Barriers and Drivers to Renewable Energy Investment in Sub-Saharan Africa[*]

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Abstract

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Sub-Saharan Africa has the world's lowest electricity access rate, at only 26%. The rural electricity access rate is only 8%, with 85% of the population relying on biomass for energy. This challenging energy security situation is in marked contrast with the abundance of natural resources in the sub-Saharan Africa region, which contains huge potential for electricity generation from renewable energy. Most importantly, renewable energy can put an end to the reliance of many countries on expensive and volatile imports of fossil fuels such as oil, and can be an avenue for Africa to better exploit the economic opportunities offered by international carbon markets. This article questions why the up-front investment needed, particularly from the private sector, to seize these opportunities and to accelerate the renewable energy deployment that has to date not materialized in a region where it is much needed. An analysis of the drivers and barriers to renewable electricity expansion—including the cost and profitability of renewable energy, the structure and design of the local energy sector and the risk landscape in sub-Saharan Africa—shows that to secure private investment, public commitment needs to be demonstrated at the local level. However, understanding is also needed, both locally and internationally, of how private investment works and how it can be effectively promoted and mobilized through smart public intervention.

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Barriers and Drivers to Renewable Energy Investment in Sub-Saharan Africa

Sub-Saharan Africa has the world's lowest electricity access rate, at only 26%. The rural electricity access rate is only 8%, with 85% of the population relying on biomass for energy. This fundamental lack of electricity supply does little to help poverty levels—70% of household income is spent on energy (such as diesel, kerosene, and charcoal); and is causing substantial deforestation—0.4 million hectares of forest are cleared each year in Africa (Ram 2006, 2). As well as being costly and inefficient, indoor cooking systems are highly dangerous—indoor air pollution from using biomass and coal is projected to cause more than 1.5 million premature deaths in Africa by 2030 (UNEP 2011, 19). Even in urban situations with access to electricity, this is unreliable, with frequent power outages creating difficulties and increasing costs—the overall economic costs of power shortages in sub-Saharan Africa typically range between one and four percent of GDP (African Development Bank 2010, 3). Please note that all references to sub-Saharan Africa in this article exclude South Africa unless otherwise stated.

While, as a whole, sub-Saharan Africa achieved average GDP and energy demand growth rates in excess of 10% from 1998–2008, the supply of grid-based electricity generation grew on average by only 5% over the same time period (U.S. EIA 2011; World Bank 2011). To meet increasing demand and support economic growth, the power sector in Africa needs to install an estimated 7,000 megawatts (MW) of new generation capacity each year (African Development Bank 2010, 3). Financing the development of the energy sector in sub-Saharan Africa is expected to cost USD 41 billion per year, 6.4% of GDP (ibid., 6). A large financing gap is created in the power sector through heavy spending needed for existing operating expenditure, with little left to fund long-term investments and address the power supply crisis. Unless stronger commitments and effective policy measures are taken to reverse current trends, half the population in SSA will still be without electricity by 2030, and the proportion of the population relying on traditional fuels for household energy needs will remain highest compared to all world regions (UN-Energy/Africa 2011, 3).

The challenging energy security situation is in marked contrast with the abundance of natural resources of the sub-Saharan Africa region, where there is huge potential for electricity generation from renewable energy. Most countries in the region have renewable energy potential many times the current energy demand that is feasible to exploit with current technology, including hydro-potential (estimated around 1,750 TWh), geothermal (estimated at 9,000 MW), wind, biomass, and solar (Deichmann and Meisner 2010, 5193). But to date, the benefits of renewable energy have not been seized, including the modular design of renewable energy distribution, which makes it particularly appropriate for remote and rural areas that can only be reached with off-grid technologies

(African Development Bank 2010). Most importantly, renewable energy can put an end to the reliance of many countries on expensive and volatile imports of fossil fuels such as oil, and can be an avenue for Africa to better exploit the economic opportunities offered by international carbon markets. This article analyzes why the up-front investment needed, particularly from the private sector, to seize these opportunities and accelerate renewable energy deployment has to date not materialized in a region that is in dire need of it.

Risk and Return as the Key Determinant of Investor Behavior

From a private sector perspective, each decision made on whether or not to undertake and finance any given project, will be influenced by a wide set of variables. In order to understand how these variables will influence the final decision, it is helpful to recognize that they will have an impact on the project, from a financial perspective, essentially through its forecasted risk-return profile, perceived or real.

Financial return and risk are not stand-alone categories; project sponsors, lenders, and investors want to make a return proportional to the level of risk they undertake. As with all other classes of projects and investment, renewable energy investment becomes more likely and frequent if the perceived levels of investment risk are reduced for a given level of return, or returns are increased for any given level of risk. The impressive growth in sustainable energy investment throughout the last decade in many parts of the world has been triggered by such shifts in risk and return.

Geographically, this rapid growth has taken place very unevenly, and the region of sub-Saharan Africa, despite considerable endowments with renewable energy and despite its dire need for electrification, belongs to those regions with least renewable energy development. Therefore, this article aims to provide answers to the following questions:

Why is sub-Saharan Africa failing to expand electricity generation from renewable sources? What are the barriers to such expansion? What is keeping the risk-return profile of renewable energy investments in sub-Saharan Africa unattractive, and projects commercially unviable? What can be learned from the modest successes of a few sub-Saharan African countries for replication in others? What was done in these countries to improve the risk-return profile of renewable energy and unlock investment?

Part 1 provides an overview of broad developments in the electricity markets of the region over the last decade. Against this background, the following sections provide an analysis of what is driving and what is impeding private investment for renewable energy solutions.

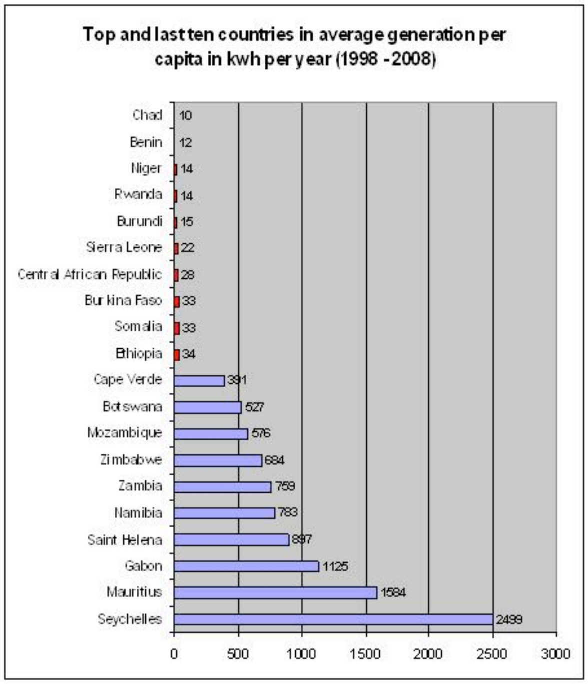
Part 1: The Big Picture—Electricity Generation Trends in Sub-Sahara Africa Over The Last Decade

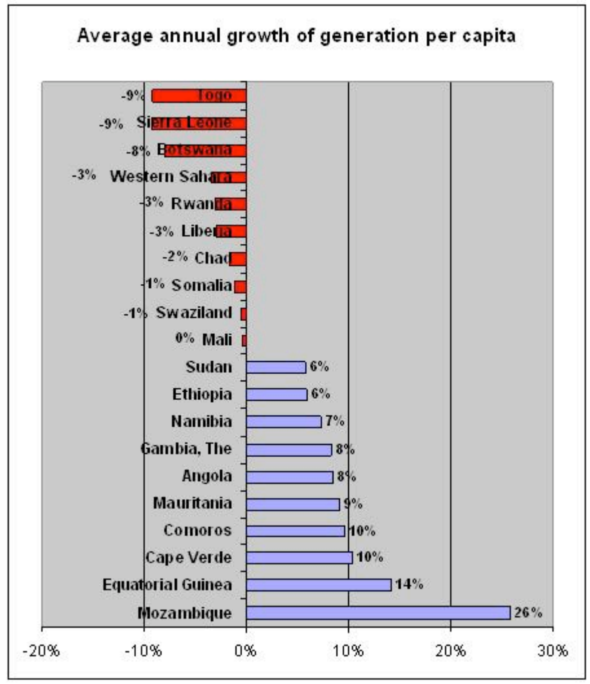
Overall grid-connected electricity generation in the countries of sub-Saharan Africa has grown by an impressive 70% (from 73 to 123 terawatt hours) in the 10 years from 1998 to 2008, translating into an average annual growth rate of 6%. Coupled with a population growth of 30% in those same countries over the same time period, the overall result has been an increase of 31% in the per capita generation of electricity across all countries concerned. It should be noted that the analysis in this article only makes use of generation-related data and ignores data on actual electricity consumption, hence ignoring cross-boundary transfers of electricity.

Despite the low starting point of only 128 kilowatt-hours of average generation per capita in 1998 and 73 terawatt hours of total generation in that same year, these developments are encouraging. In comparison, total electricity generation in Latin America and the Caribbean grew by "only" 44% in that same time period. The expansion of electrical provision, however, has been unevenly spread throughout the region (Figure 1).

Recent growth in the area of renewable energy has been equally strong, with total electricity generation from renewable sources growing by 72% from 1998 to 2008 (from 45 to 78 terawatt hours per year). This means that 66% of all new electricity generated in sub-Saharan Africa after 1998 has come from renewable sources. However, most of this growth has essentially meant an increase in hydro-based electricity generation, such as in Mozambique, Zambia, Namibia, Angola, and Zimbabwe. While being a renewable resource, hydropower can also be considered a conventional type of electricity generation—in terms of costs it is competitive with fossil-fuel-based generation, and represents a mature and proven technology with a long track record; it is therefore deployable and financeable with relative ease. Furthermore, hydroelectric development can result in serious environmental damage as well as social conflict, particularly in the case of large-scale, dam-based generation, and it is immediately exposed to the effects of drought, a pertinent risk category in a sub-Saharan context (UNESCA & UNEP 2007). Although other innovative forms of renewable energy technologies demonstrate great potential at less social and environmental cost and are often more suited to many African countries with scarce hydrological but vast wind, solar, and biomass resources, these alternatives have to date been largely neglected.

Figure 1: **Top and Bottom 10 Countries in Electricity Generation per Capita and Annual Growth of Generation per Capita**

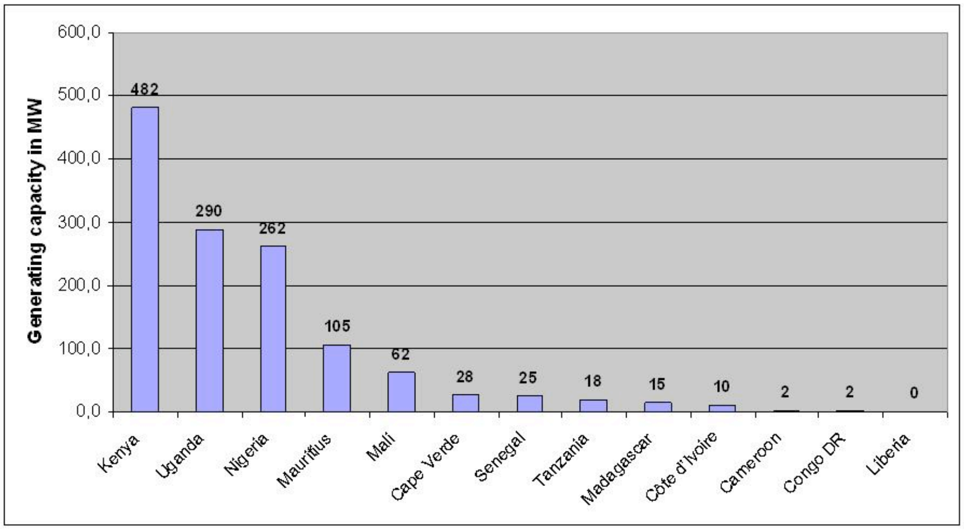




Source: Remco Fischer, UNEP Finance Initiative.

In contrast to the recent developments seen in hydro-based electricity generation, the current status of non-hydro electricity generation from renewable sources in sub-Saharan African countries is disappointing. According to data from the U.S. Energy Information Agency (U.S. EIA 2011) this type of electricity is generated only in a handful of countries including Kenya, Ivory Coast, Senegal, Gabon, Ethiopia, Cape Verde, Togo, and Eritrea. The only sub-Saharan African country where electricity generation from renewable, non-hydro energy sources has played a somewhat significant role over the last decade is Kenya. In 2008 one fifth (21%) of the Kenyan national electricity mix came from such sources, while all renewable energy, including hydro, reached a level of 62%. Notwithstanding, data from the current pipeline of CDM projects appears to suggest that increased renewable energy interest has started to materialize on the continent after 2008 (see Figure 2).

Figure 2: Total Renewable Energy Capacity in the 2011 CDM Pipeline per Country



Source: Remco Fischer, UNEP Finance Initiative.

These observations raise important questions regarding the only marginal uptake of non-hydro renewable energy technologies in the region despite immense potentials. The following sections explore this by providing an overview and discussion of the barriers faced by the proponents of renewable energy technologies, including in particular, their financial backers.

Part 2: Drivers and Barriers to Investments in Developing Countries

All factors and variables that shift or alter the risk-return profile of any given renewable energy project or investment will act as either drivers or barriers. In the context of energy and, particularly, renewable energy projects, drivers and barriers can be categorized as follows: (i) those related to the technology at hand or the physical location of the project; or (ii) those related to the partners and counterparts in the project; or (iii) most importantly, those variables that are related to the local jurisdiction, such as the general economic environment, the institutional landscape and political stability of the location of the project, and the reliability of local regulation.

These categories play an important role in all commercial ventures, and their consideration is standard practice in any project viability assessment or financial due diligence process. The technical characteristics and features of a technology, for instance, its competitiveness with other technologies or its likely performance given the physical characteristics of the project site, will be important issues to consider in any jurisdiction of the world. This applies also to the track record and skills of project partners and counterparts.

In particular, the last category will play a significant role in the specific context of investments in developing countries, and even more so when it comes to investments in the area of renewable energy. This is due to two fundamental aspects, which are discussed in fuller detail below:

> *The need for public intervention*—Despite the fact that many renewable energy technologies have gained competitively against conventional technologies, their implementation remains inferior in purely financial terms. In order to be viable at all, renewable energy needs regulation and incentives to create a level playing field between innovative, more expensive but clean technologies on the one hand, and the proven, cheaper but dirtier technologies on the other. Such regulation and incentives will ultimately have to be put in place by policy makers and regulators and implemented by local governments under a legal framework. The key role of public actors in enabling private actors to deploy, install, operate, and finance renewable energy technologies makes it imperative that project sponsors and investors can trust that these incentives will remain in place over the lifetime of projects and that public institutions and the legal system are stable and can be trusted.
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> *Public intervention in developing countries*—In developing countries, public institutions and legal systems often lack the stability, ability, and reliability over the medium to long term to put in place and enforce laws and private sector regulation in general, as well as supportive incentives for renewable energy in particular.

It does not come as a surprise, therefore, that in the literature the failure to expand electricity generation from renewable sources in developing countries, including in sub-Saharan Africa, is—not exclusively but mostly—linked with barriers that originate from the local characteristics of public governance, energy regulation, law enforceability, and institutional stability.

More specifically, three critical factors appear to influence and determine the levels of investment in, and the growth of, renewable energy capacity in countries across sub-Saharan Africa: (i) the cost and profitability of renewable energy (see Part 3); (ii) the structure and design of the local energy sector (see Part 4); and (iii) the risk landscape in sub-Saharan Africa (see Part 5).

Part 3: The Cost and Profitability of Renewable Energy in Sub-Saharan Africa

The risk-return profile of any investment opportunity will be strongly influenced by the financial profitability of the underlying technology and the extent to which it is competitive with other technologies. While it is still generally the case that, in a complete policy-vacuum and even under the consideration of total life-cycle costs, electricity generation from renewable sources is more expensive than it is from conventional sources, additional aspects further deteriorate the competitiveness of, and prospects for, renewable energy investment in a sub-Saharan Africa context.

The cost of electricity generation per se and poverty—The cost of electricity in most of sub-Saharan Africa is exceptionally high already, due to a combination of the small size of the electricity markets and the resulting lack of economies of scale; the common reliance on expensive oil-based generation; and other inefficiencies such as low historic levels of maintenance investment and resulting inefficiencies and electricity losses in generation and distribution. The average electricity generation cost in sub-Saharan Africa amounts to US$0.18 per kilowatt-hour with an average effective tariff of US$0.14 per kilowatt-hour when compared with tariffs of US$0.04 per kilowatt-hour in South Asia and $0.07 in East Asia (African Development Bank 2010). This means that in the quest for the quick expansion of energy access, particularly to poor communities, and in light of tight public budgets with only limited interest from private investors, cost efficiency and minimization are likely to be high priorities for policy-makers, developers, and the local population. These priorities place the most cost-efficient options, usually gas and particularly coal, as the preferred political choice. The picture changes, however, in the context of rural communities that are distant from current grid infrastructure—here renewable energy can represent the most cost-efficient option through small-scale, off-grid applications such as rooftop PV or solar water heaters (Deichmann and Meisner 2010).

The capital intensity of renewable energy options in a challenging risk landscape—In more advanced economies, renewable energy technologies are becoming increasingly competitive on the back of innovation as well as from long-term upward price trends for fossil and nuclear fuels. (The price of oil in 2009, for instance, was US$59.21 per barrel and is predicted to be US$135.22 per barrel in 2035, an increase of 125%. The price of natural gas was US$3.33 per 1,000 cubic feet in 2009 and is predicted to be US$8.06 in 2035, an increase of 142%.). In other words, much of the competitiveness gains of renewable energy technologies are attributable to their relatively favorable OPEX profile (the level of ongoing operations-related expenditure), while in terms of CAPEX (up-front capital investment expenditure), renewable energy technologies feature a higher level of capital intensity. However, the circumstances in many countries of sub-Saharan Africa will mean that the CAPEX associated with different energy options will often play a more important role in assessments and decision making than the corresponding OPEX, leading to a preferential treatment of technologies that are relatively low in CAPEX and relatively high in OPEX. These "African" circumstances in particular include the variety of investment-related risks (country, regulatory, commercial, and market risks) that will be more pronounced in sub-Saharan Africa and other developing countries than in developed countries or emerging economies (see a more detailed elaboration on such risks further in the following section). Such risks will immediately increase the return expectations of investors and, with these, any project's cost of capital—which will tend to discourage capital-intensive energy options and encourage less capital-intensive options. Higher risks associated with the novelty of most non-hydro renewable energy technologies will also contribute to increased return expectations of investors—more so in developing countries than in mature markets, given the usually longer track record of renewable energy technologies in the latter. In addition, many countries in sub-Saharan Africa have at their disposal sufficiently large endowments of fossil fuels or access to cheap imports from neighboring countries, making the OPEX-related benefits of renewable energy more negligible (KfW 2005, 38).

Public subsidies for fossil-fuel-based generation—Public subsidies are a global problem that has been addressed by, among others, the G20 (the Group of Twenty comprises finance ministers and central bank governors of 19 countries and the European Union). The countries of sub-Saharan Africa are no exception to their effects, since such subsidies further deteriorate the competitiveness of renewable energy technologies that do not enjoy equally large public support. This support, totaling approximately US$500–$700 billion per year, for conventional energy (mostly fossil fuels) creates an uneven playing field for the adoption of renewable energy. By comparison, the IEA estimated government support for electricity from renewables and for biofuels at US$57 billion in 2009. Realigning these subsidies is the most obvious way to alter the market advantage in favor of sustainable energy production, as was recognized by the G20 in 2009 when it pledged to phase out "inefficient and wasteful" fossil-fuel subsidies (UNEP 2011). The World Bank and the International Energy Agency put global figures for such subsidies in the order of US$100–$200 billion per year. Such subsidies can take a wide range of forms: direct budgetary transfers, tax incentives, R&D spending, liability insurance, leases, land rights-of-way, waste disposal, and guarantees to mitigate project financing or fuel price risks (Beck and Martinot 2004, 365-383).

The un-priced externalities of carbon emissions—Renewable energy technologies can outperform conventional technologies, but only if the comparison is done on a total cost basis: when the environmental and social costs are included in the cost & benefit analysis. In many jurisdictions globally, putting a price on carbon is mainstreaming the internalization of such costs, be it through carbon taxes or the establishment of emissions trading schemes. For a variety of reasons, such measures are difficult to justify politically in developing countries, particularly those less advanced, given poverty eradication priorities coupled with the fact that resulting environmental externalities will be global while the costs to internalize them will be borne locally. A softer alternative approach consists in putting a price on carbon as an incentive only in the event of carbon reductions, as done through the Clean Development Mechanism (CDM) under the Kyoto Protocol, rather than as a sanction on existing or increasing emissions. Further detail on the extent to which the CDM has catalyzed renewable energy in a sub-Saharan Africa context is provided below. At this stage, no African country has put in place a price on carbon that would truly create a level playing field in terms of costs and benefits between conventional and renewable energy technologies.

Low returns with positive cash flows coming first in the long run—"In principle, the profile of long-time exposure calls for compensation in the form of higher interest rates and returns on equity. The possibility for that is limited by the low project returns, which make such kind of projects rather unattractive" (KfW 2005). Investors, sponsors and finance providers can view this characteristic of renewable energy projects as a form of risk intensifier. Given the generally riskier circumstances in sub-Saharan Africa, this feature of renewable energy projects becomes much more burdensome there than in other, less risky geographies of the world.

High transaction costs—The relatively high transaction costs of renewable energy technologies as well as some of the unique aspects of those technologies or projects tend to be exacerbated by the local circumstances of, in particular, sub-Saharan Africa countries:

- Renewable energy projects are typically smaller than conventional energy projects, a fact that automatically increases transaction costs, which tend to be fixed. The transaction costs per kilowatt (kW) for a central coal plant, for instance, are lower than the sum of the costs of the many thousands of transactions required for comparable capacity from solar home systems, for instance. Faced with the choice, investors are wary of the latter (UN Technical Cooperation 2011). In sub-Saharan Africa, many, if not most, opportunities for the development of renewable energy present themselves in the form of small-scale projects.

- Projects may require additional information not readily available, including historic weather-related data such as the wind, solar radiation, and precipitation records. While such data are often readily available in developed countries, there is a large gap in the availability of this data in developing countries, particularly in those of sub-Saharan Africa.

- Renewable energy projects may often require additional time for or attention to financing or permitting because of unfamiliarity with the technologies or uncertainties over performance. For these reasons, the transaction costs of renewable energy projects—including assessing resources, siting, permitting, planning, developing project proposals, assembling financing packages, and negotiating power-purchase contracts with utilities—may be much larger on a per-kilowatt capacity basis than for conventional power plants. However, in practice some transaction costs may be unnecessarily high, for example, overly burdensome utility interconnection requirements and high utility fees for engineering reviews and inspections.

Part 4: The Structure and Design of the Local Energy Sector

The lack of renewable energy capacity, or the environmentally unsustainable nature of electricity generation, is only one of many challenges that the local energy sector in many developing countries, including most of sub-Saharan Africa, is currently confronted with. The need to shift from carbon-intensive and other relatively unsustainable energy alternatives to low-carbon and sustainable options, is a relatively new challenge, and needs to be viewed within the context of the broader history of the energy sector as well as alongside current developments and efforts to respond to other, more immediate challenges.

In developing countries, these more immediate, fundamental challenges include: the limited scope and coverage of energy infrastructure in terms of both geographic area and users; a large gap in generating capacity; obsolete employed technologies and the poor state of the overall energy infrastructure; the low levels of resource efficiency that lead to high costs per output unit, which—given low affordability levels among local populations—are often kept down through subsidies from already constrained public budgets; the manipulation of electricity prices for political reasons; the low levels of electricity penetration in the local population; and so on (Bacon 1995, 119-143; World Energy Council 1998, 121; Paterson 1999, 203; International Energy Agency 1999, 106). The fundamental problem can most often be traced back to the overall inefficiency as well as the run-down and unsustainable finances of government-owned utilities and the resulting lack of much needed investment, be it for expansion or refurbishment. The typical approach to solve what appears to be a vicious circle has been a reform process comprising elements of decentralization (either horizontally, vertically, or both) and privatization. This approach was motivated especially by expectations of enhanced efficiency, both in terms of resources and overall management; capital investment into technologies and infrastructure; and increased competition in an energy market. Jointly, these were expected to create more innovation, wider coverage, better service, lower

prices, and more sustainable public finances. Such energy reform typically involves several components, particularly (i) the introduction of competition in order to improve sector performance in terms of efficiency, customer responsiveness, innovation, and viability; (ii) the restructuring of the electric power supply chain to enable the introduction of competition, through the unbundling of vertically or horizontally integrated companies; (iii) the privatization of the unbundled electricity generators and distributors under dispersed ownership; and (iv) the development of economic regulation of the power market that is applied transparently by an agency that operates independently of influence by government, electricity suppliers, or consumers (Bacon and Besant-Jones 2002, 2).

The Need for Grid- and Energy-Market Access

Whether or not energy sector reform—along the lines set out above—will lead to the expected results is not the subject of this article. But it appears that such reform can have fundamental implications on the uptake and development of renewable energy. In many developing countries, the conventional market structure is one dominated by a state-owned national power utility with a legally endowed monopoly and a vertically integrated supply chain encompassing power generation, transmission, distribution, and customer services (Bacon and Besant-Jones 2002)—a system that by default lacks the flexibility to provide easy grid- and market-access, on fair terms, to third-party and/or private-sector power producers.

A critical point here is that such private sector electricity companies and independent power producers (IPPs) are the ones readily equipped with the ability and expertise to rapidly mobilize investment, and therefore such private sector capability must be fully encouraged and utilized. However, it must be remembered that IPPs and private sector companies have the expertise, capacity, and skills not only to install and operate new energy infrastructure in the specific context of renewable energy technologies, but also in fossil-fuel-based or other areas of conventional electricity generation. What this means is that while broader energy sector reform can be conducive—or may even be a key requirement—for the rapid uptake of renewable energy, if it is not complemented with a set of dedicated renewable energy policies and incentives, it can actually turn out to be counter-productive. This is shown precisely by evidence from sub-Saharan Africa, where energy sector reform and up-scaled IPP initiatives led to increased fossil-fuel-based rather than renewable energy generation (UNESCA & UNEP 2007), resulting in increased overall need for fossil fuel imports, and negative implications for the balance of the overall energy mix. Companies that illustrate the potential of IPPs in renewable energy deployment include Ormat Inc., which operates a 100 MW geothermal plant in Kenya, and Compagnie Thermique de Belle Vue Limitee, which operates a 70 MW cogeneration plant in Mauritius. The geothermal plant in Kenya incorporates a high-tech air-cooling and re-injection system of all geothermal fluid, thereby avoiding an estimated 200,000 tons of CO^2 emissions per year (ibid).

Increasing grid- and market-accessibility for the private sector therefore can be a double-edged sword. The fundamental reason for this, as mentioned above, is the continued financial inferiority of renewable energy relative to conventional technologies, within a policy vacuum. As investors, IPPs will be guided first and foremost by the risk-return profile of investments, and given the lower overall cost structure of fossil-fuel projects in the short term and the particularities of the sub-Saharan Africa risk landscape, conventional technologies have scored and will continue to score better in terms of risk-return. A purely financial assessment of risk and return by private sector actors will typically not consider long-term and broader costs and benefits of renewable energy, such as: the need for a strategic orientation of the national electricity mix in light of resource scarcities; the financial competitiveness of renewable energies in the long term given the more favorable OPEX profiles; and the environmental and social benefits given their carbon-efficiency and the fact that renewable energy systems can be developed in a modularized and off-grid manner that is more appropriate for rural areas.

Public Intervention for a Level Playing Field

A wide variety of policy instruments and incentive mechanisms can be deployed with the objective of leveling the playing field for renewable energy technologies. The question of which specific combination of these will lead to the most effective and most cost-efficient results is subject to the local socio-economic circumstances, and the availability of naturally endowed renewable energy and the best-suited technologies, as well as the national goals for renewable energy expansion. Four main categories are within the scope of public incentives for renewable energy (UN-Energy/Africa 2011, 27) (Table 1).

Table 1: Policy Instruments for Renewable Energy Development

1.	**National renewable energy targets**
	Design. Such targets are not necessarily a policy instrument, but rather the policy objective that is aimed for through the implementation of the instruments.
	Impact on the risk-return ratio of renewable energy projects. Targets are a critical component of any renewable energy package because they allow private sector actors to know "where the journey is going" and, therefore, increase the reliability and trustworthiness of any instruments put in place subsequently.
	Application in non-Annex B countries. More than 25 developing countries have put in place renewable energy targets, including 13 countries in Africa, of which 8 are countries from sub-Sahara Africa, other than the Republic of South Africa (REN21 2010).
2.	**Feed-In-Tariffs and other renewable energy production incentives**
	Design. These are favorable, obligated fixed-rate tariffs for generators to sell renewable energy (usually as electricity) to networks. The purchasing "suppliers" are therefore obligated to buy at the special tariff rate and are allowed to fund the extra cost from a relatively small levy on all their consumers.
	Impact on the risk-return ratio of renewable energy projects. Output-based incentive systems such as renewable energy production incentives as well as feed-in tariffs can considerably enhance the risk-return profile of sustainable energy projects. Providing an above-market price premium for renewable energy compensates for the cost disadvantages of clean energy sources enhancing the profits of projects and returns on investment. Feed-in tariffs as well as renewable energy production incentives are mostly offered at a predetermined height and over a predetermined number of years and provide medium- to long-term certainty on prices and revenues. Market risk is therefore entirely mitigated while prices for conventional energy remain volatile.
	Application in non-Annex B countries. Until early 2010, more than 30 jurisdictions in developing countries, either at the national or sub-national level, had put in place feed-in tariffs. In sub-Saharan Africa this has only been the case in Mauritius (1988), Uganda (2007), Kenya (2008), and Tanzania (2008).
3.	**Quotas such as Renewable Portfolio Standards (RPS) / Renewable Obligation Certificates (ROC)**
	Design. Require power generators and/or utilities to generate and/or supply a pre-determined proportion of electricity from clean energy sources. Such obligations, when combined with systems of tradable renewable energy credits or renewable obligation certificates, can reduce the macro-economic costs associated with expanding renewable energy capacity by enabling flexibility on where sustainable energy is generated and by whom (sustainable energy being generated where it is cheapest).

	Impact on the risk-return ratio of renewable energy projects. Quota schemes force utilities and power generators to install a certain amount of renewable energy capacity (or generate/sell a certain proportion of sustainable energy) or to compensate for a lack of such capacity with the purchase of credits or certificates. This means that: A fixed level of demand for renewable energy technologies and projects is upheld, thus enabling scale as well as a less risky market, in addition to revenues based on electricity sales. Renewable energy projects can earn revenues based on the sales of such credits and certificates, adding an additional layer of return for a given level of risk to the financial profile of such projects.
	Application in non-Annex B countries. Until early 2010, only 9 jurisdictions in developing countries had put in place quota-based policies for renewable energy development, most of them in a number of Indian states. No such policy had been put in place in sub-Saharan Africa.
4.	**A price on carbon driving the internalization of the environmental costs of GHG emissions**
	Design. A price on the right to pollute the atmosphere with greenhouse gases can be put in place through a carbon tax or through an emissions trading scheme.
	Impact on the risk-return ratio of renewable energy projects. By forcing the internalization of environmental costs, a meaningful carbon price creates a level playing field between renewable and conventional energy options. The risk-adjusted investment returns of the former increase relative to those of the latter as a carbon price entails costs only for conventional technologies, not, however for zero- and low-carbon technologies. Under a cap-and-trade system or an international crediting mechanism, a price on carbon can open new revenue streams for sustainable energy projects.
	Application in non-Annex B countries. At present, only a few jurisdictions feature a price on carbon. Not one developing country, and no country in Africa, provides for a price on carbon. More than 4,200 CDM projects that are expected to generate 2.9 billion CERs by 2012 are in the global pipeline. However, the current distribution of projects is uneven, with 75% percent of registered projects located in Asia Pacific and less than 1% in sub-Saharan Africa.

Source: UNEP FI.

What appears to have led to success in the deployment of existing renewable energy technologies and the installation of renewable energy generating capacity in numerous countries worldwide—and what many countries in sub-Saharan Africa appear to lack—are two fundamental conditions:

Easy market access—The regulatory framework for the electricity sector needs to provide easy grid- and market-access, on fair terms, to private sector entities and independent power producers (IPPs). This condition can be fulfilled even in the case of a monopolistic energy sector where IPPs rely on power purchase agreements (PPAs). However, it is suggested that, by definition, the likelihood and reliability of easy market access—and ultimately energy investment—will be higher in the case of a decentralized and liberalized energy sector.

A level playing field—Market access alone will not be enough; it needs to be complemented by policies that enhance the short-term financial competitiveness of renewable energy relative to conventional options. Given the difficulties and limited support provided by international carbon markets, domestic incentives are essential. The mere existence of incentives, however, is also not enough; private sector actors must trust the reliability of the schemes in the medium to long term (see the low-carbon policy risk category discussed in Part 5).

To date, most countries in sub-Saharan Africa seem to have fallen short of making progress on these two fundamental conditions:

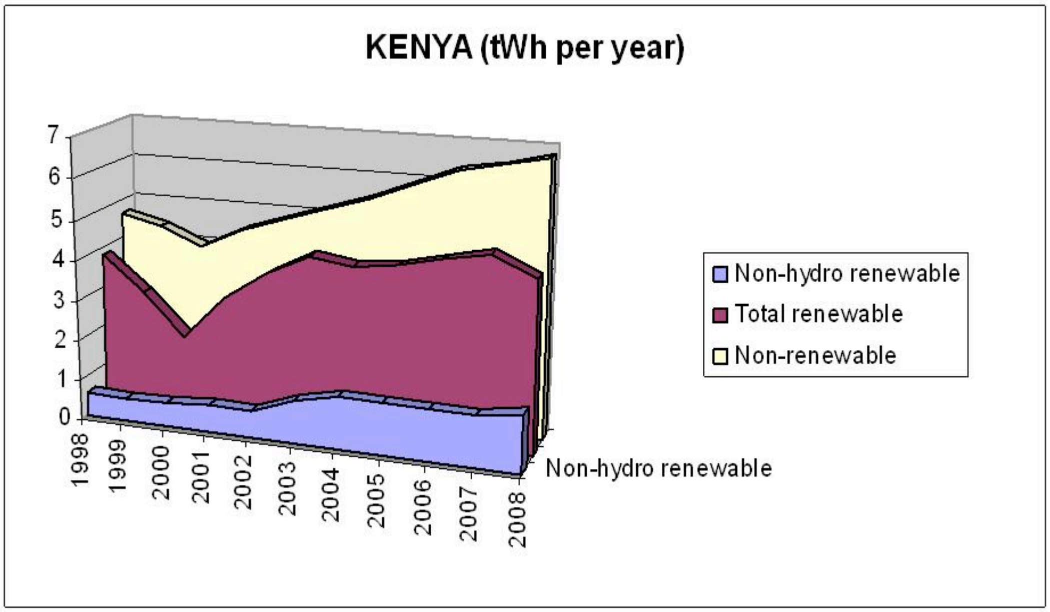
1. When compared with reform processes worldwide, sub-Saharan Africa has been the slowest to implement power sector reforms towards higher degrees of liberalization and decentralization. This observation is supported by the United Nations Environment Programme (UNEP) and the Economic Commission for Africa (UNESCA and UNEP 2007), and is according to the latest and most comprehensive global survey of the status of power sector reforms in developing countries (Bacon and Besant-Jones 2002). The survey included 48 sub-Saharan African countries and revealed that, in contrast to other regions in the developing world, overall sub-Saharan Africa's power sector was the least reformed (UNESCA and UNEP 2007). Where reforms have led to the establishment of IPPs, they have tended to favor large and centralized systems in either hydroelectric or fossil-fuel-based generation. Most reform efforts in the sub-Saharan energy sector have primarily focused on partial privatization, most often in the form of commercialization, implemented through management contracts or tariff reform, and only secondarily on liberalization, decentralization and increased competition. It is, however, these latter reform components that can ultimately enhance energy market access to IPPs.

2. Many sub-Saharan countries have put in place national targets for the expansion of renewable energy and have acknowledged the importance of renewable energy in national development and poverty reduction plans (see Table 1). Despite such support and endorsement at the political level, however, the same countries have to date failed to put in place the supportive policies needed to create the level playing field. Without these policies and incentives, as we have seen, and even with a conducive sector reform in place, investors and IPPs will continue to place emphasis on conventional energy options. It is interesting to note that those sub-Saharan countries that appear to lead the way in the expansion of renewable energy are those that have put in place concrete measures that go beyond political statements. Notably, these countries include Kenya, Uganda, and Mauritius, as well as a few others.

Kenya

Kenya is the undisputed leader of sub-Saharan Africa in the generation of electricity from renewable sources, particularly non-hydro (see Figure 3). This is mostly due to the large-scale exploitation of geothermal energy in the Rift Valley, which started as early as the 1980s. Kenya is one of only a very few countries in sub-Saharan African to have put in place a system of feed-in-tariffs (which they did in 2008) that cover geothermal, wind, biogas, and small-scale hydro generation. Kenya has also reformed its energy sector to

Figure 3: Electricity Generation in Kenya (1998–2008)



Source: Remco Fischer, UNEP Finance Initiative.

allow for easier access and competition among independent electricity generators under a single-public-buyer scheme. Given that the feed-in-tariff scheme was introduced only in 2008, however, it appears that Kenya's earlier positive developments may be explained by the mere availability of vast geothermal resources rather than by the development of renewable energy support policies at the national level. However, current trends in the Kenyan pipeline of renewable energy projects under the Clean Development Mechanism (CDM) appear to indicate that since 2008 renewable energy activity has accelerated: at present, almost one third of all renewable energy CDM projects in sub-Saharan Africa (excluding South Africa) are located in Kenya, including the notable 310 MW wind project at Lake Turkana. In 2008, overall installed capacity in Kenya reached 750 MW for hydro-based energy generation and 115 MW for other renewable energy generation. In 2011, however, there were roughly 575 MW of renewable energy projects in the CDM pipeline, albeit with only 85 MW having achieved registration under the CDM Executive Board.

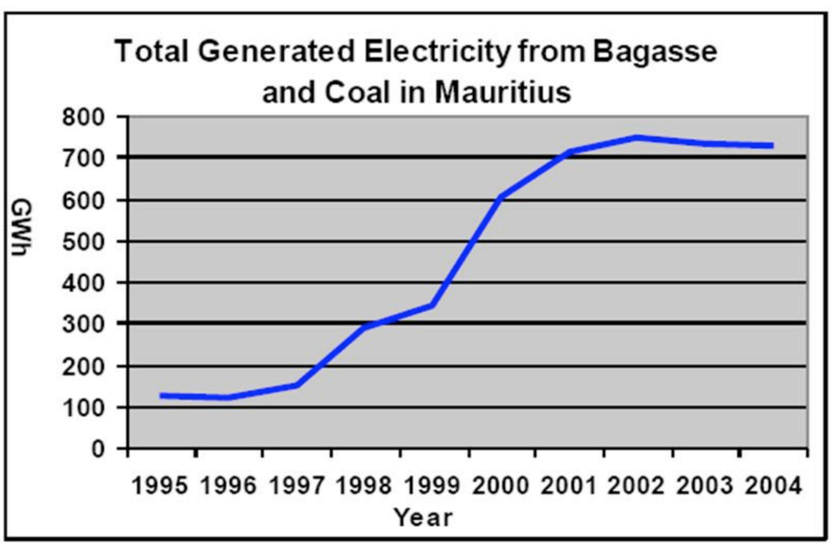
Uganda

Uganda scores highly both in terms of its renewable energy capacity in the current CDM pipeline as well as in the comparably advanced state of its dedicated renewable energy policy. The latter has been praised for its sophistication and in consideration of the lessons learned from experiences abroad—covering tariffs for wind, solar PV, biomass, biogas, landfill gas—by differentiating wisely between size categories of hydro-power generation, and providing both yearly and cumulative caps on each technology. Together with the development of an effective institutional infrastructure for management of the CDM (UNEP FI 2011), the scheme seems to only quite recently considerable spurt in renewable energy activity. In 2008 Uganda had 550 MW of total installed capacity, of which 315 MW were hydro-based. In 2010 there were 300 MW of renewable energy in the CDM pipeline, comprising new terrain for Uganda in the area of biomass, including the controversial Bujagali dam project of 250 MW, and only 17 MW worth of registered projects.

Mauritius

The Mauritian experience in co-generation is one of the success stories in the energy sector in Africa: Since 2002, biomass-based electricity co-generation from sugar estates (over half of it from bagasse) has stood at 40% of the total electricity demand in country (AFREPREN 2011). Mauritius has, over a period of nearly two decades, developed a feed-in pricing policy on co-generated power, which has been the key driver for increased production of bagasse co-generated power (AFREPREN/FWD 2009) (Figure 4).

Figure 4: Total Electricity Generated from Bagasse and Coal in Mauritius



Source: Quelle: MSIRI, 2006; AFREPREN/FWD and E-Parliament, 2009.

Additional Renewable Energy Projects in Sub-Saharan Africa Countries

All countries in sub-Saharan Africa that have developed at least nascent industries in renewable energy generation and distribution have achieved this through supportive policies and the provision of grid-access to IPPs.

Tanzania, which currently carries 18 MW of new capacity in its CDM portfolio, offers a feed-in tariff to hydroelectricity generators, and grid-access to IPPs through long-term PPAs with the vertically integrated public monopolist. Cape Verde, which has recently seen wind generation development in the order of 30 MW, had previously put in place an ambitious plan for wind energy development and regulation that allows the import of renewable energy equipment, such as solar panels and wind generators, with tax exemptions (REEEP 2010). Nigeria, Senegal, Mali, and Ivory Coast have established some very modest regulatory support, mostly of a fiscal nature, for renewable energy generation, and made IPP generation possible through different grid-access models.

In the rest of sub-Saharan Africa, while targets may have been put in place in some countries, the lack of concrete regulatory support has meant a lack of grid-based renewable energy infrastructure development. Such a gap has only marginally been closed by the CDM.

Part 5: Investment Risks in Renewable Energy

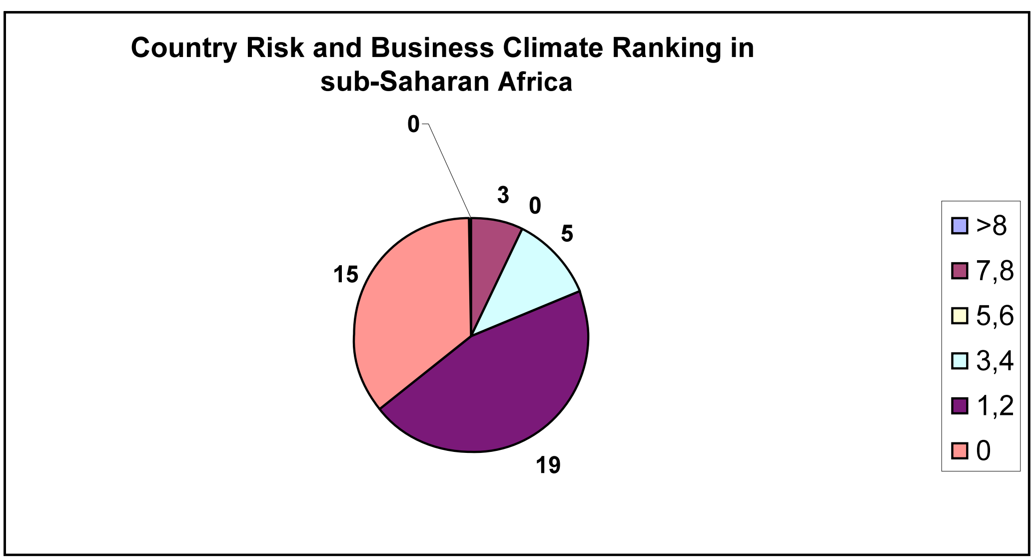
In addition to the lack of a level playing field other obstacles limit the development of renewable energy technologies. The accumulation of various significant investment risks makes it difficult to invest in a developing country context. First, the general risk associated with the novelty of renewable energy technologies is particularly pronounced in developing countries that lack the track record, overall business infrastructure, and professional expertise in these technologies. Second, this risk is exacerbated by investment risks that are typical for developing countries, including political, refinancing, and commercial risks introduced by the poor creditworthiness of state-owned utilities that have payment obligations to buy generated power under PPAs (African Development Bank 2010). The poor creditworthiness is often explained by poor billing and payment collection systems, limited innovation, and prices that reflect neither costs nor demand, but are determined on political grounds. The accumulation of these risks increases the return expectations of potential developers and their financial backers to prohibitive levels, which are particularly detrimental to renewable energy technology given its capital-intensive nature, as previously discussed.

According to the United Nations Environment Programme (UNEP and Partners 2009) the main nontechnology risk categories that characterize the environment for investments in developing countries, including those in sub-Saharan Africa, are country and political, low-carbon policy, and currency.

Country and political risk

The country and political risk category encompasses risk of expropriation, breach of contract, war, and civil disturbance. As vague and all-comprising this category of risk may be, it is critical: for foreign investors and financial institutions, it will often act as an early selection filter in many financial decision-making processes, and does very often hinder, on the basis of broader macroeconomic, political, or legal concerns, the implementation of otherwise promising and high-potential projects on the ground (Baldwin 2006, 35-38). An indication of how countries in sub-Saharan Africa currently perform with respect to "country risk" and "business climate," is calculated on a scale of from 0 to 12 and is based on a composite indicator that combines the country ratings (Figure 5). The bulk of the analyzed countries (34) find themselves in the two lowest possible categories; while five countries—Cape Verde, Senegal, Gabon, Benin, and Lesotho—make it to the third worst category (out of 6 categories). Only three countries—Botswana, Mauritius, and Namibia—make it into the second highest category. The Multilateral Investment Guarantee Association (MIGA) or export credit insurance agency, a member of the World Bank group, insures against such risk for a fee. However, the availability of such insurance is limited only to foreign investors, financiers, or exporters.

Figure 5: Distribution of Countries in Sub-Saharan Africa According to Country Risk and Business Climate Ratings

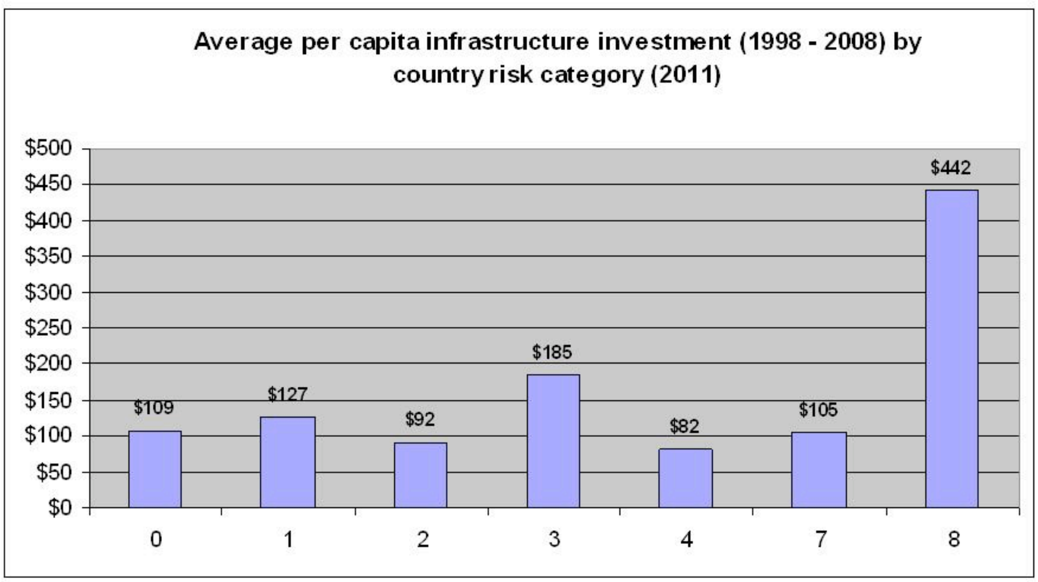


Source: Remco Fischer, UNEP Finance Initiative.

Several studies point to the close links between country risk and related aspects of public governance (including quality of administration, public accountability, and political stability) to levels of private investment, and especially, but not only, foreign direct investment (Ramcharran 1999, 49-59; Aysan and Ersoy 2007, 1-16). This rationale also appears to apply in a specific sub-Saharan Africa context: the total average per capita infrastructure investment with private participation (1998–2008) by country risk category (as measured by the above composite indicator) (Figure 6). When compared, as a whole, with all other macro-regions of the world, sub-Saharan Africa is the most risky (Ferrari and Rolfini 2008, 6).

Furthermore, political risk in sub-Saharan Africa, more than in any other part of the world, is seen to be not only rooted in the potential behavior of governments and other official actors, but in that of any organization or individual with political aims. Even relatively advanced states such as Uganda cannot always claim control of their entire sovereign territory (Baldwin 2006). In such vacuums of public authority, competing investors, NGOs, militia groups, individual politicians, or specific arms of a government—all are potential threats to investment.

Figure 6: Total Average per Capita Infrastructure Investment with Private Participation (1998–2008) by Country Risk Category



Source: Remco Fischer, UNEP Finance Initiative.

Low-Carbon Policy Risk

Low-carbon policy risk pertains to the possibility that policies underpinning investments in renewable energy projects (such as the policies and mechanisms outlined above) might be reversed. In addition to operating in an overall difficult and risky political, legal, and macro-economic context, renewable energy technologies in developing countries are also exposed to more specific regulatory risks given their financial inferiority and the resulting reliance on public support mechanisms and incentives. If such concrete incentives are discontinued or, even worse, altered or reversed retroactively, renewable energy projects suddenly become unviable. Low-carbon policy risk is essentially the component under regulatory risk that applies specifically to renewable energy projects and other decarburization efforts; it relates to the question of how credible and reliable public policies, regulation, and incentives are over the appropriate timeframes, and how effectively they are implemented by government agencies (Helm and Hepburn 2003, 438–450).

Such risks have materialized also in developed country regions such as Europe, where the German, Spanish, and Czech feed-in tariff levels were suddenly corrected, at times entirely discontinued, or reversed retroactively. The reason for these corrections was partly the over-generous design of the feed-tariffs in the first place, which allowed investors to seize overly high and unjustified returns (Konttinen 2010). In the Czech Republic, a tax of 28% on solar photovoltaic revenues was introduced in 2010, with a retroactive effect, leading to a loss of investor confidence and trust in ongoing national regulation and promotion of renewable energy technologies (Renewable Energy Focus 2010).

Given the political instability, frequent lack of law enforcement or implementation of regulation in many developing countries, even if supportive policies for renewable energies are put in place, private initiative and investment will only materialize if the continuity of such policies is ensured, including through so-called grandfathering clauses. Such clauses can prevent the discontinuation of policies when there are changes in the public administration, for instance after elections. Establishing regulatory agencies that are independent, to a certain degree, from central governments and thus less exposed to political tactics can also contribute to the continuity and stability of regulation (Kirkpatrick and Parker 2005).

Currency (Foreign Exchange) Risk

Currency risk is a trivial but critical risk class, particularly in the least developed countries with volatile currencies and weak financial markets, which makes capital investments, particularly those related to infrastructure, reliant on foreign financing. Currency risks are especially pertinent for projects delivering a public good to local populations, such as electricity or water, given that project cash flows are mostly denominated in local currency while debt service or dividend payments are expected in hard currency. In addition, there is a lack of commercial markets for currency risk hedging instruments for "small" currencies that are not traded much internationally. This gap has been partly closed by the Currency Exchange Fund, which has a mandate of international development cooperation and is partly capitalized by public European actors. It offers those investing in developing markets the opportunity to hedge their local currency risk with swap products. But not even this noncommercial instrument with developed country donor backing covers all countries of sub-Saharan Africa; it excludes Liberia, Malawi, Sierra Leone, Sudan, Democratic Republic of Congo, Eritrea, and Somalia.

Given their novelty and short track record, renewable energy technologies are particularly and strongly affected by foreign exchange risk, especially in countries with volatile currencies. This circumstance also contributes to a lack of technology know-how among local financial institutions and a heavier reliance on foreign finance for renewable energy than for conventional technologies.

Conclusion

Africa's need for energy—together with its considerable and untapped resources in renewable energy—point to where the continent should be headed in developing its energy sector and infrastructure. The rapid expansion of renewable energy capacity in sub-Saharan Africa contains the potential to address several problems and seize opportunity at the same time by (i) quickly increasing electricity penetration, including to remote communities distant from current grid infrastructure; (ii) reducing the current reliance on expensive fossil fuel imports, as well as—in the case of countries that rely heavily on hydropower—exposure to the considerable risk of drought; and (iii) increasing clean private investment, including from abroad, by tapping into international carbon markets.

While renewable energy options remain, at least in the short term, more expensive than conventional options, proven avenues and promising steps can already be taken so that developing countries are able to profit from the long-term benefits of renewable energy generation. Supportive incentives at the local level can be powerful levers of private investment when carefully combined with energy sector reform, but they have to be concrete and go beyond high-level statements of political correctness. Furthermore, public support must be reliable in the medium to long term, which is challenging given the bad standing of many governments in areas such as public accountability and political stability. These types of local constraints can be bridged, however, with international support. Country risk instruments, deployed internationally, already play a significant role in enabling private investment in risky countries, and the international carbon markets can push return expectations to levels that justify higher levels of risk.

Ultimately, serious public commitment is needed at the local level. In addition, local and international communities need to cultivate an understanding of how private investment works and how to effectively promote and mobilize it through smart public intervention—not for short- but for long-term benefit.

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