IASS STUDY

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The Future of Africa's Energy Supply

Potentials and Development Options for Renewable Energy

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Table of Contents

List of Tables

List of Figures

List of Boxes

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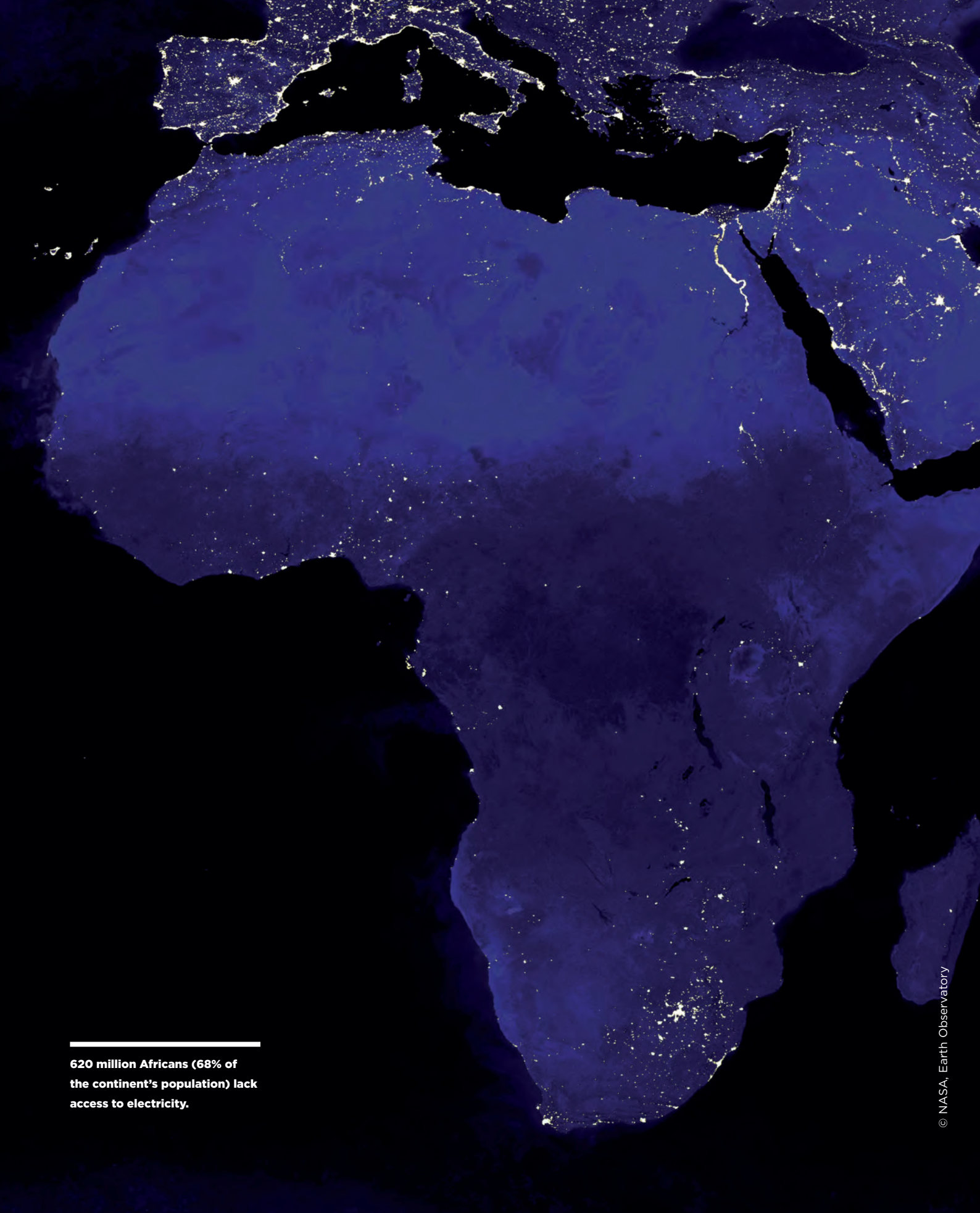
List of Abbreviations

AA	Federal Foreign Office
AEEP	Africa-EU Energy Partnership
AFD	Agence Française de Développement (French Development Agency)
AfDB	African Development Bank
AMCEN	African Ministerial Conference on the Environment
APP	Africa Progress Panel
AREF	African Renewable Energy Fund
AU	African Union
BMUB	Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
BMWi	Federal Ministry for Economic Affairs and Energy
BMZ	Federal Ministry of Economic Cooperation and Development
BNEF	Bloomberg New Energy Finance
CAPP	Central African Power Pool
CIPA	Climate Change Investment Program for Africa
COP	Conference of the Parties
Comelec	Comité Maghrébin de l'Electricité (Maghreb Electricity Committee)
CSP	Concentrating Solar Power
CTF	Clean Technology Fund
DEG	Deutsche Investitions- und Entwicklungsgesellschaft
DoE	Department of Energy
DREI	Derisking Renewable Energy Investments
EAPP	Eastern African Power Pool
EBRD	European Bank for Reconstruction and Development
ECOWAS	Economic Community of West African States
ECREEE	ECOWAS Centre for Renewable Energy and Energy Efficiency
EIB	European Investment Bank
EnDev	Energising Development
EPAs	Energy Purchase Agreements
ERA	Uganda's Electricity Regulatory Authority
ESMAP	Energy Sector Management Assistance Program
EU NIF	European Union Neighbourhood Investment Facility
EU	European Union
EUEI PDF	European Union Energy Initiative Partnership Dialogue Facility
EWURA	Energy and Water Utilities Regulatory Authority of Tanzania
GCCI	Global Climate Change Initiative
GEEREF	Global Energy Efficiency and Renewable Energy Fund
GEF	Global Environmental Facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation)
GOGLA	Global Off-Grid Lighting Association
GW	Gigawatt
GWEC	Global Wind Energy Council
IASS	Institute for Advanced Sustainability Studies
IEA	International Energy Agency
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change

IPPs	Independent power producers
IRENA	International Renewable Energy Agency
KfW	Kreditanstalt für Wiederaufbau (Germany's development bank)
kWh	Kilowatt hour
LCOE	Levelised cost of electricity
MASEN	Moroccan Agency for Solar Energy
MEMDU	Ministry of Energy and Mineral Development, Uganda
MENA	Middle East and North Africa
MorSEFF	Morocco Sustainable Energy Finance Facility
Mtoe	Million Tons of Oil Equivalent
MWh	Megawatt-hour
NEPAD	New Partnership for Africa's Development
NERSA	National Energy Regulator of South Africa
O & M	Operation and Maintenance
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
ONE	Office National de l'Electricité et de l'Eau Potable
PAYG	Pay-as-you-go
PIDA	Programme for Infrastructure Development in Africa
PPA	Power Purchase Agreement
PPP	Public-private partnerships
PSIA	Poverty and Social Impact Analysis
PV	Photovoltaic
RCREEE	Regional Centre for Renewable Energy and Energy Efficiency
RD&D	Research, Development and Demonstration
RECP	Renewable Energy Cooperation Programme
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
REN21	Renewable Energy Policy Network for the 21st Century
REPP	Renewable Energy Performance Platform
SAPP	Southern African Power Pool
SDG	Sustainable Development Goals
SE4ALL	Sustainable Energy for All
SEFA	Sustainable Energy Fund
SPP	Small Power Producer
SREP	Scaling Up Renewable Energy in Low Income Countries
SSDG	Small-Scale Distributed Generation
TVET	Technical and vocational education and training
TWh	Terawatt hour
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organisation
USAID	US Agency for International Development
WAPP	West African Power Pool
WEC	World Energy Council
WEF	World Economic Forum



620 million Africans (68% of the continent's population) lack access to electricity.

Executive Summary

Background

This study was conducted by the Plattform Energiewende at the Institute for Advanced Sustainabilty Studies on behalf of the Ministry of Economic Cooperation and Development (BMZ). The report represents an input to discussions following the Leaders' Declaration issued at the G7 Summit held on June 7/8, 2015 in Elmau "to accelerate access to renewable energy in Africa and developing countries in other regions with a view to reducing energy poverty and mobilizing substantial financial resources from private investors, development finance institutions and multilateral development banks by 2020 building on existing work and initiatives". More specifically, the G7 declaration formulates the objectives to reach up to 10 GW of additional installed renewables capacity by 2020 in Africa and "to improve sustainable energy access in Africa by 2030 by accelerating the deployment of renewable energy". It thereby supports corresponding goals of the Africa Renewable Energy Initiative, launched by the African Ministerial Conference on the Environment (AMCEN). This report provides an analysis of available literature and data on the development of renewable energy in Africa and suggests policy options for achieving the objectives supported by the G7 declaration.

Status quo and major trends in Africa's (renewable) energy sector

Africa is an energy poor continent. Most people in Sub-Saharan Africa face severe energy poverty, and low availability of energy services hampers economic development. North African countries and South Africa are major exceptions with significantly higher levels of electrification and overall energy consumption. Meeting current and future energy demand poses a major challenge in all African countries.

Traditional biomass is the most widely used energy source in Africa, mainly for cooking. Fossil energy dominates electricity generation and the transport sector. Renewables are primarily employed in the electricity sector. Renewable energy use has seen a significant expansion in recent years, though – except for hydro – from a very low base. South Africa leads the continent in both installed capacity and investments. While the majority of renewable energy capacity is grid-connected, off-grid applications have seen strong growth in recent years. Renewable energy policies now exist in the majority of African countries, dominated by support instruments in the electricity sector.

Scenarios, potentials and targets for renewable energy development in Africa

The target of 10 GW deploying an additional renewable energy capacity Africa by 2020, supported by the G7, is in line with the objectives of other international initiatives and scenarios. The technical potential for renewable energy in Africa is abundant. In the coming years, capacity additions are expected to focus on wind energy (up to 17 GW), hydro power (up to 15 GW) and solar PV (up to 12 GW). The exact numbers differ significantly across scenarios.

Drivers and opportunities for renewable energy deployment in Africa

Renewables offer multiple benefits and opportunities in the African context. Firstly, they are domestically available. Net energy importers can reduce import bills by deploying renewables, whereas energy exporting countries can increase revenues from fossil-fuel exports and improve current account

balances. Secondly, renewables are cost-competitive. Recent data on renewable energy projects in Africa reveal that the levelised cost of electricity (LCOE) of solar PV and wind is significantly below the LCOE of oil-based power plants and in some cases even below the LCOE of new coal-fired power plants. Integrating renewables in diesel-based micro-grids offers important cost savings. In addition, renewables can be deployed much faster than fossil-fuel based power plants. Renewables can also trigger additional economic benefits, such as job creation and socio-economic development, in particular in rural areas. Finally, renewables are core components for any low-carbon strategy and offer important environmental co-benefits, such as improved local air quality and water security.

Challenges for renewable energy deployment in Africa

The poor financial health of utilities is a major challenge for investment in Africa's energy sector as a whole. This is further compounded by high upfront investment costs of renewable energy projects. In addition, even though most African countries have established policies for the promotion of renewable energy sources in the past decade, the legal and regulatory frameworks often remain patchy and inconsistent. Technical challenges include resource data availability, O&M skills at the local level, and system integration of fluctuating power from renewable energy sources.

Strategies and policies for renewable energy deployment in Africa

Many African countries already support grid-connected renewables via feed-in tariffs, auctions, net metering and investment incentives. The South African auction program has been especially successful in deploying renewables. While most renewable energy deployment was grid-connected in the past two decades, a number of countries have adopted policies for decentralized approaches for rural electrification based on renewable energy. Finally, the establishment of regional power pools and renewable energy transmission corridors is an important building block for the future expansion of renewable energy.

Donor initiatives and the derisking of renewable energy investments

Major donor agencies have a well-established or growing focus on renewable energy projects. Germany is a leading donor in Africa's energy sector with a major focus on renewable energy. Major donor initiatives have been launched over the past years to support Africa's renewable energy sector. Derisking investments in grid-connected renewable energy represents a key to enabling renewable energy deployment in the short- to medium-term. A number of financial derisking instruments are being supported by the donor community.

Priorities for the international donor community

Reaching the 10 GW target supported in the G7 Leaders' Declaration at Elmau will require strengthening of existing programs, the introduction of additional derisking instruments targeting specific bottlenecks and the expansion of integrated country-level derisking programs. Bilateral donors should contribute to derisking investments by providing risk guarantees.

Continued support to the enabling environment for renewable energy represents the basis for all other activities and the key to accelerated deployment in the medium-term. This should include institution and capacity building and engagement with the political economy of reform. Expanded support to local value creation and employment in the renewable energy sector, including the development of off-grid value chains, should represent a particular priority. Strong socio-economic benefits and an important potential for innovation justify strong donor support to Africa's off-grid sector. Dedicated and stable support in this area will play an important role in enabling further investment.

Priorities for German development cooperation

To reach the 10 GW target, German development cooperation should provide targeted support to the identification and initiation of bankable projects and strengthen its derisking instruments. In addition, German bilateral development cooperation should further strengthen its technical assistance to support an enabling environment, capacity building and skill development as well as value creation and employment in the renewable energy sector. Closer cooperation between the programs of the Federal Ministry of Economic Cooperation and Development (BMZ) and the Federal Ministry for Economic Affairs and Energy (BMWi) in the field of international renewable energy promotion could offer a win-win opportunity for accelerating renewable energy expansion as well as the engagement of the German private sector in Africa. North-South-South cooperation offers important potential, due to the growing role of emerging countries both as donors and markets for renewable energy. Finally, the analytical basis underpinning development cooperation in Africa's renewable energy sector should be strengthened.

With a potential of 1750 GW hydropower is an attractive energy source for Africa.

1. Objectives and Structure of the Report

This study was conducted by the Plattform Energiewende at the Institute for Advanced Sustainability Studies on behalf of the Federal Ministry of Economic Cooperation and Development (BMZ). The report represents an input to discussions following the Leaders' Declaration issued at the G7 Summit held on June 7–8, 2015 in Elmau "to accelerate access to renewable energy in Africa and developing countries in other regions with a view to reducing energy poverty and mobilizing substantial financial resources from private investors, development finance institutions and multilateral development banks by 2020 building on existing work and initiatives". More specifically, the Declaration formulates the objectives of reaching up to 10 GW of additional installed renewables capacity in Africa by 2020 and "[improving] sustainable energy access in Africa by 2030 by accelerating the deployment of renewable energy". It thereby supports corresponding goals of the Africa Renewable Energy Initiative, launched by the African Ministerial Conference on the Environment (AMCEN).

This report provides an analysis of available literature and data on the development of renewable energy in Africa and, based on this, suggests policy options for achieving the objectives supported by the G7 declaration. Given the short-term priority placed on accelerating the deployment of renewables in the electricity sector (i.e. 10 GW by 2020) and the explicit focus on this goal in the Terms of Reference for this study, the report concentrates on the most promising options for expanding electricity generation from renewables in the short term. It also highlights key trends and opportunities for supporting the broader goal of improving sustainable energy access by 2030. The research and writing of this report was undertaken between 16 July and 26 August 2015. Research consisted of desktop research based on secondary literature as well as documentation provided by the BMZ, interviews with four representatives from the main implementing agencies (KfW, GIZ, DEG) as well as a two-round expert survey with nine experts on renewable energy in Africa from Germany and Africa.

The report is structured as follows. Chapter 1 provides an overview of Africa's current energy mix and the status of renewable energy on the continent. Chapter 2 offers an overview of existing scenario studies and related expectations for the deployment of renewable energy on the African continent by 2020. Following this, Chapter 3 discusses key opportunities and challenges for renewable energy deployment, existing policies for promoting renewable energy and the role of private sector engagement in the sector. Chapter 4 provides an overview of key donor initiatives to support renewable energy in Africa, including an overview of available financing instruments. Chapter 5 discusses options for further engagement for the G7 and the international donor community in general and for the German government specifically.

With 11,000 GW solar energy has the highest technical potential of all energy technologies in Africa.

2. Status Quo of Renewable Energy in Africa

2.1. Key issues and challenges in Africa's energy development

Major findings at a glance:

- Africa is an energy-poor continent. Most people in Sub-Saharan Africa face severe energy poverty, and the low availability of energy services hampers economic development.
- North African countries and South Africa are major exceptions with significantly higher levels of electrification and overall energy consumption.
- Meeting current and future energy demand poses a major challenge in all African countries.

Africa's energy sector is commonly characterised as being poorly developed. For most people in Africa, energy is inaccessible, unreliable, and unaffordable. With a total installed grid-based capacity of roughly 158 GW in 2012 (IEA 2014: 40), Africa has less power generation capacity than Germany (REN21 2015: 23). However, it is important to note that energy development differs widely between African countries. Sub-Saharan Africa is the least electrified region of the world, whereas Northern Africa has near to universal access to electricity. In Sub-Saharan Africa, South Africa is the major outlier: it accounts for almost half of the power generation capacity on the sub-continent (IEA 2014: 196, 220) and 85 per cent of its population enjoys access to electricity (REN21 2015: 160). Due to the low availability of energy services and low levels of economic development in Sub-Saharan Africa, two-thirds of total energy use occurs in the residential sector; and here, most energy is used for cooking (IEA 2014: 45). Sub-Saharan Africa is the world region with the lowest per capita energy consumption. It is only one-third the world average and half the level of developing Asia, the second most energy-poor region (IEA 2014: 37). Energy supply has expanded significantly in recent years. Between 2000 and 2012, African power generation increased by 65 per cent (IEA 2014: 192). Nevertheless, satisfying current and future energy demand – particularly in the light of population and economic growth – remains a tremendous challenge on the African continent.

The majority of the African population lives in conditions of severe energy poverty. Six hundred and twenty million Africans – 68 per cent of the continent's population – lack access to electricity (REN21 2015: 159). While the electrification rate has improved significantly since 2000, Sub-Saharan Africa is the only region in the world where the absolute number of people living without electricity is increasing (IEA 2014: 30). Energy poverty is particularly widespread in rural areas (IEA 2014: 444). In addition to lacking electricity access, four out of five Sub-Saharan Africans rely on traditional biomass for cooking (REN21 2015: 163).[1] The World Health Organization reports that 900,000 deaths in Africa were attributable to household indoor pollution in 2012 (WHO 2014). Energy poverty poses a major barrier to human development. It does not only compromise health and education opportunities, but also hampers agricultural activities and access to improved water resources and sanitation. The latter

[1] Here, major exceptions are South Africa and Namibia.

is a particularly pressing issue on the African continent, as 36 per cent of the population has no access to improved water resources and 70 per cent lacks access to improved sanitation services (UNESCO 2015: 86).

Poor electricity supply in Sub-Saharan Africa also poses major challenges to the economic development of the region. Acute energy supply constraints hamper economic activity in many parts of Africa, and businesses in Sub-Saharan Africa regard inadequate electricity supply as a major barrier to their effective operation (IEA 2014: 25). Where electricity supply is available, it is frequently unreliable and costly. There are frequent power outages, and Sub-Saharan electricity tariffs are among the highest in the world, with averages ranging from US$130 to 140/MWh (IEA 2014: 66). The insufficient and unreliable supply of electricity causes many households and firms to use costly oil-fuelled back-up generators. According to the IPCC (2012: 122), almost 50 per cent of firms in Sub-Saharan Africa maintain their own backup power generation equipment.

While the African continent is home to significant fossil fuel resources, many African countries are highly dependent on fossil fuel imports. As of 2009, 38 African countries were net oil-importing countries (AfDB 2009: 124). The import dependency does not only pose macroeconomic challenges due to the outflow of foreign exchange but also increases the vulnerability to supply disruptions and price volatility.

Efforts to expanding electricity supply are confronted with a series of challenges. The electricity sector struggles with low capacity utilisation, inefficient grid operations, and high transmission and distribution losses (IEA 2014: 41). Even though electricity tariffs in Sub-Saharan Africa are high, pricing frequently fails to reflect supply costs. According to the IEA (2014: 66), this price gap poses a major obstacle to the financial sustainability of many Sub-Saharan power utilities. Corruption, weak institutions and poor transparency exacerbate the challenges in the energy sector of many African countries even further (IEA 2014: 26). In addition, high country risks pose a major barrier to the much needed investments in the sector.

2.2. The African energy mix: status quo and major trends

Major findings at a glance:

- Traditional biomass is the most widely used energy source in Africa, and is mainly used for cooking.
- Fossil energy dominates electricity generation and the transport sector.
- Renewables are primarily employed in the electricity sector.

2.2.1 Overview of primary energy demand in Africa[2]

The most widely used energy source on the African continent is bioenergy, accounting for almost half of total primary energy demand in 2012 (see Figure 1). This is primarily due to the strong reliance on the traditional use of solid biomass for cooking in Sub-Saharan Africa. Oil is the second-largest energy source, followed by gas and coal. Hydropower accounts for one per cent of African primary energy demand, while nuclear power and other renewables account for even less. The energy mix of North Africa differs significantly from the continental average. In North Africa, bioenergy only accounts for a share of 2 per cent of total primary energy demand, which is dominated by oil and gas. Between 2000 and 2012, total primary energy demand in Africa grew by almost 50 per cent (see Figure 1). Bioenergy accounted for the largest share of this growth, followed by oil and gas[3].

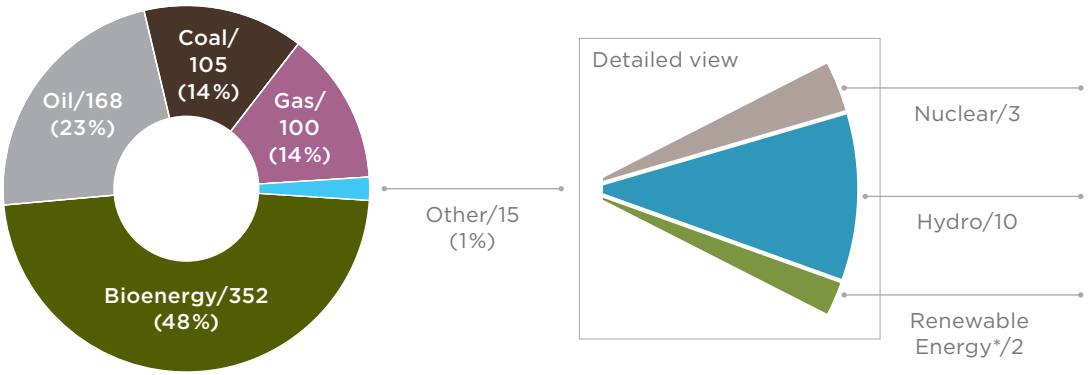
2.2.2 Electricity generation

African electricity generation is dominated by fossil energy. In 2012, gas and coal were the major electricity sources (see Figure 2). The high share of coal in African electricity generation is primarily due to its predominance in South Africa. Hydropower provides 15 per cent of electricity generation. The remaining renewable energy sources only account for 1 per cent.

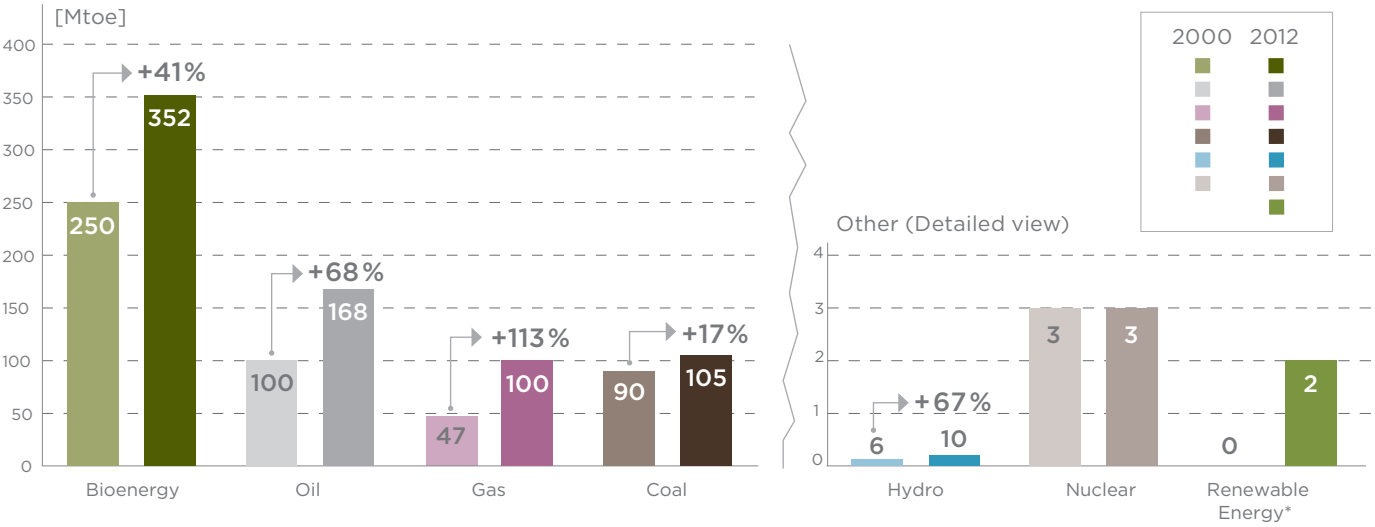
[2] If not stated otherwise, the data cited in this subsection are based on IEA (2014: 190).
[3] Data for North Africa are based on own calculations with data from the statistical annex of IEA 2014.

FIGURE 1: THE AFRICAN ENERGY MIX

a) Status in 2012 (Mtoe)



b) Growth in total primary energy demand (2000 – 2012)



*Renewables excl. bioenergy and hydro. No significant demand in the year 2000.

Source: a) Author's own graph based on on IEA (2014: 192), b) Own calculation based on IEA (2014: 190). Please note that there are some discrepancies in the data on the absolute increase, as the IEA only presents rounded figures.

The electricity mix differs significantly across African regions. Electricity generation in North Africa is dominated by gas and oil; in Southern Africa coal prevails. In Central and East Africa, most of the electricity is generated by hydropower. In West Africa, gas accounts for almost half of electricity generation, while oil and hydropower make up most of the remainder.

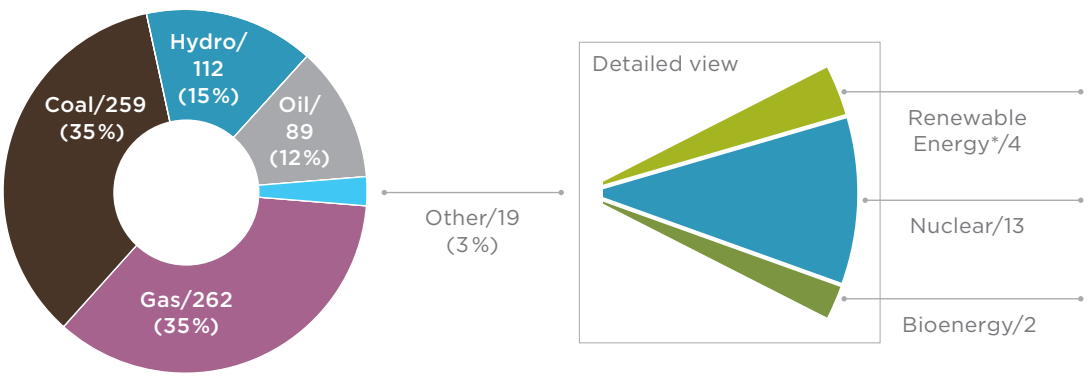
Electricity generation in Africa increased by 65 per cent between 2000 and 2012 (see Figure 2). Gas accounts for more than half of this increase, expanding primarily in North Africa. Coal- and oil-based power generation also grew significantly in absolute terms. Coal-based electricity generation expanded in South Africa, while North and West Africa accounted for the bulk of growth in oil-based electricity generation.

2.2.3 Residential and transport sectors

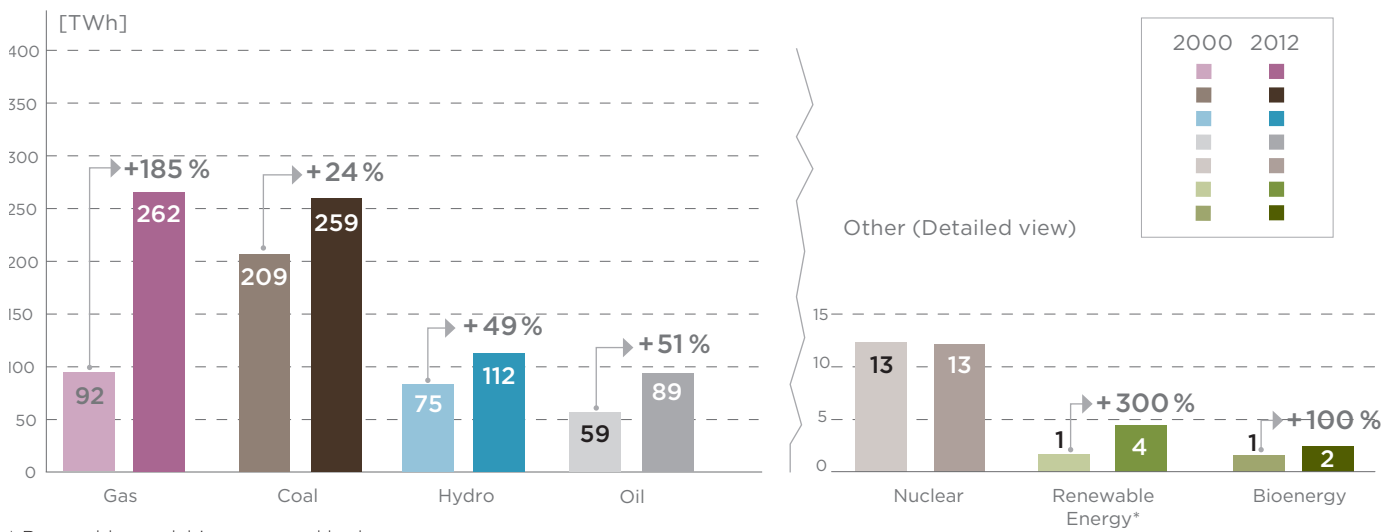
Energy use in the residential sector is dominated by traditional biomass (86%) (IEA 2014: 190). This picture differs significantly in North Africa, where bioenergy only plays a minor role. The African transport sector relies almost exclusively on oil, which accounts for 98 per cent (88 Mtoe) of energy demand. The dominance of oil applies to all sub-regions. Gas and electricity account for the remaining 2 per cent. Gas is primarily used in North Africa, while electricity makes up a share of 2 per cent in South Africa's transport sector. The contribution of renewable energy (other than traditional biomass) in the residential and transport sectors remains insignificant.

FIGURE 2: THE AFRICAN ELECTRICITY MIX

a) Status in 2012 (TWh)



b) Growth in electricity generation (2000 – 2012)



* Renewables excl. bioenergy and hydro

Source: a) Author's own graph based on on IEA (2014: 192), b) Own calculation based on IEA (2014: 192). Please note that there are some discrepancies in the data on the absolute increase, as the IEA only presents rounded figures.

2.3. Current status of renewables in African electricity sector

Major findings at a glance:

- Renewable energy policies exist in the majority of African countries, dominated by support instruments in the electricity sector.
- Renewable energy has expanded significantly in recent years, though – except for hydro – from a very low base.
- South Africa leads the continent in both installed capacity and investments.
- Off-grid applications have seen strong growth in recent years.

2.3.1 Renewable energy policies

The majority of African countries have introduced national support instruments for renewable energy – covering renewable energy targets, regulatory policies, fiscal incentives and public investment (for a comprehensive overview see table A-1 in the annex). Renewable energy targets exist in 40 countries. Most regulatory policies focus on electricity from renewable sources. Here, the prevailing instruments are tendering (in 12 countries), feed-in tariffs/ premium payments (in nine countries) and net metering (in seven countries). In addition, tax reductions are a common instrument, existing in almost 30 countries. Twenty countries support renewables via direct public investment, loans, or grants. Capital subsidies or rebates are employed in 13 countries (REN 21: 2015). In the transport and heat sectors, the promotion of renewable energy still remains the exception rather than the rule. Nine countries have adopted biofuels obligations or mandates, while three countries have renewable heat obligations and mandates.

2.3.2 Electricity generation from renewables

As illustrated in section 2.2, renewable energy sources, excluding traditional biomass, are primarily employed in the electricity sector. Here, the use of renewable energy has expanded significantly in recent years, though – except for hydro – from a very low base. In 2012, all renewable energy sources combined generated 118 TWh of electricity. This represents a share of 16 per cent. Hydropower alone accounts for 15 per cent. As shown in Figure 3, the shares of the remaining renewable energy sources vary significantly across the various sub-regions.

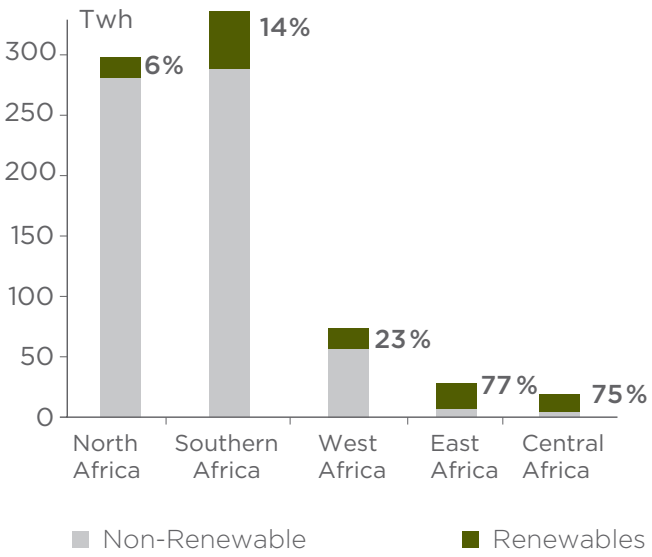
Small scale, stand-alone solar energy applications (e.g. solar lamps, solar home systems) are beginning to play an important role in bringing basic energy services, like lighting and cell phone charging, to rural populations lacking grid access. In 2014, more than two million small solar systems were distributed in ten Sub-Saharan countries (REN21 2015: 165).[4] This market has rapidly grown within the past years (A.T. Kearney and GOGLA 2014: 15f).

Hybrid mini-grids (diesel plus wind and/or PV) are also growing in importance, though from a low base. They are currently used as an approach to electrification in rural areas as well as for off-grid/captive industrial applications. Comprehensive data on existing mini-grids in Africa is not available. The data provided in the latest REN21 Status Report (2015: 165ff.) as well as a recent IRENA report suggest that the total capacity as well as the number of electrified households remains insignificant (see tables A-2 and A-3 in the annex). More comprehensive data exists for the sub-segment of mobile phone towers powered by renewable energy systems. To date almost four thousand mostly solar-based systems have been deployed, representing approximately three per cent of off-grid telecom towers (IFC et al. 2014).

[4] REN21 data on small solar systems do not cover all African countries.

FIGURE 3: RENEWABLES SHARES IN AFRICAN ELECTRICITY GENERATION BY SUB-REGION IN 2012 (%/TWH)

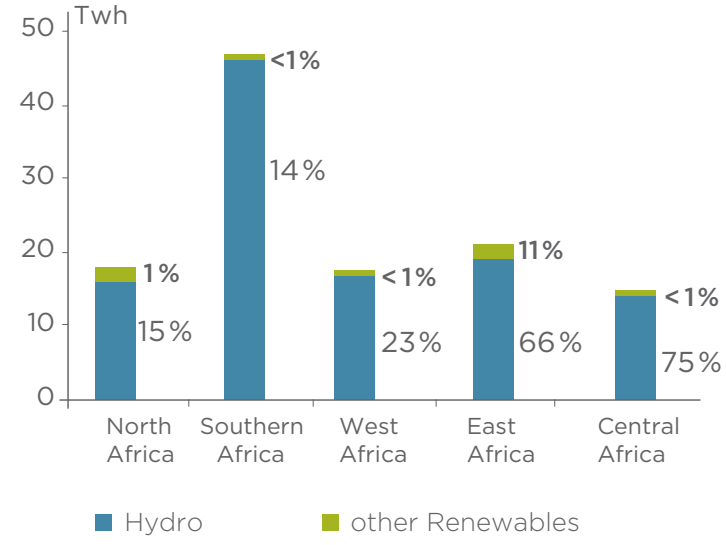
a) Renewables as share of total electricity generation



Renewables account for 16 percent of Africa's electricity generation.

Source: Based on IEA (2014)

b) Share of hydropower and other renewables in renewable electricity generation



Hydropower accounts for approximately 80 percent of Africa's electricity generation from renewable sources.

Source: Based on IEA (2014)

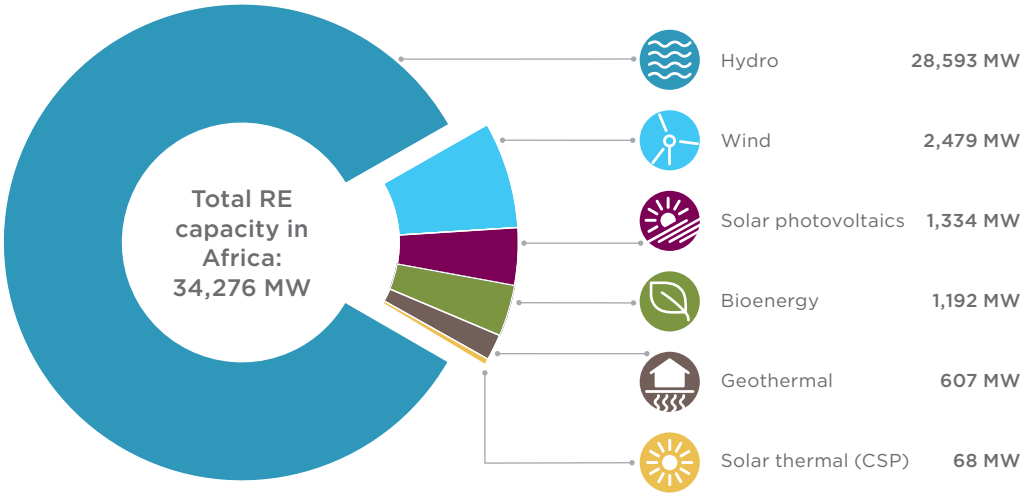
2.3.3 Trends in installed renewable energy capacity

According to IRENA (2015a)[5], there was over 34 GW of installed renewable energy capacity in Africa in 2014 – almost 50 per cent more than in 2000. Hydropower accounted for more than 80 per cent of this capacity in 2014, mainly in the form of large hydroelectric power plants (see Figure 4). This represents an increase of almost 30 per cent compared to 2000. There are only 44 MW of small hydro capacity (< 1 MW) and 437 MW of medium hydro capacity (1-10 MW). Among the non-hydro renewables, wind represents the largest share of installed capacity (7%), followed by PV (4%) and bioenergy (3.5%). In relative terms, the expansion of PV has been the most impressive with installed capacity growing by a factor of 50 between 2000 and 2014. South Africa leads the continent with over 4 GW of installed renewable energy capacity. It accounted for more than half of the African capacity additions in renewable energy in 2014 (REN21 2015: 30). Figure 5 provides an overview of the African countries with the largest installed capacity by renewable energy source and technology (for more detailed information, see figures A-4 to A-11 in the annex).

2.3.4 Trends in renewable energy investments[6]

South Africa also led the African continent in terms of renewable energy investments in 2014. It invested 5.5 billion US$ in renewable energy (Frankfurt School-UNEP Centre/BNEF 2015: 15), with more than 70 per cent going into PV and CSP (REN21 2015: 82). Kenya saw the second-largest investments in renewables (US$ 1.3 billion), followed by Algeria, Egypt, Nigeria, and Tanzania (REN21 2015: 82, Frankfurt School-UNEP Centre/BNEF 2015).

FIGURE 4: RENEWABLE ENERGY CAPACITY IN AFRICA (2014)



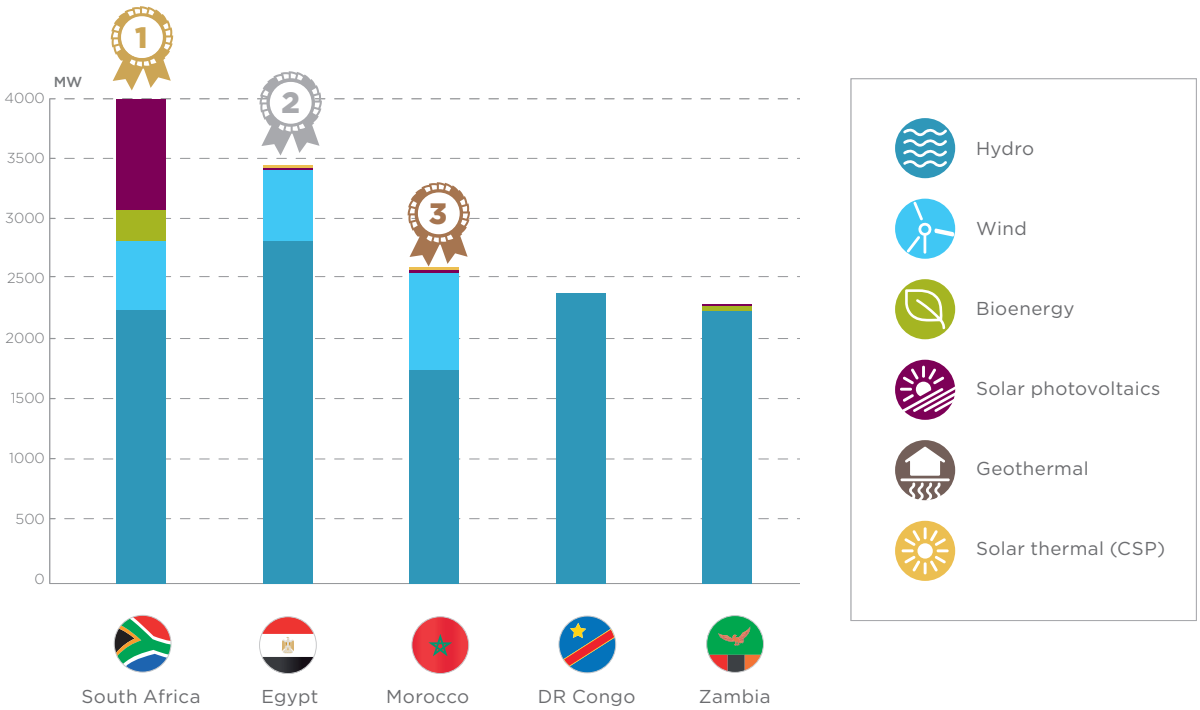
Source: Based on IRENA Renewable Energy Capacity Statistics 2015.

[5] IRENA Renewable Energy Capacity Statistics 2015 provides the most comprehensive and recent data on installed renewable energy capacity in Africa. IRENA does not provide data on non-renewables capacities. Here, the IEA Africa Outlook offers the most comprehensive data. IRENA and IEA data are not fully compatible.

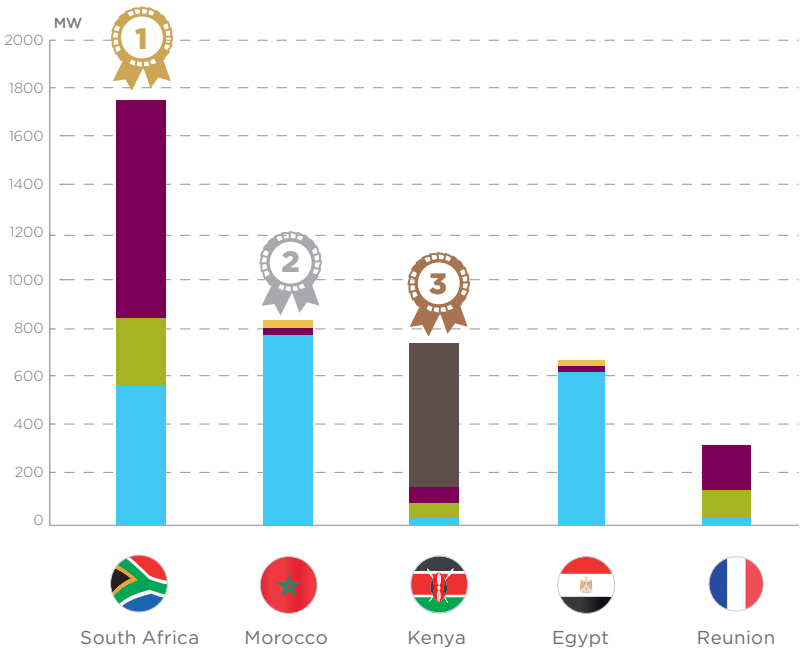
[6] If not stated otherwise, data in this sub-section are based on IRENA Renewable Energy Capacity Statistics 2015.

FIGURE 5: AFRICAN FRONTRUNNERS IN THE DEPLOYMENT OF RENEWABLE ENERGY (2014)

A) Top Five Countries – renewable energy capacity



B) Top Five Countries – renewable energy capacity, excluding hydropower



Detailed information on renewable energy capacities in African frontrunner countries can be found in the annex (see figures A-4 to A-11).

C) Top Three Countries - installed capacity for different renewable energy technologies

Source: IASS based on IRENA Renwable Energy Capacity Statistics (2015)

The total wind energy potential in Africa is estimated at 1300 GW.

3. Potentials for Growth and Development

3.1. Scenarios, potentials and targets

Major findings at a glance:

- The target of deploying 10 GW of additional renewable energy capacity in Africa by 2020 is in line with the objectives of other international initiatives and scenarios.
- In the coming years, the main capacity additions are expected in wind energy (up to 17 GW), hydropower (up to 15 GW) and solar PV (up to 12 GW). The exact numbers differ significantly across scenarios.

3.1.1 Scenarios for 2020

As mentioned above, the G7 Leaders' Declaration supports the goal of installing 10 GW of additional renewable capacity in Africa by 2020. The same goal was previously formulated by the Africa Renewable Energy Initiative, initiated by AMCEN. Neither, however, makes reference to an explicit baseline (G7 2015). The Africa-EU Energy Partnership (AEEP) and the US government's Power Africa Initiative set similar targets for renewables in Africa. In 2010, the AEEP set the goal of installing additional 18 GW[7] of renewable energy by 2020 compared to the existing capacity in 2010 (AEEP 2014: 2). As of 2015, an additional capacity of 12 GW is necessary to reach the AEEP 2020 goal. In 2013, the Power Africa Initiative set the goal of adding 10 GW of renewable energy and gas power plants, though without specification of a target year (USAID 2015: 2). In 2014, President Obama increased the goal to 30 GW.

The 2014 status report of the Africa-EU Energy Partnership (AEEP) evaluates the likelihood of the Partnership reaching its target of 18 GW based on the existing project pipeline (AEEP 2014: 44). The report concludes that if 50 per cent of the project pipeline is implemented, the AEEP target is within reach. If only 25 per cent of the project pipeline is implemented, Africa will fall short of meeting the AEEP target.

The International Energy Agency (IEA) describes a probable pathway for the African electricity sector in its "New Policies Scenario" which is based on the continuation of current policies and the implementation of political commitments announced by mid-2014 (IEA 2014: 70). According to this, the IEA assumes that the total installed capacity of renewable energy will amount to 50 GW by the end of 2020. In the more ambitious IEA scenario, termed the "African Century Case", the installed capacity will total 52 GW. These two scenarios comprise an additional capacity of 25 GW and 27 GW. Although capacities of conventional power plants are also expected to increase strongly till 2020, the share of renewable energy in electricity generation is expected to reach 23 per cent by 2020, up from 16 per cent in 2012. Table A-12 in the annex provides an overview of the scenarios discussed above.

[7] The goal is resource specific and includes 10 GW of hydropower, 5 GW of wind power, 500 MW of PV and CSP and 2.2 GW of other renewables such as biomass and geothermal power.

Other organisations like McKinsey, the World Energy Council and industry associations like the Global Wind Energy Council (GWEC) have also developed scenarios for Africa (McKinsey 2015, WEC 2013, GWEC 2014). The scenarios developed by McKinsey and the World Energy Council foresee a relatively modest increase of the installed renewable energy capacity in the coming years. However, the "medium scenario" developed by the GWEC, which is based on the current project pipeline and national targets, significantly exceeds the AEEP and IEA scenarios. It estimates a total capacity of 19 GW by the year 2020 (increase of 17 GW compared to 2014) (GWEC 2014: 24).

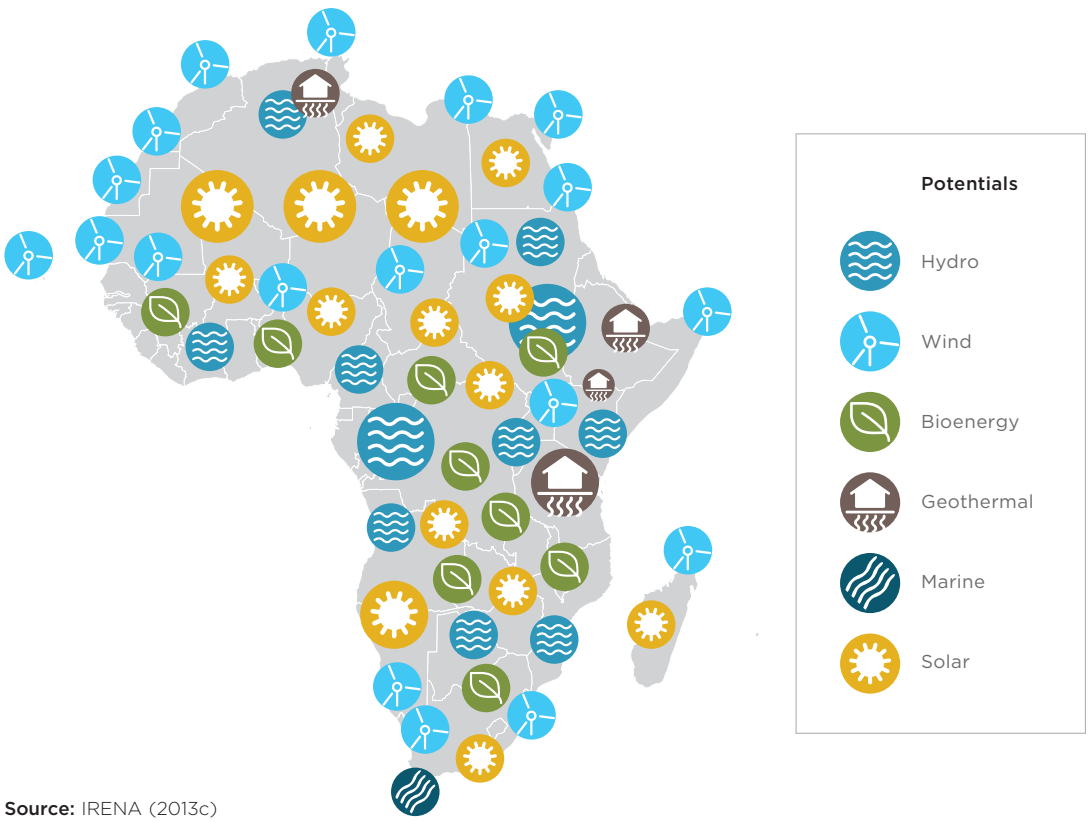
3.1.2 Key country-level targets and technical potential of renewable energy technologies

There is an abundant technical potential for renewable energy in Africa (see Figure 6 below) and most countries have adopted targets to promote renewables, primarily focusing on the electricity sector. Out of 54 African countries, 30 countries have set targets for renewable energy deployment in the electricity sector, some also including technology-specific targets (e.g. wind power) (see REN21 2015: 137–158 for country-specific targets).

The density of countries with renewable energy targets is especially high in the ECOWAS region. In addition to the regional target of reaching 48 per cent renewable energy penetration by 2030 (EREP 2012: 12), all member states are currently in the process of developing National Renewable Energy Action Plans (IRENA 2015d). Cape Verde's target is particularly ambitious, aiming to reach 50 per cent renewables penetration by 2020 (Fonseca 2014).

Table 1 shows a list of African countries that plan the highest capacity additions for specific renewable energy technologies in the next years. Hydropower is an attractive source for Africa with a total technical

FIGURE 6: DISTRIBUTION OF IDENTIFIED RENEWABLE ENERGY POTENTIAL IN AFRICA



Source: IRENA (2013c)

potential of 1 750 GW (UNIDO 2009). More than 90 per cent of this potential remains untapped, and levelised costs of electricity (LCOE) are low (IEA 2014: 56). The cumulative capacity target of the selected countries in Table 1 (14 GW) is relatively close to the expected capacity additions by the IEA (12-14 GW depending on the scenario). Ethiopia has the most ambitious hydropower target (22 GW by 2030), although environmental considerations and cross-border issues with Kenya are considerable (Vidal 2015).

According to the national targets, the largest capacity additions until 2020 may come from wind power. These targets surpass the expected capacity of several scenarios including those from AEEP and IEA. However they are in line with the "medium scenario" of the industry association GWEC. In Egypt, Morocco, Tunisia, and South Africa several projects are under construction or have reached financial close (GWEC 2014: 28). The total wind potential in Africa is estimated at 1 300 GW (IEA 2014, Mandelli et al. 2014).

Solar energy (PV and CSP) will also play an increasingly important role in the African power sector, with the highest targets for solar PV in Algeria, Morocco, and South Africa. South Africa and Morocco are also the most active markets for CSP construction and planning. Solar also has the highest technical potential of all technologies (11 000 GW) (McKinsey 2015). As in the case of wind power, the cumulative

Table 1: Technology specific targets for additional renewable energy capacity of selected African countries for the year 2020 (additional planned capacity compared to existing capacity in 2014, MW)

	Wind power	Hydropower	PV	CSP	Geothermal	Bioenergy
Algeria	1,881**		5,064**	766**	6**	375**
Egypt	7,200		220	1,100		
Äthiopien	770	9,481**			379**	
Kenia	635*		423*		2,250**	
Morocco	2,000	2,000	2,000			
Rwanda		382*			310*	300*
South Africa	2,700		2,700			
Tunisia	797**		566**	188**		113**
Uganda		1,285*			45*	
Libya	600		344**			
Nigeria	23**	1,114**	273**			
Sudan	240**		235**	18**		
Total	**16,846**	**14,262**	**11,825**	**2,071**	**2,990**	**788**

* The target must be fulfilled before the year 2020. There is no specific target for the year 2020 or beyond.
** The target refers to a year after 2020 (e.g. 2030). We assume a constant increase in renewable capacity till 2020.

Source: Based on REN 21 (2015), DoE, South Africa (2013)

capacity of the solar energy targets exceeds the scenarios of AEEP and IEA.

The technical potential for geothermal power along the Great Rift Valley is also considerable (10–15 GW) (IEA 2014). Kenya has established a target of 2.25 GW and is leading the development in this sector. In Kenya and Ethiopia, geothermal projects are at different stages of development including projects that are under construction. Additionally, Rwanda and Uganda have projects at early stages of development (IEA 2014).

Finally, biomass is widely used in Africa for cooking purposes, but only rarely for power generation. Power generation using bagasse residues and co-firing of biomass is the largest source of power from bioenergy, and is mostly used in Southern Africa (e.g. Mauritius currently produces almost 20 per cent of its electricity from bagasse). Countries like Rwanda, Algeria, and Tunisia plan to increase their bioelectricity capacities. Agricultural residues like rice husk also represent interesting opportunities (IRENA 2012, 2013a, 2014a). However, the technical potential of these fuels is significantly limited compared to other renewable energy technologies.

3.2. Drivers and opportunities for renewable energy deployment in Africa

Major findings at a glance:

- Renewables are cost-competitive with conventional power plants, in particular oil-based power plants and in some cases even new coal-fired power plants. Renewables can be deployed much faster than fossil-based power plants. The integration of renewables in mini-grids offers significant cost savings.
- Renewables are domestically available. Net energy importers can reduce import bills by deploying renewables, whereas energy exporting countries can increase revenues from fossil-fuel exports.
- Renewables can result in additional economic benefits, such as job creation and socio-economic development, in particular in rural areas.
- Renewables are core components for any low-carbon strategy.

3.2.1 Benefiting from declining renewable energy costs

In many part of the world, including Africa, renewable energy generation is still perceived to be expensive. However, thanks to technological advances and a massive global roll-out, renewable energy technologies have become cost-competitive with conventional alternatives. Cost reductions have been especially pronounced in the case of wind energy (50% in the past five years) and solar PV (70% between 2009 and 2014) (IRENA 2014a). Investment in renewable energy is now the rule, and no longer the exception (IRENA 2014a).

In South Africa, for instance, the purchase price for large-scale PV has dropped from 22.44 €cent/kWh in December 2011 to 7.17 €cent/kWh in October 2012 (UNEP Risø Centre 2014). This compares to a revised cost estimate for the new coal-fired Medupi Power Station in South Africa of 8.1 €cent/kWh (Carbon Tracker 2014). Wind is even less expensive – 30 per cent below the costs of new coal-fired power plants (The New Climate Economy Report 2014: 13f). In addition, renewable energy in the electricity sector is significantly cheaper than diesel-based electricity generation, where power generation costs are as high as 20 €cent/kWh. In Kenya, the Updated Least Cost Development Plan 2011-2031 shows that the levelised cost of electricity (LCOE) for imported resources (nuclear and coal) is higher than local resources (geothermal and wind) and is the basis for an expected decrease in electricity costs by 30 per cent by 2016 (Republic of Kenya 2011).

3.2.2 Benefiting from rapid deployment and stable costs

Renewable energy projects also have the major advantage of relatively short lead times in contrast to fossil-fuel based solutions. This is crucial in many African countries where utilities are not able to keep up with ever-rising electricity demand. Although a lack of experience in project development and realisation means that lead times for renewable energy projects in Africa are longer than in European contexts (under one year for large-scale PV; 2–3 years for wind, biomass, and CSP), they are still significantly shorter than those for coal and nuclear projects (10 years or more). Moreover, large-scale energy pro-

jects in Africa have a history of large cost and schedule overruns (33% on average) – except for solar PV, where final costs have actually been found to be below the initial price tags (McKinsey 2015: 27).

3.2.3 Renewable energy as a cost-effective option for rural electrification

Access to modern energy services is a prerequisite for human and economic development. There is a direct link between electricity consumption and economic development. Businesses in Sub-Saharan Africa state that lack of access to electricity and electricity outages are the primary hindrance to effective business operation (IEA 2014: 25). Small-scale and decentralised renewable energy solutions can have significant benefits for human development and represent an important instrument for reaching the Sustainable Development Goals (SDGs) on the continent.

There is a consensus that small off-grid solutions such as solar home systems on a pay-as-you-go (PAYG) basis are a cost-effective and quick way to provide a basic level of electricity access to the rural poor, enabling them to light their houses and use small electronic devices. This explains the rapid market developments that this market segment has experienced in recent years (Alstone et al. 2015).

To enable a higher level of service (e.g. for productive purposes), hybrid mini-grid systems based on diesel generation in combination with renewables are emerging as a cost-effective alternative to rural electrification by means of traditional grid expansion programmes. Depending on the distance from the existing grid and the targeted level of service, mini-grid systems are frequently the least costly option for rural electrification. Moreover, hybrid mini-grid systems that incorporate renewable energy-based generation offer significant cost savings compared to traditional diesel-based systems. Since 97 to 98 per cent of existing mini-grids are diesel-based, there is an important potential for incorporating renewables in existing mini-grids, including captive systems employed by industrial customers as well as off-grid telecom towers (IFC 2014, IRENA 2015, Gallego 2013).

3.2.4 Benefiting from increased energy security

As of 2009, 38 African countries were net energy importers of fuel and therefore vulnerable to fluctuating global fossil price and supply volatility (AfDB 2009: 124). For these countries, renewable energy deployment can substitute imports and reduce import bills to ease pressure on government budgets and currency reserves that can be used for other productive activities – an especially beneficial outcome for countries with large trade balance deficits.

The cost of Ethiopia's fuel imports, for example, grew by a factor of eight between 2000 and 2012 to reach about US$2.2 billion annually (UNECA 2014: 66). To confront this trend, the country's Climate Resilient Green Growth Strategy aims to reduce current dependency on fossil fuel imports by about one-third, and improve the balance of payments by a total fuel cost savings of US$ 1 billion per annum by 2030 (Ethiopia 2011). In Tunisia, the roll-out of the planned renewable energy programme could lead to net savings of about €4.6 billion between 2015 and 2030 (Meister Consultants Group 2013).

3.2.5 Benefiting from innovations and local value creation

Deployment of renewable energy in many regions around the world has led to additional economic benefits. IRENA has estimated that the renewable energy sector employed 7.7 million people worldwide (IRENA 2015c). Most renewable energy technologies provide more employment opportunities than fossil-based energy, due to a higher labour intensity (Jacob et al. 2015). As technology costs continue to decline, the share of local value creation relative to the total project cost will continue to increase. Countries also seek to attract investment in the manufacturing of components. To achieve this, several African countries have introduced local content requirements in their support policies. The procurement mechanism implemented in South Africa is just one example of this development.

Finally, emerging innovation in off-grid solutions promises the creation of important economic and entrepreneurship opportunities for African firms. New financing business models have shown notable levels of success in several African Countries. PAYG

schemes have the potential to drive the scaling-up of off-grid renewable energy services for customers with low and irregular incomes along with the expansion of a local off-grid industry (Alstone et al. 2015).

3.2.6 Benefiting from low-carbon, climate-resilient development

As of 2014, Africa accounts for only 2.3 per cent of global CO_2 emissions. Although the contribution of African countries to global greenhouse emissions is – in total and on a per capita basis – much smaller than that of industrialised countries, increasing the share of renewables presents an economically viable option today. In the long-term, a full decarbonisation of the African power sector will also be needed in order to combat climate change effectively (World Bank 2015).

At the same time, Africa will be one of the continents most affected by climate change. Many African countries will experience increased water scarcity as well as health and food security risks. In this context, the expansion of renewable energy offers not only an economically viable mitigation strategy, but can also create additional environmental co-benefits, such as improved air quality and reduced water use (IPCC 2014: 1152). In particular, wind and solar PV are less reliant on water resources and can thus mitigate water-related risks (IRENA 2015b).

3.2.7 Resource endowments and country-specific opportunity structures for renewable energy expansion

Finally, Africa as a whole possesses abundant renewable energy and fossil resources. However, these resources are not evenly distributed among the 54 African states. Depending on the availability of fossil fuels and the resource potential for renewable energy sources, countries will follow different trajectories and set different priorities when deploying renewables. Box 1 discusses different opportunities for three major country groupings: countries rich in fossil energy resources, countries with abundant hydropower resources, and countries with an abundant supply of other renewable energy sources (excl. hydropower).

3.3. Challenges for renewable energy deployment in Africa

Major findings at a glance:

- The poor financial condition of utilities, due to low levels of cost recovery, is a major challenge for investment in Africa's energy sector as a whole.
- This is further compounded by high upfront investment costs in the renewable energy sector.
- Even though most African countries have established policies for the promotion of renewable energy sources over the past decade, legal and regulatory frameworks often remain patchy and inconsistent.
- Technical challenges include resource data availability, O&M skills at the local level, and system integration of fluctuating power from renewable energy sources.

Despite the abundant technical and economic potential for renewable energy sources in Africa, a number of challenges need to be overcome. These include technical issues, market (including financing) and policy-related challenges, and the local political economy.

3.3.1 Technical challenges

As an emerging sector in Africa, renewable energy deployment faces a number of technical barriers. Often, there are limited and scant data on renewable energy resource availability, e.g. solar radiation levels and wind speeds. To confront this challenge, IRENA's Global Atlas initiative[8] has improved data convergence and availability in many regions, though deficits remain. Also, inadequate local technical skills often cause after-sales service, operations and maintenance contracts to be placed with foreign technology providers. Another key technical challenge relates to the integration of increasing shares of fluctuating renewable energy into the generally weak power systems in many African countries. Stringent grid codes imposed by grid operators necessitate highly sophisticated and flexible technology (see for example NERSA 2014). In the medium-term, as increased

[8] See http://globalatlas.irena.org/

Box 1: Country-specific opportunity structures for renewable energy expansion

COUNTRIES WITH ABUNDANT FOSSIL ENERGY RESOURCES

Many African countries are rich in fossil fuel resources. There is the potential of 400 GW of gas-fired power plants (primarily in Mozambique, Nigeria, and Tanzania) and 300 GW of coal-fired power plants (primarily in Botswana, Mozambique, and South Africa) (McKinsey 2015). Nevertheless, a number of these fossil-fuel rich countries are beginning to pursue renewable energy strategies. The motivation of these countries is to reduce the domestic use of fossil fuels in order to capture increased export revenues. This is especially interesting for countries that produce part of their electricity with oil-based power plants, such as South Sudan (UNECA 2014: 179). Nigeria uses inter-generational funds from fossil fuels for infrastructure investment that might be channelled towards renewable energy projects.

COUNTRIES WITH ABUNDANT HYDROPOWER RESOURCES

Many African countries have a very low-carbon power mix due to the high share of hydropower. In several African countries hydropower accounts for more than half of electricity generation, including Angola, Cameroon, Congo (Dem. Rep.), Congo (Rep.), Ethiopia, Ghana, Kenya, Mozambique, Namibia, Sudan, Togo, Zambia, and Zimbabwe. The question is therefore not how to end the predominance of fossil fuels but rather how to expand the power generation portfolio without investing heavily in new fossil-based power plants. Ethiopia, for instance, already produces more than 95 per cent of its electricity from hydro.[9] More hydropower projects are currently being planned, partly to increase electricity exports to neighbouring countries. Moreover, hydropower presents an ideal complement to other fluctuating renewables, offering additional scope for their combined expansion.

COUNTRIES WITH AN ABUNDANCE OF OTHER RENEWABLE ENERGY SOURCES (WIND, SOLAR, GEOTHERMAL)

Other countries are trying to diversify their electricity mix and strengthen energy security by investing in locally available new renewable energy technologies, namely solar PV, wind energy, and geothermal. The island state Cape Verde already has a share of wind energy of about 20 per cent – up from 2 per cent in 2009 (IRENA 2015d). Cape Verde is likely to become an African example for the integration of high shares of fluctuating renewables (wind and PV) in the electricity system. A key success factor of Cape Verde's wind energy deployment was a PPP, involving the government, the local utility, and a privately-managed, donor-supported infrastructure development company. Kenya, traditionally reliant on hydropower, is diversifying its energy mix by investing in various locally available renewable energy sources, including geothermal, wind, and PV.

[9] See http://data.worldbank.org/indicator/EG.ELC.HYRO.ZS

amounts of renewable energy become available, weak levels of integration across Africa's electricity markets will become an increasing challenge.

3.3.2 Market and policy-related challenges

Even though most African countries have established policies for the promotion of renewable energy sources over the past decade (see section 2.3.1), the legal and regulatory frameworks often remain patchy and inconsistent. For example, tax exemptions for renewable energy technologies may exclude accompanying accessories or may be limited to import duties. The full implementation of secondary legislation can be a lengthy process. In Ghana, for example, the Renewable Energy Law was passed in 2011 (Republic of Ghana 2011), but it was not until 2013 that the feed-in tariff payment levels were finally published. There is also often a lack of clear separation of responsibilities between different government agencies and institutional capacity deficits.

In addition, broader challenges of the electricity sector often hamper renewable energy expansion. In many countries, only a few steps have been taken towards market liberalisation. Vertically integrated, state-owned utilities frequently lack the capacity to manage large-scale investments in new power generation capacity. End-user electricity tariffs in many parts of Sub-Saharan Africa do not fully reflect the cost of electricity supply, so that national utilities are frequently underfinanced and have poor credit ratings. Poor quality of supply and high transmission and distribution losses represent further obstacles to full cost recovery (IEA 2014). This raises capital costs for the utility and creates important off-taker risks for independent power producers (IPPs). This challenge relates to the energy sector as a whole. However, due to a higher share of upfront capital costs, renewable energy projects are even more reliant on long-term financing and secured payment mechanisms. This is further compounded by the lack of an IPP track record in the sector.

Cost recovery represents a particular challenge for rural electrification schemes, including those based on hybrid mini-grids, as the costs for supplying electricity in rural areas are higher than national averages. As a result of this, electricity prices for rural consumers either need to be higher, raising equity issues, or require some form of (cross-)subsidisation. Lack of flexibility among electricity regulators in allowing cost-covering tariffs as well as uncertainty about the actual demand for electricity can be a major obstacle for investment. This can be partially mitigated by introducing PAYG systems similar to those pioneered for solar home systems. In addition, challenges in obtaining licences and permits can represent additional barriers. Finally, uncertainty regarding grid expansion and the process for integration of existing mini-grids when local grid expansion occurs can deter investors in mini-grid systems (EUEI PDF 2014).

While important challenges remain in the overall enabling environment for renewable energy in Africa, it should also be noted that a number of countries have taken significant steps towards improving the investment climate in the energy sector, albeit with mixed success (see Box 3 below).

Box 2: South Africa's Renewable Energy Independent Power Producer Procurement Programme

South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) represents an important success story in Africa's renewable energy sector, leading to the installation of 1.4 GW of wind energy and photovoltaics since 2013. Key to the scheme was a competitive tender mechanism for independent power producers. Since the scheme's first round in 2013, three tender processes have been held and a total of 3.9 GW has been contracted.

The scheme's success is linked to a variety of factors, including its effective design and management as well as factors related to the enabling market environment. Although these success factors cannot simply be transferred to other countries, the REIPPPP offers valuable lessons on how renewable energy could be boosted across Africa. For an in depth analysis of REIPPPP, see Eberhard et al. (2014).

3.3.3 Political economy challenges

Finally, necessary policy and market reforms are often hampered by important political economy challenges. Vested interests in the existing fossil-based energy sector and a reluctance to change existing business models and practices mean that many decision makers in governments and national utilities may be resistant to change. This makes levelling the playing field between renewable and fossil energy by phasing out subsidies particularly difficult. Similarly, the introduction of cost-reflective tariffs is politically challenging, as it typically meets strong resistance from politically influential groups as well as the broader public. A common argument against energy price increases is the affordability of energy services for the poor people – even if poor consumers are typically not the ones that benefit most from the subsidies (Clements et al. 2013, IEA 2014: 313ff.).

3.4. Strategies and policies for renewable energy deployment in Africa

Major findings at a glance:

- Many African countries already support grid-connected renewables via feed-in tariffs, auctions, net metering, and investment incentives. The South African auction programme has been especially successful in deploying renewables.
- The establishment of regional power pools and renewable energy transmission corridors is an important building block for the future expansion of renewable energy.
- While most renewable energy deployment was grid-connected in the past two decades, a number of countries have adopted policies for decentralised approaches for rural electrification by using renewable energy.

3.4.1 Feed-in tariffs, auctions, net metering and fiscal incentives

Most countries around the world use feed-in tariffs, auctions, and other support mechanisms for re-financing grid-connected renewable energy projects. Feed-in tariffs are currently implemented in nine African countries (Algeria, Egypt, Ghana, Kenya, Nigeria, Rwanda, Senegal, Tanzania, and Uganda) (REN21 2015). For instance, Ghana's Renewable Energy Act of 2011 establishes a Renewable Energy Fund for the promotion of grid interactive renewable electricity by means of feed-in-tariffs and capital subsidies. Egypt launched a feed-in tariff for solar PV and wind projects of capacities below 50 MW in 2014. Uganda's feed-in tariff has received important donor support through the innovative GET FiT scheme (see section 4.3.2).

Auctions are conducted in 13 African countries, including Algeria, Burkina Faso, Cape Verde, Egypt, Ivory Coast, Kenya, Lesotho, Mauritius, Rwanda, Senegal, and Uganda. South Africa's auction system has led to major expansions of installed renewable energy capacities with five rounds of reverse auctions for the construction and supply of 3 625 MW of large-scale (>5MW) renewable energy capacity (see Box 2 for more details). Since 2011, Morocco's Office National de l'Electricité et de l'Eau Potable (ONE), a state-owned company, has been responsible for managing auctions for wind and hydro projects, while solar auctions are undertaken by the Moroccan Agency for Solar Energy (MASEN). MASEN's solar auction scheme aims to install 2 000 MW across five sites in Morocco by 2020, and the first solar auction was announced in 2012 for 500 MW at Ouarzazate, which will be the largest CSP project in the world (combined with some PV) (IRENA 2013b).

In the case of small-scale solar PV systems, self-consumption can be incentivised through net metering programmes. Net metering allows prosumers using solar or other forms of renewable energy to bank excess electricity on the grid (i.e. to use the electricity grid as a temporary storage unit), usually in the form of kilowatt-hour (kWh) credits. Net metering is currently used in Cape Verde, Egypt, Lesotho, Morocco, Senegal, Seychelles, and Tunisia (REN21 2015). In addition to this, a Small Scale Distributed Generation (SSDG) feed-in tariff scheme was launched in Mauritius in 2010 for existing grid-connected utility customers and is geared towards household level production up to a maximum of 50 kW.

Other countries employ fiscal measures. Cameroon, for example, has removed the value-added tax on all renewable energy products, and Madagascar has reduced import taxes for renewable energy equip-

ment. In Burkina Faso, the Law of Finance 2013 provides an exemption for solar technology equipment from customs charges and value-added tax until 2018. Several countries offer rebates for renewable energy technologies such as Botswana, South Africa, Egypt, Mauritius, Zambia, Tanzania, and Uganda.

3.4.2 Institution building

In a number of countries important progress has been made in developing dedicated institutions to support renewable energy development. Examples include public authorities, like Egypt's New & Renewable Energy Authority and the Renewable Energy Authority of Libya, as well state-owned, technology-specific development companies such as MASEN in Morocco or Kenya's Geothermal Development Company. In addition, two sub-regional institutions explicitly target the promotion of renewables: the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE), set up by the ECOWAS Commission and based in Cape Verde, and the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE) based in Cairo. The latter is an independent, not-for-profit regional organisation aiming to enable and increase the adoption of renewable energy and energy efficiency practices in the Arab region, including the North African countries.

3.4.3 Regional power system integration and planning

Advances have also been made in the promotion of regional power system integration, an important aspect for supporting the increased integration of large shares of renewable energy. McKinsey estimates that regional integration could save more than US$40 billion in capital spending (McKinsey 2015). A number of regional power pools have been established, including the Maghreb Electricity Committee (Comelec), the West African Power Pool (WAPP), the Central African Power Pool (CAPP), the Eastern African Power Pool (EAPP) and the Southern African Power Pool (SAPP) (AEEP 2014, IRENA 2014a). Several corridors are foreseen under the Programme for Infrastructure Development in Africa (PIDA) and its Priority Action Plan to be completed by 2020. A strategic goal is to create an Africa Clean Energy Corridor reaching from Egypt to South Africa. Despite these advances, electricity trade in Sub-Saharan Africa remains limited and is mainly concentrated in the Southern Africa Power Pool, where over 5.3 TWh of electricity was traded in 2012-13 (SAPP 2013).

3.4.4 Renewable energy in rural electrification strategies

In the past, countries in Sub-Saharan Africa have prioritised grid expansion for rural electrification. More recently, a number of countries have adopted policies for decentralised approaches for rural electrification based on renewable energy sources. Uganda's Rural Electrification Strategy and Plan of 2013–2022, for instance, includes support for community-based mini-grids and solar PV systems (MEMDU 2012). The Kenya Feed-in-Tariff of 2012 provides for a solar off-grid (mini-grids) systems tariff to partly displace oil-based thermal generation in off-grid areas (MOEK 2012). Tanzania's Small Power Producer (SPP) REFiT also offers an off-grid tariff for all renewable technologies to feed into existing mini-grids run by state utility TANESCO or to create new mini-grids (EWURA 2015).

3.4.5 Policies and strategies for cleaner cooking

More than 80 per cent of the population (around 700 million Africans) still rely on traditional biomass in the form of charcoal, dung, or fuelwood for cooking purposes. Several African countries are supporting the diffusion of cleaner cookstoves, including Ghana, Rwanda, Uganda, Ethiopia and Nigeria (ESMAP 2015). These national initiatives are backed by various multi-national strategies and programmes, such as the UN's Sustainable Energy for All initiative and the Global Alliance for Clean Cookstoves. Support focuses mainly on more efficient options for burning biomass, while solar or biogas-based solutions are less prevalent.

3.4.6 Policies and strategies for renewables in the transport sector

Strategies for decarbonising the transport sector are still at an early stage in Africa – similar to the only nascent policy frameworks in Europe and other developed countries. Dependence on imports of petroleum products account for significant proportions of export earnings and exposes Sub-Saharan

Africa's energy sector to an external energy price risk. Fuels from renewable sources, such as ethanol, would assist in mitigating the negative impact of high fossil fuel imports for transportation. Some countries have adopted biofuels blending mandates, including Angola, Ethiopia, Ghana, Nigeria, and South Africa.

3.5. Private sector engagement in Africa's (renewable) energy sector

Major findings at a glance:

- Private sector engagement is crucial for meeting Africa's investment needs in the energy sector. However, the role of IPPs remains limited.
- Important efforts have been made to improve the investment climate for IPPs in recent years.
- The market for solar home systems and other off-grid renewable energy services is currently experiencing a rapid, private sector-led expansion.
- Positive trends in international private equity targeting renewable energy projects in Africa are emerging.

It is clear that reaching Africa's investment needs in the energy sector will not be feasible without substantial private sector engagement. To date, however, independent power producers (IPPs) still play a limited role in the African energy sector. A total of 130 IPPs are currently operating across Sub-Saharan Africa (APP 2015). Important efforts have been made in a number of countries to increase their role (see Box 3). In a number of countries public-private partnership arrangements have proven to be useful vehicles for enabling investment in renewable energy projects, as seen in the case of the Ouarzazate CSP project in Morocco and the Cabeólica wind energy project in Cape Verde (Monteiro 2012, Climate Policy Initiative 2012).

In addition, promising developments are taking place in the field of off-grid renewable energy services. The market for stand-alone systems is currently experiencing a rapid, private sector-led expansion, combining small-scale solar technology (solar home systems and solar lanterns) with mobile banking and PAYG business models. Nearly 30 companies operating in over 30 countries provide access to consumer capital for off-grid solar using digital finance (Alstone et al. 2015). Important players include German-based Mobisol and Kenya's M-KPOPA. Another promising trend is the increasing role of international private equity targeting the renewable energy sector in Africa, particularly in wind and solar (Ernst & Young 2014).

Box 3: Electricity market reforms and the increasing role of IPPs in selected countries

Morocco exhibits the largest role of IPPs, which now generate more than 50 per cent of the country's power. The climate for private sector investment is to be further enhanced by the creation of an independent power and gas regulator. Similarly, in Kenya reforms of the institutional landscape and regulatory framework have enabled the first private investments. Six IPPs now account for 25 per cent of installed capacity, including a number of large-scale wind projects. Moreover, 30 per cent of the national generator, KenGen, is held in private ownership, while KPLC, the transmission and distribution company, is 51 per cent privately owned (World Bank 2009). In Tanzania, six IPPs contribute 40 per cent of the generated power in the country and a number of private firms are currently developing large-scale renewable energy projects. In 2010, the government adopted the PPPs Act of 2010 to boost private public partnerships in energy projects (AfDB 2015). South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) has successfully channelled substantial private sector expertise and investment into renewable energy (see Box 2 above).

Nigeria has pursued an ambitious privatisation process since 2010, albeit with a mixed record (KPMG 2013, WEF 2015). Though stakeholders are hopeful that the reforms will help remove structural bottlenecks in the system (Amadi 2014), it is yet to generate the intended results in terms of boosting power production (McKinsey 2015). In Senegal, a rural electrification programme was initiated in 2003 with the assistance of the World Bank as a priority programme for the efficient scale-up of rural electrification, using PPPs structured as privately operated concessions. Heralded as an innovative approach to leverage private sector investment, progress has been slower than expected (Mawhood 2012).

Along the Great Rift Valley in East Africa the geothermal potential is estimated at 10 to 15 GW.

4. Ongoing Donor Initiatives in Africa's Renewable Energy Sector

4.1. Key donors and their approaches to renewable energy promotion in Africa

Major findings at a glance:

- All major donor agencies actively support renewable energy projects in Africa.
- Germany is a leading donor in Africa's energy sector with a major focus on renewable energy.

4.1.1 The role of renewable energy in international development cooperation

SE4ALL

All major bilateral and multilateral donors are committed to the promotion of renewable energy and support the UN's Sustainable Energy for All (SE4ALL) initiative and its three central objectives of ensuring universal access to modern energy services; doubling the global rate of improvement in energy efficiency; and doubling the share of renewable energy in the global energy mix. Key to the SE4ALL initiative is the development of Country Action Agendas, based on a Rapid Assessment/Gap Analysis, followed by the development of a country-level Investment Prospectus, which outlines short- to medium-term projects and programmes (SE4ALL Country Action Reference Document).

Renewable energy in bilateral development cooperation (including the European Commission)

Most major bilateral donors address the promotion of renewable energy as an important element of their international climate and development policies. All are actively supporting renewable energy programmes and projects in Africa. The Global Climate Change Initiative (GCCI), launched by the US government in 2010, represents the overarching framework for addressing climate change in US development cooperation.[9] A major programme launched in this context is the Power Africa initiative to promote "cleaner, healthier energy" in Africa (see also section 4.2). Support to renewable energy by Agence Française de Développement (AFD) represents its number one priority for climate change mitigation in its Climate Action Plan (AFD 2012) as well as a strategic priority in its Sector Intervention Framework for the energy sector. [10] Similarly, all major Nordic donor agencies explicitly address sustainable energy within their approaches to climate change mitigation. In Germany, the promotion of renewable energy is a major priority of its climate- and energy-related development cooperation (see Box 4 for a detailed

[10] See https://www.usaid.gov/climate/us-global-climate-change-initiative/program-profiles
[11] See http://www.afd.fr/lang/en/home/projets_afd/infrastructures_energie/Energie/strategie-energie

overview of Germany's engagement in Africa's renewable energy sector). The UK does not explicitly mention renewable energy in its external climate change policy (GoUK 2012). However, it does provide support to a number of programmes and funding facilities in the sector, including the Energising Development (EnDev) energy access partnership (see section 4.2 for more details).

In the European Commission's Development Policy, approved in 2011, the goal of promoting low-carbon development is formulated as a key priority of its cooperation in the energy sector. In Africa, the Africa-EU Energy Partnership (AEEP) represents its key framework for dialogue and cooperation in the energy sector. It has formulated a set of political targets for 2020 on energy access, energy security, renewable energy, and energy efficiency (AEEP 2014).

■ Renewable energy in the multilateral development banks

While the World Bank continues to support large-scale fossil-based energy projects, including coal-based power plants, it has significantly increased its support to renewable energy in recent years. It is a major stakeholder of the SE4ALL initiative, hosting the SE4ALL Knowledge Hub and its energy sector strategy places an important emphasis on renewable energy deployment; similarly, the African Development Bank (AfDB) co-hosts the SE4ALL Africa Hub (SE4All 2014). Moreover, AfDB's Climate Action Plan 2011–2015 includes the target to increase the share of renewable energy in Africa's energy mix to 10 to 20 per cent and to increase AfDB's clean energy lending by 10 per cent annually. In 2014, renewable energy investments totalling €231.9 million (i.e. support to Morocco's Ouarzazate solar project and South Africa's Xina Solar One project) accounted for approximately 30 per cent of newly approved projects in the energy sector (AfDB Annual Report 2014).

■ Renewable energy at UNDP and UNEP

The United Nations Development Programme (UNDP) cites the field of sustainable energy as a key priority of its climate change-related development cooperation. It co-hosts SE4ALL's Africa Hub and supports the development of the Country Action Agenda process in a number of African countries (SE4All 2014). In recent years, UNDP has taken forward important conceptual work on the issue of "derisking" of renewable energy projects (UNDP 2013), which underpins the ongoing GET FiT Uganda programme (see section 4.3.2 for more details).

The United Nations Environment Programme (UNEP) is a key proponent within the UN system of renewable energy deployment. It has been supporting the UN SE4All initiative since its inception on both the political and technical levels and is intervening in building capacities and knowledge transfer to Africa within the framework of SE4All. Moreover, UNEP facilitates AMCEN, from which the Africa Renewable Energy Initiative has emerged.

4.2. Key ongoing initiatives for supporting renewable energy in Africa

Major findings at a glance:

- Major donor initiatives have been launched over the past years to support Africa's renewable energy sector.
- Important funding sources are the Climate Investment Funds and the EU Infrastructure Trust Fund.
- Energising Development (EnDev) and Lighting Africa represent the central donor initiatives targeting the expansion of off-grid renewable energy services.

Both bilateral and multilateral donor agencies have launched a significant number of new initiatives to support the energy sector and renewable energy in Africa over the past years (see Table A-13 in the annex for a summary of key initiatives). In addition to the SE4All initiative, major political initiatives exist at the regional and sub-regional level, supporting political dialogue between African countries and major donor agencies. An overarching initiative in this regard is the **Programme for Infrastructure Development in Africa** (**PIDA**) led by the African Union Commission, the NEPAD Secretariat, and AfDB. PIDA is a continent-wide programme to develop a vision, policies, strategies, and a programme for the development of priority regional

Box 4: German engagement in Africa's renewable energy sector[12]

Germany is a leading donor in Africa's energy sector. Mirroring the SE4ALL goals, Germany's development priorities in the sector are energy access, promotion of renewable energy and energy efficiency (BMZ 2014). In addition to this, Germany supports the development of grid infrastructure and regional power markets and emphasises the importance of a "nexus perspective" that takes into consideration the interactions of the energy sector with other important resources such as water and land (BMZ 2014). German bilateral development cooperation in Africa's energy sector focuses on seven priority countries (Egypt, Morocco, Nigeria, Senegal, South Africa, Tunisia, and Uganda). Additional projects are underway in Ghana, Kenya, D.R. Congo, Namibia, and Togo. Commitments for 2012 to 2014 totalled €1.4 billion, mainly in the field of renewable energy. In its partner countries, BMZ engages in an ongoing sector policy dialogue, which is led by a local BMZ representative and supported by focal area coordinators from GIZ and KfW.

German technical assistance in Africa's energy sector represents a funding volume of approximately €250 million. A key focus is the multi-donor initiative "Energising Development" (EnDev), an outcome- and performance-based programme to support access to energy. GIZ is the lead implementing agency of this initiative, which is active in more than ten African countries.[13] In North Africa, German technical assistance focuses on supporting an enabling policy environment for renewable energy as well as scenario and strategy development for renewable energy deployment and local value and employment creation. This includes several regional programmes as well as support for the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE).

KfW Development Bank has current commitments of €3.36 billion in Africa's energy sector (initiated between 2000 and 2015), of which more than 80 per cent are invested in renewable energy projects. Two-thirds of this funding is committed to projects in Morocco (in particular the Ouarzazate solar project), South Africa (a mixed portfolio with focus on solar and energy efficiency) and Egypt (centred on wind energy and the rehabilitation of the Aswan hydroelectric dam). In addition to this, the promotion of geothermal power plants in East

[12] If not otherwise stated, information in this box is based on data provided by BMZ, GIZ and KfW.
[13] See endev.info

Africa/Kenya and activities in support of the GET FiT programme in Uganda have received substantial commitments. A number of smaller investments are being made in support of rehabilitating hydropower plants and building transmission lines. Solar and wind energy receive relatively little support outside the focus countries mentioned above. Additional finance is provided by the Deutsche Investitions- und Entwicklungsgesellschaft (DEG), KfW's overseas private sector lending arm. It currently holds investments in approximately 20 energy generation projects, including hydro, wind and recently also solar PV projects (in addition to diesel and gas combined-cycle power plants). Finally, the German government has recently decided to increase the number of African governments that can benefit from German export guarantees, thus increasing the scope of funding in Africa's renewables sector.

German development cooperation is complemented by activities led by the Federal Ministry for Economic Affairs and Energy (BMWi) and the Federal Foreign Office (AA). The so-called Energy Partnerships represent a key policy instrument for promoting cooperation between Germany and a number of strategic partners. Led by BMWi in Algeria, Morocco, Tunisia and South Africa, and the AA in Nigeria, the Energy Partnerships offer not only a framework for political dialogue but also provide a networking platform for private sector actors.[14] German private sector engagement is further enhanced by the export promotion initiative "Renewables Made In Germany" (also BMWi). In this context, the "Project Development Programmes" in Africa provide targeted assistance for German businesses to enter African markets and supports lighthouse projects involving German partners (GIZ 2013).

Finally, the Federal Ministry for the Environment (BMUB) finances projects in support of renewable energy under its International Climate Initiative.[15] Key projects in the region include "Political dialogue and knowledge management on low-emission strategies in the MENA region, particularly involving renewable energies" (up to €3.9 million), "Credit line for the promotion of renewable energies and energy efficiency in Southern and Eastern Africa" (€9.3 million) and "Ouarzazate I Solar Power Plant" (€15 million).

[14] See http://www.bmwi.de/DE/Themen/Energie/Europaische-und-internationale-Energiepolitik/internationale-energiepolitik,did=551754.html
[15] See http://www.international-climate-initiative.com/en/about-the-iki/iki-funding-instrument/

and continental infrastructure. It currently focuses on hydroelectric power plants and regional interconnections in electricity as well as oil and gas pipelines. Renewable energy is not an explicit priority. Within PIDA, **Africa Power Vision** is developing a comprehensive vision for developing African energy infrastructure. The **Africa Clean Energy Corridor**, initiated by IRENA and supported by the Eastern and Southern African Power Pool (EAPP&SAPP) countries, combines regional grid development with a focus on renewable energy.

The **Scaling Up Renewable Energy in Low Income Countries Program** (**SREP**), financed by the Climate Investment Fund and implemented in Africa by AfDB, represents a key programme for supporting renewable energy development by the multilateral development banks. Participating countries are required to develop investment plans, which may include investments in renewable energy infrastructure as well as related capacity building and advisory services. To date, investment plans for Ethiopia, Kenya, Liberia, Mali, and Tanzania have been approved. The **Clean Technology Fund** (**CTF**), also implemented by AfDB, provides finance to large-scale renewable energy projects in several African countries (including Egypt, South Africa, Morocco, and Nigeria) with the particular aim to drive down technology costs.

As mentioned above, the **Africa-EU Energy Partnership** (**AEEP**) represents the central framework for political dialogue and cooperation between the EU and Africa to support renewable energy development as well as broader energy policies. The **EU Energy Initiative Partnership Dialogue Facility** (**EUEI PDF**) acts as its secretariat and the implementing agency for the **Renewable Energy Cooperation Programme** (**RECP**). In addition, EUEI PDF focuses on analytical work, dialogue events, and capacity development. The RECP is a European multi-donor programme aimed at stimulating Africa-European private sector cooperation and supporting renewable energy project development, feeding into and complementing financing instruments. The **EU-Africa Infrastructure Trust Fund**'s SE4ALL window supports the SE4ALL targets via funds for project preparation and supervision, investment grants, and interest subsidies as well as guarantees and other risk sharing instruments. Finally, in North Africa, the **Mediterranean Solar Plan** aims to deploy clean technologies to harness the abundant solar resources in North Africa, and create EU-North African partnership in solar power development and trade. This is supported by a number of programmes to promote an enabling environment for solar power development, capacity building, and project preparation activities.

Power Africa is the US flagship initiative in the sector and provides what is referred to as "transaction-centred support" to Sub-Saharan countries. Interagency teams work on expediting investment projects in the field of power generation and transmission, leveraging financing, insurance, technical assistance, and grant tools, including both a grid-connected and an off-grid component. After an initial focus on Ethiopia, Ghana, Kenya, Liberia, Nigeria and Tanzania, Power Africa is now rapidly expanding its portfolio of countries.

Energising Development (**EnDev**) represents another key initiative with support from five European bilateral donors (Netherlands, Germany, Norway, UK and Switzerland) and Australia. EnDev supports energy access mainly in rural communities by promoting economically sustainable energy solutions and distribution schemes as well as the underlying value chains. A key feature of the initiative is its rigorous monitoring system to track progress and improve systems and approaches. The **World Bank's Lighting Africa** programme supports commercial markets for clean energy services in rural areas that lack connection to the gird, while the **Global Alliance for Clean Cookstoves** provides support to financial institutions and other stakeholders to enable poor consumers to access to cleaner cooking solutions.

In addition to the initiatives described above, a number of instruments have been developed with the primary purpose of leveraging private sector funds. These initiatives are discussed in the following section on financing instruments.

4.3. Financing renewable energy expansion

Major findings at a glance:

- Derisking investments in grid-connected renewable energy represents a key to enabling renewable energy deployment in the short- to medium-term.
- A number of financial derisking instruments are available, including the Sustainable Energy Fund for Africa, the Geothermal Risk Mitigation Facility, and risk guarantee instruments from the World Bank and the AfDB.
- The GET FiT Uganda programme represents an innovative, integrated approach to derisking renewable energy projects at the country-level.

4.3.1 "Derisking" investments in grid-connected renewable energy

The attractiveness of an investment project is determined by its risk-return-profile. Relatively high risks prevail in the African energy sector as a whole thus constraining investment in the sector. As outlined above, the African energy sector suffers from a number of structural problems, such as the weak financial strength of utilities, grid bottlenecks, and an unstable policy environment, which all translate into a high level of investor risk for the sector as a whole. This makes it difficult for potential investors to access needed infrastructure finance.

As the LCOE of renewable energy technologies (with the exception of bioenergy) are exclusively driven by capital costs (debt and equity cost, no fuel costs), changes in risk – whether real or perceived – have a particularly strong impact on their attractiveness compared to fossil-based technologies. Moreover, in spite of major advances in renewable energy technologies and their rapid expansion around the world, technology-related risks are still higher than for traditional fossil-based technologies. This is further compounded by high exploration risks in the field of geothermal energy.[15]

Accordingly, reducing investment risks – called derisking – is a key to attracting the necessary private sector investments in the African energy sector as a whole and for scaling up renewable energy, particularly from wind, solar, and geothermal sources (UNDP 2013). UNDP has developed a framework for Derisking Renewable Energy Investments (DREI) and distinguishes between two ways of derisking (UNDP 2013): Policy derisking removes the underlying barrier/root cause of investment risks and relates to the long-term effort of improving what is also known as investment climate (policy design, institutional capacity, grid connection etc.). Financial derisking, on the other hand, transfers risk away from the investor (loan guarantees, insurances etc.).

Derisking policies usually consist of nationally tailored sets of instruments combining a cornerstone instrument with other supplemental instruments. The cornerstone instrument typically represents a power purchase agreement (PPA) that provides suppliers of renewable energy with a fixed long-term price for power and guarantees access to the electricity grid. PPAs can take the form of feed-in tariffs as well as auctions. These PPAs have both a policy derisking effect by offering guaranteed market access over determined period of time and a financial derisking effect by offering a predetermined price over a selected time period. In the past, the instruments have also offered a financial incentive in the form of a premium over the market price thus also influencing the revenue-side of the risk-return-profile. More recently, prices have been reduced so significantly, however, that this is no longer always necessary.

Supplemental instruments can be employed to further improve the risk-return profile by targeting those risks that are identified as particularly harmful – and hence costly – in a given context. As demonstrated in the UNDP report, this can significantly reduce the need for a price premium, hence lowering the overall cost of renewable energy deployment. Such supplemental instruments include measures to improve various aspects contributing to areas like

[16] See http://www.grmf-eastafrica.org/

the enabling environment of the energy sector and challenges related to the grid infrastructure as well as targeted financial derisking instruments such as loan guarantees, risk insurance for specific political or technology risks, or loans from public sector banks, which act as a de facto insurance against policy risks. The UNDP report provides a systematic framework for the selection of an appropriate mix of derisking instruments, based on an assessment of the costs of various risks, on the one hand, and the cost of various derisking instruments, on the other.

4.3.2 Key initiatives and trends

■ GET FiT Uganda

A practical example of an exercise in derisking small-scale renewable energy projects is the **GET FiT Uganda** programme implemented by Uganda's Electricity Regulatory Authority (ERA), the Government of Uganda, and KfW with financial support from the EU, Germany, Norway, and the UK. In addition, the World Bank supports this programme with a partial risk guarantee facility. The programme combines a mix of measures, including a donor-financed premium to supplement the Ugandan feed-in tariff in the first five years of the project lifetime, the World Bank's partial risk guarantee to mitigate the risk of default by the utility, and capacity building and technical assistance to ERA to reduce technical and administrative risks as well as grid infrastructure bottlenecks. Another critical feature of the programme is its multi-stakeholder governance structure, involving the ERA, governmental stakeholders, donors, and a number of energy sector and infrastructure investment experts, which monitors progress and proposes measures to address relevant challenges (GetFiT 2014).

■ Regional funds and derisking facilities[16]

A number of regional efforts focus on mitigating early-stage project development risks. The **Sustainable Energy Fund for Africa** (**SEFA**), a multi-donor trust fund, focuses on providing technical assistance for early-stage project preparation and efforts to promote an enabling environment for investment in renewable energy in Africa. It has also contributed US$100 million to the African Renewable Energy Fund (AREF), a multi-donor equity fund. The **EU-Africa Infrastructure Trust Fund** also offers risk insurance, although this had only been applied in one case, according to a 2012 evaluation (Ernst & Young 2012). The **ElectrifiFi** Initiative, soon to be launched by the EU, will provide convertible grants for project preparation, which are converted into subordinated debt upon financial closure. The **Geothermal Risk Mitigation Facility** for Eastern Africa provides grant-based co-financing for studies and exploratory drilling, in an effort to lower the exposure of investors to the risks of geothermal exploration. **Green Africa Power** provides long-term, junior-ranked capital and a guarantee for construction-based risk and policy support to introduce cost-reflective tariffs to mitigate off-taker risks.

The **Africa 50 Fund**, a new investment bank focused on different types of infrastructure investments, takes a broad approach. It offers a portfolio of financial instruments aimed at derisking high-impact infrastructure investments at different stages of the project cycle. In addition, AfDB has supported the creation of a number of **infrastructure investment funds**, including the ARM-Harith Infrastructure Fund of US$250 million with a focus on Nigeria and West Africa, and the US$630 million Harith-run Pan African Infrastructure Development fund focusing on PPPs across the continent.

■ Building capacity of local banks

Within the context of country-level approaches, another key need is to develop capacity within local level banks to assess and fund renewable energy projects. Oftentimes local banks lack the technical know-how to engage in investments in this emerging sector. International investors without a physical presence in the respective countries, on the other hand, lack the requisite knowledge and understanding of the local context, making it difficult to make an adequate assessment of risks. For instance, to be able

[17] Unless otherwise noted, information provided in this section is drawn from the official websites of the respective initiatives.

to estimate political risks a partner with local knowledge is profoundly important (Baker & McKenzie 2013). In other words, actual risks are further compounded by informational deficits, adding to the overall risk profile.

The IFC's Climate Change Investment Program for Africa (CIPA) tackles these challenges by supporting local banks with financing and advisory services for renewable energy-related investments. Another example is the Morocco Sustainable Energy Finance Facility (MorSEFF), launched jointly by EBRD, EIB, KfW, and AFD. MorSEFF represents a €80 million facility for investments in renewable energy and energy efficiency projects in Morocco and is channelled through a number of participating local banks. It is supported by a technical assistance facility provided by the European Union Neighbourhood Investment Facility (EU NIF). As capacity is developed within local financial institutions, an additional positive effect will likely be that these institutions will be able to raise funds from the growing pool of local financial resources.

Positive private sector trends

In addition to these donor-driven initiatives, a number of positive trends are also apparent in the ability of African countries to mobilise international funds for infrastructure investment. Improved credit ratings have enabled several governments (Zambia, Rwanda, Nigeria, Ghana, Gabon) to issue Eurobonds to raise funds (AEEP 2014). As important as tapping into international financial resources is investment from domestic sources, which lowers transaction costs and currency risks. Domestic sources of growing importance include bonds and equities that are backed by local funds such as the Botswana Public Officer Fund, the Nigeria Social Insurance Trust Fund, and Ghana's Social Security and National Insurance Trust. African savings provide rising contributions despite their low starting levels. Another potential source of finance may be provided by Africa's large diaspora population (AEEP 2014). Taken together domestic sources are estimated to cover 50 per cent of finance, rising to 75 per cent by 2040.[17]

[18] See http://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/PIDA%20brief%20financing.pdf

Electricity generation from bagasse is the most common form of bioenergy in Africa's electricity sector.

5. Options for Further Engagement

5.1. Priorities and entry-points for engagement

Key policy options at a glance:

- Reaching the 10 GW target will require the strengthening of existing programmes, the introduction of additional derisking instruments targeting specific bottlenecks, and the expansion of integrated country-level derisking programmes. Bilateral donors should contribute to derisking investments by providing risk guarantees.
- Continued support to the enabling environment for renewable energy represents the basis for all other activities and the key to accelerated deployment in the medium-term. This should include institution and capacity building, and engagement with the political economy of reform.
- Expanded support to local value creation and employment in the renewable energy sector, including the development of off-grid value chains, should be a priority.
- Significant socio-economic benefits and an important potential for innovation justify strong donor support to Africa's off-grid sector. Dedicated and stable support will play an important role in enabling further investment and cost reductions.

5.1.1 The importance of continued political support and coordination of existing initiatives

The need for infrastructure and energy sector investments has been widely recognised and is afforded a high priority by the donor community in Africa. The Africa Renewable Energy Initiative, promoted by African leaders within AMCEN, is the only continent-wide political initiative focused exclusively on renewable energy and deserves the support of the international community. The G7 Leaders' Declaration sends an important signal in its support, which should be backed up by strong political action. Moreover, **to be successful, it is essential that the Africa Renewable Energy Initiative actively engages with existing initiatives as well as private sector and civil society actors** so that their priorities, needs, and expertise can be captured. Among other things, engaging IRENA's expertise in the sector could add important value to the initiative.

In the medium-term, the momentum following from the recent adoption of the Paris Agreement might be utilised to generate political discussion of the potential benefits of phasing-out fossil fuel subsidies and introducing cost-covering electricity tariffs. This is important for creating a level playing field for clean energy investments and improving the financial health of utilities in the region, a key bottleneck for investment in the sector. In other words, it represents an important win-win opportunity and a key entry-point for enabling renewable energy expansion. At the same time, it implies important short-term socio-economic impacts. **Political dialogue on the issue should therefore integrate discussions on how to address related distributional impacts and manage the political economy of reform** (building on the Poverty and Social Impact Analysis (PSIA) agenda) (World Bank 2003).

5.1.2 Strengthening existing initiatives and harvest low-hanging fruit

As previously noted, there are a number of existing funding opportunities for infrastructure and energy sector investments in general and for climate-friendly investments specifically. **Unlocking further investment in the short-term will only be successful if additional support builds on existing country-level processes and is channelled through existing programmes and initiatives**. A key is to support the development of bankable projects to access the various investment facilities, such as SEFA, SREP, CTF, and others. Programmes dedicated to providing much needed technical assistance include the EUEI PDF and RECP as well as existing bilateral programmes. The newly established Green Climate Fund represents another source of climate finance which should be exploited for renewable energy financing in Africa.

In the short term, deployment is most likely to occur in countries with an existing track record in renewable energy, suggesting a **short-term focus on existing frontrunners and other low-hanging fruit, such as the rehabilitation of existing hydro facilities to increase their actual output.**

It is also notable that most programmes focus on adding additional generation capacity and extending grid infrastructure. Although these are crucial to meeting Africa's energy needs, **measures to boost efficiency in the use and distribution of energy are equally important.** In addition to supporting energy efficiency measures among consumers of energy, this means investing in improved performance of utilities and other actors in the electricity system. This will not only make more energy available to consumers, but will improve the financial health of utilities and invigorate the investment climate in the energy sector (McKinsey 2015).

5.1.3 Derisking renewable energy investment in Africa – the way forward

Existing financial derisking instruments are a step in the right direction, offering solutions for a number of important project development risks alongside targeted technical assistance. They represent important resources on which investors and project developers can draw. In the context of a broader derisking framework, however, they can only function as supplemental instruments. **To generate significant investment in renewable energy infrastructure in Africa in the short-term, more comprehensive, country-level derisking initiatives will be needed.** Without these, investments will remain heavily concentrated in those countries with relatively high levels of capacity such as South Africa and Morocco. The approach adopted in GET FiT Uganda offers a promising solution in this regard, offering a tailor-made portfolio of derisking measures built around a donor-supported feed-in tariff scheme. **Ongoing plans to expand GET FiT to other African countries should be fully supported.** These efforts should build on a thorough analysis of the programme and its success factors to ensure that lessons learned are appropriately harnessed.

In addition to these country-level approaches, the need for scaling-up and introducing additional regional funds and financial instruments to tackle specific derisking challenges should be assessed. Dedicated work by the Global Innovation Lab for Climate Finance on renewable energy in Africa might provide valuable input. More specifically, a **key challenge that has been identified is the lack of sufficient support to early-stage project development as well as the difficulties among smaller players to access existing facilities.** Offering additional funding to programmes targeting the early stages of project development should represent a key entry-point.

Moreover, **it would be useful if bilateral donors could participate in the provision of risk guarantees, which are crucial to unlocking finance**. This is currently hampered by the fact that such funding is not counted towards the respective donor's ODA commitments (unless actually drawn down). Conversely, partner governments that provide such risk guarantees themselves are required to record this as an expenditure in their balance sheets (according to the rules of the International Monetary Fund). Facilitating an environment that is more conducive to the provision of risk guarantees represents an important international policy issue.

Finally, local banks can play a decisive role in the financing of small- and medium-sized enterprises going forward and the mobilisation of domestic financing for this purpose. At present many of these institutions lack the experience and capacities to do so. **Increased efforts to channel donor funds through local banks while developing needed capacities can make an important contribution.**

5.1.4 Supporting the enabling environment for increased private sector engagement

■ Supporting policy development and reform

In addition to the derisking agenda outlined above, it is crucial that efforts to support the strengthening of enabling environments for investment in the renewable energy sector and the energy sector as a whole are continued. This includes support to the development of a dedicated and stable institutional and regulatory framework for the renewable energy sector as well as support for the continuation of reform efforts addressing broader energy sector challenges. This means supporting a reform agenda focused on unbundling, the creation of independent regulatory bodies as well as the necessary legal framework for IPPs to invest in the energy sector in general and the renewable energy sector specifically.

In addition, McKinsey has identified two key elements for improving the investment climate for IPPs. Firstly, African countries should move towards cost-reflective tariffs. **While financial derisking can help to reduce off-take risks, in the long-term only the improved financial health of utilities can enable investment at the required scale.** Hence, phasing-out fossil-fuel subsidies and moving towards tariff structures that support the financial health of utilities represents a key for promoting greater private sector involvement. Closely related to this is the need for increased transparency of costs in the electricity sector. While cross-subsidisation of certain target groups may have sound political, economic, or social motivations, it is important that such arrangements are transparent. This represents the basis for their effective and sustainable management.

In the field of off-grid and mini-grid investments, key regulatory issues include the issuing of permits and licences for electricity generation, the creation of cost-covering tariffs and the legal framework for the potential integration of mini-grids into the national grid.

■ Addressing the political economy of reform

In some cases progress in the area of policy reform can be severely hampered due to vested interests and other political economy issues. As a consequence, identifying the appropriate entry-points for constructive and action-oriented dialogue on reforms in the energy sector is a key challenge. The phasing-out of fossil-fuel subsidies is a case in point. While offering important opportunities for mobilising investment in the energy sector and relieving state budgets, it has remained an intractable issue. **This should not discourage donors from engaging with partners on these issues, but implies the need for sound analysis on related political economy issues and an approach which builds on favourable political trends and opportunities where they arise.**

■ Institutional strengthening and capacity building

Dedicated institutional development and broad-based capacity building has not been given a high priority in comparison to the mobilisation of financial resources for investment in the (renewable) energy sector. Support for regional and country-level renewable energy agencies as well as civil society organisations such as renewable energy associations can play an important role. Similarly, supporting offerings in the education and vocational training system can fill a large gap in local technical capacity.

5.1.5 Local value creation and employment

The role of local value and employment creations as a potential co-benefit of renewable energy expansion represents another relatively neglected topic. While it has an important potential, it is still poorly understood and rarely addressed systematically. Efforts to provide analytical and technical support in this field have been seen mainly in the North African context. These experiences should be exploited for the purpose of further developing relevant knowledge and identifying approaches to supporting such opportu-

nities. A better analytical base is needed for understanding and exploiting local potentials. In addition, the role and potential of emerging off-grid value chains in rural areas should be analysed, so their potential can be harnessed for local economic development.

5.1.6 Harnessing Africa's off-grid potential

Investments in off-grid and mini-grid renewable energy technologies are unlikely to contribute significantly to the goal of adding 10 GW of installed renewables capacity by 2020. Nevertheless, they offer an important potential for meeting energy access targets and catalysing related socio-economic benefits at low-cost. A number of donor programmes already focus on the development of innovative business models to enable the commercialisation of off-grid and mini-grid systems as well as support to micro-finance institutions active in the sector (APP 2015). **Given the vast potential and significant socio-economic benefits, there is an important argument in favour of further scaling up effective programmes like EnDev in support of the deployment of off-grid technologies.** Strong and stable donor support will significantly increase the investment case in the sector and help reinforce important positive trends in the sector.

Off-grid and mini-grid technologies also bear important potential for further innovation and technological development, which deserves the support of the international donor community. This potential can only be captured by supporting investment in the various stages of the innovation cycle and the related eco-system of entrepreneurs, technology developers, non-governmental organisation, financial intermediaries, etc. While Africa represents a particularly challenging environment for innovation and technological development, it is also inherently linked to the lack of existing grid infrastructure, which could be a key driver for innovation.

As well as implementing dedicated support to the deployment of off-grid systems, further efforts should be considered in the following areas.

Firstly, ambitious efforts to support the development of dedicated investment funds for scaling-up and sustaining innovative business models aimed at delivering off-grid renewable energy infrastructure could play an important role in further developing Africa's off-grid potential. The design of such funds would require a careful analysis of the specific financing bottlenecks facing such ventures so that the fund could be structured to address the identified needs.

Secondly, support for the development of dedicated quality infrastructure should be provided (**e.g. standardisation and certification systems for solar home systems**). This could play a major role in enhancing confidence in the emerging solutions by both investors and consumers.

Thirdly, substantial, mission-oriented RD&D financing is justified not only due to the pressing social needs that it can help address but also due to the important positive externalities of the related knowledge development and innovation (Mazzucato 2013). To be effective, it is essential that the majority of such funding goes to research centres located in African countries, as past experience has shown that proximity to the target markets is an important prerequisite for the development of technologies and business models adapted to the respective needs (Meyer-Krahmer & Reger 1999). At the same time, it is important to support high quality research, which suggests the development of a limited number of centres of excellence (i.e. no more than 3) to act as poles of research and innovation. These efforts should be complemented by funds to facilitate cooperation with regional and international partners. The results of such an international, mission-oriented research, development and demonstration effort would offer benefits far beyond Africa and could be pursued in cooperation with existing research funding bodies in OECD countries.

Finally, dedicated funding for the monitoring and evaluation of existing off-grid/mini-grid programmes and for building a consolidated knowledge base on important trends in the field would offer substantial benefits. While knowledge on the sector is beginning to emerge, a consolidated effort to collect and systematise information on the sector would be beneficial to investors as well as donors. IRENA would be a suitable organisation for carrying forward such an effort.

5.2. Priorities for German development cooperation

Key policy options at a glance:

- To meet the 10 GW target, German development cooperation should provide targeted support to the identification and initiation of bankable projects and strengthen its derisking activities.
- German development cooperation should further strengthen support for an enabling environment, capacity building, and skill development as well as value creation and employment in the renewable energy sector.
- Closer cooperation between programmes administered by BMZ and BMWi in the field of international renewable energy promotion could yield a win-win opportunity for accelerating renewable energy expansion as well as the engagement of the German private sector in Africa.
- North-South-South cooperation holds important potential due to the growing role of emerging countries both as donors and markets for renewable energy.
- The analytical basis underpinning development cooperation in Africa's renewable energy sector should be strengthened.

As outlined above, German development cooperation is already well positioned as a donor in Africa's renewable energy sector. Additional support for renewable energy should build on existing country processes and programmes. Rapid, short-term expansion of renewable energy is only feasible in partner countries with existing capacities and, ideally, experience in the implementation of renewable energy projects. **Working in relatively high-capacity partner countries and through existing programmes and initiatives is therefore the most promising pathway to achieving the 10 GW target**. In the short term, German technical assistance can play a useful role in supporting the identification and initiation of bankable projects in these country contexts.

In addition, **BMZ should provide further support to the derisking of investments in the sector**. The following specific measures might be considered:

- **Ongoing efforts to transfer the GET FiT approach to additional partner countries represents a promising entry-point for catalysing further investment.**
- **Dedicated funding for early-stage project development could close an important investment bottleneck.** This could be channelled through DEG in the form of equity investments in project development companies targeting projects in Africa. This would boost the ability of these developers to engage in early-stage project development. Moreover, the backing of the international donor community of these project developers would improve their ability to address important bottlenecks with the relevant governmental authorities. In addition, the proposed Renewable Energy Development Company with funding from KfW should be considered as a potential vehicle in this context.
- **The German government's existing political risk insurance for foreign direct investments could be extended to lenders that offer debt-based financing for renewable energy projects.** To date, only firms investing directly in foreign countries can be covered by Germany's political risk insurance. If lenders (such as the DEG) could also be covered, this could significantly enhance their ability to offer funding to projects in Africa. To further enhance the scope of this derisking instrument, eligibility could be extended to include selected non-German firms (possibly limited to enterprises from EU member states).
- **Further proposals aimed at derisking investments, such as the Regional Liquidity Support Facility, should be considered for support.**

This focus on enabling project-specific investments should be complemented by **continuing support to long-term capacity building**, an important strength of German development cooperation. A number of areas stand out in this area:

- Support for the **enabling environment for renewable energy** development and related institutional and capacity development.
- Support for **skill development and vocational training**, targeting the renewable energy sector.

Germany's strength both in the field of technical and vocational education and training (TVET) and the renewable energy sector make this an important field for German development cooperation. It also represents an opportunity for engaging the German private sector.

- Closely related to the field of skill development, further support to the development and implementation of **strategies aimed at supporting local value creation and employment** in the renewable energy sector, which are currently being pursued with a focus on a number of North African countries. This includes the further development of a corresponding analytical base as well as advisory approaches targeting Sub-Saharan African countries.

In addition, **German development cooperation should consider further streamlining existing initiatives pursued by BMZ and BMWi in the renewable energy sector in order to strengthen the engagement of the German private sector**. The African Energy Partnerships, the Renewable Energies Export Initiative, the related Project Development Programmes as well export guarantees and DEG's private sector lending represent established instruments for engaging and supporting private sector partners in the renewable energy sector. Closer coordination across these initiatives may provide opportunities for engaging larger numbers of German businesses in the early stages of project development when risks are greater. It may help identify key bottlenecks for more serious engagement and bolster business confidence that important project development challenges will be resolved.

In addition, the Renewable Energies Export Initiative could offer enhanced services aimed at boosting investments by German firms in Africa. This might include strengthening **advisory services and coaching programmes for German small and medium-sized enterprises from the renewable energy sector seeking to enter the African market.** In addition to trainings on the business and policy environment in African countries, these programmes could offer advice on developing business models tailored to the African market. Moreover, country-specific financing studies could be supported for a larger number of African countries. To date, such studies are only available for selected sub-sectors in six countries. Finally, a continuation of the EZ-Scout programme with a particular focus on promoting renewable energy in Africa might be explored.

A relatively new but potentially promising field of cooperation in the renewable energy sector might be the development of collaborative approaches involving African countries as well as important developing and emerging countries in the field of renewable energy. Such **South-South-North cooperation** might offer important avenues for leveraging finance and expertise from Asian countries as well as African frontrunner countries. Such collaboration should of course only be pursued in areas where the principles of German development cooperation are compatible with the approaches of potential third country development partners.

Finally, the scaling-up of support for renewable energy deployment in Africa would benefit from a **systematic effort to strengthen the analytical base underpinning development cooperation in the field**. This might include the following priority areas:

- Collection and systematisation of lessons learned from Germany's and other development partners' engagement in Africa's renewable energy sector, including approaches pursued by non-traditional development partners such as China, India, and other emerging countries;
- Monitoring of international targets and evaluation of programmes in the African renewable energy sector;
- Political economy analysis and Poverty and Social Impact Analysis (PSIA) of energy sector reform processes with the aim of identifying country-level entry-points and strategies for the promotion of renewable energy;
- Analysis of potential for local value creation and employment from deployment of renewable energy in Africa;
- Contextualised analysis of the inter-relationship between the water and energy sectors in water scarce African countries with a particular focus on the potential of renewable energy.

Annex

Table A-1: Overview of existing renewable energy targets and instruments in African countries

Country	Renewable energy targets	REGULATORY POLICIES						
		Feed-in tariff / premium payment	Electric utility quota obligation/ RPS	Net-Metering	Biofuels obligation/ mandate	Heat obligation/ mandate	Tradable REC	Tendering
Algeria	×	×						×
Angola					×			
Benin*	×							
Botswana	×							
Burkina Faso								×
Burundi*	×							
Cameroon								
Cabo Verde	×			×				×
Central African Republic*								
Chad*								
Comoros*								
Congo, D.R.*								
Congo*								
Djibouti*	×							
Egypt	×	×		×				×
Equatorial Guinea*								
Eritrea*	×							
Ethiopia	×				×			
Gabon*	×							
Gambia	×							
Ghana	×	×	×		×		×	
Guinea	×							
Guinea-Bissau*	×							
Ivory Coast	×							×
Kenya	×	×				×		×
Lesotho	×			×				×
Liberia	×							
Libya	×							
Madagascar	×							
Malawi	×							
Mali	×				×			

FISCAL INCENTIVES AND PUBLIC FINANCING					Country
Capital subsidy, grant or rebate	Investment or production tax credit	Reduction in sales, energy, CO_2, VAT or other taxes	Energy production payment	Public investment, loans or grants	
×				×	Algeria
				×	Angola
					Benin*
×		×			Botswana
	×	×	×		Burkina Faso
					Burundi*
		×			Cameroon
	×		×		Cabo Verde
					Central African Republic*
					Chad*
					Comoros*
					Congo, D.R.*
					Congo*
					Djibouti*
×		×			Egypt
					Equatorial Guinea*
					Eritrea*
		×		×	Ethiopia
					Gabon*
		×			Gambia
×		×		×	Ghana
		×			Guinea
					Guinea-Bissau*
×		×			Ivory Coast
		×	×	×	Kenya
×	×		×	×	Lesotho
		×			Liberia
		×			Libya
		×			Madagascar
		×		×	Malawi
		×		×	Mali

Country	Renewable energy targets	REGULATORY POLICIES						
		Feed-in tariff / premium payment	Electric utility quota obligation/ RPS	Net-Metering	Biofuels obligation/ mandate	Heat obligation/ mandate	Tradable REC	Tendering
Mauritania*	X							
Mauritius	X							X
Morocco	X			X			X	
Mozambique	X				X			
Namibia	X					X		
Niger	X							
Nigeria	X	X			X			
Rwanda	X	X						X
São Tomé and Principe*								
Senegal	X	X	X	X				X
Seychelles	X			X				
Sierra Leone*	X							
Somalia*								
South Africa	X		X		X	X		X
South Sudan*								
Sudan	X				X			
Swaziland*								
Tanzania	X	X						
Togo	X							
Tunisia	X			X				
Uganda	X	X						X
Zambia								
Zimbabwe	X				X			

Source: Own compilation based on REN21, Global Status Report 2015. The Global Status Report 2015 provides only incomplete data on regulatory policies, fiscal incentives, and public finance for the countries marked with an asterisk (*).

FISCAL INCENTIVES AND PUBLIC FINANCING					Country
Capital subsidy, grant or rebate	Investment or production tax credit	Reduction in sales, energy, CO_2, VAT or other taxes	Energy production payment	Public investment, loans or grants	
					Mauritania*
×		×		×	Mauritius
				×	Morocco
		×		×	Mozambique
					Namibia
		×			Niger
×		×		×	Nigeria
	×	×		×	Rwanda
					São Tomé and Principe*
		×			Senegal
	×	×		×	Seychelles
					Sierra Leone*
					Somalia*
×		×		×	South Africa
					South Sudan*
					Sudan
					Swaziland*
×		×	×	×	Tanzania
		×			Togo
×		×		×	Tunisia
×		×		×	Uganda
×		×		×	Zambia
		×		×	Zimbabwe

Table A-2: Available information on the deployment of renewable-based and hybrid mini-grid systems (REN21 2015)

Country	Technology / System	Cumulative capacity at end of 2014	Additional information
Benin	Hybrid mini-grid	30 kWp (2013)	■ Implemented in North Benin under an Energias Sin Fronteras (EsF) project
Burkina Faso	Hybrid mini-grid	45 kWp	■ Three hybrid PV/diesel mini-grid projects with an installed capacity of 15 kWp each
Cameroon	(PV/diesel)	23 MW	■ 30 hybrid mini-grids operating
Congo, DR	Hybrid mini-grid	16 kWp	■ Palm oil biofuel-based mini-grid run by co-operative; 100 households electrified
Gambia	Mini-grid (biofuel)	350 kWp	
Ghana	Mini-grid (wind)	6 kWp	■ Two compact mini-grids
Kenya	Mini-grid (solar)	19 MW	■ 18 systems installed
Kenya	Hybrid mini-grid	113 kWp	■ A mini-grid (45 kW), 25 compact mini-grids (58 kW), and four containerised mini-grids (10 kW)
Madagascar	Mini-grid (solar)	3.2 kWp	■ Micro-grid of 2 kW
Madagascar	Micro-grid (PV)	622 kWp	
Mali	Mini-grids (solar)	2.1 MW	■ 21 hybrid mini-grids installed
Mauritania	Hybrid mini-grid	6 units	■ PV/diesel power plants (three systems of 15–20 kWp and three systems of 25 kWp)
Mozambique	(PV/diesel)	9 kWp	■ Three compact mini-grids installed by ARE members
Niger	Hybrid mini-grid (PV/diesel)	27.5 kWp	■ 105 households electrified and electricity for productive use; Implemented by Plan International under the ECREEE EREF II
Nigeria	Mini-grid (solar)	6 units	
Nigeria	Mini-grid (solar)	4 kWp	■ 150 residents electrified
Nigeria	Hybrid mini-grid	16 kWp	■ 12 compact mini-grids
Rwanda	Mini-grid (hydro)	1,000 kWp	
Rwanda	Mini-grid (solar) (PV/diesel)	50 units	■ 50 mini-grids of 3–6 kWp for health care centres
Sierra Leone	Hybrid mini-grid (PV/hydro)	1 unit	
Tanzania	Mini-grid (solar)	6 kWp	■ Two compact mini-grids
Uganda	Hybrid mini-grid	5 kWp	

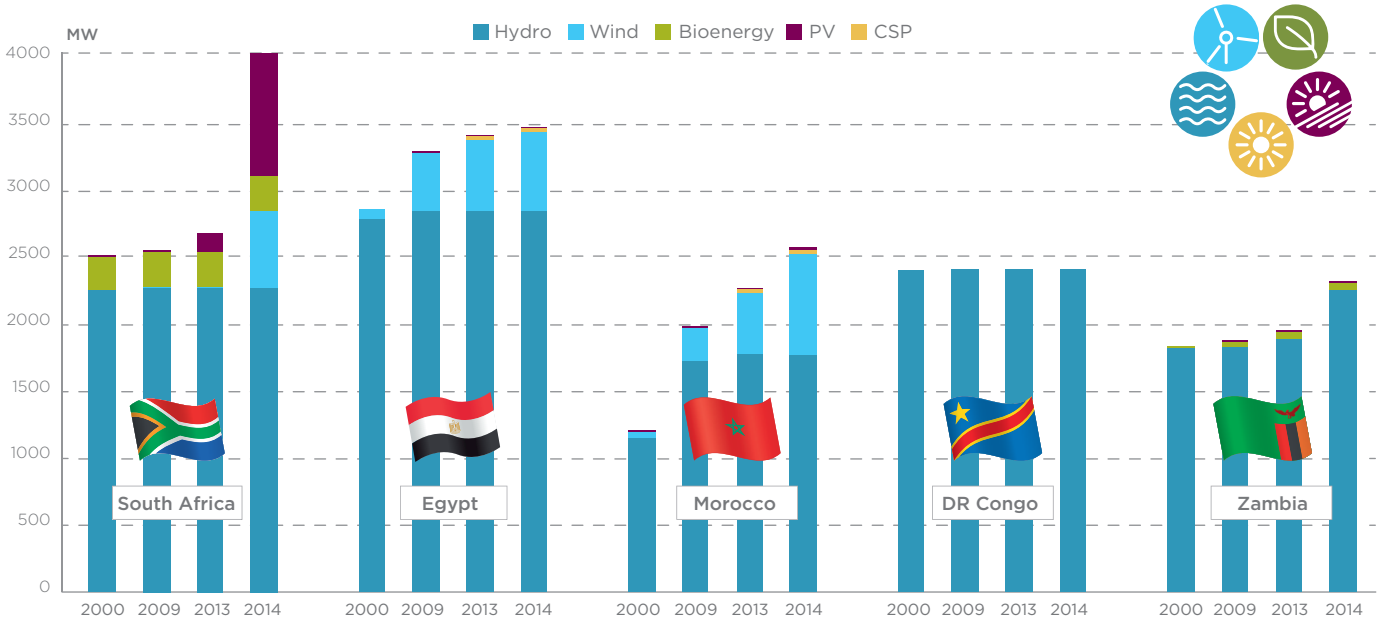
Source: Based on REN 21 (2015)

Table A-3: Available information on the deployment of renewable-based and hybrid mini-grid systems (IRENA 2015e)

Country	Information on mini-grid deployment
Nigeria	6 units / 700 households
Tanzania	17 MW in 2010 (biomass & small hydro)
Kenya	18 mini-grids (19 MW), all diesel-based, six with renewables
Algeria	20 villages electrified using PV
Uganda	Hybrid systems have been implemented in 5kWp range
Morocco	3 663 villages, 50 000 households, 1/10 with renewables
Madagascar	2 systems, 137kW (14kWp Renewables)
Cameroon	30 system, 23 MW total
Mali	216 kWp hybrid PV/diesel (largest in Africa)
Senegal	16 hybrid power plants (5 kWp PV and 11 kVA diesel each)
Rwanda	Hybrid PV/diesel systems installed at 50 health centres (3–6 kWp PV and 16-20 kVA)
Mauritania	6 installations of 15-25 kWp

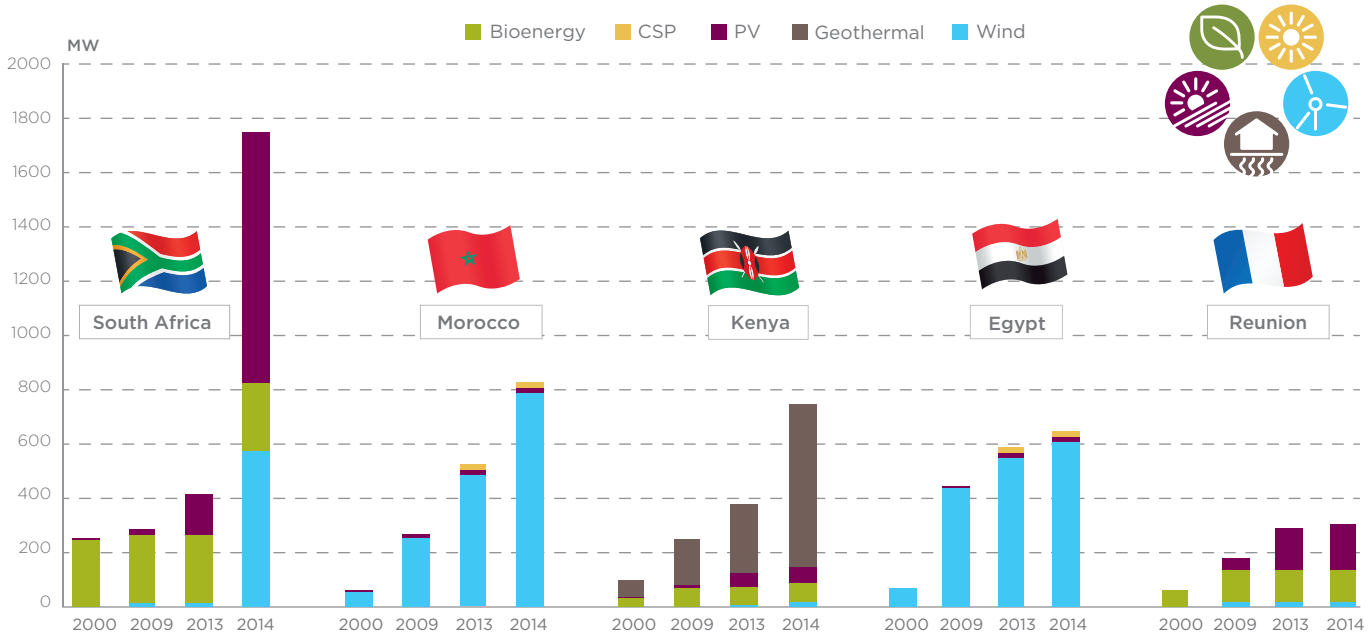
Source: Based on IRENA (2015e)

FIGURE A-4: TOP FIVE COUNTRIES – RENEWABLE ENERGY CAPACITY



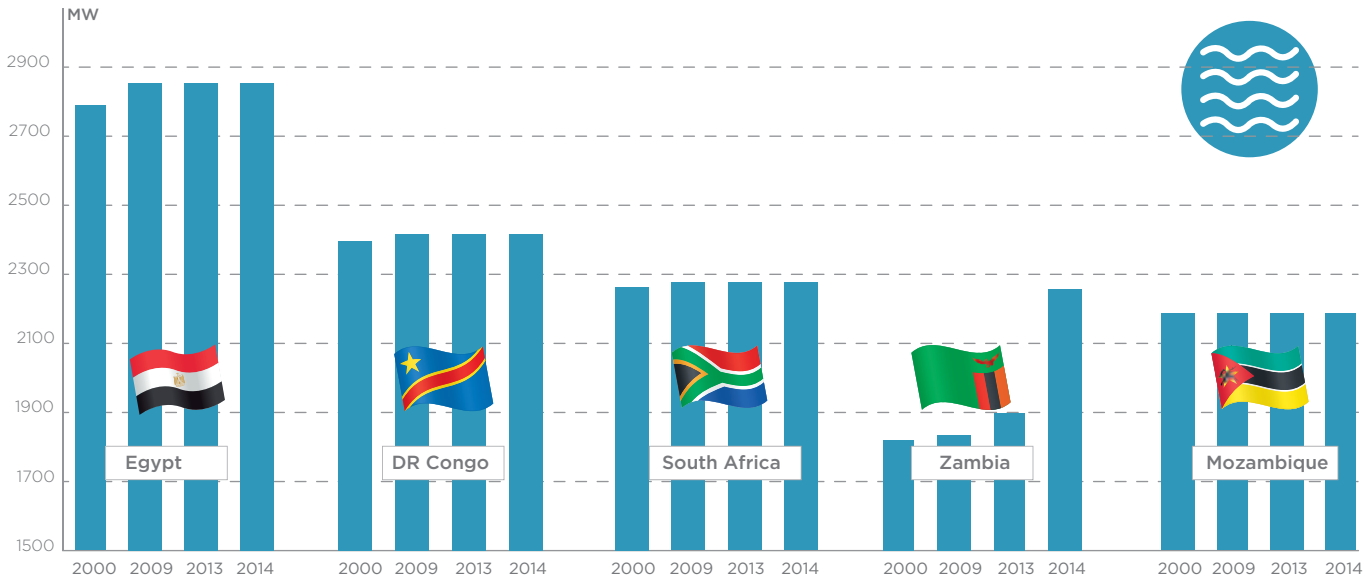
Source: Author's own graph based on IRENA Renewable Energy Capacity Statistics 2015

FIGURE A-5: TOP FIVE COUNTRIES – RENEWABLE ENERGY CAPACITY WITHOUT HYDRO



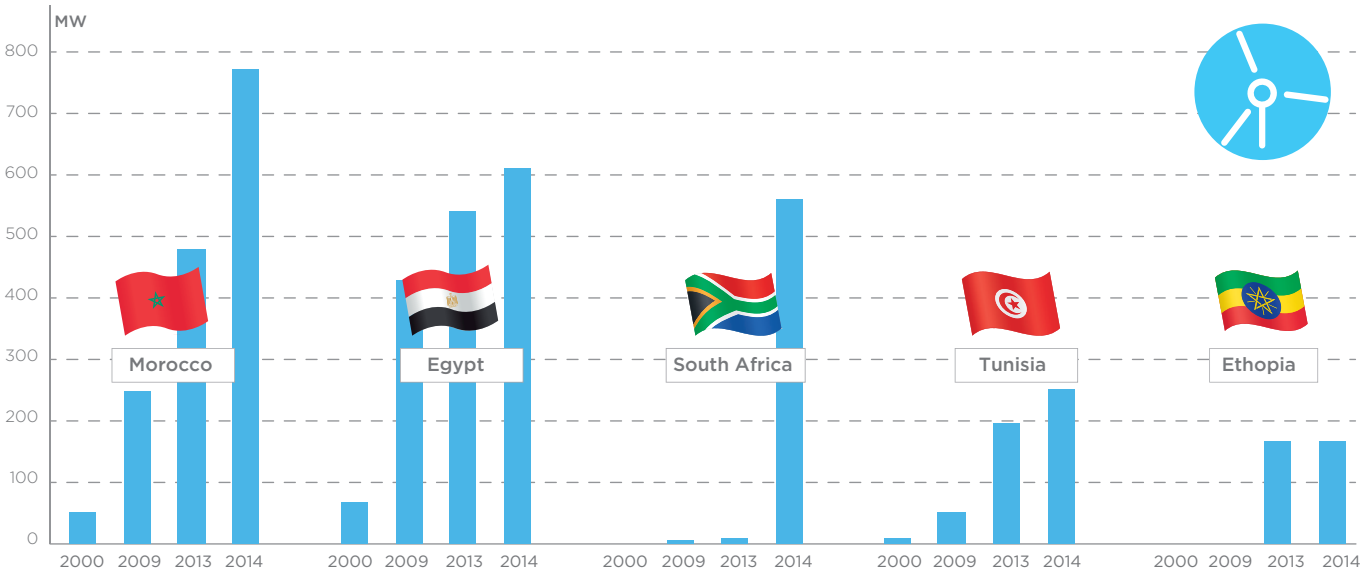
Source: Author's own graph based on IRENA Renewable Energy Capacity Statistics 2015

FIGURE A-6: TOP FIVE COUNTRIES – HYDRO CAPACITY



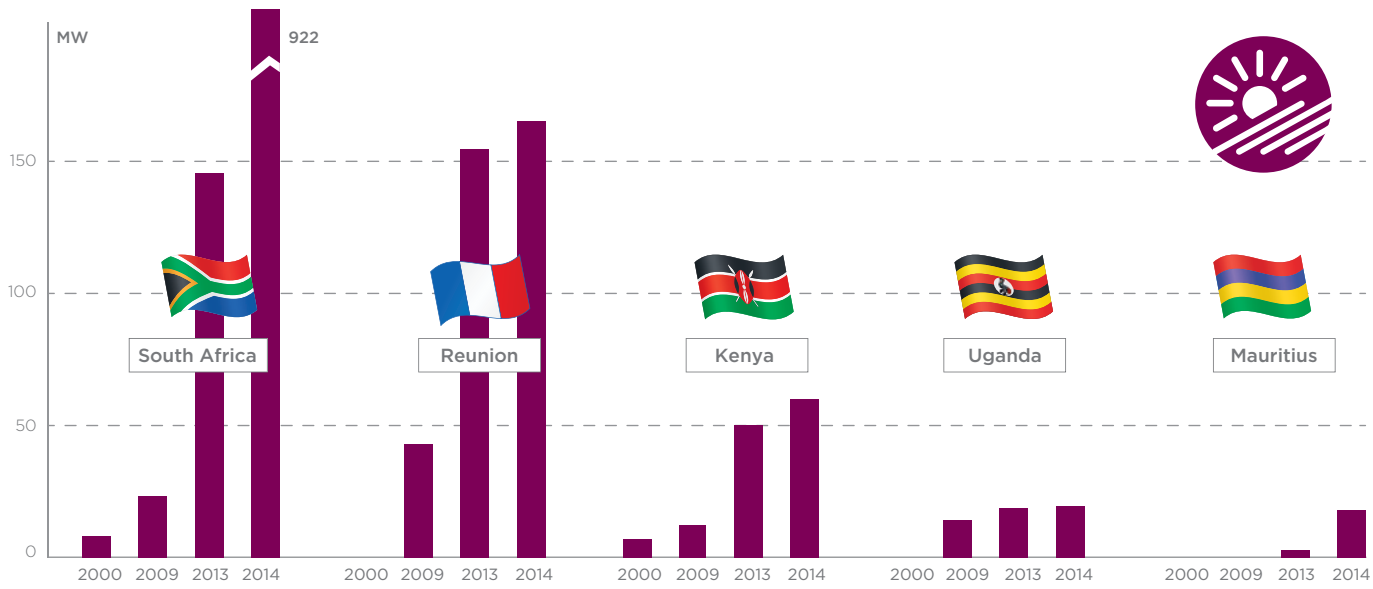
Source: Author's own graph based on IRENA Renewable Energy Capacity Statistics 2015

FIGURE A-7: TOP FIVE COUNTRIES – WIND CAPACITY



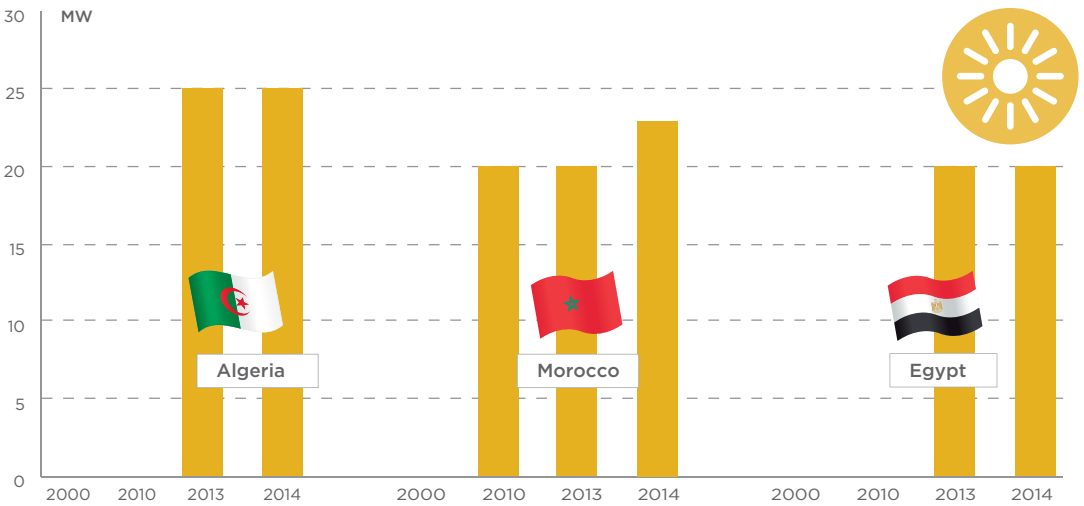
Source: Author's own graph based on IRENA Renewable Energy Capacity Statistics 2015

FIGURE A-8: TOP FIVE COUNTRIES – SOLAR PV CAPACITY



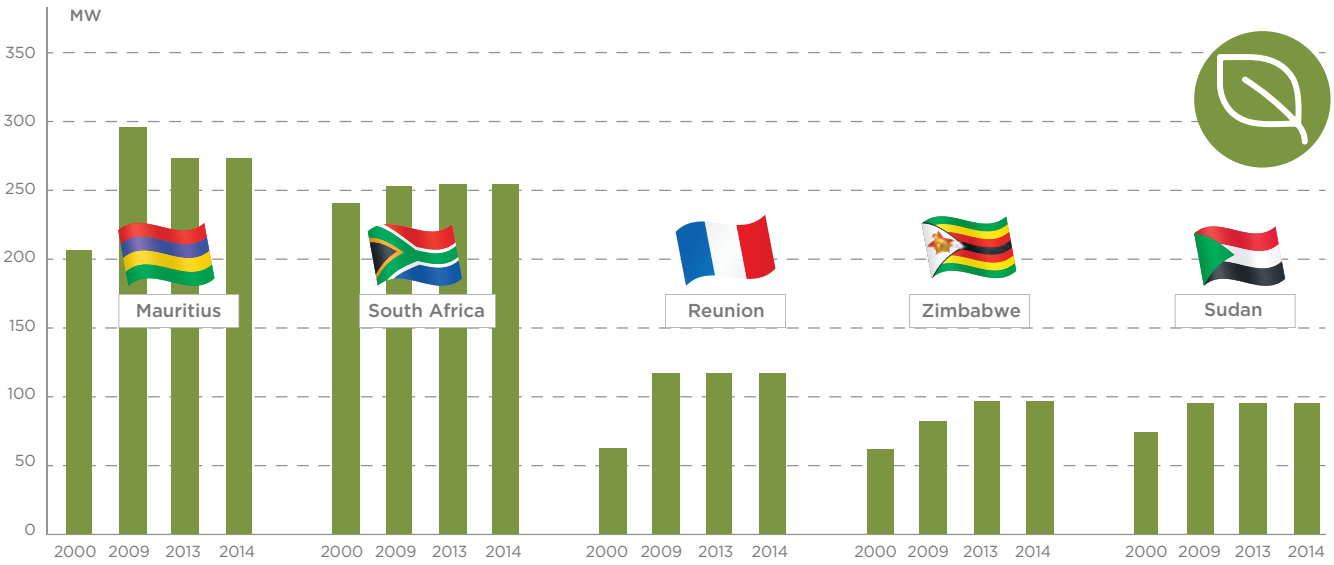
Source: Author's own graph based on IRENA Renewable Energy Capacity Statistics 2015

FIGURE A-9: TOP THREE COUNTRIES – CSP CAPACITY



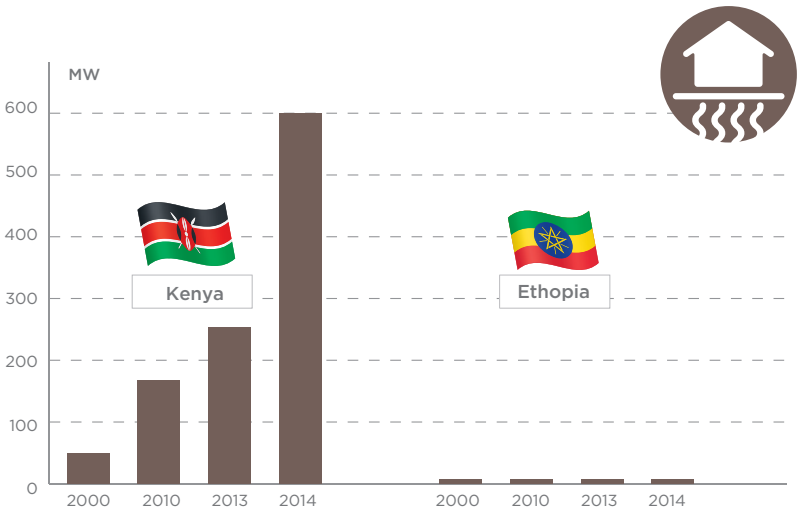
Source: Author's own graph based on IRENA Renewable Energy Capacity Statistics 2015

FIGURE A-10: TOP FIVE COUNTRIES – MODERN BIOENERGY CAPACITY



Source: Author's own graph based on IRENA Renewable Energy Capacity Statistics 2015

FIGURE A-11: TOP TWO COUNTRIES – GEOTHERMAL CAPACITY



Source: Author's own graph based IRENA Renewable Energy Capacity Statistics 2015

TABLE A-12: SCENARIOS FOR RENEWABLE ENERGY IN AFRICA BY 2020 (in GW)

	IRENA	AEEP	AEEP	IEA	IEA
	Current	25% scenario	50% scenario	New Policies	Century Case
Year	2014	2020	2020	2020	2020
Hydro	29	34	40	41	43
Biomass	1	-	-	2	2
PV	1	1*	2*	7	7
CSP	0	-	-	-	-
Ocean	0	-	-	-	-
Wind	2	2	3	-	-
Geothermal	1	-	-	-	-
Not specified	-	2	3	9	9
Total renewable energy capacity	**34**	**39**	**48**	**59**	**61**
Additional renewable energy capacity		**5**	**14**	**25**	**27**

* The AEEP report provides an aggregate value for PV and CSP capacity
Source: Author's own graph based IRENA (2015b), AEEP (2014), IEA (2014), GWEC et al. (2014)

TABLE A-13: OVERVIEW OF KEY INITIATIVES

Programme	Implementing agency / donors	Geographic scope and focus	Funding
High-level initiatives			
Africa Renewable Energy Initiative	**Partners:** African Heads of State, Africa Union Commission, NEPAD Agency, African Group of Negotiators, AfDB, UNEP, and IRENA	Africa	N/A
Africa Clean Energy Corridor Initiative	**Implementing agency:** IRENA **Partners:** East and Southern African Countries	Countries in the Eastern Africa and Southern African Power Pools	N/A
SE4ALL	**Africa Hub Secretariat:** AfDB	Global Country-level processes in Africa: Burkina Faso, Burundi, Ethiopia, Gambia, Ghana, Guinea, Kenya, Liberia, Mozambique, Rwanda, Sierra Leone, Tanzania, Uganda	N/A
Africa-EU Energy Partnership (AEEP)	**Secretariat:** EUEI PDF (GIZ) **Donors/Partners:** European Commission and EU member states, African countries	Africa	N/A
Program for Infrastructure Development in Africa (PIDA)	**Implementing agency** African Development Bank **Partners:** African Union Commission United Nations Economic Commission for Africa NEPAD Planning and Coordinating Agency **Donors:** Initial financial support from African Development Fund, Nigeria Technical Cooperation Fund, African Water Facility, NEPAD Infrastructure Project Preparation Facility Special Fund, European Union, Islamic Development Bank, DFID	Africa	PIDA initiative requires a total amount of US$11 million, mainly for sector studies
Africa Power Vision	**Implementing agency:** NEPAD Planning and Coordinating Agency (NIPCA) Jointly developed by the African Union Commission (AUC), NPCA, the Federal Ministry of Finance, Nigeria, the Economic Commission for Africa (UNECA) and the African Development Bank (AfDB)	Africa Supra-regional	N/A

	Main objectives and activities related to renewable energy development
	▪ Regional initiative that focuses on building integrated solutions to the challenge of widening access to clean energy services for improved human well-being and sustainable development while putting African countries on a climate-friendly sustainable development path ▪ Between 2016 and 2020, the Initiative seeks to facilitate and support the establishment of particularly promising incentive structures and comprehensive policy packages for national governments in a number of piloting African countries ▪ During the initial four-year period, the Initiative seeks to enable at least 10 GW of new and additional renewable energy installations in a number of countries, in line with its approaches, priorities, and selection criteria
	▪ Initiative to promote accelerated deployment and cross-border trade of renewable power in a continuous network from Egypt to South Africa ▪ Policy dialogue and capacity building supported by IRENA
	▪ Promote energy access and sustainable development in Africa, double the share of renewable energy in the energy mix ▪ Implement and finance transformative energy projects, through energy policies, rural electrification plans, and strategies for scaling up renewable energy, energy efficiency, and clean cooking solutions ▪ Development of country-level action plans and investment prospectuses

	▪ Political targets for 2020 for energy access, energy security, renewable energy and energy efficiency
	▪ Renewable energy targets for 2020:
	  ▪ 10,000 MW of new hydropower facilities
	  ▪ 5,000 MW of wind power capacity
	  ▪ 500 MW of all forms of solar energy capacity
	  ▪ Tripling the capacity of other renewables

	▪ Continent-wide programme to develop a vision, policies, strategies, and a programme for the development of priority regional and continental infrastructure in transport, energy, trans-boundary water, and ICT ▪ Activities include creation of an independent advisory panel of experts, workshops, creation of an infrastructure database, sector studies
	▪ Developed by African energy and finance ministers on the basis of Programme for Infrastructure Development in Africa (PIDA) ▪ Identification of priority energy projects (not only RE) with broad-ranging regional impact for rapid implementation

Programme	Implementing agency / donors	Geographic scope and focus	Funding
Technical assistance and analysis			
EU Energy Initiative Partnership Dialogue Facility (EUEI-PDF)	**Implementing agency:** GIZ **Donors:** EU, Austria, Finland, France, Germany, the Netherlands, and Sweden	▪ Global ▪ Activities in Burundi, Cameroon, Congo, DR, Ethiopia, Guinea, Mozambique, Uganda, Tanzania, Benin ▪ Regional studies and workshops	€13 million in expenditures (2012 – 2015)
Africa-EU Renewable Energy Cooperation Program (RECP)	**Implementing agency:** EUEI PDF (GIZ) **Donors:** RECP start-up phase funded by European Commission	Africa	Data not available
Power Africa	**Implementing agency:** USAID **Donors:** USA Contributions from Sweden, World Bank, AfDB	▪ Scope: Sub-Saharan Africa ▪ Pilot countries: Ethiopia, Ghana, Kenya, Liberia, Nigeria, and Tanzania ▪ Additional countries: Guinea, Sierra Leone, Malawi, Zambia, Rwanda, and Uganda	Pledge of US$300 million in assistance per year (though not clear whether all channelled through USAID)
Mediterranean Solar Plan	**Hosted by:** Union for the Mediterranean **Donors:** Financial support from European Commission and BMUB	▪ Mediterranean/ MENA region ▪ Africa: Tunisia, Morocco, Algeria, Libya	
Global investment funds (renewable energy, clean technologies)			
Clean Technology Fund (CTF)	**Donors:** All major bilateral donors **Implementing agencies in Africa:** AfDB EBRD World Bank	▪ Global ▪ Focus in Africa: Algeria, Egypt, Morocco, Libya, Tunisia, Nigeria, South Africa	US$5.3 billion concessional financing (2008–2014)
Strategic Climate Fund (SCF)		▪ Global ▪ Focus in Africa: Benin, Ethiopia, Ghana, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Rwanda, Sierra Leone, Tanzania, Uganda, Zambia	US$2.8 billion concessional financing (2008–2014)
Scaling Up Renewable Energy in Low Income Countries (SREP)			▪ Total: US$796 million ▪ Approved funding (2014): US$161.5 million ▪ Africa indicative allocation: US$303.9 million approved US$79. 2 million

	Main objectives and activities related to renewable energy development
	▪ Policy, regulation and strategy development ▪ Institutional building and strengthening ▪ Private sector cooperation ▪ Capacity development and knowledge sharing ▪ Secretariat of the Africa-EU Energy Partnership (AEEP) ▪ Implementing agency of the Renewable Energy Cooperation Programme (RECP)
	▪ Foster technical expertise and encourage business cooperation ▪ Policy advisory services, flagship investment projects, private sector cooperation, technology innovation, capacity development
	▪ Aims to add 30 GW and 60 million connections across Sub-Saharan Africa in five years ▪ Transaction Assistance, i.e. early- and late-stage advisory work during project development ▪ Support for improving enabling environment and accessing finance ▪ Capacity building
	▪ Initiative to develop and implement a regional strategic action plan and roadmap (MSP Master Plan) ▪ Common working platforms ▪ New financial support tools ▪ Pilot projects ▪ Capacity Development and other cooperation mechanisms
	▪ Part of the Climate Investment Funds (CIF) ▪ Finance for scaled-up demonstration, deployment and transfer of low-carbon technologies for significant greenhouse gas (GHG) reductions within country investment plans
	▪ Part of the Climate Investment Funds (CIF) ▪ Financing for targeted programmes in developing countries to pilot new climate or sectoral approaches with scaling-up potential
	▪ Targeted programme under the Strategic Climate Fund ▪ Aimed at demonstrating the social, economic, and environmental viability of low-carbon development pathways in the energy sector; ▪ Supports scaled-up deployment of renewable energy solutions

Programme	Implementing agency / donors	Geographic scope and focus	Funding
Global Environmental Facility (GEF)	**Implementing agency:** Mainly UNDP, UNEP, and World Bank, but also AfDB and others **Donors:** 39 donor countries	Global	▪ Since 1991: US$13.5 billion in grants ▪ Africa: US$3.2 billion (1991-2013)
Global Energy Efficiency and Renewable Energy Fund (GEEREF)	**Implementing agency:** European Investment Bank **Donors:** EU, Germany, Norway	▪ Global ▪ €10 million invested in DI Frontier equity fund with focus on Eastern and Southern Africa ▪ €10 million invested in Evolution One equity fund with focus on Southern African Development Community	▪ €112 million ▪ Equity
Green Climate Fund	**Interim trustee:** World Bank **Donors:** 36 countries	Global	▪ Total announced: US$10.2 billion, of which signed: US$5.8 billion (2015/08/12) ▪ Mixture of grants and loans
Investment funds and programmes for Africa (renewable energy, clean technology)			
Sustainable Energy Fund for Africa (SEFA)	**Implementing agency:** AfDB **Donors:** Denmark, United Kingdom, United States	▪ Sub-Saharan Africa ▪ In 2015, projects in Burkina Faso, Nigeria, Cameroon, Mali, Chad, Comoros, Ethiopia, and Tanzania were approved together with supra-regional projects	US$87 million (grants and equity)
African Renewable Energy Fund (AREF)	**Implementing agency:** Berkeley Energy LLC **Donors:** AfDB, Sustainable Energy Fund for Africa	▪ Sub-Saharan Africa (excluding South Africa) ▪ Will focus on two regions (to be determined)	▪ Fund size US$132 million, target size US$200 million (inception in March 2014) ▪ Closed-end private equity limited partnership
Renewable Energy Performance Platform (REPP)	**Implementing agency:** EIB, UNEP **Donors:** EU	▪ Sub-Saharan Africa ▪ Target regions/countries: West Africa (Sierra Leone, Liberia, Burkina Faso, Ghana, Nigeria) and East Africa (Ethiopia, Uganda, Kenya, Tanzania, Mozambique)	US$15 million

	Main objectives and activities related to renewable energy development
	▪ Serves as financial mechanism for a number environmental conventions (e.g. UNFCCC) ▪ Finances renewable energy technologies, supports renewable energy technology transfer and the removal of barriers to the adoption of renewable energy ▪ Pioneer in the demonstration and deployment of new, pre-commercial technologies in developing countries (e.g. first large-scale concentrated solar power plants in the developing world in Egypt and Morocco) ▪ Demonstration, deployment, diffusion, and transfer of renewable energy technologies
	▪ Fund-of-Funds, invests in private equity funds that specialise in providing equity finance to small and medium-sized clean energy projects in developing countries
	▪ Operating entity of the financial mechanism of the UNFCCC ▪ Thematic funding windows for mitigation and adaptation, private sector facility
	▪ Provides grants to facilitate the preparation of medium-scale renewable energy generation and energy efficiency projects ▪ Engages in equity investments to bridge the financing gap for small- and medium-scale renewable energy generation projects ▪ Supports public sector efforts to improve the enabling environment for private investments in sustainable energy
	▪ Investment into small hydro, wind, geothermal, solar, stranded gas, and biomass projects
	▪ Facilitate the delivery of existing risk mitigation instruments ▪ Assist in identifying appropriate lending facilities ▪ Provide results-based financial support in order to facilitate the realisation of viable projects ▪ Focuses on small- and medium-size projects

Programme	Implementing agency / donors	Geographic scope and focus	Funding
Green Africa Power	**Implementing agency:** GAP is an autonomous legal entity owned by the PIDG Trust **Donors:** UK Government (DECC, DFID) and Norwegian Government	Sub-Saharan Africa	£95 million (€133 million) by UK government and £26 million (€37 million) by Norwegian Government
Nordic Climate Facility	**Implementing agency:** Nordic Development Fund (NDF) and Nordic Environment Finance Corporation (NEFCO) **Donors:** Nordic Development Fund (NDF)	Benin, Burkina Faso, Cape Verde, Ethiopia, Ghana, Kenya, Malawi, Mozambique, Rwanda, Senegal, Tanzania, Uganda, Zambia, Zimbabwe	€1 billion by Denmark, Finland, Iceland, Norway, and Sweden
Investment funds and programmes for Africa (energy sector, infrastructure)			
EU-Africa Infrastructure Trust Fund (EU-AITF)	**Implementing agency:** EIB **Donors:** EU Commission and Member States	Sub-Saharan Africa Focus on East Africa	€536 million in grant operations (2007-2014)
Africa50	**Implementing agency:** Africa50 is a corporation operating on fully commercial terms **Donors:** Aims to attract a variety of investors, including African states, international financial institutions, pensions funds, sovereign wealth funds and private sector entities	Africa	Initial target capitalisation of US$500 million (to be scaled up to at least US$1 billion)
Risk mitigation / Derisking			
Geothermal Risk Mitigation Facility	**Implementing agency:** African Union Commission (AUC), KfW **Donors:** BMZ, EU Infrastructure Trust Fund	Pilot phase: Ethiopia, Kenya, Rwanda, Tanzania, Uganda Second round: Burundi, Comoros, Djibouti, Democratic Republic of Congo, Eritrea, Zambia	€115 million
GET FiT	**Implementing agency:** Uganda's Electricity Regulatory Authority (ERA), Government of Uganda (GoU), KfW, and World Bank **Donors:** Norway, Germany, UK, EU, World Bank	Uganda Expansion to other countries under consideration	€90 million by Norway, Germany, UK and EU plus Risk guarantee by World Bank
World Bank Guarantee Program	**Implementing agency:** Weltbank	Utilised by Morocco, Côte d'Ivoire, Mozambique, Uganda, Ghana, West Africa, Senegal, Sierra Leone, Kenya, Nigeria, Cameroon	N/A

	Main objectives and activities related to renewable energy development
	▪ Finance approximately 270MW of new renewable energy generation capacity in four years ▪ Financial instruments used: mezzanine capital and contingent lines of credit
	▪ Provides grant co-financing between €250 000 and 500 000 for projects that combat climate change and reduce poverty in low-income countries
	▪ Provides grants for regional and cross-border infrastructure projects (including projects relating to renewable energy and energy efficiency) ▪ 62% of grants approved by the ITF to date were in the energy sector (57 grants amounting to €332 million) ▪ Projects supported to date are expected to result in 1.99 GW of additional electricity from renewable energy sources and 14 171 km of transmission or distribution lines installed or upgraded
	▪ Africa50 is an Investment Bank for Infrastructure in Africa which targets private and PPP projects in energy, transport, and mining infrastructure ▪ Aims to narrow the infrastructure finance gap and overcome early-stage bottlenecks
	▪ Encourage public and private investors as well as public-private partnerships to develop geothermal prospects for power generation in Eastern Africa by providing grants ▪ Surface studies and drilling projects
	▪ Fast-track a portfolio of about 20-25 small-scale renewable energy projects (total of 170 MW) ▪ Additional premium payment for renewables ▪ Partial risk guarantee by World Bank ▪ Consultancy on standardising PPAs and other legal documents ▪ General policy consultancy
	▪ Partial Risk Guarantees (PRG) can be structured to protect lenders of limited-recourse project finance debt or to protect the project company ▪ Partial Credit Guarantees (PCG) support commercial borrowing of either the government or non-government borrower (e.g. state-owned utilities, banks) chiefly in support of public investment projects ▪ Policy-Based Guarantees (PBG) is a version of a PCG in support of commercial borrowing of the government for budget financing and to support a reform programme

Programme	Implementing agency / donors	Geographic scope and focus	Funding
African Development Fund Partial Risk Guarantee (ADF PRG)	**Implementing agency:** AfDB	Kenya, Nigeria	**Guarantee volume** US$184.2 million (Nigeria) US$12.7 million (Kenya)
MIGA	**Implementing agency:** MIGA (World Bank)	Angola, Cameroon, Côte d'Ivoire, Ghana, Kenya, Mozambique, Senegal, Uganda	**Guarantee volume** (examples) US$184.2 million for Ghana US$61.5 million for Kenya US$95.4 million for Rwanda
Renewable / Cleaner energy for rural communities			
Energising Development (EnDev)	**Implementing agency:** GIZ (lead) in cooperation with Netherlands Enterprise Agency (RVO) **Donors:** Netherlands, Germany, Norway, Australia, UK, Switzerland Contributions from Ireland and EU	Global Activities in Benin, Burkina Faso, Burundi, Ethiopia, Ghana, Kenya, Liberia, Madagascar, Malawi, Mali, Mozambique, Rwanda, Senegal, Tanzania, Uganda	Phase II (since 2009): €203.9 million ▪ Africa has receives 58% of funding
ElectriFI	**Implementing agency:** To be appointed **Donors:** European Commission	Global, with a focus on Sub-Saharan Africa	Initial allocation of €75 million (long-term subordinated debt through convertible grants)
Lighting Africa	**Implementing agency:** World Bank, IFC **Donors:** Denmark, Global Environment Facility (GEF), Italy, Netherlands	Sub-Saharan Africa Activities in Burkina Faso, Congo, DR, Ethiopia, Kenya, Liberia, Mali, Nigeria, Senegal, South Sudan, Tanzania, Uganda	US$3.2 million (2011, last annual report)
Global Alliance for Clean Cookstoves	**Implementing agency:** Hosted by the United Nations Foundation **Donors:** Canada, Climate and Clean Air Coalition, Finland, Germany, Ireland, Malta, Netherlands, Norway, Spain, Sweden, United Kingdom, USA, World Bank Also corporate donors, foundations, civil society donors	Global Activities in Burkina Faso, Central African Republic, Ivory Coast, Ethiopia, Lesotho, Rwanda, Liberia, Malawi, Niger, South Africa, Sudan, Tanzania Focus countries in Africa: Ghana, Kenya, Nigeria, Uganda	▪ US$50 million grant funding for secretariat activities ▪ US$50 million investment for the sector

	Main objectives and activities related to renewable energy development
	▪ Partial Risk Guarantee related to well-defined political risks (e.g. regulatory risks, breach of contracts)
	▪ Partial Risk Guarantee related to well-defined political risks (e.g. regulatory risks, breach of contracts)
	▪ Promote sustainable access to modern energy services for households, social institutions and small to medium-sized enterprises ▪ Focus on solar home systems, picoPV, hydro mini-grids, biogas, grid connection, improved cookstoves
	▪ Accelerate rural electrification in developing countries by generating business opportunities in this area by supporting the private sector
	▪ Catalyse commercial markets for the delivery of clean, affordable, reliable energy services to some 600 million people not connected to grid electricity
	▪ 10-year goal to foster the adoption of clean cookstoves and fuels in 100 million households by 2020 ▪ Market-based approach that brings together the public and private sectors to help overcome the market barriers that impede the production, deployment, and use of clean cookstoves and fuels

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