RES4AFRICA FOUNDATION

Scaling up a **Sustainable Electrification** in **Africa** and with **Africa**

Executive Summary

in knowledge partnership with enel Foundation

Scaling up a **Sustainable Electrification** in **Africa** and with **Africa**

Executive Summary

March 2025

RES4AFRICA FOUNDATION

in knowledge partnership with

enel Foundation

Table of Contents

Foreword

Africa stands at the threshold of a transformative era. Blessed with abundant natural resources, fertile lands, a youthful and dynamic population, and a burgeoning spirit of innovation, the continent is poised for remarkable growth. Yet this moment of opportunity arrives alongside an unprecedented challenge: to pursue development paths that are both sustainable and carbon-neutral, contributing to the global fight against climate change while ensuring long-term socio-economic prosperity.

Electrification emerges as a central solution to this challenge. As a cost-effective and efficient strategy, it serves the dual purpose of decarbonising energy use across transport, buildings, industry and agriculture, while simultaneously supporting continued socio-economic development. This approach promises to drive GDP growth, create millions of jobs, and enhance access to essential services including healthcare, education, and digital infrastructure. To realize these benefits, governments will need to drive the energy transition by developing and implementing consistent long-term plans, policies and electricity roadmaps. Critical to this effort are transmission and distribution networks, which will require substantial investments alongside regulatory frameworks that promote zero and low-emission technologies. Although the necessary electrification technologies are mature, persistent policy and economic barriers continue to hinder their full potential.

The financing gap represents one of these significant barriers. Despite global renewable energy investments reaching record highs, Africa's share remains critically low at just 1.6% of global renewable power capacity. This disparity signals that despite strong investor appetite in the global clean energy transition, financing isn't reaching where it's needed most. Addressing these investment barriers and scaling up clean energy financing in Africa is therefore crucial for driving the continent's sustainable economic growth and development.

The benefits of transitioning from fossil fuels to electricity extend beyond environmental considerations. This shift offers numerous benefits for customers, the environment, and society at large, including increased energy security and efficiency, economic savings, reduced greenhouse gas emissions,

improved air quality, and enhanced safety. Most significantly for Africa, electrification can improve energy access and human health, particularly for vulnerable households, by transitioning from inefficient and polluting energy sources to more reliable, cost-effective and clean electricity. Additionally, this transition can unlock new markets, potential clients, and business models, fostering innovation and economic growth, while promoting more sustainable community and business practices.

Central to this transformation is the principle of a just and fair energy transition – ensuring no one is left behind and supporting economies dependent on unsustainable technologies in their shift toward new economic opportunities. Women and young people will be at the forefront of this change, driving political and economic progress and shaping Africa's future prosperity.

Africa's diversity, encompassing countries with unique histories, cultures, and resources, demands tailored approaches to sustainable development. Building an effective electrification framework requires a multi-faceted strategy: defining optimal electrification plans suited to local needs, expanding renewable energy deployment, developing reliable electric grids, embracing digitalization and smart grid solutions, supporting green industrialization, and electrifying end-use energy consumption.

This paper, developed in a joint effort between RES4Africa and Enel Foundation, aims to help policymakers and stakeholders understand how existing electrification technologies can be scaled across Africa. It highlights the key barriers and challenges currently holding back implementation, proposes solutions, and outlines the potential benefits of these steps when applied at scale.

African policymakers now have a crucial opportunity to prioritise and deliver on these actions to enable real and lasting socioeconomic development. By doing so, they will equip the continent to better handle the consequences of climate change and other global developments challenging current infrastructure, business operations, societies and communities.

Roberto Vigotti
Secretary General RES4Africa Foundation

Giulia Genuardi
Managing Director Enel Foundation

Executive Summary

Africa has historically often been considered a marginal continent in terms of global geopolitics and economic influence on the world stage, despite its size and population. This perception has now changed largely as a result of the exponential levels of growth being witnessed across multiple areas.

This growth will happen amidst inadequate levels of existing infrastructure, weak governance, conflicts and increasingly severe climate events. New solutions and investment to support progress in these areas is urgently needed and **energy systems are at the heart** of this.

Leveraging on sustainable electrical energy technologies emerge as a cost-effective and efficient strategy approach for delivering Africa's socio-economic development. Governments will need to drive this change also for decarbonising energy final uses, in transport, buildings, and across industry and agriculture, and to prepare for and mitigate the effects of climate change and further geopolitical instabilities.

This **document proposes a six-step model to encourage the rapid uptake of electrification solutions** in the Continent. It also provides a **set of actions**, recommendations and case studies for policymakers and other stakeholders to enable and encourage a swift transition. The aim is to provide an objective perspective for policy makers, public entities, financing entities, utilities, manufacturers of components, small entrepreneurs and communities regarding the role of **sustainable electrification as a necessary prerequisite to eradicate poverty and inequalities in Africa,** and provide practical and actionable insights and suggestions to support next steps. Doing so will enable continued progress on socio-economic development and equip the Continent with the resilience that it needs to cope with the consequences of climate change.

RES4Africa remains focused, engaged and committed to supporting African stakeholders, and deploying the resources and services at its disposal to enable the electrification transition in the coming years.

Chapters

1. Setting the Scene: Key Macrotrends in Africa

Climate Change

Africa is the least polluting continent and the first to suffer from it

Urbanization & Megacities

By 2030, more than 50% of the population of Africa will be living in cities and over 60% by 2050

Demand growth

Driven in large part by demographic and urbanization trends, energy demand is expected to increase faster than anywhere else globally

Population growth

Africa is the world's fastest-growing region in demographic terms. More than half of global population growth between now and 2050 is expected to occur in Africa

Economic growth

African economic growth is projected to accelerate, but it remains insufficient to address structural challenges

Technological breakthroughs

Deeper penetration of new technologies with significant cost reduction and performance increase

Africa is experiencing **exponential growth across multiple dimensions**. Population levels continue to increase, urbanisation trends are accelerating, and there continues to be a transition in many rural and traditional economies, with the help of digitisation and new technologies, to greater levels of industrialisation. This will result in a growing expectation for demand for food, water, jobs etc. and access to services such as healthcare, education, transportation.

With severe climate events now happening more frequently, challenges faced by initiatives to improve the healthcare system, food security, access to clean water, and resilience of the energy sector are multiplied.

Ensuring a stable, affordable, and reliable energy supply for economic growth is an urgent imperative. To ensure that its local communities and businesses can continue to thrive, Africa can and should ensure that its plans include a significant role in the global energy system considering its abundant natural resources, including solar radiation and other renewables, minerals and fossil fuels.

These issues need to remain at the centre of international debates such as Conferences of Parties and G20 to enable meaningful progress to be made in the Continent. As a precursor to engaging in an open dialogue with African stakeholders, EU countries need to re-establish themselves as a reliable and long-term partner and commit to support Africa's development imperative.

2. Energy's Role in Africa's Sustainable Transformation

Urban and peri-urban areas in Johannesburg

With more and more people being attracted from the regions to the big mega-cities, one consequence is the rapid growth of informal townships or slums. These usually do not have any formal housing or public services available, including water, electricity or sewage systems. Guaranteeing access to energy in those areas as a minimum will become as important if not more crucial. The figure provides a visual example of the disparities that can arise if peri-urban areas development is left unplanned and unmanaged.

Africa's long-standing and heavy reliance on fossil fuels**,** particularly coal and oil, presents a significant legacy challenge to any proposed change in the energy sector. Given their ease of use, fossil fuels remain the dominant energy sources of choice in many African countries, even though their use contributes to continued environmental degradation, air pollution, and climate change.

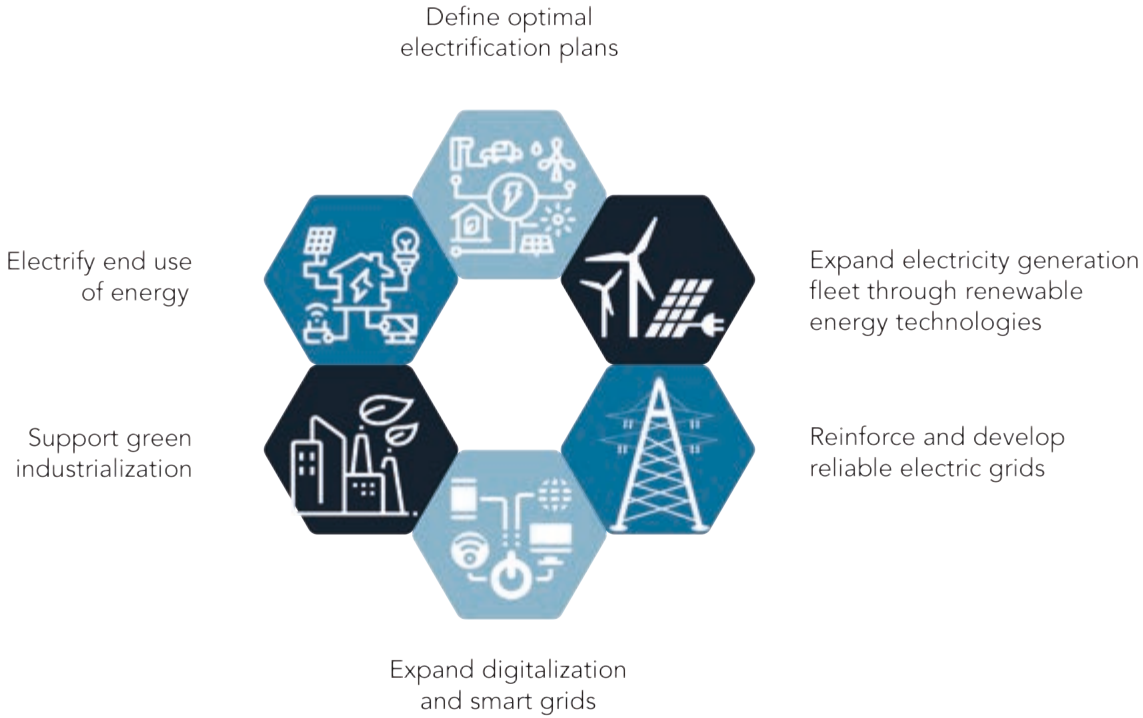
International experience has shown that **sustainable energy sources have the potential**, and are a much better fit, **to support a just and lasting approach to socio-economic development**. The introduction of clean energy sources and improved electric systems in Africa can promote wider and faster regional economic growth that is inclusive, environmentally sustainable, and that addresses the shortcomings and failings of legacy approaches.

By this approach, African countries can stimulate economic growth. Access to reliable and affordable energy remains essential for powering industries, businesses, and in supporting the development of wider infrastructures**.** Energy-intensive sectors such as manufacturing, mining, and agriculture will require significant amounts of power to operate efficiently. By attracting investments to develop these sectors there is the opportunity to create jobs, enhance productivity, and increase poverty alleviation efforts.

Delivering energy access at scale needs to remain a key priority. Despite advancements in recent years, population growth continues to outstrip the expansion of access to electricity, leaving an estimated 600 million Africans without energy. This lack of access inhibits economic growth and restricts opportunities for education and healthcare. It also perpetuates cycles of poverty, particularly in rural areas where electrification rates lag behind urban centres, further deepening socio-economic disparities. It is crucial to recognise that historically, no country has achieved improved living standards and societal prosperity without a corresponding increase in energy consumption.

RES4Africa has formulated a comprehensive framework delineating the essential elements needed in order to **solve the energy equation for Africa.**

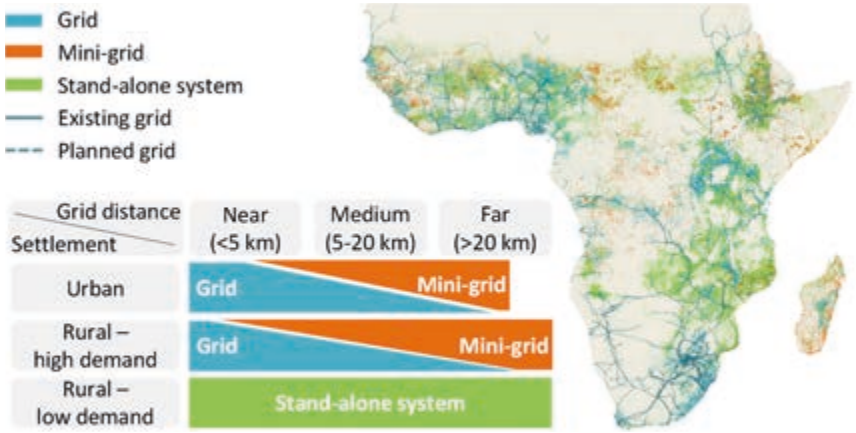
3. Key Components of Sustainable Electrification



The transition to a new energy system will be complex and will take time. A coherent, structured and holistic approach will be needed to enable the sustainable electrification of the Continent. An increase in power supply capacity on its own will not be enough to deliver the outcomes needed. In this regard, Res4Africa has identified the **key areas of intervention**: (a) electrification plans, (b) renewable energy technologies, (c) reliable electric grids, (d) digitalisation and smart grids, (e) green industrialisation supply chains and (f) electrification of end uses.

3.1. Define optimal electrification plans

People gaining access to electricity by technology by 2030 in IEA's Sustainable Africa Scenario



Source: IEA, Africa Energy Outlook 2022

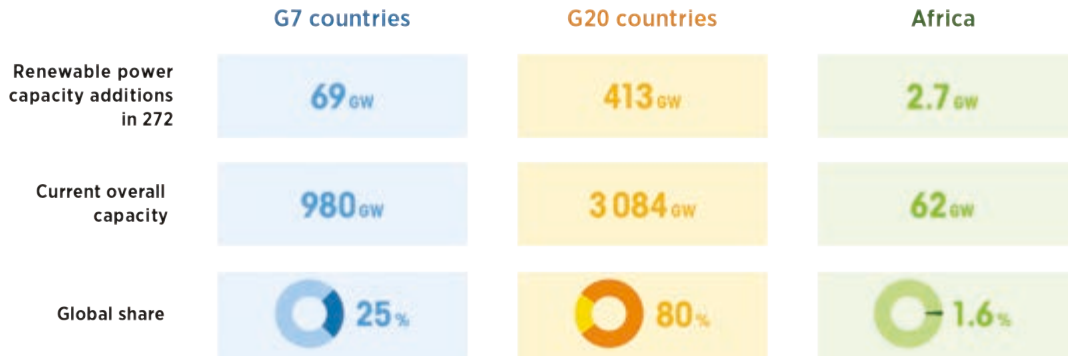
The decisions and actions taken in the next decade will decide whether Africa future energy and electricity systems are future-proof, inclusive, sustainable, and equitable.

To meet the urgent need across much of Africa for universal access to reliable electricity for its communities, businesses, and energy systems, new electrification plans will require meticulous planning, prioritisation, and resource allocation.

Electricity emerges as a critical energy vector and represents an unprecedented opportunity to foster a clean energy transition and the decarbonization of energy uses. A cost competitive approach could involve a combination of centralised solutions, such as large-scale power plants coupled with grid extension, and decentralised approaches including mini-grids and stand-alone systems utilising renewable energy resources. Energy Storage System, utility scale and behind the meter, has to be considered as a fundamental element of modern electric infrastructure.

3.2. Expand the use of renewable energy technologies

Renewable Capacity Growth Disparities



Source: IRENA, The energy transition in Africa, 2024

The potential benefits of adopting clean energy technologies in Africa are many and wide-ranging given that local renewable resources such as solar, wind, hydro, and biomass are available in abundance.

Renewables can deliver a viable, efficient, and sustainable solution that helps to reduce on local and imported fossil fuels, mitigate environmental impacts, enhance overall national energy security, and contribute to greater resilience of local electricity systems. It is well proven they can be deployed rapidly, are scalable, climate resilient, and cost-competitive.

Renewable energy systems can be adjusted to match varying levels of consumption and integrated into mini-grids or standalone systems, which can later be connected to the main grid as demand grows. Moreover, renewables can electrify urban, peri-urban, and remote areas based on various technologies and can enable much-needed socio-economic development co-benefits.

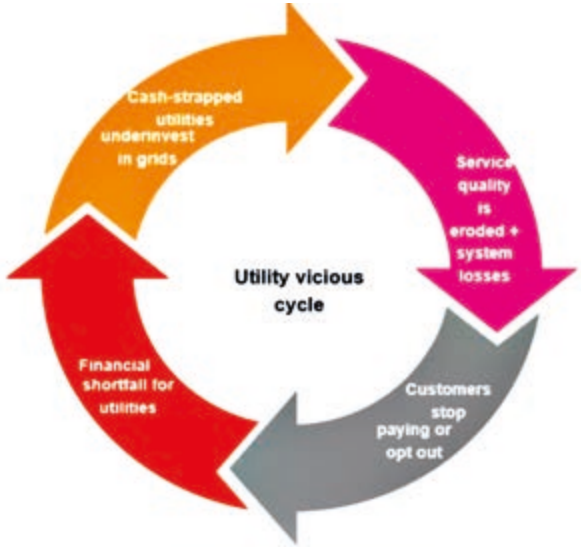
3.3. Reinforce and develop reliable electric grids

Reliable electric grids are a critical prerequisite to provide stable and resilient supply of electricity for communities and businesses. **Grids serve as the backbone of power systems**, acting as essential conduits that also enable the inclusion of new intermittent sources of supply.

Most African infrastructure suffers from inefficiencies, congestion, experiences high levels of both technical and non-technical losses, regularly has outages and blackouts, delivers poor power quality, and only has limited hosting capacity for new renewable energy projects. Underinvestment has been the main reason behind this.

The widespread adoption of renewable energy in Africa will need to be accompanied by concurrent investments in transmission and distribution grids, modernization and maintenance, digitalization as well as energy storage infrastructure.

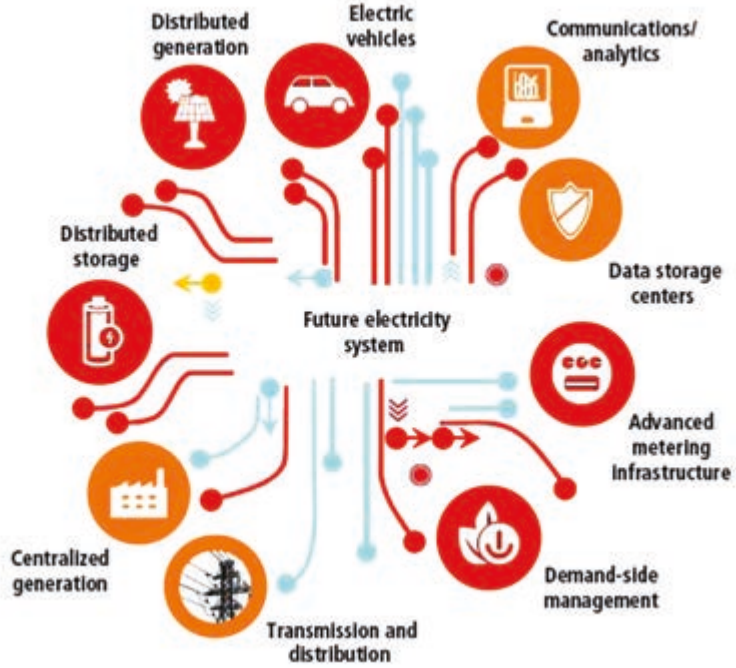
Utility vicious cycle



Source: PwC Private sector participation presentation at Grids4Africa launch November 2021

3.4. Expand digitalisation and smart grids

The new dynamic paradigm of distribution operator

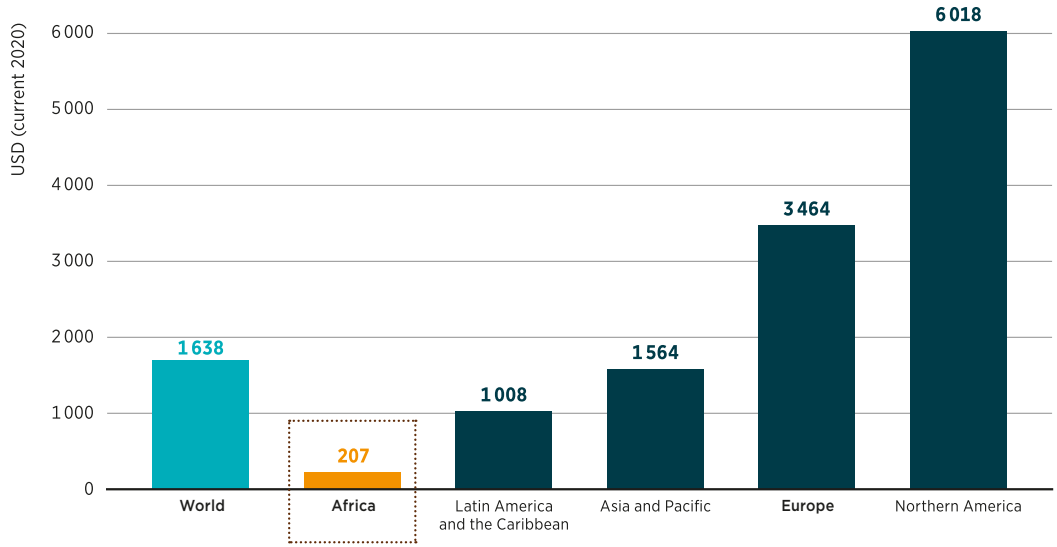


The introduction of **digitalisation in planning, designing, building, operating and maintaining generation assets, electrical grids and final customers** has not been massively deployed in Africa. This should represent a priority in shaping the energy agenda.

A great focus on digital technologies and smart grids would provide utilities with the means to better plan, monitor, manage, and optimise their electricity systems. The opportunity exists for the grid to become increasingly digitized, with smart meters and sensors and increasing automation.

3.5. Support green industrialisation

Manufacturing value added per capita by world region, 2020



Source: IRENA, The energy transition in Africa, 2024

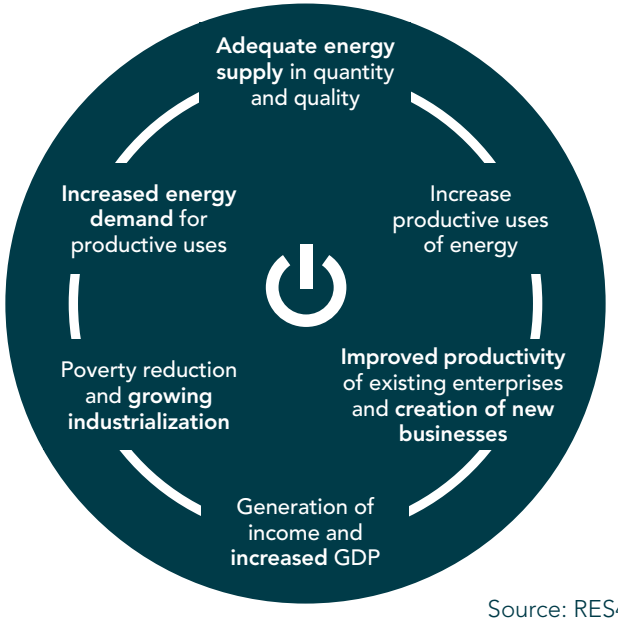
Historically, Africa has suffered a very low level of industrialization compared with the huge potential related to the abundance of raw materials, including critical materials needed to the energy transition. The creation of the entire value chain up to the end product is a no longer deferrable target. Almost unlimited renewable energy sources and electrification are at the core of Africa's new industrialization strategies.

Clean hydrogen could be in particular a critical element for the green industrialization but there remain some existing technological and economical challenges that need to be addressed (costs, production, storage, transportation).

3.6. Electrify end use of energy

Africa still has the lowest per capita utilisation of modern energy globally. Expanding electrification for various end-uses presents a significant opportunity across the Continent. Immediate focus areas should include sectors such as **mobility, heating, cooling and cooking**. These can deliver immediate benefits due to improved efficiency of electrical appliances than fossil fuel-based ones.

Another relevant area is agriculture taking into account the well-known water, energy and food relationship (WEF Nexus). If done comprehensively, electrifying energy consumption can help achieve significant emission reductions, reduce national and local dependence on volatile imported fuels, and raise both social and economic well-being.



Source: RES4Africa, Connecting the Dots, 2020

4. Recommendations for Policy Makers

Recommendation 1

Setting Ambitious LT Targets and Goals, Coordinate and Harmonise Policies

- The first step needs to be **the establishment of clear, ambitious and longer-term targets**, such as a percentage of total energy consumption to be sourced from (clean) electricity or a timeline for phasing out fossil fuel-powered generation.
- This statement of intent, **if projected at regional level,** will allow for increasing coordination and collaboration amongst relevant government agencies, who can then work on creating harmonised and appropriate policies, standards, and regulations, and ensure that administrative processes are streamlined.
- By having key government stakeholders assuming a stronger, more central and coordinated role, a **clear signal can be sent to the market that there is stable intent and aligned political support.**

Recommendation 2

Implementing Regulatory Reforms and Focused Incentives

- Conducive **signals for the energy sector and in particular for private investors** could be sent through the **implementation of the necessary regulatory reforms** and incentives needed to promote sustainable electrification.
- Part of this should focus on the **simplification and removal of existing structures and processes** that currently hinder the progress of sustainable energy projects.
- Implementing correctly designed and supportive policies, regulations, and incentives can also help **to create a more supportive environment for local electrification**, favour the establishment of **new local manufacturing capabilities** and, if sustained, provide a showcase for other regional countries to follow.

Recommendation 3

Developing Partnerships and Collaboration

- Enhancing existing, and developing **new partnerships and collaboration arrangements among African government agencies, the private sector, civil society organisations, and international partners** will be fundamental to the success of any efforts aimed at improving sustainable electrification across Africa.
- Stakeholders can then use these to **keep the energy transition dialogue focused on the realities and benefits of renewable energy for Africa. Improving access to single sources of reliable** data on energy demand, resource availability, and market dynamics, **sharing best practices and insights, and coordinating efforts** will maximise the impact of electrification initiatives.
- At a regional level, **the development of more longer-term arrangements**, such as interconnected regional power markets, power sharing, the promotion of energy trading, **could also lead to more efficient and resilient electricity systems at a lower cost.**

Recommendation 4

Breaking the Investment Ceiling

- **Overcoming entrenched investment hurdles and mindsets** that hinder investment flows are a priority focus area if renewable energy and electrification projects and sustainable electrification efforts across Africa are to succeed.
- Factors relating to the cost or reliability of the technologies are not the issue. Most typically it relates **to the cost of capital.**
- **Governments and policymakers can play a large role** by ensuring political stability, creating conducive macroeconomic conditions, putting in place a supportive policy and regulatory framework, conveying institutional stability, and ensuring full transparency of procurement and contractual arrangements.

Recommendation 5

Raising Awareness and Building Capacity

- There will be a need to **significantly scale up the education of communities, policymakers, and industry professionals** on the basics of renewable energy, as well as on the profound **benefits of electrification for socio-economic development**.
- Efforts should begin by focusing on concerted action to **raise awareness, dispel myths and build capacity for the change amongst all stakeholders in society**. Common myths include that renewables are more expensive, unreliable, or take up too much land, are energy negative and result in job losses.
- Electrification will work better, happen more quickly, deliver wider and longer lasting sustainable and resilient socio-economic growth if **society at large is engaged, understands what is being planned and required of it, and is supportive of the transition.**

Conclusion

Supporting socio-economic development and access to energy remain the highest priorities for Africa. The view of this report is that one of the core ways in which all of these areas could be addressed is by **increasing the penetration of sustainable electrification**. It is, on all counts, the **most cost-effective and efficient strategy** for decarbonising energy consumption in transport, buildings, and across industry and agriculture, preparing for the effects of climate change and further geopolitical instabilities, and for delivering enduring socio-economic benefits for African customers, the environment, and society at scale.

It is well known that **underinvestment in electricity systems** historically has caused the inefficiencies, losses, congestion, and outages that we see more and more frequently today. African nations know that they need **more investment in grid extensions, interconnections, and digitalisation** to improve electricity access. However, that investment has been held back as a result of national monopolies, limited investment capacity of public utilities, non-cost-reflective tariffs, technical losses, and perceived risk premiums for African projects. Private sector participation needs to be a major part of the solution, but current efforts remain insufficient, especially international ones.

This policy paper has identified the major barriers that currently hinder full engagement and uptake of these technologies across the continent. It has proposed a six-pillar framework, that explains the key components that RES4Africa feels are needed to support the design and delivery of sustainable electrification at scale. These areas include: (1) **updated electrification plans**, (2) **greater use of renewable energy technologies**, (3) **reliable electric grids**, (4) **increased digitalisation and smart grids**, (5) **development of green industrialisation supply chains** and (6) **greater electrification of end uses**. Policymakers have also been provided with a list of areas where their influence could make a difference. Together, these activities could turn this ambition into reality.

RES4Africa recognises that once the decision to embark on this journey at scale has been made, **it will be challenging, and it will take time**. It will require a **rethinking of the current status quo**, especially in terms of the economy, infrastructure, operations, engagement with the private sector and local communities, and with international stakeholders. A **long-term view** will need to be taken with regular evaluations of progress and outcomes. It will also require that some long-standing economic areas of focus and activities stop, and support is provided for legacy as well as replacement areas of the economy. This may often need to span electoral cycles. However, this journey need not be made by national governments alone. **Greater regional collaboration** on what are ultimately shared and common agendas, and hoped for outcomes, can reduce the financial requirements, streamline approaches and speed up the achievement of key changes. Delivering on the socio-economic benefits outlined in this report and managing the consequences of climate change and continuing other global developments will deliver a positive and lasting legacy for generations to come.

With this work, RES4Africa Foundation hopes to have provided **African policy makers with valuable insights** that will enable them to **prioritise the steps that are needed to make this happen** within a generation, and remains excited about the opportunity to continue to play an active supporting role as this journey unfolds.

Acknowledgments

Production: RES4Africa Foundation Secretariat in Rome, Italy

Authors: Roberto Vigotti, Gus Schellekens, Fabrizio Bonemazzi, Sara Pochesci, Assia Bellaroto

Case studies by RES4Africa Members (by alphabetical order): ABB, Afry, CESI, Enel Green Power, GME, Gridspertise, NIDEC, RINA, Schneider Electric.

Special thanks go to Enel Foundation, RES4Africa's longstanding knowledge partner.

Contributors from RES4Africa International Advisory Board (by alphabetical order):

Ahmed Baroudi, Director General, Société d'Ingénierie Energétique (SiE)

Carmelo Cocuzza, Head of Unit, Advisory Services for Infrastructure and Climate, Corporate Finance and Global Activities Department, European Investment Bank Global (EIB Global)

Daniel Alexander Schroth, Director Renewable Energy and Energy Efficiency Department, African Development Bank

Esther Wanza, Youth Representative, Co-founder SDG7 Youth Constituency, Raynow Energy

Ignacio Pérez-Arriaga, Professor and Director of Energy Training, Florence School of Regulation

Laura Cozzi, Director of Sustainability, Technology and Outlooks, International Energy Agency (IEA)

Nicolas Felix Souche, Senior Investment Officer in the Infrastructure Africa team of IFC

Norah Magero, Co-Founder and CEO, Drop Access

Robert Lisinge, Chief of Section, PSDFD Energy Infrastructure & Services, United Nations Economic Commission for Africa (UNECA)

Rosemary Idem, Programme Manager, Women and Youth at the Forefront, SEforALL

Salvatore Bernabei, CEO of Enel Green Power and Head of Enel Green Power and Thermal Generation

Ute Collier, Acting Director, Knowledge, Policy and Finance Centre (KPFC), IRENA

Design and Layout: Gangemi Editore

Disclaimer: This report reflects the views of the RES4Africa Secretariat but does not necessarily reflect the views of the individual RES4Africa members or any particular funder, supporter, or collaborator.

This publication is available for download on www.res4africa.org/library

For further information: info@res4africa.org

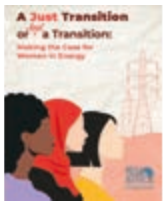
Contact:
Via Ticino 14, Rome, Italy, 00198
T: +39 068552236
www.res4africa.org

RES4Africa Library

Scan the QR code to unlock the full version of this Paper and access our Library

Flagship Publications

Latest reports and studies published



About RES4Africa

Founded in 2012, RES4Africa (Renewable Energy Solutions for Africa) is a Foundation dedicated to supporting Africa's sustainable and equitable energy transition, ensuring access to affordable, reliable, sustainable, and modern energy for all. Acting as a bridge between Europe and Africa, we bring together a network of members from the clean energy sector across both continents and high-level international partners, facilitating continuous dialogue among key energy stakeholders interested in investing in clean energy technologies.

To learn more about Res4Africa

- Subscribe to our newsletter: receive a selection of the most important news, as well as editorials and comments on the most relevant topics in the world of renewable energy.
- Follow us on social media: we update our accounts daily with information about our activities and news from the renewable energy sector.
- Visit our website: find everything you need to know about the Foundation, past projects, ongoing initiatives, and publications.
- Participate in our events and webinars.

RES4AFRICA FOUNDATION

This report reflects the views of the RES4Africa Secretariat but does not necessarily reflect the views of the individual RES4Africa members or any particular funder, supporter, or collaborator.

Contact:
Via Ticino 14, Rome, Italy, 00198
T: +39 068552236
www.res4africa.org

info@res4africa.org