread across the continent. Without substantial effort, 600 million people, three in five people living in Sub-Saharan Africa, would still be without electricity access in 2030. While several countries are on track to reach universal electricity access by 2030 – including Gabon and Gambia, as well as Kenya and Ethiopia – other populations are most likely to continue to rely on expensive, polluting and inadequate lighting, to lack the option to power basic appliances for convenience in daily life or improve agricultural yields. Those living in rural areas would be particularly left behind, as 90% of those without access in Sub-Saharan Africa in 2030 would live in rural areas. This clarifies the next steps needed: electricity for all depends on the deployment of a combination of on-grid and off-grid systems. We will need to see grid extensions for 150 million additional people, with hydropower accounting for the lion's share of additions, while decentralized solutions, mainly solar photovoltaics, will be essential in reaching the remaining 450 million people in rural areas. In order for universal access by 2030 to be achieved, 225 million Sub-Saharan Africans living in rural areas would need to gain access via off-grid renewable energy. Fortunately, cost reductions in renewables and energy-efficient lighting and appliances are making decentralized renewables an increasingly attractive and affordable electrification solution for households who would otherwise wait many years for a grid to arrive.

● Figure 12. (See Infographic Section).

A silent killer – lack of clean cooking access

There is a longer way to go for achieving the 2030 objective of universal access to clean fuels and technologies for cooking. Today, an estimated 2.8 billion lack access to clean cooking facilities. One-third of the global population – 2.5 billion people – relies primarily on the traditional use of solid biomass to cook meals. Zooming in on Sub-Saharan Africa, almost 80% of the population still cooks with solid biomass. Population growth has led the number of people still co-

oking with solid biomass to increase by around 250 million since 2000 to over 783 million. Looking forward, around 320 million people in Sub-Saharan Africa are projected to gain access to clean cooking facilities during the period to 2030, but the switch would not be rapid enough to keep up with population growth. Therefore, the number of people cooking with biomass is projected to increase to 820 million people by 2030. As the number of people without clean cooking access continues to increase in both rural and urban areas, varied strategies will be needed to reverse the trend. Increased supply and use of liquefied petroleum gas (LPG) will be particularly important in urban areas of Sub-Saharan Africa, while improved biomass cookstoves will be more important in rural areas.

Figure 13. (See Infographic Section).

Clean cooking efforts have been very constructive in some areas, such as in Ghana, where the government has committed to a nationwide program to further the use of LPG, complemented by the distribution of improved cookstoves in rural households. Under the rural LPG promotion program, 70,000 cylinders and cookstoves have been distributed to households to defray the initial capital cost (GACC, 2016), with an overall distribution target of 200,000 (Ghana Ministry of Power, 2015). Another initiative is underway to design cleaner cookstoves based on the local gyapa-style stoves in order to meet local needs. Efforts such as these, tailored to individual nation's resources and needs, will be essential to providing clean cooking for all.

Synergies with other SDGs: connecting energy to unexpected dots

While it will require further policy, investment, and technology to achieve universal energy access, the additional effort is undoubtedly worthwhile. Energy access is a pillar of human development, economic growth, and environmental sustainability. It will be a crucial precursor for Africa to fully harness its potential and achieve an array of other including gender equality (SDG 5), climate action (SDG 13), and life on land (SDG 15).

There is a clear and important intersection between access to modern energy and gender equality. Inequalities in social standing, economic capability and gender-defined roles mean women often suffer disproportionately from a lack of energy access. Health consequences are especially grave for women responsible for most of the cooking, and the lack of access to modern energy poses a huge time burden, limiting women's participation in productive economic life. Nearly half of households in developing countries depend on wood, waste and other biomass to cook their daily meals – this entails spending over five hours each day gathering fuel and cooking over inefficient stoves. Thus, achieving energy access can be immensely beneficial for women's rights. In South Africa, electrification has raised female employment in newly electrified communities almost 10% because it has improved the efficiency of achieving household tasks (Dinkelman, 2010).

Correspondingly, women are often best positioned to identify, champion and deliver energy access solutions. Evidence suggests significant advantages in involving women from start to finish in the design of modern energy access technologies and programs, and empowering women to become involved in the provision of energy services. This is because they hold specific local knowledge about how different options could serve household needs, and because of their ability to influence their peers. Universal access to clean cooking cannot be achieved unless women are at the heart of delivering solutions.

The environment also stands to benefit from more people having access to modern energy. Even though the use of biomass for cooking is not the main factor responsible for deforestation (most of it is due to land-use change for agriculture and urbanization), significant deforestation has been observed in countries where fuelwood consumption is greater than sustainable biomass potential. Using other fuels to replace the 10% of total primary energy demand which is currently reliant on biomass would help to protect forest stocks. Another important finding is

that universal access to modern energy does not necessarily exacerbate climate change. Universal access can be achieved in a way that is compatible with climate change targets, contributing to minimal changes in energy demand (+37 Mtoe or +0.23%) and carbon dioxide emissions (+70 Mt or +0.20%).

Conclusion

Africa has the opportunity to create a new energy access paradigm – one that depends on a cleaner energy supply and more efficient energy lamps, air conditioners, refrigerators. Encouragingly, our analysis shows that the private sector is increasingly engaged, and that new business models and creative partnerships are increasing the pool of potential investment for projects, from large-scale infrastructure to targeted micro schemes.

IEA analysis estimates that it would require $26 billion per year in cumulative investment in the period to achieve universal access by 2030. This is just over double the share of investment in modern energy access that we see already committed in policies today, over the same time period. Furthermore, the right policies, governance structures, capacity building and inclusive planning processes will need to be in place to provide a predictable, efficient and effective investment climate. In the space of a decade, Africa has moved from being depicted as the lost continent to "a land of hope." Improved governance in several countries, alongside a sustained period of peace in many areas, has changed the lens through which the world looks at the continent. Increased investment in energy supply now, together with the improved management of natural resources and deeper regional cooperation, could yet make this the African century.

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Fig.11

Annual number of people in Sub-Saharan Africa gaining access to electricity by fuel.

Source: IEA, Energy Access Outlook, 2017.

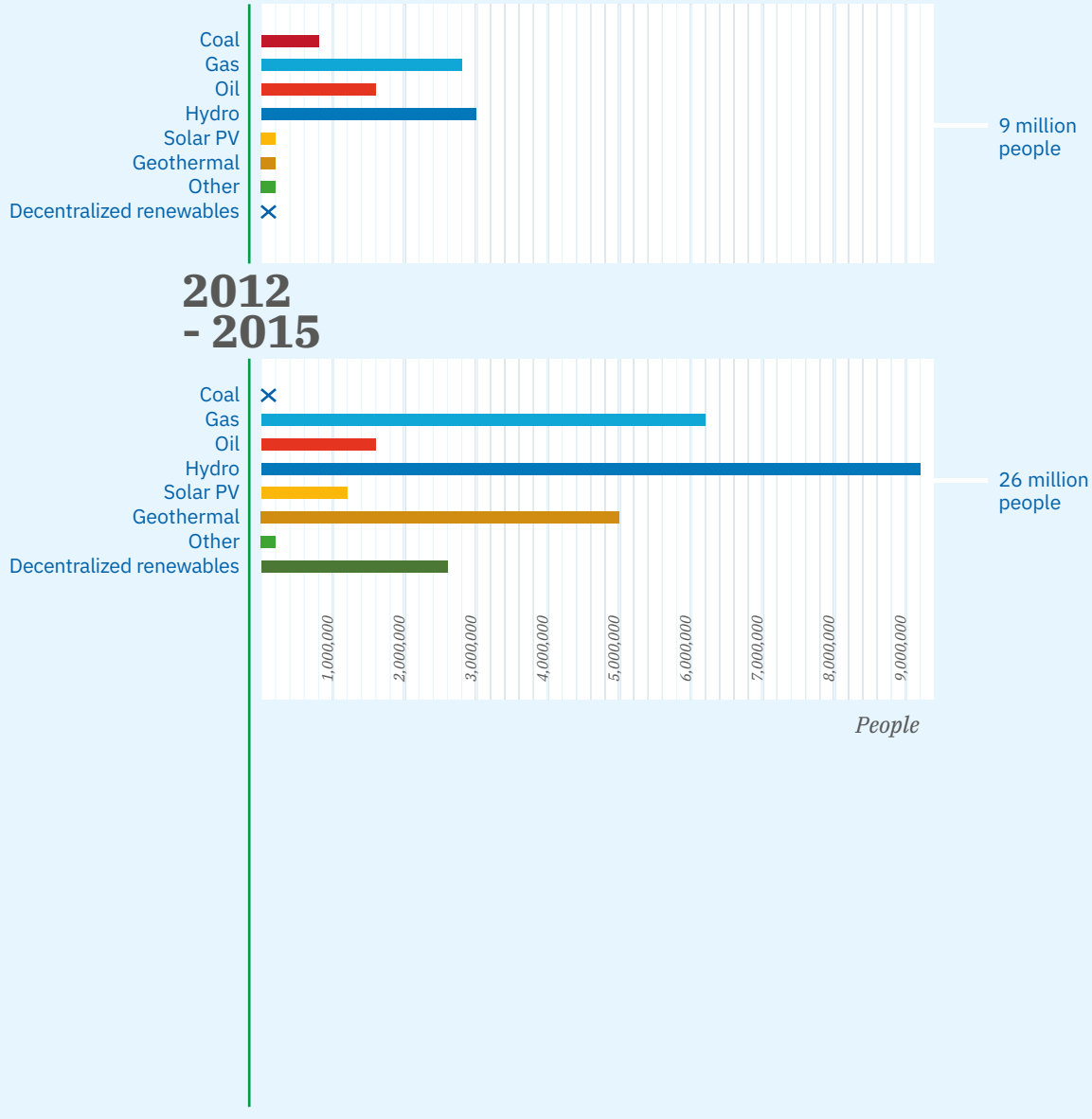

Fig.12

New connections and power generation for electricity access in Sub-Saharan Africa to achieve universal access by 2030.

Source: IEA, Energy Access Outlook, 2017.

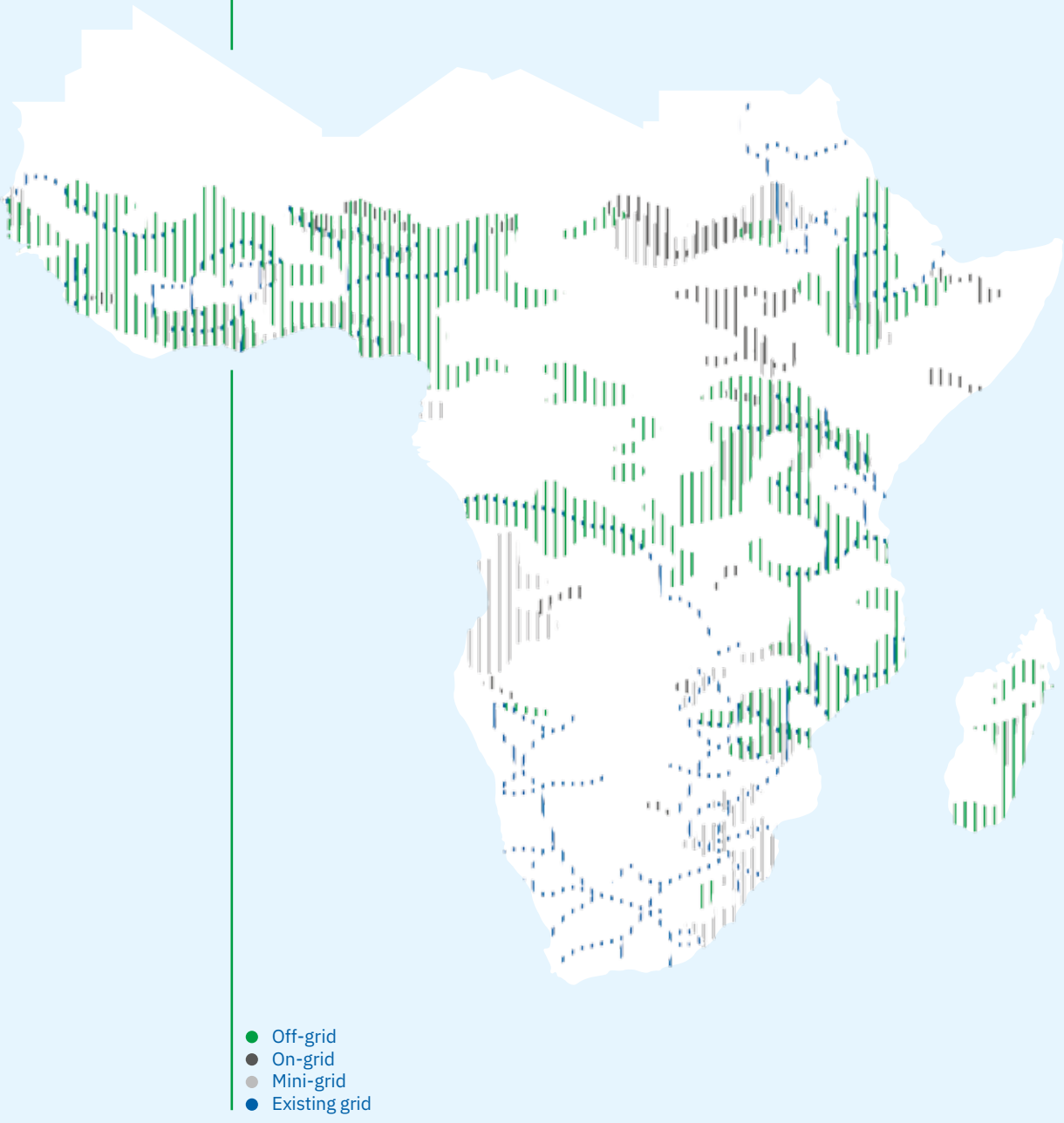

Fig.13

Population relying on solid biomass for cooking in Africa by country, 2015.

Source: IEA, Energy Access Outlook, 2017.

Angola	15
Benin	10
Botswana	<1
Burkina Faso	16
Burundi	11
Cabo Verde	<1
Cameroon	17
Central African Republic	5
Chad	13
Comoros	<1
Congo	3
Democratic Republic of Congo	74
Djibouti	<1
Equatorial Guinea	<1
Eritrea	4
Ethiopia	93
Gabon	<1
Ghana	20
Guinea	12
Guinea-Bissau	2
Ivory Coast	17
Kenya	34
Lesotho	1
Liberia	4
Madagascar	24
Malawi	17
Mali	9
Mauritania	2
Mauritius	<1
Mozambique	26
Namibia	1
Niger	19
Nigeria	128
Reunion	<1
Rwanda	11
Senegal	10
Seychelles	<1
Sierra Leone	6
Somalia	11
South Africa	5
South Sudan	12
Sudan	26
Swaziland	<1
São Tomé and Príncipe	<1
Tanzania	50
The Gambia	2
Togo	7
Uganda	38
Zambia	14
Zimbabwe	11

This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Renewable Energy and the Water-Energy-Food Nexus

Access to water, affordable and sustainable energy, and food and nutrition security are essential for Africa's prosperity. The Water-Energy-Food (WEF) nexus builds on these linkages and presents an integrated approach to balance expected global increases in demand and supply for water, food and energy. Applying the WEF nexus approach can drive local economic growth, especially through the installation of renewable energy generation for agro-processing and productive uses. Private sector actors and solution providers need de-risking and support schemes that bridge the financing gaps to scale up their business, stimulate private sector participation, and to have a catalytic impact on economic growth. Integrating SDGs compliance into these support schemes is key to ensure overall positive impact and additionality.

ROBERTO RIDOLFI

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The WEF nexus as guidance to interlinkages in the 2030 Agenda

The world is expected to face huge increases in water, energy and food needs in coming decades. Feeding a population of 9.8 billion by 2050 will require a 60% increase in food production and a substantial reduction of waste along the food value chains. Simultaneously, global energy consumption is expected to grow by almost 30% by 2040, while total global water withdrawals for irrigation are set to increase with 10% by 2050 and with 2% by 2040 for the energy sector compared to 2014 (FAO, 2011). Agriculture is the largest user of fresh water resources accounting for 70% of total global water withdrawals, while 30% of global energy consumption takes place along food supply chains (FAO, 2011). At the same time, the energy sector accounts for 10% of global water withdrawals and 3% of total global water consumption (IEA, 2016). Evidently, the challenge of simultaneously balancing demand and supply for water, energy and food requires an integrated approach that addresses these needs in a sustainable way.

Access to water, to affordable and sustainable

energy, and to food and nutrition security are interlinked and essential for a community because they represent the asset base for prosperity. Food systems require inputs such as water and means of production like energy, whereas water production needs energy and can generate energy. In turn, food systems are subject to producing waste, which can be a balancing factor of the energy needed in the community. Therefore, the central sustainability question around the future of food systems revolves around how we can increase productivity of food production and consumption while reducing their water and energy usage.

The WEF nexus, as shown in ● Figure 14. (See Infographic Section) builds on these close linkages between the world's expected growing water, energy and food needs. WEF nexus thinking is key to drive sustainable economic development in remote areas because the drivers to sustainable water management, access to energy and soil management can bring immediate solutions when looked at simultaneously. Sustainable food systems can for example be achieved by aiming to produce less water to food, less soil to food, include waste to biomass-energy to balance the solar sources for water pumping in the day and to create a gravity battery to run energy in a turbine at night. Applying a WEF nexus approach becomes part of the solution to effectively reduce carbon emissions and to increase carbon retention in soil and trees increasing biodiversity in the food cycle.

The importance of water, energy and food in sustainable development is evidenced by the fact that they have their specific Sustainable Development Goals (SDGs) and that these sectors are interlinked with other SDGs, as well as the Paris Climate Agreement. Progress towards the majority of SDGs is directly related to the sustainable use of resources such as land, food, water and energy. In turn, SDGs compliance can be used at the service of economic sustainability if activities are assessed against a set of positive impact on SDGs indicators. The WEF nexus can assist in identifying potential tradeoffs in the policy stage but for WEF-investments there are no trade-offs. In fact, one solution can positively benefit multiple SDGs, thereby improving economies of scale. The example of switching cooking energy from firewood to clean fuels is part of the solution to reduce carbon emissions, increasing carbon retention in trees, water retention in soils and increasing their organic content.

Increase synergies and reduce risks by approaching water, energy and food simultaneously

The positive engagement within the WEF nexus is essential to the challenge of feeding people in a planet that needs to breathe and sustainably regenerate itself to serve the prosperity for a future of peace. The WEF nexus approach has the potential to address the key development challenges of our time such as growing demand for goods and services due to population growth, rapid urbanization, changing diets, economic development through sound management of resources within planetary boundaries, all within the context of climate change. The fundamental questions that need to be addressed are: how can sustainable renewable energy projects create real value for development and growth that is both decent and sustainable? Can food systems be the trigger for energy access? Is water an economic asset in the nexus? Here, the WEF nexus has intimate capabilities of synergizing with the development dynamic.

The WEF nexus approach shows that economic growth of Africa's rural communities can come from the opportunities of energy availability created by the installation of energy generation for agro-processing. A formidable trigger for sustainable development is the provision of renewable energy at affordable cost to get the transformation place closer to the production and to save water in the ecosystem. The approach of decentralized energy installations such as off-grid or mini-grid applications is inherently coherent with an equitable effort to reach the poorest while also serving the economic theory of seeking the biggest growth where the needs are greatest. This is also true in a context where

the ultra small-scale and acute energy needs are catalytic for the promotion of innovation in agriculture and agribusiness.

A further advantage of nexus-thinking is that it moves the investment target from the individual to the community. Investments that have an important impact and added value in the following areas can be prioritized through a strong nexus approach: (i) improved health and life of women and girls; (ii) enabled productive uses of energy; (iii) provision of social services to the bottom of the pyramid (health, education, security, etc.); (iv) actions in the WEF nexus: the validity of a combined effect of support schemes such as ElectriFI and AgriFI is very strong also through hybridization of existing systems; (v) establishment of local mini-utilities; and (vi) innovative solutions in terms of organization, value chain, production and trade of agri-products, financing or delivery of energy services.

The complete perception of the WEF synergies become powerful if value chain methodologies are adopted. Positive and accurate value chain analysis cannot be done without the assumption of electricity. The use of renewable energy in selected food value chains can have significant positive impact on both optimizing water use while ensuring food production. Access to water is both part of the value chain in agriculture through irrigation and part of the food system. In turn, access to energy can become transformational when adopted within the economics of the value chain. The community can grow around solar panels and pumping water but can also sustainably develop and prosper through energy provided to the agro-economic value chain.

Beyond social theory, the enormous opportunities offered by the economic synergies around the nexus can overcome substantial factor risks and provide a solid enabling environment for investments. Small-scale agribusiness endowed by energy are probably the most promising area of job creation in Africa today. To be effective at this transformation, decent and sustainable SDGs compliance must be assured at all levels.

Synergies are good for business and investments are better through multiple beneficiaries

Agribusiness enabled by renewable energy is a driver for access to energy for communities through captive operations. Addressing the lack of clean safe water is essential for life, while climate change is posing more challenges every day on irrigation. Addressing the lack of access to clean, reliable and affordable electricity and energy services is a major development challenge and a key pillar of the Paris Climate Agreement. Cost-efficient access to water, energy, food, seeds, finance, health services, education, etc. are central to inclusive and equitable economic growth in all sectors and a precondition for the poorest of the planet to be able to escape poverty. Reaching the goal of global energy access through sustainable solutions is fundamental for mitigating the worst impacts of climate change, which most affect the poor, especially in rural areas.

The usage of solar technologies in agri-food value chain applications, for complex or innovative agri-processing or simply to reduce post-harvest waste, is fundamental. This captive market will greatly increase access to energy while also improving resilience of households, fostering the case for more electricity consumption and better business for the service provider installing the captive generation applications. This represents a virtuous cycle as the provision of water and energy works inside and outside the value chain of food systems, i.e. for the resilience of the community as a whole. De-risking from public financing is essential to stimulate investments and scale up and multiply these applications. In turn, this de-risking can only happen in the presence of additionality, which is ensured by the SDGs compliance on the whole WEF nexus.
A major barrier to investments in small-scale agribusiness as well as access to water services and renewable energy in developing countries is the lack of access to seed, mid- and long-term capital. In immature market conditions this is aggravated by the reluctance of commercial

banks to provide suitable lending that respond to the needs of investors and by the existing capacity limitations in terms of structuring and bringing projects to financial close. Many private players offering WEF nexus solutions to the agri-food value chains are mostly innovative and early-phase or even start-up companies with the common problem of lacking access to adequate finance. To attract investment and scale their business, these actors need de-risking and support schemes that would bridge the gaps in structuring and financing necessary to stimulate the private sector, to mobilize financiers and to have a catalytic impact on economic growth.

United Nations agencies in charge, *inter alia*, of sustainability such as the Food and Agriculture Organization (FAO), have an active role to play in the investment sector. Moreover, the normative mandate gives a unique perspective to policy dialogue in parallel with de-risking initiatives like the European Union's External Investment Plan (EIP) or the private sector window of the World Bank, which represent great opportunities for this.

One of the most successful of such de-risking and financial facility schemes is ElectriFI by the European Union. ElectriFI aims to support investments that increase and improve access to modern, affordable and sustainable energy services through intervention at the development stage of a project. Without distorting good market conditions (where present) ElectriFI boosts investments by making support available throughout the entire project cycle, from the project idea to its successful implementation and scaling up. ElectriFI, coupled by AgriFI, which aims to accelerate and leverage investments with a value chain approach for agriculture and agribusiness for Micro, Small and Medium Sized Enterprises (MSMEs), can constitute a comprehensive and inclusive platform for investment support services, rendering due attention to bankability at very early stages, whilst facilitating access to senior debt at later stages. The successful integration of ElectriFI and AgriFI is comprised of four stages ● Figure 15. (See Infographic Section):

1. Pipeline boosting: The first stage aims to build a pool of mature quality project proposals by mobilizing actors and partnerships with financiers, industry and established networks. The provision of small grants for feasibility is foreseen. The agribusiness and value chain can provide a lot of working proposals. FAO can be a strong player in this.
2. Pipeline enhancement: Projects at a very early stage can be supported by structuring feasible and bankable project profiles. At this stage, support would be made available in the form of subordinated debt. The combination of economic aspects for agriculture and waste reduction is very powerful to increase economic reliance. FAO's presence in all countries is beneficial, whereas its experience and knowledge based on SDGs compliance is essential for additionality of project pipeline enhancement.
3. Project implementation and monitoring: At this stage a franchising model comes into play to monitor the SDGs compliance with NGOs and other local actors.
4. Project scaling up: This level foresees the bridging of financial gaps and securing senior development and commercial debt. The presence of an anchor through the captive modeling can be extremely beneficial to assist sustainability in this stage.
The G7 Leaders' Summit in Germany explicitly acknowledged ElectriFI in the Declaration of July 8, 2015, while AgriFI was presented at Expo 2015. Since then, financing has been growing. The captive model is very promising in terms of multiple SDGs compliance and impact. The European Development Finance Institutions together with other major development financing institutions must strongly consider SDGs compliance as an added-value coming from the nexus approach.

The key feature of public de-risking is additionality - SDGs compliance in the WEF nexus can guarantee it

Integrating SDGs compliance into the public de-risking support schemes is key to ensure positive impact and additionality, and the private

sector must see business value in applying the SDGs framework. The involvement of partners from local private sector and civil society organizations is also instrumental to enhancing effectiveness and ownership of the actions deployed. Considering the needs of partner countries in accessing sustainable electricity and energy services and the ever-increasing interest demonstrated by the private sector and development financiers to partner and invest in electrification, ElectriFI can be combined with the AgriFI approach to put the WEF nexus at the center stage of development of decentralized captive installations.

There is a powerful advantage in profiling business models around the WEF nexus and considering the nexus as an economic opportunity. The value chain analysis shows the advantages of energy availability for industrial uses. In turn, the presence of a community business hub in agro-processing requires labor, water and energy, which can be provided to the community members for smallholders use. They become more resilient and better players in the food systems and cold chains can be within and outside the value chains.

The investments further de-risked in a combined manner through ElectriFI and AgriFI can therefore become more economically sustainable. Support schemes such as ElectriFI and AgriFI can run only in presence of true additionality, which cannot be justified without error on the basis of financial parameters. By integrating SDGs compliance and WEF nexus in de-risking mechanisms, we can ensure additionality is taking place. Thorough SDGs compliance can only be guaranteed by designing powerful monitoring, through civil society organizations as partners, to ensure ultimate creation of decent and sustainable jobs providing prosperity to people in a peaceful planet.

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Fig.14

Water-Energy-Food Nexus Approach.

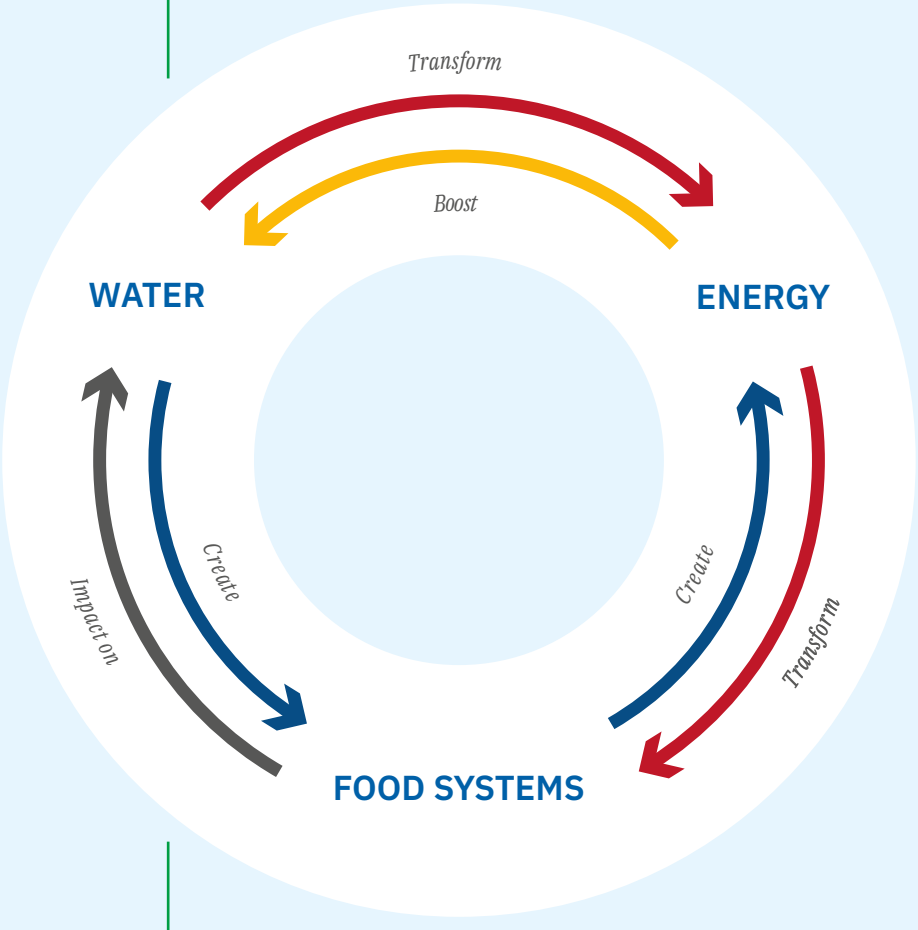
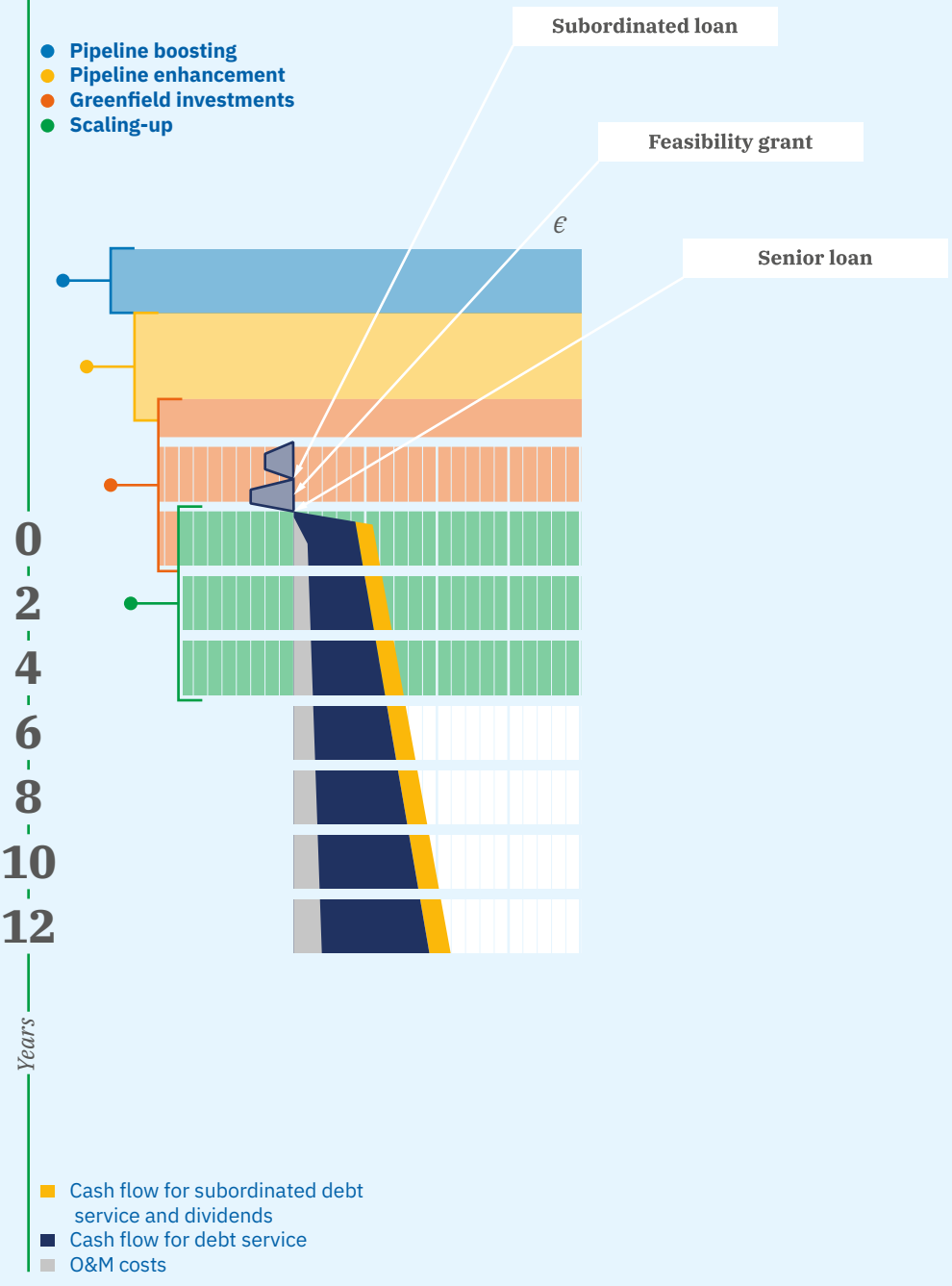


Fig.15

Four stages of ElectriFI.

Source: Electrification Financing Initiative (ElectriFI), European Commission.



Women carrying clay pots to collect water in Poa, Burkina Faso.

Unleashing Africa's Renewable Energy Potential

African countries present perfect conditions to attract renewable energy investors: a fast growing energy demand, strong resources potential and the need to develop large quantities of fast scalable power generation solutions in order to electrify their entire territories. Nevertheless, investments remain at low levels and private capitals struggle to find bankable projects in such markets. By focusing on the reinforcement of regulatory frameworks and market design rules and empowering public authorities in charge of energy system planning, we will be able to overcome those investment barriers and increase African renewable market attractiveness for private investors.

MARTIN À PORTA President & CEO, Pöyry PLC

Renewables have ceased to be the future of the energy sector to become its very present. In 2016, around 165 GW of new renewable capacity came online against 57 GW of net coal capacity additions and 29 GW of natural gas. New solar photovoltaic (PV) and wind capacities reached 74 GW and 52 GW respectively, confirming their leading role in the transition of the world energy sector. Investment figures confirm this trend with $333.5 billion invested globally in renewables in 2017, the second highest annual figure ever.

Africa presents perfect conditions to attract investments in renewables: a huge resource potential (in terms of solar irradiation, wind speed, geothermal and hydro resources), as well as the need to develop large amounts of fast scalable power generation solutions to bring power to everyone and reach full electrification. Recent experiences with competitive renewable tenders (South Africa in 2015, Morocco and Zambia in 2016, and Ethiopia in 2017) demonstrated that utility scale renewables are viable options for procuring reliable electricity at low cost also for African countries. However, such examples are

still rare and the continent collected less than 8% of global renewable investments in 2016[1]. Today, the risk for Africa is to remain at the outskirts of the energy revolution.

Overcoming barriers

In the past, three barriers slowed down renewable development in developing markets: (i) high technology costs, (ii) the difficulty to raise capitals for investing in risky countries, and (iii) the lack of sound policy and regulatory frameworks, necessary to provide the right visibility to long-term investors.

As of today, renewables cost competitiveness is no more a concern. Investment costs dramatically decreased in the last years, in particular for solar PV and on-shore wind. The drop of tariffs awarded in competitive renewable tenders reflects this reality: in Zambia, for instance, a 50 MW solar PV plant has been awarded a fixed tariff of $60/MWh over 25 years in the framework of the first bidding round of its "Scaling Solar" Program. The tariff, awarded in 2016, is still the lowest ever reached in Sub-Saharan Africa for PV energy, and among the lowest in the world, but we can easily expect PV tariffs going down to $40/MWh on average in competitive tenders during 2018.

Moreover, capitals are available in the marketplace and ready to be invested in profitable projects. Private investors are looking with every-day growing interest to renewable assets, which in many cases have offered good predictability on returns over a long period (sometimes above 20 years). As a result, the panel of potential investors is growing beyond the utility sector with banks and institutional investors (such as pension funds, insurances, etc.) attracted by the fixed, predictable investment rates of return of renewable assets in many parts of the world.

Nevertheless, in countries with higher risk profiles, as most African markets, project bankability is still a huge challenge and investors point out the lack of bankable renewable projects in such markets. High political risk perception, as well as great uncertainty about project execution and operations, push moneylenders to ask for more guarantees. The result is the increase in the cost of capital and the reduction of project profitability. Renewables are particularly affected; thanks to the decrease of technology costs and growing economies of scale, the cost of financing has become the major driver of long-term LCOE[2] (levelised cost of electricity) of wind and solar plants, representing already around 50% of the generation costs. As a result, in markets where costs of financing are extremely high, fixed-cost based renewables do suffer from a loss of competitiveness with respect to thermal generation, where costs of generation are mainly driven by costs of fuels.

Signaling the way forward

As recently stated by the International Energy Agency (IEA), "policy, market and regulatory frameworks have a critical role in guiding operational and investment decisions" (IEA, 2017). This is particularly true in the power sector, where political intervention in the market is high, natural monopolies exist in electricity networks and fair competition is easily harmed. As a result, clear and stable regulatory frameworks, consistent power market designs and more sophisticated, integrated and coordinated approaches to power system planning are fundamental elements to increase electricity market attractiveness for investors.

These elements are essential to provide investors with the long-term visibility, reducing uncertainties about project timelines, from design to execution, and providing a clear set of rules for project implementation and operation, from permitting to asset management and decommissioning. They will offer stability on the assumptions behind the expected rates of returns for investors, which have to take appropriate decisions in a crucial, long-term standing and capital-intensive industry. Following such an approach, public authorities could easily reduce risk perception of moneylenders, lowering the cost of capital and, finally, increasing the overall bankability of renewable projects in a determined country.

If there is no one-size-fits-all solution on the optimal design of the electricity sector, with the right approaches depending on different factors (the

physical characteristics of the power system, the degree of market liberalization, the number of market participants and the institutional capability of public bodies), some principles are, however, commonly applicable:

• the creation of an independent regulatory body is the first step to ensure the stability and reliability of the regulatory framework against political intervention. Independent regulators protect consumers and supervise fair competition among all the market players. In markets where the liberalization process is still at preliminary stages (i.e. non-unbundled markets), as most African markets, regulators act also as the last guarantor of the network access right for all market participants;

• being natural monopolies, power network operators have to ensure their role of neutral market facilitators, under the supervision of independent regulators;

• transparent regulation of network operation, by the adoption of grid codes and well-defined network access rules, is key to ensure technical and economic integration of new generation assets into the power system. Actually, unclear dispositions about dispatching rules, imbalances settlement and curtailment act as indirect barriers to market access, reduce profitability and prevent investors from entering such markets;

• network tariff methodologies, as well as retail prices in liberalized markets, have to be designed in a way that maximizes the integration of renewables in the market;

• clarity about renewable energy routes to market, in the absence of wholesale energy markets, and long-term visibility on any direct or indirect financial support are essentials for investors, who need clarity on such aspects to perform their evaluations on project expected profitability.

● Figure 16. (See Infographic Section).

Comprehensive and reliable energy policies, setting realistic and coherent targets, as well as consistent system planning methodologies, are also crucial for investors. Policy makers and authorities in charge of system planning must be able to outline the best-suited evolution scenario to provide reliable and competitive energy in the long term in a world of disruptive technology changes, evolving costs, different resources availabilities and so on. This means being able to forecast how much and what kind of new capacity the system will need for the next twenty to thirty years in order to provide appropriate economic signals to investors.

To develop consistent renewable development scenarios and forecast the physical integration capability of the system, broadening the inputs of system planning modeling assumptions is vital. Up-to-date methodologies for consistent system planning have to go beyond power demand paths to include energy efficiency efforts, storage capabilities, as well as extreme weather patterns among others. Integrated approaches, able to include power networks adequacy together with generation capacity development, could provide greater visibility on the investments required to accommodate increasing quantities of renewables and manage efficiently their intermittency. Moreover, methodologies ready to broaden the geographical scope across different balancing areas could give a clearer picture on how to better exploit regional complementarities, increase system flexibility, enhance system efficiency and lower system costs; thus providing the first step for further regional market integration.

Conclusion

Today, international benchmarks on policies, system planning methodologies and regulation are available and can provide useful guidelines to governments interested in strengthening their energy policy making processes. Tools as least-cost dispatch software for system planning are available in the market and offer valuable assistance to such processes. African countries could rely on such methods and seize them to attract new investments, particularly from international private investors, in order to modernize their energy systems. This will enable Africa to unleash its renewable potential and translate its renewable ambitions into tangible and sustainable projects.

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[1] The figure includes also the Middle-East region.

[2] The LCOE represents the total cost (€/MWh) of building and operating a power plant over an assumed financial life and duty cycle. Its key inputs are capital costs, fuel costs, fixed and variable operations and maintenance (O&M) costs, financing costs, and an assumed utilization rate for each power generation technology.

Fig.16

Renewable energy regulatory frameworks.

Source: Pöyry, 2018.

Institutional & legal frameworks

- Sector governance
- National energy strategy
- National renewable energy strategy
- Energy policy target

Energy system planning

- Generation development plan
- National assessment of renewable potential
- Renewable energy integration study
- Network development plan

Incentives and support schemes

- Procurement models (centralized, competitive, auctions)
- Financial incentives (FiT, CfD, FiP, etc.)

Regulatory incentives

- Direct fiscal incentives
- Indirect fiscal incentives
- Other regulatory incentives

Connection policies and network access

- Connection rules and costs
- Network codes
- Imbalances and curtailment dispositions
- Network tariff methodologies

Market framework

- Market unbundling
- Liberalization and private sector participation
- Market design model

Central Luanda, Angola.

Rethinking Innovation to Drive Africa's Energy Future

Innovation is behind everything we can conceive of. Indeed, the world itself is part of a constant and never-ending innovative process based on self-disruption. Technology, business and the economy at large rely on breakthroughs in innovation. As the world faces increasing levels of change, the question is which kind of innovation is most suitable and how this innovation could really become a game changer for Africa's sustainable energy future. Making the innovation process leaner by applying the simplest but most effective paradigm of frugality is the key. Enel X aims to apply the principles of frugal innovation to go beyond electrons and enable energy innovation itself to electrify African markets with access to clean, affordable and reliable energy, which is fundamental to the continent's sustainable development. These new business models that couple socio-economic growth with the development of commercial and productive activities are truly key to make Africa's future green and sustainable.

FRANCESCO VENTURINI
CEO, Enel X

The world constantly evolves. Technology constantly evolves. The energy sector gives birth daily to new solutions, new technologies or simply improvements of existing ones, pushing them towards their limits. The world, by its very nature, lies in a disruptive process that changes every second the way we are, despite all of those who try to slow this process down or play against it to maintain an impossible status quo. Innovation is the key word that stands in every process, it can have different declinations and since it is always a destructive practice the choice is between disrupt or be disrupted by it. As such, innovation itself is rapidly evolving in ways that have the potential to significantly impact Africa's sustainable economic take-off.

Innovation evolves: from large to simple

Traditionally, innovation has taken place in university laboratories and companies' Research & Development (R&D) departments where thousands of patents, new products and services

emerge and become part of our daily lives. But innovation is increasingly taking on another shape through a so-called bottom-up approach that is far removed from the resource-intensive research laboratories of universities and companies. Innovative processes are taking place in small mobile laboratories made available to entrepreneurs and young innovators who, for a small fee, have access to tools to develop, experiment and prototype new ideas. These ideas are born from the need to address existing and pressing problems that could really have an impact on society because they reflect the real population and user needs. It is precisely those needs that become the driving force behind the bottom-up innovation process. From this perspective, the paradigm of making new things is changing radically: it's no longer the technology that makes the difference, but rather the people behind the idea, considered as the true innovators. Manufacturers can put wonderful new features in their machines, but people want a tool in their hands that costs little and meets their needs. This is especially true if people cannot afford nor have a real need for over-specified products, which essentially applies to a large part of the world population, especially for those living in developing countries. Instead, bottom-up driven innovation responds to customers' real needs who seek to improve their quality of life. For the first time in the technology process users become innovators, empowered by tools and platforms, where they can bring their perspective, creativity, problem and solution understanding to the drawing board.

Doing better with less

Unlike well-established R&D processes of large academia and big companies, this different approach to innovation is not structured, at least not as we suppose it to be. Instead, this innovation approach aims at getting a short time-to-market period at the lowest cost. This leads to a change of paradigm: not only the created product is innovative but the innovation process itself is reinvented and innovated. It sounds like a tongue twister but it contains the sense of creating through disruption. A well-known illustrative case of this paradigm change is how the French car company Renault reinvented its innovation process through the challenging target of going to market with a $6,000 vehicle. In 2004, it launched Logan, an affordable, reliable and well-designed car with many simplified features to reduce costs. Not only did it become a best-selling product, finding market share across emerging and recession-hit European markets, but it also kicked off a process that put lean innovation in every segment of the Renault value chain (Prabhu & Radju, 2016). The Renault Logan model revolutionized the manufacturing process and validated the principle of this new form of innovation, which instead of "doing more with less" shifts to "doing better with less". It is unsurprising that the Renault Logan caught the interest not only of the low-end market but also of those who, despite of having the possibility to afford a more expensive car, prefer to spend less and have a good product.

A new category of consumers: pro-sumers

This innovation approach is based on the participation of the user. The standard model of R&D that represents the concept "what I think may be better for you" no longer works. Instead, the consumer increasingly wants to become a protagonist. Indeed, the digitally-enabled on-demand economy created a new kind of consumer, particularly embodied by the millennial generation that is gradually entering all consumer categories. The line between producers and consumers is blurring thanks to flexible platforms, asset sharing, and the real-time matching of supply and demand. For many millennial consumers for example, buying a car or a house is no longer a priority investment, which uproots traditional consumption trends. Moreover, consumers empowered by information and the Internet become aware of an enormous variety of choices on products or services, thereby increasingly influencing suppliers on their desired products and services. This has effectively turned the traditional business model of supply and demand upside down. On the supply side, innovative digital technologies are enabling new offerings, such as super customi-

zation, where big data and advanced algorithms help to target the right audience, at the right time and with the right approach. Successful will be those companies who are rapid and agile enough to use innovation to perform better and meet the needs of those new consumers. Consumers that more often play as producers creating a new category in the market called "Pro-sumers" are willing to participate in the innovative process, too.

The reverse perspective of innovation

The bottom-up innovation approach can go further, taking us from existing to disruptive technology, and even beyond into reverse innovation. Imagine having an innovative product that was conceived and launched to meet the needs of people in emerging markets and ends up meeting the needs of customers in mature markets, as illustrated in **Figure 18. (See Infographic Section).** This type of innovation arises from people's needs, from the dialogue with people, and from validating the idea in the market.

Here, reverse innovation refers to the innovative product that comes from a mobile laboratory with a laptop and a 3D printer, that enters the market, books positive results and then expands into other markets for which, even if not thought of with that objective, it is entitled to get citizenship. This goes beyond research and development. This is shuffling the cards on the table. This is the agile approach of a process that is tailored to the real needs of those who will use that product and not to whom could eventually use it. This innovation brings products on the market quickly and rapidly figures out whether they work or not. This innovation comes from a restructuring on the organizations and the governance of big companies that are obliged to change themselves from the inside to take advantage of this opportunity. This innovation really looks at the consumer. This innovation is frugal innovation.

Innovation and convergence

Innovation feeds itself with the convergence of different industries and sectors and by doing so it better addresses their needs. The energy sector and the digitization with all its opportunities are one example of this convergence. After revolutionizing the financial sector through mobile transactions and instant finance, the digitalization of the real economy is well on its way. The energy sector is indeed next in line: incumbents are encouraged to digitalize and innovate their operations by focusing on integrated customer service, asset management, offer new behind-the-meter services, and grid disintermediation. Indeed, a complete shift in business models and revenue generation is on its way, leaving conventional energy sources such as coal and oil far behind.

The deployment of renewable energy technologies and grid enhancement represents the most effective strategy to accelerate Africa's socio-economic transformation. Because Africa's energy challenges are so diverse and large scale, a conjunction of decentralized renewables and grid enhancement will be key to unlocking the continent's economic transformation and sustainable development. Especially off-grid renewable energy technologies bring new opportunities to tap into potential huge markets, able to deliver electricity to almost 600 million people without access to electricity in Africa, such as rural communities far removed from one another with low population size and close to non-existent demand for electricity. These characteristics hamper traditional electrification because grid extension is an expensive and lengthy process. That is why off-grid renewable energy applications combined with latest developments in energy storage can provide a real solution to electrifying these communities. With the right formula in terms of business models and revenue remuneration schemes, mini-grids will multiply, not in the least due to the speed and ease of their deployment.

To enable these business models we need to disrupt the way we have previously addressed the issue. This will require a continuous and strong focus on innovation. Thanks to the African continent's dynamic economic growth, its young population, its renewable energy abundance, a growing entrepreneurial start-up culture, and

a proliferation of enabling digital technologies, prioritizing real inclusive and open innovative thinking can lead to business models that present unique solutions to local challenges. What is needed is to gather innovative technological solutions, business models and capable players to scale up investments into projects that can deliver clean, affordable and reliable electricity to African communities. The different consumer profiles and entire value chain has to be considered in order to obtain a successful business model. Far beyond R&D, innovation needs to be integrated in a holistic and cross-sectorial manner connecting energy, health, business, education, technology and environment. By applying innovative thinking to real time situations with technology as a stepping stone, new markets are revealed for Africa's economic take-off.

Applied frugal innovation: the Enel X approach

Enel X is the new Enel global business line dedicated to developing innovative products and digital solutions in sectors in which energy is showing the greatest potential: cities, homes, industries and electric mobility. Enel X has been launched to capitalize upon the power industry transformation and is aimed at understanding and servicing the needs of Enel's global customer base, by exploring opportunities in areas of new technologies to develop customer-centric, innovative products and both non-commodity and digital solutions.

Enel X considers itself as a liquid reality, a wave to ride as it moves between the present and future of energy. We have a completely new perspective in which customers become global, and technology creates opportunities and generates shared value for all. The mission of Enel X is to become a global producer of sustainable, innovative and simple technology solutions. All of the Enel X product lines represent potentially significant business opportunities, leveraging the disruptive technology evolution to create value in a period of deep and transformational cross-industry changes.

A long cycle of relative abundance of resources (such as food, water, oil, credit) that improved industrialization and development in the western economies, ended in 2008. An increased demand of services and products combined with a rising population led to the current supply exhaustion. In this era of scarce resources, we have to re-think different concepts of design, moving toward the frugal innovation approach. Indeed, large companies that succeed in assuming this method to create affordable offerings are very likely to gain a competitive advantage over their peers. Nowadays, everything is about entrepreneurs making the most of what they have, adapting existing technologies in new ways, cutting costs intensely and focusing on the problems consumers need solved.

In this context, Enel X gets the chance to innovate in different ways: reframing challenges as opportunities for growth, making constraints work for it and constantly adapting to a changing environment by improvising solutions to the challenges it faces along the way.

At Enel X we do not design solutions by sitting in an insular R&D lab. Instead, we collaborate with start-ups to learn about real customer problems and identify end user needs. We co-develop disruptive and sustainable solutions by engaging local – and even global – partners to design and build frugal offerings. We co-deploy products and services to a large number of users. We collaborate with innovators in emerging markets too, and we help them in solving the "last-mile problem" by creating connections with different partners to make their solutions accessible to a large number of people.

Recently, Enel X started a partnership with a Kenyan start-up: Solar Freeze. This local company was recognized as the best energy access start-up in the African continent upon the successful conclusion of the RES-EXPO conference "Renewable Energy in East-Africa: New Frontiers" organized by RES4Africa in Nairobi in January 2018. Almost 600 million people are lacking access to electricity in Africa and food loss could feed 300 million people. Even if just one-fourth of the food currently lost or wasted globally could be saved, it would be

enough to feed 870 million hungry people in the world. In many African regions, the agricultural industry is lacking refrigeration. Farmers in rural areas often are not connected to the electrical grid or simply cannot afford cold storage. It means that these farmers not only have to struggle every day against drought and extreme weather conditions, but that they also have to bring their harvest to the market very quickly if they don't want to risk losing it. This also gives the rural farmers less power to negotiate better prices since dealers know very well they have an urgency to sell.

Dysmus Kisilu, founder of Solar Freeze, saw this challenge as an opportunity and came up with the idea of using solar-powered cold storage units to offer pay-as-you-go refrigerated crates to rural farmers. Using a rugged simple solution and solar panels, Dysmus is able to offer cold storage at a low price while farmers rent only the crates they need for the time needed. These new business models, which couple socio-economic growth with the development of commercial and productive activities, are truly key to make Africa's future greener and more sustainable.

Figure 17: Solar-powered cold rooms - Solar Freeze

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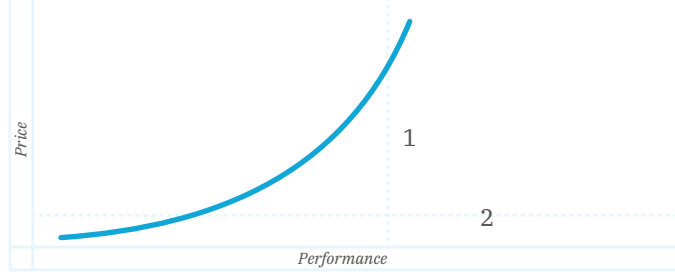
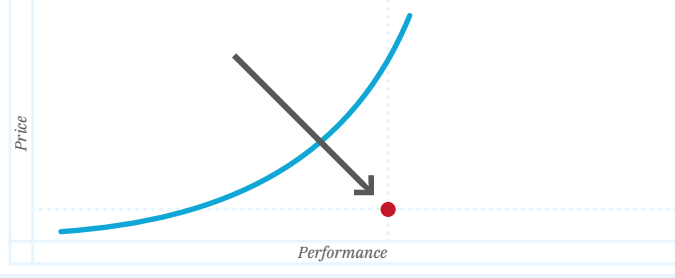
Fig.18

How a disruptive technology in a poor market becomes a high-value platform in a rich one.

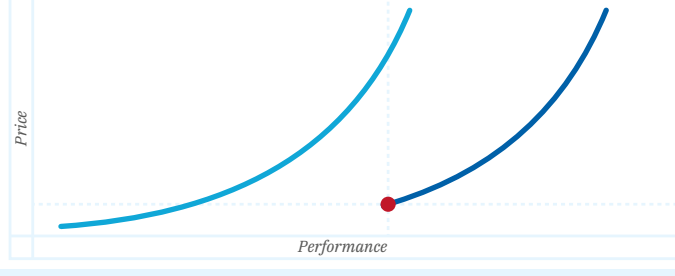
Source: What engineering a reverse innovation looks like - Winter, A. and Govindarajan, V. (2015) - Harvard Business Review.



Disparity between what **existing technology** can provide (blue curve) and the performance and price constraints and requirements dictated by an emerging market (lines 1 and 2).



The constraints drive innovation (black arrow) towards a **disruptive technology** (red circle).



The disruptive technology becomes a high-value product platform that can be transferred from poor to rich markets through **reverse innovation** (darker blue curve).

Turning Risk into Added Value – Achieving Economically, Environmentally and Socially Sustainable Renewable Energy Projects in Africa

Africa with its incredible size, biodiversity and growing need for clean power presents a fabulous opportunity to develop renewable energy. There are important drivers for strong management of Environmental & Social Governance (ESG) issues for renewable energy projects in Africa. Several examples that highlight concerns and opportunities are presented, and a five-step strategy to unlock finance and project value is detailed.

JAMES ARCHER
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Africa and its diversity

We start this article by reminding the reader of the incredible diversity that is present in Africa. More than any other continent on this planet, Africa continues to amaze and impress us all with its incredible people, animals and plants, expanse, and complexity of diversity. Africa holds more than 1.1 billion people. Within this population there are over 3,000 different ethnic groups that speak more than 2,000 different languages. Africa includes 8 of the world's 34 biodiversity hot spots. These include the coastal forests of Eastern Africa, the Eastern Africa Afromontane Forests, and the Horn of Africa that are world-known for their incredible beauty and bio-diversity. All of this is spread over a continent that is three times the size of Europe or North America, and all of China could fit twice overlaid over Africa. The continent is split into fifty-four different countries and it is a continent that is experiencing very rapid overall population growth. Africa is going through rapid urbanization, and the very rapid growth of an incredibly hard-working middle class that is hungry for a new and bright future, including good in-

frastructure. We have a huge responsibility to deliver very well thought out renewable energy projects that involve, include and sustain Africa for the longer term. This is our responsibility to make this fit for Africa.

Infrastructure projects in Africa – environmental & social risks – are they real or are we imagining things?

When building a large infrastructure project, the customer, Engineering, Procurement, Construction (EPC) contractor, developer, and financiers all want the project to be delivered on time. Based upon a review of multiple capital and infrastructure projects over the years (including numerous power projects), we find that almost half (46%) of these projects experience some kind of project delay. If we study the reason for the delay, we have found the following causes of project delays.

Figure 19. (See Infographic Section).

Of the projects that have been delayed, it turns out that almost 80% of these projects are delayed due to some Environmental or Social (E&S) issues. These can generally be classified as non-technical risk (NTR). However, good management of E&S issues starting at the earliest stages of a project, whilst costing a small fraction of the overall costs, can make all the difference. We believe that good ESG management is essential to every successful renewable energy project in Africa.

NTR can be classified into numerous ESG topics including the following:

- Biodiversity & Sensitive Environments;
- Community & Culture;
- Water Scarcity;
- Livelihoods;
- Land Acquisition, Compensation & Resettlement;
- Health Safety Security, Labour and working conditions;
- Stakeholder Engagement & Social License to Operate.

Some recent examples of these kinds of NTR issues (taken from already published articles, news reports, and publically available information) that have been raised associated with renewable energy projects in Africa, and examples to address them are presented below.

Biodiversity & sensitive environments

In East Africa, there have been several wind farms projects in Southern Kenya and Northern Tanzania that have been affected by the reclassification of vultures into the endangered or threatened species category. This reclassification has occurred as a result of external environmental and social issues related to nomadic herders and the consumption of carcasses of poisoned lions that have been cattle-raiders. East Africa has seen a massive decline in vulture populations including the now endangered Egyptian vulture (Neophron percnopterus). This now means that any bird kill at a wind farm involving a vulture (including Egyptian, Rüppell's or white-backed vultures) has extremely serious consequences. Several wind farms have had to carefully re-evaluate their current projects due to the prevalence of Egyptian and other vultures in the region. There is an opportunity here for wind farms to be located in other locations in the region, to be considered following detailed studies including migratory birds, bats, and vultures.

Community & culture

At a solar power project in Central Province, Kenya, the developer has planned a solar farm on several hundred acres of property. After initial concerns were raised by the community, NGOs and local authorities, the developer spent significant time understanding the community needs, and committed to training and project participation, including a mid-term strategy to hire key people from the community into the project management and operating teams for the solar farm. As a result of this, the project has since received local support, and local authorities have also followed with their support.

Water scarcity

A very large infrastructure project in Ethiopia around the Gibe Dam has included several large-scale irrigation projects that have been subject to claims of reducing the dry season flow of the Omo River flowing into Lake Turkana. Some hydrologists claim that the longer-term potential implications of this is to threaten the water supply to Lake Turkana. The solution to this issue is, as part of early project planning, to carefully study river flow volumes, especially dry season flows, to ensure that the volume of water flowing into Lake Turkana is maintained, keeps the lake within normal levels and accounts for any variations perceived from climate change considerations. In some cases, during project development, this may require the adjustment and re-calibration of the upstream development schemes, dam fill times, and reconfiguring water management for irrigation of sugar and cotton associated with the dam.

Livelihoods and land acquisition, compensation & resettlement

At the southern end of Lake Turkana is a wind farm project which has faced several delays including the power lines. This was partly delayed due to compensation issues brought on by local communities who were unhappy with the compensation originally offered as part of the power line routing. The power line authority were not able to secure access and community agreements early in the process, and were faced with negotiating with communities that were already aware of the project and were asking for more compensation or other benefits. As an additional part of this project, one of the original concerns of the local nomadic Samburu was the availability of the land for grazing. Lake Turkana Wind was originally planned around 150,000 acres. Local herders thought that they would lose all of this land to the development. After some careful planning and negotiations, and development of a pilot project to show the herders that cattle grazing can go ahead below wind turbines, the developer was able to offer almost all of this land to the herders, and only approximately 85 acres of land were actually used for infrastructure, wind turbines, and energy related equipment. Today, cattle and goats graze around the wind farm project with very little loss of land to the nomadic community.

Stakeholder engagement & social license to operate

At the Kinangop Wind Park, the developer had plans to install a series of wind turbines for a 60 MW project in a region that already has human settlement on the Kinangop, Kenya. The local community was initially very positive about the project. A combination of misunderstandings related to set back distances, community benefits, communication to the community, and local political influence ended up in major opposition to the project. The main Nairobi to Naivasha highway was blocked by protesters and after wind turbine damage and sadly a fatal shooting during protests, the financiers decided to pull out of the deal. This is a very well-known case of ESG issues leading to significant community concerns that ultimately led to the abandonment of a project, where the community in fact withdrew the social license to operate.

Five-point strategy to manage environmental and social risk

From a perspective of putting a renewable energy project together, each of the key players have slightly different drivers and motivation. The business developer seeks to minimize any extra costs and is always aware of streamlining ESG expenses that may be viewed as non-core costs. In fact, we have found that the most successful developers place ESG at the forefront and can even use this opportunity to increase their competitiveness in the long term. Brand and reputation are also core values that can be managed and protected once the ESG issues are properly and promptly identified and resolved. When the construction is unfolding, there may also be extra costs and unforeseen situations that were not anticipated, that invariably drive the cost of con-

struction higher, possibly significantly affecting also the EPC's performance. As we shall see below, in order to ensure success for renewable energy projects here in Africa, we recommend investing in good quality ESG support. Following the five-point strategy described below provides the best practices and essential ways to identify and manage key ESG risks and turn these risks into added long-term value.

1. Early action

Renewable-energy projects generally take several years to implement. The most successful developers integrate ESG considerations into the early stage project evaluation. The work needs to be started at the point of conceptual project inception, with the ESG officer or external advisor performing the up-front strategic screening and risk assessment. This screening work can be usually completed at a relatively low cost, which takes into account the level of risk and the investment at this stage. An ESG screening review can involve a few days of desktop work where information on the project and magnitude is evaluated, and sometimes a site visit is needed to search for any obvious E&S issues that a professional ESG expert, with training and background aligned with the potential areas of concern can identify early on. The screening can also highlight ESG areas that will require early intervention such as community concerns or obvious biodiversity issues, or other environmental issues that need more attention and focus.

2. Fully understand lender requirement

In today's world developers have various lender financing options to choose from. Each lender has a comprehensive strategy to address risks for the projects that they finance. Lenders usually require projects to apply the International Finance Corporation (IFC) Environmental and Social Performance Standards and may even have their own specific guidelines and requirements. As part of the renewable energy transactions, it is incredibly important to identify the lender for the project early on. This allows for all considerations listed above to be considered carefully in ensuring that each of the lenders requirements are completely fulfilled. Generally, when developers bring the ESG advisor in early and openly disclose the project financing early on, this makes assessing and evaluating the ESG elements of the project a much easier task, as the ESG advisor is then able to customize the approach to meet the specific lender requirements. Many times, ESG advisors will have already worked with specific lenders and will automatically know many of the ESG issues and focus areas that can typically define the bankability of a project.

3. Comply with local requirements and follow international standards

Each country, and in some cases each region or province, will have their own E&S guidance and legal requirements for capital projects. The sophistication and knowledge of each African country is changing rapidly, so requirements that were in place a few years ago, may not be relevant today, and vice versa. The most efficient way to fully understand these requirements is to complete an E&S register for the project that includes both the Local Requirements and the International Standards. This requires that the developer provides details regarding the renewable energy technology used, site development plans, and the likely environmental and safety risks associated with the technology (such as effluent discharge, noise, air pollution, wastes generated, and labor, working at height or confined space entry requirements). The ESG advisor can then support the developer to develop and integrate these programs. Once the technology is understood, the legal register can be crafted to develop an International Standard Environmental and Social Impact Assessment (ESIA), an Environmental and Social Management System (ESMS), an Environmental and Social Management Plan (ESMP) and an Environmental and Social Action Plan (ESAP), that outline how both local and international requirements are managed and actually complied with on the ground.

The international requirements come directly from knowing what the lender will need, such as complying with the IFC Performance Standards that are well recognized today as the core standard for ESG compliance in International Project Finance. The requirements can then be translated into ESMP that can be presented to the lender. The lender uses the ESMP and the ESAP as a way to assess ESG compliance, and completes audits against the ESMP and ESAP to ensure that agreed obligations are complied with as a legal part of the financing. Our advice is for the developer to complete ESG studies that take into account both local and international requirements at the same time, fully aligned to financing as outlined in Step 2.

4. Understand the process and fully integrate communities into the project

Developers need to be able to very carefully visualize and plan each step of the ESG process. Good developers spend lots of time understanding ESG issues and brainstorming the different ways to fully meet the lenders requirements. The ideal coach and business partner for this work is the ESG advisor along with members of the developers' team. We have often seen developers working closely with lenders to get input and ideas from lenders on solving certain issues. The importance of fully integrating the community into the project at an early stage cannot be underestimated. Here is where the developer has the opportunity to listen and learn about the community. Community solutions that require efforts from the community as well as the developer, where the community has been consulted deeply, participates actively in the process, and is involved with developing the solution, often provide the best longer term outcomes. The solution is about integrating the value for the community into the projects and can include initiatives that help or train communities in agriculture, manufacturing, develop educational improvements, or select and train key people from the community that get an opportunity to participate in the construction and then the longer-term operation and/or management of the project. We have also seen where the community benefits in the right way from a project; a feeling of ownership is developed that creates a long-term sustainable solution for the project.

5. Develop effective ESG awareness and performance

Once the project is underway, the developer needs to ensure that the project is being constructed and operated in line with the requirements outlined in points 2 and 3 above. The easiest and most efficient way to ensure ESG awareness and performance is executed on a project is to have knowledgeable and aware management and team members that are fully engaged and focused on ESG requirements, and to have an active ESAP that is actively being reviewed and complied with at every moment of the project.

Finally, the lender will require a review of all the ESG elements with an ESG audit, which is the final piece of the puzzle that allows the lender to confirm that the ESG items have been respected and fully addressed, thereby unlocking the funds for the project.

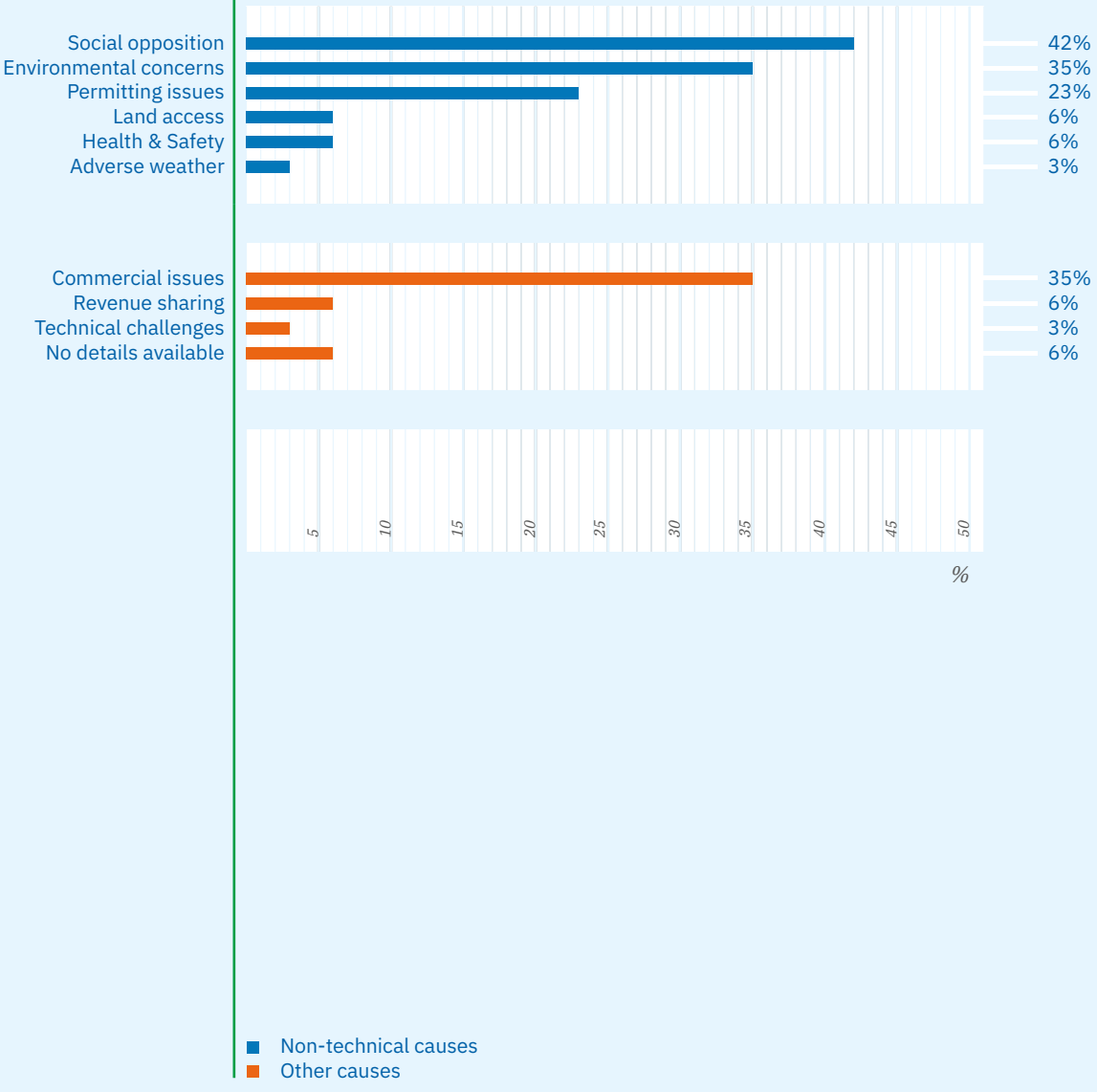
Conclusion

The advice we give to the developer and all other parties is for renewable energy projects in Africa: get serious very early on about ESG issues. Build ESG into every single day, from day one, for every part of the project. Consider integrating our proposed five-point strategy to ensure ESG success for your renewable energy project. Africa presents a huge need for sustainable and responsibly constructed renewable energy projects. There are some fabulous opportunities to develop sustainable solutions for African infrastructures, at the same time providing a positive and supportive project for each community. The ultimate objective is to prepare projects to be bankable, and then further develop the project that sustains the community for generations to come.

Fig.19

Causes for project delays.

Source: ERM Data from 67 projects, does not sum to 100% due to multiple causes of delays.



Energy Access with or without the Electric Grid: What We Learnt through a Decade of Fieldwork in Sub-Saharan Africa, 2007-2017

The technological, financial and payment system innovations of the last ten years have made it possible to imagine new ways to bring early electricity access to Sub-Saharan Africa. While solar home systems are a great start, they limit possibilities of electricity consumption growth. With modest public investments, we are coming close to bringing grid-like services to the poor where grid roll-out might take time or is cost prohibitive. Such an approach opens possibilities to spur economic growth, thus allowing countries to make larger investments where they would have the most impact. Some of the lessons learnt show that one needs to keep upfront costs low, there should be no fixed monthly fees, promote efficient appliance acquisition – possibly through tariff-based or on-bill financing, and incrementally grow infrastructure with consumption.

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My first set of travels to Sub-Saharan Africa started in earnest around 2006, and were primarily to impoverished rural areas in both East and West Africa. I was an engineer and was tempted to jump to solutions, but others with more experience reminded me that it was critically important to observe and listen to people, their needs and their constraints before action. I became aware that I was learning much more from the poor than they were learning from me. Some electricity needs were simply dire, such as those at health clinics or to operate a critical drinking water pump. There was no time to wait for a cost-benefit analysis – household access clearly was an obvious and visible challenge. Based on detailed surveys to 300 households (disaggregated by energy source and service), findings from our 2007 study[1] showed that in most settings monthly household spending on energy ranged from $2 to $7 per month, with higher levels of spending generally in settings with larger household sizes. Back then, nearly everyone cooked with solid biomass and most do so even now. At the time, conversations with electricity utilities

and local governments made it evident that the electric grid was unlikely to arrive in most areas for at least 5 years. In retrospect, the observation turned out to be generally true – it took closer to 10 years for the grid to arrive and not even all households were connected. I make strong generalizations here and indeed not all communities were equally remote or far from the grid, country policies varied and so did the persuasive power of those lobbying on behalf of the poor.

Improved biomass cook-stoves seems harder than rocket science

We recognized the multiple challenges of cooking with solid biomass, carefully measured household consumption of biomass and gender-disaggregated time to gather that biomass. Even without the difficult measurements of health impact from exposure to harmful, it was clear that barring subsidies, a shift from fuelwood without a significant increase in income would be near impossible. Like others in the energy access field, we thought improved cook-stoves could alleviate at least the environmental and time-effort burden. We chose multiple promising improved cook-stoves for testing by local cooks with local foods. We carefully measured the fuelwood used. We tried to address several bottlenecks – such as those of supply chains, of behavior change and innovative financing models. We failed miserably. Meanwhile, we learnt through the careful health impact studies of others that reducing the biomass consumption by a third would not reduce the health burden by a third. Even chimney stoves that vented the smoke outside were being questioned in the literature, despite visibly reducing exposure given East-Africa's spare settlement patterns. The dose response of exposure to health was nowhere near linear. However, we do know that many urban households value convenience and use purchased charcoal[2] for cooking, while the adoption of robust charcoal cook-stoves that save fuel and hence save expenditure has actually scaled in some cities.

Lacking electricity access, it was not even possible to boil a cup of tea with an electric kettle or use an electric rice cooker. Today, with nearly twice as many people cooking with solid biomass than those lacking access to electricity, I see an opportunity that a billion people gain access to grid electricity while still cooking with biomass. I wonder if at least some of the many fuel-intensive chores could not be carried out using grid power, which at least in some countries is low-cost – even though economists and many energy experts tell us this due to wrong reasons such as electricity subsidies. Is it because we have well-developed appliance supply chains, or that social norms prevent even the smallest investments in low-cost appliances when the gain may be for women? Is it because recurrent cost of electricity is a cash burden that the household cannot afford or is the grid so unreliable that a household cannot be sure if they are able to finish their cooking? Solar cookers that work by channeling sunlight to heat a pot never took off. As costs of solar photovoltaic (PV) fall dramatically, access to surplus daytime power might become so low-cost that it would be worth promoting as a cooking option at different times of the day. We actually don't know the answers but these are questions worth answering.

Residential electricity

A decade ago, I can safely say that in most Sub-Saharan African countries at least half of the rural population lacked grid electricity access. In 2007, solar solutions were still expensive, LEDs were not yet low-cost, and nearly all lighting came from kerosene, candles or disposable batteries. Small petrol generators were being used to charge cellphones or used car batteries. An enterprising farmer using a diesel-powered pump for irrigation was a rare sight even though this was not uncommon five decades ago in many agrarian rural settings of India, the country of my birth.

Populations in rural areas were very much aware of their urban counterparts who had grid access. They knew that the grid was not always reliable, but a grid connection was certainly an aspirational goal. In urban settings where the capital cost of provisioning access was presumably lower

than in rural settings, the utility had traditionally provided such grid access at a minimal cost. Hence those in urban settings enjoyed energy services with electricity tariffs anywhere from $0.02 to $0.20 per kWh, in effect two orders of magnitude lower than their rural cousins using kerosene lamps. It was not surprising that the poor aspired to a grid connection, even if the grid supply was erratic.

The gift of kerosene becomes a curse

Note that a kerosene wick lamp puts out such low level of lumens per unit fuel consumption that, in operating costs, the kerosene consumption (at $1/liter) is equivalent to purchasing electricity at rates upwards of $20 per kWh (Mills, 2005). Of course, a kerosene wick lamp costs a household less than $0.25 to purchase whereas a solar system would then have cost several hundred dollars. Countries such as India that couldn't rapidly roll out the grid even provided small monthly rations of subsidized kerosene in rural areas to ensure at least some form of lighting. It is today easy to blame kerosene for all ills when we have other options.

The cost of grid access on the other hand could have been anywhere from $500 to $2,000 per household, a prohibitive investment for many countries. The bulk of generation and transmission investments were government-financed at least in urban areas where demand density was high or where industry had larger loads. China, where local government in effect had control of all land, was able to leverage that land towards capital for grid expansion. An early observation in many countries was that when a customer wanted to connect to the grid, their connection cost was based on the actual cost of extension from the nearest utility grid to that customer, even though the wire would pass close to several others. This serial expansion approach combined lacking financing to spread out the cost, or any attempt to reduce costs through scaled deployment, meant that grid expansion was both sporadic and expensive. Even if the first costs had decreased, still not everyone could afford them. There would be potential knock-off benefits of a such roll-out but would that benefit justify even a $100 per capita expenditure of the exchequer (assuming that last mile access would cost $500 per household)?

Should the country leadership borrow, say $500 per household from a multilateral bank to finance a large-scale roll-out, especially when such loans competed with other important national priorities such as roads, health, water and education? I and others certainly thought so, and today a $500 per household cost for grid extension would be considered a low-hanging fruit for grid expansion. My laboratory's early work was to support some utilities in finding such opportunities at national scale. The World Bank also recognized the importance of sector-wide approaches to achieve scale and cost reduction through standardization, supply chain and technical assistance capacity building. We have since learnt that ideally a very small or no fraction of this upfront cost should be passed on to the consumer, unless perhaps rolled into the tariff, since the customer would need resources to make investments in inside wiring. Ironically, some of these lessons were learnt through mini-grid pilots that taught us the importance of payment systems adapted to the needs of the poor.

Lighting and cellphone charging breakthroughs

But many locations were too remote and settlement patterns too sparse to connect a household for $500. Moreover, there were also limits to how fast the grid roll-out would take. Instead, distributed energy technology costs were decreasing. Over the last decade costs of solar PV and LED lights started to come down and they are sharply lower today compared to 2006. Household budgets that wouldn't permit more than say $2 per month of cash spending on lighting and cellphone charging needed to be addressed. Given that affordability price point, one could only envision the possibility of small solar lanterns with a few days of battery storage for a couple of low-wattage CFL lighting points. Our experience at the time showed that small portable solar lanterns could be viable if the circuit design was

optimized to ensure proper charge discharge of a lead-acid battery, with temperature-corrected battery parameters. We chose a 12V 5Ah lead-acid platform packaged along with a circuit board adequate for lighting and for cellphone charging. Such systems were distributed through a monthly payment plan, unlike pay-as-you-go (PAYG) for a service that you may choose to use when you want. At the time, we estimated that such a unit, which we called a "powerpack", would cost $15 - $20 to manufacture in volumes of thousand units and could be rented at perhaps $1 - $1.50 per month to allow modest margins. We made the circuit designs available publicly.

The market for such solar lanterns had begun to emerge and by 2010 commercial entities started to make these at scale. That and the lack of a reliable grid made it possible for a solar lantern or a solar home system to be viable, as it was possible to provide minimal but essential lighting and cellphone charging services of say 2 kWh per month at $3 to $5 per kWh (including the cost of financing the initial capital costs). The objective was that the bulk of the poor without grid access would be served rapidly and nearly all would have at least basic access to high quality illumination and cellphone charging at a cost per kWh much lower than that of using kerosene-based lighting. Such solutions expanded rapidly and yet the access gap is so large that the initial dent has not reached the poorest half. If the government's ability to subsidize or scale access was inefficient, the private sector's cost structure and transaction costs weren't low either. Now, mobile money and PAYG-schemes adapted to such purchases are making a significant headway.

The promise of mini-grids

What the poor really aspired to, as we learnt from numerous informal interviews, was the ability to consume electricity when they want (more in some hours of day, less in some months), in the amount they wanted (the ability to flexibly increase their consumption without making additional capital expenditures), and pay only for the amount of electricity they used (as opposed to a fixed monthly fee plus a tariff based on consumption). With erratic seasonal income streams, such payment plans would allow them to dial-down consumption and avoid having to pay fixed costs in months they had to prioritize other consumption, or to have to pay for a service they may not be able to use due to poor supply. But crucially, grid-like service would allow them to imagine the possibility of buying even the smallest next appliance, whether it be another light bulb, a fan, a stereo or a television set.

This is what led us to start our mini-grid effort in 2009, initiating procurement in 2010, and finally installing eight pilot "SharedSolar" mini-grids in Mali and another eight in Uganda, becoming fully operational in June 2011. The pilots allowed us to explore the commercial viability of grid-like access to provide flexible power (within limits) and to observe consumption growth, emergence of small business under reliable supply of electricity. Electricity could be provided as a service and hence the first cost could be financed by a larger entity that could leverage scale, data and credibility to attract low interest rates. The deployment provided near 24/7 reliable AC electricity supply, on a PAYG basis, with time of day tariffs, reflective of the operation and replacement costs.

The target initial cost per connection was $500 per household at scale, with a target average solar capacity per household of 100 W. The emphasis here is on average capacity, since households within the community would consume more or less at any given point in time. Entrepreneurs could even start a small business and would not need new investments in their personal powerplant as their consumption would grow. And if the mini-grids would reach full utilization, one could incrementally increase capacity to provide for higher consumption. At this point, the marginal cost of adding capacity would be much lower. A connection cost of $500 could presumably be split three ways. One split we envisioned was recovering $50 from the household with payments spread out over the first three years, a residual value of the infrastructure to be $150 after say 5 to 10 years, and the other $300 from national budgets, thus ensuring lower cost to go-

vernment budget than for grid access. Moreover, when the grid would arrive the utility would find a mature customer base with some non-residential loads as well as some degree of residual infrastructure. In practice, at least with the pilots, the former assumption turned out to be true but not the latter.

A small microprocessor ensured that the supply/demand and battery were well managed. The microprocessor was also the central coordinating software-controlled metering system. Full digital management of supply and demand was implemented, with a PAYG payment scheme deployed from the start. Since the supply was from solar PV modules and batteries, there were customer-specific daily energy limits and power limits to guarantee high reliability for some minimum consumption, regardless of multiple cloudy days or higher consumption by a few. Initial designs had about 10 kWh of storage for each kW of peak solar PV generation capacity.

The last five years saw many new start-ups scaling up off-grid technologies through what have been variously called mini-grids, micro-grids and nano-grids. While their service is still expensive per kWh compared to grid tariffs, they offer the possibility of a lower capex, faster execution times, potentially higher reliability than the grid, innovative payment mechanisms, and institutional flexibility in deployment. They also offer governments the option of developing financial support programs that can be based on verified connections and data.

To our knowledge, when first fully operational in the field in 2011, SharedSolar minigrids were the first small-scale mini-grids with grid-like 220 V AC to each customer from a central location. The customer distances were maintained so that the individual customer never needed more than around 100 meters of wire. Given the spatial spread of customers, this implied roughly 20 customers per single central system. Wiring allowed for up to 15 Amps of load for each customer, even though smart meters were designed for 6 Amps and circuit breakers and fuses allowed no more than 2 Amps per customer. The systems were adequately oversized to allow for reliable supply for the first few years even with consumption growth, which did in fact occur. Tariffs were progressively reduced as customer payments in effect were paying off the initial capital. This decreasing pricing also allowed for one to observe to some degree the effect of pricing on consumption but this was in no way a rigorous study in this regard.

● Figure 20. (See Infographic Section) below shows the evolution of the electricity consumption over the first three years from the start of the operation for the set of micro-grids in Uganda. It can be noted that, despite the high price per kWh (from $3.2 per kWh to $1.2 per kWh in the day, and from $4.0 per kWh to $2.0 per kWh at night), which is an order of magnitude higher than usual grid tariffs, there has been a very strong growth in electricity consumption. ● Figure 20 provides a strong indication of what value households place on electricity. An important observation was that the consumption growth was not uniform across customers.

Energy for productive uses

Lack of reliable and low-cost power severely constrains the economics of irrigation. Mini-grids that utilize battery storage or fuel become expensive for irrigation. But if irrigation can be carried out when the sun is shining, then solar-powered irrigation can be made affordable without storage or use of engines. One way to keep costs low for users is to ensure full utilization of unstored solar power, and this can be achieved through sharing of a power source. One can schedule pump operations based on solar availability. Thanks to low solar PV costs and appropriate financing, electricity can be produced and distributed to the farm at a price approaching grid power costs. If in addition, the farmer can pre-pay for their daily water then that can further remove constraints to capital costs. In Senegal for example, we observed that a single hectare of irrigated land can generate $5,000 in annual revenue from two horticulture crops per year, such as onions and carrots. In shallow groundwater areas an investment of $5,000 per hectare in solar power irrigation was needed to generate such a revenue. Moreover, these sy-

stems are also suitable with some added electronics to feed power into the grid when it arrives. The absence of batteries keeps the costs low and equipment lifetime high.

Conclusion

Some of the lessons learnt have been that it is important to develop distribution models that keep first costs of access or appliances low and that it is easier for the poor to pay in smaller increments based on their usage. The poor also seek opportunities to grow income and catalyzing such opportunities requires electricity supply that can grow seamlessly as their needs grow, without making incremental investments in system capacity each time.

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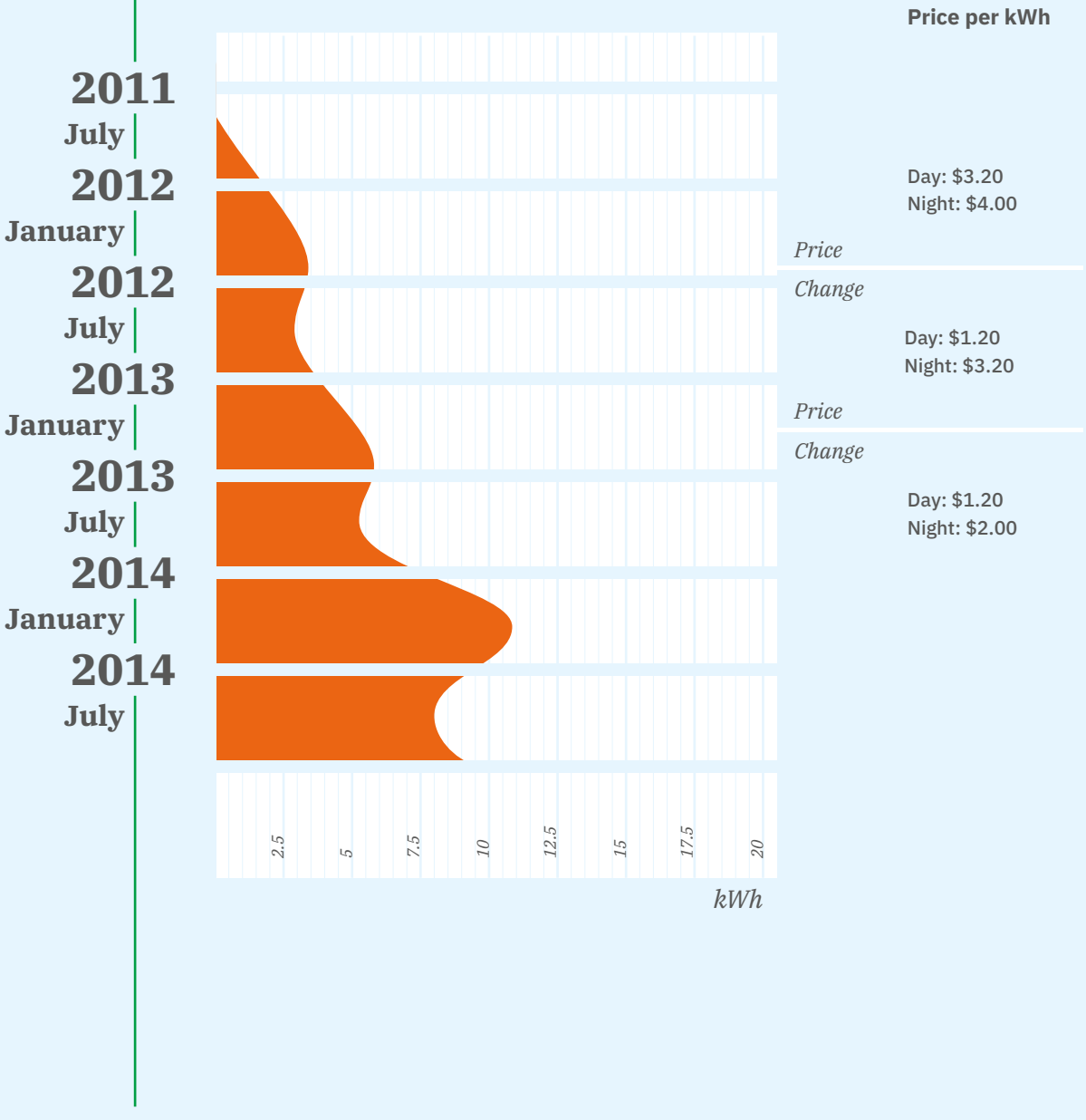
[1] http://qsel.columbia.edu/assets/uploads/blog/2013/09/HouseholdEnergyAfrica.pdf.

[2] When LPG is too expensive or at least the purchase is too lumpy.

Fig.20

Daily energy usage for a group of SharedSolar customer in Ruhiira, Uganda.



Unleashing Sustainable Human Capital through Innovative Capacity Building and Vocational Training: The Micro-Grid Academy Can Unlock the Micro-Grid's Potential in East Africa

Access to reliable, affordable and renewable energy is essential to sustain the socio-economic growth of rural and remote communities in Sub-Saharan Africa. Decentralized renewable energy technologies present the most favorable solution to electrify rural areas and boost their sustainable development, especially where it is costly and time-consuming to connect independent villages to the main grid. But providing technology alone is not enough to ensure long-term access to electricity of rural communities. Extensive capacity building and training activities are key to ensure community participation, support the roll-out of technologies and business models, and enable the local ownership of projects in the long run. In the context of access to energy, capacity building efforts should also be undertaken in power sector regulation and across the whole value chain for renewable energy project development, adapted to accelerate the electrification process. The Micro-Grid Academy (MGA) is such an initiative with the purpose of developing a broad range of professionals in East Africa trained in various facets of micro-grids.

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Introduction

Reliable and affordable energy, along with education, communication and income-generating activities, is an essential component of a community's socio-economic development and economic growth (Micangeli, 2017). Despite concerted and global efforts, as evidenced by a variety of international agreements and policy strategies over the last decade, progress is needed in every area of sustainable energy to achieve energy access for all and to meet the UN Sustainable Development Goals (SDGs). The IEA Energy Access Outlook 2017 estimates show that worldwide 1.06 billion people or 14% of the global population lack access to energy, of which 588 million are in Sub-Saharan Africa. Those most affected live in remote and rural areas, where the percentage of people with access to energy is only 23%. More efforts are needed to ensure access to electricity in remote Sub-Saharan Africa and create opportunities for sustainable development.

An important strategy to achieve tangible progress on access to energy in Africa is to build on communities' existing capacities and identify

potential capabilities and opportunities ripe for empowerment. Providing extensive capacity building is instrumental to ensure the full inclusion of the community, support the roll-out of new technologies and enable the local ownership of sustainable projects in the long run. Development projects can further enable capacity building, which refers to much more than training in electrification activities, since it includes human resource development, as well as organizational and institutional development (Merino, 2012).

The prominence of capacity building in development practices has increased in the 21st century and is now considered essential to sustainable participatory development at the local level. In the context of access to energy, capacity building efforts should be undertaken across the whole value chain for renewable energy project development. From policy and regulatory design and management, to project preparation, evaluation, development, implementation and financing, a wide array of skills needs to be built up for all actors involved, including government ministries, financing institutions, regulatory agencies, utilities and communities. Inadequate skills and capacities in the regulatory framework inhibit renewable energy development through slower permitting and licensing processes, as well as higher perceived risk among financing institutions and regulators themselves. Off-grid renewable energy projects can be challenging for developers due to the high investment risk and limited project bankability caused by an uncertain political and regulatory environment. In this context, international donors are prioritizing funding programs for integrated action aimed at positively impacting rural communities' development by using access to energy as a driver for socio-economic empowerment.

The need for capacity building

Capacity building in international development is a $15 billion industry and is about social and political change (Guy 2016). For optimal design and implementation, capacity building programs should be based on lessons learnt from other development sectors, such as public health, which instruct that organizations undertaking capacity building must align incentives of trainees and industry (Mallett, 2015). In addition, capacity building programs should consider adjacent systems such as supply chain, regulatory environment, and capital investment. Lastly, program beneficiaries can develop capacity through strengthening social relationships and promoting south-south professional collaboration (Petersen and Engberg-Pederson, 2013).

The importance of sound regulation and context-relevant, sustainable business models cannot be overstressed. Both should be adapted to the specific characteristics of the individual country, considering not only quantitative analysis of costs and benefits, but also the concomitant social, political, cultural, and administrative factors (Pérez-Arriaga, 2016). The principles of economic regulation, whose application to mature power sectors in industrialized countries is well established (Pérez-Arriaga, 2013), must be adapted to the specific conditions of developing countries. In particular, it is necessary to design policy and regulatory approaches that make possible the creation of viable business models to accelerate the electrification process so that universal electricity access can be achieved within the next decade. The development of power sector regulation courses with this specific objective is a necessary and very welcome contribution to the overall capacity building on energy access for all worldwide (MIT, 2017; FSR, 2018).

Technical training is a necessary component of pilot micro-grid projects because projects require specific technical skills. However, this slows down their development because organizations and enterprises piloting such projects in East Africa must set aside a portion of their budget for training due to the lack of readily accessible and skilled systems installers, operators, and maintenance staff. These projects stand to benefit from institutions specializing in providing micro-grid specific capacity building services.

Capacity building in action: the Micro-Grid Academy

One such initiative that aims to support the ra-

pid development of micro-grids throughout East Africa is the Micro-Grid Academy (MGA). Launched in January 2018, the MGA is a Nairobi-based initiative by partner organizations RES4Africa, Kenya Power Lighting Company (KPLC), AVSI Foundation, Strathmore University and St. Kizito Vocational Training Institute (Aresti 2018). The purpose of this kind of capacity building initiative is the development of a broad range of professionals trained in various facets of micro-grids supplied primarily by renewable energy, with battery or diesel generator backups when necessary (Lantero, 2014). As noted above, achieving the roll-out of micro-grids in the region depends on the success of many different actors working on micro-grid development, as well as collaboration and cooperation with regulatory bodies, the private sector, and various financing institutions. Within this broad network of actors, the MGA is focused specifically on capacity building and vocational training.

The partner organizations that have come together to launch the MGA identified technical capacity as one of the key barriers limiting the proliferation of micro-grids. Other barriers include regulatory challenges associated with setting up small-scale Independent Power Producers (IPPs), lack of financing to cover the high up-front capital costs, and uncertainty about the cost and complexity of micro-grid installations. Several players in the region, including the GIZ initiated Talek Power project (Blechinger, et al. 2016), have undertaken demonstration programs, and tied to those programs are efforts to streamline regulatory processes and oversight. Instead of adding to the growing list of pilot programs in the region, the MGA founders decided to support the ongoing efforts of existing pilot projects, as well as the development of the sector in general, through capacity building and vocational training.

Academic institutions in developing countries can be considered as a crucial actor in the provision of capacity building to ensure long-term sustainability of actions for local development (Sendegeya, 2016). As a training program supported by several academic institutions, the MGA can facilitate cross-regional exchange of best practices and lessons learned among project developers, government agents and financiers, which is crucial to the empowerment of local professionals (Sendegeya, 2017).

The MGA hypothesis

The barriers to widespread adoption of micro-grids can be addressed through targeted interventions by international and local partners. The rationale underpinning the MGA and other efforts to eliminate these barriers is that: (i) micro-grids will naturally proliferate throughout East Africa if the market conditions are right and unjustified barriers are removed; (ii) micro-grids, particularly renewable energy micro-grids, may be the most cost-effective solution to lacking electricity access under various conditions; and (iii) in particular, micro-grids can be preferable to centralized grid extension for dispersed rural townships in Sub-Saharan Africa. Finally, (iv) once built – usually with some donor support – micro-grids can support themselves and be cash-flow positive through the generation of user fees.

Within this context, the role of the MGA is to train individuals and, in doing so, provide a pool of technicians for micro-grid developers to hire, build, operate, and maintain their micro-grids. Capacity building at the MGA is not limited to training, however. The MGA also aims to build capacity by improving project delivery and the supply chain, which necessarily includes enhancing the organizational performance of certain key institutions, including regulating bodies, service providers, and private enterprises. Technical capacity gaps exist throughout the project delivery process – from conception to financing, siting, planning and design, to procurement and installation, operation and maintenance. Lastly, the MGA's services should extend to building capacity and awareness of producers, customers and energy consumers, so they can reap the benefits of access to energy, thereby enabling people to pay tariffs and improve livelihoods.

Micro-grid operators include IPPs who operate and maintain systems and collect tariffs. Some companies build, operate, and maintain their

own systems, while others build the grid and then create an organization or local business to operate and maintain the system. In the latter scenario, the micro-grid operator will require training by the partner organization, which the MGA can provide. These capacity building offerings help align incentives between individuals undergoing training and the industry's needs. The MGA centralizes the training of personnel in such a way that organizations and enterprises can seek out graduates or send employees for training, thus eliminating or expediting a step in their processes.

Moreover, training required for micro-grid development is not limited to technicians. The MGA technical training may be directed towards engineers and planners responsible for the planning, siting, and design of systems. Persons filling these roles must be indigenous to the regions for micro-grids to proliferate. North-South collaboration and funding tend to be limited to pilot projects, but for micro-grids as a solution for energy access to become sustainable, projects must be initiated locally, so that new projects are conceived, resourced, sited, planned, designed, and implemented in all phases together with local skilled personnel.

Conclusion

Capacity building plays a central role in delivering progress on energy access, and the MGA represents an opportunity to accelerate the growth of micro-grids in East Africa. Success requires not only smooth execution, but rigorous and consistent follow up by monitoring both the program and its graduates. The curriculum's design must take into account the system or market as a whole, as training is more effective when incentives such as opportunities after training are well defined. The development of a talent pool will not by itself spur the emergence of a new sector, but rather must complement the work of other market development efforts. Lastly, technical knowledge is important, but so are the people skills associated with service provision, as, at the end of the day, the micro-grid IPP is a service provider.

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RES4Africa Micro-Grid Academy.

Access to affordable, reliable and sustainable energy is a key driver of development in Sub-Saharan Africa, though today almost 600 million people still live without access to electricity, especially in rural areas where it is costly and time-consuming to connect independent villages to the main grid. To that end, decentralized renewable energy solutions are among the most viable means to electrify households and boost sustainable development. However, providing technology alone is not enough to ensure the autonomous and long-term economic and social sustainable development of rural communities. Extensive capacity building activities are therefore necessary to support the roll-out of new technologies and enable the local ownership of sustainable projects in the long run.

RES4Africa recognized the role of decentralized renewable energy solutions for energy access in Sub-Saharan Africa, combining it with the necessity of local training programs to ensure their long-term sustainability. The Micro-Grid Academy (MGA) is a regional capacity building platform that provides theoretical and practical training on energy access and decentralized renewable energy solutions to young East-African and international technicians, entrepreneurs and engineers. The program includes theoretical lectures including technical and managerial training, coupled with practical learning on a real 30-kW hybrid mini-grid that will be installed on-site thanks to the contribution of RES4Africa members. The MGA aims to enhance access to energy in rural communities fostering local enterprise and job creation, while positively impacting health and education services, female empowerment, climate change mitigation, reliable water and food production and energy security, in line with the United Nations Sustainable Development Goals (SDGs).

Located in KPLC Institute of Energy Studies & Research in Nairobi, Kenya, the MGA is coordinated by RES4Africa, in partnership with Enel Foundation, the national Kenyan Utility KPLC, Strathmore University, AVSI Foundation and St. Kizito Vocational Training Institute, and endorsed by the East African Centre for Renewable Energy and Energy Efficiency (EACREEE). The Micro-Grid Academy first launched with a pilot course held in Nairobi in January 2018, gathering 40 students from Europe and East-Africa including lecturers from KPLC, Strathmore University, St. Kizito VTI, UN Habitat, Massachusetts Institute of Technology, Columbia University of New York, State University of New York, Sapienza University of Rome, Sigora and GIZ. In April 2018, the MGA held a second course and trained 40 students, including 20 women selected by the United Nations Environment Program (UN Environment) from the Africa Women Energy Entrepreneurs Framework (AWEEF), a platform that aims to empower women entrepreneurs as main stakeholders across the energy value chain. The course lectures had a direct focus on entrepreneurship and clean energy access, both central to the UN SDGs. Other than UN Environment, the latest MGA course actively involved UN Habitat and the United Nations Industrial Development Organization (UNIDO).

The MGA concretely contributes to accelerating the sustainable development of East-African rural communities by enhancing energy access through capacity building in a socially, environmentally and economically sustainable way. The MGA aims to fully launch a series of capacity building activities by 2019, training at least 300 students per year, looking to form future professionals in the sector and positively impact all areas involved in the sustainable development of local rural communities.

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Investment in Climate-Resilient African Infrastructure

Africa's vulnerability to the impacts of climate change threatens to undermine major developmental gains, exacerbate existing weaknesses, and hamper growth prospects. There is concerted action required to move Africa to a more climate-resilient future that is critical for its poverty alleviation efforts and growth, as well as mainstreaming of climate action within the development dimension. Accelerating investment in climate-resilient infrastructure is an immediate priority. The Paris Agreement increases opportunities for climate-smart investment in African infrastructure including energy, transport, water, agriculture, and urbanization, and sends a decisive market signal that the transition to a thriving clean economy is inevitable, irreversible, and irresistible, with an important role for private sector and private investment in climate solutions[1].

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Africa is more victim than contributor to climate change, so adaptation and investment in climate-resilient infrastructure are high development and investment priorities. Africa contributes a meager 5% to global GHG (greenhouse gas) emissions and the bulk of its emissions derive from deforestation and land use change. Warming in the range of 3 to 4 °C would have disastrous consequences for Africa, including heat extremes affecting the vast majority of the continent's land areas, heightened risks of extreme drought (particularly in Southern Africa), reduced yield and crop failures, and flooding.

Furthermore, it is estimated that by 2050 almost 60% of people (800 million) in Africa will live in cities, increasing demand for transport, housing, water, and energy infrastructure. It is thus imperative to invest in resilient infrastructure, including water management (irrigation, hydropower, water supply, and flood control), roads, bridges, energy, and other transport infrastructure. All countries will have to invest significant public and private resources in infrastructure, both to

upgrade existing systems and build new networks. Over the next 13 years up to 2030, the world will need to build infrastructure in the order of $75-86 trillion – approximately double the current estimated $50 trillion stock of infrastructure. Around 70% of these infrastructure needs will be in emerging markets and developing economies, Africa in particular. These investments will be driven by a range of factors including the ageing of existing infrastructure and changing demographics, as well as policy objectives such as greenhouse gas mitigation. In order for Africa to meet its infrastructure gap, it is estimated that over $95 billion per year will need to be spent over the next decade, split evenly between investment and maintenance costs. This is about double the current spending levels, which amount to around $45 billion annually – with more than half being funded by the public sector. This leaves a financing gap of around $50 billion per year.

The Programme for Infrastructure Development in Africa (PIDA), endorsed in 2012 by the continent's heads of state and government, lays out an ambitious long-term plan for closing Africa's infrastructure gap, including through major increases in hydroelectric power generation and water storage capacity. Much of this investment will support the construction of long-lived infrastructure, including dams, power stations, roads and irrigation canals, which may be vulnerable to changes in climatic patterns, although the direction and magnitude of these climatic changes remain uncertain. In any event, the location, design, construction and operation of infrastructure will have profound impacts on the resilience to climate change of both individual countries and the continent as a whole.

Building climate resilience into infrastructure investment decisions provides scope to both enhance resilience and avoid the risk of costly retrofitting in future. But several barriers to financing climate-resilient infrastructure need to be overcome. These include:

- **lack of transparent and bankable pipelines of projects**, arising from the absence of long-term development plans and failure by many African governments to communicate infrastructure needs to investors;
- **high development and transaction costs**, due to inefficient bidding and procurement processes that require investors to tailor each infrastructure project to different standards;
- **lack of viable funding models**, so that investors demand higher returns than can be delivered or require high charges that users are unwilling or unable to pay, particularly in developing countries;
- **inadequate risk-adjusted returns** that do not compensate investors in developing countries for the additional risk associated with unfavorable regulations and policies, including foreign investment restrictions.

Public concessional climate finance has a key role as a low-cost source of finance which, when blended with other sources of public finance, can de-risk African infrastructure projects and crowd-in private finance. Concessional climate finance invested as part of a broader funding package could lower risk and overall financing costs, thereby leveraging the private sector capital needed to close a good portion of the infrastructure spending gap.

Using climate finance for climate-resilient infrastructure in Africa

Financing African infrastructure projects requires matching various sources of capital – climate finance, Multilateral Development Banks (MDBs), and private sector – with the different risks incurred during the project lifecycle. At the project preparation stage, concessional climate finance blended with finance from MDBs is needed to de-risk and reduce the cost of capital in order to leverage private sector (mainly sponsor equity) investment. As projects progress to the construction phase, there is scope for more private sector debt and equity finance. At the operational stage, where returns are proven and risk is much reduced, there are significant opportunities to securitize and refinance projects and bring in institutional investors with long-term debt finance. The higher-risk, early-stage concessional climate finance can then be recycled into other projects.

Attracting institutional investors to African infrastructure projects and bringing that source of financing to scale will also require developing new financial instruments that institutional investors are willing to hold. Options include investing directly in African infrastructure, increasingly as partners in infrastructure funds, or leveraging Africa's pension funds. For instance, Sub-Saharan African pension funds have about $380 billion in assets under management that could be tapped as a source of investment for infrastructure. Pension funds are already investing in infrastructure projects and service delivery to the poor in countries such as Cape Verde, Kenya, South Africa, Swaziland, Tanzania and Uganda. By leveraging private and public funds, projects are able to increase both the sources and overall levels of financing.

Paris COP21 and beyond

In Paris, it was decided that the United Nations Framework for Cooperation on Climate Change (UNFCCC) will be served by the Green Climate Fund, the Global Environment Facility (GEF), the Developed Country Fund and the Special Climate Change Fund administered by the GEF. However, countries are not limited by the UNFCCC in terms of which climate funds they can use to deliver their UNFCCC financing commitments. In addition to the climate funds formally serving the UNFCCC, there are the Climate Investment Funds as well as a number of bilateral funds such the UK's International Climate Fund, Germany's International Climate Initiative and Norway's International Climate and Forest initiative, through which public climate finance will continue to be channeled. The World Bank Group and the African Development Bank (AfDB) Group have also committed substantial funds.

President Trump's decision to withdraw the United States from the Paris Climate Agreement represents a decisive juncture in the world's effort against climate change. However, the international community will need to continue its tremendous efforts preparing for and mitigating climate change risks. Under the Paris Climate Agreement, developed countries including the US were to contribute to a $100 billion annual fund for developing countries by 2020. African countries especially need these funds to implement resilient infrastructure solutions and expand clean energy. By 2050, the costs of adapting to climate change may be as high as $50 billion a year for the continent, according to the United Nations Environment Programme. While the US's absence will impact other countries' attempts to tackle climate change, overall the impact could be mitigated given the international efforts to keep global warming below 2 °C this century. Furthermore, the loss of a fraction of US official development aid associated with climate change might focus African countries on looking for private sector and domestic solutions in addition to international solutions. Many private sector companies are already investing in African resilience projects and we should expect a substantial increase in the coming years. We must also remember that many of the driving forces for that economic transition in Africa actually originate outside of Africa, in places like China, Europe and the US, either through demand for Africa resources or through the direct establishment of farming and bio-energy enterprises on the African continent.

Now, a growing number of analysts view climate risk as a business opportunity, as reflected by the demand for private "climate resilience solutions" or products and services that protect buyers from a range of climate risks. These include: resilient building materials and services, renewable energy sources, new weather and climate analytics, climate-resistant seeds, crops, and farming methods, financial and insurance products that incentivize resilience building, water-efficient technologies, flood control and site drainage, efficient air conditioning services, back-up power generation systems, insulation against heat and many other products and services; these solutions are a major opportunity for large and small firms across the planet. There are many emerging infrastructure and agriculture resilience opportunities, solutions and tailored insurance to improve climate resilience in developing countries. However, they need to be both scaled up and accelerated to meet the challenges:

- **financial, insurance and investment metho-**

dologies and products: debt instruments such as the green/climate bonds mentioned above could support investments in resilience. Credit rating agencies now recognize climate change as a material risk, a fact that will incentivize climate resilience considerations in private decision-making. Catastrophe bonds have been successfully deployed as risk transfer instruments, and new types of climate risk insurance vehicles and risk assessment schemes are entering the market. There is also early and growing interest among venture capital and private equity investors in companies that produce climate-resilient products;

• **Africa climate resilience project preparation facility**: provided it is adequately financed with grant, concessional and private-sector resources, the facility launched at COP21 in 2015 by a World Bank-led consortium could play an important role in facilitating the development of climate-resilient infrastructure. It could cater to the specific needs of different sectors or different stages of the infrastructure development cycle. For example, the facility could provide support to climate-resilient infrastructure master plans or to the integration of climate resilience into individual projects;

• **public-private partnerships for resilient infrastructure**. Public-private partnerships (PPPs) are increasingly common in water, transportation, telecommunications, and energy infrastructure. The demand for greater resilience in PPPs drives the demand for new metrics, stress tests, climate resilience materials, risk sharing, flood maps, and other measures needed to assure investors that PPP designs address climate resilience;

• **increased climate change risk disclosure**: with increasing climate variability, the pressure for increased climate risk disclosure will mount, generating opportunities for firms that specialize in reporting and disclosure activities. Currently, few companies, investors, or lenders disclose their climate risks with adequate rigor;

• **resilience in energy**: clean and renewable energy sources, such as wind and solar installations, both contribute to mitigation and are part of climate resilience. These installations and more conventional energy sources need resilient measures, particularly along coasts and in flood zones. Resilience also requires adequate back-up power generation, distribution, microgrids, storage facilities, and disaster recovery. Providing universal access to electricity in Africa using clean energy would increase emissions by only a further 1%;

• **resilience in transport**: climate change is likely to shorten the road rehabilitation life-cycle, which, in addition to maintenance, usually entails resurfacing every 20 years. In the worst climate scenarios compared with historical climate conditions, stress imposed on roads by precipitation can lead to rehabilitation costs that are 10 times higher. Modifying the design in response to an anticipated higher temperature is a low or no-regret option for paved roads. Not doing so may result in the need for more frequent repair of damages related to higher temperature;

• **resilience in water**: failure to integrate climate change in the planning and design of power and water infrastructure could entail significant losses of hydropower revenues and increases in consumer expenditure for energy;

• **climate-smart agriculture**: the impacts of climate change on Africa's agriculture are already being felt and will become increasingly severe going forward. A rise in average temperatures of 2 °C by the middle of the century is projected to reduce expected yields by up to 20%. Vulnerability to climatic shocks is especially acute in dry land areas which have a fragile ecology that limits agricultural potential. In these areas, land has already been degraded – de-forested, eroded, and nutrient depleted – over time, increasing its sensitivity to weather-induced shocks and reducing the resilience of rural populations and ecosystems. Africa's agriculture will need to adapt and improve its resilience to climate change. Climate-smart production technologies and agro-forestry, livestock and pasture management not only reduce the impact of climate change but also reduce the net emission intensity of greenhouse gases associated with agriculture, and have the added advantage of sucking carbon out of the atmosphere and storing it in trees and soils;

• **urbanization**: Africa's expanding cities will be

increasingly exposed to climate shocks. Africa is already the fastest urbanizing continent, and the rate of urbanization is likely to increase over the next 10-20 years. To avoid locking cities into an irreversible pattern of vulnerability to rising sea levels, floods and other shocks, climate resilience will need to be built into the design and development, not just of cities themselves, but also of the wider range of urban infrastructure that is instrumental to their growth and sustainability, including water supply, drainage, energy, and transport;

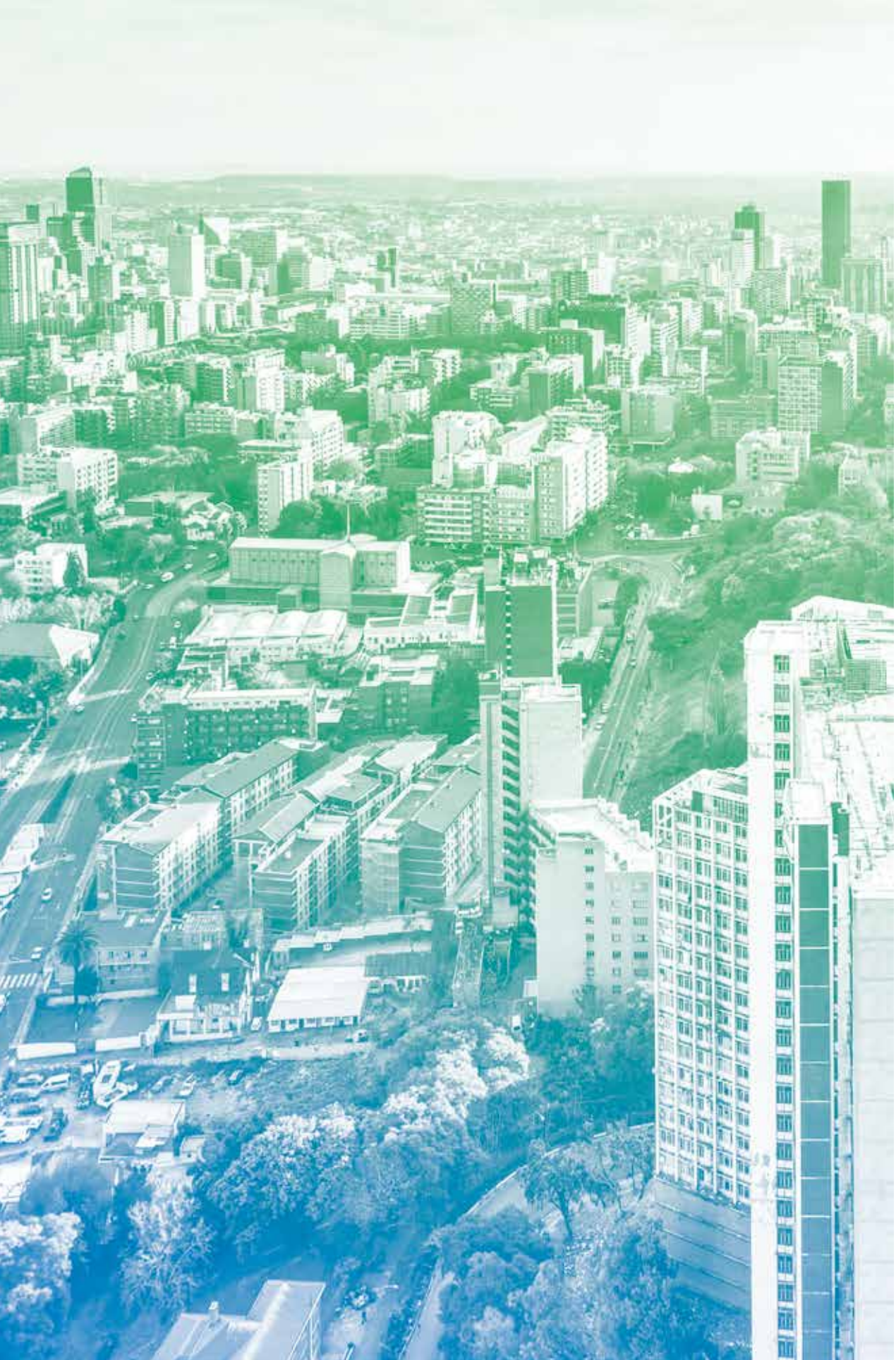
• **examples of investment potential**: according to the World Bank's Africa Climate Business Plan, these climate specific investments amount to $5-10 billion per year. For instance, the estimated total investment potential for the climate-smart needs of Ivory Coast, Kenya, Nigeria, and South Africa is $783 billion by 2030. 16% of this is for renewable energy generation ($123 billion), while well over half ($499 billion) is for the transportation sector. By 2030, the commercial investment potential in the construction of low-carbon buildings is estimated at nearly $153 billion.

Conclusion

Africa's extreme vulnerability to the impacts of climate change threatens to undermine major developmental gains, exacerbate existing weaknesses, and hamper growth prospects. Business as usual is not an option. There is concerted action required on better managing climate risks, moving Africa to a more climate-resilient future that is so critical for its poverty alleviation efforts and growth; and mainstreaming of climate action within the development dimension. Accelerating investment in climate-resilient infrastructure is an immediate priority. The Paris Agreement increases opportunities for climate-smart investment, and "is a historic turning point, as it sends a decisive market signal that the transition to a thriving clean economy is inevitable, irreversible, and irresistible," according to the We Mean Business Coalition. The private sector itself played an important role in urging governments to reach the Paris Agreement. The World Economic Forum's CEO Climate Leadership effort includes CEOs from over 70 companies and 20 economic sectors with operations in more than 150 countries and territories that generated over $2 trillion of revenue in 2014. It, along with other private sector groupings, demanded bold government action to reach an agreement at COP21. Now they are pushing the implementation agenda forward to ensure that the necessary financing for climate-resilient infrastructure in Africa is raised and the crucial services they provide can meet the challenges that lie ahead. Private investment in climate solutions is set to grow in Africa and the rest of the world. Under the Paris Climate Agreement, developed countries including the US were to contribute to a $100 billion annual fund for developing countries by 2020. African countries especially need these funds to implement resilient infrastructure solutions and expand clean energy. By 2050, the costs of adapting to climate change may be as high as $50 billion a year for the continent, according to the United Nations Environment Programme (UNEP).

We must also remember that many of the driving forces for that economic transition in Africa actually originate outside of Africa, in places like China, Europe and the US, either through demand for Africa resources or through the direct establishment of farming and bio-energy enterprises on the African continent.

[1] This article is an edited version of a background paper prepared by Professor Jamal Saghir for the 3rd Africa Climate-Resilient Infrastructure Summit in February 2018.



View from Ponte Tower onto the skyline of Johannesburg, South Africa.

Renewable Energy Investment Trends in Africa: An Overview

Renewable energy investments in Africa have been growing in recent years, boosted both by public policies and by international investors. Italy plays a significant role in the deployment of renewables in several countries of the continent. The growth of these investments brings about many important benefits. By generating economic development, reduction in emissions, and job creation as main advantages, investors share value with local communities. Italian companies investing in Africa in particular deliver important contributions; not only do they build new power plants and increase access to clean energy, but they also participate in supplying necessary know-how and capacity building.

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Renewable energy (RE) investments are growing faster and faster worldwide, surpassing conventional thermoelectric investments. In eight years, from 2009, after the worst global financial crisis, to 2016, a total of $2,025 billion were invested in RE, excluding large hydro. With an average annual growth rate of 6%, total investments increased by 36%, moving from $178.3 billion in 2009 to $241.6 billion in 2016. The total amount of new power installed compared to 2015 recorded a growth of 9% reaching 138.5 GW. While capacity increased, investments fell by 23%, from $312.2 billion in 2015, explained by a huge decrease in costs that led to more added capacity at less money per single unit of power. While RE investments worldwide are rather stable, Africa shows large fluctuations from year to year, due to greater differences between countries, as illustrated in ● Figure 21. (See Infographic Section). The world's largest share of RE investments is located in China with 32% of global resources in 2016. The Asian giant is, in fact, especially active in the solar photovoltaic (PV) sector. Investments in Europe come second with 25%, followed by

United States at 19%. Africa and the Middle East accounted for only 3% of investments in 2016. In the African continent a crucial role is played by public investments that between 2009 and 2016 represented an average of 56% of total amount invested, giving a solid and predictable flow of resources in the renewable industry. However, some years recorded private sector contributions at around 80%. The role of private investments will have to grow more in order to boost RE deployment while reducing public expenditure.

In recent years, the Italian RE industry has been capitalizing its domestic experience, developing a growing share of its business abroad. During this time, African countries attracted a not negligible share of Italian foreign investments. Between 2011 and 2017 for example, 58 RE project deals were made in the African continent, totaling 5,180 MW in planned capacity with an estimated value of €5.3 billion. The localization of investments is spread between Maghreb, Eastern and Southern African countries, with South Africa, Morocco and Egypt as favorite destinations, as illustrated in ● Figure 22. (See Infographic Section).

Italian RE investments in Africa mainly consist of new power capacity building, given that the sector is still at an early stage of development. In the majority of African countries, RE has only in recent years been deployed with structured policies and targets. The growth of RE is driven mainly by large international utilities, Independent Power Producers (IPPs) and technology/installer companies. The former strengthen their core business by adding generation capacity and diversifying geographical distribution of plants. The latter, often pulled by the largest national utility, aim to expand their business in new markets through supplying components and Engineering, Procurement and Construction (EPC) contracts. New generation capacity added by Italian investors between 2011 and 2017 was composed by 49% onshore wind, 46% solar photovoltaic and 5% hydro. The average investment size in new solar PV power plants in Africa is, in fact, 42 MW, which is definitely higher compared to Italy's average new solar PV plant size of 6.5 MW.

Africa also offers different ways of business development. Distributed energy, self-production and electrification of remote rural areas create the opportunity to develop high-tech solutions. Italy, that is quickly developing smart energy business, can use its know-how to better improve the energy sector in Africa. Opportunities for Italian renewables players are wide. An advanced and sound manufacturing value chain, joined with some major utility and IPP, allows to successfully enter the developing African market. Innovative business models are crucial for accessing high quality energy services, jumping over research and test phases already developed abroad. The liberalization processes of the energy industry that are being implemented in the whole continent, even if at different rhythms, could open new possibilities for investors, from generation and distribution to final client services.

Italian RE investments in 2015 hit a record high by involving nearly €1.6 billion and 14 deals, as shown in ● Figure 23. (See Infographic Section).

However, other strategies in addition to building new plants are pursued in the continent. Supply and partnership agreements and new branches set out an evolving sector, which is now gradually becoming more mature. The energy transition in Africa needs to be supported by supplying know-how and technologies. In doing that, Italian investors are both helping local growth and laying the foundations to further develop their own business. In 2017, for example, an Italian player active in the smart energy industry has powered up a micro-grid in Somalia composed by three wind power plants and a storage system. Another paramount issue is distributed generation. By way of example, in 2015, the Italian utility Enel Green Power started a partnership with the US company Powerhive to build and operate solar mini-grids in Kenya.

Access to electricity is the first step for remote villages to guarantee minimum standards of living. The type of investments is strongly related to the features of local markets. In Morocco, in 2017, Gruppo Green Power, an Italian player operating in energy services, acquired shares

of a local Energy Services Company (ESCO) that manages energy efficiency of Moroccan correction facilities. These are examples of new trends emerging in Africa, ranging from new business models as distributed energy and smart services, to more traditional operations in power markets.

Beyond being an opportunity for foreign investors, investing in RE brings unique benefits for local economies and communities. The positive impacts generated by RE are wide and cross-cutting, involving direct and indirect effects. Estimations have been made on direct impacts of solar PV, onshore wind and small-hydro deployed by international investors in the continent. 22% of resources invested between 2009 and 2016 have been directly received by local players. All the activities related to civil works, grid connection, installation and land attracted $7.9 billion to the continent in eight years.

RE investments imply job creation, too. Between 2009 and 2016, 77,100 Full Time Equivalent (FTE) direct jobs were estimated to come from the construction, installation and O&M activities in solar PV, onshore wind and small-hydro for Africa as a whole. While this is a rough evaluation, since the jobs' estimation is complex and varies considerably from country to country, the higher worker-density level includes solar photovoltaic (59% of jobs) followed by onshore wind (40%) and small-hydro (1%).

Environmental benefits are obviously key advantages of RE deployment. Renewable power generation in eight years in Africa has avoided 40.2 million t of CO_2 emissions. Small-hydro, onshore wind and PV have produced nearly 46.8 TWh of electricity; if this energy had been generated by fossil fuels, assuming the average African fuel mix, emissions would have been 98% higher.

These figures, however, represent only a part of the benefits generated by renewables in the continent. Stakeholders are spread among different sectors and RE have the peculiarity of being cross-cutting and generating wide fall-out that are strongly variable and context specific.

In conclusion, challenges and opportunities characterize investments in Africa. Growing economies are fostering the markets but structural weaknesses threaten the security of investing. Italian players have a growing role in the deployment of African RE, both with direct investments and contributing with know-how and capabilities building.

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Fig.21

RE investments worldwide and in Africa, 2009-2016, excluding large hydro.

Source: Althesys on BNEF, Frankfurt School, UNEP and IRENA data.

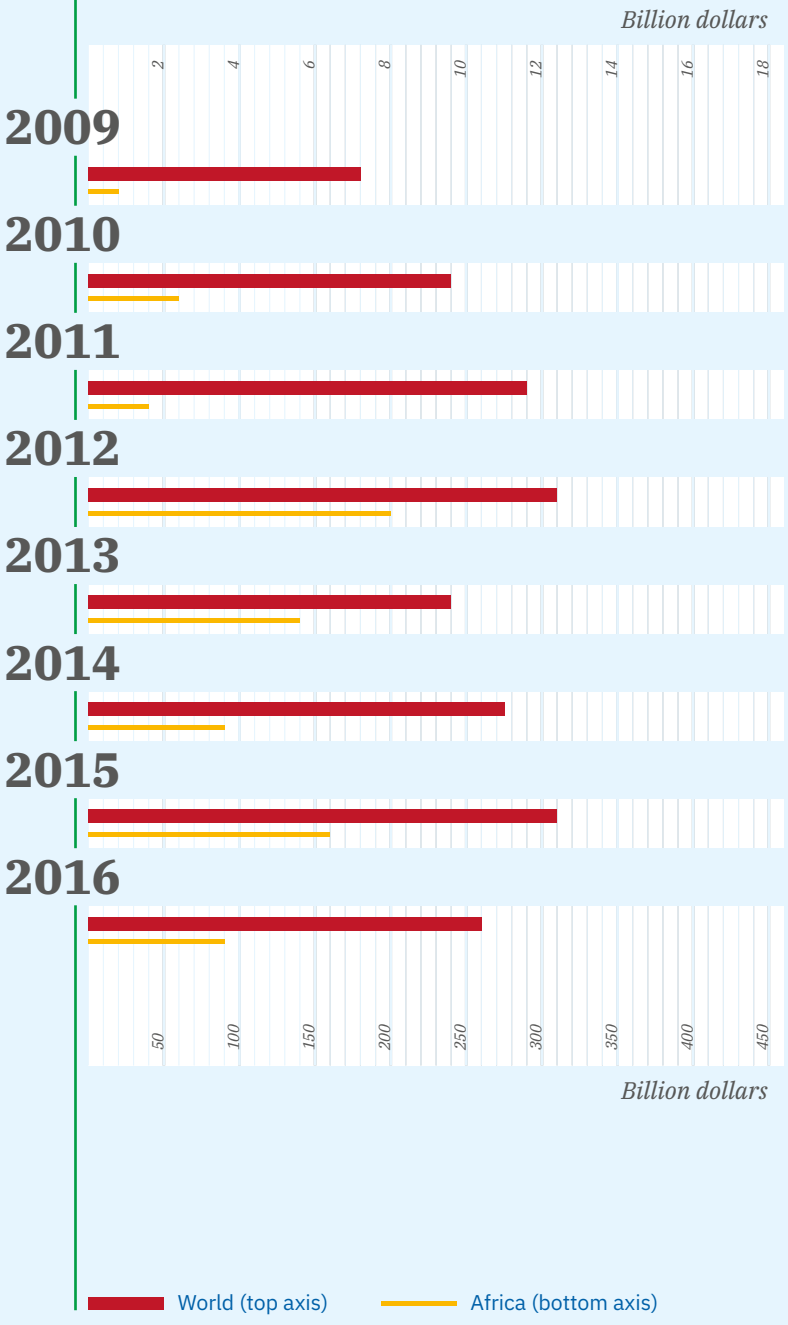


Fig.22

Italian RE investments in Africa, 2011-2017.

Source: Althesys, 2018.

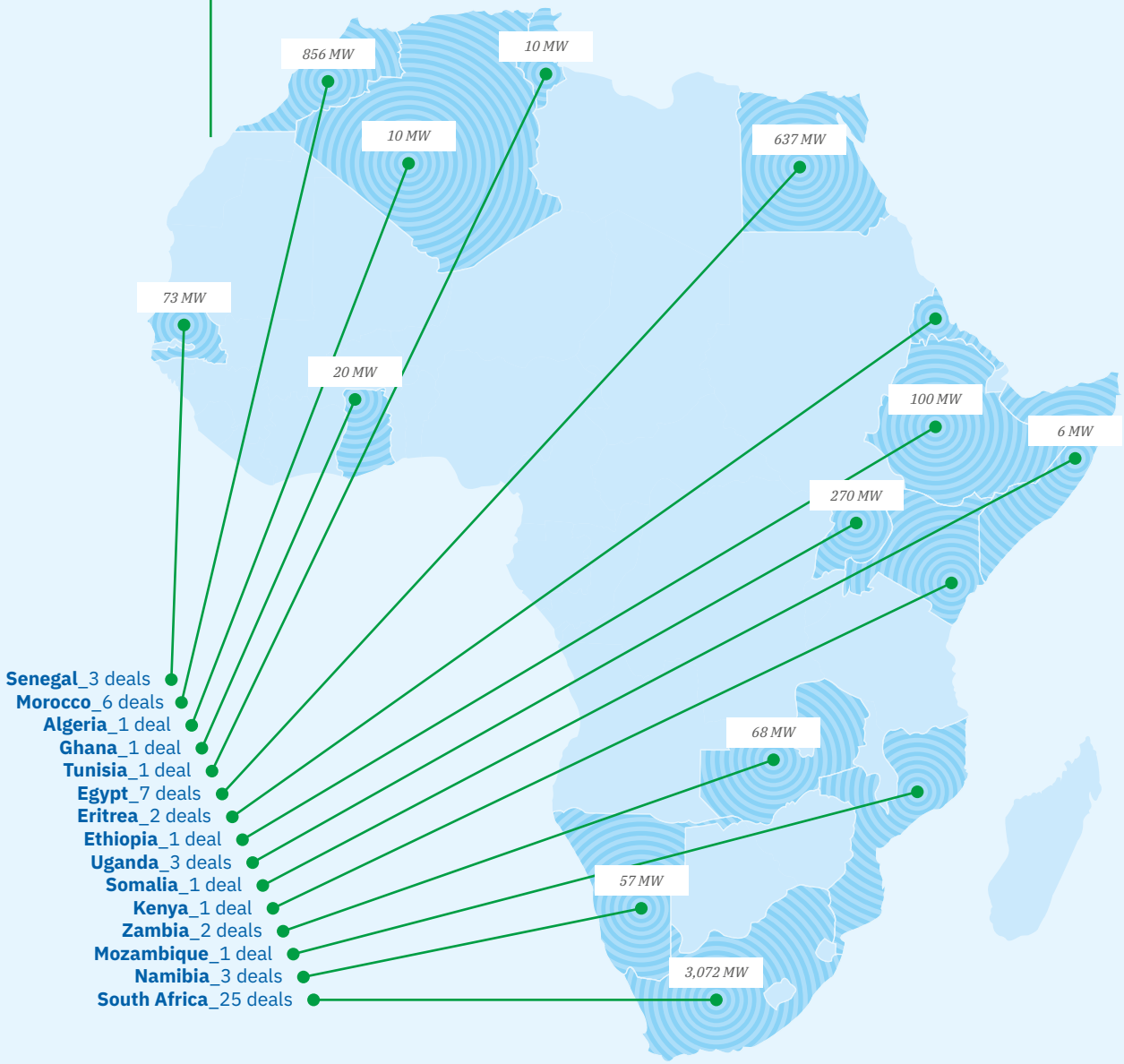
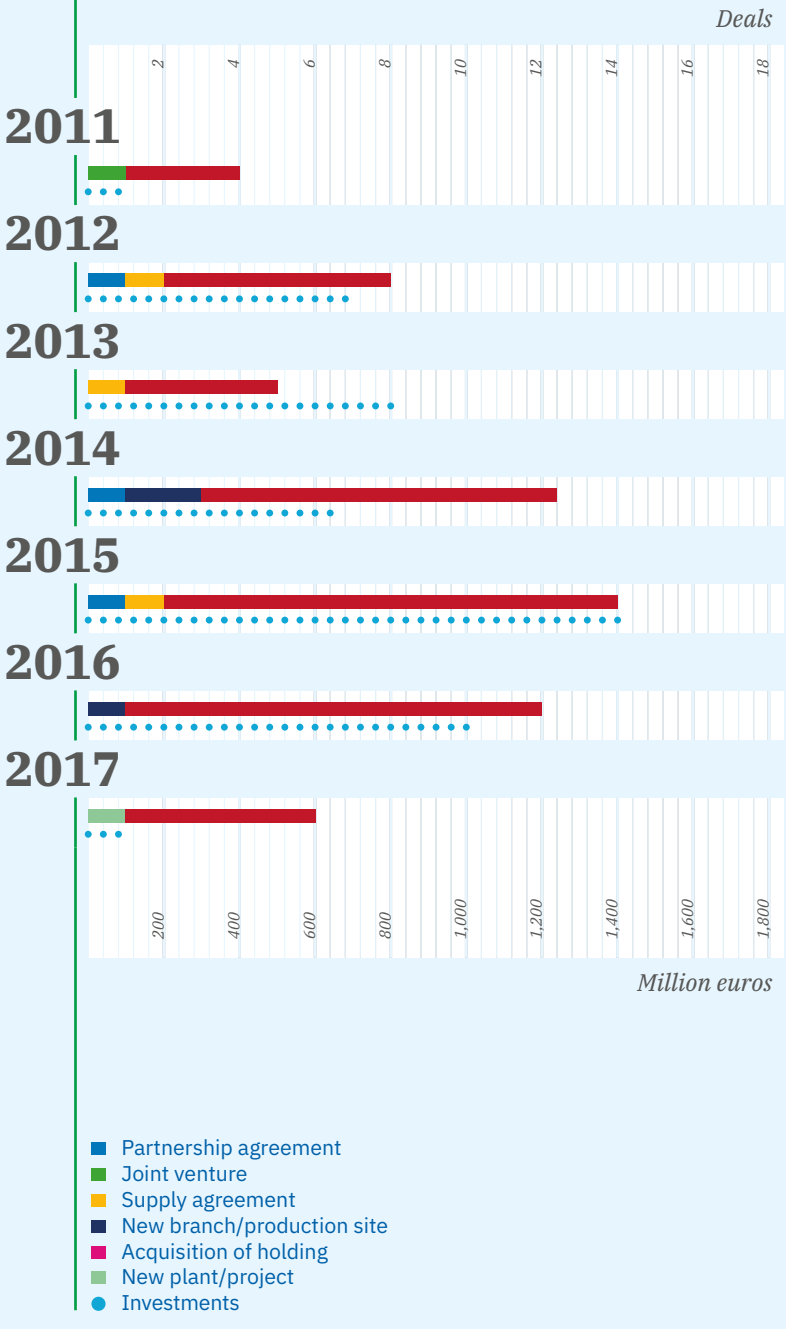


Fig.23

Trend of Italian investments and deals in Africa, 2011-2017.

Source: Althesys, 2018.



Sustainable Energy as a Turnkey for Delivering the Sustainable Development Goals

The world has embarked on a sustainable development transition with the United Nations Sustainable Development Goals (SDGs) as its roadmap. The Goals serve as a unique framework for multi-stakeholder action on the defining social, economic and environmental challenges of our time. Access to energy is a fundamental pillar within this shift to sustainable development. Ensuring universal, affordable, and reliable energy for all (SDG 7) cannot happen without sustainable energy, that not only electrifies but also impacts all other SDGs and sustainable development overall. Greater efforts are needed to achieve progress on SDG 7 by 2030, with a leading role for sustainable energy business. By scaling up sustainable energy investments congruent with SDG-aligned sustainability strategies, industry can leverage their leadership to achieve meaningful progress on the 2030 Agenda.

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Global ambition for sustainability

We are in the midst of a global transition towards sustainable development. In a world facing major interlinked economic, environmental and social challenges such as climate change, demographic growth, urbanization and finite natural resources, there is a need to shift to a new global reality in which economic development is environmentally and socially sustainable in the long run. The United Nations 2030 Agenda for Sustainable Development (2030 Agenda) – adopted by all 193 United Nations member countries in 2015 – has formally anchored sustainable development at the center of the international cooperation agenda. The mainstreaming of sustainability into development has rarely been more important, as we face global problems that are complex, interconnected, and in need of concerted action. The Paris Climate Agreement, ratified by more than 130 countries pledging to take action to limit global warming to well below 2 °C, and the 2030 Agenda represent a historic turning point necessitating bold and transformative steps to shift the world onto a sustainable and resilient path.
The 2030 Agenda – composed of 17 Sustainable

Development Goals (SDGs) and 169 targets – covers a broad range of social, economic and environmental issues, including poverty, health, education, climate change, gender equality, water, sanitation, energy, environment and social justice, as illustrated in ● Figure 24. (See Infographic Section).

By integrating development, environmental and social objectives, the SDGs have equipped the international community with a unique framework for sustainable development transformation. The Goals and targets stimulate action over the next 12 years with inclusive sustainable economic development and climate change resilience at its core. In doing so, the 2030 Agenda aims to move away from the current sectorial approach where social, economic, and ecological development are approached as separate fields. Instead, the SDGs represent the interconnected nature of sustainable development with its social, economic and environmental dimensions, resulting in interlinkages among the 17 SDGs. By learning from the shortcomings of its predecessor framework, the Millennium Development Goals (MDGs), the 2030 Agenda not only applies to developed and developing countries alike, but also defeats siloed-thinking, as illustrated in ● Figure 25. (See Infographic Section), where progress in one SDG directly or indirectly impacts other SDGs.

An innovative and integrated framework for change

The 2030 Agenda is ambitious and innovative for multiple reasons. The SDGs frame the holistic nature of sustainable development by balancing the three dimensions of sustainability with concrete goals for 2030, in such a way that progress in one SDG enables progress in another. The framework was also adopted by all UN countries, was developed through inclusive multi-stakeholder consultation, and enjoys widespread public endorsement, resulting in a truly universal agenda. Thanks to this widespread commitment, SDGs allow us to have a framed discussion, track progress and hold the international community accountable for their contributions to the Goals. Furthermore, the SDGs propose concrete goals and indicators that measure progress, reflecting a determination to enable measurement of efforts and demonstrate impact. This "SDG accounting" also allows the Goals to be integrated into national, regional, and non-state actor development plans, mobilizing resources and building relevant capacity. Finally, the 2030 Agenda enables the commitment of non-state actors by proposing a common language and shared purpose that all stakeholders can get behind and take action on – thereby allowing multi-stakeholder cooperation and partnerships needed for global change. Such an approach is pivotal, as delivering the SDGs must be a joint endeavor. In particular, the Goals encourage the private sector to purposefully engage. The international community has come to acknowledge the central role that business actors play in mobilizing financing and implementing the solutions required for sustainable development. In doing so, the private sector itself stands to gain. As the global transition to a low-carbon sustainable economy progresses, we can already observe that customers, employees and investors expect more socially and environmentally reasonable investment opportunities in line with the SDGs. As sustainability practices evolve beyond corporate social responsibility into core business, aligning with the SDGs not only creates reputational dividends, but also opens new markets, while targeting sustainability-conscious customers, employees, and investors – thereby becoming a new for business actors to set themselves apart.

Energizing sustainable development

Sustainable development is unimaginable without access to affordable, reliable, and sustainable energy. Every economy requires secure access to modern energy services: to provide lighting, heating, transport, communications and mechanical power; to ensure access to social services, like education and health; and to guarantee an enabling framework for boosting economic development. Yet today, one in five people in the world still lacks access to modern electricity, whilst 3 billion people rely on wood, coal, char-

coal or animal waste for cooking and heating. Energy is the dominant contributor to climate change, accounting for around 60% of total global greenhouse gas emissions.

Unlike the MDGs, the 2030 Agenda formally acknowledges the role of energy as a key enabler to development by establishing its own Goal (SDG 7 - See Box) which aims to "ensure access to affordable, reliable, sustainable and modern energy for all". SDG 7 is underpinned by three targets; ensuring universal access to energy services (SDG 7.1), increasing the share of renewables in the energy mix (SDG 7.2) and improving energy efficiency (SDG 7.3). The priorities for implementing SDG 7 are to enhance international cooperation and promote investments (7.a) and to expand infrastructure and upgrade technology in developing countries (7.b).

Renewable energy is central to the implementation of SDG 7. Renewable energy is not only by definition sustainable in terms of resources, but also due to its inherent ability to generate low-carbon energy. In developed and developing countries alike, the techno-economic feasibility of renewable energy technologies is ushering in a decarbonization of the energy sector at a global scale. As renewable energy technologies have become market-ready and in many countries are economically competitive with conventional electricity sources, they present an important strategy for scaling up energy access.

SDG 7: Ensure universal, affordable, and reliable energy for all.

- SDG 7.1 - By 2030, ensure universal access to affordable, reliable and modern energy services
- SDG 7.2 - By 2030, increase substantially the share of renewable energy in the global energy mix
- SDG 7.3 - By 2030, double the global rate of improvement in energy efficiency
- SDG 7.a - By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology
- SDG 7.b - By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programs of support

Besides energy, renewable energy technologies can bring about sustainable development benefits. Renewables directly and indirectly impact other SDGs, reflecting crucial interlinkages among sustainable energy, development and climate action, as illustrated in **Figure 26. (See Infographic Section)**. In terms of environmental sustainability, renewable energy development can help mitigate environmental impacts of energy consumption, reduce pollution and fight climate change, build more sustainable cities and communities and improve biodiversity. Renewables also enable social and human development by improving general wellbeing through increased access to basic services, including health care and water, supports income-generating activities, resulting in poverty alleviation, catalyzing quality education and thereby promotes gender equality. Moreover, renewable energy impacts sustainable economic development by fueling

long-term economic growth, allowing for new productive and industrial uses of energy and creating jobs. The REMAP scenario of IRENA estimates for example that as many as 26 million jobs could be created in renewables by 2050, more than offsetting fossil fuel job sector losses, while boosting global GDP around 0.8% (or $1.6 trillion) by 2050 (IRENA, 2018).
It is clear that sustainable energy can significantly advance SDG 7 while creating significant spillover effects across the 2030 Agenda's 3 dimensions of sustainability, as seen in Figure 26.

A need to step up efforts

2018 is a crucial year for SDG 7, as the United Nations takes stock of progress made on its energy target. Reports published at the Global SDG 7 conference in Bangkok last February reveal that despite improvements, efforts to achieve SDG 7 fall short of what is needed.
In terms of energy access (SDG 7.1), the amount of people without access to power fell from 1.7 billon people in 2000 to 1.1 billion in 2016, mostly through grid connection. Currently, more than 95% of those without electricity access live in Asia and Sub-Saharan Africa. In developing Asia 870 million people have gained access since 2000 – 500 million of those in India alone. But despite positive developments in Sub-Saharan Africa, demographic growth and uneven progress means that on the basis of current efforts, 600 million people will still remain without access to power by 2030 (IEA, UNDP, IRENA, 2018).

Business-as-usual approaches indicate limited growth on doubling renewable energy's share in the energy mix by 2030 (SDG 7.2), despite important progress in the power sector. According to a policy brief by IRENA et al. (2018), by 2030 the share of renewables in total final energy consumption needs to be substantially increased to 36% from currently less than 20%, requiring growth in share of 1.4% points on average per year – a sevenfold acceleration – compared to 0.2% growth rate per year between 2010 and 2015. The renewables share in global power generation needs to grow further to 60% by 2030 from 25% in 2017. To meet SDG 7, the IEA and the World Bank estimate that between $442 billion and $650 billion per year will need to be mobilized in renewable energy investment until 2030, compared to actual investment levels of $263 billion in 2016 (IRENA et al., 2018) Furthermore, to enable significant decarbonization beyond 2030, the share of renewable energy in final consumption must rise to over 65% in 2050, from under 20% today, and will require an impressive investment mobilization of $830 billion per year up to 2050 (IRENA et al., 2018).

SDG 7.3, or the global energy efficiency goal, as measured by the world's primary energy intensity, has improved at a faster rate (2% per year) since 2010 than in the previous two decades (1.4% per year). However, this rate of progress still falls far short of the annual rate of 2.7% now needed over the period to 2030 for the world to embark on a sustainable development pathway (UN Environment, IEA, Copenhagen Centre on Energy Efficiency, 2018).

Meeting these ambitious energy targets will require bolder policy commitments from governments, stronger involvement of private sector, and higher levels of financing, especially in developing countries, supported by increased capacity building, innovation, public-private dialogue, knowledge sharing, enabling environments, raising awareness and mobilization of financing. Specifically, upscaling sustainable energy to double its share in the global energy composition will require a true concerted effort from multiple players and partnerships that promote the uptake of renewables in developing and emerging countries, each according to their mission and strengths.

The role of sustainable energy business

Given the crucial role of renewables to sustainable development, sustainable energy companies can take leadership to advance the success of SDG 7:
• sustainable energy sector players are uniquely placed to integrate environmental, social and

economic sustainability as a driver for growth, to position themselves on the 2030 Agenda, and to mainstream SDGs into their business practices. The latter will be crucial to the roll-out of sustainable renewable energy projects, since international finance, government, private sector, and public-private partnerships increasingly adopt SDGs compliance as an operative framework for impact. By taking the lead, private sector actors can reap significant benefits from aligning with the SDGs. Sustainability strategies enable businesses to build new markets, attract new sustainability-conscious customers, employees and investors, strengthen relationships with stakeholders, build reputational capital and create opportunities for leadership by virtue of speaking the same language and sharing a similar purpose;

• the narrative on renewables in the industry needs to expand beyond the business case towards their transformational impact on sustainable development and climate change. As renewables are expected to become more competitive, they need to be promoted by sustainable energy companies as a strategy for sustainable development and climate action, in alignment with SDGs. This narrative should accompany business development in particular in developing countries to enable public-private partnerships with governments and development financing institutions;

• business actors should keep in mind and trace the many points of intersection between renewable energy and the SDGs, including ways in which the renewables sector can contribute toward the realization of the SDGs. Sustainable energy industry and the UN should pursue an open dialogue to create a shared understanding on how the renewable energy sector can most effectively contribute to the SDGs, and demonstrate leadership such as through the UN Global Compact and other initiatives. This can create value for shareholders and stakeholders;

• SDG interlinkages should apply to projects. Projects should reflect SDG-impact and nexus-thinking by integrating cross-sectorial partnerships between energy and water, agriculture, urbanization, etc. If renewables are implemented in a sustainable manner, they can bring about social, health and environmental benefits such as reduced health impact from less pollution, sustainable livelihoods, social inclusion, gender equality, better quality of life, decreasing the costs and efforts of climate change adaptation. In addition to investments made and capacity installed, companies can for example highlight total of people connected by renewable energy and resulting development impact. Industry should remain aware of the risks renewable energy operations can pose for sustainable development, the realization of human rights, and the implications of the SDGs for the sector's future operations.

Conclusion

Our age is characterized by global challenges that can only be met through partnerships, collaboration and nexus thinking. Sustainable development hallmarked by the SDGs has become the central paradigm for achieving sustainable and inclusive growth by 2030. To achieve this, countries and businesses have to step up their efforts to implement bold and forward-thinking policies that drive the sustainable development transition. The SDGs need to be mainstreamed as a common language across policies and business activities, so that each actor can contribute according to their strengths and their sector's competitive advantage. As business actors around the world face increasing pressure to contribute to a more sustainable global economy, the SDGs enable alignment with the key international cooperation agenda of our time. More than ever, sustainable energy business needs to take the lead on the energy transition to ensure access to affordable, reliable, sustainable and modern energy for all, and to achieve meaningful progress on the 2030 Agenda.

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Fig.24

The 17 Sustainable Development Goals (SDGs).

Fig.25

Interconnectedness of the Sustainable Development Goals (SDGs).

Source: from J. Rockström/P.Sukhdev. Azote Images for Stockholm Resilience Centre. 2016.

Fig.26

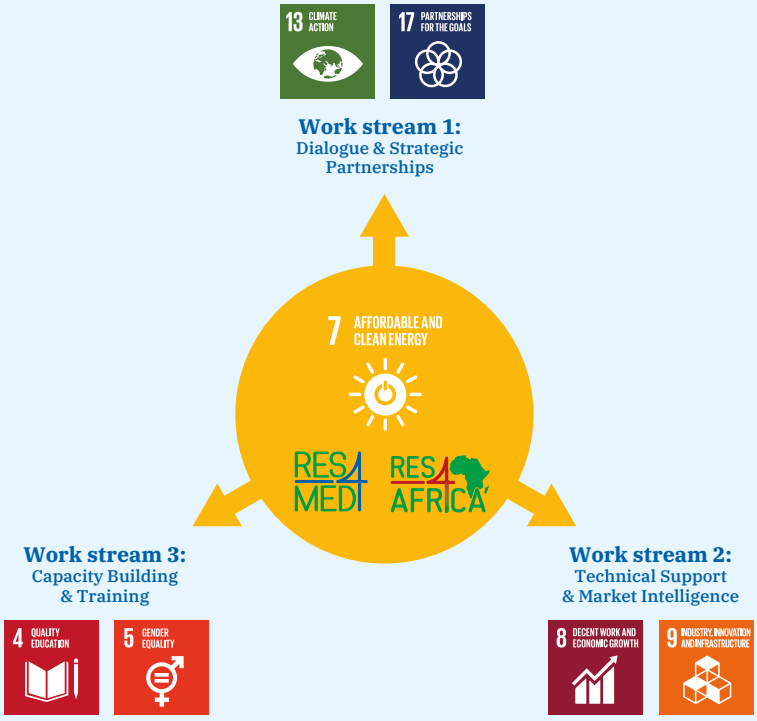
Interlinkages between SDG 7 and other SDGs.

Source: IRENA (2017), REthinking Energy 2017: Accelerating the global energy transformation. International Renewable Energy Agency, Abu Dhabi.

RES4MED&Africa and SDG 7.

RES4MED&Africa is dedicated to creating enabling environments for renewable energy investments in Southern Mediterranean and Sub-Saharan African markets. As a platform for cooperation and exchange, RES4MED&Africa's added value to progress on SDG 7 lies in its ability to be a common denominator and connecting bridge between the experience of private sector actors from across the renewables value chain, and public sector in high-impact countries accelerating their sustainable energy transition. The association works precisely where the 2030 Agenda recommends the enabling role of cooperation platforms: by making efforts to catalyze partnerships that support countries to develop renewable energy strategies, foster knowledge exchange, and strengthen capacity.

RES4MED&Africa contributes to SDG 7 by promoting progress on doubling the share of renewables in the global energy mix by 2030. RES4MED&Africa has a vested interest to apply the SDG framework to its operational model given its mission to promote renewables in emerging markets. Moreover, the aim is to share the knowledge and experience of actors seeking to invest in new markets – thereby aiming to facilitate investment flows to renewable energy markets in these countries. Given the SDG interlinkages, the association's work streams and activities help to promote progress on SDG 7 and on other key SDGs, namely quality education (SDG 4), gender equality (SDG 5), decent work and economic growth (SDG 8), industry, innovation and infrastructure (SDG 9), climate action (SDG 13), and partnerships for the goals (SDG 17).



RES4MED&Africa work streams

Work stream 1: Dialogue & Strategic Partnerships

RES4MED&Africa promotes public-private partnerships to raise awareness on renewable energy investments in growing economies. RES4MED&Africa facilitates dialogue between public and private partners in emerging markets and promotes joint collaboration, allowing for a solid base for coordination of efforts to grow renewable energy markets. By acting as a connecting platform for dialogue and strategic partnerships between solution providers and decision-makers, there can be an exchange of perspectives and of local needs, proposing matchmaking between policymakers that are planning for renewable technologies and private sector that can deploy them, impacting SDG 17 and SDG 13.
Activities include:

- engaging public and private stakeholders through annual conferences, RES4MED & RES4Africa days in Morocco, Egypt, Kenya, Ethiopia as well as the 2017 G7 Energy side event for public-private dialogue and sharing of technical expertise;
- partnering with key national stakeholders in focus countries and international cooperation partners engaged in renewable energy promotion worldwide.

Work stream 2: Technical Support & Market Intelligence

By gathering the extensive body of experience and knowledge from its member network, expertise and best practices are shared with national policymakers in high-impact countries that provide the elements and recommendations on how to advance enabling environments for renewable energy investments. By handing over this technical expertise to policymakers, sustainable economic development based on renewable energy systems is promoted, thereby impacting SDG 8 and SDG 9.
Activities include:

- conducting analysis and studies on market liberalization in Morocco, job creation potential for the Tunisian renewables markets; and policy & regulatory recommendations for Algeria's auction design, as well as grid integration studies for Algeria, Kenya, and Ethiopia;
- presenting position papers to high-level and government representatives as technical knowledge exchange.

Work stream 3: Capacity Building & Training

Vocational and institutional skill-building are central to closing the loop on raising awareness with technical knowledge and are crucial to local ownership of renewables. Capacity building and training efforts based on private sector experience can enable much-needed skills and knowledge transfer that support the long-term renewables market creation, which in turn support investments (SDG 7a) and local job creation (SDG 8).
Activities include:

- leading institutional executive seminars to high-level national policymakers and stakeholders in Algeria, Tunisia, the European Commission and the Italian Ministry of Foreign Affairs &

International Cooperation, as well as training on policy responses to climate change, sustainable development and energy transition with Ministry of Environment of Ethiopia and of Italy;
- launching the regional East-African Micro-Grid Academy (MGA) capacity building project;
- training over 100 participants from North- and Sub-Saharan Africa over four years in the RES4MED&Africa flagship Advanced Training Course (ATC).

Through these activities, RES4MED&Africa contributes to global efforts on achieving progress on SDG 7. RES4MED&Africa operates within a narrative of renewable energy business cases, where private sector plays an active part in its development and take-off. By helping to lay the foundations on policy & regulation, capacity building, financing recommendations, and technical knowledge, RES4MED&Africa helps to create the right conditions for renewable energy take-off in emerging and high-impact countries.

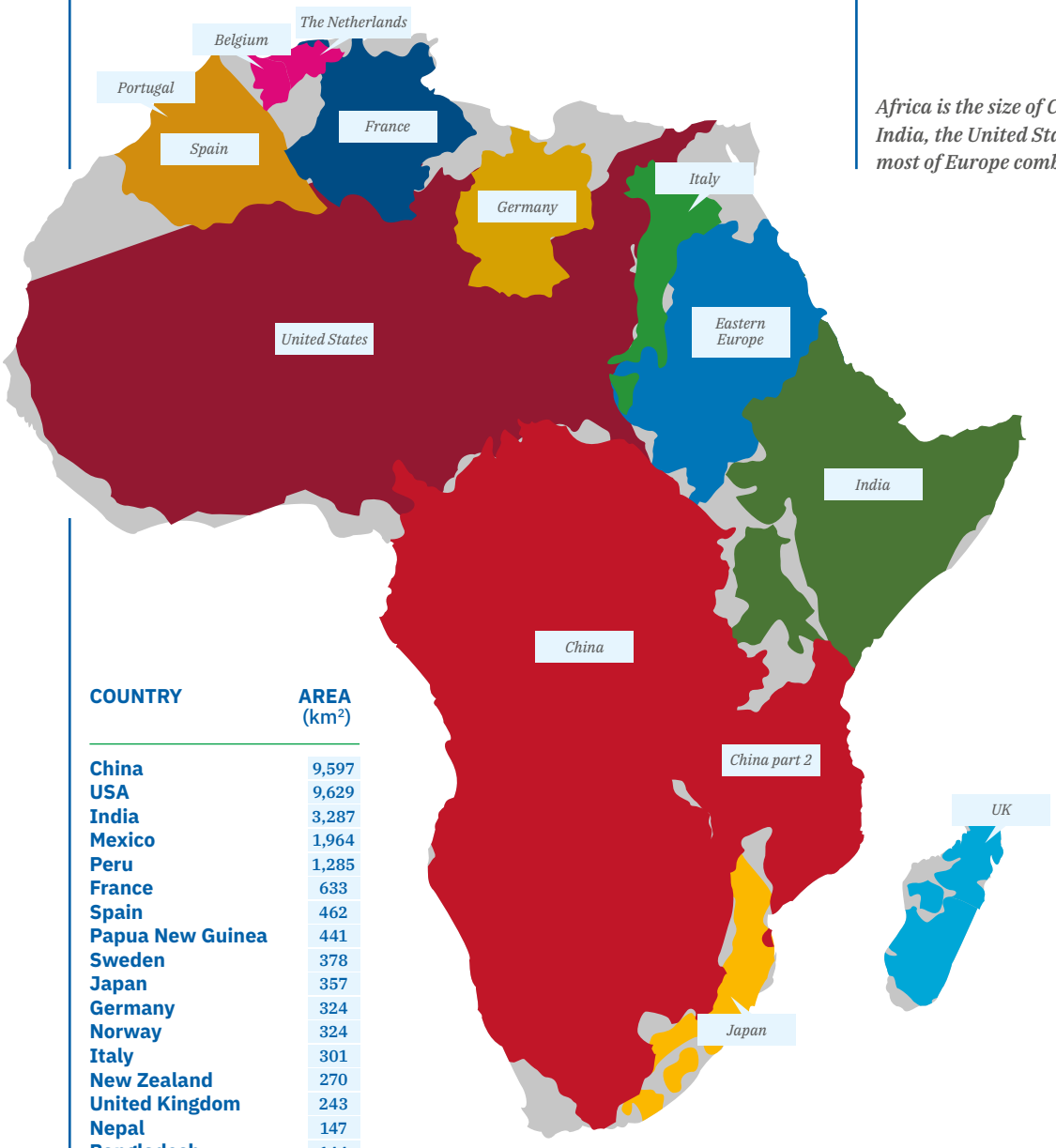
Mount Kilimanjaro and cloud line at sunset.

Fig.27

The size of the African continent.

Source: https://www.economist.com/graphic-detail/2010/11/10/the-true-true-size-of-africa.

Africa is the size of China, India, the United States and most of Europe combined.

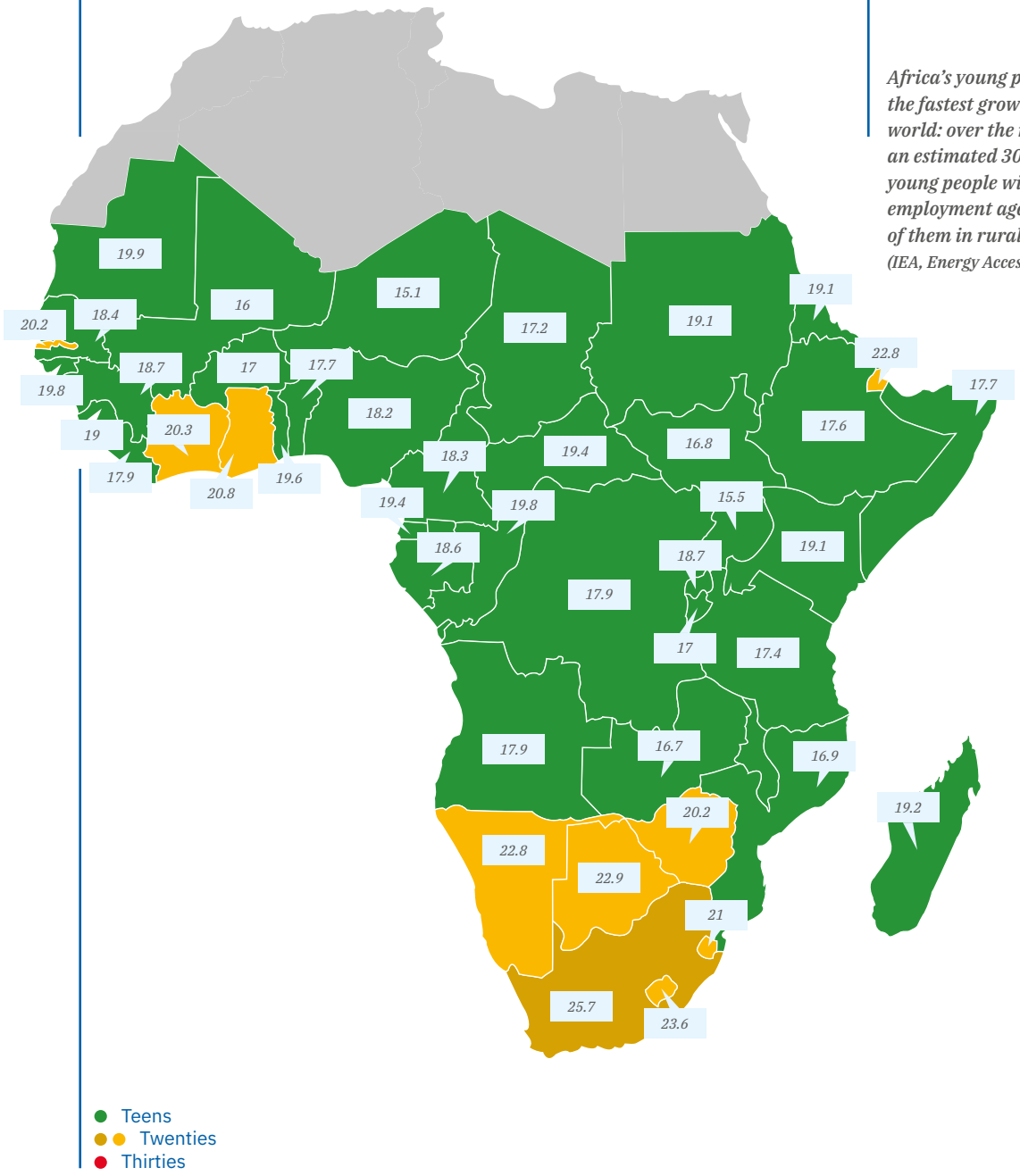


COUNTRY	AREA (km²)
China	9,597
USA	9,629
India	3,287
Mexico	1,964
Peru	1,285
France	633
Spain	462
Papua New Guinea	441
Sweden	378
Japan	357
Germany	324
Norway	324
Italy	301
New Zealand	270
United Kingdom	243
Nepal	147
Bangladesh	144
Greece	132
TOTAL	30,102
AFRICA	30,221

Fig.28

Median age in Sub-Saharan Africa.

Source: http://theweek.com/articles/443122/8-maps-show-median-age-every-country-earth 2014.



Africa's young population is the fastest growing in the world: over the next 15 years, an estimated 300 million young people will reach employment age, two-thirds of them in rural areas.
(IEA, Energy Access Outlook, 2017)

Fig.29

Renewable energy capacity investment needs in Africa.

Source: IRENA Africa 2030: Roadmap for a Renewable Energy Future.

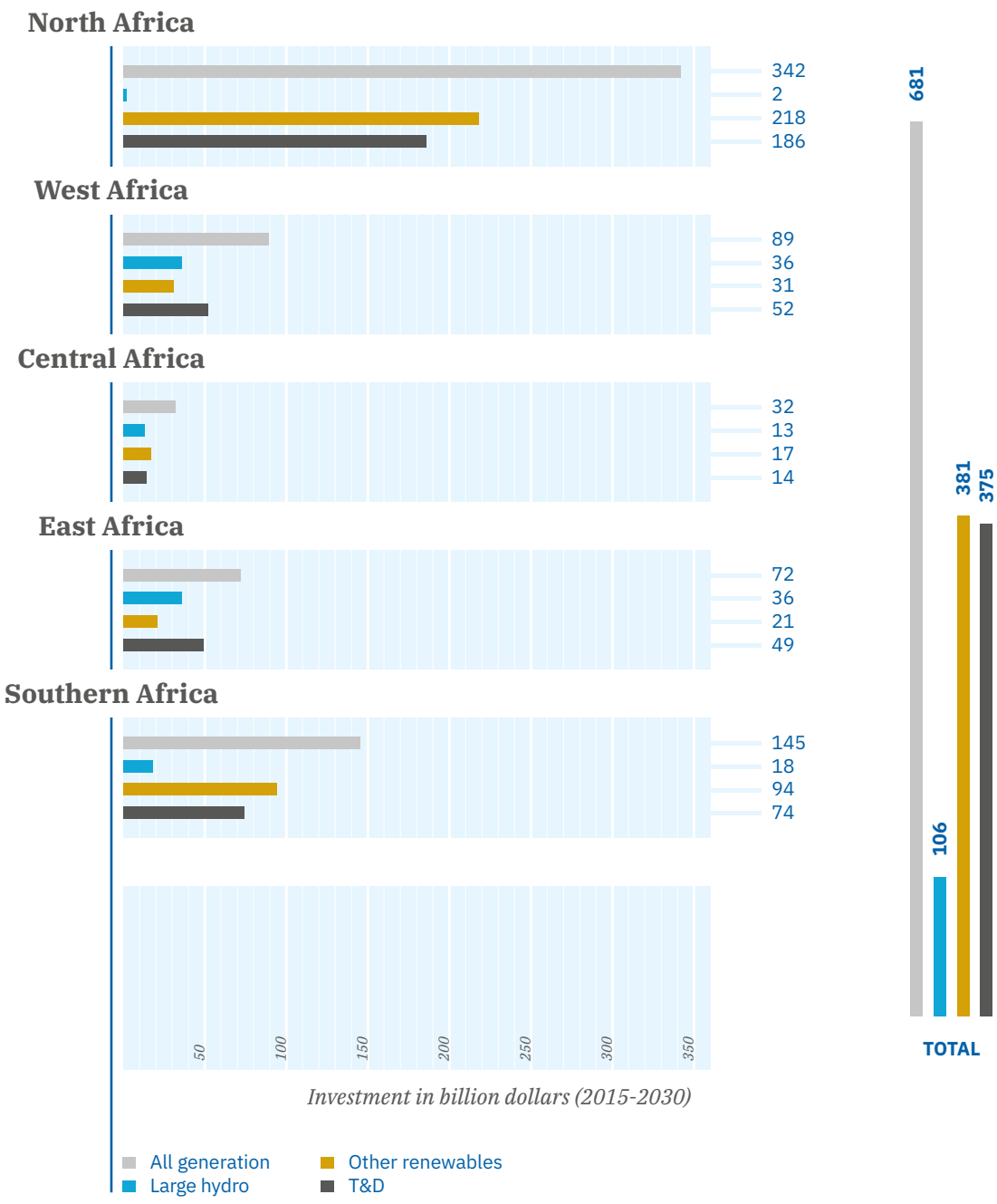
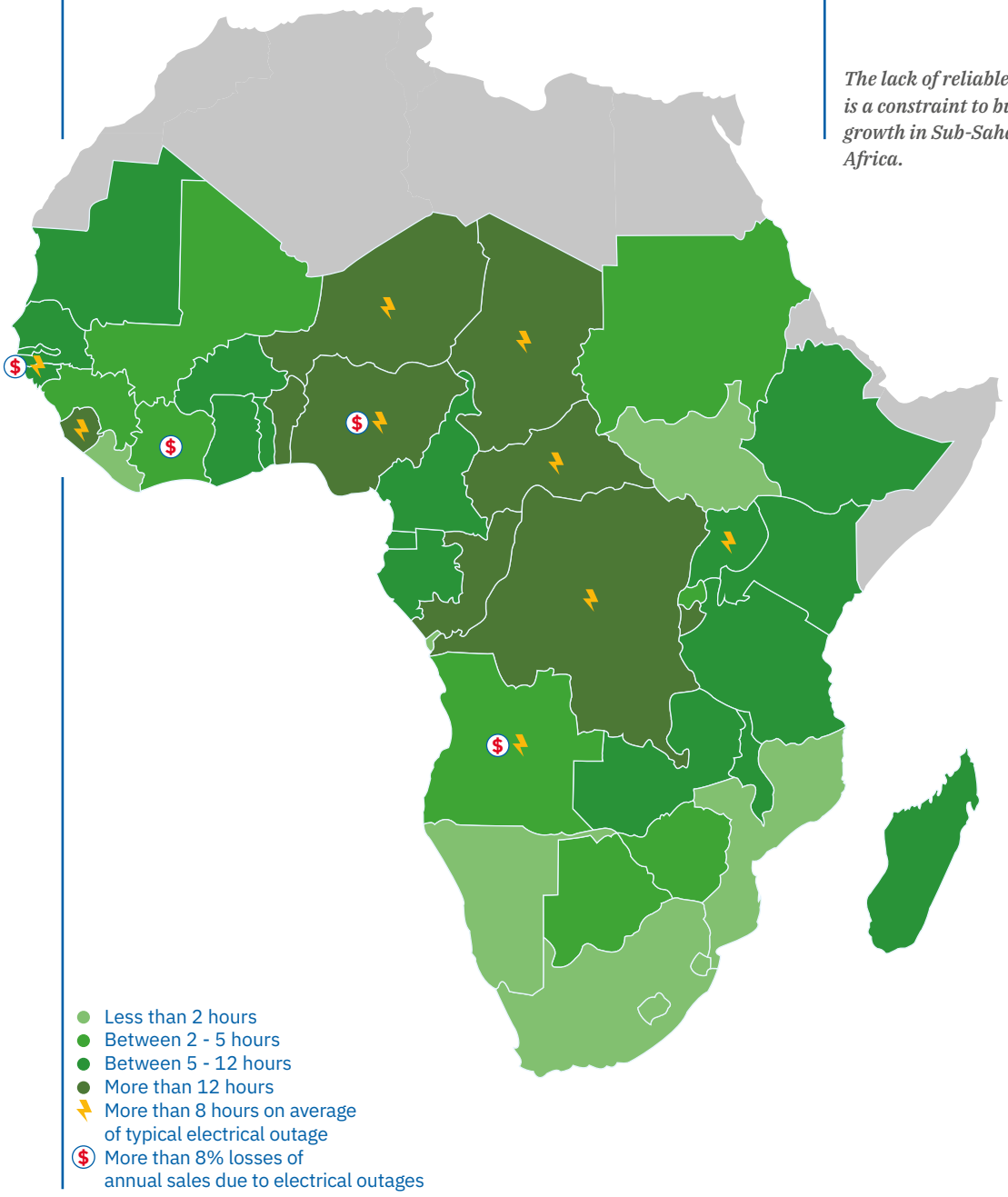


Fig.30

Power outages in a typical month and impact on firm sales.

Source: Bloomberg New Energy Finance (BNEF), 2017.

The lack of reliable electricity is a constraint to business growth in Sub-Saharan Africa.



About RES4MED&Africa:

Renewable Energy Solutions for the Mediterranean and Africa (RES4MED&Africa) promotes the deployment of large-scale and decentralized renewable energy solutions in Southern-Mediterranean and Sub-Saharan African countries to meet local energy needs. RES4MED&Africa's mission is to create enabling environments for renewable energy investments in emerging markets. Since its inception in 2012, the association gathers the perspectives of a member network from across the sustainable energy value chain. RES4MED&Africa functions as a platform for members and partners to foster dialogue and partnerships, share knowledge, and build capacity to advance sustainable energy investments in emerging markets.

About Enel Foundation:

Enel Foundation is a knowledge platform that focuses 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 for 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. We 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.

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Renewable energy underpins Africa's future sustainable development. RES4MED&Africa is committed to creating enabling environments for renewable energy investments that can accelerate Africa's clean energy transition and foster sustainable economic growth. The RES4MED&Africa flagship publication aims to be an example of partnership at work and sheds a light on what is needed to make Africa's sustainable energy future a reality. The 2018 edition gathers a multi-stakeholder and pluri-disciplinary overview that explores what is needed to scale renewables in Africa and how this creates real added value for Africa's growth. The report represents RES4MED&Africa's dedication to push forward the renewable energy momentum in Africa that can ensure affordable, reliable and sustainable energy for all.

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