*Part II*

# Spotlight on the Southern Atlantic

*Chapter Five*

# Africa's Energy Scenario and the Sustainable Energy for All (SE4All) Initiative

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The Millennium Development Goals (MDGs) launched in 2000 are coming to an end in 2015. While tangible gains have been achieved, there is an understanding that some inputs to the MDGs, previously overlooked, but recognized as cross-cutting, need to be emphasized post-2015 in order to increase the gains. The global backdrop of a changing climate has focused on the emissions of greenhouse gases (GHGs) and impacts of this on climate change. Along with the deforestation, fossil fuel combustion is the main source of GHGs in Africa, focusing attention on the largest global resource sector, energy, and on the opportunities and implications of energy use. The development of this sector, dominated by the traditional policy paradigm of supply security since the 1970's oil crises, and characterized by a large, centralized, dirty and hidden energy system, is starting to fray at the edges. Despite the use of coal, oil and natural gas being consumed at unprecedented rates, a new paradigm is emerging, characterized by being smaller, increasingly decentralized, cleaner and more transparent—and most importantly, by a focus on services, rather than fuels and technologies.

The emerging paradigm comes into sharp focus in Africa where fossil lock-ins have thus far been avoided due to underdevelopment, where access to modern energy services are limited and where climate impacts are the most severe. This fecund continent of vast underutilized natural resources, resilient, but predominantly very financially poor people, has the potential to do energy differently. Despite the recent location of reserves of fossil fuels, a range of international economic instruments may provide sufficient incentives to inspire national leadership in order to catalyze a more sustainable energy trajectory.

> Imagine spending 30 hours per week fetching wood from forests that keep moving further away—carrying 10 to 20 kilograms over many kilometers—through wind and rain or the sun beating down on your head; just to cook your food. Imagine having to breathe in smoke for the 3 to 4 hours you spend cooking every day. Imagine what your eyes feel like after being exposed to smoke particles, day in and day out, year after year. Imagine being a young woman in Africa. (Source: Restio Energy)

An international United Nations-lead initiative, Sustainable Energy for All (SE4All), aims to inspire this leadership and leverage the resources to make it happen. This will, however, be extraordinarily difficult in light of the rapid rate of economic growth and ramping up of a spate of exploitable oil and natural gas reserves on the African continent.

## Introduction

The world has finally come to realize the fundamental importance of adequate and affordable modern energy as a precondition for economic growth, development and poverty alleviation. Today, some 1.3 billion people globally live without access to electricity. This means they are forced to live without electric lighting in their homes, while their health centers are unable to refrigerate vaccines, their schools have no computers, and local businesses cannot pump water for irrigation or grain mills.

Twice that number of people, 2.6 billion, lack access to clean cooking facilities. For most of these people, cooking requires hacking down trees with a daughter and starting fires by rubbing stones.

The United Nation's Secretary General has called for Sustainable Energy for All (SE4All) by 2030, and the European Union, the United Nations Development Program (UNDP), the Global Environmental Facility (GEF), the African Development Bank, and the U.S. Power Africa program, along with numerous bilateral, multilateral and non-governmental donors, have generously committed support to this initiative, paving the way for larger private and public investments. SE4ALL aims to achieve three simple, but very challenging, global objectives, all by 2030:

**Table 1. Energy Indicators for Selected Sub-Saharan African Countries Relevant to SE4All[1]**

| Country | Access to electricity % 2008–2012[1] | kWh/capita 1998–2002 | kWh/capita 2003–2007 | kWh/capita 2008–2012 | Renewable energy %[2] |
|---|---|---|---|---|---|
| Angola | 26.2 | 207 | 230 | 248 | 2.20 |
| Congo, Dem. Rep. | 11.1 | 98 | 104 | 95 | 2.87 |
| Congo, Rep. | 37.1 | 142 | 152 | 145 | 2.37 |
| Cote d'Ivoire | 47.3 | 202 | 210 | 210 | 1.67 |
| Ghana | 60.5 | 267 | 276 | 298 | 6.37 |
| Kenya | 16.1 | 149 | 147 | 156 | 7.37 |
| Namibia | 34.0 | 1,740 | 1,576 | 1,479 | 7.37 |
| Nigeria | 50.6 | 127 | 121 | 136 | 0.43 |
| Senegal | 42.0 | 164 | 196 | 195 | 0.60 |

1. Access and consumption source: World Bank (www.data.worldbank.org/indicator); Budget sources: www.cia.gov/library/worldfactbook, www.indexmundi.com, www.africaneconomicoutlook.org, www.pwc.com/ghana-budget2013, www.statehousekenya.go.ke/economy/budget2009-2012, www.energystar.gov.index/togo, www.worldbank.org
2. Excluding biomass.

- Ensuring universal access to modern energy services;
- Doubling the share of renewable energy in the energy mix; and
- Doubling the global rate of improvement in energy efficiency.

While these objectives will be difficult to achieve in much of sub-Saharan Africa, it is crucial to firstly define these objectives and understand that countries begin the race at different starting points. On the basis of Rapid Gap Analyses at the country level, the next step African countries undertake includes the development of action agendas and investment prospectuses designed to stimulate the domestic public and private investments required to achieve modern energy access, improve efficiencies and introduce more renewables. By March 2014, 83 countries had opted in to SE4All, of which 42 were in Africa.

### *Universal Access to Modern Energy Services*

Access to modern energy refers to electricity for lighting—in the very least—and, typically, also clean fuels and/or technology for cooking. Africa is predominantly rural, yet rural electrification rates in sub-

Saharan Africa average only 16%. Ghana, for example, has one of the highest electrification rates in sub-Saharan Africa, but even that is not enough to supply energy to the 20,000 Lake Volta island communities. Many national power companies are insolvent, unable to expand or even efficiently maintain their current networks. The Tanzanian power company (TANESCO) owes independent power producers hundreds of millions of dollars. And where grid lines exist, consumers find it difficult to pay the connection fees.

In Africa, policy directions which pursue cost recovery pull in different directions from those that pursue equity (access and affordability). This lack of resources results in an inability to extend access to those who actually need it, while often providing subsidized access to those who do not need the subsidy. The general decay of infrastructure that follows erodes reliability, financial and technical efficiencies. Many countries in Africa have dealt with this challenge and many more are still facing it and taking on painful and mostly incomplete power sector reforms. In 2010, African state-owned electricity utilities operated with deficits equivalent to 1.4% of sub-Saharan Gross Domestic Product (GDP), according to the International Monetary Fund (IMF).

The absence of grid power, however, is conducive to alternative opportunities: the markets for off-grid solar photovoltaic (PV) technology and solar lanterns with light-emitting diodes (LEDs) are booming. Soon Africa will see the emergence of small energy supply companies, operating micro-grids in villages, generating power from biomass waste or small hydro sites, and most interestingly selling services rather than consumption of energy. Small energy systems providers have tried out many models (triangulating users, micro finance and technology providers for purchase of systems, rentals and hire purchases schemes), but more recently they have attempted to reduce the transactions costs through rural energy utilities (combining finance and technologies), making use of developing mobile money schemes and offering fee for service, an approach that has been somewhat successful.

Depending on whether you live in a rural or urban area, cooking fuels in sub-Saharan Africa depends primarily on firewood or charcoal (a wood derivative). Both are biomass and, thus, theoretically, represent a renewable form of energy (assuming equivalent biomass re-

**Country Default Values of Fraction of Non-renewable Biomass**

| | | | |
|---|---|---|---|
| Angola | 97 | Liberia | 97 |
| Benin | 81 | Madagascar | 72 |
| Burkina Faso | 90 | Malawi | 81 |
| Burundi | 77 | Mali | 73 |
| Cape Verde | 89 | Mauritania | 85 |
| Chad | 92 | Mauritius | 100 |
| Comoros | 100 | Mozambique | 91 |
| Djibouti | 100 | Niger | 82 |
| DR Congo | 90 | Rwanda | 98 |
| Equatorial Guinea | 68 | Senegal | 85 |
| Eritrea | 97 | Sierra Leone | 95 |
| Ethiopia | 88 | Sudan | 81 |
| Gambia | 91 | Togo | 97 |
| Guinea | 96 | Uganda | 82 |
| Guinea-Bissau | 85 | UR Tanzania | 96 |
| Lesotho | 98 | Zambia | 81 |

Source: CDM EB 67 Annex 22 11th May 2012.

growth, which is not that common—see the box above on Non-Renewable Biomass default factors for Africa). Simply put, trees are still not typically re-planted and forest management is universally insufficient.

Charcoal, in particular, is a vast business, comparable to agriculture in many countries and informally employing millions of people across the continent. The charcoal market in Kenya is valued at more than 200 million dollars annually, and in Tanzania it is the third largest contributor to GDP and almost entirely informal and out of reach of revenue services. Alternatives to wood fuels (electricity, liquefied petroleum gas [LPG], biomass, and briquettes) are generally more expensive or inaccessible due to undeveloped markets. Wood fuel stoves with improved efficiency have been introduced and promoted in most countries, sometimes successfully, such as the Fourneaux Nansu in Benin, Sewa in Mali, or the Jiko in Kenya.

However, there is a significant opportunity to produce and consume wood fuels sustainably through participatory forest management, nurseries and tree planting, more efficient kilns for wood-to-charcoal conversion, and sustainable charcoal certification. Formalization of the sector, along with enhanced policies, policy instruments, legal frameworks and regulation, could also provide greater revenue to governments. Though difficult to achieve, it seems more realistic to expect future African families to cook with sustainable wood fuels in efficient stoves rather than with electricity or LPG. LPG usage was nearly universal in Dakar until very recently; however, most households switched back to charcoal when the LPG subsidies were removed. Similarly, the World Bank reports back-switching to charcoal from electricity and gas in response to poor reliability and high prices in Tanzania.[1]

### *Doubling the Share of Renewable Energy in the Energy Mix*

The second SE4All objective—doubling the quantity of renewables in the energy mix—also requires defining, and understanding, the wide spectrum of starting points, from which African countries depart. Clearly, the unsustainably produced and consumed wood fuels used for cooking throughout Africa cannot be considered to be renewable energy. *But perhaps they should be considered renewable if the processes were reinvented into sustainable formal sectors*. Large hydropower installations (such as the 200MW Manatali Dam shared by Mali, Mauritania, and Senegal) exist across the continent; however, given their socio-economic impacts, both positive and negative, it is unlikely that the SE4All effort will build another 100 large-scale dams across Africa. Although this might contribute to increasing lower carbon (rather than fossil fuel-based) electricity supply in Africa, given the potential environmental and social impacts of large-scale hydroelectric power, it is unlikely to be considered by SE4All as sustainable or even renewable.

Instead, SE4All could support the development of thousands of run-of-the-river hydropower projects for rural mini-grids and decentral-

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1. From 2001 to 2007, the proportion of households in Dar es Salaam using charcoal as their primary energy source has increased from 47% to 71%. Use of liquefied petroleum gas (LPG) has declined from 43% to 12%. In other urban areas, the share of households using charcoal for cooking remained at 53%, while the share of fuelwood use increased from 33% to 38%. The use of electricity for cooking is below 1%. *Environmental Crisis or Sustainable Development Opportunity*, World Bank Report and Policy Note, 2009.

ized electrification. Furthermore, the doubling of renewable energy should be coupled with the aim of universal access to electricity. In this sense, a focus on small-scale off-grid solar solutions might make more sense than a more traditional focus centering overwhelmingly on large-scale and centralized grid-based access solutions to be favored by Africa's national power companies. Such a distributed renewables focus would mean that most of rural Africa could eventually be provided with power by small, private energy service companies (ESCOs) that generate electricity from biomass, hydro, solar and wind resources. These micro village grids will provide electricity in the volumes required by value-adding agri-businesses, powering irrigation, processing mills and cold storage, fostering the economic growth and development that Africa so badly needs and keeping much of the revenue in local economies. Other larger renewable energy electrification projects will, nevertheless, connect to main grids.

### *Doubling the Rate of Improvement of Energy Efficiency*

The objective of doubling energy efficiency requires a baseline and a unit of measurement. However, in many sub-Saharan Africa countries, it may be easier to save 100 MW of power through energy efficiency rather than through adding 100 MW of renewable electricity. Tanzania has added almost no renewable energy to its power mix over the last decade, while Ghana saved 124 MW in 2007 by replacing 6 million incandescent light bulbs with compact fluorescent lights (CFLs). The South African electricity utility—through Demand Side Management (DSM) and a "Standard Offer"—reduced power consumption by more than 3 GW in just 3 years (between 2010 and 2012) at just over US$ 600/kW. Nevertheless, their spokesman suggested this was a disappointing, if significant, outcome. In response, standard offer efficiency subsidies there have been withdrawn. The fact of the matter is that few utilities like demand management interventions—unless demand shortages threaten.

In addition to lighting, other widespread opportunities to improve energy efficiency include upgrading antiquated cogeneration installations, improving maintenance of power plants and grid networks to reduce losses, and improving maintenance of thermal performance in structures, along with heat pumps to decrease the use of air conditioning, water, and space heating. Improved cookstoves, successfully introduced and marketed, will also be major contributors to energy efficiency savings and improved respiratory health, as would improved kilns for wood-to-charcoal conversion. There are a multitude of industrial interventions that are possible, such as efficient boilers and variable speed drives—but in all cases energy management is the most powerful contributor to improving efficiency.

Though renewable energy feed-in tariffs (REFITs) and other tools have been developed as incentives for renewable energy power projects, few such incentives are in place to promote energy efficiency. In fact, in many African countries Ministries and government officials do not pay their electricity bills and, therefore, do not feel the financial pain of energy inefficiency. The same is true for most foreign diplomats and development workers in Africa (who often run multiple freezers, refrigerators and air conditioners 24 hours per day). The opportunity is present, therefore, to improve energy efficiency simply through awareness raising, energy audits, incentives to offset verified energy reductions for both suppliers and users, carbon market mechanisms, independent regulation based on least-cost principles, capacity building and monitoring in the public sector. Businesses are most sensitive to energy efficiency, but many lack the technical knowledge to become more efficient, lack the financing to implement measures, and plan on very short payback periods for retrofits and new construction. There are, however, some notable exceptions in Africa in which energy efficiency is world class. For example, some breweries target energy per volume of beverages.

The SE4ll initiative is timely, and critical, for Africa's growth and development, but it must be implemented with skill, wisdom and transparency. Many countries will require energy sector policies and reforms (i.e. REFITs, new tendering schemes for renewable additions to grids, establishment of rural energy agencies, etc.), capacity building in both the public and private sectors (without ignoring the financial sector), technology transfer and technical support in deploying new renewable technologies, simple and low-cost financial instruments (including targeted preferential credit, loan guarantees and grants) and affirming demonstration projects in order to meet SE4All's commendable objectives. Each country should first develop a SE4All Action Agenda that rests on good participative processes that facilitate informed decision-making—and hence ownership—by beneficiaries (such as the European Union's Best Practices Guide for Policy Makers and Energy Planners, or similar planning tools for broad consultation and buy-in) before moving onto the development of Investment Prospectuses.

Africa could learn relevant lessons from the trajectories of those countries exhibiting a track record of getting it right. Allegedly, Tanzania's primary energy mix today (along with a number of other African countries with a near 90% primary energy contribution from biomass) is comparable to the one of the United States in the 1850's. Therefore, examples in Asia and across the southern Atlantic in Latin America could be utilized in order to propel Africa's energy systems forward. Particularly salient examples are the ones which boast an abundance of traditional biomass resources in the energy sector that have been modernized and made more efficient in achieving modern energy access that is cleaner, right sized, efficient and sustainable.

## Ensuring Universal Access to Modern Energy Services

> Access to modern energy has been typically defined as an electricity connection in the household and use of non-solid fuels. Although convenient, this definition does not encompass standalone off-grid solutions and isolated mini-grid solutions. Nor does it capture important aspects of availability (time and duration), reliability, quality (voltage) and affordability of supply from the grid as well as legality of connection. On the cooking solutions side, this definition does not capture the use of solid fuels in advanced cookstoves. Further, this household focused definition ignores the importance of access to energy for community institutions, such as schools, health clinics and community centres, and for productive purposes, including micro-mini enterprises, essential for socio-economic development.[2]

Under the Sustainable Energy for All initiative, the target of Universal Access to modern energy services by 2030 has become a priority Sustainable Development Goal of the international development agenda. It is an ambitious goal that will require commitment from a

2. *Consultation on Global Tracking Framework: Proposed Methodology for Global Tracking of Energy Access, November 2012.* World Bank/ESMAP World Health Organization (WHO), International Energy Agency (IEA), Global Alliance for Clean Cookstoves (The Alliance).

**Table 2. Electricity Access Rates* in Africa, 2012**

| | Population without electricity (millions) | Electrification rate % | Urban electrification rate % | Rural electrification rate % |
|---|---|---|---|---|
| Africa | 622 | 43 | 68 | 26 |
| North Africa | 1 | 99 | 100 | 99 |
| Sub-Saharan Africa | 621 | 32 | 59 | 16 |

*Not to be confused with "access to modern energy services."
Source: IEA, World Energy Outlook, 2014.

broad array of stakeholders and significant amounts of funding. The SE4All Finance sub-committee estimates the achievement of the universal access goal will require $45 billion per year to 2030, up from the current $9billion per year currently (mostly in sub-Saharan Africa, South and South East Asia and Pacific. The Global Climate Fund (GCF), which is set to serve as the centerpiece of efforts to raise $100bn a year by 2020 for climate finance, has a crucial catalyzing role to play in this effort. Given the limitations of public finance, it is argued that significant private finance will need to be leveraged as a complement. This presents a significant challenge as it is the concentrated and relatively well off who have access to modern energy services—not those who are are poor and disparate in location. The low-lying fruit in Africa has already been picked; what remains on the tree does not easily lend itself to the making of markets, or that too would have been done by now.

Where national data is available, the International Energy Agency publishes figures for electrification rates by region, country, urban and rural sectors. Table 2 summarizes the aggregated data for Africa.[3]

In North Africa, power access is virtually universal. In sub-Saharan Africa, however, the average figure is a low (32%), with Mauritius (100%), and South Africa (85%) at the higher end of the range. At the lower end (essentially the African Least Developed Countries) are Malawi (9%) and Uganda (15%), Ethiopia (23%), and Tanzania (24%).[4]

3. The database shows detailed data on urban and rural electrification collected from industry, national surveys and international sources.

4. IEA World Energy Outlook 2011.

Access to electricity is constrained throughout sub-Saharan Africa, but the constraint is most prominent in rural areas in the least-developed countries (LDCs). Such areas are difficult to supply power to through traditional grid solutions: they are typically geographically remote; transmission and distribution lines present expensive investments; and the ultimate consumers are relatively poor and limited in their ability to pay for consumption. Therefore, there is insufficient return on investment for African power companies that are already financially stressed. Lessons can certainly be learned from the telecommunications industry as to how it successfully built markets in such rural locations. A further complication for developing and particularly LDCs is that replacing fiscal revenues from fossil fuels with renewables or even energy efficiency may not be popular with treasuries.

References to services, including energy and other public services and providers, can be found in national constitutions, bills of rights, and energy policies throughout sub-Saharan Africa. Occasionally, these policies also include specific targets. But physical access to modern energy is only part of the economic growth and sustainable development equations. *The ways in which people and their productive activities connect to, afford and effectively utilize the energy are critical considerations in ensuring modern energy access sustainability*.

Energy is needed as a precondition for rural development, powering value-adding activities such as irrigation pumps, food and minerals processing equipment, cold storage and other food preservation activities, etc. This economic development improves the ability of the local population to consume other, and more, goods and services, including energy services, which in turn contributes to further development. So, while physical access can be achieved using public money, energy consumption beyond a poverty tariff quantity of supplied energy presents a challenge to the economic sustainability of utilities.

With sub-Saharan Africa growing, primarily as a result of mineral, energy, forestry and other extracted commodities, bilateral and multilateral donors, along with international private capital, demonstrate an increased interest to stimulate the deployment of power distribution infrastructure. Foreign development assistance plays a decisive role in supplementing national initiatives. At present, many countries have agencies dedicated to rural energy/electricity access (sadly, their focus often does not incorporate traditional biomass). For its part, the SE4All initiative, through its regional and thematic hubs and High Impact Opportunity clusters, aims to enable accelerated access that avoids large-scale fossil fuel technology lock-ins and improves efficiency in generation, transmission/transportation, and distribution and use.

Other than the thematic Hubs for Decentralized Energy Access (UNDP), Energy Efficiency (UNEP RIso) and Renewable Energy (IRENA), there are thematic Hubs for Capacity Development (TERI) and Communications and Knowledge Management (World Bank) including some 50 High Impact Opportunity clusters. Furthermore, three Regional Hubs have also been established in the regional public banks (African Development Bank, Asian Development Bank and the Inter American Bank) to facilitate and coordinate national Action Agendas and Investment Prospectus.

### *SE4All: Roles, Definitional Issues, and Monitoring*

National trends of increasing (or decreasing) energy access provide insight into the implementation of national developmental policies, institutional mobilization, leadership and budgetary priorities. Thus, the definition of access underpinning the numbers at each national level is important. Improved cook stove ownership and use is not systematically tracked in most countries, except in a few carbon financed projects or occasional cross-cutting, one-off, sample-based surveys. These surveys, however, do not reveal trends, but rather penetration levels at a particular moment in time. Furthermore, the definition or standard interpretation of what constitutes an efficient, advanced, or improved cook stove still requires agreement.

> In a recent meeting with the Permanent Secretary of the Ministry of Energy and Minerals in Tanzania, he acknowledged that published access figures include national grid, mini-grid, stand-alone generators, solar systems, and solar lanterns. The combination of all of the above results in an access figure of 18.4% (November 2012) the reported figure is now increased to 24% according to IEA 2014.

**Table 3. The Tier System of Measuring Electricity Access on the Supply Side as Interpreted by CIF**

| Attributes | Tier 0 | Tier1 | Tier 2 | Tier 3 | Tier 4 | Tier 5 |
|---|---|---|---|---|---|---|
| Peak available (Weq) | - | >1 | >50 | >500 | >2000 | >2000 |
| Duration (hrs) | - | >4 | >4 | >8 | >16 | >22 |
| Evening supply (hrs) | - | >2 | >2 | >2 | >4 | >4 |
| Affordability | - | - | Yes | Yes | Yes | Yes |
| Formal (legality) | - | - | - | Yes | Yes | Yes |
| Quality (voltage) | - | - | - | Yes | Yes | Yes |
| Global tracking for SE4All | No | Basic | Advanced | | | |

**Table 4. The Tier System on the Demand/Service Side**

| Tier 0 | Tier 1 | Tier 2 | Tier 3 | Tier 4 | Tier 5 |
|---|---|---|---|---|---|
| - | Task lighting and phone charging | General lighting and TV and fan | Tier 2 and any low-power appliances | Tier 3 and any medium power appliances | Tier 4 and any high power appliances |

Source: https://www.climateinvestmentfunds.org/

Access in the context of SE4All refers to households, livelihoods, public institutions and productive uses. Faced with this complexity, the World Bank and IEA through ESMAP have pioneered a multi-tier framework to support SE4All that focuses on major attributes of energy supply across energy sources, and includes aspects of performance with respect to: quantity and quality of supply, duration, reliability, affordability, legality, convenience and health and safety.

Included above is the Climate Investment Funds (CIF) interpretation of the ESMAP's tier approach to assessing energy access. The approach, while comprehensive, demands considerable emphasis on measuring and monitoring for assessing baselines and tracking progress (see Tables 3 and 4).

The Tier system for non-electric energy uses (mostly for cooking and heating) has been elaborated and qualifies the technologies and fuels in relation to a range of attributes including: capacity, duration/availability, quality, affordability, convenience and health/safety. The tier rating for the household is calculated by applying the lowest of the tier ratings across all attributes.

Technically improved cook stoves (ICS) and advanced cook stoves (ACS) are capable of wood savings of up to 60%, and over the longer-term, it will be important to aim for more ambitious targets. The additional health benefits of ACS make their introduction an important aspiration.

An International Standards Organization workshop agreement (ISO, 2012) identified four performance tiers for cook stoves depending on their efficiency, environmental and health impacts: Tier 0 includes to unimproved traditional cooking methods; Tier 1 relates to measurable improvements; Tier 2 substantial improvements; Tier 3 currently achievable technology for biomass stoves; Tier 4 stretch goals for targeting ambitious health and environmental outcomes.

An on-going review by the World Bank ACCES Project of the status of clean cook stoves in sub-Saharan Africa (SSA) shows how different types of available stove perform compared to these tier levels. (ACCES (African Clean Cooking Energy Solutions Initiative), 2014) The majority of ICS used in Sub-Saharan Africa today operate at Tier 1 level. However, the report stated that more advanced versions have substantially better performances, and can potentially perform close to those of kerosene or LPG stoves.

In terms of potential wood savings, the performance of the tiers is estimated by ACCES as shown in Table 5.

In addition to electricity and cooking solutions, similar attributes for tier levels are in place for access to electricity for productive and public uses.

### *Other Definitions of Energy Access*

The International Energy Agency's definition, though blunt, is simpler to apply and less onerous to monitor: access to modern energy services is defined as household access to electricity and to clean cooking facilities. The latter is defined as access to clean cooking fuels and stoves, including advanced biomass cook stoves and biogas systems. (International Energy Agency, 2010).

The Practical Action Group (2013) has developed the concept of Total Energy Access, which they define as households, enterprises and community services having sufficient access to the full range of energy

**Table 5. Cook Stove Efficiency Ratings for Proposed ISO Tiers**

| Proposed ISO Tier | Illustrative stove type | Efficiency |
|---|---|---|
| Tier 0 | 3-stone fire | <15% |
| Tier 1 | ICS | >15% |
| Tier 2 | Rocket stove | >25% |
| Tier 3 | Forced draft | >35% |
| Tier 4 | LPG | >45% |

Source: World Bank ACCES Project.

supplies and services that are required to support human social and economic development.

### *SE4All Initiative: Value-Added Energy Services in Africa*

The SE4All Africa Hub in the African Development Bank (AfDB) is designed to facilitate SE4All activities on the continent and provide some process and output cohesion and quality, as well is input cohesion such as with the recently established EU-funded SE4All Technical Assistance Facility, The U.S. Power Africa initiative, and the numerous Chinese and Nordic country energy infrastructure projects. It aims to contribute to enabling policy, legal frameworks and favorable environments for the private sector to supply clean modern energy that is transported and utilized more efficiently. The SE4All Hub and facilities will provide technical assistance capacity building for public and private sector actors, including financial institutions. The Initiative could also offer dedicated clean energy finance and grant funding for demonstration projects. In some countries, SE4All may be applied to strengthening and augmenting existing initiatives that target access, efficiency and renewables. In other countries, policy and policy instruments may need to be built up from scratch.

The SE4All Africa hub based at the AfDB will, in turn, facilitate the development of Action Agendas and Investment Prospectuses for the 83 (of which 42 are in Africa) countries that have opted into SE4All and have completed their rapid assessment gap analyses, that have examined existing policies, policy instruments and initiatives baseline to enable the SE4All 2030 goals.

If energy access strategies are designed around minimum energy service levels (i.e. a lighting = solar lantern and cooking = an improved cook stove), many existing value chains will deliver effectively and

**Table 6. Access to Energy Services: Range of Energy Sources and Technologies in Africa**

| Energy services | Energy sources | Access technologies |
|---|---|---|
| Lighting | Hydropower, biomass, wind, and solar | Grid, mini-grid, solar PV, solar lanterns and LEDs |
| Cooking and water-heating | Electricity, LPG, briquettes, sustainable wood fuels | Improved cook stoves |
| Communications media and amplification | Hydropower, biomass, wind and solar | Grid, mini-grid, solar PV, solar lanterns and LEDs |
| Food preservation (refrigeration) | Hydropower, biomass, wind and solar | Grid and mini-grid |
| Food preservation (drying) | Hydropower, biomass, wind and solar | Grid, mini-grid, CHP and solar driers |
| Food processing | Hydropower, biomass, wind and solar | Grid and mini-grid |
| Water pumping | Hydropower, biomass, wind and solar | Grid, mini-grid and solar pumps |
| Transportation | Biodiesel or bioethanol | |

Source: J. Felten, Camco 2013.

potentially at the lowest cost. Through bottom-up consultations with the targeted energy access beneficiaries on service and technology options, increased project ownership can be achieved and willingness to pay can be measured, while ensuring sustainability for the SE4All initiatives.

Key to achieving efficiency of energy use and sustainability is providing energy at cost-reflective prices while avoiding systemic subsidies. Consumers use energy most efficiently when they feel the cost. This does not mean that universal access cannot be achieved in economically poor areas. The cost of clean energy technology is forever falling as a result of technological learning, and new lower cost technologies are constantly being manufactured and reaching economies of scale. Also, development actors are skilled at inventing creative ways to facilitate access to the poor, through microfinance and informed technology receptivity programs, for example.

Energy access *for productive uses* requires special consideration, given its critical role in economic growth and sustainable development. It is these productive consumers of electricity that represent the anchor clients for grid extensions, the nucleus of mini-grids, and markets for other energy services. Productive activities create jobs and generate community-wide income, making power more affordable for the population as a whole, including households, public, social and cultural institutions.

Numerous sources could generate productive clean energy, but one of the cheapest and most technically robust can be found in agricultural residues (also known as biomass waste). Investigations of decentralized, least-cost solutions will be a priority in advancing access, and in particular low carbon access with renewables, which are abundant in Africa.

A key challenge for the SE4All will be to devise sustainable and bankable strategies and projects that deliver energy access to poor, remote and sparsely populated rural areas, where income is low and markets for modern energy do not exist. Specialists will have to assist national and subnational governments, private sector associations and their members, communities, and others to design, finance and implement access programs. Specialists' key skill sets should include policy development and processes, business development, finance, marketing, technology transfer, training, project implementation, and monitoring and evaluation.

## Doubling the Share of Renewable Energy in the Energy Mix

The fact that Africa's energy infrastructure is so relatively underdeveloped presents a tremendous opportunity. Going forward, sub-Saharan Africa does not have to follow the same (or similar) industrial revolution development model (based on a large, centralized, dirty and hidden energy system) that developed economies rely on. Africa could build its energy sectors around more sound business models that are less dependent on imported and polluting fossil fuels. Africa can build energy sectors based on decentralized power generation and distribution (often referred to as distributed power), exploiting its own indigenous renewable energy sources and, thereby, reducing transmission losses, creating jobs and augmenting income in rural areas. However, if this was to happen, the fiscal holes left behind by reduced fossil fuel tax income to Africa governments (a large proportion of fiscal revenue in Africa) would have to be filled and the rent seeking associated with large infrastructure projects would have to be overcome.

The SE4All objective of doubling the share of renewable forms of energy in the global energy mix will be primarily met in two ways:

- Electricity will increasingly be supplied using renewable energy sources, which would replace fossil fuels;
- Households and institutions will increasingly cook with renewable energy sources, which would replace unsustainable wood fuels.

### *Electricity with Renewables*

Different forms of renewable energy are available throughout the world, each with its own advantages and limitations. Solar PV is perhaps the most expensive renewable energy technology, but it can be deployed almost anywhere in Africa, in rural areas far away from any grid network. Small and mini-hydro developments generate volumes of reliable power capable of powering agri-business equipment such as grain mills and cold storage, but not every African village is situated near a river. Evidently, it would be counterproductive to install 1MW of solar panels in a mountainous temperate zone where a timber industry would generate a great deal of biomass waste. Biomass boiler systems are much more reliable and cost-effective.

***Solar and Wind.*** Solar and wind energy resources are somewhat similar in their capacities. Solar PV does not work in the rain, and wind turbines remain motionless when the wind is not blowing. For this reason, both are usually coupled with storage technologies (batteries), so that consumers can have access to power even in the absence of sunlight or wind. The batteries add considerably to the cost of using solar and wind energy and are the weak points of these systems.

On the other hand, solar PV and wind systems have the potential to be deployed in far away off-grid rural areas. This frees the consumer from having to rely on any power provider. In fact, the owner of the solar home system, for example, is simultaneously a power producer and consumer. He/she can never consume more power than her system has generated, and must keep that in mind or damage the solar system.

The use of solar PV technology in Africa is more widespread than wind power technology, but wind power is deployed in large grid-connected projects, such as the 300MW Lake Turkana Wind Power Project in Kenya. The entire sub-Saharan market for solar PV (excluding the newly booming South African Independent Power Projects - IPP market) can be approximated at less than 40MW annually. According to the IEA, solar-installed capacity has increased from less than 80 MW in 2010 (mainly small-scale PV) to around 125 MW in 2013 (including some larger plants). Solar projects including a 15 MW one in Mauritania and a 33 MW one in Burkina Faso are currently under construction.

Table 7 provides examples of potential markets for solar PV technology in Africa.

For example, the capacity of PV panels imported into Tanzania has been growing exponentially between 2005 and 2012, increasing from 100 to 2336 kWp (kilowatt peak). In the period between 2009 and 2013, the retail price dropped from 6.30 dollars/Wp to 1.67 dollars/Wp (watt peak).[5] Table 8 shows trade of PV capacity in Tanzania

5. Dr. Matthew Matimbwe, Director of TAREA, personal communication November 24, 2013, states that prices in November 2013 had reached 1.50 dollars/Wp.

**Table 7. Potential Solar Markets in Africa**

| No. | Market | End user | System size | Supplier | Beneficiary |
|---|---|---|---|---|---|
| 1 | Social Services | Schools, health facilities, government offices | 400Wp - 1.3kWp | Importer/ wholesaler | Government, rural population |
| 2 | Business | big business, like hotels, telecoms, horticulture, mines | 300kWp - 2MW | Importer/ wholesaler or project developer | Private business |
| 3 | | SMEs, like village markets, irrigation | 1 - 30kWp | Project developer | SME and rural community |
| 4 | | Fishermen and their co-ops | 220Wp | Wholesaler/ retailer | Fishermen |
| 5 | Households | Rural, off-grid homes | 50-200Wp | Wholesaler/ retailer | Rural families |
| 6 | | Village grids | 10-30kWp | Project developer | Rural community |
| 7 | | Urban gird-connected doing net metering | 1,000-5,000kWp | Importer/ wholesaler or retailer | National grid, system owner |
| 8 | The Poor | Rural families of modest means buying or renting lanterns | 0.5 - 2Wp | Retailer or credit union or lantern renting station | rural household |
| 9 | Utilities | Utility buying from solar IPP | 20MW - 50MW | International project developer | National grid |

Source: Jeff Felten, Camco 2013.

between 2005 and 2012. The Tanzanian Renewable Energy Association (TAREA) reported prices in November 2013 at 1.50 dollars/Wp. Only time will show whether this is as a result of technological learning or the dumping of Chinese surplus.

***Hydro and Biomass.*** Like solar and wind renewable energy resources, hydro and biomass energy are also similar in their capacities. The principle difference is that the embodied energy in the biomass and water in the reservoir (or run-of-the-river) is the storage, and, therefore, batteries—typically the weakest component in other types of renewable systems—are not required.

Hydro and biomass power technologies have existed since the industrial revolution, and are, thus, very mature technologies. The can generate high volumes of reliable power. Therefore, they are well suited to supplying electricity to mini-grids in order to allow rural industries to meet their energy requirements, such as irrigation equip-

**Table 8. Solar Panels Capacity Traded (imported) in Tanzania 2005–2012**

| Year | Capacity in kWp |
|---|---|
| 2005 | 100 |
| 2006 | 206 |
| 2007 | 285 |
| 2008 | 638 |
| 2009 | 1161 |
| 2012 | 2336 |

Source: Tanzanian Renewable Energy Association (TAREA), 2013.
Note: figures rounded to nearest kilowatt digit

ment, drying, processing, cold storage, etc. This advantage is of critical importance because, in the absence of rural industry, African villages fail to develop, and remain poor. Hydro and biomass power plants can also, theoretically, provide electricity 24 hours a day, 365 days a year.

A 30kWp village mini-grid powered by biomass waste (i.e. rice husks, maize cobs, cashew shells, etc.) can cost as little as 40,000 dollars to develop, whereas a similarly sized village grid using solar PV technology would likely cost four times as much. In addition to solar panels, the other major difference in project costs comes from batteries, which would be required for a solar mini-grid. But hydro and biomass technologies also have their obvious limitations. A hydropower plant requires water and a waterfall or gradient of some kind. A biomass power plant requires sufficient quantities of agricultural waste or sustainable supplies of woody biomass.

### *Cooking with Renewables*

As electricity under the SE4All initiative will increasingly deploy renewable energy sources, so, too, will the kitchens of Africa.

The SE4All initiative ultimately imagines a world where all households and institutions cook with renewable, biomass, electricity and compressed natural gas (CNG) or LPG. This may be possible in the long-term future. However, it is likely that small African businesses will develop markets (both rural and urban) for alternatives to the current unsustainable use of woody biomass and charcoal fuels as has been seen in the highly differentiated kerosene value chains on the continent. Small and medium industries producing briquettes from agricultural waste are emerging in many countries. These businesses produce local value-added biomass-based alternatives to charcoal and firewood, allowing consumers to continue with their cultural culinary habits, while adding value to previously unused waste streams that require the introduction of appropriate and affordable fabrication technologies.

Other small businesses are marketing biogas systems that digest waste and transform it into methane. The methane can then be lit, creating a flame that can boil water and cook meals. Though biogas technology was originally developed for rural uses to exploit animal manure as feedstock, new technologies are suitable for urban settings as well, using food and other biodegradable wastes. Development aid from the Netherlands has historically been at the forefront of biogas technology dissemination.

Ethanol gel made of sugar processing waste and other starches (like cassava in Mozambique) is another clean energy alternative for cooking and is being vigorously explored, but questions could arise around real and perceived threats to food security.

However, the most likely future renewable energy alternative to the current use of unsustainable wood fuels would be sustainable wood fuels. Wood fuels are biomass, and as such, they are by definition a renewable form of energy when the biomass resource is not depleted by harvesting. The problem lies in the fact that charcoal is currently neither produced, nor consumed in a sustainable way: forests are not managed; trees are not re-planted; wood is processed into charcoal using the least efficient methods; and the sector is almost entirely informal and unregulated. The biomass deficit in most African countries is increasingly rapidly threatening this massive informal energy sub-sector, the livelihoods of those that live off the forests, biodiversity and top soils. Lessons from Brazil and other Latin American countries may assist in turning the biomass energy sub-sector into a sustainable business opportunity in the future.

Strategies to sustainably replace unsustainable wood fuels should be integrated with landscape restoration projects, in line with the Bonn Challenge (like 20x20 Initiative in Latin America), and catalyzed and coordinated through the regional development banks in the Southern Atlantic (ie, the IDB and the AfDB).

### *Renewable Energy, Public Institutions, and Private Companies*

Ideally, government and the private sector play complementary, albeit different, roles in the development and uptake of renewable energy technologies. In theory, the government facilitates an enabling environment for business, and then business delivers good quality and low-cost clean energy products and services to consumers.

The government can enable by simplifying procedures, such as offering standardized small power purchase agreements (PPAs) or by exempting renewables from taxation. The government can do this by providing incentives, such as renewable energy feed-in-tariffs (REFITs) or project grant funding from rural energy funds. Alternatively, it can do this by requiring mandates—for example, insisting that a percentage of the energy consumed by industry comes from renewables, or that all schools and health centers use briquettes instead of charcoal for cooking and solar water heaters for warm water. Businesses then operate in this enabled environment. Stimulated by government facilitation, incentives and mandates, companies are asked to create business models that deliver clean energy products and services in profitable and sustainable ways (generating income and creating jobs along the way).

Since their roles are different, it is not surprising that the capacity-building needs of the public and private sectors are different as well. Governments need to know strategic options, best practices and policy design and legal frameworks that induce clean energy business development. Businesses need exposure to different business models and technologies, (often) business management training and access to low-cost and easily accessible financing. But most of all, business needs certainty in the environment it operates: "long, load, and legal" has been the request from businesses worldwide for energy markets in new and risky environments, according to Chatham House climate finance researchers.

This highlights the importance of a country's financial sector in the development of clean energy. Banks and other financial institutions have capacity-building requirements specific to their sector. They need assistance in developing financial products and services that are profitable for them in areas with which they are familiar and which can offer returns, but at the same time, they need to be helpful to the clean energy businessman or woman. They may also need assistance finding those clean energy clients and learning about the financial resilience of the sector in order to lend efficiently and reduce transaction costs.

The SE4All initiative must keep these different needs of government, business, and the financial sector in mind when designing training programs for human skill development and institutional capacity-building. Africa can certainly learn from other countries and particularly those with similar socio-economic and resource realities, like Africa's partners across the Atlantic in Latin America and the Caribbean, which are farther along this process of enabling clean energy.

## Doubling the Global Rate of Improvement in Energy Efficiency

Energy efficiency is a powerful and cost-effective way for achieving sustainable development. It should be considered as a key to the path towards increased energy security because it breaks the link between economic growth and rising energy demand. The result is that national economies become more competitive. Energy efficiency is also a cost-effective way of lowering $CO_2$ emissions and local pollutants and improving bottom lines of enterprises.

In spite of its relevance and potential benefits in African countries, policy makers pay little attention to energy efficiency and few countries have developed energy efficiency strategies. This is primarily because efficiency is a reluctant add-on for most utilities who concentrate on adequate and stable supply before efficiency. However, short-term efficiency measures are introduced during supply crises.[6]

6. In South Africa, efficient lamps, solar water heaters, and negotiations with large energy users to reduce demand (by 10%) were amongst the strategies employed to achieve improved efficiency.

> South Africa's electricity utility, Eskom, achieved 3GW of savings efficiency during the last three years (more generation capacity than most countries in Africa) at a cost of 549 U.S. dollars/kW. At the same time, it enthusiastically promoted more supply, despite facing a potential bill of more than a trillion rands for a 9.6GW nuclear plant at a cost of 12, 400 U.S. dollars/kW. So when we hear Eskom's spokesman, Andrew Etzinger, who knows efficiency issues well, lamenting the less than expected efficiency savings, we wonder what is going on. What is really inhibiting greater achievements in system efficiency? South Africa has subsequently removed the efficiency rebate, and in the process, destroyed opportunities for many ESCO start-ups.
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> Source: Business Day, September 7, 2012 and Mail and Guardian, March 23, 2012 included in http://www.helio-international.org/Thorne-Energy%20reforms-CF2.pdf.
> Note: South Africa has subsequently removed the efficiency rebate, and in the process, destroyed opportunities for many ESCO start-ups.

The SE4All objective of doubling the rate of efficiency of the use of energy globally will be achieved through reduced energy consumption per unit of service and more efficient supply and consumption of wood fuels particularly in Africa.

### *Efficiency and Electricity*

The concept of energy efficiency (EE) has not been addressed in any systematic long-term way in sub-Saharan Africa (with perhaps the exception of Ghana), other than on the supply side of electricity generation, transmission, distribution, oil refining, and off-grid power systems. Generally, however, African power companies have struggled to provide quality services and cost recovery. This can be blamed in part on technical and management inefficiencies, but also on political interference in regulation and on tariff setting. Such political intervention, while typically justified on the compelling grounds of equity, tends to undermine the financial sustainability of energy companies.

On the demand side, one of the most successful energy efficiency initiatives has been implemented by the Ghanaian government. It saved 124MW in 2007 by replacing six million incandescent light bulbs with CFLs. The South African electricity utility, Eskom, through Demand Side Management (DSM), reduced power consumption by more than 3 GW (see text box), but this was an emergency peak demand saving measure utilizing short-life technologies. Some multinational companies, such as SABMiller[7] and Kempinski Hotels, have undergone energy audits and implemented EE improvement projects and are world leaders in their footprint endeavors. The United Kingdom's Department for International Development (DfID) has done the same in several African countries within their diplomatic missions. Most companies in Africa that rely on electricity are required to have parallel back-up (mainly) diesel generators to utilize in the event of outages, so their interest in energy efficiency should be easy to stimulate, to avoid the costs of parallel stand-by electricity systems.

African energy intensity per capita is low compared to the global average (although South Africa is an exception), while energy intensity per unit of GDP is high. Both of these figures are linked not only to the underdeveloped power sectors in Africa, but also to the nature of African economies, which are dominated by energy-intensive primary and extractive industries (i.e., mining, oil, and gas), with limited value-added service industries contributing to local GDP.

Africa has relatively small, but rapidly growing markets for energy-utilizing technologies. Compounded by weak standards, leaky customs and low public awareness, it has become a dumping ground for second hand and sub-standard inefficient equipment and vehicles, putting further pressure on already strained energy systems. For example, the introduction of low quality CFLs can undermine market penetration of efficient lighting solutions. Some countries have implemented energy efficiency standards for appliances (and, in some cases, vehicles) such as air conditioners and refrigerators. However, enforcement of these standards has suffered in light of national Bureaus of Standards that are understaffed, under-trained and under-resourced.

Renewable energy associations have multiplied around the continent and have in many cases been instrumental in the removal of tariffs on imported clean energy technologies, the enforcement of minimum standards, the design of energy access financial instruments and codes of practice for their members.

7. SABMiller has 63 plants across Africa and places much value on promoting and achieving intensity benchmarks of 8 to 11 kWh/hectoliter (Greenfield and retrofits) as a contribution to their brand.

Traditionally, energy policy in Africa has focused on supply options, and, thus, is unlikely to alter efficiency in the absence of:

- Policy instruments that value highly and reward efficiency improvements;
- Empowered public utility commissions that demand efficiency for cost recovery and environmental reasons;
- Enforcement of the least-cost energy planning regulatory principle;[8]
- Dedicated energy departments that drive efficiency policy implementation rather than feeble cross-cutting intentions in overworked and under-capacitated ministries;[9]
- Regulatory instruments that provide sufficient incentive for utilities and users to promote and invest in efficiency; and
- A cadre of trained and accredited auditing and verification professionals.

### *Efficiency and Cooking*

Energy efficiency is partly dependable on technology, but much of its success will depend upon behavior patterns and management changes that are commonly considered, a major determinant in achieving efficiency and moderating demand. Ironically, it is the energy poor that have good management skills in abundance. Amongst the energy poor, energy is typically managed well as a necessary survival strategy within the stark constraints of the fuels and appliances people have access to. Planners and implementers of energy systems would be well-positioned to harness this behavioral attribute of the African poor, as their populations gain access to modern energy services, through sustainable energy pricing and access to efficient lighting and other efficient technologies.

When it comes to biomass, African governments have not managed to adequately formalize a sector that will continue to dominate the energy balances of most sub-Saharan African countries for the fore-

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8. Least-cost energy planning is an international principle applied to energy regulation, by which selections of supply and demand resources can be selected and priced to achieve the delivery of energy services at the lowest cost to an economy.

9. Many African Ministries of Energy have a Renewable Energy Section, however energy efficiency sections are unheard of.

seeable future. The IEA estimates that biomass still accounts for 60% of the primary energy mix, and more than 80% in the sub-region use it for cooking. The quest for modernization in many countries has neglected biomass as an energy subsector, despite possibilities for the sustainable utilization of Africa's enviable forest resources. Efficiency saving opportunities in the biomass/domestic energy value chain exist at the transformation stage, with efficient kilns for wood to charcoal conversion, and at the consumption stage, with improved cook stoves.

What is clear in Africa is that modern energy is relatively expensive, but it is becoming less so. The leadership is promoting investments in large centralized energy supply, but not small, decentralized and efficient systems. The potential for efficiency in Africa is large, but almost entirely neglected in favor of securing supply. To harness the opportunity that energy efficiency represents, fundamental policy changes and policy instruments that reward verified efficiency gains are necessary. The SE4All Facility will concentrate on energy efficiency policy and regulatory instruments in assisting Africa policymakers to achieve modern energy/low-carbon economies.

Development partners, who value energy efficiency in their strategies, have been at a loss as to how to assist in achieving a valuable process to introduce efficiency measures with possibilities of success. The daunting prospect of multi-sectoral interventions and limited institutional capacity has reduced energy efficiency to something that would be nice to have. The energy regulators have an fundamental role to play in this regard.

### *Efficiency, Public Institutions and Private Companies*

Energy efficiency can be addressed in different ways by the public and private sectors. African governments and foreign diplomatic and development partner missions can have a major impact on the efficient energy consumption in their countries simply by creating awareness amongst staff, conducting energy audits (and perhaps carbon footprinting exercises), implementing energy saving recommendations, monitoring and evaluating. This process is continuous and cyclical (and must be transparent and applied to all). When one cycle of audit, recommendation, implementation and evaluation ends, another cycle must begin. Additionally, energy efficiency in the public sector is frequently simpler than in the private sector because it involves replacing inefficient appliances (such as lights) and behavioral change (such as turning off the space heaters or the air conditioning).

Energy efficiency in the private sector requires broader technical knowledge of such appliances as boilers, motors, pumps, and condensers. Supposedly, the private sector has a greater incentive to implement energy efficiency solutions than the public sector, as inefficiency negatively affects profits. However, energy efficiency in the private sector requires greater knowledge transfer as well as low-cost and accessible financing tools for EE projects.

## Learning from Best Practices in Similar Socioeconomic Conditions

Across the southern Atlantic from sub-Saharan Africa, the Latin America and the Caribbean (LAC) region has in the past faced similar problems in achieving modern energy services access for its populations and for their productive activities. Particularly applicable to sub-Saharan Africa would be the Latin American experience with modern renewable biomass-based energy generation and gaining access to modern energy services. The enabling policies for such Latin American and Scandinavian transformations, which have allowed biomass to play a major role in modern energy economies, may provide policy pointers and should be studied in Africa.

Too many sub-Saharan African countries neglect sustainable biomass energy policy implementation simply because it is considered to be a primitive, last-resort form of energy and an abundant resource for the poorest. However, as the non-renewable biomass fractions estimations in the table above suggest, biomass energy will hit an availability wall unless forestry, energy, natural resources and subnational governmental authorities can implement and enforce policy and strategies that will result in a sustainable biomass energy services future. The key to sustainable biomass transition will be to project a path for the transformation from traditional to modern biomass including power generation and cogeneration, efficient cook stoves, afforestation and reforestation strategies, utilization of agricultural and other biomass resides, briquetting, etc.

These bridges are already available in the energy sector, certainly between Brazil and the African Lusophone countries, such as Angola and Mozambique. But such transnational energy cooperation revolves more around oil and gas. However, the deepening BRICS agenda has already strengthened trade links between BRICS partners and Angola: China, Brazil and South Africa are all among Angola's top trade partners. When it comes to sustainable energy, linkages are likely to grow and could be further catalyzed by south-south (or southern Atlantic) cooperation in achieving low emissions energy access for all, with transatlantic policy platforms (for example, a new Atlantic Energy Forum, which is currently being established under the auspices of the Atlantic Basin Initiative) also facilitating the exchange.