INSTITUT MONTAIGNE

Bright Perspectives for **Solar Power in Africa?**

POLICY PAPER JANUARY 2020

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There is no desire more natural
than the desire for knowledge

TABLE OF CONTENTS

INTRODUCTION

The population of Africa is set to double over the next 30 years, reaching 2.5 billion inhabitants in 2050.[1] Many people see the economic development of African countries as being the main response to this exponential demographic growth.

Other topics that are regularly brought up are the difficulties of accessing essentials, such as water, food, education, healthcare, housing and employment. French President Emmanuel Macron mentioned the promotion of culture and sport during his recent visit to Nigeria.[2] Bill Gates has recommended investing in people first: education and healthcare.[3]

However, one fundamental aspect is all too often ignored: access to energy. Without energy, all other efforts are destined to fail. Pumping fresh water from the groundwater supplies, operating medical dispensaries, enabling school children to do their homework in the evening or giving them access to the internet: all economic or human developments need energy. Yet over 645 million Africans still do not have access to electricity,[4] and this figure continues to climb, without the deprived populations perceiving any indication of a trend reversal.

The difficulties involved in implementing infrastructure projects in most Sub-Saharan African countries are well-known: political risks, cost of mobilizing capital, weakness of existing electric grids, inadequate assets management capacities, insufficient training of local authorities, insufficiencies with the regulatory frameworks, lack of planning, liquidity shortages in the financial sector, financial robustness of the off-takers, etc.

While there is a general consensus that the massive and rapid deployment of power generation facilities in Africa is essential to the continent's economic and human development, there are several ways to achieve this goal. A long term view could mean favouring the deployment of large hydropower dams, decarbonised solutions that take a long time to implement and are not necessarily suitable for all regions. Conversely, the pressing urgency may encourage decision makers to opt for easier solutions: the use of thermal power generation plants (coal, gas or diesel fired power plants) that are quicker to deploy but generate more CO_2. Although complementary,

[1] INED biennial study (September 2017) - https://www.ined.fr/fichier/s_rubrique/26889/547.population.societes.septembre.2017.tous.les.pays.du.monde.fr.pdf

[2] http://premium.lefigaro.fr/international/2018/07/03/01003-20180703ARTFIG00300-au-nigeria-macron-veut-seduire-l-afrique-anglophone.php

[3] http://premium.lefigaro.fr/vox/monde/2018/09/18/31002-20180918ARTFIG00004-bill-gates-il-n-y-a-pas-d-effet-immediat-de-l-aide-aux-pays-pauvres-sur-les-migrations.php

[4] African Development Bank: https://www.afdb.org/fr/documents/document/afdb-groups-strategy-for-the-new-deal-on-energy-for-africa-2016-2025-96494/

these two strategies each appear unable to provide a single response to the future needs of a population that will count an additional 1.3 billion people in thirty years' time:[5] the first option has the disadvantage of a development phase that is too long for the state of urgency observed, the second is inadequate in both climatic and economic terms, due to the increasing prices of fossil fuels.

For almost a decade, the development of photovoltaic solar power generation technologies offers new perspectives for electrifying the African continent. The falling prices of solar panels and batteries, the exponential growth of solar[6] energy worldwide,[7] and various initiatives, including the Africa Renewable Energy Initiative (AREI) or Jean-Louis Borloo's public addresses,[8] have implied that the problem of access to energy in Africa had been resolved, or is at least in the process of being so. In fact, the truth is quite different. Today, only around ten solar power plants of more than 5 MW[9] have been connected to the grid in the whole of Sub-Saharan Africa (excluding South Africa), four of which are in Senegal. Africa remains notably absent from the global wave of solar power plant deployment. This is a collective failure for which the underlying reasons must be analysed.

[5] INED biennial study (September 2017) - https://www.ined.fr/fichier/s_rubrique/26889/547.population.societes.septembre.2017.tous.les.pays.du.monde.fr.pdf

[6] For this paper, we have chosen to focus on the subject of electricity. Thus, "solar power" should be understood herein as being electricity produced by solar power.

[7] In 2017, solar power plants representing 98 GW were commissioned, compared with just 76 GW in 2016 and 50 GW in 2015 (source: AIE: http://www.iea-pvps.org/fileadmin/dam/public/report/statistics/IEA-PVPS_-_A_Snapshot_of_Global_PV_-_1992-2017.pdf).

[8] Between 2015 (http://premium.lefigaro.fr/politique/2015/03/03/01002-20150303ARTFIG00338-borloo-l-afrique-est-le-principal-relais-de-croissance-de-l-europe.php) and 2017 (https://www.jeuneafrique.com/404369/economie/clap-de-fin-ambitions-africaines-de-jean-louis-borloo/)

[9] A 5 MW solar power plant can provide electricity to cover the average annual consumption of a population of 30,000 inhabitants (estimation based on solar production of 2,000 kWh/kWp and average consumption of 300 kWh per household per year).

I

REVIEW OF THE CURRENT SOLAR POWER SITUATION IN AFRICA

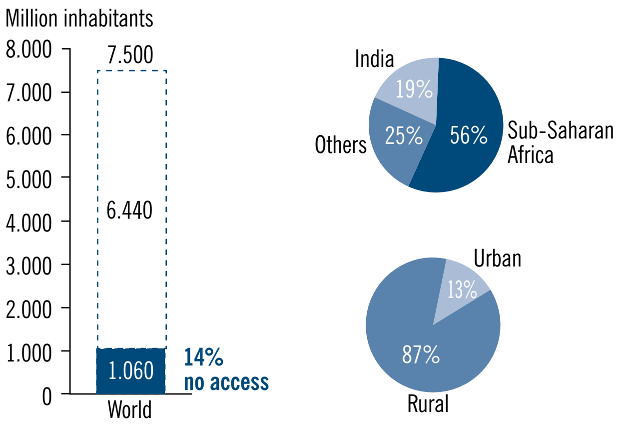
1. Electricity remains rare and expensive in most Sub-Saharan African countries

a. Considerable needs

The African continent suffers from a chronic deficit of electricity, which obviously hinders its economic and human development. This deficit is measured by observing three variables that must be clearly separated: ***access*** to electricity, ***consumption*** of electricity (demand), installed ***capacity***[10] (supply).

14% of the world's population, i.e. more than one billion people, do not have access to electricity. The vast majority (87%), live in rural areas. More than half (56%) live in Sub-Saharan Africa. The rate of access to electricity in Sub-Saharan Africa is the lowest in the world, at an average 32%, according to the African Development Bank.

Figure 1 – Access to electricity (2016)



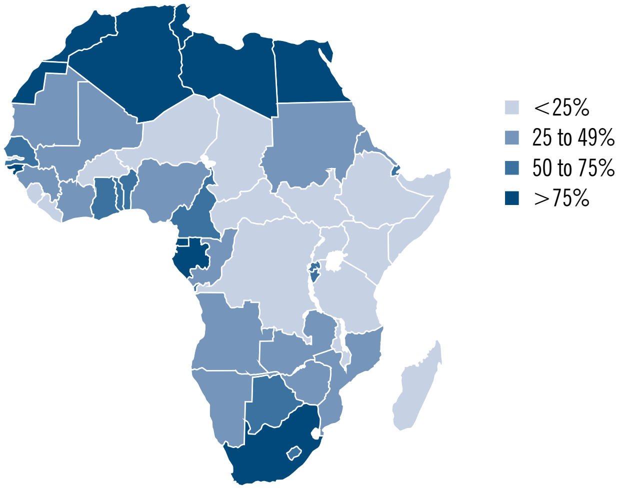
Source: Rate of access to electricity (2016, source: ATKearney[11] - IEA World Energy Outlook 2017).

[10] Actual capacity is correlated with electricity production: at equal capacity, the higher the load factor, the higher the electricity production.

[11] ATKearney – Energy Poverty Factbook : http://www.energy-transition-institute.com/Insights/EnergyPoverty.html

According to a McKinsey study,[12] in 2015, only 7 Sub-Saharan African countries enabled access to electricity for more than 50% of their populations: South Africa (85%), Ghana (72%), Gabon (60%), Namibia (60%), Ivory Coast (59%), Senegal (57%) and Cameroon (54%). In the rest of Sub-Saharan Africa, the average rate of access to electricity barely exceeds 20%.

Figure 2 – Rate of access to electricity in Sub-Saharan African (2015, breakdown by region)



Source: AIE, BAD.[13]

7

Since the year 2000, more than one billion people have obtained access to electricity, but the global population has risen by 557 million. The proportion of the world's population without access to electricity has therefore decreased by 34% since 2000, due to progress achieved in Asia, where the rate of access has increased from 67% in 2000 to 89% today. Sub-Saharan Africa is the only region in the world where this trend is downward, with demographic growth (270 million more inhabitants than in 2000) being higher than the rate at which the populations are being given access to electricity (200 million additional people obtaining access over the same period). Based on the trends induced by current policies, the number of people

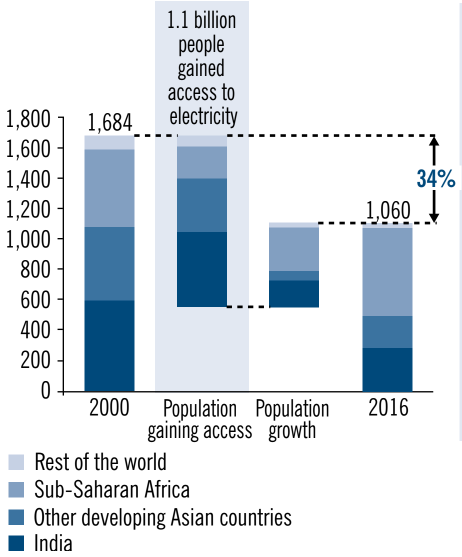
[12] Brighter Africa : The growth potential of the sub-Saharan electricity sector (2015) : https://www.mckinsey.com/~/media/McKinsey/dotcom/client_service/EPNG/PDFs/Brighter_Africa-The_growth_potential_of_the_sub-Saharan_electricity_sector.ashx

[13] African Development Bank: https://www.afdb.org/fr/documents/document/afdb-groups-strategy-for-the-new-deal-on-energy-for-africa-2016-2025-96494/

without access to electricity in Sub-Saharan Africa is expected to continue to rise until 2025[14] or even 2040[15] according to some estimates. In 2040, almost 95% of the world's population without access to electricity will be in Sub-Saharan Africa.

Figure 3 - Evolution of the global population without access to electricity

Million people, 2000-2016



- Today, almost 1.1 billion people do not have access to electricity facilities; about 14 percent of global population.
- Since 2000, 1.1 billion people gained access to electricity and the global population grew by 557 million people. As a result, the proportion of the global population without access to electricity fell by 34 percent.
- India experienced one of the fastest electrification rates 800 Providing electricity to an additional 500 million people Over the 16 years. Other developing countries in Asia 400 Also registered significant progress, and Asia's electrification rate is now 89 percent, compared to 67 percent in 2000.
- Sub-Saharan Africa is the only region exhibiting a negative trend, with the number of people without electricity increasing by 70 million people over the period.

Note: Developing Asia : Bangladesh, Brunei, Cambodia, China, India, Indonesia, North Korea, Malaysia, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Viet Nam, Afghanistan, Laos, Pacific Nations. Note: World total includes OECD and Eastern Europe/Eurasia

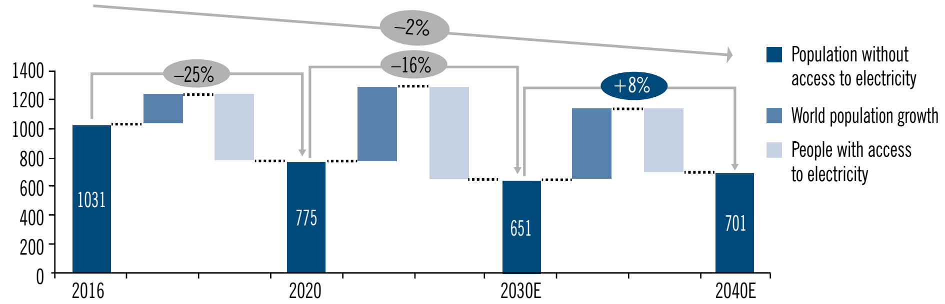
Source: ATKearney[16].

[14] McKinsey analysis - https://www.mckinsey.com/industries/oil-and-gas/our-insights/renewable-energy-evolution-not-revolution

[15] ATKearney – Energy Poverty Factbook : http://www.energy-transition-institute.com/Insights/EnergyPoverty.html

[16] ATKearney – Energy Poverty Factbook : http://www.energy-transition-institute.com/Insights/EnergyPoverty.html

Figure 4 - Estimation and prediction of the population* without access to electricity



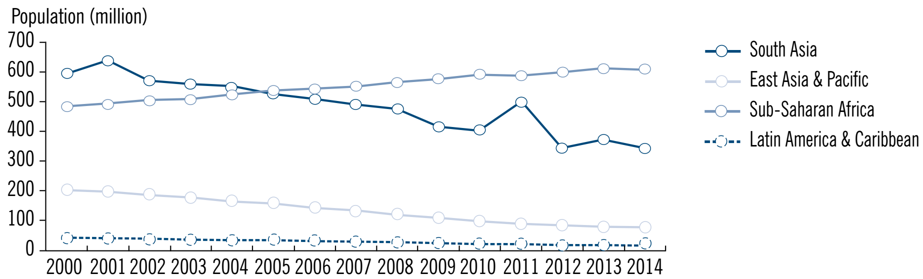
From 2016 to 2030, the number of people without access to electricity should decrease, from 1,031 million to approximately 650 million. After 2030, the global population without access to electricity should start growing again. Deprived population is expected to exceed 700 million people, an estimated 9% of the global population at that time. Nearly 95 % of the deprived population will be in sub-Saharan Africa.

* The World Bank estimates 1031 million people without access to electricity, thus there is a small difference with the IEA estimate of 1,061 million.

Source: ATKearney[17], 2016.

This analysis is largely shared by the World Bank, which observes that the rate of increase in the number of inhabitants with access to electricity (5.4% per year) is well below the rate that would be necessary to achieve universal access to electricity by 2030 (8.4% per year), taking demographic growth into account.

Figure 5: Evolution of the population without access to electricity[18]



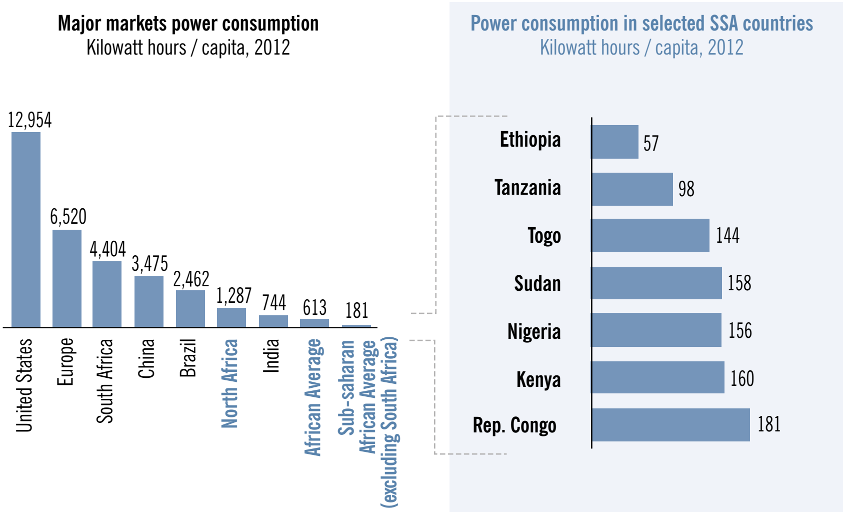
Source: Data from IEA and World Bank, 2017.

[17] ATKearney – Energy Poverty Factbook : http://www.energy-transition-institute.com/Insights/EnergyPoverty.html

[18] World Bank – State of Electricity Access Report http://documents.worldbank.org/curated/en/364571494517675149/pdf/114841-REVISED-JUNE12-FINAL-SEAR-web-REV-optimized.pdf

This rate of access measures the proportion of the population with a source of electricity, but this source is usually too unreliable or insufficient – sometimes both - to meet their needs. The average consumption of electricity per inhabitant in Sub-Saharan Africa (excluding South Africa) is 181 kWh/year/person,[19] compared with India (744 kWh/year/person), Brazil (2,462 kWh/year/person), Europe (6,500 kWh/year/person) and the USA (13,000 kWh/year/person).

Figure 6 - Electricity consumption throughout the world and in Sub-Saharan Africa



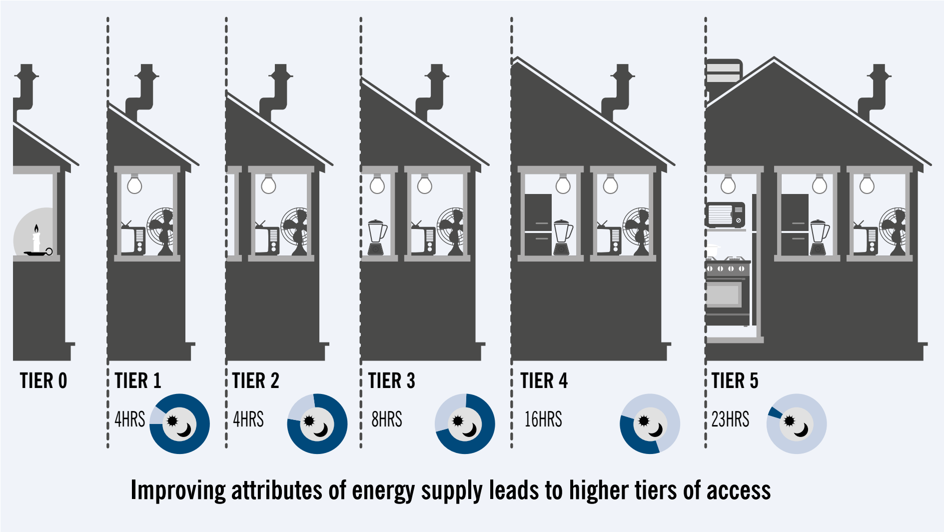
Source: *World Bank and African Development Bank).*[20]

The notion of access to electricity must be approached with care since it is important to differentiate between perfectly stable access and less reliable access. The *"Sustainable Energy for All"* (SE4ALL) initiative supported by the World Bank has come up with the *"Multi Tier Framework"* concept to define 5 different levels of quality of access to electricity, as shown in the illustrations below.

[19] African Development Bank: https://www.afdb.org/fr/documents/document/afdb-groups-strategy-for-the-new-deal-on-energy-for-africa-2016-2025-96494/

[20] African Development Bank: https://www.afdb.org/fr/documents/document/afdb-groups-strategy-for-the-new-deal-on-energy-for-africa-2016-2025-96494/

Figure 7 - The different levels of quality of access to electricity (Multi Tier Framework developed by SE4ALL, World Bank)[21]



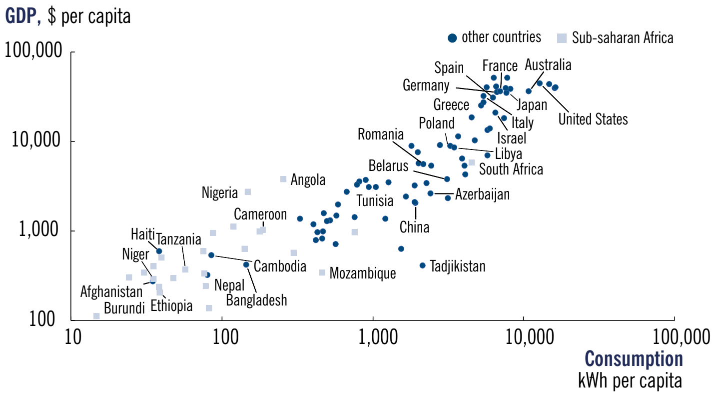
	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Capacity		Capacity (from 3W to above 2kW) and ability to power appliances (applicable for off-grid solutions)				
Duration - day		From at least 4 hours a day to over 23 hours a day				
Duration - evening		From at least 1 hour in the evening to over 4 hours				
Reliability					Number and duration of outages	
Quality					Voltage problems do not affect the usage of desired appliances	
Affordability				Basic service less than 5% of a household income		
Legality					Service provided legally	
Heath and Safety					Absence of accidents	

[21] SE4ALL: https://www.seforall.org/sites/default/files/MTFpresentation_SE4ALL_April5.PDF

The absence of access to electricity and the poor quality of this access if it exists have serious repercussions on local populations and businesses. According to the WHO,[22] some 600,000 Africans (mostly women and children) die each year from inhaling fumes related to the use of combustion fuels for cooking or lighting. The ADB[23] reports that 90% of primary schools in Sub-Saharan Africa have no access to electricity, which obviously impacts learning conditions for pupils. The lack of electricity in hospitals and maternity clinics prevents the use of adequate equipment to treat patients.

With regard to economic activity, the situation is not any better: according to a World Bank study,[24] electricity supply failures are directly responsible for 4% of net losses on turnover, even though 48% of businesses use a diesel generator to compensate for these failures. 13.3% of the businesses consulted mention the lack of a reliable supply of electricity as the main obstacle to their development.

Figure 8 - Relationship between electricity consumption and GDP



Source: McKinsey[25], 2013. IHS, IES, EIA, 2013.

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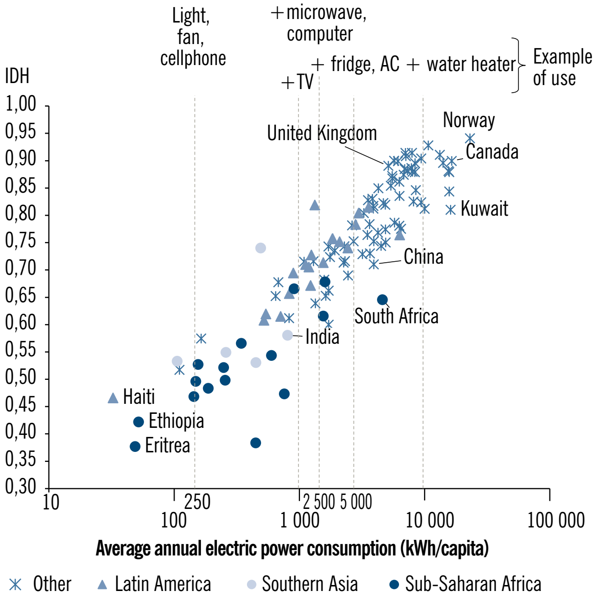
[22] Report by the African Development Bank: The Bank Group's Strategy for The New Deal on Energy for Africa 2016 – 2025: https://www.afdb.org/en/documents/document/afdb-groups-strategy-for-the-new-deal-on-energy-for-africa-2016-2025-96494/

[23] Report by the African Development Bank: The Bank Group's Strategy for The New Deal on Energy for Africa 2016 – 2025: https://www.afdb.org/en/documents/document/afdb-groups-strategy-for-the-new-deal-on-energy-for-africa-2016-2025-96494/

[24] World Bank Enterprise Survey : http://www.enterprisesurveys.org/

[25] Brighter Africa: The growth potential of the sub-Saharan electricity sector (2015): https://www.mckinsey.com/~/media/McKinsey/dotcom/client_service/EPNG/PDFs/Brighter_Africa-The_growth_potential_of_the_sub-Saharan_electricity_sector.ashx

Figure 9 - Relationship between electricity consumption and the human development index



- The Human Development Index (HDI) is a composite statistic that incorporates life expectancy, education, and per capita income indicators.
- A country scores higher in the HDI as lifespan lengthens, education improves, and GDP per capita rises.
- HDI is closely correlated to electricity consumption per capita per year in the case of all countries.
  - The correlation holds true for GDP per capita too.
  - The correlation begins to break down when per capita power consumption starts to exceed 5000MWh/year, highlighting the importance of energy efficiency in richer industrialized nations.
- In many developing countries, low average electricity consumption are compounded by low electrification rates, further restricting socio-economic development to a limited share of the population.
- According to the d. Light basic energy access level is set to be at 250 kWh/capita/year for rural areas, and 500 kWh/apita/year, for urban area.

Source: World Bank Energy Use Database. Data bank UNDP on the HDI. McKinsey[26], 2013.

b. Mostly thermal and hydropower installed capacities

Installed **capacity** measures the power of all centralised or decentralised power generation facilities. This capacity is mainly based on thermal (coal, gas, diesel) and hydropower (dams) sources. The installed capacity in Africa is massively insufficient due to its inadequate size, dilapidated condition, inadequate maintenance, vulnerability to low water problems[27] (hydro power plants) and the fluctuating prices of fossil fuels (thermal power plants).

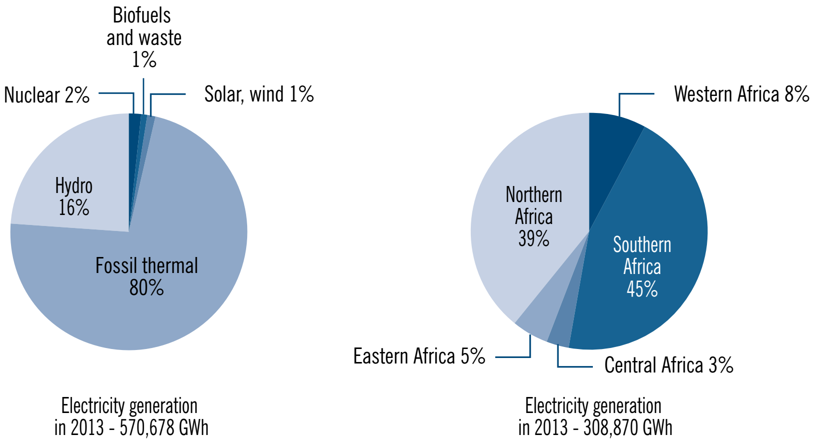
The total installed capacity in Africa is estimated to be 168 GW,[28] 76 GW of which is in North Africa (Maghreb and Egypt), and 92 GW in Sub-Saharan Africa, with 46 GW in South Africa alone.

[26] ATKearney – Energy Poverty Factbook : http://www.energy-transition-institute.com/Insights/EnergyPoverty.html

[27] It is difficult to operate a hydroelectric dam at full power if the volume of water available (reservoir dam) or the flow (in-river hydroelectricity) is insufficient for seasonal reasons (dry season), or because of human impact either locally (over-use of local water resources) or globally (repeated drought periods due to climate change).

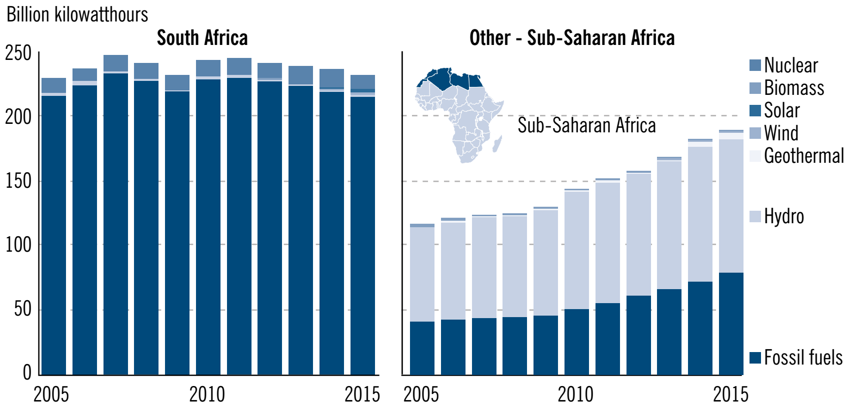
[28] https://www.afdb.org/fileadmin/uploads/afdb/Documents/Development_Effectiveness_Review_2017/ADER_2017__En__Ch._2.pdf

Figure 10 - Breakdown of the installed capacity in Africa, by source and by region



Source : United Nations and ADB, 2013[29].

Figure 11 - Evolution of the installed capacity in Sub-Saharan Africa



Source: EIA: https://www.eia.gov/todayinenergy/detail.php?id=37153

[29] Atlas of Africa's energy resources: https://www.icafrica.org/en/knowledge-hub/article/atlas-of-africa-energy-resources-329/

The 48 countries of Sub-Saharan Africa (excluding South Africa) therefore only have 46 GW installed capacity for a population of over one billion - compared with 106 GW installed power in Spain for 45 million inhabitants.[30]

In view of this deficit and of the demographic and economic growth predictions, major investments (representing around $490 billion)[31] will be required in the power generation sector by 2040. Only $45.6 billion was invested in this sector between 1990 and 2013, $14.3 billion of which was invested in South Africa alone.[32]

The huge gap between the current level of investment and the level required to satisfy demand illustrates the fact that such investments cannot be made solely by the countries concerned, nor by development grants or other forms of public funding. Massive private investment will be necessary, initiated by Independent Power Producers ("IPP") whose role is to finance the construction of new power generation facilities.

Several projects of this type have already been implemented in Africa. The table below shows the list of power generation facilities built using private investment in Africa (outside Maghreb) over the past 10 years.[33]

[30] Independent Power Projects in Sub-Saharan Africa: Investment trends and policy lessons, Energy Policy 2017, Anton Eberharda, Katharine Gratwickb, Elvira Morellac, Pedro Antmannc

[31] Brighter Africa : The growth potential of the sub-Saharan electricity sector (2015) : https://www.mckinsey.com/~/media/McKinsey/dotcom/client_service/EPNG/PDFs/Brighter_Africa-The_growth_potential_of_the_sub-Saharan_electricity_sector.ashx

[32] Independent Power Projects in Sub-Saharan Africa: Investment trends and policy lessons, Energy Policy 2017, Anton Eberharda, Katharine Gratwickb, Elvira Morellac, Pedro Antmannc.

[33] Source BCG: https://www.africafc.org/Publications/Publications-Documents/BCG-Report-Africa-May-2017-Electronic-v12-may.aspx

Country	Launching year ("financial closing")	Project name	Type	Total investment (millions of USD)
South Africa	2013	Avon OCGT	Thermal	654
South Africa	2013	Dedisa OCGT	Thermal	327
South Africa	2012	Solar Capital De Aar3 PV	Solar	n.a.
South Africa	2012	Abengoa KaXu Solar I CSP Solar Plant	Solar	844
South Africa	2012	Abengoa Khi Solar I CSP Solar Plant	Solar	430
South Africa	2012	Biotherm - Aries Solar PV	Solar	34
South Africa	2012	Dreunberg Solar PV	Solar	n.a.
South Africa	2012	Inspired RustMo1 Solar Plant	Solar	25
South Africa	2012	Kathu Solar Plant	Solar	394
South Africa	2012	Konkoonsies Solar PV	Solar	34
South Africa	2012	Mainstream De Aar Solar Plant	Solar	150
South Africa	2012	Mainstream Droogfontein Solar Plant	Solar	150
South Africa	2012	MEMC Soutpan Solar Plant	Solar	180
South Africa	2012	MEMC Wiktop Solar Plant	Solar	195
South Africa	2012	Mulilo De Aar Solar Plant	Solar	35
South Africa	2012	Old Mutual - Greefspan Solar PV	Solar	48
South Africa	2012	Old Mutual - Herbert Solar PV	Solar	96
South Africa	2012	Old Mutual Hopefield Wind Farm	Solar	173
South Africa	2012	Scatec Kalkbuilt Solar Plant	Solar	259
South Africa	2012	Soitec CPV Solar Plant	Solar	150
South Africa	2012	Solar Capital De Aar Solar Plant	Solar	259
South Africa	2012	SolarReserve Lesedi Solar Plant	Solar	294
South Africa	2012	SolarReserve Letsatsi Solar Plant	Solar	280
South Africa	2012	Witkop Solar Power Plant	Solar	185
South Africa	2013	ACWA - Bokport CSP	Solar	n.a.
South Africa	2013	Bokpoort CSP Plant	Solar	382
South Africa	2013	Jasper Solar PV	Solar	n.a.
South Africa	2013	Linde Solar PV Plant	Solar	386
South Africa	2013	Sishen Solar PV	Solar	239

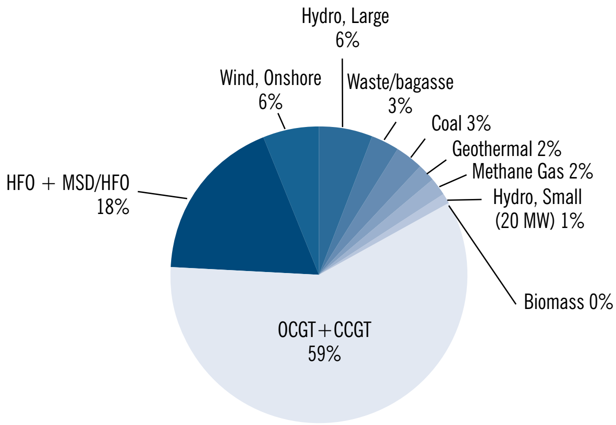
Country	Launching year ("financial closing")	Project name	Type	Total investment (millions of USD)
South Africa	2014	Mulilo Prieska Copperton Solar Plant	Solar	70
South Africa	2015	Adams Solar PV 2	Solar	110
South Africa	2015	Karoshoek Solar One CSP	Solar	688
South Africa	2015	Mulilo Prieska Solar PV Plant	Solar	59
South Africa	2015	Paleisheuwel Solar PV	Solar	110
South Africa	2015	Pulida Solar PV Plant	Solar	266
South Africa	2015	Second Mulilo-Sonnedix Prieska Solar PV Plant	Solar	133
South Africa	2015	Tom Burke Solar Park	Solar	88
South Africa	2015	Upington Solar PV	Solar	n.a.
South Africa	2015	Xina Solar One CSP	Solar	900
South Africa	2015	Johannesburg Landfill Gas to Electricity	Biogas	26
South Africa	2013	Neusberg Hydro Electric Plant	Hydro	56
South Africa	2006	Darling Wind Farm	Wind	10
South Africa	2012	ACED Cookhouse Wind Farm	Wind	300
South Africa	2012	Biotherm - Dassiesklip Wind	Wind	68
South Africa	2012	Gestamp Karoo Wind Farm	Wind	185
South Africa	2012	Jeffrey's Bay Wind Farm	Wind	296
South Africa	2012	Metro Wind Van Staadens Wind Farm	Wind	50
South Africa	2012	Standard Bank Kouga Oyster Bay Wind Farm	Wind	222
South Africa	2012	Sumitomo Dorper Wind Farm	Wind	258
South Africa	2013	Amakhala Emoyeni Wind Farm	Wind	410
South Africa	2013	Chaba Wind Farm	Wind	36
South Africa	2013	Gouda Wind Farm	Wind	272
South Africa	2013	Grassridge Wind	Wind	109
South Africa	2013	Waainek Wind Farm	Wind	46
South Africa	2013	West Coast One Wind Farm	Wind	213
South Africa	2015	Gibson Bay Wind Farm	Wind	174
South Africa	2015	Khobab Wind Farm	Wind	281
South Africa	2015	Loeriesfontein 2 Wind Farm	Wind	281

Country	Launching year (“financial closing”)	Project name	Type	Total investment (millions of USD)
South Africa	2015	Mulilo De Aar 1 Wind Farm	Wind	180
South Africa	2015	Mulilo De Aar 2 Wind Farm	Wind	253
South Africa	2015	Nojoli Wind Farm	Wind	266
South Africa	2015	Noupoort Mainstream Wind	Wind	160
South Africa	2018	Kangnas Winf Farm	Wind	140
South Africa	2018	Perdekraal East Wind Farm	Wind	110
Angola	2009	Luapasso	Hydro	120
Angola	2017	Caculo Cabaça	Hydro	2 172
Botswana	2011	KSE Orapa and Mmashoro IPP	Thermal	104
Burkina Faso	2018	Essakane	Solar	20
Cameroon	2009	Dibamba Power Plant	Thermal	126
Cameroon	2010	Kribi Power Plant	Thermal	342
Cameroon	2018	Nachtigal Power Plant	Hydro	420
Cape Verde	2010	Electra Cabeolica	Wind	80
Ivory Coast	2009	CIPREL III	Thermal	80
Ivory Coast	2015	CIPREL IV	Thermal	380
Ivory Coast	2015	Azito	Thermal	392
Ivory Coast	2015	Singrobo	Hydro	120
Ethiopia	2014	Daewoo Aysha	Wind	120
Gabon	2011	CODER FE II SHPP	Hydro	234
Gabon	2012	CODER Ngounie Imperatrice SHPP	Hydro	124
Ghana	2007	Osagyefo Power Barge	Thermal	100
Ghana	2007	Sunon-Asogli Gas Fired Power Plant	Thermal	200
Ghana	2009	Tema Osonor Plant Limited	Thermal	140
Ghana	2011	Sunon-Asogli Gas Fired Power Plant	Thermal	360
Ghana	2013	Takoradi 2 Thermal Power Expansion	Thermal	440
Ghana	2014	Kpone Independent Power Project	Thermal	900
Ghana	2016	Winneba	Solar	30
Guinea	2018	Tè Power Plant	Thermal	50

Country	Launching year (“financial closing”)	Project name	Type	Total investment (millions of USD)
Kenya	2008	Rabai Power Plant	Thermal	155
Kenya	2012	Thika Thermal Power Project	Thermal	112
Kenya	2012	Triumph HFO Power Plant	Thermal	140
Kenya	2014	GEL Heavy Fuel Oil Fired Power Plant	Thermal	96
Kenya	2013	Aeolus - Ngong Wind Project	Wind	171
Kenya	2014	Aldwych Lake Turkana Wind Farm	Wind	635
Kenya	2008	Mumias Power Plant	Cogeneration	50
Kenya	2013	Kwale Sugar Plantation	Cogeneration	200
Liberia	2009	Buchanan Biomass Plant	Biomass	170
Liberia	2009	Kakata Power Plant	Biomass	170
Mali	2017	Kayes Power Plant	Thermal	90
Mauritius	2014	Suzlon Plaine Sophie Wind Farm	Wind	70
Mauritius	2015	Plaine des Roches	Wind	13
Mozambique	2013	Kuvaninga Energia Power Plant	Thermal	99
Mozambique	2014	Ressano Garcia Gas-Fired Plant	Thermal	250
Mozambique	2018	Scatec Mocuba Solar Plant	Solar	41
Nigeria	2007	Egbin Power Plant	Thermal	280
Nigeria	2013	KEPCO Egbin Power Plant	Thermal	407
Nigeria	2013	Ughelli Power Plc	Thermal	215
Nigeria	2015	Azura-Edo Gas-Fired Power Plant Phase 1	Thermal	880
Nigeria	2013	Kainji Hydroelectric Generation	Hydro	170
Rwanda	2010	Gisenyi Methane Gas Plant	Thermal	16
Rwanda	2011	KivuWatt	Thermal	142
Rwanda	2014	Agahozo-Shalom Youth PV Solar Plant	Solar	24
Rwanda	2012	Rwanda Mountain Tea Giciye SHPP	Hydro	12
Rwanda	2015	Akanyaru Valley Peat-Fired Power Project	Biomass	320
Senegal	2014	Senegal Thermal Facility	Thermal	172
Senegal	2014	Tobene IPP	Thermal	164
Senegal	2015	Cap des Biches Oil-Fired Power Plant	Thermal	114
Senegal	2016	Bokhol PV plant	Solar	29
Senegal	2016	Malicounda PV plant	Solar	35

Country	Launching year ("financial closing")	Project name	Type	Total investment (millions of USD)
Senegal	2017	Meouane PV plant	Solar	46
Senegal	2018	Ten Merina PV plant	Solar	48
Senegal	2018	Taiba Ndiaye Wind Plant	Wind	158
Sierra Leone	2011	Addax Biomass Plant	Biomass	30
Tanzania	2011	Symbion Rental Ubungo Power Plant	Thermal	129
Togo	2008	Centrale Thermique de Lome	Thermal	100
Uganda	2008	Namanve Power Plant	Thermal	88
Uganda	2009	Tororo Power Station	Thermal	32
Uganda	2016	Soroti - GetFit	Solar	19
Uganda	2007	Bujagali Hydro Project	Hydro	860
Uganda	2008	Bugoye Hydro Electric Power Project	Hydro	35
Uganda	2008	ECO Ishasha Mini Hydropower Plant	Hydro	14
Uganda	2008	Mpanga Hydro Power Project	Hydro	23
Uganda	2009	Buseruka Hydropower Plant	Hydro	27
Uganda	2012	SAEMS Nyamwamba SHPP	Hydro	34
Uganda	2015	Rwimi Hydroelectric Power Plant	Hydro	30
Uganda	2015	Siti Small Hydro Power Plant	Hydro	15
Uganda	2006	Kakira Cogeneration Plant	Cogeneration	43
Uganda	2009	Kinyara Cogeneration Plant	Cogeneration	29
Uganda	2009	Kinyara Cogeneration Plant	Cogeneration	30
Zambia	2015	Maamba Coal-Fired Power Plant- Phase-I	Thermal	830
Zambia	2010	Sinohydro Kafue Gorge Lower HPP	Hydro	1,500
Zambia	2011	TATA Itezhi-Tezhi HPP	Hydro	230
			Total investment	**26,891**
			Average investment	**208**

Figure 12 - Breakdown of installed capacity using private investment in Sub-Saharan Africa (excluding South Africa)



Independent Power Project Capacity (% de MW), by Technology : Sub-Saharan Africa (Excluding South Africa), 1994 - 2014. Note : CCGT = combined-cycle gas turbine ; HFO = heavy fuel oil; MSD = medium-speed diesel ; MW = megawatts ; OCGT = open-cycle gas turbine.

Source : Compiled by the authors, based on utility data, primary sources, and the Private Participation in Infrastructure (PPI) database.

Source: *Energy Policy*[34], 1994-2014.

There are a number of observations to be made from the analysis of these different projects:

- In spite of the recent arrival on the market of photovoltaic solar technology, the power plants commissioned over the past ten years continue to mostly rely on thermal or hydro sources, as in previous decades.
- There is one exception to be underlined: South Africa has managed to implement a large number of solar power plant projects, for reasons that will be presented below.
- The total amount of these investments is $26.9 billion, almost half of which ($12.8 billion) are in South Africa alone.

[34] Independent Power Projects in Sub-Saharan Africa: Investment trends and policy lessons, Energy Policy 2017, Anton Eberharda, Katharine Gratwickb, Elvira Morellac, Pedro Antmannc.

- The average investment is $208 million. Almost all of these projects represent an investment of more than $30 million.

The implementation of projects - particularly the smaller ones - financed by the private sector seems to be difficult in a certain number of African countries. These observations will be developed hereafter.

c. Expensive electricity

According to the African Development Bank,[35] the cost of producing electricity in Sub-Saharan Africa is approximately $0.20-0.50 USD/kWh, which is very high compared with the global average of around $0.10 USD/kWh.

This high cost is due to a number of factors: dilapidation of the generation facilities, difficulty of accessing fossil fuels (which must be imported or transported to often remote or isolated locations), high cost of capital, etc. In addition, the populations are obviously forced to seek substitute solutions, notably diesel gensets, to compensate for the failures mentioned in paragraphs a and b. These substitute solutions meet a specific need, but the electricity they produce is more expensive than electricity produced by appropriate dedicated infrastructures.

For customers finding it hard to mobilise funding, such substitute solutions remain attractive, due to the low cost of acquisition. However, the electricity produced by these generators proves much more expensive than the electricity produced by centralised thermal plants or centralised or decentralised hydropower or renewable plants. The cost of fuel represents a significant share of operating costs, often with a large dose of uncertainty, not to mention the issue of CO_2 emissions and the dangers for users (air quality, fire risk, etc.).

The fact that these substitutes remain attractive illustrates a broader issue: challenging access to capital together with uncertainty over the future encourage economic agents (households and businesses) to adopt a short-term vision. In terms of power generation, a short term vision leads to a preference for “low capex, high opex” solutions, i.e. solutions whose initial cost (“capex”) is as low as possible, even if this implies a higher cost of use (“opex”). This is typically the case of diesel

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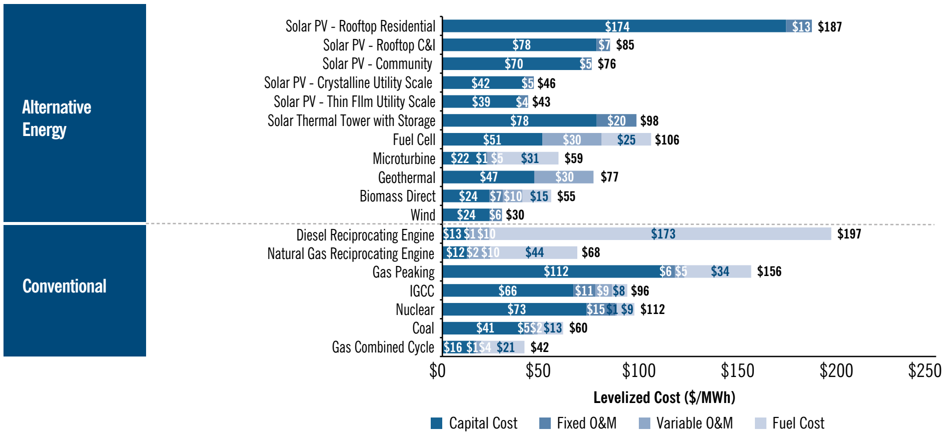
[35] African Development Bank: https://www.afdb.org/fr/documents/document/afdb-groups-strategy-for-the-new-deal-on-energy-for-africa-2016-2025-96494/

gensets, but it is also true of thermal power plants in general.[36] However, the capacity to mobilise capital and a sufficiently long-term view enable economic agents to opt for "high capex, low opex" solutions. This is typically the case for solar power plants, wind farms, nuclear or hydro power plants.

The graph below illustrates this difference between capex and opex: the cost of acquisition of a solar power plant appears higher than the cost of acquisition of a diesel engine, but when fuel costs are included, the total discounted cost of electricity ("LCOE"[37]) produced by the diesel engine is much higher ($197/MWh) than that produced by the solar power plant ($46/MWh).

Figure 13 - Comparison of LCOE of different sources of electricity[38]



Source: Lazard.

This question of arbitrage between the short and the long term - if indeed it is pertinent - arises at governmental level as well as at the level of the customers having to choose between a solar power plant or a diesel genset. A country's capacity to deal with long-term issues depends largely on its monetary reserves, without which it cannot make plans on a time scale of 25-30 years. For a customer

[36] Although the latter, above a certain size, fall into the "high capex, high opex" investment category.

[37] LCOE (Levelized Cost of Electricity) is the "discounted cost of the electricity", corresponding to the total cost throughout the lifetime of the equipment producing the electricity.

[38] Lazard study of LCOE (11th edition): https://www.lazard.com/media/450337/lazard-levelized-cost-of-energy-version-110.pdf The study concerns the US market: LCOE values cannot be transposed to other markets and particularly not to the Sub-Saharan African market, where is the cost of capital is much higher.

(private householder, business manager, etc.), it leads to the fundamental question of access to credit, hence the need for credit enhancement mechanisms, which will be discussed below.

2. Solar power: a high potential yet to be developed

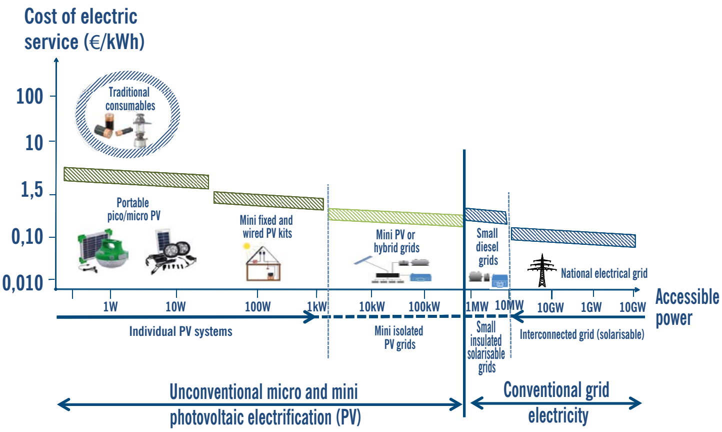
In view of these difficulties, solar power appears to be a solution particularly well-suited to Africa's specific needs. Its competitiveness makes it all the more attractive when compared with thermal solutions (coal, gas, diesel, etc.). It is quick to build and easy to operate, even in isolated locations. Its capacity to operate off-grid makes it a power source that can supply isolated rural populations immediately, without having to wait for the deployment of high voltage power lines, which can be a long and costly process. However, solar electricity without storage remains a variable energy source, produced only during the day, which means a solid, diversified energy mix is essential.

Finally, photovoltaic solar electricity can be adapted to all scales of projects. From solar kits to equip an isolated household to large-scale solar farms supplying entire cities, the same photovoltaic cells are used - the technical progress achieved on the cells themselves thus benefits all sizes of projects.[39] Solar power can therefore offer affordable electricity, even for small projects more suited to local realities – whereas other sources of electricity rely on the use of turbines which generally have to be of a certain size to be profitable.

Solar power in Africa is present in various forms: lighting (solar street lamps or lanterns), individual kits (typically with just a few watts of power), small scale off-grid power plants (typically a few kilowatts), self-consumption industrial rooftops (from ten to a hundred kilowatts), large solar farms (from one to a few dozen megawatts).

[39] This advantage is specific to solar power. This specific characteristic is illustrated by the observation that the technical progress achieved on supercritical coal power plants or CCGT has little impact on electricity generators used on the scale of a village or a single household.

Differentiated and complementary electrification methods, adaptable according to demand levels



Source: B.Cornut (ADEME), C. de Gromard (AFD).

These forms are deployed in two radically different contexts:

- The areas connected to the main grids, known as *"on-grid"* areas (interconnected grids or small, conventional grids supplied by diesel units);
- The areas not connected to the grids, known as *"off-grid"* areas, where the only sources of electricity are batteries, recycled car batteries or small, individual diesel gensets.

a. Individual kits

For the populations living in rural, off-grid areas, and for populations connected to the grid but suffering from its failures, the acquisition of a solar kit, also known as a *"Solar Home System"* (usually comprising a panel and a battery), can cover needs such as recharging a mobile phone, lighting and even a TV or a small fridge. During the first half of 2018 alone, 3.66 million *"off-grid"* solar products were sold worldwide, including 2.7 million solar lamps and 395,000 *"Solar Home System"* type kits, representing a total capacity of 26.43 MW. 40% of these products (i.e. 1.5 million) were sold in Sub-Saharan Africa.

A major milestone could be achieved by facilitating access to more powerful solar kits. Such intermediary kits enable not only immediate access to a primary source of power enabling basic usages, such as lighting, recharging mobile phones or use of a TV, but also appliances requiring more power, such as freezers, converters and laptop PCs with 3G internet access. The immediate benefit is the deployment of income-generating activities (IGA) and a leverage in favour of turning the informal economy into micro-businesses. Digital technology, with mobile money combined with "tontine" applications, accelerates this leverage, adding the democratisation of access to banking systems *via* cellphone accounts. This all combines to help create a virtuous economic cycle comprising energy, banking and entrepreneurship.

Thanks to the high rate of mobile phone equipment in Africa, the *"Pay-as-you-go"* model is very successful: rather than asking customers to pay the acquisition cost, which is often too expensive, telephone operators finance the kits themselves and provide them to their customers, who reimburse them by paying for the time used via smartphone, in exactly the same way as they buy telephone credit. Buying credit provides a pincode to enable use of the solar kit. Companies such as M-Kopa, Fenix International and Off-Grid Electric have thus installed 700,000, 250,000 and 150,000 solar kits respectively, notably in Kenya, Tanzania, Uganda and Zambia – and provided millions of beneficiaries with electricity (one installation can be used by up to 5 people).

b. Mini-grids

A mini-grid refers to any local electric grid isolated from the main electric grid. It has its own production means, which might be renewable, thermal or hybrid. Unlike an individual installation, it enables the connection of several consumption points, typically within a village or a group of villages.

The development of these mini-grids has been difficult without grants because it is hard to find the right economic model, even for technically and socially pertinent projects:

- In spite of its small size, a mini-grid still represents an investment that increases the cost of electricity delivered to users;
- The commercial risk also appears high: customer solvency, payment of bills, unauthorised connections to the grid, etc. The small size of the grid implies a

limited number of customers, which means the possibilities of spreading the risk by extending the customer base are limited within each mini-grid. The difficulty of identifying a single, financially credible buyer, able to buy electricity for 20 years, makes it very difficult to fund the projects without support;

- Finally, there are numerous regulatory obstacles to be overcome too: in many countries, the historic, national operator is in a monopoly situation, which, in principle, prevents private operators from selling electricity directly to end users.

However, as with the household kits, recent technological progress (digitalisation, falling price of photovoltaic cells and batteries) is opening up more promising perspectives for mini-grids, provided the regulatory frameworks continue to be adapted accordingly. The international institutions and impact funds have become aware of the difficulties of implementing power plant projects connected to national grids. Various initiatives are currently under way to fund more projects that are not connected to the national grids (*"off-grid"* projects), and notably mini-grid projects. The following can be cited (non exhaustive list):

- **OGEF fund:** The African Development Bank, in collaboration with Nordic Fund, GEF and Calvert Impact Fund, has launched a $58 million off-grid fund (*Off Grid* Access Fund, OGEF), with the goal of reaching $500 million, thanks to the Facility for Energy Inclusion (FEI).[40]

- **ROGEP programme:** The World Bank is currently setting up the ROGEP programme (Regional Off-Grid Electrification Project), representing $150 million.[41]

- **Energos programme:** The European Union (under a joint initiative with the EIB and local development banks) is funding various grid deployment initiatives within the framework of the 11th European Development Fund, *via* a programme called ENERGOS, notably including $117 million allocated to Ivory Coast in 2016.[42]

- **Millennium Challenge Corporation programme:** This initiative by the American Administration consists of a partnership with countries implementing reforms to ensure better governance and an environment favourable to private initiatives.

[40] https://www.afdb.org/fr/news-and-events/african-development-bank-nordic-development-fund-and-partners-launch-off-grid-energy-access-fund-with-us-58-million-18432/

[41] http://projects.worldbank.org/P160708?lang=en

[42] http://www.eib.org/fr/infocentre/press/releases/all/2016/2016-076-la-bei-renforce-son-action-en-cote-divoire-117-meur-pour-le-developpement-du-projet-energos.htm

It includes the constitution of a fund to accelerate growth to reduce poverty. In several countries, this fund provides finance for off-grid electrification and the construction of mini-grids. Benin is one example, having received $32 million.[43]

- **Essor Access to Electricity programme (A2E):** The British Department for International Development (DFID) is helping the government of the Democratic Republic of Congo to achieve its business climate reform objectives (Essor programme) with an "Access to electricity" section to set up concessions for solar projects linked to independent grids.

- **Direct loans:** The African Development Bank has provided $28 million (in local currency) to Zola EDF Ivory Coast (EDF/Off-Grid Electric consortium) for the deployment of their *Solar Home System* supply business.

To conclude, the development of this segment will be subject to better involvement from the public players to provide a response to these various challenges, which in the short term cannot be addressed solely with a market-based approach.

Individual kits and mini-grids can make a decisive contribution to the development of income-generating activities and public services in rural communities. Since most economic activity takes place during the day, linking these solar facilities to very small-sized storage solutions (sufficiently large to compensate for intermittency but not to provide electricity during the night) enables most needs to be covered without incurring significant extra costs. Hybridisation with other sources of electricity (mini-hydro, mini-wind, biomass, diesel gensets, etc.) enables the continuity of the supply of electricity and services during the night. These solutions will come to play a major role: according to one study by the African Development Bank,[44] almost 70% of the electricity produced in rural parts of Africa will come from *off-grid* or *mini-grid* solutions, including two-thirds from renewable energy sources (mainly solar or mini-hydro).

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[43] http://www.mcabenin2.bj/event/show/lancement-du-2eme-appel-a-propositions-de-projets-ocef

[44] https://www.afdb.org/fileadmin/uploads/afdb/Documents/Development_Effectiveness_Review_2017/ADER_2017__En__Ch._2.pdf

Role of NGOs

NGOs, often *via* partnerships with private operators and endowment funds,[45] also play an important role: they enable coverage of remote areas that are difficult to access, where use of the public grid is almost non-existent and diesel gensets are complicated and costly to use. By supporting projects providing solar power, the NGOs help to accelerate the main vectors of development: agriculture, healthcare, education, entrepreneurship. The deployment of small *off-grid* projects, along with the incubation of these income-generating activities, enables the development of new expertise that is easy and quick to replicate. The Governments can contribute to pilot projects, reproducing them throughout their territories, with the support of development banks if necessary. This incubation effect offers many benefits: it is quick, inexpensive and highly efficient. It offers a rapid response to local requests made directly by the populations whose demand for electricity would not be met by the State or the national public utility for several years. Thus, some users develop their own affordable and easily deployable electricity. The testimonials gathered by the French "Agence des Micro-projets" (micro-projects agency) are unanimous: 97% of beneficiaries do not intend to go back to using electricity from diesel gensets, a source they see as being harmful to the environment, noisy, costly and demanding complex logistics.

c. Self-consumption on industrial and commercial rooftops (or carports)

Many industrial and service sector companies face energy challenges. As well as the extra cost of using diesel gensets, which is harmful to their competitiveness, some industrial activities demand a stable, quality supply of electricity, since the slightest interruption could damage the industrial production, incurring exponential costs.

In this context, the decision to equip a roof with a solar facility or a car park with a solar facility should be an obvious solution for any decision-maker seeking to improve production costs. However, few have implemented such projects to date, for various reasons:

- **Investment time scale:** Substituting some or all of the electricity from the grid or electric generator with electricity from a solar facility is profitable after

[45] Such as Synergie Solaire, a group of 130 businesses from the French renewable energies sector.

4-10 years, depending on the price of the electricity provided by the grid (which is often subsidised) and the price of the diesel used by the generator (again, often subsidised). This 4-10 year period remains dissuasive for many industrial operators, whose investment payback time expectation is often around 2 years.

- **Risks of a single counterpart:** This difficulty related to the investment payback time could be overcome by involving a third party investor, whose income would come from selling the electricity or by leasing the facility to the building's occupant. Unfortunately, this solution encounters two major problems: a commercial difficulty, as the occupant must make a long-term commitment (at least longer than the period necessary for the operation to be considered profitable by the third party investor), which is problematic in view of the multiple factors that may be involved (relocation, evolution of the business, etc.); and a financial difficulty, since the investor remains exposed to the possible default of its sole customer.

- **Inadequacy of the regulatory framework:** Supposing this second difficulty could be overcome (for example, by aggregating several projects together in a portfolio approach to mitigate the impact of one customer defaulting), the operation often remains impossible to implement for regulatory reasons: monopoly of the historic national operator, no mechanism in place to receive revenues from any surplus electricity injected into the grid, etc. However, there has been a recent resurgence of *off-grid* or hybrid systems that have managed to overcome this difficulty, thanks to *"leasing"* type models.

- **Insufficient knowledge of the possibilities offered by photovoltaic solar power:** Many commercial and industrial clients are unaware of the benefits they could get from a solar installation and do not make provisions for the investment required.

d. Large-scale solar power plants (solar farms)

Individual or *off-grid* systems alone cannot solve the entire issue. Demand for electricity is growing strongly in the cities, where population density, collective residential buildings and a higher per capita consumption of electricity mean that solar kits cannot cover all needs. Solar plants of larger scale and higher power capacity, connected to the grid, are therefore necessary.

The scalability of solar power generation enables it to be positioned on an "intermediate" sized market segment, mid-way between the solar home systems or mini-grids designed for villages and the utility-scale, centralised solar plants suitable to supply a metropolis.

For the sake of simplicity, we consider this intermediate range to include power plants from 5 to 50 MW, a range of power that is:

- Large enough to meet the current day-time needs of an conurbations with 30,000-300,000 inhabitants.[46] It is in such medium-sized conurbations, not in the capital cities, that the energy crisis is most critical.

- Small enough to fit with existing electric grids, which are often under-sized, not having been designed to export the electricity produced. It is very unusual to find grid substations able to absorb solar capacities in excess of 50 MW, the norm being closer to 10-20 MW – capacity levels that are considerable compared with that of an individual solar kit, but relatively low compared with other thermal or hydro facilities, whose capacity is often around several hundreds of megawatts.

On the scale of the African continent, only a very small number of solar plants belonging to this mid-size range have been commissioned.

Figure 14 - Solar plants of more than 5 MW built, connected and in production (excluding Maghreb and South Africa) by end of 2018

Country	Project	Power capacity	Year of commissioning	Comments
Senegal	Santhiou Mékhé - Senergy I	30 MW	2017	
Senegal	Bokhol - Senergy II	20 MW	2017	
Senegal	Ten Merina	30 MW	2018	
Senegal	Malicounda	22 MW	2017	
Burkina Faso	Zagtouli	33 MW	2017	Project subsidised by the EU and AFD
Burkina Faso	Essakane	15 MW	2018	Private *off-grid* project for the sole use of a mining site
Rwanda	Agahozo Shalom - Gigawatt Global	8 MW	2014	Subsidised project (OPIC's US Africa Clean Energy Finance, and EEP https://eepafrica.org/)

[46] Estimation based on possible solar production of 2,000 kWh/kWp and average consumption of 300 kWh per household per year.

Country	Project	Power capacity	Year of commissioning	Comments
Uganda	Soroti - GetFIT	10 MW	2016	Project subsidised *via* the GetFIT mechanism, where a large part of the purchase price of the electricity is paid by KfW
Ghana	Winneba	20 MW	2016	
Mauritania	Toujounine	50 MW	2017	Project subsidised by the Arab Fund for Economic & Social Development
Niger	Malbaza	7 MW	2018	Project subsidised by Indian cooperation

Source: authors.

By aggregating all segments, the total solar installed capacity in Africa at the end of 2017 is estimated at approximately 3.06 GW,[47] 1.7 GW in South Africa alone and 0.5 GW in the Maghreb countries. This figure should be considered in the context of the total installed capacity on the continent for all energy sources, which is 168 GW.[48]

However, it is important to make a distinction between the on-grid power generation capacity and the question of the number of people having access to electricity: fifty Gigawatts of new photovoltaic power capacity could be added to the African electric grids without actually improving the situation of rural populations, since they are not connected to these grids. At the same time, individual solar kits could be distributed to tens of millions of isolated users, without even touching the national grids, and this would have no impact on the statistics concerning Africa's electric under-capacity. These electrification methods are different and complementary, and can be used to adapt to the volume of demand. Overcoming the challenge of access to electricity for the populations of Sub-Saharan Africa therefore implies a joint development of all available solutions according to the particularities of local demand.

47 IRENA, Renewable energy capacity statistics 2018.
48 https://www.afdb.org/fileadmin/uploads/afdb/Documents/Development_Effectiveness_Review_2017/ADER_2017__En__Ch._2.pdf

3. Current initiatives

Promising international initiatives are beginning to see the light of day in response to the urgent need for access to electricity in Africa, but their potential remains to be proved.

a. COP 21 initiatives

Following the Paris climate agreement signed at the end of 2015, COP 21 has resulted in a number of sectorial initiatives being launched for green energies.

For solar power, the largest of these initiatives is probably the **International Solar Alliance (ISA)**, launched by France and India. It currently counts 47 member states, including more than half of the African states. Initially limited to countries in the tropical region, the ISA will soon be opened to all UN member states.

The ISA's objective is to deploy a further 1,000 GW of solar capacity by 2030, representing an estimated $1,000 billion. To achieve this goal, ISA is working with a large network of partners in several areas: improving and harmonising regulatory frameworks; drafting standardised contract models; identifying demand and launching harmonised, multi-national calls for tender, notably for agricultural solar applications; creating a financial mechanism to mitigate risks for small solar power plants, stimulated by the World Bank and AFD; setting up training programmes for decision-makers and technicians as well as instructor training (via the STAR-C network). ISA has also launched specific programmes for decentralised applications (mainly agricultural), mini-grids and solar rooftops. ISA will have to demonstrate the added value of its contribution in the coming years, since its work really only began in 2018.

Launched at the same time as ISA at the COP21 in 2015 to resolve the issues of upscaling solar deployment, the **"Terrawatt Initiative"** - recognised as an NGO by the UN (CNUCED) - is an open platform, bringing together all volunteers and stakeholders on a non-profit basis to design and implement new frameworks and local institutions (regulations, guarantees, standardised contracts, capital markets, process digitalisation) to accelerate the global transition. Supported by various private players (Engie, Total, IBM, Société Générale, KPMG, Schneider Electric, Blackrock, etc.), it aims to help structure the dialogue between the private sector and the governments. The ultimate goal is to enable the deployment of one terrawatt of new photovoltaic capacity by 2030 by harmonising regulatory frameworks, developing suitable financial instruments and creating a global market place – these achievements would then be applicable to other sustainable infrastructure markets.

Along the same lines as the ISA's efforts and the Terrawatt Initiative, Togo has launched a project involving six Sub-Saharan African countries (Benin, Burkina Faso, Gabon, Mali, Niger and Togo) to form a "group of pilot countries" to implement the priorities defined by the International Solar Alliance.[49] These six countries, supported by legal experts financed with help from ISA partner institutions and countries, will thus be able to define a joint regulatory and legal framework in order to "fast track" renewable energy projects.

Although less advanced than ISA, **the African Renewable Energies Initiative (AREI)** is directly coordinated by the African Union, supported by the African Development Bank. Its main contribution could be to mobilise the African governments around shared objectives to improve regulatory frameworks to attract investments and reinforce the local capabilities.

"Mission Innovation" can also be mentioned: its goal is to increase public and private investments in R&D and clean technologies. The initiative includes several "challenges" coordinated by cooperation projects between countries. France and India are joint coordinators of the access to off-grid electricity "challenge".

b. The International Renewable Energies Agency (IRENA):

The International Renewable Energies Agency (IRENA) was founded in 2011. 159 countries are currently members with a further 24 in the process of joining, making it an almost universal organisation. Its initial goal was to gather and share available knowledge on renewable energies. This includes not only technical information, but also reviewing the resources and deployment potential for each type of renewable energy in the various member states. To do so, it has a team of full-time researchers, and produces relevant studies and tools: Renewable Energy Roadmaps (REMaps) and Renewable Readiness Assessments (RRA) for the countries, publications on technologies, data and statistics reports and a global atlas of renewable energy potential.

[49] The Lomé Initiative: https://www.agenceecofin.com/solaire/1209-59880-6-pays-africains-se-mobilisent-pour-plus-d-investissements-dans-l-energie-solaire

IRENA has diversified its activities. It facilitates project implementation with networking tools for decision-makers and investors (Project Navigator, Marketplace), and through a joint financial scheme with the Abu Dhabi Fund for Development (ADFD). IRENA also coordinates sectorial initiatives for the targeted deployment of different types of renewable energies: Global Geothermal Alliance (GGA), Small Island Initiative (SIDS Lighthouses), Clean Energy Corridors in Africa and Central America. IRENA also works with Terrawatt Initiative on the drafting of standardised contractual frameworks.

One of the priority work topics for IRENA is to improve dialogue with the private sector, which exists but is largely insufficient. Such dialogue would notably enable IRENA to find out more about the needs of the solar sector businesses, and to send the right messages to its member states. This will be one of the major challenges for the next few years.

c. Other ongoing initiatives

Other initiatives include the following (non exhaustive list):

- **"Sustainable Energy for All",** launched in 2011 by the United Nations General Assembly, with three objectives for 2030: to ensure universal access to energy, notably electricity, to double energy efficiency in order to reduce overall energy consumption and to double the proportion of renewable energies in the global energy mix.

- **"Global Electricity Initiative"** launched in 2012 by a partnership between the World Energy Council, the World Business Council for Sustainable Development and the Global Sustainable Electricity Partnership. This initiative encourages action and cooperation between electricity *utilities* around the world to achieve the objective of universal access to energy by 2030.

- **"Power Africa",** launched in 2013 by the USA, aimed at adding 30 GW of decarbonated power generation capacity in Sub-Saharan Africa and to offer access to electricity to a further 60 million households and businesses.

- **"Energy Africa campaign",** launched in 2015 by the UK, to encourage the use of solar power in rural locations and investment in companies specialising in *off-grid* electricity.

- **"New Deal for Energy in Africa",** launched in 2015 by the African Development

Bank, with the goal of universal access to electricity by 2025. This programme has a target of an extra 160 GW power generation capacity.

- **"African Energy Leaders Group" (AELG),** launched in 2015 to bring together political and economic leaders on the essential issues of reforms and investment acceleration to eradicate energy poverty and to create the conditions for the future growth of the African continent.

- **"Electrification Financing Initiative",** launched in 2016 by the European Commission, to develop access to energy and off-grid solutions for rural communities in Sub-Saharan Africa. The current budget stands at €115 million.

- **"Clean Energy Transitions Programme",** a programme launched in 2017 by the International Energy Agency and 13 countries, with a budget of €30 million. This programme provides technical support to governments in emerging countries for their efforts to develop renewable energies.

While encouraging, these initiatives also illustrate a certain dispersion of resources, and have not yet succeeded in offering immediately operational solutions corresponding to the scale of the challenges faced.

They show the appearance and increasingly clear formalisation of the need for an open, innovative dialogue between stakeholders, but their difficulties also reflect the existence of cultural barriers between the public and private sectors, which can only be overcome by strong political leadership. France, host country of COP 21 and founder of the One Planet Summit, has a unique role to play in this area.

Finally, these initiatives demonstrate the commitment of the international community to tackle the problem of electrifying the African continent, and to mobilise substantial means to do so. However, this determination comes up against further obstacles, some of which have been clearly identified and others that are less well known - which is the topic of the second part of this document.

II

PREREQUISITE CONDITIONS FOR THE DEVELOPMENT OF SOLAR PROJECTS FUNDED BY THE PRIVATE SECTOR

The first part of this report addressed the issue of access to electricity in Africa and has identified photovoltaic solar power as a possible solution, whose potential is, as yet, largely underexploited. Among the different scales of solar power deployment, from individual home to industrial-scale solar farms, the segment of on-grid ground-mounted power plants of intermediate size (5-50 MW), deserves particular attention: its high generation potential makes it an essential component in achieving the electrification objectives, and yet this is also the area in which the obstacles appear to be the most challenging.

- Decentralised solar power, on the scale of the individual home with a pay as you go model, is apparently economically viable in a number of countries, although the lasting nature of the model has yet to be confirmed. These efforts must be continued.

- Solar power in mini-grids or on the scale of industrial or commercial buildings faces difficulties, as mentioned briefly in the first part. These difficulties are known and clearly identified.

- However, the factors that prevent medium-sized solar facilities (5-50 MW) from being more widely developed are less clear-cut; in theory, there is nothing to stop their development, as illustrated by the example of South Africa. The rest of the African continent seems to remain in the grip of powerful brakes and, if this situation persists, the objective of a solar installed capacity of around 100 GW[50] by 2030 appears difficult to achieve. Yet this is the lower limit necessary to keep up with the demographic growth rate, while avoiding the use of more expensive, more CO_2-producing thermal plants to meet the growing demand for electricity.

The specifics of the hurdles preventing the development of mid-sized power plants, so crucial to the successful electrification of the African continent, and the scale of the investments required, is the focus of the rest of this report

[50] According to AREI, by 2030, total installed capacity could be 610 GW, with 330 GW in renewable energies – i.e. an increase of a factor of more than 8 – with hydro power contributing 100 GW, wind farms 100 GW, photovoltaic solar power and concentration solar plants 93 GW, biomass 32 GW and geothermal sources 4 GW. For the purpose of comparison, India has set an objective of 100 GW solar for 2022.

particularly on the obstacles in deploying mid-sized solar power plants financed by the private sector (Independent Power Producers or "IPP").

This second part begins with a reminder of the prerequisite conditions for the success of any infrastructure deployment programme of this type: a proactive, ambitious political vision, rigorous and realistic planning, efficient implementation mechanisms, and the availability of technical capacities and expertise to facilitate the integration of renewable energies into the existing electric grids.

1. The various players active in the solar IPP market in Africa

It is important to distinguish between the different types of players, whose needs and constraints are quite distinct: project developers, investors, lenders, EPC and O&M contractors, solutions or product suppliers.

a. Project developers

Developers face high risks. Project development is the activity of implementing all the steps prior to construction: securing rights for suitable land, completing technical and environmental studies, obtaining the necessary rights and authorisations, fund raising, etc. It is not unusual for this upstream phase to take several years, between three and ten, depending on the complexity of the project. It is a very high risk business, insofar as the resources invested are lost if the project is not completed – which can happen for a multitude of reasons that are beyond the control of the developer.

The main project developers active in the solar power plant sector in Africa include:

- French players: Akuo Energy, Générale du Solaire, GreenWish Partners, Greenyellow, Neoen, Orion Solaire, Quadran International, Smart Energies, Total Eren, Urbasolar, Voltalia, etc.;

- Non-French players: Access Power, Acciona, Acwa Power, Aldwych, Alten, Biotherm Energy, Building Energy, Enel Green Power, FRV, Globeleq, Ibvogt, Masdar, Mulilo, Scatec Solar, Windiga etc.;

b. Equity investors

Equity investors (who may or may not be vertically integrated with the developer) face very long term risks. Most renewable energy production facilities are capital intensive infrastructures, in the sense that most of the investment is made during the construction phase – the relative proportion of operating costs being comparatively low. Such investments require between 15 and 25 years of stable, pre-determined income, to enable debt financing under viable conditions. Such time scales mean a very high level of uncertainty for a number of reasons: political, regulatory or fiscal stability, currency exchange rate, off-taker's capacity to pay the bills, etc. This implies very specific contracts to allocate these various risks to avoid discouraging the investment. To be able to invest, this type of player may have interest in getting involved in the development phase, such as the social or environmental dimension of the project.

The main investors that are active in the solar power plant sector in Africa include:

- French players: EDF EN, Engie, Eranove, Meridiam, STOA, Total Eren, etc.

- Non-French players: Actis, Acwa Power, Africa 50, AIIM, Globeleq, IFC, InfraCoafrica, InfraMed Infrastructure, Norfund, Scatec Solar, etc.

c. Lenders

The lenders finance the projects in the form of debt. These might be commercial banks, multilateral development banks (World Bank, African Development Bank, Asian Development Bank, etc.), national development agencies (AFD, KfW, OPIC, etc.) or their subsidiaries dedicated to the private sector (Proparco, IFC, FMO, DEG, etc.), export credit agencies (BPI Coface, Exim Bank, etc.). Since debt often represents a large proportion of the amount invested (typically 70-90%, depending on the project), the lender also takes on the largest share of the project's financial risk, but it is important to remember that, in the event of default, lenders take priority over equity investors for reimbursement.

The main lenders that are active in the solar power plant sector in Africa include:

- French players: AFD, BNP Paribas, Crédit Agricole, Natixis, Proparco, Société Générale, etc.

• Non-French players: AfDB, BEI, BIO, CDC, DEG, Finnfund, FMO, KFW, MUFG, OPIC, etc.

The financial capacities of these players will probably not be sufficient in view of the continent's needs, which is why market finance mechanisms must also be implemented. Access to market finance implies being able to aggregate the various projects into a unique class of assets, with securitisation and rating standards. This is one of the working areas of the International Solar Alliance and Terrawatt Initiative (as mentioned in the first part).

d. EPC and O&M contractors

EPC *(Engineering, Procurement, Construction)* contractors build the power plants; this includes an execution engineering part *(Engineering)*, purchasing and logistics *(Procurement)* and the actual building *(Construction).* The EPC contractor is involved in the project further downstream than the developer, and is therefore exposed to risks of a different kind, but which must be borne in mind nonetheless: fiscal risk (notably VAT), security risk, local legal risk, etc.

O&M *(Operation and Maintenance)* contractors operate and service the power plants, which includes a management aspect (monitoring, supervision) and a highly local aspect (rapid intervention in the event of technical failure, cleaning of the panels, outdoor maintenance, etc.).

The main EPC and O&M contractors that are active in the solar power plant segment in Africa include:

• French players: Bouygues Energies & Services, Eiffage RMT, INEO, Sagemcom, SNEF, Vinci Energies, etc.

• Non-French players: Biosar, Electrotech, METKA, Siemens, Sterling & Wilson, Wartsila, etc.

e. Solution and product suppliers

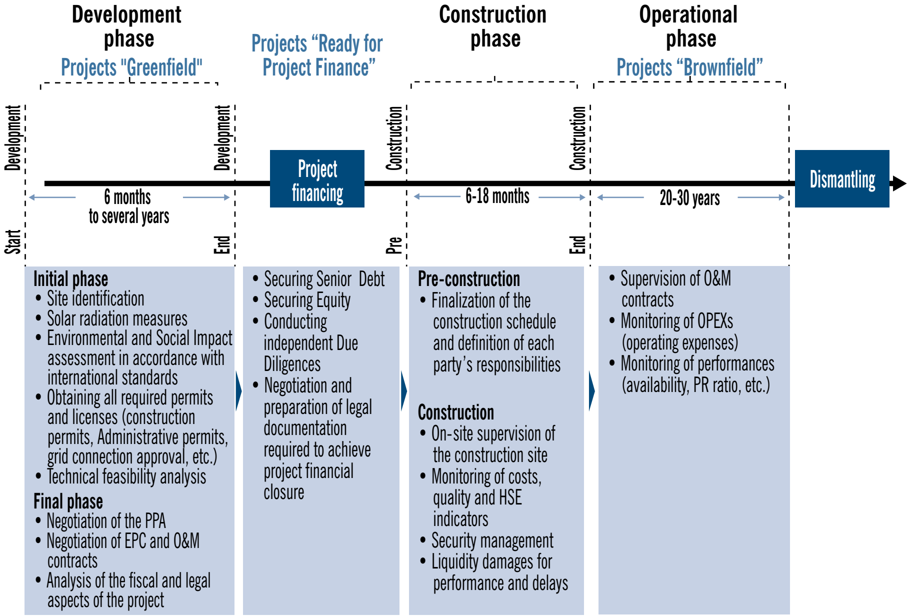
Finally, the solution/product supplier faces various long-term risks inherent to any business (market risk, copyright infringement, etc.). However, the risk of counterpart default or currency exchange risk are shorter term risks than for the above-mentioned players: the time scale is typically the period necessary to produce the project or provide the service required by the customer (which might be either developers, investors or other parties).

Any supplier might supply products to the African market, according to customer demands (developers and EPC contractors). The main players include:

- French players:
  – Solar panels: Photowatt, Sunpower, Voltec
  – UPS Systems: Schneider, Socomec
  – Transformers: Pommier/Cahors
  – Cables: Nexans

- Non-French players:
  – Solar panels: Canadian Solar, First Solar, Jinko, Talesun, Yingli,
  – UPS Systems: ABB, Huawei, Ingeteam, Jema, SMA
  – Transformers: Ormazabal, Siemens
  – Cables: General Cable, Prysmian

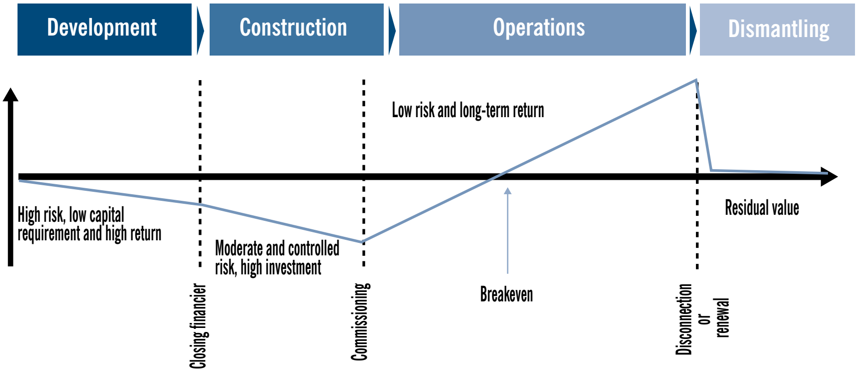
Figure 15 - The various stages of a solar project



Source: authors.

Completion of a project demands perfect control over the risks throughout the development, construction and operating phases. The risks must be allocated between the various stakeholders according to their role and capacity to act. For example, the political risk (change in regulations, change in fiscal policy, etc.) should not be borne by the investor, but by the country. Conversely, the risk of the power plant underperforming should not be borne by the country, but shared between the EPC contractor (who is required to deliver a power plant guaranteeing a certain level of performance) and the O&M contractor (who must ensure maintenance to preserve a satisfactory level of performance), etc.

Figure 16 - Financial flows and risk exposure throughout the life of a solar project



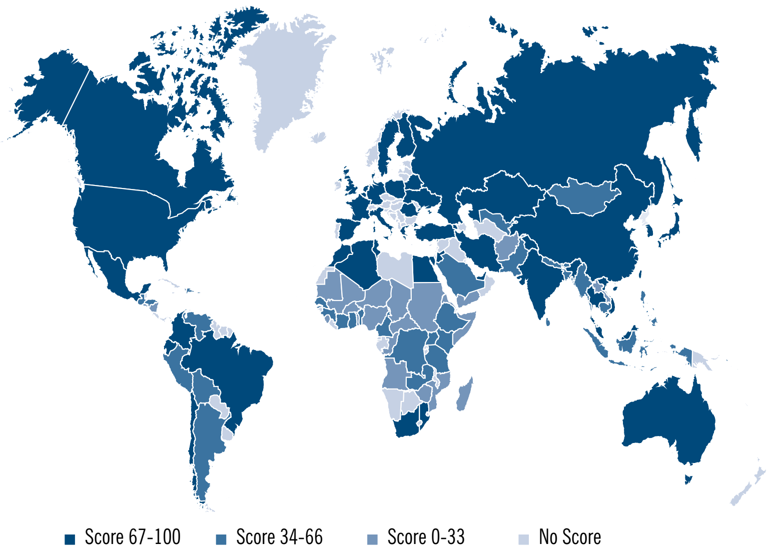
Source: authors.

Private investment in the field of infrastructure is generally a very long-term investment. Developing this investment means reducing the risk factors to a strict minimum, which notably involves implementing a suitable institutional and regulatory framework.

2. A suitable policy and regulatory framework, a fundamental prerequisite

The World Bank has developed a tool called RISE *(Regulatory Indicators for Sustainable Energy)*[51] to measure the implementation of regulatory frameworks and policies suitable for the development of renewable energies by countries.

Figure 17 - Regulatory frameworks Worldwide[52]



Source: World Bank, 2016, Regulatory Indicators for Sustainable Energy.

This section describes the main policy and regulatory schemes that exist to catalyse the development of renewable energy, and notably solar, projects. The above map appears to show that most of these schemes are incomplete or defective in Sub-Saharan Africa, which is an essential component in explaining the observed difficulties.

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[51] http://documents.worldbank.org/curated/en/538181487106403375/pdf/112828-REVISED-PUBLIC-RISE-2016-Report.pdf

[52] http://documents.worldbank.org/curated/en/538181487106403375/pdf/112828-REVISED-PUBLIC-RISE-2016-Report.pdf

This situation is all the more regrettable since stable, pertinent and efficient sets of business law rules exist in other fields: 17 French-speaking countries in Sub-Saharan Africa have thus incorporated the Acts of the OHADA (*Organisation pour l'Harmonisation en Afrique du Droit des Affaires* - Organisation for the Harmonisation of Corporate Law in Africa) into their national law. These acts enable the creation of companies by using company structures that are compatible with the development of these projects and that enjoy a shared foundation of security law to suit the expectations of even the most demanding lenders.

Efforts must now be made at country level on sectorial regulations (i.e. codes and laws on electricity and public-private partnerships) and mandatory laws (i.e. codes and laws on public procurement, taxation and investments), which are, by definition, unlikely to be adopted jointly by a group of sovereign states.

a. The different power purchase mechanisms

When a country decides to increase the proportion of solar power in its energy mix by involving the private sector, it is fundamental to create a context that encourages investors to finance and build projects within its territory. This is not about delivering grants and subsidies, but about implementing a stable regulatory framework and offering long-term visibility over the remuneration conditions of the electricity to be sold. This is why almost all of the solar power plants (as well as wind farms and hydroelectric plants, etc.) throughout the world have been built under a long-term "Power Purchase Agreement" contract (or "PPA") signed by the national operator supervising the sale of electricity, setting the price and volume conditions in advance and over a period of between 15 and 25 years.

Depending on the case, these PPA contracts might correspond to:

- A *"Feed-in-Tariff"*: a set amount remunerating each kWh produced in full,[53] and calculated to enable satisfactory remuneration to attract investors to finance the power plant projects;

- A *"Contract for Difference":* this contract offers a guaranteed bonus corresponding to the difference between a spot market price (assuming such a market exists)[54] and

[53] Or which could have been produced if a risk allocated to a player other than the power plant operator did not occur (i.e. the so-called *"take-or-pay"* mechanism)

[54] A spot market exists in Europe and in Chile, but not yet in West Africa (where the WAPP is currently being set up) or in East Africa.

the level of remuneration required to ensure profitability of the initial investment in the power plant. Again, it should be noted that this type of contract differs from a subsidy: if the market price rises above the required level of remuneration, this type of contract generally states that the electricity producer must continue to sell at the required level, without benefiting from the market price upside;

- Other intermediary variants, such as the *"Feed-in-Premium"* (a set bonus added to the spot market price) or *"Green certificates"* (exchanged on a dedicated market), etc.

b. Mechanisms to award power purchase agreements

One of the essential roles of the regulatory framework is to define the terms of awarding the above-mentioned contracts to the prospective project developers. The two most common instruments are the "counter" mechanism (open or restricted) and the tender mechanism.

i. The "counter" mechanism

The "counter" mechanism consists in the public authorities setting upfront the purchase price for the electricity produced, and awarding a long-term purchase contract (feed-in-tariff or contract for difference) to any project able to demonstrate its relevance and feasibility at this price. According to AIE, this is a particularly effective method to attract project proposals and initiate a large volume rapidly - it has enabled the scale-up of renewable energy projects to be started in most countries,[55] notably in Germany, Japan, Italy and, of course South Africa. In 2017, this mechanism was applied in more than 80 countries, compared with 34 in 2005.

There is certainly a risk of a "runaway situation" if the proposed price is too high or if the project eligibility criteria are not strict enough. This happened in France, for example, when an "open-counter" mechanism was implemented in 2008, with excessively high prices, causing the formation of a speculative bubble, then a sudden closure of the scheme (moratorium) in November 2010. Conversely, there is also a risk of inefficiency if the proposed price is too low or if the eligibility criteria are dissuasive.

There are ways to avoid these two pitfalls:

[55] Renewable Energy Policies in a Time of Transition (IEA, IRENA, REN21).

- Setting appropriate eligibility criteria as prerequisite: for example, it is possible to impose the issuance of a production licence by an independent regulation authority (see paragraph d) having the competence to determine whether the project is technically relevant and mature enough to benefit from the proposed price.

- Setting the right price level: to mitigate the inevitable asymmetry of information between public authorities and the private sector, the price should be modifiable and able to adjust quickly according to new information[56] and technological progress.[57] Feedback loop mechanisms can be implemented: for example, automatic decrease of the proposed price according to the volume connected quarterly or according to the number of projects reaching a certain stage of development. However, this requires a strong administrative capacity making this type of mechanism difficult to implement without specific assistance from dedicated experts (notably the multilateral development agencies).

Subject to the aforementioned precautions, this is a simple and legible mechanism, well-suited to countries in the early stages of their solar power electrification efforts.

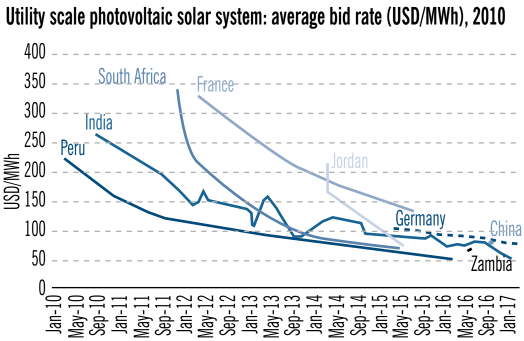
ii. The tender mechanism

The *tender mechanism* (or *auction*) brings projects into competition with each other, based on certain criteria, amongst which the proposed price of electricity is a main concern, then granting the winning projects long-term contracts (feed-in tariff or contract for difference) at the proposed price.

[56] NREL (National Renewable Energy Laboratory) (2016a), Feed-in Tariffs: Good Practices and Design Considerations, NREL, Golden, CO, www.nrel.gov/docs/fy16osti/65503.pdf.

[57] IRENA (2015a), Adapting Renewable Energy Policies To Dynamic Market Conditions, IRENA, Abu Dhabi, www.irena.org/-/media/Files/IRENA/Agency/Publication/2014/policy_adaptation.pdf

Figure 18 - Price reductions obtained through tender mechanisms

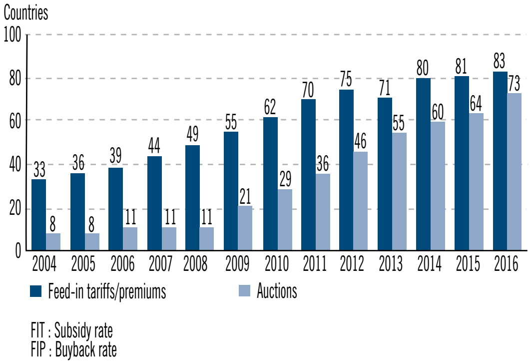


It is remarkable to note that the price observed in Zambia is lower than that is observed in Germany and France during the same period, which is totally illogical given the difference in country risks (and therefore financing conditions). The third part will be more particularly focused on the reasons for such market anomalies.

Source: IRENA[58], 2017.

The main advantage of this mechanism is its capacity to encourage very substantial price reductions (figure 18). This is probably why tenders have become more popular over the past ten years (figure 19).

Figure 19 - Number of countries implementing tenders



Source: AIE - IRENA[59], 2017.

[58] *Renewable Energy Auctions: Cases From Sub-Saharan Africa* (IRENA 2018 http://www.irena.org/publications/2018/Apr/Renewable-energy-auctions-Cases-from-sub-Saharan-Africa).

[59] *Renewable Energy Policies in a Time of Transition* (IEA, IRENA, REN21 : http://www.irena.org/publications/2018/Apr/Renewable-energy-policies-in-a-time-of-transition

While offering the advantage of pulling prices down, such systems also have several disadvantages, which will be discussed in more detail in the third part of this report but can be briefly summarized:

- The most common pitfall is the asymmetry of information between the instructing party and the applicants. In the absence of any experience of similar projects, the tender rules (specifications) might not be well designed to prevent speculative bids or deadweight effects;

- Tenders incur extra costs and lengthier timeframes, and are therefore less suited to small scale projects;

- Tenders can constitute entry barriers to prevent small players or newcomers from accessing the market;[60]

- Tenders only reflect the degree of competition that already exists in the market (IRENA)[61] which is why it is important only to use them in markets that have already reached a certain stage of maturity (see next section).

Although these different types of contracts and the award mechanisms each have their advantages and disadvantages, it should be remembered that it is only their adequate implementation that will determine their success. This is the topic of the sections below.

c. Articulation of the various mechanisms

i. Timing

An essential factor for success is to choose the type of contract and award mechanism best suited to the state of maturity of the market at the time of implementation.

Most of the countries that have managed to significantly increase the proportion of photovoltaic solar power in their energy mix started with a "counter" mechanism. This is for instance the case for China, Japan, Germany, Italy and South Africa. It appears that the countries that use these mechanisms are more successful in

[60] IRENA (2015b), Renewable Energy Auctions: A Guide to Design, IRENA, Abu Dhabi, www.irena.org/publications/2015/Jun/Renewable-Energy-Auctions-A-Guide-to-Design

[61] Renewable Energy Policies in a Time of Transition (IEA, IRENA, REN21).

developing a deployment dynamic. Realisation of the first projects results in building up skills and expertise in local human resources (labour, financial sector, public authorities) and therefore, more generally, contributes to the creation of a favourable ecosystem.

The subsequent move to tender mechanisms will then have the best chance of success: better definition of specifications, reduction of the asymmetry of information between public authorities and foreign investors, etc.

Similarly, without a "spot" market for electricity,[62] a "contract for difference" type contract cannot be used. In Europe, market platforms (Epex Spot, EEX, etc.) were launched in the early 2000s. Their level of maturity and integration have enabled a gradual evolution from "feed-in tariff" to "contract for difference" contracts (implemented in Germany in 2014 and in France in 2016). In most African countries, these markets are still in the process of being created. For example, the West African Power Pool ("WAPP") was founded in 2001 to promote electricity exchanges between 14 West African countries (Benin, Burkina Faso, Ivory Coast, Gambia, Ghana, Guinea-Conakry, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo). Even without going so far as to establish an electricity trade exchange, such a market enables the implementation of very promising integration initiatives: cross-border connections, legal and regulatory harmonisation (notably for grid codes and norms), regional planning, etc. In 2020, it will be possible for any independent electricity producer to sign an electricity sales contract (PPA) with a buyer within the zone covered by the WAPP, even if the producer and the buyer are in different countries.

ii. Project size

Although many countries are gradually altering their regulatory mechanisms away from the "counter" model towards the tender procedure, some (including France, Germany, Italy, Malaysia, etc.) have chosen to allow the two systems to co-exist: tenders for large projects and the "counter" system for small projects. Many research articles on this topic suggest that below a certain size of project, tenders ultimately prove to be more expensive for the community than a counter system.[63] The difficulties of using tenders for small projects are discussed in the third part of this paper.

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[62] i.e. A platform enabling definition of an exchange price balancing supply and demand for electricity almost in real time, according to 30-min (or shorter) intervals.

[63] Effectiveness and efficiency of auctions for supporting renewable electricity – What can we learn from recent experiences? (Fraunhofer ISI, 2017, Jenny Winkler, Magdalena Magosch, Mario Ragwit)

d. The need for rigorous planning

These mechanisms must be tools to serve the implementation of serious, realistic planning. The primary objective of planning is to ensure supply security, an appropriate production mix and a suitable balance between imports and exports.[64]

However, most Sub-Saharan African countries suffer serious failings in this respect: electricity demand scenarios are often incorrect, while the intended projects are all too often the result of "political" announcements with no foundation on technical considerations such as grid capacity, location of future and current demand, positioning with respect to other power generation or distribution facilities in development within the country and neighbouring countries, etc.

As a fundamental prerequisite to the implementation of any regulatory mechanism for the development of solar energy, planning aims to provide a specific response to these, and other questions:

- What are the current and future needs?
- What is the state of the existing grid?
- What is the available solar resource potential and how is it distributed geographically?
- Based on these considerations, what is the best response in terms of capacity (volume) and distribution of this capacity within the territory?

Hand in hand with rigorous planning, the presence of a regulation agency for the electricity sector is often cited as a requirement. Although necessary, its presence alone is not enough. The quality of regulations and the regulator's capacity to do its job independently of any political influence are essential to attract private investors. Investors see this as a form of insurance that the decisions concerning the sector (access to the market, prices, income, etc.) will be made fairly and transparently, which reduces uncertainty and encourages investments.[65]

[64] IPPs in Sub-Saharan Africa: determinants of success (Eberhard, A., Gratwick, K.N., 2011). Energy Policy 39, 5541–5549. http://dx.doi.org/10.1016/j.enpol.2011.05.004.

[65] IPPs in Sub-Saharan Africa: determinants of success (Eberhard, A., Gratwick, K.N., 2011). Energy Policy 39, 5541–5549. http://dx.doi.org/10.1016/j.enpol.2011.05.004.

Recognising the need to implement a regulatory framework before making any attempt to develop renewable energies in partnership with the private sector, six Sub-Saharan African countries (Benin, Burkina Faso, Gabon, Mali, Niger and Togo) have chosen to pool their resources, under an initiative proposed by Togo, to define a shared regulatory and contractual framework together. This initiative, known as the Lomé initiative, is the first real attempt to create a common solar market with an international treaty, broadly applying the principles promoted by the International Solar Alliance and Terrawatt Initiative. This "pilot" approach deserves to be praised as a real step forward.

A suitable policy and regulatory framework is an essential prerequisite to the deployment of solar projects, but it is not the only requirement. The third part of this paper reviews three major obstacles hampering the deployment of solar projects.

III

UNDERSTANDING THE SOLAR IMPEDIMENTS

The second part of this report explained the specificities of the mid-sized solar "IPP" segment, and recalls the prerequisite conditions for the success of any deployment programme concerning infrastructure of this type. Although these conditions are well known, the fact remains that very few solar power plants of this kind eventually have been built in Sub-Saharan Africa. This third part therefore examines three obstacles that might explain this absence: financing challenges due to the small size and capital-intensive nature[66] of solar projects, market distortions caused by subsidized projects benefiting from some development support mechanisms and, finally, the limits of the tender mechanisms when implemented in markets that are not adequately prepared.

1. A solar power plant is a small, capital-intensive facility that faces financing challenges

The first reason is due to the very nature of these solar power plants: highly capital-intensive, small-sized facilities.[67]

a. Capital investment demands a stable environment and long-term visibility

Almost the entire cost of a solar power plant is tied up in the initial investment ("Capex"), while operating and maintenance costs represent a much smaller proportion of the overall lifetime cost. This characteristic is also shared by other technologies, such as wind farms or hydropower plants, and constitutes a fundamental difference compared with other power generation assets, notably thermal power plants, for which most of the cost is related to operation (the purchase of fossil fuels).

[66] Here, the word "capital-intensive" refers to the large proportion of the initial investment in the total cost of the power plant throughout its lifetime (compared with relatively low operating costs).

[67] Here, "small-sized" refers to the typical size of solar projects being developed in Sub-Saharan Africa, whose power rarely exceeds 50 MW due to grid connection difficulties. This is a relatively smaller capacity compared with centralised electricity sources (coal, gas, nuclear, large hydropower dams, etc.). Larger solar projects exist (50-1,000 MW) in countries where they are compatible with the grid capacity and the volume of local demand for electricity (e.g. India, Gulf countries).

Figure 20 - Weight of Capex and Opex in the respective LCOE[68] of a solar power plant and a combined cycle gas turbine

	Solar power plant		Combined cycle gaz turbine (CCGT)	
	LCOE $/MWh (on the US market)	Relative weight	LCOE $/MWh (on the US market)	Relative weight
Capex	36	90%	16	38,1%
Fixed O&M	4	10%	1	2,4%
Variable O&M	0	0%	4	9,5%
Fuel	0	0%	21	50%
Total	**40**	**100%**	**42**	**100%**

Source: Lazard[69]. The study concerns the US market, and the absolute values of LCOE cannot be transposed to other markets. However, the relative weights remain similar in terms of size on most markets

The price of the electricity produced by a thermal power plant depends on the price of fuel. If there is an unexpected drop in the selling price of electricity, or if the customer (often a national public utility) defaults, the investor that financed the thermal power plant might lose the amount of the initial investment, but the losses can be limited to some extent[70] by simultaneously ceasing to buy fuel. This is not the case for a solar power plant, which is why it can only be financed if the sale of all the electricity can be guaranteed upfront at a predetermined price for a sufficiently long period (generally 15-25 years) to reimburse the initial investment. In some countries, such long-term visibility is not possible: structural deficit of electricity companies, political uncertainty heightened by sometimes irrational decisions, chronic financial difficulties of the countries which thus finds itself unable to provide appropriate guarantees, etc. Without a sovereign guarantee, escrow account or stand-by letter of credit, financing will be impossible to secure. This is the subject of the next section of this report.

[68] LCOE (Levelized Cost of Electricity) is the “discounted cost of the electricity”, corresponding to the total cost throughout the lifetime of the equipment producing the electricity.

[69] https://www.lazard.com/media/450773/lazards-levelized-cost-of-energy-version-120-vfinal.pdf

[70] Particularly in the (frequent) cases for which a “capacity bonus” is payable, generally calculated to remunerate the initial investment, as the purchase price of the electricity is intended to remunerate the variable cost and the cost of fuel.

b. Risk mitigation instruments are not fit for small projects

Instruments are available to mitigate most risks (political risk, liquidity risk, currency exchange risk, convertibility risk etc.). There are for instance insurance or guarantee instruments offered by leading multilateral development organisations, notably the World Bank (MIGA insurance, partial risk guarantee ("PRG"), etc.). However, only limited quantities are available, since they result from a multilateral agreement between a country and the World Bank group, with a limited budget. Furthermore, due to their cost and the procedure required to implement them, these tools are only accessible to very large projects that can absorb the associated transaction costs, which then results in a race for large-scale projects. The «INGA» hydropower project in the Democratic Republic of Congo is a perfect illustration of the excesses that can result, with the knock-on effect of additional difficulties related to the excesses themselves (social and environmental impact, sizing of electric grids, etc.).

The convertibility risk

The convertibility risk is a real obstacle as well as being difficult to mitigate. Two instruments exist:

- MIGA insurance (Multilateral Insurance and Guarantee Agency) proposed by the World Bank, comprising coverage of currency transfer and non-convertibility risks.
- Export finance instruments (Export Credit Agencies) which cannot generally enable non-recourse financing on a long-term basis.

The MIGA cover instrument is capped at a certain volume in each country, and this maximum has already been reached in many African countries. MIGA must therefore "increase its intervention volume significantly for projects related to the transition to a carbon-free economy",[71] and some voices call for a "European MIGA" to be set up.

Another idea, probably requiring more time, would be to increase the proportion of equipment produced locally and to have the projects funded by local corporate financing.

[71] Canfin Grandjean report, June 2015: https://alaingrandjean.fr/wp-content/uploads/2015/06/Rapport-CANFIN-GRANDJEAN-FINAL-18062015.pdf

This is where the second unique characteristic of solar projects comes into play: their capacity to be deployed in small-sized units. Whilst this small size is a benefit in technical terms, enabling better integration in the existing electric grids and adapting to the nascent demand, it becomes an almost impossible hurdle when it comes to financing projects. Solar power plants are too small to bear the costs of development and risk mitigation instruments,[72] as well as being too small to be attractive to lenders, whose project finance teams charge "due diligence"[73] fees that are incompatible with any project representing an investment of less than €50 million.

The most competitive finance options available on these markets are often proposed by development banks; it is often difficult to get such organisations interested in small projects, and their requirements can seem ill-suited to the size of such projects – notably in terms of legal due diligence or the environmental and social compensation plan.

As for local banks, which would be able to examine small projects, they often do not have suitable financing instruments to enable such projects to be funded on a non-recourse basis. In any case, without suitable securities and guarantees, it is not feasible to ask a commercial bank to finance these projects.

c. The capital-intensive nature of the projects makes financing a key challenge

Contrary to common belief, Africa does not face any shortage of capital to finance solar power plants. On the contrary, capital is massively abundant and directed into green projects: the profitability levels involved attract much interest from different investor profiles (infrastructure funds, family offices, sovereign funds, impact funds, climate funds,[74] etc.). However, in the absence of projects offering a critical size within a suitable regulatory framework, investors do not yet have much appetite for the existing solar projects, being more accustomed to larger assets. To overcome this difficulty, the contractual structure of projects must be standardised[75] to facilitate

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[72] However, the RLSF (Regional Liquidity Support Facility) product, created in late 2017 by the ATI-ACA (African Trade Insurance Agency), is of interest as a guarantee mechanism financed by the KfW for €31 million and accessible to small projects, provided they are located in an ATI member country. http://www.ati-aca.org/energy-solutions/facilities/regional-liquidity-support-facility/

[73] "Due diligence" refers to the technical, legal and financial audit of a project before making an investment decision or granting a bank loan.

[74] Such as the Green Climate Fund or the R20 SnCF fund: https://regions20.org/sub-national-climate-fund-sncf-2/

[75] Several such initiatives have already been launched, notably by the International Solar Alliance and Terrawatt Initiative.

their aggregation and the securitisation of the debt tranches, thus facilitating their refinancing on the relevant market places.

Facilitating finance is certainly crucial, for two reasons: firstly because deploying the 100 GW required to satisfy the continent's demand by 2030 will need some $100 billion, and secondly because 70-90% of a solar project is financed by senior debt, making the selling price of solar electricity even more dependent on financial conditions than on the price of the solar panels or the solar irradiation. Thus, a solar power plant in the UK, with a mediocre solar potential of 1,000 kWh/m^2, but a senior debt interest rate of around 2%, produces cheaper electricity than a solar power plant in Chad, a country whose excellent sunlight of 2,500 kWh/m^2 is not enough to compensate the senior debt interest rate of around 8%. The same analysis can be extended to the question of the cost of equity capital (10-30% of a solar project), for which investors expect much higher rates of remuneration in Africa (around 12-15%) than in Europe (less than 5%) due to the various perceived risks: risk of buyer's default, political risk, currency exchange risk, etc.

However, reducing the cost of financing is an essential lever to reduce the selling price of electricity, thus reducing the risk of customer default, which, in turn, reduces the cost of finance... It would be the trigger for a virtuous dynamic towards more economically and socially affordable electricity prices. Bank interest rates could be reduced, for example, by setting up concessional loans available to private parties or by providing appropriate guarantees covering the risk of buyer's default.

In conclusion, the problem of access to electricity for the hundreds of millions of people who are deprived of this power source could come down to a purely financial problem, that could one day be resolved by initiatives to reduce the cost of implementation (standardised contracts) and the cost of financing (e.g. by providing loans at concessional rates). However, there are two other factors (described in paragraphs 2 and 3 below) that complicate matters significantly.

Adapt financing to the capital-intensive nature and small size of solar projects

Recommendation n°1 - Promoting planning efforts, a prerequisite for the development of solar power, notably by adapting regulatory frameworks to the particularities of solar projects.

Recommendation n°2 - Facilitating access to finance: specifically enabling the aggregation of several projects by creating freely available standardised documentation accepted by all parties (buyer, public authorities, lenders, operators, developers, etc.), and reducing the cost of examining files by adapting lender demands to the size of the project.

Recommendation n°3 - Reducing the cost of finance: facilitating access to debt enhancing tools (guarantees, insurance) and making concessional loans available to IPP projects.

2. Some development aid subsidies cause serious market distortions

This section deals with a more discreet obstacle, but whose impact is equally negative: the market distortion caused by the subsidy policies implemented by certain development agencies.

Subsidising projects can sometimes be advantageous in immature markets: implementing the first subsidised project can help train local players (notably national utilities), to convince local decision-makers that solar power offers a reliable solution, and to assist with planning efforts. Furthermore, given the market potential and the volume of the demand, some public projects may co-exist alongside private projects, subject to artificial price signals being avoided whenever possible and that the projects are wisely coordinated to avoid duplicating projects and the possible destruction of value that can result.

a. Not enough projects to satisfy the growing appetite of investors

We have already discussed the risks that solar power plant project developers are facing in Africa. For the developer, it means investing in technical studies and project structuring for several years with no certainty that the project will eventually get built. For the investor,[76] it means committing equity for the power plant to be built, gambling on the fact that the electricity will be paid at a suitable price for the next 20 years to be able to reimburse the initial investment of the shareholders and lenders. As risky as this may be, there are a number of companies active in this market (see *supra*) but paradoxically, they are often faced with a lack of "bankable" projects, i.e. projects whose regulatory environment (notably property rights, permits, etc.) and legal documentation (notably the PPA, concession contract, etc.) are considered satisfactory by the lenders and investors.

Some of the reasons for this lack of bankable projects have already been mentioned: the risks of the local environment are difficult to reconcile with the capital-intensive nature of the projects which demand long-term visibility, the small size of the projects means they cannot support the costs associated to risk mitigation, and the regulatory frameworks (contract award mechanisms, planning, etc.) are largely insufficient.

The competition for projects subsidised by development grants is yet another factor, whose consequences are discussed in the paragraphs below.

b. Planning problems resulting in local overlaps

Planning deficiencies in a country's energy policy can lead a country to accept a subsidy from a development agency (or a similar institution) to finance a project that will be in direct competition with an existing project, financed by a private investor. The limits of the electric grid and the demand volume mean that the public authorities must then choose between the two projects, generally in favour of the subsidised project.

[76] The developer and the investor can be the same entity or two different entities (the developer works on the upstream elements of the project, while the investor comes into play when plant construction must be financed).

The Defissol project (AFD)

A private company, specialised in solar power project development, identified a suitable site for a solar power plant in southern Benin, near Onigbolo. The company paid for the various key stages of project development. First, the land had to be secured legally, which was a complicated and costly process because there was no land registry and the prevalence of customary law. Initial discussions with the State confirmed the latter's interest in supporting the project. A Memorandum of Understanding was signed, under which the developer promised to pay for all studies (notably the environmental impact study and the electric grid study), while the public authorities promised to grant the necessary rights and licenses to the project and to have an electricity purchase contract signed by Benin's national public utility at a "market" price.

At the same time as this private initiative, and within the framework of the government's ambitions to develop photovoltaic electricity production in Benin, a preliminary feasibility study was funded by the MCA (Millennium Challenge Account) to identify suitable sites. At the request of Benin's government, the AFD thus financed a detailed feasibility study of the Illoulofin site (Pobé commune, approximately 25km from Onigbolo), to validate project pertinence. The project, called DEFISSOL,[77] consists in providing Benin with a €60 million grant in the form of a direct subsidy donation from the EU (€10 million) and a subsidised loan from AFD to the Benin government (€50 million at IMF conditions), to build a 25 MWp power plant, to implement a capacity building programme for the SBEE (Benin's electricity company), and to modernise the SBEE's IT system. An EPC-O&M contract is in progress for the construction of the power plant and its operation-maintenance for a 3-year period.

In view of the region's demand for electricity and the limited capacity of the electric grid, a second solar project in the same place was neither possible nor relevant: the private developer's project was thus abandoned, after three years worth of work.

[77] https://bj.ambafrance.org/La-France-et-l-Union-europeenne-s-engagent-aux-cotes-du-Benin-pour-construire

The Boundiali project (KfW)

In June 2013, an invitation to tender was issued by the Ivory Coast to select a 20MW solar power plant project. After an initial pre-qualification phase, eight candidates were selected and were sent a more detailed specification in September 2014, asking them to complete the following steps to submit a complete project by February 2015: identify and secure the land, complete all studies, notably the environmental impact study, obtain preliminary financial agreements from banks and investors, compile a lengthy application file with all the documents demanded. Three offers were ultimately submitted by three private developers, which had chosen different locations for their projects: Korhogo, Odienné and Boundiali.

In April 2015, it was announced that the Korhogo project had won the contract. The two other projects, although fully developed and ready to build, were terminated. Three years later, the winner had still not begun to build the project (section 3 presents the reasons for this situation, which is unfortunately not an isolated example). The candidate that had developed a project in Boundiali continued the discussions with the Ivorian government because electricity needs in Boundiali remained urgent and its project – whose technical aspects had already been validated and was therefore ready for rapid implementation – was all the more relevant.

In June 2018, the candidate was astonished to read a press release from KfW (the German development agency) announcing that it had granted a €36.7 million subsidy to the Ivorian government (including a €9.7 million donation from the EU) to finance the studies and the construction of a 37 MW solar project in Boundiali.[78] Aside from the pure loss due to the duplication of project studies, this initiative obviously ended the private project that had been developed five years earlier in the context of the government's invitation to tender.

[78] https://eeas.europa.eu/headquarters/headquarters-homepage/51612/une-nouvelle-centrale-solaire-375-mw-%C3%A0-boundiali-cofinanc%C3%A9e-par-lunion-europ%C3%A9enne-et_en

These two examples are not unique: there are similar examples in Niger[79] (recently announced 20 MW project in Niamey co-funded by the AFD and EU) and Senegal[80] (15 MW project in Diass financed by KfW, announced in 2015 and still not finished).

c. Artificially low price signals with repercussions on other projects

Even if the subsidised project is not in direct competition with a private project at the same point on the electric grid, its impact can still cause other problems. A subsidised project helps to create a price signal that does not reflect the true cost of project implementation; this can ultimately penalise other, non-subsidised projects, even in neighbouring countries.

The Scaling Solar example (World Bank)

This initiative, launched by the World Bank in several African countries, mobilises the International Finance Corporation (member of the World Bank group):

- To help public authorities implement a suitable regulatory framework, an essential task that must be strongly encouraged;
- To carry out the project development work (site selection, feasibility studies, etc.), then issue an invitation to tender with very strict qualification criteria which seem to have been designed to eliminate all but the largest groups;[81]
- To include specific subsidy-based benefits[82] (on the cost of grid connection, land availability, or financial conditions), resulting in a final price of electricity

79 https://www.connaissancedesenergies.org/afp/niger-une-centrale-electrique-solaire-bientot-construite-niamey-181101

80 https://www.jeuneafrique.com/289823/economie/energie-solaire-kfw-octroie-27-millions-deuros-senegal

81 For its first edition (Zambia, 2015), candidates were required to produce one of the following references: 1/ at least one solar power plant of more than 25MW in Africa; 2/ at least one power plant (any technology) of more than 75MW in Africa; 3/ a least three solar power plants in three different countries with a total capacity of more than 100MW; 4/ a connected capacity (any technology) of at least 1,500MW; 5/ Net Assets of at least $75 million (USD).

82 Press release for the Scaling Solar project in Zambia:

"The equity for the project is provided by Neoen/First Solar and the Industrial Development Corporation of Zambia (IDC). The financing package includes senior loans of up to $13.3 million from IFC, up to $13.3 million from the IFC-Canada Climate Change Program, and up to $13.3 million from OPIC, along with an interest rate swap from IFC and a partial risk guarantee from the International Development Agency." […] "It includes a 'one-stop shop' package of technical assistance, templated documents, pre-approved financing, insurance products, and guarantees. Scaling Solar has financing support of USAID's Power Africa, the Private Infrastructure Development Group company, DevCo, the Ministry of Foreign Affairs of the Netherlands, the Ministry of Foreign Affairs of Denmark, and the UK Department for International Development » https://ifcextapps.ifc.org/ifcext/pressroom/ifcpressroom.nsf/0/EABBB3BCACC7DCB4852581FC00549777?OpenDocument that is artificially low, so that the price proposed by private projects without the same subsidy-based benefits simply cannot compete.

Generally, these private projects are therefore abandoned, and the governments prefer to wait for the Scaling Solar programme to be set up. This situation has been observed in countries where the programme is already in place (Zambia, Ethiopia, Madagascar, Senegal) or about to be set up (notably in the Ivory Coast). The Ivory Coast government even interrupted one of its solar programmes (invitation to tender for a solar power plant in Odienné) after publication of the results of the Scaling Solar tender in Senegal: a record price (but benefitting from the aforementioned subsidy-based benefits) of $38/MWh (indexed at 1.2% per year). Without these same conditions, the Odienné tender would probably have resulted in a price of $70-80/MWh. Although this price level remains very competitive compared with thermal power plants and diesel gensets (around $200/MWh), it was considered politically preferable to wait for the Scaling Solar programme to be implemented, even if this resulted in delaying the projects by several years – and discouraged private developers (not to mention the urgent climatic issues and the rights of the local populations to have access to energy).

The goals of the Scaling Solar programme are legitimate, as it aims to propose suitable regulatory frameworks and planning instruments, and to improve financial conditions: it would be an ideal solution if it was not restricted to projects developed by IFC but proposed *via* a broader system, open to existing projects originated by private initiative.[83]

Scaling Solar is based on advantages that can be described as “indirect” subsidies: they concern development, connection, financing, presence of guarantees, etc. However, the project investment remains entrusted to a private partner. The following example illustrates a subsidy that can be qualified as “direct”, i.e. a development agency provides a subsidy to a State to allow the latter to invest directly in the project.

[83] This is the vision proposed by the International Solar Alliance, in which the World Bank participates actively.

The Zagtouli project (Burkina Faso)

The Zagtouli solar project in Burkina Faso (33 MW solar power plant) was inaugurated in October 2017 by French President, Emmanuel Macron, and his Burkinabe counterpart, Roch Marc Christian Kaboré. For a total estimated cost of €47.5 million, the project received a €25 million subsidy from the European Union's European Development Fund (EDF) and a subsidised loan from the French development agency, AFD, for the remaining €22.5 million. This project led to a proud announcement by Burkina Faso that "the energy produced by the solar power plant in Zagtouli would cost[84] approximately CFA 45[85] (7 euro cents) per kilowatt/hour(kWh), i.e. three times cheaper than the electricity produced by thermal power plants, which costs 145 CFA francs". This announcement[86] resulted in various other projects in the region being interrupted, because the governments concerned were expecting similar price levels, even though the projects did not have the same subsidies.

These subsidised initiatives – whether direct or indirect – have serious consequences on the availability of projects mentioned previously and on the rate of deployment of future solar projects.

- Firstly, they dissuade private developers from continuing to take the risks involved in undertaking new projects in these countries. This is one of the reasons for the current lack of mature projects.

- Secondly, it sends an artificially low price signal to the rest of the market, causing unrealistic expectations among African decision-makers. These expectations cannot be satisfied by non-subsidised private projects, making them politically unacceptable.

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84 Note that this is misuse of the notion of "cost". See the work by Professor Claude Riveline (Ecole des Mines, Paris) for a reminder that the "cost" depends on the observer's point of view (http://www.riveline.net/poly/). In the case of the Zagtouli power plant, wholly financed off-market, the "cost" of electricity has no absolute meaning and depends on multiple hypotheses (amortisation period, discount rate, etc.) and cannot therefore be used as a reference to compare with the price proposed by other IPP projects in the region.

85 This is a cost price for SONABEL, calculated on the basis of the EPC contract amount. The cost was calculated excluding financing to limit the bias induced by the financing structure which includes an investment subsidy.

86 http://www.lepoint.fr/economie/le-burkina-faso-lance-la-plus-grande-centrale-solaire-d-afrique-de-l-ouest-27-11-2017-2175374_28.php

These two cases illustrate how a public initiative, made with the best of intentions to begin with, can end up discouraging private investment in these countries and ultimately thwarting the initial objective.

d. How can the public and private sectors collaborate to accelerate the development of solar power?

It is regrettable that institutions like the EU (either directly or at the initiative of a Member State) or the World Bank, which incidentally extols the virtues of free competition and respect of market rules, subsidise projects in competition with those proposed by private companies (although this is not their main intention), albeit in the name of a development policy. In theory, a development policy should be designed to encourage initiatives in segments where the private sector is unable to find an economic balance or is absent for whatever reason.[87] It should not aim to subsidise public projects for which competitive alternatives already exist and attract private investors.

The custom of offering developing countries subsidised power generation infrastructures should be banned for the aforementioned reasons and for an even more obvious reason: a State to which a subsidised infrastructure is proposed will be less inclined to keep it in optimal condition than an investor which must protect its capital tied up in the project. Sadly, there are numerous examples in Africa of subsidised power plants being abandoned after completion of the works or being left in seriously dilapidated condition.[88]

Fruitful collaboration between public and private sectors does remain possible, even necessary, in order to achieve the goal of deploying 100 GW of solar power in Africa by 2030. The development agencies and multilateral lenders that subsidise projects do not have the human resources nor the financial capacity to develop and fund these 100 GW, without seeking substantial support from the deployment capacities of the private sector.

[87] This is notably the case of grid deployment programmes, for which public funds that are currently used for projects, such as Defissol or Scaling Solar, could be better employed.

[88] For example, Kariba dam in Zambia, Maria Gleta thermal power plant in Benin, Lagdo dam in Cameroon, etc.

In particular, what should be done with the public funds mobilised throughout the world to promote green energies? Three options should be favoured:

- Firstly, these funds should be used to propose and improve **risk mitigation instruments** (guarantees, insurance, exchange risk cover, etc.) for private investors, rather than substituting them. These tools would encourage investors to take the plunge, particularly in an environment in which the perceived risks are particularly high. Some instruments are already available (e.g. RLSF[89]): these could be strengthened, extended and made more accessible to small projects. New tools could be created, such as a support fund (at the level of one or more countries) for currency fluctuations, to protect the electricity buyer (if the PPA uses an international currency) or seller (if the PPA uses the local currency).

- Secondly, these funds should be used to offer **financial solutions at rates better than the market rate** ("concessional" rates) for mature projects developed by the private sector. To avoid distorting the market, it is important that these financial solutions are granted after the "unsubsidised" price has been defined (by way of a "counter") or announced (by way of a tender) to avoid creating any confusion between the market price and the subsidised price.[90]

- Finally, these funds must be used to **finance essential initiatives that are not able to attract private investors:** update of the legal framework, reinforcement of grid infrastructures, capacity development programmes (training for civil servants, for example), etc. In particular, multilateral organisations can help governments with their efforts in the fields of planning and implementation of a suitable regulatory framework. Several of them already do this (e.g. the African Development Bank's action with the ALSF programme[91] mentioned previously, or

[89] The RLSF (Regional Liquidity Support Facility) product, created in late 2017 by the ATI-ACA (African Trade Insurance Agency), is a guarantee mechanism financed by the KfW for €31 million and accessible to small projects, provided they are located in an ATI member country. http://www.ati-aca.org/energy-solutions/facilities/regional-liquidity-support-facility/

[90] The Lebanon example is a good illustration of this approach. The Central Bank of Lebanon proposes subsidised financing ("National Energy Efficiency and Renewable Energy Action" or NEEREA), but when the tender concerning 15 MW solar power plants was issued in 2017, it stipulated that candidates had to build their price without taking into account the NEEREA subsidised finance. It is only at later stage that this subsidised financial solution could be proposed to the awarded projects, reducing their price and thus benefiting the end consumers without interfering with the price signal communicated to the market (which remains a price excluding NEEREA subsidies).

[91] The African Legal Support Facility is an international public institution hosted by the African Development Bank (ADB) whose mission is to provide legal advice and technical assistance to African States to develop their negotiation capacity for complex commercial transactions and to settle disputes with their creditors (http://www.aflsf.org/).

the remarkable progress of the Millennium Challenge Account[92] and RECASEB[93] programmes in Benin) but concentrating more resources on this type of initiative in other countries would accelerate the changes. The Scaling Solar programme also includes assistance with implementing a suitable regulatory framework and has developed very strong expertise in this field since 2013.

In short, it means using scarce and precious public funds not to compete with the private sector but to leverage more private financing. A 10MW solar power plant can be funded directly with a public subsidy of €10 million. If these €10 million were used instead to guarantee private investors one year of turnover for a power purchase agreement, a capacity thirteen times larger could be commissioned. In other words, public funds of €10 million placed in a guarantee fund can "raise" €130 million in private financing that is actively seeking to be invested in this type of project. The power of this leverage is essential to succeed in deploying the necessary infrastructure within the required timeframe.

We cannot emphasise strongly enough the need to redirect public subsidies and development aid towards credit enhancement mechanisms, towards capacity reinforcement programmes and towards sectors that still need subsidies (such as rural electrification or grid extension). It is essential to avoid the use of these resources for projects initiated by the public sector causing serious distortion in an already complex market.

Restrict public subsidies that create market distortions

Recommendation n°4 - Check that there are no private projects within the specified zone before considering the location of a public project.

Recommendation n°5 - Limit artificial price signals whenever possible: avoid subsidies (for studies, real estate, connection, etc.) that might discourage private investment.

Recommendation n°6 - Promote better collaboration between public and private funds: focus public funding on projects that fail to attract private investors, such as medium and low voltage grid infrastructures, provision of credit enhancement tools for public counterparts, capacity building.

92 http://www.mcabenin2.bj/texte/show/reformes-politiques-et-renforcement-institutionnel/project
93 https://eeas.europa.eu/delegations/benin/39856/appel-%C3%A0-candidatures-pour-le-projet-de-renforcement-des-capacit%C3%A9s-des-acteurs-du-secteur-de-l_fr

3. The tender mechanism is not adapted to small projects in immature markets

This section examines a third obstacle: the use of tenders without considering the limits of this mechanism when applied to immature markets or small-sized projects.

The limits of the tendering mechanism when misused in immature markets can be illustrated by the three examples below.

Invitation to tender for two 5MW solar power plants in Togo in 2014

The Togolese government issued an invitation to tender in June 2014 to select project proposals and award contracts for the development, financing, construction and operation of two 5MW solar power plants, one in the north and one in the south of the country. In 2015, the plant in the southern area was declared unsuccessful, and a consortium won the contract for the power plant in the north. Due to the small size of the projects, the winning consortium tried to renegotiate the conditions by increasing the size of the plant (from 5 to 20MW) to make it easier to finance. The negotiations failed and the project was ultimately abandoned.

Invitation to tender for solar power plants in Burkina Faso in 2013

Burkina Faso issued an invitation to tender in December 2013 to select projects for the development, financing, construction and operation of 10-30MW power plants in various locations throughout the territory. After numerous delays and cancellations, a new call for expression of interest was launched in 2016 for eight solar projects. In 2017, the pre-qualified companies were allocated the various sites, with two to three candidates per site, and asked to submit a new offer in October 2017. Some companies received qualification letters, but the conclusion of the invitation to tender was seriously slowed down in 2018, notably due to budget commitments by the Burkinabe government related to the structuring of these projects and the operation of the "open book" audit principle. It was only very recently that the final selection procedure for the developers was relaunched within the framework of a competitive dialogue, although much uncertainty remains as to the actual implementation of these projects.

Invitation to tender for solar power plants in Mali in 2015

Mali issued an invitation to tender on 22 April 2015 for the development, financing, construction and operation of two solar power plants, 25 and 50MW, located in Koutiala and Sikasso, respectively. In 2016, two companies, Access Power (Koutiala) and Building Energy (Sikasso), were selected by the ministry of water and energy in Mali. As part of the legal and financial documentation negotiations, the Ministry of Water and Energy received legal support (via the ALSF facility)[94]. Contract negotiation and project development (grid studies, environmental studies, etc.) were started in 2016 and are still in progress. The financial closing of operations is estimated at the end of 2019, with plant commissioning in late 2021.

At the same time as the invitation to tender for these two solar projects, Mali signed two concession agreements for two solar projects:

- 50MW in Kita – Project developed by Akuo Energy in collaboration with the R20 association since 2014. On October 17, 2018, Akuo Energy announced the financial closing of the operation, whose construction costs amount to €85 million. The project will be funded by Akuo Energy (equity investor) and by international lenders (Emerging Africa Infrastructure Fund Limited, the West African Development Bank (WADB), the National Agricultural Development Bank of Mali (BNDA) and the Dutch Development Bank (FMP) to finance the development). The plant is due to be commissioned before October 2020.

- 33MW in Segou – Project developed by the Norwegian company Scatec Solar, and the IFC (World Bank Group). Since the signature of an electricity purchase contract and a concession agreement with EDM and the State was announced in July 2015, Scatec Solar and the IFC have still not announced the financial closing or the time frame for plant commissioning.

[94] The African Legal Support Facility is an international public institution hosted by the African Development Bank (ADB) whose mission is to provide legal advice and technical assistance to African States to develop their negotiation capacity for complex commercial transactions and to settle disputes with their creditors (http://www.aflsf.org/)

a. Tender mechanism is ill-suited in terms of context and project type

Although it offers the advantage of drawing prices downwards, the tender mechanism also has a number of disadvantages that make it unsuitable for the development of solar projects in immature markets.

i. Increasing costs

Tenders are creating additional costs due to the heavier commercial risk for the project sponsors, as well as the burdens and delays inherent in the process. These higher costs are incompatible with small solar projects. Contrary to popular belief, a tender does not necessarily result in the lowest price. A simple outline rule can be proposed: the higher the risk, the higher the price of the electricity. Investing in Sub-Saharan African countries is a risky enough business without adding further commercial risks related to a tendering procedure whose outcome is, by nature, uncertain. Furthermore, tendering procedures are complex and lengthy: drafting specifications, examining offers, awarding contracts to the winners, managing possible appeals, etc. The lead times are therefore often long[95] and the costs are high for both the instructing party and the candidates, which must include the costs related to all unselected projects into the price proposed by a possible winning proposal. Many research articles on this topic conclude that below a certain size of project, tenders ultimately prove to be more expensive for the community than a feed-in tariff system.[96] However, there are ways to lower this threshold by reducing the costs related to the tender procedure: simplification, digitalisation, etc.

ii. Information asymmetry

The technicalities of examining projects and the asymmetry of information between instructing parties and private players make the tendering process unsuitable in countries where the market is in its early stages. The tender examination process means being able to sort the various bids and detect manipulation attempts by certain candidates. The instructing party must have the skills necessary to complete this task. Experience shows that tendering procedures in countries that have not developed significant local expertise result in the selection of attractive but not

[95] Note that this point is not restricted to developing countries. In France, tenders for off-shore wind or solar farms offer a good illustration of the difficulties inherent to the system: weightiness, incentive to implement speculative pricing strategies, “waste” rates (i.e. winning projects that are never actually realised) can be up to 20-50%, depending on the tenders, etc.

[96] Effectiveness and efficiency of auctions for supporting renewable electricity – What can we learn from recent experiences? (Fraunhofer ISI, 2017, Jenny Winkler, Magdalena Magosch, Mario Ragwit)

necessarily feasible projects, ultimately leading to the project being severely delayed or even abandoned several months or years later. Better cooperation between regulators and public authorities in the different countries would help to facilitate the sharing of feedback from countries that have acquired expertise in handling tenders with countries that want to organise a tendering operation for the first time.

iii. Incentive for speculative strategies

In a market where prices are constantly declining due to structural reasons, tender candidates often have to implement speculative price strategies. Due to the downward price spiral in this market over the past ten years – a spiral that is still continuing at a fast pace – there is a strong temptation for tender candidates to propose electricity at a price that is lower than the price they know is feasible in the short-term, counting on future decreases in solar panel costs and interest rates. The method to win a tender is simple: use very ambitious hypotheses to calculate a highly competitive price. Once the contract has been won, the initial hypotheses are obviously not realised, so the contractor must then negotiate with the buyer a higher price or more time – because the ongoing decline in solar panel prices or the country's improving economic and financial context will, at some point, end up making the project profitable. As for the buyer, it is almost impossible to refuse a lead time extension and cancel the tender because, by this stage of the project, the solar power plant will have been announced to the local populations two or three years ago and failure would be politically unacceptable.

iv. Unfounded comparisons and disrupted price signals

By encouraging contractors to speculate on lower prices, often combined with media hype, tenders end up slowing down the implementation of other projects. The consequences of a tender in one country can impact an entire region, and even the continent. However, the comparison of prices obtained in one country or another (or even a single bid within a single country) is generally unfounded. Any price comparison must be based on strictly identical conditions, which is impossible in practice. The conditions of a "Scaling Solar" project in Zambia are quite different from those of a more "conventional" project in another West African country. The factors below, among others, are essential components of the price:

- ***« Auction design »:*** i.e. the tender specification and particularly the ranking criteria, the level of the bid bond to be issued, the exact scope of the work required of the project developer etc. The price obtained by a tender for which no bid bond is required, studies are provided by the instructing party and whose ranking process is solely based on competitiveness criteria, cannot be compared with the price obtained by a tender demanding a 10% bid bond, for which the candidate is responsible for project development and studies, and whose ranking process include technical or environmental criteria.

- **The country risk:** the price obtained by a tender in a country in which the project site is a remote base camp, where the solar panels have to be transported under armed escort and in which the business environment is very difficult (corruption, etc.), cannot be compared with the price obtained by a tender in a secure country with a favourable business environment.

- **The legal, regulatory and fiscal framework of the country:** the presence of high customs duties (up to 100% in some countries and for some of the equipment required to build a solar power plant), vastly different taxation conditions in the countries (notably with local taxes, such as occupational tax, withholding tax, registration fees, etc.), and the absence of a suitable legal/regulatory framework (which results in higher legal consultant fees for the project) have a strong impact on the price of the electricity.

- **The cost of finance:** resulting from the previous two factors, as well as from the economic and financial environment (reference interest rate of the central bank, currency exchange risk, inflation, etc.), conditions of access to capital, represent a decisive factor (see section 1.c).

- **Solar potential:** probably the most obvious factor at first glance, which does not prevent many countries from asking projects whose solar potential can differ by a factor of two to compete with each other in the auction process.

- **Size of the power plant:** economies of scale obtained on very large projects mean they can achieve price levels that simply cannot be replicated on smaller-sized projects. Tenders in France show a price difference of around €10/MWh[97] between projects whose capacity is between 500 kWp and 5 MWp, and projects whose capacity is between 5 and 30 MWp.

[97] Source: summary report on the CRE tender for the construction and operation of solar power electricity power plants "Ground-mounted power plants between 500 kWp and 30 MWp" - 11 July 2018.

- **Completion schedule:** in a market in which price reductions are significant, it is important to distinguish between the price of electricity produced by power plants already funded and built, and the price proposed in new bids. Among the ten projects actually commissioned in the region (see table in part I.2.d.), none have a price below $0.11/kWh (USD).

- **Presence of subsidies:** whether these are indicated in the invitation to tender and available to all candidates or obtained by certain candidates who apply for available subsidies to propose a better price than their competitors.

The World Bank's Scaling Solar programme has already been mentioned. Launched in 2013, this programme aims to implement "World Bank tenders in various African countries, along with various facilities and advantages (provision of real estate, connection, financing). After three years' preparation and examination, two projects were selected in Zambia (47.5 MW and 28.2 MW) in June 2016 with prices of $6.02 cUSD/kWh and $7.84 cUSD/kWh, respectively, which was an all-time record in the region at that time (as shown in figure 18, this price was lower than that obtained by tenders in Germany and France). At such price levels, project realisation is often complex, because the slightest hiccup can seriously threaten the economic balance. As of the end of 2018, five years after the Scaling Solar programme was launched, no kWh have yet been produced.

Although comparison with other projects is obviously unfounded, the announcement of these prices caused various similar projects throughout the continent, that were about to be signed at a higher price, to be abandoned because the public authorities and national utilities expected prices equivalent to that of Zambia. The price might have been attractive, but it was artificial, and could not be replicated without these specific conditions.

For these and other reasons, most tender attempts in immature markets have thus failed or resulted in extremely long completion times. However, many institutions continue to recommend (and even impose) tenders in the countries that contact them for advice on how to develop renewable energies.

The global preference for tenders shows no signs of fading. The latest price records attained in Zambia ($6.02 cUSD / kWh in 2016), Egypt ($8.4 cUSD / kWh in 2017) and Senegal ($3.8 cUSD / kWh[98] in 2018) have certainly garnered much attention, but such hype does not result in any actual production for many years. Alternatives to the tender process exist, but it is difficult to question a method that is part of the free competition promotion policies implemented by many development banks and institutions, as well as most of their legal, technical, financial and strategic advisors.

b. Alternative solutions

Other mechanisms to award contracts can be implemented as a substitute to the widely known tender mechanism, and each has its own advantages and drawbacks.

i. Over-the-Counter negotiation following an "unsolicited offer"

Public authorities or the electricity off-taker (typically a national public utility) receives lots of expressions of interest from private developers proposing power generation projects. This method has the advantage of being flexible and (relatively) quick. Its two main disadvantages are, firstly, the risk for the buyer to commit to poorly qualified project developers and, secondly, the risk of not getting the "best price".

However, these two risks can be controlled:

- The technical and financial qualifications of project developers are not difficult to assess, provided the capacity to do so is available.
- The price can be optimised, for example, via competitive dialogue between the various private parties expressing an interest, or by conducting an "open book" audit of the proposed price: in a situation in which the main variables (solar potential, construction costs, operating costs, cost of financing) are known, the "right" price of electricity can be calculated by simple financial modelling.

[98] Indexed price of 1.2%/year for 25 years.

Over-the-Counter negotiation of a Feed-in-Tariff– the case of Senegal

Solar power has developed in Senegal – a relatively stable country that is economically attractive to investors – because the country's economic heart, its capital city Dakar, and the country's largest regions (Thiès, Kaolack, Diourbel, Saint-Louis) interconnected by the national electric grid, concentrate the majority of the demand for electricity and are very well located geographically to develop this technology. Furthermore, the solar power plant development programme has received strong political support, due to the very delicate situation of electric power in Dakar in the early 2010s (multiple daily load-shedding powercuts). The Renewable Energy Orientation Law, adopted in December 2010, provided a transition period of two years for the Ministry in charge of energy to approve project offers submitted by private investors. The government thus approved a number of projects, resulting in the signature of ten PPAs by the end of December 2013 by SENELEC and project investors. The projects, ultimately selected on the basis of a transfer price, include nine solar power plants and one wind plant. Four of the solar projects were completed between 2016 and 2018, two others have been connected in the past couple of months and the rest have been abandoned.

ii. Creation of a "semi-open counter" with development milestones

A government can set up a programme in which the solar power purchase terms and conditions are defined *upfront* and the project developers are invited to complete increasingly restrictive technical and financial formalities until a licence is issued to enable the signing of a solar power purchase agreement (the buyer might be the State or a specific entity such as a national public utility).

"Semi-open counter" Feed-in-Tariff programme - the case of Namibia

In April 2015, Namibia launched a programme called REFIT (Renewable Energy Feed-in Tariff[99]): any project (solar, wind or biomass) whose power is less than 5 MW can submit an application for a power purchase agreement with a price defined upfront (variable from $0.10 to 0.30/kWh (USD), depending on the

[99] https://www.iea.org/policiesandmeasures/pams/namibia/name-146076-en.php

technology and power capacity). To avoid all risk of creating a "bubble", the programme was limited to a total volume of 70 MW, and only the applicants that met specific conditions (technical, administrative or financial) were eligible. The programme was fully subscribed (14 projects), and nine power plants were already running by May 2018, representing a total of 45 MW, while the remaining 25 MW were in the finalisation stage.

The case of Kenya

Since 2008, Kenya has been developing a renewable energy promotion policy, via an "open counter" system (with Feed-in Tariff, or "FiT"). In March 2008, the Energy Ministry published the "2008 FiT Policy" offering a FiT for wind power plants (maximum 50 MW), small hydro plants (maximum 10 MW) and biomass plants (maximum 40 MW). In January 2010, the tariffs were revised and a FiT was implemented for solar, biogas and geothermal facilities. As well as defining a feed-in-tariff for each power source, this regulatory text defines a standard power purchase agreement (PPA) which distinguishes between projects according to their power: above or below 10 MW.

In June 2017, the Energy Ministry, regulation commission (ERC) and national utility (KPLC) announced the signing of PPAs for four 40 MW projects based on the FiT system (Frontier Energy, supported by the European Investment Bank, for the Eldosol and Radiant projects; Malindi, developed by Globeleq; the Kesses project, proposed by the Alten group). In July 2018, Globeleq and the British development agency announced financial closure of the 40 MW project in Malindi, representing a total amount of €66 million.

For wind power, Kenya negotiated and signed a PPA from 2008 to 2014 with the LTWP group (KP&P BV Africa, Aldwych International Limited, Norfund, IFU-Danish Development Bank, FinnFund and Vestas) for the creation of a wind farm with a total capacity of 310 MW at Lake Turkana. Construction began in October 2014 and mechanical commissioning was completed in January 2017. In October 2018, after completion of the transmission line by the grid company (KenGen), the farm was eventually commissioned.

iii. Competition based on licence price

This mechanism is quite similar to an invitation to tender, although competition is not based on the price of the electricity but on the purchase value of a licence. This system was successfully implemented in Portugal, for example, in the early 2010s.

The main advantage of this method is that speculation has no effect (it does not generate artificially low price signals that affect competition) and helps generate income for the State. The possible speculation proves to be all the more controllable if the authorities supervise (or even prohibit) the resale of these licences on the secondary market before the plant is commissioned.

It does have two disadvantages however: as for the other two methods cited above, the authority (or regulator) must be able to determine the price.[100] There is also a risk that this system excludes small businesses, favouring large groups whose financial resources are sufficient to purchase the licence.

However, these two risks can be controlled:

- In terms of price setting, a feedback loop can be implemented based on the values proposed for the licences. If the value rises too high, this indicates that the electricity price is too favourable. If the value collapses, this indicates that the electricity price is probably too low to be viable.

- With regard to the risk of excluding small businesses, a mechanism can be implemented to allow payment of the licence when the project is commissioned rather than when the bid is submitted.

iv. Vickrey auctions

This type of auction consists in granting to the awarded bidder the price proposed by the second best offer. Based on his work on game theory, American economist William Vickrey (1914-1996) showed that this type of auction encouraged participants to propose "true prices" and not to engage in speculative behaviour.

Different variations of these auctions have been used (or are still in use) by Google for ad auctions and for granting mobile phone licences in the UK. However, they have never yet been used for solar power plant tenders.

[100] And not to give in to the temptation of setting a higher price to generate higher licence prices.

c. The confusion between tenders and competition

In recent years, tenders have been implemented for most renewable energy projects. The number of countries resorting to the tender procedure has thus increased from 6 in 2005 to 67 in 2017, according to IRENA.[101]

This trend is due to the mechanism's proven efficiency in accelerating decreases in the price of solar electricity in many mature markets (see Part II, paragraph 2.b.ii). Attracted by the promise of very competitive prices, more countries are tempted to imitate this movement without a clear understanding in the difficulties of implementing this mechanism in less mature markets (as mentioned above).

The trend is also due to the belief shared by many institutional lenders and governments that a price-based auction is the only way of getting a competitive price for electricity.[102] It is easy to believe at first sight that tenders guarantee both transparency and competition, while the other price setting methods open the way to an arbitrary selection. However, the alternative methods cited in the paragraph above show that reality is somewhat different.

- **Setting a "counter" price does not prevent the government from decreasing it later.** Kenya had set a price of $0.12 USD/kWh, which attracted a large number of project developers. Those who completed all the technical stages are currently in the process of signing their electricity sales contracts - but the price has since been decreased by the public authorities and the developers are being asked to sign at a price of around $0.075 USD/kWh, said price having been obtained thanks to a competitive dialogue between the project developers concerned.

- **The fact that a developer makes a price offer outside the tender or "counter" framework does not necessarily mean that the buyer will accept it without negotiation.** The public authorities receive dozens of project proposals, which ensures competition, even if there is no formal invitation to tender.[103]

[101] http://www.irena.org/policy/Renewable-Energy-Auctions

[102] For many multi-lateral lenders, it is actually a mandatory requirement imposed by the statutory rules of operation.

[103] In many countries, hundreds of Memorandums of Understanding (MoUs) have been signed by governments and project developers. These MoUs state that the project developer must finance the feasibility studies and, in exchange, will be granted an electricity sales contract. In practice, only a few project developers take the risk of financing these studies and completing their projects. They are justifiably inclined to believe that competition has had just as much effect here as in a formal tender procedure.

- **Implementation of a tendering procedure, thanks to its public and often widely publicised nature, tends to act as bait for unscrupulous intermediaries,** which thus find themselves included in a process that never would have interested them without the tender. This observation leads us to suggest that corruption exists as much within the tendering procedure as without it – although it is obviously impossible to prove or to make an objective comparison. In any case, it has not yet been proved that implementing a tendering procedure is able to guarantee perfect transparency in project selection.

As shown by the three observations above, considering that a tender guarantees healthy competition, and that the absence of a tender must mean the absence of any competition, is overly simplistic.

The rise of tendering procedures could also be explained by other, more political, factors. It might be worth launching an invitation to tender to give the appearance of taking action. It is not unusual, in the run-up to elections, to see multiple tender announcements, work commencements and even fake inaugurations.[104] Furthermore, many players (consultants, design offices, various foundations, etc.) can, in some cases, have a financial advantage in a tendering procedure, for which they can sell associated services (technical, legal or similar) to the public authorities at country level over a longer period.

The case of Guinea Conakry

For example, the Tony Blair Institute (TBI) has been advising the Guinean government since 2010 on the implementation of private-public partnership (PPP) energy infrastructure projects. As part of this mission, TBI notably helped the government to define and negotiate the Souapiti (hydropower, 450MW) and Kaleta (240MW) projects and to implement a financial and economic framework (PPP code, creation of a PPP unit within the energy ministry). This technical and legal consulting and assistance mission, aimed at building the skills present within the Guinean Republic, is subsidised by the World Bank.[105] Alongside this mission, several private players have completed the development of solar projects

[104] For example, the Central African Republic inaugurated a plant in April 2018 (http://centrafrique-presse.over-blog.com/2018/05/rca-lancement-des-travaux-de-construction-d-un-champ-solaire.html) for which the World Bank launched an invitation to tender in August 2018 (https://www.devbusiness.com/ProjectViewer.aspx?ProjectID=144712&ProjectType=1)

[105] https://institute.global/governance/guinea

validated by the authorities (energy ministry, administration ministry, inspection of major projects and public markets, Electricité de Guinée, etc.).[106] These projects were ready for launch in 2017 (and could have been completed *via* the PPP unit, assisted by the TBI), but TBI strongly recommended that the Guinean authorities implement a tender procedure. Almost two years later, the invitation to tender has still not been officially published and no projects have been completed. However, this period was used to conduct a number of consulting missions required by the tendering procedure: drafting of specifications, adaptation of the regulatory framework, skills development, etc.

d. The conditions for a successful tender

Notwithstanding the reservations and precautions cited above, what recommendations can be made if the authorities decide to implement a tender?

Meet the prerequisite conditions: A mature market, credible planning, suitable regulatory framework.

Guarantee a perfectly transparent process: public opening of bids, publication of examination reports, etc.

Prefer tender programmes lasting several years on a recurring basis, which offer stability of rules and visibility of volumes in the long term, rather than an invitation to tender limited to a single session, which does not allow parties to capitalize on experience.

Indicate the volume put on the market, taking into account local demand, electric grid capacity, and the available offer: it must not be too large (or the tender might not be fully subscribed) or too small (or candidates might be tempted to propose excessively low prices, or the tender might not attract international developers).

Segment the volumes proposed to enable competition between similar projects (notably in terms of size and location).

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[106] Incidentally, one of these players received a grant from ADEME during the state visit to France of President Alpha Condé in April 2017. https://presse.ademe.fr/2017/04/enr-et-gestion-des-dechets-une-cooperation-renforcee-entre-la-france-et-la-guinee-conakry.html

Define objective qualification criteria and publish the evaluation grid in advance. There is a simple way of checking that the criteria are objective: the candidates should be able to calculate their own scores upfront. These criteria should not limit access to large corporations only.

Limit access to already developed and "ready to build" projects. Opening a tender to undeveloped projects runs the risk of a high rate of "non-completion".

Demand short completion times and adequate guarantees to dissuade speculative behaviour.

It is all the more crucial that these basic precautions are respected in countries where the market is immature, because the failure of a first tender often affects the country's power to attract developers and investors, which, in a global market, constantly decide in favour of the countries that offer the best conditions for the development of solar projects.

In conclusion:

- In mature markets:
  - invitations to tender can be useful to select the most competitive projects for large solar power plants (provided the above recommendations are respected);
  - the "counter" mechanism remains best suited to small projects.

- In immature markets:
  - implement a regulatory, legal and fiscal environment that is suitable for solar projects;
  - ensure objective, credible planning (see paragraph II.2.d);
  - adopt standardised contracts applicable to all projects (power purchase agreement, concession agreement, grid connection agreement) and validated by the lenders;
  - set a feed-in-tariff associated with a retroactive feedback loop mechanism (see paragraph II.2.b), and impose solid guarantees for both electricity purchasers and producers.

Limit the almost systematic use of tendering, especially in immature market contexts and for small-sized projects

Recommendation n°7: Prefer mechanisms suited to the size of the project and the context of immature markets.

Recommendation n°8: Provide assistance for the first developments, furnishing public authorities and instructing parties with the expertise they lack, then organising the skills transfer to create a real lasting industrial sector.

Recommendation n°9: Once the market has matured, **consider the gradual introduction of tendering mechanisms,** but limit them to very large scale projects.

CONCLUSION

Electrification of the African continent via solar power is based on two quite different levers:

- **The connection of new solar power plants to existing grids,** notably under an IPP initiative.

- **The development of "access to electricity",** i.e. electrification of rural zones that are not connected to the grids using solar kits and decentralised mini-grids that are not connected to the main grid.

The three main reasons developed herein are not the only explanations for the difficulties observed hereto in completing solar power plant projects in Africa. Other factors can also be suggested, such as the economic or political difficulties currently facing certain countries, the multiplication of national ministries and authorities that might be in charge of the energy sector, the negative effects of fossil fuel grants applicable in many countries that have so far preserved the relative profitability of diesel gensets.

However, the three factors discussed herein are both the most prohibitive and the least known obstacles to solar power development in Africa. They also have one other thing in common: providing they have been properly identified, these obstacles can then be eliminated relatively easily.

Adapt financing to the capital-intensive nature and small size of solar projects

Recommendation n°1: Promoting planning efforts, a prerequisite for the development of solar power, notably by adapting regulatory frameworks to the specificities of solar projects.

Recommendation n°2: Facilitating access to finance: specifically enabling the aggregation of several projects by creating freely available standardised documentation accepted by all parties (buyer, public authorities, lenders, operators, developers, etc.), and reducing the cost of examining files by adapting lender demands to the size of the project.

Recommendation n°3: Reducing the cost of finance: facilitating access to debt enhancing tools (guarantees, insurance) and making concessional loans available to IPP projects.

Restrict public subsidies that create market distortions

Recommendation n°4: Check that there are no private projects within the specified zone before considering the location of a public project.

Recommendation n°5: Limit artificial price signals whenever possible: avoid subsidies (for studies, real estate, connection, etc.) that might discourage private investment

Recommendation n°6: Promote better collaboration between public and private funds: focus public funding on projects that fail to attract private investors, such as medium and low voltage grid infrastructures, provision of credit enhancement tools for public counterparts, capacity building.

Limit the almost systematic use of tendering, especially in immature market contexts and for small-sized projects

Recommendation n°7: Prefer mechanisms suited to the size of the project and the context of immature markets.

Recommendation n°8: Provide assistance for the first developments, furnishing public authorities and instructing parties with the expertise they lack, then organising the skills transfer to create a real lasting industrial sector.

Recommendation n°9: Once the market has matured, consider the gradual introduction of tendering mechanisms, but limit them to very large scale projects.

The above recommendations assume that decision-makers (notably but not only politicians) will reject simplistic solutions and make the selfless choice of more complex options that might be less visible to the general public. This is the cost of efficiency – and perhaps it applies even more to infrastructure deployment than in any other field. Is it utopic to hope for such changes? There is little point in even asking the question, because there is no longer any viable alternative. Today's decision-makers have an unprecedented responsibility as climate change is gaining momentum worldwide and demographic growth is taking off in Africa – the time for bold actions has now come.

- The first prerequisite to offer to Africa's youth a future matching its legitimate aspirations is to accelerate the deployment of energy infrastructure, so that this rate overtakes the rate of demographic growth over the next five years. If we fail to do this, the African exodus will continue and worsen, starting with the most qualified profiles.

- The global increase in CO_2 emissions, makes the use of low carbon technologies necessary to meet the electricity demands of a growing African population and to enable access to power for the 650 million Africans living without electricity. Without minimising the importance of reducing CO_2 emissions in France (1.2% of global emissions) or in Germany (2.7% of global emissions), the absolute priority of a global climate policy should also aim to prevent the considerable future emissions that would result from the massive adoption of fossil-based power generation to supply the 2.5 billion people who will be living in Africa in 2050.

The responses to both the climatic and demographic challenges, probably the most daunting challenges facing the 21st century, share a common point: the rapid deployment, on a *very large scale,* of *low carbon* and economically *affordable energy*. Solar power is currently the main if not the only option available to meet all these conditions in Africa. Removing the obstacles identified herein is the utmost condition to enable this power source, at last, to make a contribution in line with its immense potential.

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THERE IS NO DESIRE MORE NATURAL THAN THE DESIRE FOR KNOWLEDGE

Bright Perspectives for Solar Power in Africa?

Responses to the climate and demographic challenges of the African continent, probably the most important ones of the 21st century, have one common denominator: the rapid deployment, on a very large scale, of economically accessible low-carbon electricity. Solar energy is today the main vector at our disposal to meet all these conditions in Africa. Its advantages are known; however, to date, an insignificant number of solar power plants have been installed on the continent.

Several obstacles can explain this situation. The existing financing tools are not adapted to the capital-intensive nature of the project and to the small size of the solar power plants. The almost systematic use of calls for tenders to identify and select solar projects raises some problems (cumbersome procedures in relation to the size of projects, underbidding of candidates). Finally, the subsidy policy implemented indiscriminately by a few states and development banks leads to a price signal, certainly very attractive, but artificial, thus accentuating the difficulties met by private developers. This policy paper sets out proposals to remove these obstacles, which is an essential prerequisite so as to finally allow solar energy to make a contribution commensurate with its immense potential.

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