

SCALING UP RENEWABLE ENERGY DEPLOYMENT IN AFRICA

DETAILED OVERVIEW OF IRENA'S ENGAGEMENT AND IMPACT

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About IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future and serves as the principal platform for international co-operation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.

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KEY FINDINGS

Endowed with substantial renewable energy resources, Africa can adopt innovative, sustainable technologies and play a leading role in global action to shape a sustainable energy future. The continent could meet nearly a quarter of its energy needs from indigenous and clean renewable energy sources by 2030 and increase the share of renewables in its total energy mix to as much as two-thirds by 2050.

The International Renewable Energy Agency (IRENA) has pursued strategic, results-oriented partnerships with African organisations and development partners since its inception in 2011. In July 2011, IRENA convened a high-level consultative forum where Sub-Saharan African nations identified priority areas for joint action between intergovernmental agencies, governments and regional partners.

The resulting “Abu Dhabi Communiqué on Renewable Energy for Accelerating Africa’s Development” called for an assessment of existing conditions and needs, strengthening national, regional and continental policy frameworks to stimulate investment in renewables, and support for technological research and development through South-South co-operation.

Accordingly, IRENA has adopted a comprehensive, practical approach, providing technical support through regional, country-specific and thematic initiatives. These aim to develop knowledge, establish stronger policy and investment frameworks, and enhance institutional and human capacities to accelerate renewable energy deployment.

This report covers IRENA’s three main channels for engagement in Sub-Saharan Africa:

- i. Regional-level Clean Energy Corridors;
- ii. Country-level Renewables Readiness Assessment (RRA) studies; and
- iii. Activities focused on expanding modern energy access.

IRENA’s regional work has created a strong framework for building technical knowledge and capacity. The Clean Energy Corridor approach has encouraged countries across Eastern, Southern and West Africa to scale up renewable power generation and expand their cross-border electricity trade.

Corridor initiatives are implemented via three core work streams:

- i. Zoning and resource assessment;
- ii. National and regional planning; and
- iii. Enabling Frameworks for investment, which are complemented by cross-cutting capacity building and awareness-raising activities pillars.

Supporting platforms, such as IRENA’s Global Atlas for Renewable Energy, System Planning Test (SPLAT) model, Project Navigator and Sustainable Energy Marketplace platforms, the IRENA-facilitated Global Geothermal Alliance, and a joint project finance initiative with the Abu Dhabi Fund for Development, have been achieving substantial impact on the ground. Long-term outlooks like IRENA’s renewable energy roadmap (REMap) and studies of power generation costs, along with other knowledge work, such as ongoing analysis of auctions and studies of bioenergy potential, have also added substantial value.

At the national level, RRAs consultations provide a holistic evaluation of country-level conditions and identify the key actions needed to overcome barriers to renewable energy deployment. The studies also indicate key policy and regulatory measures needed to accelerate uptake. IRENA then provides post-RRA technical support based on key actions and recommendations for each country.

The benefits of the RRA process include mobilising national stakeholders around key issues; finding consensus-based definitions of essential barriers, strengths and weaknesses; identifying opportunities for capacity building; and highlighting successes that could provide lessons for other countries. RRA findings in turn provide input to regional renewable energy action plans.

Nearly 60% of sub-Saharan Africa's (and nearly half of the continent's) population remains without access to electricity, representing the largest share among all world regions. Initiatives to promote decentralised renewables support healthier and more prosperous communities while mitigating climate change and helping to preserve the environment and natural resources.

IRENA's work under the Energy Access umbrella includes:

- The International Off-Grid Renewable Energy Conference (IOREC), first held in Accra, Ghana in November 2012;
- Certification of Sustainable Energy Skills in the Economic Community of West African States (ECOWAS);
- Creation of the Entrepreneurship Support Facility in the ECOWAS and SADC regions

These initiatives have helped to promote effective policy and regulatory frameworks, greater use of off-grid renewable energy solutions, and the centrality of modern energy access to achieve the Sustainable Development Goals (SDGs) adopted by the United Nations in 2015.

Overall, successes achieved through IRENA's engagement in sub-Saharan Africa reflect several key factors:

- i. High-level of political commitment and support from IRENA Member States;
- ii. Active collaboration from regional organisations and development partners; and
- iii. Strong linkages to regional programmes and initiatives.

Going forward, IRENA will continue strengthening its collaboration with regional organisations and development partners, aiming to maximise synergies and complementarities. Such partnerships are crucial to establish enabling frameworks, reinforce on-the-ground capacities and unleash the continent's renewable energy potential.



INTRODUCTION: GROWING ENGAGEMENT AND IMPACT

This report undertakes an assessment of progress in the implementation of IRENA's various programmes in the Sub-Saharan Africa region and, to the extent available data allows, measures the impact they created on the ground at the regional and national levels. The North Africa region is excluded from this report, except for a few mentions that underpin IRENA's international co-operation role.

The report covers the three main areas for IRENA activities to address African energy issues:

- Clean Energy Corridors at the regional level;
- Renewables Readiness Assessments at the country level;
- Activities focused specifically on the crucial issue of modern energy access.

In addition, IRENA's activities and platforms that support these key activities in the Sub-Saharan Africa are covered in varying detail.

Data needed in preparation of this report has been collected from the following sources: IRENA's institutional documentation such as Annual Reports, Progress Reports, bi/annual Work Programme and Budget, documentation related to IRENA Council and Assemblies, documentation related to IRENA's programmatic activities, IRENA workshop reports and presentations, and staff mission reports. Results of IRENA publications that cover the Sub-Saharan Africa region have been highlighted in the report where they provide additional relevant information. In addition, discussions experts have been interviewed that represent 4 regional bodies, 14 countries, 5 companies, and 11 IRENA staff. Interviews took place over the period August 2018–February 2019. An overview of the interviews is provided in the Annex.

This report is structured as follows: the next section presents the three key activities of IRENA in the Sub-Saharan Africa region and elaborates on the political context and rationale of their development. The subsequent section discusses the progress and achievement that have been made in each of these key activities and in IRENA's platforms that support these key activities. The last section concludes and paves the way forward on how IRENA can expand its work for an effective continuation of the support for transitioning the energy system in the Sub-Saharan Africa region. A summary of this report titled as "Scaling up renewable energy deployment in Africa: Impact overview" was released at the Ninth Session of the IRENA Assembly in Abu Dhabi on 10 January 2019 during the "Africa Ministerial Meeting: Scaling up Renewable Energy Deployment in Africa".

Energy transformation in Africa

Since 2000, many parts of Africa have been experiencing rapid economic growth and improving social conditions. The continent's average real gross domestic product growth reached 3.6% in 2017 and is projected to rise to around 4% in 2018 and in 2019. Given the continent's large and growing population, energy demand will rise quickly in the decades to come.

Endowed with substantial renewable energy resources, Africa can adopt innovative, sustainable technologies and to play a leading role in global action to shape a sustainable energy future. Supply unreliability is a concern holding back economic development, with most countries facing frequent blackouts and often relying on expensive and polluting solutions. Clean, indigenous and affordable renewable energy solutions offer the continent the chance to achieve its economic, social, environmental and climate objectives. Sustainable development and use of the continent's massive biomass, geothermal, hydropower, solar and wind power have the potential to rapidly change Africa's current realities.

Renewables provide the chance to leapfrog to a sustainable, prosperous future for all. Increasing access to reliable, affordable and clean energy resources is a key priority, particularly in sub-Saharan Africa. Around 600 million people in Africa still have no access to electricity, representing 48% of the continent's population of nearly 1.2 billion.

The Sustainable Development Goal on energy (SDG7) is incorporated in the social, economic and sustainability goals of Africa's Agenda 2063. Sustainable energy is at the forefront of the development plans of African nations, recognising its significant role in achieving all SDG 7 targets and mitigating and adapting to climate change. Out of the 53 African nationally determined contributions (NDCs), 45 contain quantified renewable energy targets. These acknowledge the abundant opportunities offered by Africa's vast renewable energy to put the continent on a clean development path.

Africa could meet nearly a quarter of its energy needs from indigenous and clean renewable energy by 2030. Modern renewables amounting to 310 gigawatts (GW) could provide half the continent's total electricity generation capacity. This corresponds to a sevenfold increase from the capacity available in 2017, which amounted to 42 GW. A transformation of this scale in Africa's energy sector would require average annual investment of 70 billion US dollars (USD) to 2030, resulting in carbon dioxide emissions reductions of up to 310 megatons.

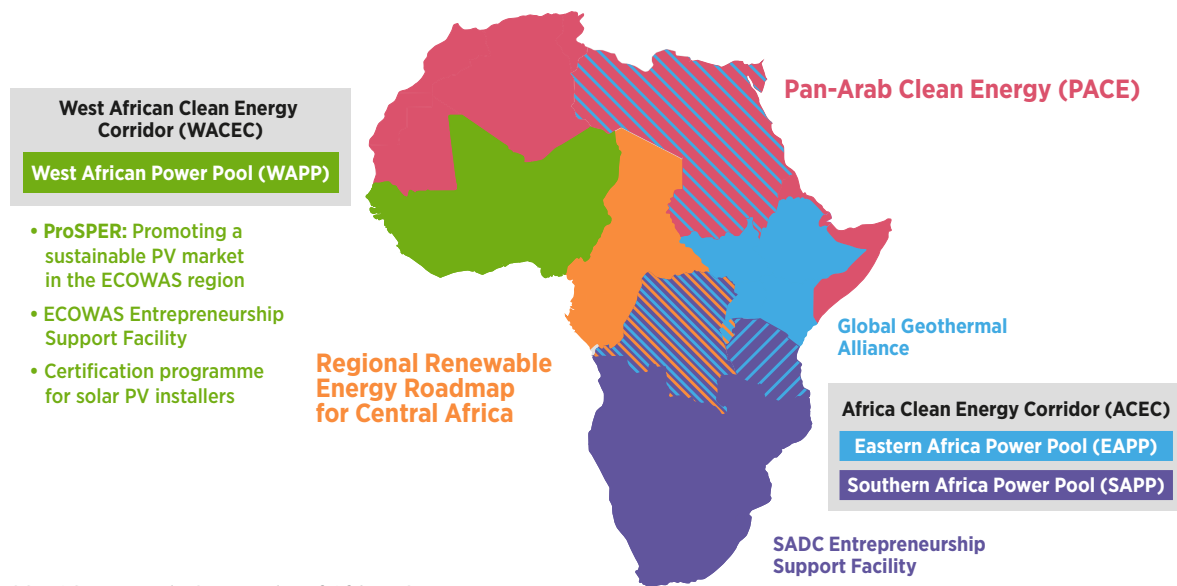
Accelerated deployment of renewables creates jobs and brings health benefits. The renewable energy sector today employs 10.3 million people worldwide. With far-sighted industrial policies and targeted skills development, millions of new jobs can be created in Africa. Doubling the share of renewables by 2030 would create additional economic value by increasing global gross domestic product by up to 1.1%. This would signify a 3.7% improvement in global welfare and jobs for over 24 million people in the renewable energy sector. This would enable further economic benefits such as improved healthcare services, especially in the most remote areas. It would also further support the empowerment of women, who represented 35% of the renewable energy labour force in 2016 and whose role will become more prominent, notably through the productive use of renewable energy.

International co-operation to bring about Africa's energy transformation

IRENA's engagement with Africa on renewables dates to the Agency's formation nearly a decade ago. In July 2011, IRENA convened a high-level consultative forum in which African nations along with development partners formulated renewable energy priorities. A Ministerial Communiqué entitled "Renewable Energy for Accelerating Africa's Development" highlighted Africa's significant potential for renewable energy and addressed the emerging issues related to climate change mitigation and adaptation. To utilise this potential, it underlined the importance of IRENA's strategic presence in Africa and its co-operation with African partners. Over the years, this has been pursued through the development of the Clean Energy Corridors, a key component of IRENA's engagement and its effort to promote regional market integration.

Clean Energy Corridors in eastern, southern and west Africa are helping African countries scale up renewable power generation and cross-border electricity trade. The Clean Energy Corridors in Africa aim to support efforts to meet the continent's fast-growing electricity needs through accelerated development and optimal use of the region's abundant renewable energy resources. The corridors largely focus on utility-scale development of renewables-based electricity with a cross-border trade dimension to benefit from resource efficiency and economies of scale. The Clean Energy Corridor was first established within the Eastern and Southern Africa Power Pools, known as Africa Clean Energy Corridor (ACEC) and then extended to the West African Power Pool, referred to as West Africa Clean Energy Corridor (WACEC).

Figure 1. IRENA's regional engagement in Africa



ECOWAS: Economic Community of African States

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Regional collaboration with North and Central Africa is being strengthened. The Pan-Arab Clean Energy (PACE) initiative provides a regional action plan to scale up renewables in power systems across the Arab region. Its implementation is complemented by IRENA's country-level support, such as through the recent launch of the Egypt renewable energy outlook. The objective is to strengthen an investment framework that will enable cost-effective provision of up to a quarter of Egypt's total final energy supply from renewables in 2030. IRENA also collaborates with the Economic Community of Central African States (ECCAS), supporting the development of a renewable energy roadmap for the sub-region. The roadmap provides a set of specific actions to strengthen enabling policies and regulatory, institutional and financial structures for renewable energy deployment at regional and national levels.

IRENA's regional work has created a strong framework for building technical knowledge and capacity, and for creating investment environments that are more conducive to renewables in a growing number of countries. This success can be attributed to several key factors described below.

IRENA's regional initiatives rest on high-level political commitment and support. An uncompromising aspect of all IRENA's work is its emphasis on local leadership and guidance, and strong ownership by all involved. The implementation of the Africa Clean Energy Corridor (ACEC) is guided by the Ministerial Communiqué that endorsed the ACEC Action Agenda in January 2014 and contributed to the development of Africa's flagship climate action programme, the Africa Renewable Energy Initiative (AREI). Enjoying broad political support from the region, the West Africa Clean Energy Corridor (WACEC) was adopted by the Economic Community of West African States (ECOWAS) Council of Ministers as an annex to the ECOWAS Treaty in December 2016. This was then endorsed by the Summit of ECOWAS Heads of States in June 2017. In March 2017, the African Union recommended the integration of the Clean Energy Corridors into national renewable energy and climate change agendas. The PACE initiative was adopted by the League of Arab States, while the Central Africa roadmap, which was technically validated in November 2018, is set to receive the endorsement of Central African Heads of State. IRENA has also pursued strategic, results-oriented partnerships with various African organisations and development partners active in the field of renewables, aiming to leverage existing efforts, avoid duplication and maximise long-term impact.

Strong linkages to regional programmes and initiatives help benefit from synergies and complementarities. From the outset, all efforts have been fully aligned with the Program for Infrastructure Development in Africa (PIDA), and since March 2018, IRENA holds observer status with the PIDA steering committee. Through this participation, IRENA has engaged with the African Union and the New Partnership for Africa's Development (NEPAD) in the formulation of the next phase of PIDA. This next phase is intended harness Africa's vast renewable energy potential in continental infrastructure planning to 2030 beyond the current emphasis on hydropower and geothermal resources. Given the full alignment of respective objectives, IRENA also closely co-ordinates its work on the Clean Energy Corridors with the AREI.

Concrete outcomes and impact have been attained on the ground. IRENA's initiatives are tailored to regional and country-specific needs and priorities. They are implemented through three core work streams, namely resource assessment and zoning, national and regional energy planning, and enabling frameworks for investment. These are complemented by cross-cutting capacity building and awareness-raising activities. The resulting work has brought about a range of valuable and tangible outcomes.

i. Mapping out resource-rich and cost-effective areas for solar and wind development

Renewable energy resource assessment and zoning analysis has identified high resource potential and cost-effective power generation zones for utility-scale wind, solar PV and concentrated solar power (CSP) development across eastern, southern and West Africa (see Figure 2). Based on this work, the financial viability and bankability of more than 90 solar PV and wind project sites have been assessed in ten African countries so far.



Photograph: Shutterstock

Box 1. Resource assessment using IRENA's Global Atlas for Renewable Energy

Featuring data from a consortium of more than 50 international research institutions, the Global Atlas is the world's largest collection of the most recent and most accurate public maps of renewable energy resources. The Global Atlas plays a vital role in IRENA's activities in Africa.

Based on wind and solar information in the Global Atlas, zoning maps of all 21 ACEC countries have been drawn. For the ACEC region, the zoning exercise revealed an aggregate economic potential of up to 3,834 GW for wind, 15,334 GW for solar PV and 5,282 GW for solar CSP. This study considered quantitative assessments of renewable energy resources as well as several parameters underpinning investment decisions, such as topography, distance to the grid and load centres, transport infrastructure and protected areas. National stakeholders have been trained in the use of the methodology and maps so that they can later re-run the model with new or updated data to get refreshed zoning results. IRENA also assessed the electricity generation potentials of solar and wind using GIS satellite maps from the Global Atlas to support long-term energy planning.

Under the resource assessment pillar of the WACEC, IRENA developed its suitability analysis using the Global Atlas. The suitability analysis helps identify areas that would be suitable for grid-connected and off-grid solar and wind projects. This exercise was carried out at the regional level in West Africa and uncovered total technical potential of up to 128 GW for on-grid wind, 171 GW for off-grid wind, 1,451 GW for on-grid solar PV and 1,830 GW for off-grid solar PV.

When trying to establish the renewable energy potential for a large region, suitability analysis and zoning are two distinct but complementary geospatial tools available. Although their goals are similar, the former is a quicker first-cut approach. Results take the form of map pixels representing suitable areas that can be sensibly aggregated to estimate the potential. The methodological approaches of these two tools, especially concerning considerations on the impact of grid availability, area clustering, costing information and major differences in size and overall resource potential of a region, explain the difference in the technical potential output for the two sets of regions.

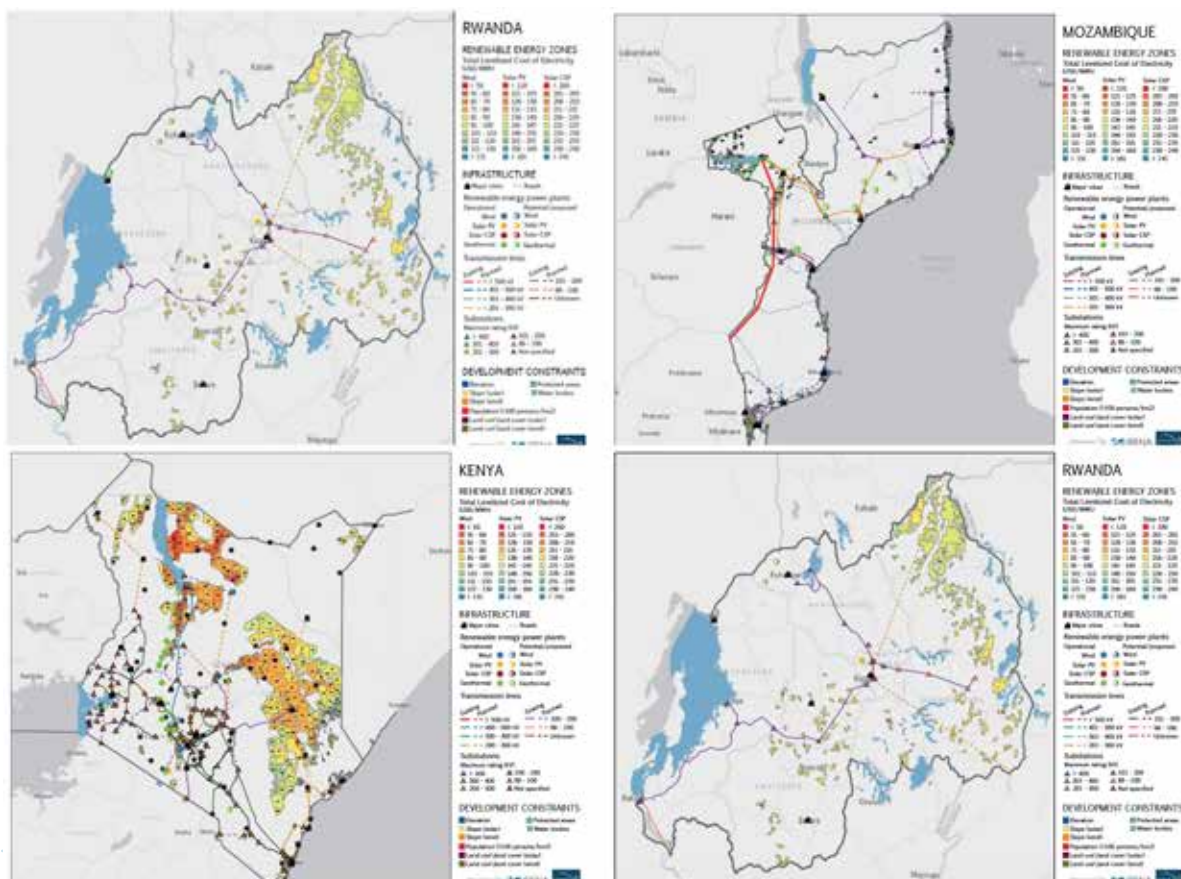
To support renewable energy investments and financial decisions prioritised by the African countries, IRENA developed its site appraisal service. This is a financial pre-feasibility analysis to provide a benchmark tariff to help guide the interactions between governments and project developers. In this way, local authorities and prospective project developers acquire a clearer understanding of the economic feasibility and investment needed to develop the sites.

The site assessment service has been used so far to evaluate solar PV and wind project sites in Cabo Verde, Comoros, Eswatini (formerly Swaziland), Mali, Morocco, Nigeria, Sudan, Togo, Zambia and Zimbabwe. Together, these amounts to prospective installed capacity 3,178 megawatts (MW) of solar PV and 2,359 MW of wind projects.

ii. Integration of least-cost investment options into national and regional planning

The outcomes of resource assessments have provided essential input into long-term planning processes at regional and national levels. IRENA's in-house planning model is configured to support long-term power generation expansion plans at continental, regional and national levels. This allows decision-makers to assess least-cost investment options in light of a specific policy goal, such as increased renewables penetration, reduced import dependency and improved electricity affordability. IRENA's input has been indispensable in the development of the master plans. For example, IRENA has contributed to the update of the West African Power Pool (WAPP) master plan by supporting the collection of reliable data on renewable energy potentials and costing, as well as through its regional planning report for West Africa. At national level, IRENA supported the development of the Eswatini Energy Masterplan 2034 launched in October 2018 (see Box 2). This included a comprehensive programme of national training, development of the national energy planning model and technical support on the development of the Masterplan report. Similarly, a national support programme is currently under way with Sierra Leone to support the elaboration of a national energy masterplan to 2040; and another is planned for Cameroon.

Figure 2. Zoning maps highlight promising solar and wind sites



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Box 2. Eswatini Energy Masterplan to 2034

The Renewables Readiness Assessment (RRA) for Eswatini (formerly known as Swaziland) featured long-term energy planning among its priority areas of action. IRENA and the Government of Eswatini subsequently launched a two-year capacity building programme for energy planning. This included a comprehensive national training programme, technical support for development of the national planning model and advising on the draft Masterplan. The Eswatini Energy Masterplan 2034 was developed by a national working team with members from key stakeholder institutions. It provides national decision-makers with a quantitative basis for planning the energy sector developments, particularly by identifying and addressing country-specific barriers in the supply of energy. Launched in October 2018 upon its endorsement by the Cabinet, the Energy Masterplan 2034 defines a national energy sector pathway that balances the affordability of energy with a move towards a sustainable energy supply future.

Investment frameworks more conducive to renewables

Supporting countries as they strengthen their policy, regulatory, technical and financial frameworks is a key priority. Through a country-led, multi-stakeholder RRA process facilitated by IRENA, 14 African countries have assessed the suitability of their existing conditions for sustained deployment of renewable energy and identified key actions to accelerate deployment.

IRENA's continuous engagement with countries during the post-RRA implementation phase, as well as the prompt formulation of assistance by development partners on the basis of RRA recommendations, have played a significant role in creating investment conditions that are more conducive to renewables in Africa.



Local capabilities enhanced across the renewable energy value chain

Capacity building is a central priority in African countries. Over the years, IRENA has provided numerous services targeting policy makers as well as other energy stakeholders who could play a part in accelerating the deployment of renewables. IRENA pays particular attention to areas where it can add most value. For example, in recognition of the essential role of reliable data, energy statisticians across Africa have been trained in the collection, processing and dissemination of renewable energy data as well as the construction of national renewable energy balances. Regional activities are adjusted to specific needs while aiming to capitalise on experiences and best practice for the benefit of the Agency's wider membership. In the Southern African Development Community (SADC) region, IRENA first organised a Renewable Energy Training Week in November 2015. This training helped regional and national regulatory authorities assess their existing planning processes vis-à-vis global best practices for empowering regulatory roles to provide greater investment certainty and ensure timely project delivery. The recent IRENA report on renewable energy auctions in sub-Saharan Africa summarised the implementation practices in auction design and impacts from the recent processes undertaken in South Africa, Uganda and Zambia to support peer-to-peer learning and exchange of experiences on the continent.

In West Africa, IRENA's capacity development focus corresponds to the region's ambition for greater solar and wind deployment. It includes grid planning and operation with variable renewables, as well as for devising power purchase agreements for renewable power. Two different courses of regional training have been provided to national stakeholders from 14 WAPP countries. Firstly, training on grid integration of variable renewable energy took place in May 2018 complemented by a study tour in China hosted by IRENA and the State Grid Corporation of China. Secondly, two rounds of training on renewable energy power purchase agreements were held in 2018. Follow-up activities have been drawn up for both components for the next phase of programme implementation.

iii. Improved project bankability and facilitation of finance

IRENA has a suite of tools and methodologies to support development and access to financing for renewable energy projects (see Box 3). The IRENA Project Navigator has provided training at sub-regional and national levels to support the development of bankable renewables projects. IRENA's Sustainable Energy Marketplace has actively promoted and facilitated access to finance for 79 projects in 24 African countries, which were seeking total investment of more than USD 3 billion. IRENA has recommended 13 transformative and scalable renewable energy projects with strong sustainable development benefits in 12 countries in Africa to the Abu Dhabi Fund for Development (ADFD) for USD 126.5 million in concessional co-funding (50% of the project costs) with the rest coming from other development funds and governments. Projects selected have included solar PV/diesel mini-grids in Mali selected in the 1st cycle that are at construction and operational, a solar PV rooftop kits programme in Mauritius selected in the 5th cycle which is advancing to implementation quickly, solar PV utility scale and wind power mini-grids and hydro projects. Since the first cycle, USD 3.75 billion have been requested in concessional loans for projects in Africa out of USD 5.9 billion for all developing countries globally through the IRENA/ADFD Facility.

The Project Navigator platform
enables training at sub-regional
and national levels

Box 3. Project facilitation platforms

IRENA has supported the development of bankable renewable energy projects and easier access to suitable financing through a range of largely web-based project facilitation tools. Notably, these include Global Atlas for Renewable Energy (Box 1), Project Navigator and Sustainable Energy Marketplace tools.

The Project Navigator's online platform provides comprehensive, easily accessible and practical information, tools and guidance to assist in the development of bankable renewable energy projects. The Navigator introduces a project life cycle process structured into several distinct phases and designed to support the progressive development of renewable energy projects. At this stage, technical concept guidelines are available for onshore wind, solar PV, woody biomass, small hydropower, mini-grids and solar home systems. The Navigator, available in French too, will continue to be used to support the development of bankable renewables projects across the continent. IRENA's Sustainable Energy Marketplace is an online matchmaking platform that connects project developers, financial institutions, and service and technology providers. Initially covering the ACEC countries, the platform was announced at the South Africa International Renewable Energy Conference (SAIREC) in October 2015. Currently, the Sustainable Energy Marketplace provides access to over 160 financing instruments and 10 service and technology providers.

iv. Amplified off-grid impact

Regional capacity building in West Africa has helped to strengthen development, management and financing for off-grid solar solutions. Through follow-up programmes in the region, IRENA has supported:

- Improvements to the skills of renewable energy professionals through a regionally harmonised certification system recognised in all ECOWAS countries and currently being piloted for certification of off-grid solar PV technicians in Ghana and Senegal.
- Capacity development of over 80 small and medium-sized renewable energy developers to help them improve their business operations and raise over USD 1 million from local financial institutions (see Box 4). The programme is now being replicated in the SADC region.



Box 4. Renewable Energy Entrepreneurship Support Facility

In partnership with the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE), and the International Institute for Water and Environmental Engineering (2ie), IRENA established the ECOWAS Renewable Energy Entrepreneurship Support Facility in 2015. The facility aims to enhance and strengthen the capacity of small to medium-sized entrepreneurs in the renewables sector.

Through capacity building, technical advisory and mentorship support, over 80 enterprises from all 15 ECOWAS member countries have so far been assisted over three annual cohorts. Approximately USD1 million in debt financing was accessed through the project proposals submitted to local funding institutions. The facility also contributed to the creation of the Regional Solar PV Professionals Association.

In conjunction with the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE), IRENA is replicating the initiative in southern Africa. Established in 2017, the facility has attracted nine partners comprising funding institutions, business incubation centres and technical training centres. With a focus on gender and youth development, the first call for applications for entrepreneurs to be supported through the facility was issued in 2018, followed by additional calls in 2019.

A stronger role for geothermal energy

While Kenya has been the centre of geothermal development so far, new projects for geothermal power generation and direct heat utilisation are planned in the region. However, the large geothermal potential remains mostly untapped, notably along the East African Rift System. Ten African countries and five regional African organisations have become members or partners in the Global Geothermal Alliance, a global platform facilitated by IRENA to promote development in this key sector through enhanced dialogue, co-operation and co-ordinated action. For the Global Geothermal Alliance, resource and market assessment are a key priority action area. In this respect, Ethiopia has been identified as a pilot country to apply international guidelines and promote standardisation in the way resource assessment is conducted, reviewed and reported. Further IRENA work aims to overcome barriers relating to high upfront costs, investment risks, policy uncertainty, shortage of skilled professionals and environmental concerns. The ongoing market assessment in East Africa will provide scope for future regional co-operation on geothermal energy, including for direct utilisation.



Box 5. The International Off-grid Renewable Energy Conference and Exhibition

The International Off-grid Renewable Energy Conference (IOREC) is the global collaborative platform convened biennially by IRENA for sharing experience and best practices in deploying off-grid stand-alone and mini-grid renewable energy solutions. Africa has hosted two IORECs – one in Ghana in 2012 and one in Kenya in 2016.

Each IOREC has emphasised that modern energy access is central to achieving the SDGs. They have all concluded that governments should consider the entire spectrum of opportunities available from off-grid renewable energy solutions to expand affordable, reliable and sustainable access to households, support livelihoods, enhance delivery of essential services (e.g. health) and strengthen gender equality. National electrification strategies should mainstream off-grid renewable energy solutions and facilitate co-operation between actors. To ensure private sector involvement in energy access, the policy and regulatory framework should provide the right set of incentives and risk coverage to private investors. It should alleviate the barriers that block financing in the sector.

The fourth IOREC that concluded in Singapore in 2018 was followed by the International Conference on Renewable Energy Solutions for Healthcare Facilities. Participants stressed the urgent need for increased co-operation between energy and health sectors at all levels, from strategy and planning to policies, budgeting, procurement and implementation. There is a particularly strong need for innovation in delivery and financing models, and dedicated financing schemes by banks and financing institutions. Innovation should also be encouraged and promoted in the design of suitable and efficient medical devices appropriate for rural areas. Implementing the right ecosystem for accelerating off-grid renewable energy deployment requires efforts to develop the necessary human capital by building capacity across the off-grid value chain and supporting local entrepreneurship.

IRENA pursues strategic, results-oriented partnerships with various African organisations and development partners active in the field of renewables. These aim to leverage existing efforts and resources but also to establish regional dialogues, support the creation of adequate enabling frameworks, reinforce capacities with a view to learning from best practices globally, and release local renewable energy potential in the best possible way.

In the implementation of its mandate in Africa, IRENA has been collaborating with regional partners including, among others, the Africa Union Commission (AUC), the African Development Bank (AfDB), the Africa Renewable Energy Initiative (AREI), the Common Market for Eastern and Southern Africa (COMESA), the Economic Community of Central African States (ECCAS), the Economic Community of West African States (ECOWAS), the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE), the ECOWAS Regional Electricity Regulatory Authority (ERERA), the League of Arab States (LAS), the New Partnership for Africa's Development (NEPAD), the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE), the Regional Electricity Regulators Association of Southern Africa (RERA), the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE), the Southern Africa Development Community (SADC), the Southern African Power Pool (SAPP) and the West African Power Pool (WAPP) as well as development partners and other members of IRENA. These include the German Agency for International Co-operation (GIZ), the Government of Luxemburg, Power Africa, Sustainable Energy for All, the European Union, the Government of Norway, the Government of Wallonia, the International Atomic Energy Agency, the State Grid Corporation of China and the United Arab Emirates.

AFRICAN ENERGY CHALLENGES AND OPPORTUNITIES

In an era of accelerating change, the imperative to limit climate change and achieve sustainable growth is strengthening the momentum of the global energy transformation. The rapid decline in renewable energy costs, improving energy efficiency, widespread electrification, increasingly “smart” technologies, continual technological breakthroughs and well-informed policy making all drive this shift, bringing a sustainable energy future within reach.

Climate change mitigation, reducing local air pollution, improving energy security and socio-economic benefits are among the key drivers for energy transition worldwide. The historic climate accord from 2015 seeks, at minimum, to limit average global temperature rise to “well below 2°C” in the present century, compared to pre-industrial levels. Renewables, in combination with rapidly improving energy efficiency, form the cornerstone of a viable climate solution.

Renewables are recognised as mainstream energy source in all nations globally. They are now cost-competitive offering grid services like balancing. Enabling solutions are also becoming economically viable allowing renewables to be integrated to the grid. These developments have been boosted by consumers’ goals to reach reliable, affordable and clean sources of energy. These trends will continue being enabled by a virtuous cycle as costs decline further and new approaches emerge to integrate more renewables to the energy system.

The generation costs for most onshore wind projects that came online in 2018 fell into a range of USD 0.044-0.1 per kilowatt-hour (kWh). This range corresponds to the lower end of the generation costs of electricity from fossil fuels. Developments in solar photovoltaic (PV) is following onshore wind’s trends. Average costs of generation dropped to USD 0.056/kWh by end of 2017 with costs of many projects well below this average making solar PV one of the cheapest sources of energy. Solar PV and all other renewable power generation technologies that are now in commercial use are expected to fall within the fossil fuel-fired cost range, with most at the lower end or undercutting fossil fuels.

These developments resulted in a record high installation of renewable generation capacity in 2018 of 171 gigawatt (GW), an increase of 7.9% compared to the renewable capacity installed in 2017. At the end of 2018, a total of 2,351 GW renewable energy generation capacity was in place globally. Solar photovoltaic (PV) installations took first place with a capacity increase of 94 GW, higher than any other source of electricity. This was followed by wind with an increase of 49 GW. With these developments, renewable energy’s share in total global electricity generation exceeded 25% by end of 2018. Wind and solar PV’s share represents around 4% of the total generation. Much of the renewable power still comes from hydropower plants.

Efficiency of the global energy system has improved on average by 1.7% in 2017 (at the time of writing this report, no data was available for 2018).¹ The average improvements over the 2011 - 2016 period were higher at 2.1%. Indeed, this is a significant rise in the rate of improvements compared to what has been achieved between 1990 and 2010, but there remains a gap to be bridged before attaining the seventh Sustainable Development Goal 7 (SDG7) target of an annual improvement rate of 2.7% by 2030.

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While the transformation is gaining momentum, it must happen faster. Around two-thirds of global greenhouse gas (GHG) emissions stem from energy production and use, which are at the core of climate change. To meet climate goals, a decarbonised power sector dominated by renewables is at the core of the transition. According to IRENA's REmap scenario (*Global Energy Transformation: A roadmap to 2050*; IRENA, 2019e; IRENA 2018b), the share of renewables in the power sector required to limit the rise in global temperature to below 2°C would increase from 25% in 2018 to 86% by 2050, mostly through growth in solar and wind. This transformation would require new approaches to power system planning, system and market operations, and regulation and public policy. Universal energy access is a key component and beyond access, huge disparities that exist at present in the energy services available in different regions will need to be addressed. Substantial additional investment in low-carbon technologies will be required compared to current and planned policies. Cumulative investment in the energy system between 2015 and 2050 will need to increase by around 30%, from USD 95 trillion if the global energy system follows current and planned policies, to USD 110 trillion to enable the energy transition.

IRENA's analysis shows that pursuing a climate scenario in line with the goals of the Paris Climate Agreement, where a transition fuelled by accelerated deployment of energy efficiency and renewable energy technologies plays the key role, would result in economic growth, more jobs and a cleaner environment that would improve human health. There are also welfare benefits of energy transition across economic, social and environmental aspects which are not necessarily captured by gross domestic product. Early action will be critical to limit the planet's temperature rise to 2 degrees Celsius (°C), and maximise the benefits of the energy transition while reducing the risk of stranded assets. Acting early is also critical to feasibly maintain the option of limiting the global temperature rise to 1.5°C.

Energy transition in Africa

Endowed with significant renewable energy resources, a rapidly growing economy and a large population with increasing energy demand, Africa's role as one of the global leaders is crucial to accelerate the transition to renewable energy.

Since 2000, Africa has experienced rapid economic growth and improving social conditions. Average annual growth in real gross domestic product reached 3.6% in 2017 and is projected to rise to around 4% in 2018 and in 2019. Given the continent's large and growing population, energy demand in Africa will rise quickly in the decades to come.

Increasing access to reliable, affordable and clean energy resources, however, remains as a challenge, particularly in the Sub-Saharan Africa region. Endowed with substantial renewable energy resources, Africa can adopt innovative, sustainable technologies and to play a leading role in global action to shape a sustainable energy future. Supply unreliability is a major concern holding back economic development, with most countries facing frequent blackouts and often relying on expensive and polluting solutions. Clean, indigenous and affordable renewable energy solutions offer the continent the chance to achieve its economic, social, environmental and climate objectives. Sustainable development and use of the continent's massive biomass, geothermal, hydropower, solar and wind power have the potential to rapidly change Africa's current realities.

Compared to North Africa which is almost fully electrified, in Sub-Saharan Africa around 600 million people still does not have access to power. This represents 48% of the continent's nearly 1.2 billion population. Close to 70% of rural areas are not connected to the grid. The remaining population has access to power, but still faces frequent blackouts and issues related to power quality. Power shortages and high energy tariffs cost around 2-4% of the annual GDP. Energy is also at the core of Africa's social and economic development. Much of sub-Saharan Africa suffers from lack of infrastructure that limits economic growth, productivity, profitability and the region's competitiveness worldwide. New infrastructure is needed, and existing systems need to be modernised. This will require significant demand for materials like steel, concrete and machinery. The region is expected to see the highest growth in demand for such materials worldwide. Africa's growing population mainly in cities, but also in rural areas will need new systems for transport and mobility. To meet all this growing demand, new sources of energy will need to be sought.

Africa deserves a strong energy future for its people and for its businesses. The challenges Africa faces related to energy and access to need to be urgently addressed, primarily for its citizens and given its essential role as a rapidly growing energy consumer for the global energy transformation (see Table 1). Renewables will provide the solution. To enable the utilisation of the region's vast potential, a thorough understanding of the potential of renewable energy resources at region and country level, long-term planning techniques and new and innovative policy frameworks and finance models to utilise them in the most cost-effective way, and efforts to create awareness and institutional and human resource capacity will be needed.

Table 1. Challenges and opportunities of Africa's energy sector

| | Challenges | Opportunities |
|--|---|--|
| Financing and investments | <ul style="list-style-type: none"> • High costs inherent to the energy sector • Limited access to funding • Creditworthy utilities/ Insufficient cost recovery • Elastic demand/Affordability • Foreign exchange risk | <ul style="list-style-type: none"> • Investing in cost reducing technology • Collaborative Investing/Engaging local investors • Alternative financing sources -such as bonds • Increasing partial risk guarantees • Enhanced refinancing opportunities |
| Policy, regulatory and institutional frameworks | <ul style="list-style-type: none"> • Lack of competition to networks • One-off PPAs • Inefficient tendering processes • Breach of contracts • Vested interests in established business models • Inability to raise tariffs to cover costs | <ul style="list-style-type: none"> • Utility unbundling to open up competition • Setting multi-year tariffs - with adjustment clauses • Clear renewable energy targets • Aligning with climate and sustainability targets • Clear and transparent procurement process |
| Information and technical capacity | <ul style="list-style-type: none"> • Limited technological capabilities • Weak judicial systems • Non-harmonised regional regulatory frameworks • Bureaucratic procedures • Uneven policies in different countries | <ul style="list-style-type: none"> • Streamlining public agencies • Education on risk mitigation • Research and development • Strengthening regional capacity and co-operation |

Total installed renewable energy capacity exceeded 35.7 GW in 2018 in the Sub-Saharan Africa. Much of the total renewable energy is related to hydropower. Just less than 13.8 GW was related to non-hydro renewables like solar, wind and geothermal (see Figure 3).

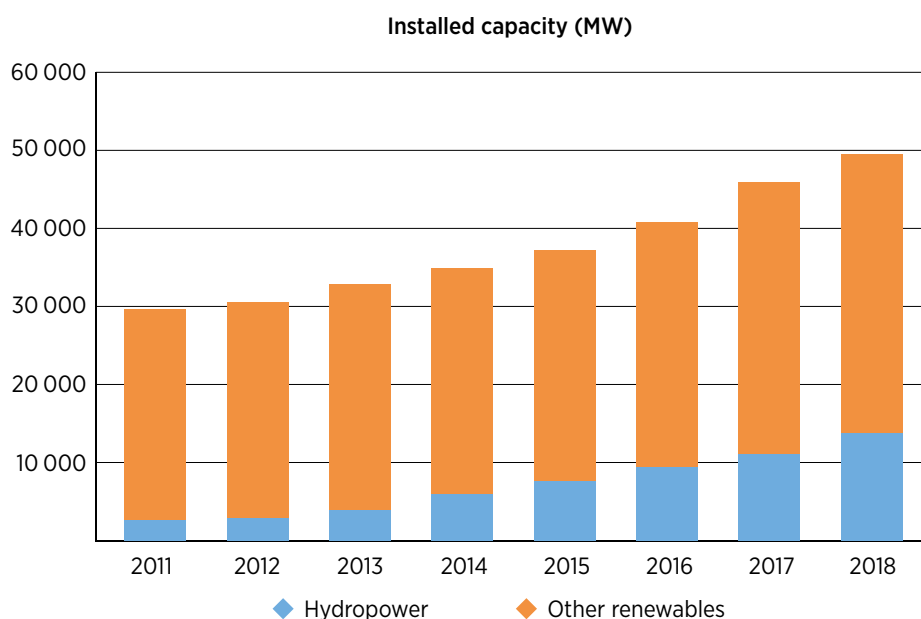
According to the latest data from the International Energy Agency (IEA), renewables account for a quarter of Africa’s total electricity generation. Renewable sources other than hydropower represent around 4% of the total generation. The largest non-hydro renewable contributor is geothermal, followed by wind, biofuels and solar PV.

SDG7 is incorporated in the social, economic and sustainability goals of Africa’s Agenda 2063. Sustainable energy is at the forefront of the development plans of African nations, which recognise its crucial role for achieving all SDG targets and mitigating and adapting to climate change. Out of the 53 African nationally determined contributions (NDCs), 45 contain quantified renewable energy targets. Acknowledging the abundant opportunities offered by Africa’s vast renewable energy to put the continent on a clean development path

Africa could meet nearly a quarter of its energy needs from indigenous and clean renewable energy by 2030. Modern renewables amounting to 310 GW could provide half the continent’s total electricity generation capacity. This corresponds to a seven-fold increase from the capacity available in 2017, which amounted to 42 GW. A transformation of this scale in Africa’s energy sector would require average annual investment of USD 70 billion to 2030, resulting in carbon dioxide (CO₂) emissions reductions of up to 310 megatonnes (Mt) (IRENA, 2015).

Accelerated deployment of renewables creates jobs and brings health benefits. The renewable energy sector today employs 10.3 million people worldwide. With far-sighted industrial policies and targeted skills development, millions of new jobs can be created in Africa. Doubling the share of renewables in the global final energy mix by 2030 would create additional economic value by increasing global gross domestic product by up to 1.1%. This would signify a 3.7% improvement in global welfare and jobs for over 24 million people in the renewable energy sector. This would enable further economic benefits such as improved healthcare services, especially in the most remote areas. It would also further support the empowerment of women, who represented 35% of the renewable energy labour force in 2016 and whose role will become more prominent, notably through the productive use of renewables.

Figure 3. Total installed renewable energy capacity in Sub-Saharan Africa, 2011-2018



The growing importance of access to reliable, affordable and clean energy in the region has put investments in the energy sector as a priority in the agenda of many African governments, regional bodies and international funders. This has led to the emergence of multiple programmes. The Official Development Assistance (ODA) to Sub-Saharan Africa on energy has increased by six times between 2003 and 2016 from around USD 750 million to USD 4.7 billion (the cumulative ODA volume between 2009 and 2013 amounted to USD 19.8 billion). Multilateral donors represent half of this total. Two-thirds of the total amount have flown to eastern and west Africa, with the remaining one-third being covered predominantly in southern Africa. Central African countries' share was 8% of the total ODA volume received by the Sub-Saharan countries.

There are numerous on-going initiatives in the region that address energy issues. These initiatives take different forms. Few are high-level programmes and partnerships. Operative programmes are most common, and they have country or technology-specific (e.g. renewables, efficiency, electricity) focus, but also include consultation platforms at the regional level (see Table 2). The geographical spread provides interesting insights: in many of eastern and west African countries, more than 10 initiatives are ongoing whereas in others at least 5 are operational. There are high levels of private-sector involvement in initiatives, as opposed to low levels of civil society participation. While renewable energy and electricity are the main sectors covered by the initiatives, there is scope for more programmes on cooking energy. In terms of assistance provided, skill development is the area that receives the least focus.



Photograph: Shutterstock

Table 2. Overview of energy-related initiatives in Africa (status of May 2016)

| High-level Initiatives | |
|---|--|
| Africa Clean Energy Corridor | Africa Renewable Energy Initiative (AREI) |
| Africa Energy Leaders Group (AELG) | Presidential Infrastructure Champion Initiative |
| Africa EU Energy Partnership (AEEP) | Programme for Infrastructure Development in Africa (PIDA) |
| Africa Power Vision | SE4ALL (Africa Hub) |
| High-level Initiatives with an operative program | |
| Africa 50 | New Deal on Energy for Africa |
| Africa Renewable Energy Access Program (AFREA I&II) - ESMAP | Power Africa |
| Electrifi | Public Private Infrastructure Advisory Facility (PPIAF) |
| | World Bank Guarantee Program |
| Global Alliance for Clean Cookstoves | |
| Operative Programmes and Delivery Mechanisms | |
| ACP-EU Energy Facility | GET FiT Uganda |
| AFREA Gender and Energy Programme | Global Energy Efficiency and Renewable Energy Fund (GEEREF) |
| Africa Clean Cooking Energy Solutions Initiative (ACCES) | Green Mini-Grids Africa Regional Facility |
| Africa Energy Guarantee Facility (AEGF) | IRENA/ADFD Project Facility |
| Africa Enterprise Challenge Fund (AECF) | Lighting Africa |
| Africa-EU Renewable Energy Cooperation Program (RECAP) | Mediterranean Solar Plan (MSP) |
| African Development Bank Partial Risk Guarantee (PRG) | NEPAD Bioenergy Programme for Africa |
| Africa Renewable Energy Fund (AREF) | NEPAD Continental Business Network (CBN) |
| Biofuels Programme for Household and Transport Energy Use | NEPAD Infrastructure Project Preparation Facility (NEPAD-IPPF) |
| Carbon Initiative for Development (Ci-Dev) | PIDA Service Delivery Mechanism (SDM) |
| Clean Technology Fund (CTF) | Private Infrastructure Development Group |
| EAP Africa - Energy and Environment Partnership | Regional Energy Project for Poverty Reduction |
| Energizing Development (EnDev) | Regional Technical Assistance Program (RTAP) |
| Energy Access Ventures | Renewable Energy Performance Platform (REPP) |
| Energy Africa Campaign | Renewable for Poverty Reduction Program (REPoR) |
| EREF - ECOWAS Renewable Energy Facility | Renewable Energy Solutions for Africa (RES4Africa) |
| EU-Africa Infrastructure Trust Fund (ITF) /Africa Investment Facility (AfIF) | Scaling Solar |
| EU Development Finance Institutions (EDFIs) Private Sector Development Facility | Strategic Climate Fund - Scaling Renewable Energy Program (SREP) |
| EU Energy Partnership Dialogue Facility (EUEIPDF) | Sustainable Development Investment Partnership (SDIP) |
| European Union's Technical Assistance Facility (TAF) | Sustainable Energy Fund for Africa (SEFA) |
| Geothermal Risk Mitigation Facility | |

Source: Africa-EU Energy Partnership

1 IRENA'S THREE KEY WORK STREAMS IN SUB-SAHARAN AFRICA

On 8-9 July 2011, Ministers of Energy and heads of delegations of African countries and the African Union (AU) Commission and the Conference of Energy Ministers of Africa (CEMA), met at the invitation of IRENA in Abu Dhabi, for the IRENA-Africa High-Level Consultations on Partnerships on Accelerating Renewable Energy. At the end of this meeting that was hosted by the Government of the United Arab Emirates (UAE), the “Abu Dhabi Communiqué on Renewable Energy for Accelerating Africa’s Development” was released.

The consultations were guided by the February 2009 AU Assembly of Heads of State and Government decision to: “develop renewable energy resources in order to provide clean, reliable, affordable and environmentally friendly energy,” (Assembly/AU/Decl. 9-XII) and the November 2010 Maputo Declaration of the Conference of Energy Ministers of Africa to “promote renewable energy in a joint effort with others to ... address all issues relating to climate change...”. To inform and invite participants for commenting on priority energy issues and required strategies, identifying the relevant stakeholders and developing engagement, IRENA released the “Scenarios and Strategies for Africa” in 2011.

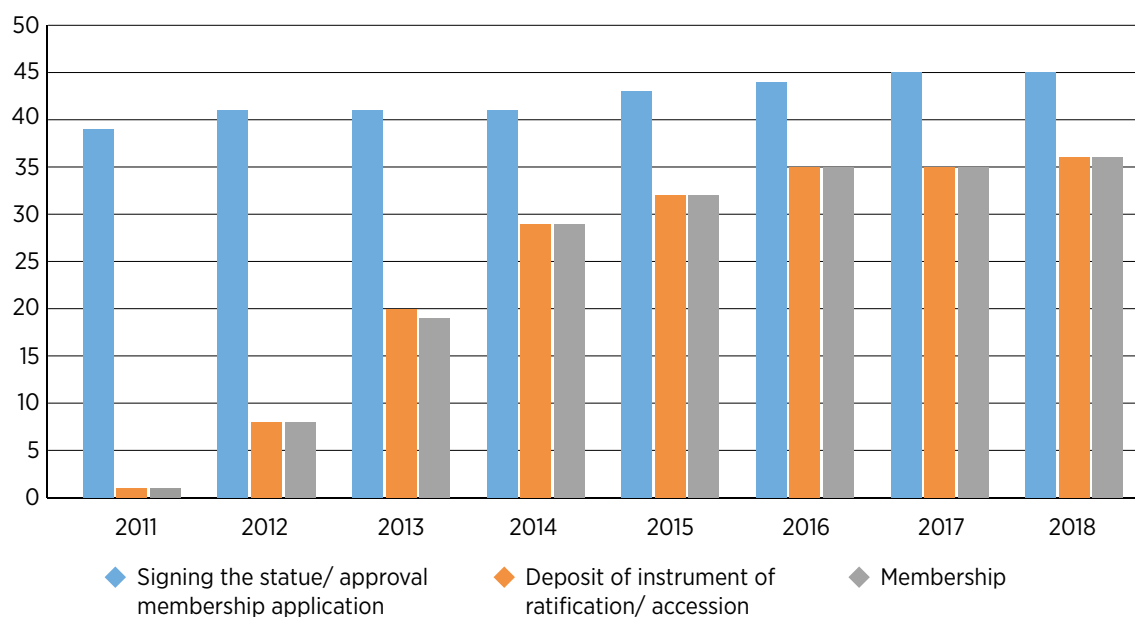
The Communiqué highlights Africa’s significant potential of renewable energy to accelerate its low-carbon development and addresses the emerging issues related to mitigation and adaptation to climate change. To accelerate the utilisation of this potential, meeting participants highlighted the crucial role of working with the IRENA and agreed on several next steps:

- Launch a concerted effort among all stakeholders to promote the intensive utilisation of the renewables potential for Africa’s development
- Using the “Renewable Energy Readiness” to understand the opportunity and barriers in countries and regions
- Engagement with the IRENA to develop action strategies for accelerating the implementation of policies and initiatives on renewable energy
- Urge IRENA to build on the messages of this communiqué in its engagement with the international community
- Work towards formalising IRENA’s presence in Africa and develop strategic partnerships with the key actors
- Co-operate and support IRENA to ensure it fulfils its mandate to accelerate the adoption of renewable energy globally and in Africa to make it a lead region in transition to renewable energy

The Communiqué was adopted by the High-Level Forum and has provided IRENA with a strong basis for institutionalising co-operation with all African countries in carrying forward the mutually complementary goals of the African Union and its member states.

At the IRENA/Africa High-Level Consultative Forum in July 2011, participants agreed that IRENA would co-operate with regional economic organisations and governments to develop a concrete and practical approach to support the knowledge, technology, capacity and policy needs of African countries.

Figure 4. Growth of IRENA's membership in the Sub-Saharan Africa, 2009-2018



Countries included are (in brackets year of membership): Angola (2012), Benin (2012), Botswana (2016), Burkina Faso (2013), Burundi, Cape Verde (2011), Cameroon (2011), Central African Republic, Chad (2018), Comoros (2015), Congo, Côte d'Ivoire (2013), Democratic Republic of Congo, Djibouti (2011), Eritrea (2010), Eswatini [formerly Swaziland] (2011), Gabon (2015), Gambia (2011), Ghana (2014), Guinea, Guinea-Bissau, Kenya (2009), Lesotho (2010), Liberia, Madagascar, Malawi, Mali (2010), Mauritania (2012), Mauritius (2011), Mozambique (2011), Namibia (2013), Niger (2010), Nigeria (2010), Rwanda (2012), Sao Tome and Principe (2014), Senegal (2010), Seychelles (2011), Sierra Leone (2011), Somalia (2013), South Africa (2010), Sudan (2011), , Togo (2011), Uganda (2012), Zambia (2013), Zimbabwe (2014).

1.1. Regional context: Clean Energy Corridors

Over the years, IRENA has pursued the importance of its strategic presence in Africa and its co-operation with African partners through the development of the Clean Energy Corridors, a key component of IRENA's engagement and its effort to promote regional market integration.

Clean Energy Corridors in eastern, southern and west Africa are helping African countries scale up renewable power generation and cross-border electricity trade. The Clean Energy Corridors in Africa aim to support efforts to meet the continent's fast-growing electricity needs through accelerated development and optimal use of the region's abundant renewable energy resources. The corridors largely focus on utility-scale development of renewables-based electricity with a cross-border trade dimension to benefit from resource efficiency and economies of scale. The Clean Energy Corridor was first established within the Eastern (EAPP) and Southern Africa Power Pools (SAPP) through the Africa Clean Energy Corridor (ACEC) and then extended to the West African Power Pool (WAPP) by way of the West Africa Clean Energy Corridor (WACEC) initiatives.

There are also several activities that provide direct input to the Clean Energy Corridors: The **Global Atlas for Renewable Energy** is a key resource for the resource assessment pillar of the Clean Energy Corridor concept. Featuring data from a consortium of 67 countries and 50 data providers, the Global Atlas is the world's largest collection of the most recent and most accurate public maps of renewable energy resources. It offers a web platform for users to find maps of renewable energy resources for locations across the world.

One of the main in-house energy system model IRENA employs is the **System Planning Test (SPLAT)** model for long-term energy planning. For the regional component of the CECs in Africa, IRENA explores the least-cost energy supply options using the SPLAT tool. Several IRENA initiatives play a key role in facilitating ACEC's enabling investments component.

The **Project Navigator**, an online platform providing comprehensive, easily accessible, and practical information, tools and guidance to assist in the development of bankable renewable energy projects. So far, technical concept guidelines have been developed for onshore wind, utility-scale solar PV, small hydropower, woody biomass, mini-grids, geothermal and solar home systems.

The **Sustainable Energy Marketplace** is a virtual platform that gathers project developers, financiers, service and technology suppliers. The Africa platform within IRENA's Marketplace is an online matchmaking platform between project developers, financial institutions, and service and technology providers, and it provides visibility to projects and facilitates investment opportunities.

The **Abu Dhabi Fund for Development (ADFD)** and IRENA have collaborated on a **joint project facility** to support replicable, scalable and potentially transformative renewable energy projects in developing countries. ADFD committed USD 350 million in concessional loans for the implementation of renewable energy projects recommended by IRENA in developing countries globally in seven annual funding cycles.

IRENA's statistics work provides the **essential data** needed to monitor the progress towards reaching the targets of renewable energy policies and to accelerate renewable energy share in African countries. IRENA also provides training for experts and data specialists at national statistics offices as well as national and regional energy authorities. These trainings aim to improve data reporting, collection and dissemination, inform about energy statistics and energy balances and provide guidance on the preparation of questionnaires and other statistical products.



Photograph: Shutterstock

Africa Clean Energy Corridor

The Ministers and heads of delegations of Angola, Botswana, Burundi, the Democratic Republic of Congo, Djibouti, Egypt, Eswatini (formerly Swaziland), Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, South Africa, Sudan, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe gathered in Abu Dhabi gathered one day ahead of the Fourth Session of the Assembly of IRENA on 17 January 2014, to discuss and endorse an action agenda for developing an Africa Clean Energy Corridor (ACEC) which address the continent's rapidly expanding electricity needs with a larger share of clean, indigenous, practical, cost-effective, and sustainable renewable energy options. This Communiqué has guided the development of the ACEC that has expanded with the additional engagement of more than 30 governments, regional organisations, development partners and financial institutions.

The IRENA Communiqué on ACEC recalls three key documents that address the importance of accelerating the uptake of renewable energy to serve Africa's growing energy needs, namely the Maputo Declaration adopted by the AU CEMA in 2010, the Abu Dhabi Communiqué on Renewable Energy for Accelerating Africa's Development agreed by Ministers and CEMA in 2011, and the Program for Infrastructure Development for Africa (PIDA) Energy Priority Action Plan agreed by CEMA in 2012. The ACEC was launched in the wake of the PIDA as a complementary initiative, and builds upon the strong political commitment of African leaders to strengthen regional institutions and transmission infrastructure, forming large competitive markets and lowering costs across production sectors. ACEC has the following objectives:

- accelerated development of renewable energy resources within EAPP and SAPP member countries, the region for the proposed North-South corridor
- co-ordinated planning and development of regional electricity infrastructure and markets
- enhanced legal, technical and institutional capacity to plan, build and operate an interconnected grid with a high share of renewables

Partners in the implementation of the ACEC include:

- **Countries:** Angola, Botswana, Burundi, the Democratic Republic of Congo, Djibouti, Egypt, Eswatini, Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, Sudan, Uganda, the United Republic of Tanzania, Zambia, and Zimbabwe
- **Partner governments:** France, Italy, New Zealand, the UAE, the United States of America
- **Regional bodies:** The African Union Commission (AUC), the East African Community, the New Partnership for Africa's Development (NEPAD), the Common Market for Eastern and Southern Africa (COMESA), Southern African Power Pool (SAPP), the Southern Africa Development Community (SADC), the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE), Regional Electricity Regulators Association of Southern Africa (RERA)
- **International financial institutions and development partners:** The African Development Bank (AfDB), French Development Agency (Agence Française de Développement – AFD)
- **United Nations agencies:** United Nations Development Programme (UNDP), the United Nations Economic Commission for Africa (UNECA) In 2017, as part of the Ministerial Declaration of the 1st Meeting of its Specialised Technical Meeting on Energy, Transport and Infrastructure, the AU recommended its member states to integrate the concept of the Clean Energy Corridors into their national renewable energy and climate change agendas as well as the process of creation of a sustainable and low-carbon power markets.

West Africa Clean Energy Corridor

The West Africa region has vast renewable energy potential to ensure energy access while supporting the region's transition to a low carbon growth path. In July 2013, the Economic Community of West Africa States (ECOWAS) Authority of Heads of State and Government adopted the ECOWAS Renewable Energy Policy (EREP) that aims to increase the share of renewable energy in the region's overall electricity mix to 35% in 2020 and 48% in 2030 (excluding large hydro, to 10% and 19%, respectively). The EREP is complemented with the ECOWAS Energy Efficiency Policy (EEEP) that targets to implement measures that would make available 2,000 MW of capacity through efficiency gains and in the long term, more than double the annual energy efficiency improvements compared to 2010.

With a view to supporting the creation of a regional power market, IRENA, in collaboration with ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE), WAPP, and ECOWAS Regional Electricity Regulatory Authority (ERERA), has initiated the West Africa Clean Energy Corridor (WACEC) initiative.

The timeline of the political framework of implementing the WACEC started in June 2015, when the initiative was included in the meeting program of the West African Energy Leaders Group (W-AELG). In September 2015, stakeholder consultations took place during the ECOWAS Sustainable Energy Policy and Investment High-Level Forum. In December 2015, the WACEC initiative was presented at the 21st Conference of Parties (COP21) in Paris and in April 2016, its implementation plan was validated by Directors of Energy of the ECOWAS Region. The WACEC action plan was subsequently approved by the ECOWAS Energy Ministers in December 2016 (endorsed by Council of Ministers and reported to the Summit of Head of States in June 2017). The concept of the WACEC was endorsed by the Summit of ECOWAS Heads of States in June 2017 in Liberia. The Clean Energy Corridors in Africa was included in the AU Commission's Action Plan on Energy for 2017-2018, and subsequently in the 2019-2020 one.

The goal of the WACEC is to transform the current fuel mix by promoting the development of clean, indigenous, cost-effective renewable power options; strengthen cross-border trade of renewable power and to support the regional efforts for the creation of a regional power market. Though some activities are done at country level, most activities implemented under the WACEC have a regional nature, often gathering stakeholders from the whole region.

Partners of the WACEC include:

- **Countries:** Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo
- **Regional bodies:** the ECOWAS Commission for Energy and Mines, the West Africa Power Pool, ECREEE, the ECOWAS Regional Electricity Regulatory Authority
- **Continental bodies:** African Union Commission, New Partnership for Africa's Development
- **Development partners:** GIZ

Nearly half of the electricity
mix across the ECOWAS
region could come from
renewables by 2030

Collaboration with North Africa and Central Africa

Regional collaboration with North Africa and Central Africa is being strengthened. The Pan-Arab Clean Energy (PACE) initiative provides a regional action plan to scale up renewables in power systems across the Arab region. Its implementation is complemented by IRENA's country-level support, such as through the launch of the "Renewable Energy Outlook: Egypt" in October 2018. The objective is to strengthen an investment framework that will enable cost-effective provision of up to a quarter of Egypt's total final energy supply from renewables in 2030.

In 2015 when "Africa 2030" was published, IRENA has started with the development of sub-regional roadmaps. In May 2015, Heads of State of the Economic Community of Central African States (ECCAS) and the Economic and the Monetary Community of Central Africa adopted a White Paper on the Regional Policy for Universal Access to Modern Energy Services and Social and Economic Development. Renewable energy was highlighted as one of the pillars of that policy, with a target of 95% renewable energy share in new power generation additions by 2030. IRENA and ECCAS signed a Memorandum of Understanding in July 2016, with the purpose to collaborate for the uptake of renewable energy in Central Africa. The ECCAS Secretariat requested IRENA's support in the development of a regional roadmap for renewable energy, which identified the gaps and bottlenecks as well as the key priority actions to address them. The Central Africa roadmap, which was technically validated in November 2018, is set to receive the endorsement of Central African Heads of State.

Box 6. IRENA's regional initiatives rest on high-level political commitment and support

IRENA's work consistently emphasises local leadership and guidance, along with strong ownership by all involved. The implementation of the ACEC is guided by the Ministerial Communiqué that endorsed the ACEC Action Agenda in January 2014 and contributed to the development of Africa's flagship climate action programme, the Africa Renewable Energy Initiative (AREI). The WACEC, enjoying broad regional political support, was adopted by the Council of Ministers for the ECOWAS as an annex to the ECOWAS Treaty in December 2016. This was then endorsed by the Summit of ECOWAS Heads of State and Government in June 2017.

In March 2017, the AU recommended the integration of the Clean Energy Corridors into national renewable energy and climate change agendas. The PACE initiative was adopted by the League of Arab States, while the Central Africa roadmap, which was technically validated in November 2018, is set to receive the endorsement of Central African Heads of State. IRENA has also pursued strategic, results-oriented partnerships with various African organisations and development partners active in the field of renewables, aiming to leverage existing efforts, avoid duplication and maximise long-term impact.

IRENA's regional work has created a strong framework for building technical knowledge and capacity, and for creating investment environments that are more conducive to renewables in a growing number of countries.

1.2. *Country context: Renewables Readiness Assessment and technical advice*

Among IRENA's flagship tools that have been implemented to support countries of the Sub-Saharan Africa is the Renewables Readiness Assessment (RRA). In 2011, the RRA began with the aim to provide input to regional renewable energy action plans and bringing together partners that can support the action plan implementation, including providing solutions for energy access. The RRA is a holistic evaluation of a country's conditions and it identifies the actions needed to overcome barriers to renewable energy deployment. The process is designed to be initiated and conducted by national governments, thus allowing countries to obtain a comprehensive overview of the conditions for renewable energy from their national perspective. The process yields country reports that provide an assessment of existing policy structures and institutional contexts in the countries and identify the elements necessary to devise an effective policy framework to support market development. RRA covers all renewable energy resources and the energy system.

1.3. *Thematic context: Access to modern energy*

The global challenge to ensure universal access to modern energy services continues with less than 1 billion people still lacking access to electricity. About 48% of Africa's total population remained without access to electricity in 2017, representing the largest share among all world regions.

Harnessing the potential of renewable energy and energy efficiency, led by solutions offered by decentralised renewable energy solutions in off-grid and mini-grid systems is of vital importance. Decentralised renewable energy solutions can contribute to multiple SDGs, from poverty elimination, nutrition, health, water, energy and environment, to decent work, sustainable infrastructure/industry, sustainable communities, reduced inequalities and expanded partnerships. Initiatives to promote decentralised renewables, therefore, support healthier and more prosperous communities while mitigating climate change and helping to preserve the environment and natural resources. A recent brief released by IRENA on the off-grid technology "Off-grid renewable energy solutions to expand electricity access: An opportunity not to be missed" highlights the latest trends and advances, including innovations in delivery and financing models. It also discusses the policy and regulatory measures governments are taking to harness the potential of off-grid renewables.

Closing the access gap to modern energy services in Sub-Saharan Africa requires establishing detailed action plans at national and regional levels, targeted policies and regulations, partnerships, awareness, capacity building and investment support. In line with its mandate to provide clean, sustainable energy for the world's growing population, IRENA has started several programmes for accelerating access to modern energy services, and it contributes to closing this gap.

Decentralised renewable
energy solutions will be crucial
to expand electricity access
across the continent

Renewable energy entrepreneurs can play a key role in ensuring energy access. In partnership with the ECREEE, and the International Institute for Water and Environmental Engineering (2ie), IRENA established the ECOWAS Renewable Energy Entrepreneurship Support Facility (ESF) in April 2015 in Ouagadougou, Burkina Faso. In July 2015, with the funding from Luxembourg Government, the Centre for Renewable Energy and Industrial Maintenance (CERMI) in Praia, Cabo Verde joined the Facility. The objectives of the Facility are to:

- provide advisory services and mentorship, upon request, to assist entrepreneurs in improving their business operations;
- refine entrepreneurs' solar energy proposals to bankable levels, when applicable; and
- create linkages between financial institutions and entrepreneurs.

Given the challenges experienced by the renewable energy small and medium enterprises (SMEs) in the region, various SADC member countries have approached IRENA to express the need for supporting SMEs. Furthermore, on 16 January 2017, at the side lines of the World Future Energy Summit (WFES) in Abu Dhabi, IRENA organised an event to showcase the work done in supporting renewable energy SMEs in West Africa under the ECOWAS Renewable Energy ESF programme. In their interventions, representatives from the SADC member states expressed support in having the ESF in SADC. To address some of the barriers and challenges experienced by the private sector and building on IRENA's successful implementation of the ESF in West Africa, SACREEE and IRENA have partnered to establish the SADC Renewable Energy ESF.

The programme for Promoting a Sustainable Market for Photovoltaic Systems in the ECOWAS Region (ProSPER) was launched in April 2015 by IRENA and ECREEE and it aims to support the development of a self-sustaining solar PV market for all ECOWAS member states through training for government officials, regulators, utilities, financing institutions, entrepreneurs, training institutions and universities, as well as the development of tools.

IRENA is supporting the ECREEE in the development of the ECOWAS Certification for Sustainable Energy Skills (ECSES). The scheme aims to support the development of renewable energy markets in all the ECOWAS member states by improving the skills of renewable energy professions through a regional certification system. ECREEE serves as the governing body of the ECSES till the time when a separate legal entity is necessitated to run the scheme with IRENA having an advisory role.

The creation of an enabling environment for ensuring access to modern energy services requires co-operation and dialogue between different stakeholders, in order to identify challenges and possible mitigating measures. The International Off-grid Renewable Energy Conference (IOREC) is the global collaborative platform convened biennially by IRENA for sharing experience and best practices in deploying off-grid stand-alone and mini-grid renewable energy solutions. The IOREC provides an opportunity to facilitate such dialogue, particularly between the public and private sector. The IOREC organised by the IRENA, is the global platform for sharing experience and best practices on design and implementation of enabling policies, tailored financing schemes, innovative business models and technology applications for stand-alone and mini-grid systems. IOREC is convened every two years. Africa hosted two IORECs: one in Ghana (2012) and one in Kenya (2016).

Launched at COP21, the Global Geothermal Alliance (GGA) serves as a platform for dialogue, co-operation and co-ordinated action between the geothermal industry, policy makers and stakeholders worldwide. The countries along the African Rift System are endowed with significant, but largely untapped, geothermal resources. As of today, only 0.6 GW of geothermal capacity is installed in the region. However, with a large estimated potential and an ever-accelerating interest in geothermal energy, the region can soon become one of the world's fastest growing geothermal markets.

1.4. Supporting platforms

These three key IRENA work streams on the ground in the Sub-Saharan Africa are supported by numerous other IRENA activities. These include the following:

- Renewable energy is a key component of Nationally Determined Contribution (NDCs). At present, the level of detail contained in NDCs differs by country, with little in-depth analysis and limited quantitative information about the role of renewable energy in meeting GHG emission reduction targets. In this regard, IRENA is leveraging its existing work on renewable energy potential and socio-economic benefits, as well as its robust data portfolio to develop a comprehensive framework for NDC analysis and implementation support.
- IRENA's renewable energy roadmap (REmap) assesses renewable energy potential assembled from the bottom-up, starting with country analyses done in collaboration with country experts, and then aggregating these results to arrive at a regional or global picture. The roadmap focuses on renewable power technologies and options in heating, cooling and transport. REmap focuses on possible technology pathways and assesses numerous other metrics, including: technology, sector and system costs; investment needs; externalities relating to air pollution and climate; CO₂ emissions; and economic indicators such as employment and economic growth. Based on these country-driven results, REmap provides insights to policy and decision makers for areas in which action is needed.
- IRENA's renewable technology cost analysis work has added significant transparency of cost trends and provided powerful communications messages about the continuing improvement in the competitiveness of renewables. The IRENA Renewable Costing Alliance encourages the sharing of real-world renewable project data to support higher quality analysis, evidence based decision making and the successful deployment of renewable energy technologies.
- Renewable energy auctions have emerged as an important market-based mechanism to drive the adoption of renewable sources for power generation. Auctions remain highly specific to each jurisdiction, with underlying differences commonly driving the resulting electricity prices. IRENA is carrying out analyses on the design elements characterising auctions, the trade-offs that must be considered when selecting them, and it investigates the factors that have been influencing the prices resulting from recent auctions.
- Biomass is the most versatile form of renewable energy and the most widely used today. It can be used to generate electricity, to supply heat for industrial processes and buildings, and to provide liquid fuel for transport. In the power sector, unlike variable renewable resources such as wind and solar, biomass can generate electricity continuously; energy is stored in the feedstock until it is combusted. As a dispatchable renewable energy resource, biomass can enable integration of higher shares of variable renewable energies by balancing power from variable renewables. When converted to biofuel for transport, biomass can be stored indefinitely and shipped over long distances, displacing petroleum in global energy markets. To understand how bioenergy can be supplied, which technologies can be used, and how it could be scaled up, IRENA's work on bioenergy focuses on three areas: sustainable supply of bioenergy feedstock, cost-effective technology for bioenergy conversion, and successful strategies for bioenergy scale-up.

2 PROGRESS, ACHIEVEMENTS AND STAKEHOLDER VIEWS

The July 2011 communiqué of the IRENA-Africa High-Level Consultation Forum was the starting point of IRENA's activities in Africa. It has provided IRENA with a strong basis for institutionalising co-operation with all African countries in carrying forward the mutually complementary goals of the AU and its member states. The participants, comprising over 25 ministers, government representatives from 60 countries including 43 from Africa, regional entities and other partners, agreed on the way forward in terms of accelerating implementation policies and initiatives on renewable energy in Africa; they also decided that IRENA would be the key inter-governmental forum for Africa in this respect.

2.1 Regional activities through the Clean Energy Corridor approach

A background paper on the representation of renewables in energy scenarios in Africa was presented at the IRENA/Africa High-Level Consultative Forum in July 2011. The outcomes of the discussions at the Forum were discussed in the expert meeting that took place in August 2011. IRENA started expanding its work in this context that included electricity sector modelling at the country level and power pools in different regions in Africa. The background paper titled "Scenarios and Strategies for Africa" that was prepared for these discussions depicts Africa's energy system based on the latest statistics available during the writing of the paper. The report quantified the potential in the continent showing that hydro, solar and wind each has resources to supply all of Africa's electricity demand of around 600 terawatt-hours (TWh) per year.

Africa Clean Energy Corridor

ACEC is IRENA's regional initiative in eastern and southern Africa that has been launched in January 2014 to complement PIDA, based on IRENA's mandate to promote the accelerated adoption and sustainable use of all forms of renewable energy.

An executive strategy workshop, hosted by IRENA in June 2013, assembled 60 representatives from countries, power pools, utilities, independent power producers (IPP), regional organisations, financial institutions and donors to suggest elements for an action agenda for consideration by ministers at the Fourth Session of IRENA's Assembly. The meeting introduced critical insights into the needs and priorities of the EAPP and SAPP countries. The participants agreed that ACEC would promote regional economic growth, goals for better health and education, and poverty reduction. The outcome of these discussions was used as a basis for the development of IRENA's programmatic work on ACEC. Subsequently, the ministers and heads of delegation of Angola, Botswana, Burundi, DRC, Djibouti, Egypt, Eswatini (formerly Swaziland), Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, South Africa, Sudan, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe endorsed a communiqué on 17 January 2014 in Abu Dhabi.

Regional collaboration through
Clean Energy Corridor initiatives
can help to drive sustainable,
climate-resilient economic growth

The ACEC was endorsed by Heads of State and Government at the Climate Summit, with 31 additional government, private sector and other partners joining the initiative. The ACEC was also one of the key initiatives launched at the United Nations Secretary General's Climate Summit in September 2014. The importance of ACEC was emphasised by the Heads of African States, the AU Commissioner who presented it to the Summit, and the Secretary General, who stressed the ACEC's critical role in reducing carbon emissions and dependence on imported fossil fuels for a more sustainable and climate resilient economic growth. The process leading to the Climate Summit resulted in 14 additional government, private sector and other partners committing to the development of ACEC.

As highlighted in the Communiqué, ACEC implementation rests upon three core work streams:

- (i) Zoning and resource assessment to site renewable power plants in areas with high resource potential and suitable transmission routes.
- (ii) National and regional planning to consider cost-effective renewable power options.
- (iii) Enabling Frameworks for investment to open markets and reduce financing costs.

These are complemented by cross-cutting capacity building to plan, operate, maintain and govern power grids and markets with higher shares of renewable electricity generation, and awareness raising activities. The resulting work has brought about a range of valuable and tangible outcomes.

To facilitate regular information sharing, engagement and collaboration, the first meeting of the ACEC Consultative Forum was organised in the margins of South African International Renewable Energy Conference (SAIREC) in October 2015. The event was attended by around 50 participants including 5 ministers and deputy ministers in charge of renewable energy from ACEC region, senior officials from ministries, regional organizations including the AUC, NEPAD, RERA, ECREEE as well as representatives of partner countries, civil society and other key stakeholders. The event provided participants the opportunity to obtain up-to-date information on the implementation status of the ACEC and exchange views on the key outcomes of the initiative for announcement at the COP21 in Paris. The participating ministers acknowledged IRENA's efforts and technical support in the implementation of the ACEC and urged the regional bodies to strengthen the collaboration with IRENA to embed these activities in the existing regional initiatives and replicate them in non ACEC countries in the long term.

IRENA became a member of the PIDA Steering Committee at the end of 2017 and attended the Steering Committee meeting that was held in Nouakchott, Mauritania in March 2018. The objective of this meeting was to evaluate the status of PIDA implementation, identify challenges and initiate discussions around the scope of the second phase of the programme. With non-hydro renewables expected to feature in this second phase, IRENA presented the ACEC initiative in eastern and southern Africa, which are based on the current PIDA's North-South Transmission Corridor.

Three key activities for implementation have been identified: capacity building; the review and update renewable energy development plans factoring in the ACEC; and, support to regional economic communities and African institutions such as the NEPAD Planning and Coordination Agency in the overall framework of PIDA. IRENA's SPLAT model configuration for the ACEC region and zoning work outcomes serve as input to regional/continental infrastructure planning processes. The assessment is in progress and preliminary insights on the scenario analysis and zone selection were shared with the PIDA Steering Committee.

The ACEC Implementation Framework is depicted in Figure 1. ACEC has been established as a comprehensive framework resting on the three work streams of resource assessment and zoning, regional and national planning and enabling frameworks for investments. The outcomes from different work streams feed into another ensuring ACEC's work streams are interrelated and its implementation is coherent. ACEC also benefits from many IRENA activities on project facilitation, regional capacity building, regulatory support and the RRAs where it also provides them with inputs.

When the ACEC initiative started, countries highlighted the role it could play in resolving the paradox of abundant sources of renewable energy and widespread energy access issues, particularly with the costs of renewables decreasing and new business models emerging. Countries have also highlighted that ACEC is a crucial tool to help national energy planning, inform stakeholders about how to reduce renewables-related investment risks, develop energy tariff regulations, assist in operation of grids with higher renewable energy shares through analysis, capacity building and information sharing on best practices. Geographically linking different countries and sub-regions at a regional level to satisfy their growing power demand, to maximise the cost and environmental benefits of renewable energy resources and to address climate challenges is essential as countries highlighted power pools as the main tool for the successful development of Clean Energy Corridors.

With the growing success of ACEC over the years, political support was strengthened and ACEC's continuation was welcomed by the countries as one of IRENA's flagship initiatives. ACEC was regarded as a priority initiative and a model that can be replicated in other regions. Some have committed to provide voluntary contributions for the continuation of its activities. This and similar requests have been taken on board by IRENA in the development of new Clean Energy Corridors, for instance the WACEC which builds on lessons learned from the ACEC.

Over the years, more countries have expressed interest in active participation in ACEC's activities. To inform other countries that participate in the ACEC and/or countries they share the same power pool, many countries have also shared their national experiences, for instance about how they integrate renewables to their grids, their grid expansion plans etc. This was particularly important for countries as they have provided frequent requests to IRENA for collection and sharing of best practices and success stories as well as knowledge transfer.

Countries have continued to request new analysis from IRENA related to the ACEC, including assisting countries about how to determine the maximum share of renewables to feed into their grids, and identify and prepare bankable projects to enable a shift from corridors to tangible projects as well as reducing renewable energy costs. Besides content, more activities on capacity building and trainings were suggested. Strategic requests were also made by countries such as more clarification being made about the framework, objectives, work plan and next steps of the Clean Energy Corridors, which was also seen important by countries to consider their engagement and possible contributions to the initiative. All these have shaped in time ACEC's programmatic activities and strategy.

Countries have also found different angles to how they can benefit from participating in the ACEC initiative such as reinforcing their efforts to increase revenues from electricity export (as being part of the power pools), ensuring energy security and energy access, and increasing power quality. Countries urged IRENA to continue its activities in those venues, such as the use of site-specific data under the zoning pillar which provides valuable information to investors.

One critical issue related to the successful continuation of the ACEC. Many countries highlighted the crucial role of political support to help allocate resources, establish proper institutional structures, provide certainty to investors and translate government commitments into workable frameworks and policy regulations. While countries endorsed the ACEC, they have highlighted the need for frequent country follow-ups and a strategy that can ensure regularity of the initiative for its continuation to create impact whilst acknowledging the human resource capacity needs for IRENA to be present in many engagement activities in countries and with regional bodies.

Resource assessment and zoning

Zones for renewable power development need to be identified both for their high resource potential and based on the need to link them to load centres via high-capacity transmission networks. Such linkages are crucial to ensure the cost-effective development of renewable power resources. The long-range master plans of both the EAPP and the SAPP include substantial hydropower capacity, but limited capacity of other renewables. Countries in these power pools consider their cost-effective renewable resource potential. However, the detailed resource assessments needed to foster investment in renewable power projects are costly and therefore were unavailable.

In 2013, IRENA initiated a dialogue with countries within the ACEC, to identify zones with high renewable resource potential and the ability to offload the electricity generated in these zones through high-voltage transmission links to cities, mines and other load centres. The work was undertaken together with the Lawrence Berkeley National Laboratory (LBNL) to elaborate a zoning methodology.

IRENA organised workshops, one on integrated resource planning (IRP) processes with nine countries of the ACEC during the Windaba Conference that took place in South Africa in September 2013 and another on regional IRP processes with the RERA in April 2014.

In 2014, the zoning methodology was validated by stakeholders from utilities, governments, regulatory bodies, power pools and academia from within the region. Countries were not interested in resource maps. Rather they were interested to learn more about and use the expertise developed within IRENA's resource assessment initiatives. The methodology was used to identify developable, high resource potential renewable energy zones for solar and wind technologies, based on the input data from the EAPP and SAPP countries. "Renewable Energy Zones for the Africa Clean Energy Corridor" includes interactive maps with information on levelised cost of electricity, generation potential, and proximity to existing infrastructure. The report was launched at the SAIREC in October 2015. Training on the zoning methodology development and on how to input data was conducted in September 2015 to ensure that country stakeholders can maintain, update and refine zoning assessments. Additional capacity building workshops were organised about the zoning process in the EAPP and SAPP regions. During the workshops that were attended by ministries, utilities, regulatory bodies and academics, the zoning process and its methodology were presented, and preliminary study results were discussed.

Wind and solar maps, developed via Global Atlas partnerships, support the zoning approach and strengthen long-term energy planning

The wind and solar maps that were developed within the Global Atlas were used in preparation of the zoning methodology developed for the ACEC. In addition, to support long-term energy planning (see next section), IRENA assessed electricity generation potentials of solar and wind using geographical information system (GIS) maps from the Global Atlas, in collaboration with the Royal Institute of Technology in Sweden. In 2014, the summary of results was published in a working paper “Estimating the Renewable Energy Potential in Africa”. Based on wind and solar information in the Global Atlas, zoning maps have been drawn of all 21 ACEC countries. For the ACEC region, the zoning exercise revealed an aggregate economic potential of up to 3,834 GW for wind, 15,334 GW for solar PV and 5,282 GW for CSP. This study considered quantitative assessments of renewable energy resources as well as several parameters underpinning investment decisions, such as topography, distance to the grid and load centres, transport infrastructure and protected areas.

ACEC’s zoning methodology was found very helpful by countries from the planning perspective. The approach has added value compared to other available estimates and methodologies. Resource assessments are generally based on a single number and since resources are generally abundant a single number does not mean much for planning. This was especially the case for solar and wind where site-specific data was earlier not available as opposed to for example hydro. The zoning approach has complemented the Global Atlas methodology that has a broader view on resource availability. The results from the zoning analysis have been used as input to the SPLAT model to improve the planning results and scenario analyses. This was then used to provide advice to PIDA as an essential input to regional planning.

Some countries have used the zoning data in preparation of their master plans as they were able to identify more specific and tangible resources for locating larger scale and on-grid renewable energy plants. Several other countries have also made use of the zoning methodology in their national analysis. One example is South Africa which adapted its national methodology with the zoning data from the ACEC. Similarly, Namibia and Mozambique started using the ACEC’s zoning methodology for their planning activities. Zimbabwe used the results from the zoning work for ground work measurements in preparing their solar PV tender. Malawi used the methodology for preparing solar PV tenders. Tanzania’s utility used the methodology in planning the national transmission grid. Eswatini has also, through IRENA capacity-building activities, used the zoning work results in its national energy planning.

The way methodology was designed brought several advantages. Techno-economic parameters were assigned to the resources, accounting for capacity factor/value, seasonal fluctuations in resource availability, investment costs related to location of specific infrastructure (e.g. road construction, transmission line), proximity to grid, areal exclusion/environment conflicts etc. The inclusion of ranges of electricity generation costs was an essential step, going beyond purely technical assessments.

Key in the success of the zoning methodology was the full engagement of member countries which ensured the use of national data in the analysis. Prioritising the use of most up to date country data instead of publicly available online data was a strength of the approach. To reinforce country data, high resolution datasets were used in some cases. Country and stakeholder engagement have also strengthened the work in the development and verification of the methodology that was initially developed by consultants. Countries have had the opportunity to use the methodology in their own country and provided feedback to refine and adjust the methodological criteria. This was especially important to account for technical, economic, policy and topological differences in countries. The deep-dive workshops created the platform for iterative discussions among country experts and stakeholders such as the GIS experts from government or academia, research organisations, utilities, regulators and ministries.

The methodology can be improved. A major issue is data updates, which are essential to make zoning a continuously evolving methodology. For instance, electricity generation costs are continuously declining, and these changes need to be accounted for. Countries must be able to update their data and apply the methodology without external assistance. To enable this, manuals were prepared after the capacity building workshops. However, the study prepared by the IRENA & LBNL as well as the methodology requires sound technical knowledge. This was evident during the workshops where some countries could follow content easily whereas others needed additional support, highlighting the need for capacity building in such countries if zoning work is to be used. One solution proposed is utilising the available expertise from academia or consultancies, but this depends on whether governments endorse external experts. To overcome these issues and for the continued use of the zoning methodology, ownership, at regional and country level will be needed.

A sub-regional workshop for countries in Southern Africa was also held in Eswatini in December 2015, where 24 statisticians from energy departments and national statistical offices in nine countries in Southern Africa were trained in the collection of renewable energy data and construction of energy balances. Data on renewable energy production and consumption in this region improved because of this intervention.

IRENA continued and deepened its zoning work at national levels. The work was also used as input in IRENA planning models to allow a more accurate assessment of renewable energy deployment potential within individual countries of EAPP and SAPP. Countries were interested in additional zoning work, but requests focused more on solutions that are simpler than zoning.

In 2017, the results from IRENA's work were incorporated into regional planning in EAPP and SAPP, as well as into the revision process of the PIDA which endeavours the inclusion of renewable energy technologies beyond large hydropower. A regional workshop was organised in Namibia in April 2017 to gather data on the sites earmarked for development. This output provided a basis for IRENA's "site appraisal" service, which aims to support renewable energy investments and financial decisions prioritised by the African countries. IRENA extended its resource assessment activity to the demonstrative utilisation of mesoscale solar and wind time series through this new methodology that serves as an early stage site appraisal and due diligence. Site Appraisal is a step beyond the "Suitability Analysis" (see section on WACEC) as it includes an additional dimension of time-series data and helps to refine zones into locations suitable for investments. Financial pre-feasibility provides a benchmark tariff for the opening of solicited bids within those sites and it allows local authorities and prospective project developers to have a clearer understanding of the economic feasibility and investment needed to develop the sites. Site Appraisal was found as a powerful process in selection of the best sites for wind and solar utility scale projects. The service has been used so far to evaluate solar PV and wind project sites in Cabo Verde, Comoros, Eswatini, Mali, Morocco, Nigeria, Sudan, Togo, Zambia and Zimbabwe. Together, this amount to 2,667 MW of solar PV and 1,745 MW of wind projects. In Zimbabwe, results were used to negotiate the initial project costs. The country indicated that they have benefited immensely from the zoning exercise and from other assistance provided by IRENA in the aftermath of this exercise including the Agency's Site Appraisal service. Zimbabwe also indicated that in situ measurements can be very expensive and significantly stretch the budgets of ministries such as theirs – who look to conduct these measurements on three of the prospective wind sites that have been marked for new development and assessed by IRENA. In Eswatini, three sites with 10 MW capacity were guided with the site appraisal process for tenders in 2017.

Regarding the Site Appraisal, some countries suggested that local experts learn how to use the tool and understand its methodology so they can use it themselves in the future. They even suggested making the tool available for IRENA's focal points

Box 7. Biomass resource potential in Africa

The REmap work of the International Renewable Energy Agency points to the need for a major scale-up of bioenergy through 2050. REmap envisions 235 exajoules (EJ) of renewable energy use by then (IEA, 2017). Roughly 37% of the 2050 renewable energy supply would be some form of bioenergy: 10% for buildings, 13% for industrial process heat, 11% for liquid transport fuels, and 3% for power. There is a need to understand how the bioenergy could be supplied, which technologies could be used, and how it could be scaled up.

Bioenergy represents more than 60% of the Sub-Saharan Africa's total energy supply today and is a strategic asset to meet the region's energy needs. IRENA's first work on biomass therefore focused on Africa and was carried out together with the German Biomass Research Centre (Deutsches Biomasseforschungszentrum gGmbH - DBFZ) in 2013 (Stecher, Brosowski and Thrän, 2013). The study reviewed earlier bioenergy potential assessment in Africa, compared various resource measurement methodologies, benchmarked results, and identified key dimensioning elements for those assessments.

IRENA released the bioenergy tool which was developed to ease the process of assessing biomass potential at scale through prospecting individual feedstock. After which, in October 2016, IRENA published a working paper titled "Bioethanol in Africa: A Case for Technology Transfer and South-South Co-operation", highlighting the benefits of technology transfer between Brazil and Africa.

The study "Biofuel potential in Sub-Saharan Africa: Raising food yields, reducing food waste and utilising residues" released in November 2017 focused on five countries which may be taken as broadly representative: Ghana, Nigeria, Mozambique, South Africa and Uganda. These countries reflect a variety of agricultural conditions and different degrees of economic development and might therefore be considered broadly representative of potentials in the region as a whole.

The study findings show major potential to displace fossil fuels with liquid biofuels in the longer term and use of solid biofuels for heat and power as advanced technologies for liquid biofuels mature. Both theoretical potentials and stretch goals for 2050 are estimated for these countries, though the portion of potential that will actually be realised depends on economic, logistical and policy variables. The estimated feedstock potential ranges between 3.4 EJ and 6.7 EJ (see Table 3). When compared with the projected liquid transport fuel use in 2050 of 3 EJ, the low end of the supply range is 17% higher than demand. In utilising this potential, a variety of policies and measures will be needed that can free substantial amounts of land for crops to produce biofuel:

- Farm and forest residue collection could be improved by sharing best practices on cost-effective logistical approaches.
- Agricultural yields could be improved through extension services to spread modern farming techniques and agro-forestry approaches, with a view to cultivating a mix of high-yielding food and fuel crops.
- Losses and waste in the food chain could be reduced through better harvesting techniques, the availability of storage and cooling facilities, and improved transport.

IRENA (2017) estimates the sustainable and technical potential of bioenergy under the Bonn Challenge pledges. In collaboration with the University of Utrecht in the Netherlands, IRENA has evaluated the sustainable bioenergy extraction from the African Forest Landscape Restoration Initiative (AFR100), utilising data from the World Resources Institute and International Union for Conservation of Nature. Findings indicated that up to 6 EJ of bioenergy could be supplied from land restoration under the AFR100 pledges if the highest yielding degraded lands were used.

IRENA released two further reports on bioenergy in Africa. The first (IRENA, 2019c) provides an estimate of the potential for sustainable bioenergy production in Africa from agroforestry and nitrogen-fixing wood crops, based on an assessment of yields for 15 short-rotation woody crops. The second (IRENA, 2018) report “Sustainable Rural Bioenergy Solutions in Sub-Saharan Africa: A collection of good practices” report provides a reference for policy makers and practitioners working to scale up bioenergy in rural areas of sub-Saharan Africa to help overcome issues in rural bioenergy, such as (i) unsustainable bioenergy feedstock which lead to deforestation; (ii) unhealthy domestic energy productions systems; (iii) the lack of a means to ensure the sustainability of better bioenergy solutions.

Table 3. Advanced biofuel potential from residues, higher yields, reduced waste and forests (PJ/year)

| | Residues potential | Potential from closing yield gap | Potential from reduced waste if yield gap is closed | Forest energy wood potential | Total primary energy potential | Converted to 40% advanced biofuel | Liquid transport fuel use in 2050 |
|---------------------|--------------------|----------------------------------|---|------------------------------|--------------------------------|-----------------------------------|-----------------------------------|
| Ghana | 245-399 | 635-1,269 | 120-246 | 6-12 | 1,006-1,926 | 402-770 | 280 |
| Mozambique | 255-429 | 513-1,026 | 122-260 | 3-5 | 893-1,720 | 357-688 | 76 |
| Nigeria | 1,214-2,059 | 2,834-5,668 | 694-1,434 | 20-39 | 4,762-9,201 | 1,905-3,680 | 1,161 |
| South Africa | 207-424 | 350-701 | 279-636 | 32-64 | 868-1,825 | 347-730 | 1,302 |
| Uganda | 315-534 | 368-735 | 359-752 | 7-13 | 1,049-2,034 | 419-814 | 125 |
| Total | 2,236-3,845 | 4,700-9,399 | 1,574-3,328 | 67-134 | 8,577-16,706 | 3,431-6,682 | 2,945 |

Note: Low- and high-end of the range refer to residue collection rates of 25% and 50%, respectively.

Bioenergy will continue to form a major portion of Sub-Saharan Africa’s total energy supply

Regional and national planning

Investment decisions made today on power plants and transmission grids can shape the energy system for decades. Long-term infrastructure planning is therefore required to support cost-effective integration of renewable energy. Effective co-ordinated and integrated energy planning is essential at both national and regional level. This takes advantage of the most cost-effective renewable power options available and ensures that these options are compared fairly with fossil fuel and nuclear power. Co-ordinated planning of generation and transmission facilities across African power pools could provide significant economies of scale.

In 2015, IRENA initiated a study to assess the readiness of the East and South African power pools to realise the potential of the ACEC; to identify the critical transmission and interconnection gaps and actions with an impact on the corridor; to raise the profile of projects that are ready for investment; and to identify stakeholders who can assist in building capacity for financing and developing projects. The study highlighted that the ACEC would rely upon the development of a strong high-voltage transmission corridor from Egypt to South Africa. A key building block would be the North-South Transmission Corridor already identified under the PIDA, which presented priorities for transmission networks and large-scale hydropower generation projects.

Least-cost energy system modelling is a tool that helps policy makers to explore which investment decisions could lead to optimal energy mixes and transition pathways in the long-term. In this context, IRENA completed the development of five African power pool models (“SPLAT” models), together with user manuals to support their use. The models were developed to build capacity of energy planning offices of interested African member states and organizations, and the project has attracted many stakeholders. SPLAT training sessions were organised in co-operation with the International Atomic Energy Agency (IAEA) and Tunisian Utility Company STEG for Northern African countries, in co-operation with IAEA and Ministry of Research of Cameroon for Central African countries, and in co-operation with UNECA and SEI for Eastern African countries, and in co-operation with ECREEE for West African countries. Co-operation with regional power pools and organisations, such as CAPP, COMELEC, and ECREEE, has commenced to provide more systematic technical co-operation on expansion planning studies.

The first phase of IRENA’s power sector planning tool was completed for all continental African countries. The publication of “Planning and Prospects of Renewable Energy” reports for the SADC region resulted in several requests for follow up action.

Using regional SPLAT tools, IRENA conducted analysis of prospects for renewables in the regional electricity mix until 2030 for five African regions including the CO₂ mitigation impact of the ACEC. This work titled “Africa Power Sector: Planning and Prospects for Renewable Energy” comprising three years of analytical and country level focus on long-term infrastructure planning, was presented in January 2015. The launch event of the report was attended by more than 70 delegates of the IRENA member countries who have welcomed IRENA’s work, underscoring the lack of adaptable, realistic energy plans for the African continent, the need for more substantive data in the power sector, as well as the need for greater co-ordination between government and industry.

The analysis puts forward two distinct scenarios. Firstly, the “renewable energy-oriented” scenario shows a potential to generate between 276 TWh and 857 TWh electricity from all types of renewable energy sources by 2030 from a total generation capacity of 109-228 GW in the Sub-Saharan Africa region. This would require investments of USD 155-356 billion per year in generation capacity and USD 156-202 billion per year in transmission and distribution capacity. Secondly, using the same tool, IRENA has also quantified CO₂ mitigation impacts of the ACEC initiative.

IRENA's assessment shows that by creating a larger regional electricity market and building upon the strong political commitment of African leaders to strengthen regional institutions and transmission infrastructure, the ACEC can attract investment to potentially meet 40%-50% of power needs in the ACEC region by 2030. Combined efforts will also diversify resource availability, improve energy security, and foster investment opportunities and job growth. Such region-wide renewable energy deployment could cut the annual CO₂ emission level in 2030 by 310 Mt, translating into 2,500 Mt savings of cumulative CO₂ emissions between 2010 and 2030, while increasing electricity supply by 2.5 times. One key input to this synthesis report was the resource-assessment paper, "Estimating the Renewable Energy Potential in Africa" prepared in collaboration with Sweden's Royal Institute of Technology (KTH) and released in 2014. This paper relied on the GIS data from IRENA's Global Atlas database.

In 2016, IRENA and the Government of Eswatini (formerly Swaziland) launched a 10-month long capacity building programme for energy planning in Eswatini, as a follow up to country's RRA two years after its release in 2014. The program was organised based on a cost-sharing bases and is the first pilot case for IRENA's post-RRA advisory service on energy planning. To ensure long-term sustainability, the programme engaged other international organisations active in energy planning such as the IAEA and AfDB. A kick-off meeting took place in April 2016 which has built consensus on the energy sector analysis, including demand analysis and the establishment of a structure and work plan as well as which data to be gathered and assessed. The national project group comprised of a working team and a steering committee. The Working Team worked on the national energy master plan by collecting data, executing computer models and developing analysis, with input from IRENA as needed. The Steering Committee, composed of senior officials, guided the efforts of the working team to ensure policy relevance and to endorse the analysis. The programme included online and face-to-face training courses on the SPLAT model and scenario development. MESSAGE software e-training (1 week) was organised in early July 2017 with the aim to familiarise participants to the concept of least-cost optimisation model and the MESSAGE software. The first and second training courses were organised in late July 2017 and October 2017 (each with a total duration of 2 weeks) with outcomes of presentation of the progress in preparation of the master plan to the Steering Committee. A training retreat took place in November 2017 about the preparation of the master plan. In the same month, the national project group finalised the draft national energy master plan and held a national stakeholder consultation workshop with key stakeholders, before submitting it to the Cabinet for approval in 2018. During the stakeholder workshop, comments were received for completing the Masterplan and a roadmap for its finalisation was developed. In October 2018, Eswatini launched the Energy Masterplan 2034 which was endorsed by the Cabinet and its preparation was supported by IRENA, first through a range of trainings on data and statistics, and energy planning, then through technical support to the national working team. In addition to the Energy Masterplan 2034, Eswatini also developed a five-year power sector roadmap based on the insights from the trainings.



In January 2017, IRENA released the report “Addressing Variable Renewable Energy in Long-term Energy Planning (AVRIL)”. The report provides an overview of methodologies for long-term energy planning with high shares of renewables. The report findings were widely disseminated, foremost through seminars and workshops organised with partners, including the National Renewable Energy Laboratory (NREL), the World Bank, the International Energy Workshop (IEW), the German Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU), and the Government of Mexico. These events reached over 300 power system planners including also from Africa with the anticipated impact of influencing policy-making.

IRENA has also contributed to different regional energy partnerships to streamline planning work across key implementation agencies and improve joint delivery. For example, IRENA forms part of the Energy Modelling Platform for Africa (EMP-A) that was launched in January 2018 and contributed to a modular training programme on Capacity Development in energy demand and supply planning in Africa that will be delivered by training institutes and universities in Africa.

IRENA also re-configured the planning model for the ACEC region, incorporating outputs from the ACEC zoning analysis that IRENA conducted in 2015. The model inputs are being finalised and cross-regional scenarios are being run and assessed; the scenarios are differentiated by the share of non-hydro renewable energy in the power sector of the ACEC region by 2040. The results of the modelling and scenario runs aim to provide an important input to the PIDA process and the updating of the regional EAPP and SAPP masterplans.

During a workshop that was organised at the Fifth Session of IRENA’s Assembly about SPLAT, countries highlighted the importance of future planning as the foundation for investments even in the short term. Many countries have received assistance and information from IRENA in for their planning processes.

The fact that SPLAT models use publicly available data is important to underline. This strengthens ACEC’s national energy planning component since countries have ownership in the planning process, they develop planning capability and have access to renewable energy information, such as costs, zoning from a single work stream package and renewable energy is better represented in the country energy plans. This ensures that a robust starting point is provided to the countries without the need to start from a very low base. There is no other comparable model in the world.



Photograph: Shutterstock

Enabling frameworks for investments

The entry of IPPs in the power market is vital if private capital is to be mobilised. Facilitating finance by reducing real and perceived risks in turn cuts the cost of capital. Renewable power investments are sometimes met with a perception of risk that does not reflect the current state of technology development. Effective national policies are therefore critical to create the kind of fair and open markets attractive to investors and financiers. Under this component, IRENA provides advice and expertise on renewable energy strategies that aim to harmonise policy and regulatory frameworks of the countries in the region in creating an effective regional power market. There have so far been two pillars to this component of the ACEC, namely “regulation” and “project facilitation” .

First, the “Regulation” pillar is discussed. IRENA developed a high-level strategy in 2013, called the Regulatory Empowerment Project (REP), for the development and implementation of enabling regulatory environments. The REP has been developed in consultation with regulators and power pool operators in SAPP and EAPP with the aim to enable more private investment and help reduce associated risks.

IRENA held a Renewable Energy Training Week (RETW) in January 2015 designed to support regulatory decision-making for the development and integration of renewable generation resources into national and regional power systems. RETW attracted participants from senior and mid-level management from nine ministries, eight regulatory authorities, four associations, three sustainable energy development authorities, one utility and a regional facility from Africa, Asia, Central and Latin America and the Middle East. The Africa RETW was implemented upon request by the RERA and the Energy and Water Utilities Regulatory Authority of Tanzania (EWURA), where 33 experts from ministries, regulators and utilities were trained on the requirements of good regulatory practices and decision making for renewable energy development. The feedback showed that the content was highly relevant to the participants’ daily work tasks.

In 2016 and 2017, IRENA continued the work, upon request, with individual countries in support of the ACEC development. Concerning the regulatory work, IRENA supported RERA to develop a knowledge base on regulatory actions supporting renewable energy development in the region. IRENA also helped RERA with its capacity building efforts and long-term planning processes and recommendations have been provided on the existing planning frameworks in the SAPP region, with pilot schemes in Namibia and Zimbabwe on how existing planning processes can be amended, including the empowerment of the regulatory roles to provide greater investment certainty and ensure timely project delivery. The first stakeholder consultation workshop took place in Namibia in April 2016 and identified key issues to enhance the role of renewables in long-term power system planning. In-depth interviews conducted with global best practice leaders and local stakeholders were fed into the “Insights on Planning for Power System Regulators” published in June 2018.

Training has helped to improve regulatory practices and strengthen decision-making for renewables

Like in other regions, auctions can help countries across Sub-Saharan Africa achieve record-low prices for solar PV and wind power. As part of its work on renewable energy auctions, in April 2018, IRENA has released the “Renewable Energy Auctions: Cases from Sub-Saharan Africa” report. In preparation of the report, IRENA and the Graduate School of Business (GSB) at the University of Cape Town (UCT) organised a high-level seminar, “Renewable Energy Auctions: Sharing the Lessons from Sub-Saharan Africa” that was held at the GSB on 24 and 25 November 2016 in Cape Town, South Africa. The report was prepared in collaboration with the GSB and it analysed the design details and price outcomes from three renewable energy auctions in SSA, specifically in Uganda (Get FIT), South Africa (Renewable Energy Independent Power Producer Programme, REIPPPP) and Zambia (Scaling Solar). There are several striking key findings and lessons learned that emerge from the report: auctions can be implemented in emerging market economies and their success depends on linkages with the countries’ renewables deployment strategies. Auction design and competent, transparent and independent programme leadership are essential as well as a design that balances diverging objectives. Upfront clarity is needed on social and environmental performance standards and socio-economic development goals. Auction qualification criteria and technical standards should maintain a reasonable degree of freedom for investors to come up with innovative and high-quality solutions. The use of concessional finance needs to be well targeted to crowd-in commercial finance.

In June 2018, IRENA released the “Insights on Planning for Power System Regulators” study which stems partly from a joint project by IRENA and the regulators of Namibia, Zimbabwe and Southern Africa, in close co-ordination with the SADC. The report identifies useful regulatory practices in an era of rapidly improving renewable energy technologies, drawing insights primarily from the United States and South African IRP processes. It also aims to encourage more effective power system planning in areas of both single and multiple jurisdiction.

IRENA’s project facilitation platforms have been supporting the development and access to financing of renewable energy projects through IRENA’s Project Navigator and the Marketplace tools.

In October 2016, in partnership with the AUC, NEPAD Planning and Coordination Agency (NPCA) and UNECA, 20 project developers were trained on the development of bioenergy projects under the Project Navigator. In April 2016, IRENA’s Project Navigator team provided a 2-day training to AfDB on the technical criteria for the bankability of renewable energy projects. In July 2016, at the request and in close co-operation with the Government of Djibouti, a five-day training of which three-days was dedicated to project development through the Project Navigator to identify common challenges faced by local developers and to disseminate guidelines to improve the bankability of projects was organised (the other 2-days were related resource assessment). The training was attended by 40 representatives from the Ministry of Energy and Mineral Resources, national public agencies and private sector entities. The training programme saw the development of an initiative to establish a national renewable energy project incubator to mobilise and engage additional local capacities. Participants at the training also stressed the importance of translating Project Navigator content into other languages to ensure a more comprehensive dissemination across the African continent.

Auctions for new power supply contracts are most effective when linked to national deployment strategies for renewables

IRENA's Marketplace covering the ACEC countries was announced at the SAIREC in October 2015. In subsequent months, the Marketplace was expanded to cover all African countries. It was officially launched at the COP21 in Paris on 7 December 2015. To promote the Africa portal of the Marketplace, a webinar targeting financing institutions and project developers from the West and Central African regions was organised in July 2016 jointly with the ECREEE and the ECCAS. Participants were informed about the Marketplace and its features and feedback was gathered to continue to respond to the needs of users. Since its launch, IRENA's Marketplace has continued to serve as an investment catalyst in Sub-Saharan Africa within the sustainable energy space. The online project preparation and matchmaking platform connects project proponents with financiers, investors, and service providers and technology suppliers and help project proponents in developing bankable project proposals. To date, the Marketplace encompasses more than 238 projects seeking funding of approximately USD 10.7 billion covering all developing countries including in Africa. Further partnerships were implemented with a view to establish the Marketplace as a "pipeline aggregator" bringing together and making visible project portfolios, and matching projects with required support. As of today, four different projects in several countries in Africa have been linked with project preparation facilities and development banks. A solar irrigation project is receiving pro bono management support to engage farmers in a rural region in Africa. Currently, Sustainable Energy Marketplace comprises 83 sustainable energy projects in Sub-Saharan Africa (translating into 1.7 GW of installed capacity and USD 3.3 billion worth of investment opportunities) and provides access to over 160 financing instruments, as well as over 130 service and technology providers. In Sub-Saharan Africa countries excluding West Africa, the Marketplace covers 60 projects with a total installed capacity of 1.3 GW (electricity and heat) worth a total investment opportunity of USD 2.2 billion.

IRENA is also launching the Risk Assessment and Mitigation Platform (RAMP), as an extension to the Marketplace, to improve access to risk mitigation instruments and support project owners and their stakeholders to reduce the transaction time and costs. The aim of this project is to provide an insight in the different solutions for credit risk, political risk and currency risk mitigation available in a specific country, for a given size and resource and to co-ordinate the work of insurers and guarantors.

A key IRENA intervention in the Sub-Saharan Africa includes the work to support the development of geothermal technologies in resource-rich countries of East Africa. The countries along the African Rift System are endowed with significant geothermal resources. However, these remain largely untapped and Sub-Saharan Africa is starting deployment from a low base: 676 MW electrical and 122 MW thermal capacity is installed in Kenya and 7 MW electrical capacity is installed in Ethiopia. More projects are expected to come into operation in Ethiopia and Djibouti shortly and exploration for high and medium temperature geothermal resources has also been initiated in Burundi, Comoros Islands, Democratic Republic of Congo, Eritrea, Rwanda, Tanzania, Uganda, and Zambia.

From the first to the sixth cycle of the IRENA/ADFD project facility, over 500 project proposals have been assessed for funding, of which. Most of the submissions were for solar PV projects in Africa. As far as eastern and southern Africa is concerned, ADFD allocated a total of USD 33.5 million to three projects. Co-funding for these projects sums to USD 38.9 million. One of the projects is a solar rooftop project connected to the grid, the other is a solar home systems project and the third is a solar PV installation integrated into an existing wind farm in the Seychelles. The Mauritius and the Seychelles projects are at the implementation stage.

West Africa Clean Energy Corridor

The West Africa region has vast renewable energy potential to cover the unmet power demand and reach the universal access to electricity while supporting the region's transition to a low carbon growth path. In that regard, in July 2013 the ECOWAS Authority of Heads of State and Government adopted the EREP that aims to increase the share of renewable energy in the region's overall electricity mix to 35% in 2020 and 48% in 2030 (excluding large hydro, to 10% and 19%, respectively). The EREP is complemented with the EEEP that targets to implement measures that would make available 2,000 MW of power generation capacity through efficiency gains and in the long term, more than double the annual improvement in energy efficiency, compared to 2010 levels.

In response to growing interest from the rest of Africa, in 2015, IRENA initiated the preparatory work to expand the Clean Energy Corridor initiative to West Africa. A consultative meeting was organised by IRENA in Abidjan, Côte d'Ivoire in September 2015 during the ECOWAS Sustainable Energy Policy and Investment High-Level Forum to begin discussions with governments, utilities, regulatory bodies, private sector and civil society from all ECOWAS countries. Based on feedback provided, IRENA worked with regional partners to identify priority actions that will constitute the main elements of the Clean Energy Corridor implementation plan in West Africa.

Subsequently, IRENA, in collaboration with ECRREE, ERERA and WAPP initiated the WACEC initiative. The goal of the WACEC is to transform the current fuel mix by promoting the development of clean, indigenous, cost-effective renewable power options, strengthen cross-border trade of renewable power and to support the regional efforts for the creation of a regional power market. Though some activities are done at country level, most activities implemented under the WACEC have a regional nature, often gathering stakeholders from the whole region. As approved by the ECOWAS Energy Ministerial in December 2016 and endorsed by the Heads of State of the region in June 2017, the WACEC's implementation plan builds on the same three components as ACEC.

The WACEC focuses on supporting an accelerated development of utility-scale, renewables-based electricity and promoting cross-border trade in the region in line with regional renewable energy targets through regional and national action plans, as well as the national Sustainable Energy for All (SEforAll) Action Agendas. An action plan for the implementation of the WACEC has been developed and validated at the technical level through a stakeholder consultation process with the governments and key regional partners in April 2016 in Dakar. Scoping work for the solar component of the WACEC was initiated in August 2016 in co-ordination with ECRREE, ERERA, WAPP and the European Union Energy Initiative's Technical Assistance Facility. The WACEC action agenda was endorsed at the ECOWAS Energy Ministerial in December 2016 in Guinea, and the agenda was endorsed by the Heads of State of the region in June 2017. Regulation on the WACEC was adopted by the ECOWAS Council of Ministers as an annex to the ECOWAS Treaty and was reported to the Summit of ECOWAS Heads of States in June 2017 in Liberia.

West Africa can draw on vast renewable energy potential to address unmet power demand

Resource assessment and zoning

The implementation of the first component of the WACEC has so far included the completion in December 2016 of a “suitability analysis” work for identifying the areas with high solar and wind potential in the region and has been used as basis for WACEC’s future zoning work.

In 2016, through the zoning methodology, IRENA supported regional market analysis in West Africa. The maps developed by IRENA identified suitable zones, for both utility-scale and decentralised solar and wind development, and provide an indicative technical potential.

In December 2016, IRENA released the “Investment Opportunities in West Africa (Global Atlas)”. This analysis used a specific and innovative methodology to provide a region-wide pre-feasibility assessment of the solar and wind opportunities for West Africa, for both grid-connected and of-grid systems. Datasets employed have spatial resolutions of 3 km for solar irradiation and 1 km for wind. The final outcome includes a high-resolution map (1 km resolution) displaying suitability for projects on land. This was done by assigning numerical values to several suitability dimensions and merging these into a single value. The outcome includes high resolution maps indicating suitable areas for solar and wind energy projects on land, taking account of resource intensity, distance to power grids, population density, land cover, topography, altitude and protected areas. The maps can be used to identify ideal sites project sites, and to initiate dialogue on energy generation and trading with regional and local entities and communities. The final maps are available in GIS image format for display and download through the IRENA Global Atlas. This exercise carried out at the regional level in West Africa has uncovered total technical potential of up to 128 GW for on-grid wind, 171 GW for off-grid wind, 1,451 GW for on-grid solar PV and 1,830 GW for off-grid solar PV. The technical potentials estimated in the study (by suitability class – higher the value more suitable) are presented in Table 4.

Table 4. Technical potential including future grid development plans according to the Suitability Analysis (in GW)

| Technical potential (GW) | 60-70% | 70-80% | 80-90% | 90-100% | Total |
|--------------------------|--------|--------|--------|---------|-------|
| Wind on-grid | 32 | 42 | 35 | 19 | 128 |
| Wind off-grid | 27 | 17 | 53 | 74 | 171 |
| Solar on-grid | 78 | 302 | 540 | 531 | 1,451 |
| Solar off-grid | 99 | 255 | 485 | 991 | 1,830 |

In addition, the financial viability and suitability of 18 project sites have been assessed within the zones of the Clean Energy Corridors to guide renewable investments using the site appraisal service. The results of this assessment are being considered by some of the countries in designing their tendering processes as well as guiding their interactions with potential solar and wind project developers. Besides these examples, many countries are using this process to check the accuracy of their datasets.

In addition to the regional capacity building activities and in view of the importance and the difficulties faced in the reliability and timeliness of renewable energy data, IRENA organised the West Africa Renewable Energy Statistics training on the collection, processing and dissemination of renewable energy data in February 2019. During the training, countries discussed the status of renewable energy in their countries, the availability of data, shared best practices and presented the challenges they face at collecting renewable energy statistics. The training paid special attention to data collection from households and enterprises where countries explored the different challenges and potential solutions. In addition, participants were informed about data estimation and validation, the IRENA Questionnaire, data dissemination and assessment of data needs.

Regional and national planning

IRENA's support to the West Africa region in long-term power sector planning started in 2013 with the development of the "planning and prospects for renewable energy in West Africa", which resulted in several requests for follow up action. ECREEE requested IRENA's support in creating national renewable energy action plans in fifteen ECOWAS Countries. IRENA provided support to the development of the ECOWAS Renewable Energy Policy, administrated by the ECREEE secretariat. The ECOWAS Renewable Energy Policy is built on baseline power sector development projections and is a key input in the development of the SEforAll Action Agenda. IRENA has provided the methodologies and base line projections computed from SPLAT models to interested ECREEE member countries.

In 2015, as part of IRENA's capacity building efforts to further understanding and use SPLAT tools in the development of power sector scenarios, the IRENA-ECREEE Energy Planning Capacity Building Programme was initiated in October 2015. In 2016, in collaboration with the IAEA and the UNFCCC, IRENA initiated a 6-month capacity development programme, to build and enhance long-term energy planning capacity in 10 ECOWAS member states. The programme selected 10 ECOWAS countries, and 25 designated energy planning officers from these countries worked with IRENA, ECREEE, IAEA and the United Nations Framework Convention on Climate Change (UNFCCC) for 6 months to develop national renewable energy scenarios, while enhancing the planning capacity within the government institutions. These collaborative efforts helped to further disseminate IRENA's planning methodologies, including as part of the IAEA training on NDCs for selected African countries in May 2017. The programme uses IRENA's system planning tool for West Africa, SPLAT-W, which helps users assess economic, technical and environmental perspectives in the future energy mix. The results of the capacity development programme were incorporated in updates of IRENA's 2013 publication. Insights from the draft analysis were shared and discussed with the WAPP leadership and the technical service provider responsible for the WAPP Masterplan update. It was adopted by the Heads of State of the ECOWAS in December 2018. IRENA has been contributing to the update of the WAPP master plan by supporting the collection of reliable data on renewable energy potentials and costing, while the West Africa planning prospects report directly fed into this master plan work.

IRENA has initiated a capacity building programme to establish a national energy planning unit for energy statistics and long-term energy planning considering cost-effective renewable energy options in Sierra Leone. The activity aims to enhance energy planning capacity within national institutions on long-term planning through training on the SPLAT model and the development of energy scenarios. As a result, the national working team will prepare a national energy master plan. Three training courses for the national working team were held during May-September 2018 with roughly 20 participants each (one 1-week online training on MESSAGE software; and two 2-week national training courses on SPLAT model configuration and scenario development) were delivered to the national working team by the IRENA staff and two experts hired for this programme. The national working team, that is co-ordinated by the Ministry of Energy, has developed a draft National Energy Masterplan report to 2040 that will be further expanded and revised based on further refinements to the SPLAT model and the scenarios. The government considered this project as one of their flagship projects. The country regards this Masterplan to be more detailed than the previous one as it includes more solar PV (including mini-grids), more hydropower as well as biomass (including waste-to-energy). In further support of long-term energy planning, IRENA has undertaken a range of capacity building programmes, such as a regional training programme for West African countries, held in close co-operation with ECREEE, IAEA and the UNFCCC in Dakar, Senegal.

In the specific case of the SPLAT model, one limitation concerned the lack of French speakers who would be qualified enough to give such trainings to the countries. In addition, a scheme for training the trainers will be important. People who have already gone through this scheme and mastered the model can train others to understand and able to work with this model in planning aspects.

Capacity building

There have so far been two work areas to this component of the WACEC, namely “Power Purchase Agreements” and “Planning and Operation of Grids with Higher Shares of Variable Renewable Energy”.

A regional capacity building programme was initiated in West Africa on the planning and operation of grids with higher shares of variable renewable energy. This was kicked-off in Dakar, Senegal in December 2017 and a gap analysis was conducted with the aim to assess the needs for capacity building on the planning and operation of power systems with high shares of variable renewable power generation across the region. Based on the outcomes of the scoping analysis and the training curricula developed for both components, specific regional trainings have been provided to national stakeholders from 14 WAPP countries on the grid integration of variable renewable energy held in May 2018 (Côte d'Ivoire for Francophone countries and Ghana for Anglophone countries), complemented with a study tour to China in September 2018 hosted by IRENA and the State Grid Corporation of China (SGCC).

The mix of participants, their background (mainly electrical engineers) and experience level were found to be very good. The organisation, selection of training and by whom the trainings are being delivered were found favourable by the participants. Some participants highlighted persisting differences among experts, which can sometimes hinder in-depth investigations of certain subjects.

Participants to trainings regarding grid planning and operation with higher renewable energy shares mentioned different areas of work where they are using the outcomes of the training sessions. Experts have mentioned that the capacity building activity was most useful for planning for least cost energy generation in the system. Also, participants mentioned that thanks to the technical depth of the trainings they can use related software. One expert mentioned that for a new IPP, training helped how to understand how to organise the system around it. Some experts mentioned the usefulness of trainings in drafting proposals. Some countries that are more advanced in operating grids with higher shares of renewables took the opportunity to share their experiences with others. Some participants requested more practical examples of grid integration in addition to theory.

A regional capacity building programme was initiated in West Africa on the development of renewable energy power purchase agreements (PPAs). This was launched in January 2018 in Cotonou, Benin and after a gap analysis was conducted across the region. Based on the outcomes of the scoping analysis and the training curricula developed for both components, specific regional trainings on PPAs have been provided to national stakeholders from 14 WAPP countries for two rounds in June and July 2018. Follow-up activities have been drawn up for both components for the next phase of programme implementation. The workshops were attended by a similar composition of technical experts as for the grid integration workshops from a similar mix of ministries, utilities and regulators. Countries found this participant mix sufficient to have in-depth discussions about the topic. The material that was presented at the workshops were found to be useful. Some countries mentioned that these guidelines can be a tool to facilitate other trainings.

Of all the topics that were discussed during the workshop, some countries found the “risk” discussion key since its impact on the price of the final project that will be awarded is significant. Participants pointed out to the importance of discussions between the government and the private sector as this will also have an impact on the final awarded project prices. Importance of considering the variability of solar and how this can be addressed in project contracts was also mentioned as crucial since for most experts this was a crucial aspect as they are used to working with conventional technologies.

The policy mechanism differs between countries and priorities. For example, some countries mainly focus on rural electrification without any PPA. While in some countries PPAs are considered as a next step, in others the regulatory framework favours feed-in tariffs. In those countries which will use feed-in tariffs, small PPAs may exist, but this would only be in certain cases such as agreements between individual owners and the utility. In general, countries found the workshop content very helpful as to learn how to develop a PPA model. For countries that have yet to implement PPAs, they are planning to do so in future and the best practices learned in trainings will be very helpful. More specifically, participants mentioned that they learned how a PPA functions and how a tender is prepared, what the roles of each party in a PPA are, related risks for renewable energy investments.

Some participants required additional workshops and assistance on financial models, how to prepare renewable energy projects as well as assessment of the environmental and economic considerations regarding project implementation. Suggestions included expanding the scope to regional bodies, so to go beyond investors and countries.

There were also some recommendations about how to make the workshops more effective:

- Concrete exercises, such as one covering the entire life cycle of the PPA, will be important to include.
- While financing modelling was covered, there was limited time to go through it in detail. Hence sessions can be organised better to cover high priority topics in detail.
- All material that was made available in English. For French speaking participants this should be in the local language since some people were not able to fully follow and the translation could have been better.
- The PPA trainings were based on an UK model. However, this is not necessarily well adapted to their national circumstances. This should be tailored to local conditions.
- If workshops focus on a specific region, the context of those countries must be considered.
- More workshops are desired. If fewer workshops are planned, they should last longer.
- Trainings should last at least five days. A training certificate would be good for the participants to enhance their career development.
- The country support to create dynamic and efficient mechanisms for financing renewable energy will be key. This will complement efforts of international donors to bigger projects since much of the population lives in rural areas and require support for smaller projects.



Enabling frameworks of investments

The “project facilitation” work stream includes the same three activities as the ACEC, namely: Project Navigator, the Marketplace and the ADFD.

In August 2017, a training of the development of bankable renewable energy projects through the Project Navigator was given to West African entrepreneurs under the ECOWAS Renewable Energy Entrepreneurship Support Facility (see section on Supporting Platforms).

The Marketplace currently covers 22 projects in West Africa with a total installed capacity of 337 MW worth a total investment opportunity of USD 0.7 billion. Much of this capacity is related to solar PV (176 MW), followed by hydropower (80 MW) and onshore wind (50 MW). The remainder is bioenergy. There is also a single CSP plant in Mali with a total capacity of 3 MW.

As far as West Africa is concerned, 7 projects from 7 different countries benefited from the concessional loans provided through the IRENA/ADFD project facility over the 6 completed cycles and they are as follows:

- **Cycle 1:**
 - » Mali: USD 9 million for the electrification of 32 villages with solar PV diesel mini-grid hybrid systems (4 MW)
 - » Sierra Leone: USD 9 million for the Freetown grid-connected solar park (6 MW)
- **Cycle 3:**
 - » Senegal: USD 13 million for the Promoting Renewable Energy for Rural Electrification with solar PV mini-grids (2 MW)
 - » Burkina Faso: USD 10 million for Rural Electrification of 42 villages using standalone solar PV kits, solar PV/Diesel hybrid mini-grids and grid extensions (3.6 MW)
- **Cycle 4:**
 - » Niger: USD 10 million for solar PV and individual solar kits for rural electrification in 100 villages (2.1 MW)
- **Cycle 6:**
 - » Liberia: USD 8 million for a hydropower project (2.1MW)
 - » Togo: USD 15 million for a grid-connected solar PV plant (30 MW)

Extending support to projects post-selection is becoming an increasing priority for the IRENA/ADFD Facility. In August 2016, the ADFD and IRENA successfully carried out their first joint onsite appraisal missions for two projects located in Burkina Faso and Senegal, which had been selected in the third cycle. The onsite appraisal mission to Niger was conducted in 2017. In November 2018, a similar mission was conducted in Mali and in Sierra Leone in May 2019. IRENA continues to facilitate communications between the country and the ADFD to help advance projects to implementation.

IRENA project facilitation can help to nurture projects for implementation across Sub-Saharan Africa

2.2 Country-level assessments and activities

The RRA is a dynamic process that can be adapted to each country's circumstances and needs. RRA process follows four steps: Initiation and demonstration of intent; Detailed country assessment and action plan; RRA validation and finalisation; Follow up.

Achieving successful RRA outcomes requires early discussions to be held with the national stakeholders and the country's preparedness and organisational ability to conduct a proper multi-stakeholder and inclusive RRA process. In addition, co-ordination with other stakeholders to avoid duplication and reinforcing synergies is important. During implementation, level of engagement of development partners from the early design phase to the finalization of the RRA and prioritization (and limitation) of actionable and feasible recommendations considering the country's broader economic and energy context are key. Post-RRA is a key success factor where IRENA provides technical support activities based on the recommendations and key action areas identified by the RRA process. This requires country commitment and ownership of the RRA process and the outcomes to mobilise funding for implementation as well as the availability of resources to IRENA for post-RRA advisory and capacity building support.

IRENA's has built a strong record of conducting RRA in Sub-Saharan Africa region, having facilitated the process in twelve countries: Botswana (in progress), Djibouti, Eswatini, Gambia, Ghana, Mali (completed), Mozambique, Niger, Senegal, Tanzania and Zambia .

The RRA reports build on a specific methodology that was initially developed and piloted in two countries of the Sub-Saharan Africa, namely Mozambique and Senegal. In 2011, IRENA partnered with the International Institute for Sustainable Development (IISD). A three-stage process has been put in place, comprising a review of literature and stakeholder mapping, barrier analysis and regional profiling. The feedback received from experts and stakeholders on the proposed criteria for assessments was reflected in the preparations for the piloting of the RRA methodology.

In 2012, IRENA further improved and deployed the RRA methodology to ensure that the RRAs capture the facts necessary to inform decision making in the countries. While the country scope was expanded beyond the Sub-Saharan Africa, Mozambique and Senegal acted as a channel for dissemination and engagement across the region through regional workshops held with regional partners in 2012 for rolling out the methodology. Furthermore, IRENA has started following up on post-RRA actions in the pilot countries, Mozambique and Senegal. For instance, in Mozambique, a strategy for more efficient use of its hydro potential has been put in place.

IRENA's growing RRA process has emerged as a flagship activity to assist countries, build capacity and to serve as a catalyst for co-operation between countries and regions. Internally, the process has also helped IRENA in prioritising its programmatic activities.

As the RRA process attracted more interest from countries in the development of national strategies by identifying a set of actions based on the national priorities, IRENA has received requests from new countries to join the programme. IRENA has scaled up the RRA process by engaging additional countries upon request. End of 2013, Djibouti, Eswatini, Gambia, Ghana, Mozambique, Niger, Senegal and Zambia were engaged in the process of RRAs. In June 2013, IRENA released a key publication titled "Renewables Readiness Assessment: Design to Action". This guide incorporated experiences gained from countries that had already conducted RRAs and streamlined the RRA process by providing more in-depth guidance on data metrics to be collected during the process.

As outcome of the RRA process has contributed to the development and adoption of a rural electrification strategy as well as adopting an internal resource mobilisation mechanism for the promotion of renewable energy in Niger. In Gambia, RRA has led to a partnership with Siemens, United Nations Environment Programme (UNEP) and Frankfurt School of Finance to assess the commercial feasibility of hybrid diesel mini-grids. In Mauritania, IRENA partnered with the United Nations Development Programme (UNDP) to use the RRA methodology for SEforAll country assessments. Mozambique has drafted its strategy for promoting small hydro development. Zambia has developed a framework for the development of small, mini- and micro-hydro generation projects. As part of the post-RRA activities in Zambia, an advisory service workshop on small hydro was organised and hosted in May 2013. The participants were policy makers, researchers, regulators and utilities from Gambia, Mozambique, Eswatini (formerly Swaziland), and Zambia. Participants formulated draft strategies to develop small hydropower and engage IPPs in their respective countries.

The RRA report for Djibouti, released in May 2015, outlined that Djibouti can meet 100% of its energy demand through renewables by 2020, sourced mainly from geothermal, wind, and solar resources and export surplus potential that has assisted the USAID in framing its intervention in Djibouti's geothermal sector based on the findings from the RRA. Particularly strengthening of the existing interconnection with the Ethiopian grid will be key. Increased integration of renewables will help Djibouti address energy access, energy security and employment concerns. Based on the RRA recommendations, Djibouti has paid attention to strengthening resources assessment and energy statistics capacities.

The RRA report for Ghana released in November 2015 highlighted the need to promote continuous and systematic building of stakeholder and institutional capacities for effective management of the renewables sector. A set of recommendations to improve access to modern energy based on renewables, including for cooking and heating, includes the development of a bioenergy policy, the formulation of end-user financing mechanisms in rural areas, and the delineation of off-grid areas for rural electrification to provide clear directions to private investors.



Photograph: Shutterstock

The Eswatini RRA was launched in March 2015 with the participation of a large group of stakeholders including government, utilities, regulators, private sector, and development partners. The report recommended various measures to support the implementation of renewable energy, with a focus on resource assessment and improvement of enabling conditions for bagasse-based power generation and solar resources. As a follow up, IRENA facilitated participation of the Government of Eswatini officials in an expert consultation workshop on bioenergy data collection in Abu Dhabi in April 2015. Furthermore, a capacity building session on statistics was held in Eswatini for the Southern African region (a similar training was also provided in Djibouti). Pursuant to the RRA action plan, Eswatini (formerly Swaziland) had already developed an IPP Framework and a Grid Code with support from the USAID Southern African Trade Hub to strengthen the enabling framework for investment in grid-connected renewable energy. A standardised PPA for various renewable energy technologies has led to the signing of four PPAs. In 2016, the Government of Eswatini, with support from IRENA, designed a programme to enhance national long-term capacity and to update the national energy master plan (see Clean Energy Corridors).

In 2016, IRENA undertook a scoping study in Burkina Faso and Mali on the potential of biomass power generation for off-grid power, as a follow up to the RRA findings. As part of the post-RRA process, a workshop was held in Mozambique in November 2016 about renewable energy investments.

The post-RRA activities spanned across several areas: in Niger, the focus was on the development of a strategy to allocate funds towards rural electrification. The Energy Masterplan in Eswatini was developed based on the RRA conducted which considered the least-cost renewable energy technology options. A renewable energy investment focused workshop has taken place in Mozambique which was the first of its kind in the country.

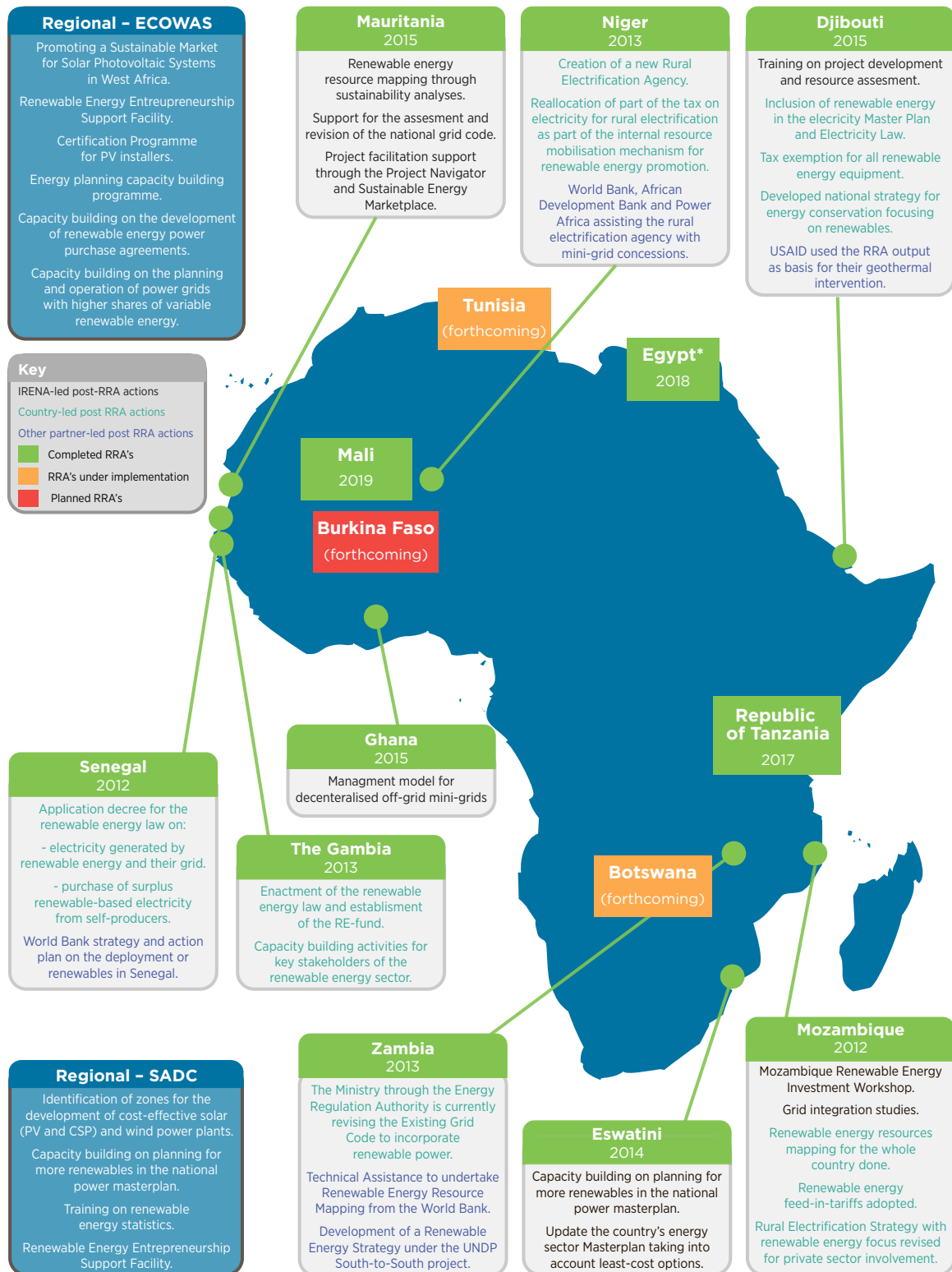
Project development was prioritised in Djibouti through the Project Navigator tool that involved stakeholders from both the public and private sectors.

In addition, capacity building for planning was provided to all countries of the ACEC and to ECOWAS countries. In improving the reliability and availability of renewable energy statistics, training was given in Djibouti and Eswatini as post-RRA follow-up. The RRA process has resulted in several partnerships for IRENA with other organisations: in Djibouti for the support on geothermal energy, IRENA teamed up with the experts of USAID. In development of renewable energy strategies in Senegal, the World Bank was the partner for strategy and action plan on the deployment of renewables. Along with the World Bank, African Development Bank and the Power Africa, IRENA supports Niger on mini-grid concessions for rural electrification.



Photograph: Shutterstock

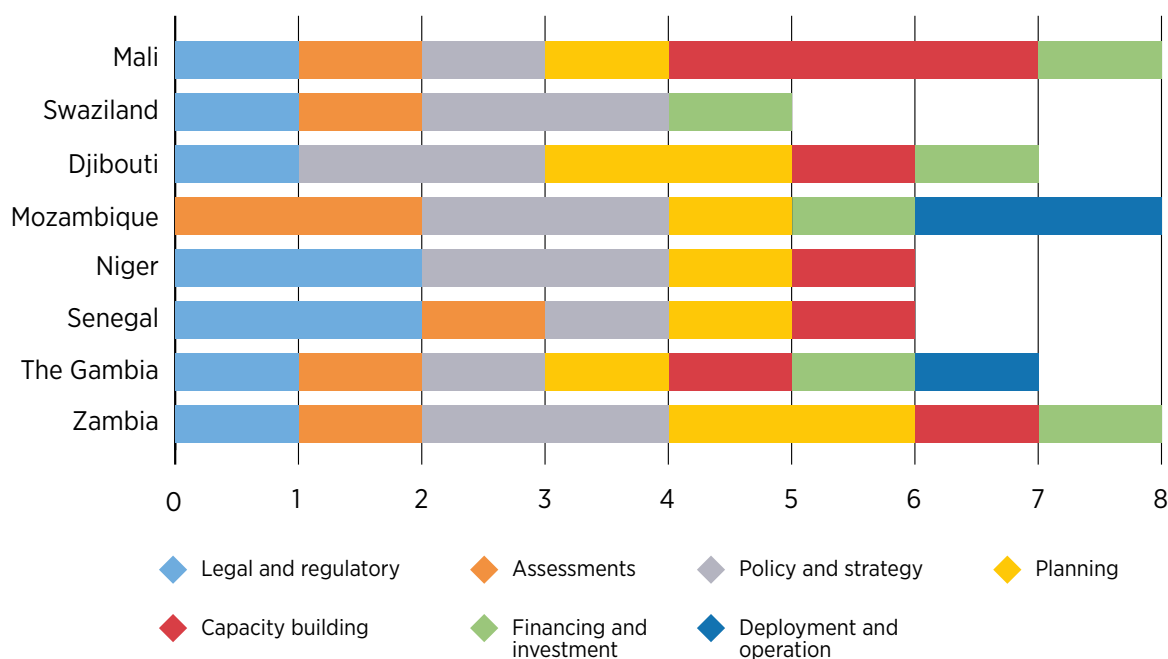
Figure 5. Renewables Readiness Assessments, technical assistance and their impacts in Africa



To varying degree, countries have implemented the recommendations across seven areas of legal & regulatory; assessments; policy and strategy; planning; capacity building; financing and investment; deployment & operation and integrated them into their long-term energy strategies. The assessment to track the uptake of recommendations from RRAs in nine countries reveals important insights (see Table 5). There is a roughly even split between the recommendations across the categories: around a quarter of them were related to policy & strategy; followed by capacity building and legal & regulatory recommendations with a 14% share each of all RRA recommendations. Deployment & operation recommendations represented 13%. Financing & investment, planning and resource assessment related recommendations accounted for 10% each.

Figure 6 shows the extent the recommendations have been addressed. In more than half of the cases, policy & strategy and planning recommendations have been addressed, often with the involvement of IRENA and the work done through its tools and resources. Concrete examples could be the support given in Sub-Saharan Africa covering the areas of auctions, and various strategies on access matters for rural areas. Only half of the legal & regulatory, assessments and capacity building related recommendations have been addressed. IRENA’s involvement in capacity building, notably in Sub-Saharan Africa, in partnership with regional and international bodies has also been instrumental in accomplishing considerable progress on reinforcing local capacities for which the need was uncovered through the RRA process. Thanks to strong internal collaborations within IRENA, resource assessments tools have been made available through the Global Atlas for Renewable Energy and have been instrumental in various regions across the globe, leading to some of the recommendations in this area having been addressed. Notable progress made through regional actions such as the zoning of the ACEC has contributed to addressing resource assessment issues. The least share of recommendations that have been addressed concerns financing and investment.

Figure 6. The breakdown of RRA recommendations in Sub-Saharan Africa countries



Djibouti, The Gambia and Mozambique display the highest level on the implementation of RRA recommendations while in Senegal and Tanzania, most recommendations are pending display the lowest. The RRAs have resulted in several impacts in the countries of the Sub-Saharan Africa. Some country specific insights into how the RRA process has resulted in impacts are discussed below:

- **In Djibouti**, as part of the newly adopted electricity law, all renewable energy equipment is exempt from import duties. Country experts participated in trainings provided by IRENA on resource assessment and project development.
- **In Eswatini**, renewable energy zones have been identified specifically for solar and wind. In addition, four PPAs have been signed. A comprehensive grid code was developed that provides renewable energy IPPs priority to grid access.
- **Ghana:** The government has set a 10% renewable energy target to be realised by 2020. In addition, as part of the ProSPER programme, capacity of local private operators and financial institutions has been built to develop and appraise bankable decentralised renewable energy project proposals.
- **Mozambique:** The country's first renewable energy resource assessment and mapping has been completed. This was used for the design of feed-in tariffs, and a related feed-in tariff law is under consideration by the government.
- **Niger:** A national renewable action plan is being developed together with the ECREEE. In addition, a renewable energy law is being drafted. The Rural Electrification Agency was established in 2016 with the mandate to promote renewable energy.
- **The Gambia:** The renewable energy law has been adopted, and the feed-in tariffs and a model PPA have been established. Regarding the standards and labels for renewable energy equipment, a UNIDO/GEF-5 project has begun to build the capacity of local entrepreneurs and financial institutions to engage in renewable energy technologies. For financing renewable energy projects, funding sources have been identified by the Renewable Energy Act, and a fund account has been created. To build stakeholder capacity, policymakers, planners and other stakeholders have been included within the ProSPER programme, solar PV certification and renewable energy target-setting programmes. The government has commenced the allocation of land for hybrid mini-grid projects.
- **Zambia:** Renewable energy targets have been identified following feed-in tariff development. To develop policies and regulations for private sector involvement in decentralised renewable technologies, IRENA is providing advisory services under its enabling regulatory environment action plan.

Renewables Readiness Assessments capture each country's key facts for effective decision-making

Countries regard the RRA tool as a valuable process and they have engaged, in general, in the implementation of recommendations. Since inception, many countries have expressed the willingness to engage more actively in the RRA process. Experts involved have expressed appreciation for the well-designed and balanced mix of participation at national workshops. Several benefits and advantages of the RRA process have been highlighted, including the following:

- Mobilisation of national stakeholders around the key issues of large-scale renewable energy development in line with national energy planning.
- Improved ownership of the challenges of scaling up renewables by clarifying the roles and responsibilities of actors.
- Shared definition of essential barriers, strengths and weaknesses, as well as achievements including good practices.
- Identification of opportunities for capacity building or support provided by IRENA and other partners to increase access to renewable energy.
- Widening of the scope and identification of renewable energy technologies that can be realistically deployed. For instance, in the case of Mali, experts realised that they should reduce the emphasis given to hydropower and jatropha-based biofuels when the county was over-optimistic about their potential.
- IRENA's tools within the RRA process complement those that countries have available to them, such as that which provides energy statistics, which is crucial for the planning stage.

Highlighted were some of the limitations relating to the implementation of recommendations and post-RRA follow up. For instance, when there is a shift in the political environment, national priorities also tend to shift, making it a challenge to implement RRA recommendations. Nevertheless, project development can continue, given that the private sector may be less affected by political changes.

The extent to which a given activity produces impact on the ground is not always clear. For example, even though stakeholders and policymakers may be deeply engaged in the RRA process at workshop events, this does not necessarily imply that they will implement the recommendations to their full extent. Progress, therefore, must be monitored and tracked. Moreover, to ensure the success of post-RRA activities, collaboration with other organisations is essential, as is the continuing formation of partnerships.



Table 5. Overview of the uptake of Renewables Readiness Assessment recommendations in sub-Saharan Africa, May 2017

| Country | Legal and Regulatory | Assessments | Policy and Strategy | Planning | Capacity Building | Financing and Investment | Deployment and Operation |
|-------------------------------|--|--|---|--|---|--|---|
| Djibouti | Strengthen legal system and regulatory framework | | Develop clear rural electrification strategy | Develop national renewable energy policy and action plan | Strengthen research and development institutions | Provide financial support for small and medium solar PV enterprises | |
| | | | Improve business environment | Implement long-term energy plan | | | |
| Eswatini (formerly Swaziland) | Stimulate market transformation leading to the long-term deployment of decentralised solar systems | RE Zoning | Strategy for the development of bagasse cogeneration | | | Assess the economics of bioethanol blending and enact E10 blending mandate | |
| | | | Independent Power Provider IPPs | | | | |
| The Gambia | Speed up law enactment of renewable energy (RE) (by end-2013); include regulation on solar water heating systems | Assess, update and validate solar, biomass and wind resource mapping | Revive Gambia Renewable Energy Centre | Allocate land for renewable energy use | Build stakeholder capacity (policymakers, regulator and the private sector) | Establish renewable energy fund and identify funding sources | Establish standards and labels for renewable energy equipment |
| Ghana | Review the tariff system for off-grid | | Design a clear policy for off-grid mini-grids | Grid integration of variable RE | Build the capacity of local private operators and financial institutions to develop and appraise bankable decentralised renewable energy project proposals | Further encourage entrepreneurs prepared to invest and support them by building capacity through grant programmes and by providing them with access to working capital | Improve existing/ introduce new cookstove technologies that increase efficiency and cut emissions |
| | | | Set targets for the share of renewables in the total energy mix | | Run awareness-raising campaigns and create communication strategies to educate operators and farmers about new business opportunities and benefits of off-grid technologies | Independent Power Provider financial support mechanisms and payment guarantees | |
| | | | Increase political support to promote sustainable use of biomass energy | | | Sound business models for stand-alone and mini-grids | |

| | | | | | | | |
|------------|--|---|--|--|---|---|---|
| Mali | Develop and adopt electric grid code | Assessment of bioenergy resource potentials | Develop Main Grid Arrival Policy | Develop Power Sector Master Plan to include non-hydro renewables | Enhance technical capacity for large scale deployments of renewable power | Enhance enabling frameworks for private renewable energy investment | Implement quality control standards for renewable energy equipment's and installers |
| | | | | | Strengthen local capacities in the development, appraisal and financing of bankable renewable energy projects | | |
| | | | | | Strengthen renewable energy data collection, processing and dissemination through statistical capacity building | | |
| Mozambique | | Evaluate the cost of energy generation from wind energy | Develop Feed-in-Tariffs for renewable based electricity generation | Include potential sites for hydroelectricity projects in grid extension planning | | Scale up deployment of rural electrification and decentralised energy | Support development of large- and small-scale hydro projects |
| | | Promote the development of sustainable biofuel projects | | | | | Clarify the requirements for biofuel producers to supply the local market |
| Niger | Develop renewable energy law and devise support mechanisms | | Develop national renewable energy policy and action plan | Support energy component in the strategic public-private partnership framework | Allow National Solar Energy Centre (Centre National d'Énergie Solaire) to flourish as leading technical institution for renewable energy research and development | | |
| | Create institutional and regulatory framework to facilitate renewable energy deployment in rural areas | | Create conditions for developing rural biogas industry | | | | |

| | | | | | | | |
|----------|---|---|---|---|--|--|---|
| Senegal | Adapt the rules of intervention for the regulator in the specific case of small electricity producers | Elaborate a process for comprehensive mapping of renewable energy resources in key areas. | Identify conditions for increased private sector involvement in renewable-related manufacturing. | Facilitate grid integration of electricity generated from renewable resources. | Identify conditions needed for operation and maintenance of off-grid motive and thermal power. | | |
| | Review the institutional, legal and regulatory conditions for utilising land for biofuels production. | | | | | | |
| Tanzania | Forecasts to include assumptions of greater renewable energy integration | | Implement a local content requirement in terms of labour and manufactured products for renewable energy projects | Revise plans by considering latest studies on potentials and on technology costs and by exploring different policy scenarios needed for investment decisions followed by an investment strategy roadmap | Make full use of current wide vocational training facility networks as well as higher education institutions to create a local supply of relevant labour skills along the value chain of renewable energy project development. | Empower the domestic financial sector, especially through collaboration by working with the Dar es Salaam Stock Exchange and the Capital Markets and Securities Authority to provide equity investments to renewable energy projects | Consider adoption of transmission and wheeling charges conducive to VRE |
| | | | | | Build capacity for renewable energy research centre | Establish a framework to enhance facilitation, collaboration co-operation and co-ordination among renewable energy private actors and financial institutions | |
| Zambia | Revise and adopt the draft Grid Code, including provisions and conditions for renewable energy power | Develop the framework and sustainability criteria for feedstock optimisation and biofuel production | Revise renewable energy policy and adopt strategy to set renewable energy targets | Develop integrated resource planning that considers all renewable energy sources | Build Capacity of local private operators, local financial institutions and relevant institutions to support renewable energy deployment | Establish tailored business models for private sector involvement in off-grid renewable energy systems | |
| | | | Develop the policy and regulatory framework to facilitate private sector involvement in decentralised renewable energy technologies | Develop a programmatic approach for utility-scale renewable power projects with the requisite financial incentives that are backed by a standardised bankable power purchase agreement | | | |

Note: Green: addressed; red: pending.

2.3 Key activities to boost modern energy access

Promoting a Sustainable Market for Photovoltaic Systems in the ECOWAS Region (ProSPER)

In partnership with ECREEE, a scoping of capacity needs was conducted for the ECOWAS region to enable the deployment of renewable energy mini-grids for off-grid electrification. The study conducted in 2015 was the first step towards expansion of the ProSPER capacity building programme – which initially focused on off-grid PV systems – to include clean energy mini-grids. The study builds on and complements existing work conducted for the assessment of training needs as well as capacity building activities. Three key activities of the ProSPER include the following:

- Promotion of national renewable energy policies and incentive schemes in ECOWAS countries: Achievements included (i) increasing knowledge and understanding of instruments and mechanisms; (ii) intensification of network contact among regional policy makers, to share best practices relating to policy implementation; and (iii) ensuring an understanding of regulator and utility requirements to increase IPP participation.
- Promotion and financing of renewable energy entrepreneurship in PV technology: Contact among entrepreneurs was intensified to share knowledge and create a West Africa association of solar entrepreneurs.
- Financing of solar energy technology projects in West Africa: Achieved were (i) an awareness and understanding of lending institutions for PV projects, as well as of the integration of lending proposals into the products of financial institutions; (ii) intensification of contact among lending institutions; and (iii) creation of a network of investment promotion agencies for knowledge sharing.

Entrepreneurship Support Facility

In partnership with ECREEE and 2ie, IRENA established the ECOWAS ESF in April 2015 in Ouagadougou, Burkina Faso. CERMI in Praia, Cape Verde, joined the technical committee of the facility in July 2015.²

The ESF aims to provide advisory assistance to SMEs in West Africa to scale up their businesses and attract financing. Since its launch in 2015, the ESF has supported over 80 enterprises through various training courses; advisory assistance; facilitation partnerships; and networking and match-making with financial institutions. Enterprises benefitting from technical assistance have managed to scale up their business activities by increasing their human resources and revenues; implementing innovative operation and marketing strategies; developing bankable project proposals; and securing financing. In 2017, the World Bank incorporated the ESF into its Regional Off-Grid Electrification Project in West Africa to ensure the continuation of IRENA's SME development initiatives.

As part of the capacity building activities under the WACEC, in 2015 IRENA engaged entrepreneurs within the West Africa region to build capacity and improve project bankability. In co-operation with ECREEE, IRENA organised training workshops for 25 entrepreneurs from West Africa and five regional financing institutions to help small- and medium-size entrepreneurs assess the business potentials of renewable energy projects, develop business plans and loan requests, and increase financial institutional confidence in renewable energy technologies. The training also contributed to ensuring sustainability

² The ESF has the following structure:

- Steering Committee: Comprises IRENA, ECREEE, CERMI, 2ie, Ecobank, Government of Luxembourg, Solar PV Professionals Association for ECOWAS. It provides direction and quality control of work undertaken, and strives to source more funding and partnerships for the facility.
- Technical Committee: Comprises IRENA, ECREEE, CERMI, 2ie, Ecobank, Maison de l'Entreprise du Burkina Faso, SNV Netherlands Development Organisation, SUNREF and Societé Generale. It evaluates and shortlists applications for assistance that are submitted to the facility by ECOWAS-based entrepreneurs; and structures training courses.
- Facility Co-ordination: Comprises a team that includes a Co-ordinator based at 2ie in Ouagadougou; a Co-ordinator based at CERMI/ECREEE in Praia; and IRENA staff.

Technical Committee meetings have taken place in June 2015, June 2016 and April 2017. The Steering Committee met for the first time in August 2016.

of capacity building in entrepreneurship within the ECOWAS region by facilitating the participation of trainers from the ECOWAS-based incubation centre, 2iE Technopole. A follow-up training was held in July, with participation of 17 regional commercial banks, development banks and micro-finance institutions, to raise awareness of solar technology financing opportunities and associated risks; and share best practices with the overall aim of increasing the confidence of financial institutions in West Africa in financing solar energy projects.

The ESF launched its first call for applications in May 2015, followed by annual calls in 2016 and 2017. The three calls for applications resulted in a total of 280 requests for assistance and, based on the selection outcome of each annual Technical Committee meeting, 80 enterprises were supported over the past three years. The profile of the enterprises supported range from small-scale PV systems for rural electrification to larger mini-grid systems for productive use. Support for the selected enterprises was structured in accordance to the requests submitted during the call for applications, and consisted of training workshops and direct mentoring and individual assistance.

The content of the technical workshops was decided based on the similarity of requests received. Relating to the first call, the initial training workshop took place in September 2015 in Ouagadougou, Burkina Faso, and its topic was defined as “Sustainable RE Business Operations and Enterprise Management”. During the workshop, participants were informed of the following topics:

- Business models for disseminating solar energy (particularly for rural electrification)
- Sustainable social enterprise operations
- Marketing and sales strategies for renewable energy enterprises
- End-user financing
- Enterprise financing
- Bankable project proposal guidelines
- Procurement and inventory management of solar system equipment
- Quality control of equipment.

The second technical workshop was on “Solar PV System Sizing, Operation and Maintenance for Technicians”. It was held in December 2015 in Cabo Verde. The topics that were discussed included the following:

- Overview of solar PV system technology for the region
- System design principles, technical specifications and component sizing (for solar pumping, standalone rooftop PV with storage, grid connected rooftop PV)
- Battery storage options
- Metering/payment options
- Quality issues of different equipment and system components
- Maintenance and operational aspects
- Fault detection and solutions.

Following the selection of successful entrepreneurs from the second call IRENA, in co-operation with ECREEE, CERMI and 2iE, organised the first technical workshop on business planning and project proposal development in September 2016 in Ouagadougou, Burkina Faso, for 23 selected entrepreneurs from 12 West African countries. A second workshop focusing on solar PV mini-grids was held in November 2016 in Praia, Cabo Verde, and was attended by the same entrepreneurs as well as the addition of six bankers from the region. Some entrepreneurs presented their project proposals and business plans, and they received individual feedback on suggested improvements to secure financing for project implementation.

The third call provided technical assistance and support to entrepreneurs to refine their renewable energy project proposals to be bankable and to develop their enterprises through mentorship and training programmes. For this third cohort, which comprised 30 entrepreneurs, trainings were held in Dakar, Senegal, and in Abuja, Nigeria, in August 2017 to focus on enterprise management training, including project proposal and business plan development to bankable stages; marketing and sales strategies; accessing finance; and case studies of various business models for rural electrification.

Based on the training material and various guidelines and project development criteria, several entrepreneurs developed project proposals that were further refined through individual advisory assistance, offered by the facility's network of experts/consultants. During the working sessions with experts, entrepreneurs were given the opportunity to present their project proposals and investment pitches in front of peers as well as representatives and experts of financial institutions. They received individual feedback on how to improve them prior to presenting their final proposals to financiers with a view to funding. Furthermore, entrepreneurs have access to the ESF network of experts who provide them with ad hoc advisory assistance for their business operations and project implementation. SELCO (India), Village Energy (Uganda) and Ecobank are three of the mentors that provided pro bono support.

Impact of the ESF's programme in West Africa since its launch is summarised as follows:

- Eighty enterprises from all 15 ECOWAS member countries have been supported over the past three annual cohorts (2015–17).
- Approximately USD 1 million in debt financing was accessed through project proposals submitted to financial/funding institutions.
- Twelve partner/advisory/funding institutions have joined the ESF.
- Additional funding was mobilised for the continued operation of the ESF.
- The Regional Solar PV Professionals Association for ECOWAS was formed.
- The ESF showcased a successful pilot regional programme for renewable energy enterprise support and, based on lessons learned and the network of partners, it has set a precedent for replicability in other regions.

The ESF in Southern Africa was launched in 2017. In April 2017, in Maseru, Lesotho, IRENA and SACREEE jointly organised the kick-off meeting to conceptualise the SADC Renewable Energy ESF. The meeting was hosted by the Government of Lesotho and supported by UNDP's office in Lesotho. Forty-five representatives from the private sector, business incubation centres, academic institutions, development partners and renewable energy associations in the region came together and expressed strong support for the initiation of the ESF programme.

Following the kick-off meeting, a regional workshop was held in November 2017 in Port Louis, Mauritius, which brought together SMEs, financial institutions and other relevant stakeholders from within and outside the SADC region to identify and discuss the challenges and opportunities in supporting entrepreneurship development; access to SME finance; managing perceived risks in SME and renewable energy finance; and facilitating renewable project implementation. The workshop provided a baseline for the programme's implementation plan, as well as, crucially, for support to entrepreneurs and financial institutions to ensure SME growth and increased financing for such businesses and renewable energy projects. This workshop also aimed to secure the necessary involvement of financial institutions and to create the linkages between SMEs and financial institutions from the programme's initial stages. Participants found the background knowledge and country mix of participants in the Mauritius workshop very balanced, since non-Southern

African SADC countries also were represented, and the structure of the workshop was found to be very well designed. Following the regional meeting in November 2017, an Advisory Board meeting for the ESF was held to discuss the findings from the workshop and to prospect future financial and technical support and partnerships for the programme.

Since the launch of the SADC Renewable ESF, nine partners that consist of funding institutions, business incubation centre and technical training centres have been attracted. Focusing particularly on gender and youth development, the first call for applications for entrepreneurs to be supported through the facility was launched in 2018 and second call launched in September 2019 where over 70 applications were received from across the region. Further, a dedicated fulltime Project Coordinator based at SACREEE was recruited in November 2019 to strengthen the implementation of the Facility. The Technical Committee for the Facility was set up in December 2019 to review applications received and prepare capacity-building activities for entrepreneurs.

The ESF helps to increase revenue and supports the creation of more employment as businesses grow. Since the ESF cannot support the same company for more than two years in a row, however, the question is how the ESF can ensure sustainability of growth and business operations. This concern is likely to grow as the roles of supporting partners have changed. As a result, ECREEE is adapting its approach to the new support structure. This also plays a role in terms of which project types ESF can expand into. Currently, the World Bank provides support under the Regional Off-Grid Electrification Project for off-grid and stand-alone systems.³ In addition, support is received from the European Union for mini-grids. ECREEE would like to expand efforts towards energy efficiency as well; however, this is tied to how institutional and financial support will develop.

Regarding the ESF workshops, participants provided very positive feedback about workshop content and how they applied trainings and skills gained in their daily businesses. Trainings that supported entrepreneurs to develop and implement a sustainable business plan and manage businesses were found very useful. An interesting learning was that participants realised the benefits their businesses were providing to society, defined as “social business”. In addition, workshops provided various advantages – such as networking opportunities, access to financing and loans, and the exchange of experiences – and they offered a platform that enables exposure to the activities of businesses from other countries and sectors. The example of doing business on telecommunication systems in rural parts of India inspired some entrepreneurs to develop similar systems in their own countries in Africa, eventually contributing to strengthening the economic viability of their businesses.

In addition to the learnings that related to the development and management of businesses, participants gained knowledge about the importance of quality issues. This helped businesses to make better informed decisions when purchasing energy equipment, by requesting their certification while at the same time paying more attention to meeting standards and raising the quality of their own products and services.

At the end of the workshops, participants were awarded certificates. They expressed their pride to attend the trainings and some participants included the attendance in their resumes. They highlighted that this creates a favourable difference and competitive advantage for them compared to many other players in the market.

Countries suggested that some of the trainings given under the ESF in West Africa may prove useful in the SADC context. Around the visibility of the ESF, the propositions made included an awareness-raising campaign prior to the second call for proposals, which includes linking up with ministries responsible for energy and associations across the region to maximise outreach. SACREEE’s National Focal Institutions have been proposed as anchors to the same end.

³ For further information, see <http://projects.worldbank.org/P160708?lang=en>.

ECOWAS Certification for Sustainable Energy Skills

The scheme requires technicians to undertake specific examinations based on the competency requirements of a regionally agreed job task analysis (JTA) to ensure a uniform competency level across the region. At present, the JTA for off-grid solar PV technicians has been developed with the support of IRENA and approved by all ECOWAS member states. Making off-grid solar PV technicians the first technician profile to be certified. There is growing interest from new partners for a second JTA on grid-connected solar PV and larger systems like solar PV mini-grids. IRENA's support for the setting up and piloting of the ECOAS Certification for Sustainable Energy Skills (ECSES) scheme entailed:

- development of the institutional structure, rules and procedures of the scheme;
- review of curricula of 21 partnering technical institutions to ensure compliance of their curricula with the agreed JTA;
- development of an examination content database for written, practical and oral exams;
- development of an examination manual elaborating the procedure for conducting the examinations, guided by the ISO 17024 standard;
- development of a regional implementation strategy for successful roll-out of the scheme in all member countries;
- supervision of first two examinations for certification of technicians under the scheme; held in January 2019 (Senegal) and June 2019 (Ghana); and
- preparation of ECREEE staff and in-country examination partner institutions to conduct, supervise and grade subsequent examinations.

A technical committee, co-ordinated by ECREEE, was established comprising all ECOWAS member states. IRENA has an advisory role on the technical committee. GIZ also has a non-executive but advisory role.

The inception meeting of the initiative took place in February 2018 in Praia, Cabo Verde. ECREEE, with technical advice from IRENA, is piloting the scheme by conducting standardised examinations for solar PV installers. Presently, 21 training institutes from eight countries are benefitting from this project. The key benefit for these institutes is that their existing curricula are being reviewed by IRENA consultants. During the same meeting, the role of ECREEE also was decided, whereby this ECOWAS regional centre would act as the certifying body until the certification programme can function independently.

Technical institutions are not directly involved in certification. There is another category of technical institution, representing partners to the certification programme. These are institutions that agree to host the examinations in the country for certification of technicians under ECSES. Memorandums of Understanding have been signed between ECREEE and the two new institutions, one in Ghana (beginning in January 2019) and another in Senegal (begun in December 2018). These institutions are where the first two certification examinations took place. All examining partners will be trained to carry out the examinations themselves. In the future, the plan is to have one or two institutions per country. Currently, IRENA is working on how to engage other ECOWAS member states by addressing long-term sustainability to generate funds and private sector engagement. In the technical meeting that took place in July 2018, Mauritania – a non-ECOWAS state – requested certification activity to be extended in the country. The final workshop, held in September 2019, completed the piloting of the certification scheme by disseminating the results of the scheme to the stakeholders including the ECSES technical committee. Since the two pilot examinations, another exam under the ECSES for off-grid solar PV technicians was held in Nigeria.

In addition to these activities, IRENA's analysis on quality infrastructure for small wind turbines (IRENA, 2015f) represents the guiding work on standards and quality control for technologies in Tanzania and South Africa.

International Off-grid Renewable Energy Conference and Exhibition

Taking into consideration the issues raised during the Bangalore energy access and rural electrification workshop that took place in 2011, IRENA organised the first IOREC in Accra, Ghana, in November 2012. The Conference was organised in co-operation with the ECOWAS ECREEE and the Alliance for Rural Electrification, and was an official contribution to the International Year of Sustainable Energy for All. It brought together stakeholders from the public and private sectors to identify barriers to scaling up off-grid renewable energy deployment and discuss possible solutions. The key findings and recommendations derived from the first IOREC concludes that adopting an effective policy and regulatory framework, together with tailored business and financing models and adapting technologies to the rural context, are all crucial factors in accelerating the deployment of off-grid renewable energy (IRENA, 2013a). Unfettered political commitment to rural electrification, together with a clear institutional framework, are key to attracting private sector involvement. At the same time, access to affordable finance and providing smart incentives that de-risk private sector investments will promote sustainable business models. Local enterprise will be instrumental in extending electricity access in rural areas and, hence, needs to be fostered and supported.

The third edition of the IOREC took place in Nairobi in September 2016. The event, which witnessed record participation of some 600 participants, was organised in partnership with Kenya's Ministry of Energy and Petroleum and the Alliance for Rural Electrification. It attracted stakeholders from government, rural electrification agencies, the private sector, financial institutions, development agencies and academia. The third IOREC highlighted that the business case for deploying off-grid renewable energy solutions to expand rural electricity access is stronger, thanks to rapid cost declines and technology innovation (IRENA, 2017a). As a result, private sector interest and participation in the sector is growing as innovative business models are being tried, tested and demonstrated. Dedicated and stable policy and regulatory frameworks are needed, however, for the development of stand-alone and mini-grid solutions, alike, and they should be formulated in close consultation with sector stakeholders. Policies need to be complemented with facilitating access to finance to ensure sector growth. Finally, technical assistance and capacity building are central to ensure human capacity and sustainability of off-grid renewable energy deployment. Dedicated measures are needed to identify skill needs and how to meet those.

The fourth IOREC that concluded in Singapore in 2018 was followed by IRENA's International Conference on Renewable Energy Solutions for Healthcare Facilities. Participants stressed the urgent need for increased co-operation between the energy and health sectors at all levels, from strategy and planning to policies, budgeting, procurement and implementation. There is a particularly strong call for innovation in delivery and financing models, as well as dedicated financing schemes by banks and financing institutions. Innovation also should be encouraged and promoted in the design of suitable and efficient medical devices appropriate for rural areas. Implementing the appropriate ecosystem for accelerating off-grid renewable energy deployment requires efforts to develop the necessary human capital by building capacity across the off-grid value chain and supporting local entrepreneurship.

Each IOREC has emphasised that modern energy access is central to achieving the SDGs. They all have concluded that governments should consider the entire spectrum of opportunities available from off-grid renewable energy solutions to expand affordable, reliable and sustainable access to households, support livelihoods, strengthen gender equality and enhance delivery of essential services (e.g. health). National electrification strategies should mainstream off-grid renewable energy solutions and facilitate co-operation between actors. To ensure private sector involvement in energy access, the policy and regulatory framework should provide the right set of incentives and risk coverage to private investors. It should alleviate the barriers that block financing in the sector.

2.4 Supporting platforms

Global Geothermal Alliance

IRENA co-ordinates and facilitates the activities of the GGA. The objective of the GGA is to facilitate enhanced dialogue, collaboration and co-ordinated action between the 46 member states and 38 partners, thereby enabling the improvement of frameworks and increased investment in the sector, given that the instrument brings together governments, regional and international organisations, industry associations and academia. From Africa, members of the GGA are Burundi, Comoros, Djibouti, Egypt, Ethiopia, Kenya, Tanzania, Uganda, Zambia and Zimbabwe. The first High-Level Conference of the GGA was organised by the Government of Italy and IRENA in September 2017 in Florence, Italy. The conference resulted in the Florence Declaration,⁴ whereby GGA members reaffirmed their commitment to collaborate in the identification and implementation of measures to significantly increase the speed of geothermal energy development around the world.

In Eastern Africa, existing direct finance options (e.g. from the Geothermal Risk Mitigation Facility for Eastern Africa) have been essential in attracting interest from the private sector and, indirectly, improving the understanding of the geology through the financing of surface studies. In particular, the Geothermal Risk Mitigation Facility, managed by AUC, aims to incentivise mobilisation of risk capital into geothermal exploration drilling. The Geothermal Risk Mitigation Facility provides 20% funding to cover the cost of infrastructure and 40% the cost of the first three exploration wells.

Under the umbrella of the GGA, IRENA supports existing efforts to foster an enabling environment to attract investments in geothermal energy. To this end, IRENA co-organised a regional workshop in January 2018 in Kenya – “Geothermal Financing and Risk Mitigation in Africa” – together with the Government of Kenya, Government of Japan and AUC.⁵ The workshop was attended by 100 participants and facilitated the exchange of knowledge and best practices on innovative financing models and risk mitigation mechanisms for the development of geothermal energy in Eastern Africa. The key messages from the workshop were:

- geological diversity across the East African Rift System calls for tailored approaches to address the challenges and opportunities of each country;
- high upfront investment costs, regulatory gaps and competition with other energy sources create a challenging environment for geothermal projects;
- governments should play a key role in reducing risks through a variety of instruments and strategies (e.g. innovative risk mitigation mechanisms, such as public-private insurance for geothermal well productivity);
- sound exploration, wellhead technology design and direct use of geothermal heat also could help reduce risks and improve bankability; and
- capacity building and mentoring support will continue to be vital to strengthen the decision-making process.

For the GGA, resource and market assessments are a key priority action area. In this respect, the activities of the Global Atlas programme on geothermal resources began in 2015. There are datasets and maps available that can bring value in preparing geothermal projects and which advocate the potential. For geothermal projects, however, one would need to go one step beyond the general understanding of resource availability and understand the resource potential by drilling specific project sites. In this context, the IRENA has reached out to potential data providers, covering more than 20 countries worldwide including Kenya.

⁴ See www.globalgeothermalalliance.org/-/media/Files/IRENA/GGA/Event/GGA-Florence-Declaration-FINAL.PDF?la=en&hash=0FFB185E9EC-6CE3DD35F439C20170C1FFD639BB7

⁵ For further information, see www.irena.org/events/2018/Jan/Regional-Workshop-on-Geothermal-Financing-and-Risk-Mitigation-in-Africa.

In addition, IRENA, together with the International Geothermal Association and the World Bank, has trained local stakeholders in Ethiopia (one of the three pilot countries in a wider project) and is testing the application of geothermal energy resources and reserves in several select fields there under the United Nations Framework Classification for Resources. The technical session in Ethiopia was organised in February 2019 under the umbrella of the GGA. The resultant classification reports and new geological maps will be displayed in the Global Atlas. The application of international guidelines to geothermal energy is expected to improve the understanding and comparison of the geothermal resource assessment.

The wider adoption of geothermal energy is hampered by many barriers, including investment risk, policy uncertainty, shortage of skilled professionals and environmental concerns. The main obstacle to geothermal investments and developments however, in addition to Africa, remains the high upfront investment required for exploration drilling at a point when the risk of project failure remains significantly high. The development of geothermal resources in the region will require some form of public intervention to absorb some of these risks, as well as to develop clear and transparent licensing requirements and mechanisms to attract private investors. The ongoing market assessment in Eastern Africa will provide scope for future regional co-operation on geothermal energy, including for direct utilisation and the overcoming of barriers relating to high upfront costs, investment risks, policy uncertainty, and shortage of skilled professionals.

Climate action

Climate change poses significant challenges to Africa's development, a situation that is further compounded by poverty as well as demographic and infrastructural limitations. IRENA's engagement in the climate change debate regarding emerging issues in Africa dates to 2011 during the Seventeenth Conference of the Parties of the UNFCCC (COP17) in Durban, South Africa,⁶ when it held a side event in collaboration with South Africa's Department of Energy and, there, released a working paper relating to the prospects for the African power sector. The paper provides an insight into the opportunities and costs of renewable energy development pathways (IRENA, 2012b).

All 53 African countries submitted their respective INDCs prior to the COP21. Not surprisingly, 52 of 53 NDCs included renewable energy targets – albeit only in 45 countries were the targets quantified. This effort acknowledges that Africa's vast renewable energy sources offer abundant opportunity to improve energy security and expand energy access in parallel to positioning the continent on a clean development path that is consistent with climate change mitigation. The NDCs of African countries predominantly focus on the power sector, with more than half of the targets representing electricity generation as opposed to other world regions, where the coverage of the heating and transport sectors are somewhat higher. Implementing NDC renewable energy targets in Africa (unconditional and conditional alike) would require a total investment volume of USD 245 billion to 2030 and would add a total of 97 GW renewable energy capacity between 2015 and 2030, according to an IRENA study (42 GW of this is related to unconditional contributions) (IRENA, 2017f). This would bring the continent's renewable energy capacity to almost 130 GW, much less than the 310 GW potential identified in IRENA's Africa 2030 roadmap, elaborated below.

For implementation of NDC-related renewable energy targets, IRENA released its guide and national climate plans relating to the advancement of renewables in Africa (IRENA, 2016f). The guide outlines a five-stage process for countries to meet their NDC targets with increased shares of renewables: Understand, Measure, Evolve, Modify, and Evaluate (UMEME). The UMEME framework highlights key sources of financial and technical assistance, as well as online tools to assist policymakers (Ibid.). The framework builds on the outcomes and experiences of the Regional Expert Meetings on Climate Change and Renewable Energy, held in Addis Ababa (Ethiopia), Libreville (Gabon) and Dakar (Senegal) in 2016. The meetings were organised by IRENA in partnership with ECREEE, UNECA, AfDB, UNFCCC Regional Collaboration Centres (Lomé and Kampala), West African Development Bank and East African Development Bank.

⁶ For further information, see www.irena.org/newsroom/articles/2011/Nov/Media-workshops-on-renewable-energy-at-COPDurban.

To develop a pathway for realising NDCs and raising the climate change mitigation ambitions in line with the goals of the Paris Climate Agreement, IRENA has been conducting key analytical pieces around its REmap programme. IRENA prepared its REmap 2030 Africa publication (IRENA, 2015a), which identifies options for renewable energy to 2030. In 2015, the Government of South Africa requested IRENA to expand its renewable energy roadmap programme to Africa, building on the findings from the ACEC power pools. The analysis presented at the SAIREC in October 2015 was built on a country-by-country assessment of supply, demand, renewable energy potential and technology prospects.

REmap Africa 2030 is IRENA's comprehensive roadmap for the continent's energy transition, building upon a country-by-country assessment of supply, demand, renewable energy potential and technology prospects, and it highlights possible roles for various renewable energy technologies across the five regions of Africa until 2030. In preparing this report, IRENA organised a workshop that took place in Abu Dhabi on 8 June 2015 which was attended by 50 participants, representing 17 countries and eight international organisations. The report was released on the side-lines of the SAIREC in October 2015, themed "RE-energising Africa".

The report concludes that modern renewable technology options across sectors and countries can collectively contribute to meet 22% of Africa's total final energy consumption by 2030, which is more than a four-fold increase from 5% in 2013. The four modern renewable energy technologies with the highest deployment potentials are modern biomass for cooking, hydropower, wind power and solar power.

The power sector presents significant opportunity to be transformed through the increased deployment of renewable energy technologies. The share of renewables in the generation mix could grow to 50% by 2030. Total installed renewable energy generation capacity would reach 310 GW. Hydropower and wind capacity could reach 100 GW capacity each, followed by a solar capacity of over 90 GW. For the power sector, this would be an overall tenfold renewable energy capacity increase from 2013 levels. The transformation, according to Africa 2030, would require on average USD 70 billion per annum of investment between 2015 and 2030. Within that total, approximately USD 45 billion would be for generation capacity. The balance of USD 25 billion would be for transmission and distribution infrastructure.

At the COP21 in Paris, the AREI was launched to accelerate the uptake of the continent's renewable energy potential. AREI aims to achieve at least 10 GW of new renewable energy capacity by 2020. Acknowledging the estimates and roadmap provided by Africa 2030, AREI developed its goal to mobilise at least 300 GW renewable energy capacity by 2030.

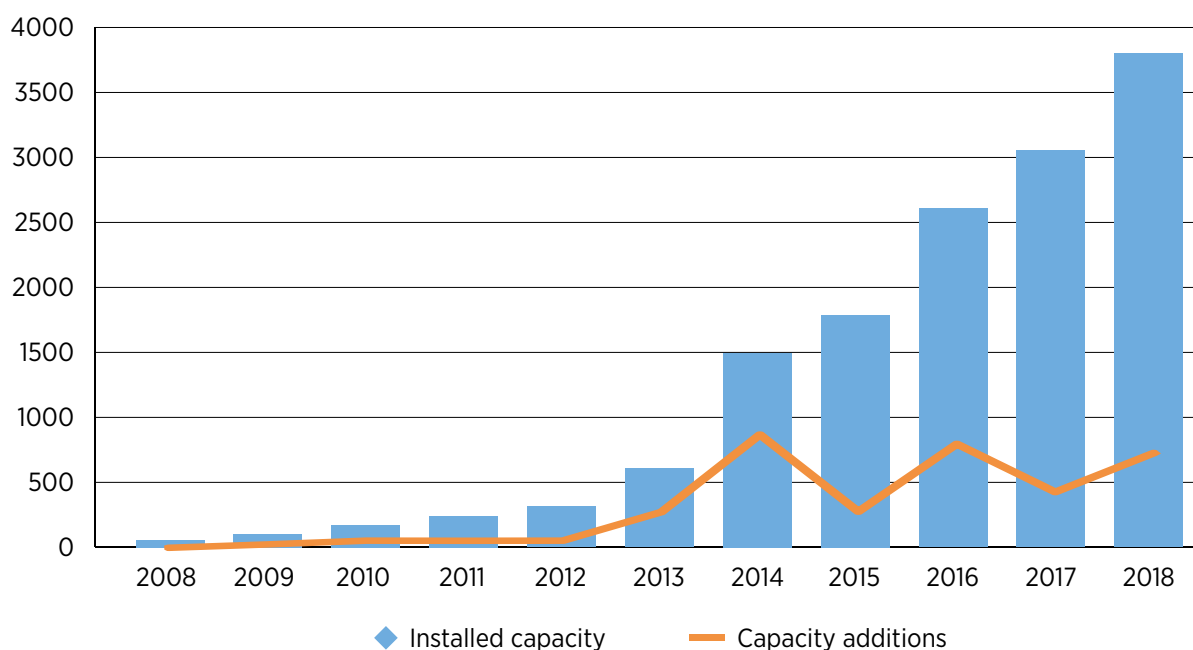
Traditionally reliant on hydropower, according to REmap Africa 2030, the continent can turn to solar PV to bolster energy security and support rapid economic growth in a sustainable manner. REmap Africa 2030 quantifies a solar PV potential of 70 GW that can be reached by 2030. Realising this would require, on average, 4.6 GW of solar PV capacity to be added each year over the 2018–30 period from a very low base of only 2.5 GW capacity installed in 2017. The annual capacity additions exceeded 800 MW in 2014, more than doubling the continent's cumulative installed PV capacity. Since then, additions are fluctuating (Figure 7).

In realising this potential, the evolution of cost reductions for solar PV must be understood. In 2014, IRENA began working with GIZ to identify current costs of solar PV in Africa as well as analyse how to balance the cost of solar photovoltaic systems to competitive levels. IRENA's Solar PV in Africa: Costs and Markets Report (IRENA, 2016e) tracks current and near-term costs in Africa, and highlights that cost trends are on track with the right enabling policies for Africa to be home to more than 70 GW of solar PV capacity by 2030. On-grid commissioned and planned utility-scale solar PV projects between 2014 and 2018 in Africa range from around USD 1 200/kilowatt (kW) to USD 4 900/kW. The cost range was between USD 3 400/kW and USD 6 900/kW in 2012. It declined by between 20% and 30% to USD 2 400–5 500/kW

in 2013 and to USD 2 000–4 900/kW in 2014. For 2015 to 2016, the cost range is anticipated to be between USD 1300/kW and USD 4100/kW. Project announcements in 2016 that are targeting commissioning dates in 2018 aim for a competitive total installed cost range of USD 1 200–1 900/kW. The report shows, additionally, that mini-grids utilising solar PV and off-grid solar home systems also provide higher-quality energy services at the same or lower cost than alternatives. Stand-alone solar PV mini-grids have installed costs in Africa as low as USD 1900/kW for systems larger than 200 kW. Solar home systems provide the annual electricity needs of off-grid households for as little as USD 56 per annum, less than the average price for low-quality energy services.

Dedicated policies, regulations and financial and fiscal support mechanisms are necessary to scale up renewable energy mini-grids. IRENA has compiled case studies relating to Nigeria, Rwanda, Sierra Leone and the United Republic of Tanzania about the experience of policymakers and the private sector, explaining the underlying factors of the evolution of the policy and regulatory landscape (IRENA, 2018d). The report evidences that countries are developing mini-grids through a range of approaches, although there is a call for regulations to cover finance support policies and de-risking instruments. In addition, approaches for renewable energy mini-grid and national rural electrification strategies should be integrated, and complementary efforts are required to build capacity across the value chain (from financial institutions to local communities) to identify cross-sector linkages and to ensure sustainability.

Figure 7. Total installed solar photovoltaic capacity and annual capacity addition in sub-Saharan Africa, 2008–18 (in gigawatts)



Source: IRENA, 2019f

The African continent has embarked on a development path that will lead to a 100% increase in its energy demand by 2030. Since 2015, this is driven by its increasing population and growing economy. Given the continent’s abundant resources, renewable energy has a crucial role to play to supply this exponential growth in energy demand and offer modern services to the population with no access to energy today. IRENA will continue facilitating and supporting this process through its well-established regional and country work in Africa, by further strengthening enabling frameworks to promote investments and by cultivating the associated knowledge and technical capabilities.

3. LEVERAGING PARTNERSHIPS FOR IMPACT

IRENA pursues strategic, results-oriented partnerships with various African organisations and development partners active in the field of renewables. This aim is to leverage existing efforts and resources, as well as to establish regional dialogues; support the creation of sufficient enabling frameworks; reinforce capacities with a view to learning from best practices globally; and release renewable energy potential in an optimal manner while taking local conditions into account.

In implementing its mandate in Africa, IRENA has collaborated extensively with regional partners. These include the AUC, AfDB, AREI, COMESA, ECCAS, ECOWAS, ECREEE, ERERA, League of Arab States, NEPAD, Regional Centre for Renewable Energy and Energy Efficiency covering the Arab region, RERA, SADC, SACREEE, SAPP and WAPP. Development partners and various IRENA members also have played a significant role, with valuable support originating from, among others, GIZ, Government of Luxembourg, Power Africa, SEforAll, European Union, Government of Norway, Government of Wallonia, International Atomic Energy Agency, State Grid Corporation of China and the United Arab Emirates.

IRENA's involvement in the region already is considered a critical factor in the acceleration of Africa's transition to more reliable, affordable and sustainable energy systems, thanks to the tangible impact of its work. IRENA will enhance collaboration and co-ordination with the AREI and PIDA and will continue aligning its work with other relevant continental initiatives and programmes to scale up the uptake of renewables in the continent's long-term energy plans.

Technical advice and capacity building will be deepened and extended to support the utilisation of the region's renewable energy potential in meeting and going beyond current targets. This will be achieved by paying special attention to renewable electricity cross-border trade and refined resource assessments that prioritise the viability of project-specific areas and investment potentials. A broader portfolio of such support will also address emerging issues relating to energy statistics, policy mechanisms and project facilitation.

Existing country-specific assessment tools, such as the RRA and REmap, will remain key to providing longer-term vision for renewable energy deployment. At the same time, they will identify major bottlenecks that warrant policy attention and will provide practical recommendations to resolve them. Such country-level engagement will inform IRENA's regional programmes to fine-tune their scope considering emerging country needs and priorities.

IRENA will continue to pay attention to energy access to create decentralised renewable energy solutions for supplying modern energy services to half the African population. This remains an essential task for sustainable development and prosperity. IRENA will prioritise maximising social and economic benefits of renewables-based energy access to advance agriculture and food security, improve human health, enhance refugee settlements and reduce poverty.



Photograph: Shutterstock

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ANNEX: DISCUSSIONS WITH EXPERTS

| Name, surname | Country | Organisation | Date of interview | IRENA activities covered during the interview |
|---------------------|-----------------------|---|--------------------------------|--|
| Alhaji Salifu Cham | The Gambia | NAWEC | 29 August 2018 | Capacity building workshop: Planning and operation of grids with higher shares of variable renewable energy (RE) |
| Monica Maduekwe | ECREEE | ECREEE | 29 August 2018 | Capacity building workshop: Development of renewable-based power provider agreements (PPA) |
| Aborak Kandine | Niger | ARSE | 3 September 2018 | Capacity building workshop: Development of renewable energy PPAs |
| Abdou Mbaye | Senegal | CRSE | 3 September 2018 | Capacity building workshop: Development of renewable-based PPAs |
| Ndeye Ami Drame | Senegal | Senelec | 7 September 2018 | Capacity building workshop: Planning and operation of grids with higher shares of variable renewable energy |
| Elisabeth Toe | WAPP | WAPP | 10 September 2018 | Capacity building workshops: Planning and operation of grids with higher shares of variable renewable energy and development of renewable-based PPAs |
| Thierno Oumar Barry | WAPP | WAPP | 10 September 2018 | Capacity building workshops: Planning and operation of grids with higher shares of variable renewable energy and development of renewable-based PPAs |
| Barry Karamoko | WAPP | WAPP | 10 September 2018 | Capacity building workshop: Development of renewable-based PPAs |
| Tijana Radojicic | Former IRENA employee | Former IRENA employee | 14 September 2018 | Clean Energy Corridors: Zoning |
| Bagui Diarra | Mali | Entreprise de Services Ecoénergétiques | 17 September 2018 (over email) | Renewables Readiness Assessment (RRA) |
| Bouh Moussa | Djibouti | Former Ministry of Energy and Natural Resources | 17 September 2018 | Renewables Readiness Assessment (RRA) |
| Yuri Lima Handem | ECREEE | ECREEE | 18 September 2018 | ECOWAS Renewable Energy Entrepreneurship Support Facility (ESF) |
| Manuel Kabore | PPS Sarl | Private sector | 18 September 2018 | ECOWAS Renewable Energy Entrepreneurship Support Facility (ESF) |
| Helmut Hertzog | South Africa | Private sector | 18 September 2018 | ECOWAS Renewable Energy Entrepreneurship Support Facility (ESF) |

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|-------------------------------|---------------------------|------------------------------|--------------------------|--|
| Habiba Ali | Nigeria | Private sector | 18 September 2018 | ECOWAS Renewable Energy Entrepreneurship Support Facility (ESF) |
| Dagobert Afanou | Togo | Ministry of Mines and Energy | 18 September 2018 | Clean Energy Corridors: National and regional energy planning |
| Malick Seck | Touba Solar Rama | Private sector | 19 September 2018 | ECOWAS Renewable Energy Entrepreneurship Support Facility (ESF) |
| Smael Khennas | Mali | Consultant | 19 September 2018 | Renewables Readiness Assessment (RRA) |
| Jeffre Rugare | Zimbabwe | Private sector | 20 September 2018 | ECOWAS Renewable Energy Entrepreneurship Support Facility (ESF) |
| Kudakwashe Ndhlukula | SACREEE | SACREEE | 20 September 2018 | Clean Energy Corridors: Zoning and national and regional energy planning |
| Stephen Dihwa | SAPP | SAPP | 29 January 2019 | Clean Energy Corridors |
| Robin Fola Mansaray | Sierra Leone | Ministry of Energy | 30 January 2019 | Clean Energy Corridors: National and regional energy planning |
| Bruno Korgo | Burkina Faso | Ministry of Energy | 5 February 2019 | Capacity building workshop: Development of renewable-based PPAs |
| Souleymane Berthe | Mali | Ministry of Energy and Water | 7 February 2019 | Site Appraisal, RRA, Abu Dhabi Fund for Development |
| Pierre Narcisse Massoma Bille | Cameroon / Central Africa | Ministry of Energy and Water | 7 February 2019 | Central Africa Roadmap |
| Asami Miketa | IRENA | IRENA | 30 August 2018 | Clean Energy Corridors: Zoning and national and regional energy planning |
| Lennart Kuntze | IRENA | IRENA | Numerous email exchanges | Clean Energy Corridors |
| Daniel Russo | IRENA | IRENA | Numerous email exchanges | Clean Energy Corridors |
| Simon Benmarraze | IRENA | IRENA | 13 September 2018 | ESF, post-RRA and Project Navigator |
| Serkan Ata | IRENA | IRENA | 17 October 2018 | Sustainable Energy Marketplace |
| Abdulmalik Oricha | IRENA | IRENA | 17 October 2018 | Global Atlas |
| Mohammed Nababa | IRENA | IRENA | 17 October 2018 | Global Atlas |
| Huiyi Chen | IRENA | IRENA | 17 October 2018 | Global Atlas |
| Luca Angelino | IRENA | IRENA | 17 October 2018 | Global Geothermal Alliance |
| Toshiaki Nagata | IRENA | IRENA | 17 October 2018 | Nationally determined contributions |
| Ali Yasir | IRENA | IRENA | 6 November 2018 | Certification |

