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Book

Private production or public project ownership to scale up the construction of photovoltaic power plants in Africa? : from an exclusive approach to seeking the best combination

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OCTOBER 2022 | Nº 10

Policy Paper

Private production or public project ownership to scale up the construction of photovoltaic power plants in Africa?

From an exclusive approach to seeking the best combination

ÉDITIONS AFD AGENCE FRANÇAISE DE DÉVELOPPEMENT

Keywords: Independent Power Producer (IPP), public-private partnership (PPP), public project ownership (PP0), Africa, solar photovoltaic (PV) power plant, development finance institution (DFI), budget sustainability, public debt, Wall Street Consensus (WSC).

Abstract: Despite its abundant solar resources, Africa currently has low solar photovoltaic (PV) power generation capacities compared to other continents. Yet, the International Renewable Energy Agency (IRENA) projects a scale-up in coming years, with a sharp increase in the rate of construction of grid-connected PV power plants to align with the Paris Agreement pathways and the Sustainable Development Goals (SDGs).

The private sector, which has historically played a major role in the development of solar power generation, has established itself as the prime player for these projects with the Independent Power Producer (IPP) model.

Yet many African countries' electricity sectors present particularities (sharp growth in demand, small grids in the process of interconnection, fragile national utilities and customers' limited ability to pay). These particularities call into question the development model that prioritizes the private sector for production, even if it is heavily supported by numerous development finance institutions (DFIs).

In this context, and in order to scale up the construction of the solar PV power plants required to deliver a "low-carbon" transition for African countries, it is worth assessing the option of public project ownership (PPO) structures in addition to IPP structures.

A simple comparative analysis of "production costs" (generally higher in the case of IPPs due to the weight of the cost of capital) and "level of public debt" (higher in the case of PPO) is not enough to guide the public party's choice of one or the other type of structure. Whatever the development model, the country's government and national electric utility are financially impacted by the direct and/or conditional commitments made. It is therefore worth examining the long-term sustainability of the public player's private investment "derisking" strategy, conceptualized under the name of the Wall Street Consensus (WSC). In addition, the public party plans national solar PV power requirements and needs a good command of the technology to build its programming capacity and negotiating power. These arguments for PPO are nonetheless counterbalanced by the fact that: *(i)* the public party does not always have the capacity to conduct as many projects simultaneously as the private sector, and *(ii)* given that public monies are limited, the public authority has to make trade-offs in terms of debt allocation among the different sectors, some of which find it harder than the electricity sector to attract private finance.

This *Policy Paper* therefore seeks to show how the complementarity of IPP and PPO set-ups can scale up the development of solar PV power plants in Africa.

Acknowledgments

The findings presented in this paper are based on a study commissioned by AFD from consultancy firm Nodalis, which we sincerely thank here for the quality of their work and discussions. The points and proposals made are those of the authors and do not necessarily represent the AFD Group's institutional position.

We are grateful to all the contributors to this study, on both the AFD and Proparco teams, for collecting information on the projects analyzed and for their attentive reviews, which helped us shape the paper and present an interesting position on financing solar power in Africa.

Some readers may find this paper too moderate and others too radical. In any event, we have endeavored to be as precise as possible and hope that the debates to which the paper may give rise will enrich our collective understanding and speed the just development of "low-carbon", much-needed on the African continent and in the world in general.

Highlights/Executive summary

Africa is projected to scale up its development of solar PV, hailed by the International Energy Agency (IEA) as the "new king of electricity" (WEO, 2020).

- Although Asia, North America and Europe will remain the dominant solar PV markets through to 2030, if not beyond, IRENA projects that growth will be strongest in Africa with 131 GW of installed capacity by 2030 (+1,500% between 2018 and 2030 as opposed to +140% for Europe and +560% for Asia), and a potential total installed capacity of 673 GW by 2050.
- On the ground, however, the development of solar power is still very slow in Africa and a rapid scale-up is needed if it is to align with the Paris Agreement pathways and the SDGs. The IEA's *Sustainable Development Scenario* (SDS) on holding warming below 2°C above pre-industrial levels and achieving universal energy access by 2030 states that renewable energies would need to account for 79% of the African electricity mix by 2040 (compared with 21% in 2019),[1] with 31% of that figure in solar PV power. Achieving that target would require 17 GW of solar capacity to be installed per year between 2020 and 2040, whereas solar capacity rose a mere 1 GW between 2018 and 2019.[2] This then calls for a scale-up by massively accelerating solar power investments.
- The steady decrease in costs observed over the last decade has made solar PV power plants among the most competitive on-grid means of generation while continuing to have one of the lowest levels of greenhouse gas (GHG) emissions.[3]

1 *World Energy Outlook* 2020, Table A.2: Power sector overview, p. 341.

2 *World Energy Outlook* 2020, Table A.3: Electricity and CO2 emissions – Africa, p. 373.

3 Even if the recent increase in solar panel costs due to the combined effect of the health crisis (break in supply chains) and inflation driven by the crisis in Ukraine raises the production cost of the electricity generated, it is not expected to undermine the competitiveness of solar power over thermal power.

It remains key for public authorities to plan investments in the electricity sector in a context of rising shares of intermittent power.

- African power systems have all seen sharp growth in demand and consequently their needs for generation, transmission and distribution infrastructures which, combined with the need to build "low-carbon" economic development, call for dynamic electricity sector planning by governments.
- There are still very few sophisticated energy markets working with spot market sales in Africa, or developing countries in general, where private producers would be prepared to build and finance production units taking a commercial risk in this market (i.e. without a long-term contract). In this context, it therefore still falls to the public operator to commit to purchase all the electricity produced on long-term power purchase agreements.
- The contract models generally used to date provide for neither producer intermittence management commitments nor the billing of intermittence management services provided by operators (even though they are starting to develop with projects including storage). Public operators are alone responsible for grid stability affected by the addition of intermittent energy sources.
- While many solar projects in Africa have been developed by IPPs on the basis of unplanned direct negotiations, public authorities have to optimally plan investments for the electricity sector by means of medium-term planning (15 years) and short-term multi-year programming (five years) so that they can determine and optimize the total volume of solar projects that need to be developed.

The production cost differential between public project ownership (PPO) and independent power producers (IPPs) is due mainly to financing cost differences.

- IPP projects are mainly developed, built, operated and owned by the private sector using private finance. However, long-term debt for solar projects developed by IPPs in Africa, generally accounting for three-quarters of financing, is very often raised from development finance institutions (DFIs), since commercial banks in most African countries are as yet unable to offer financing suited to the particularities of these projects.
- PPO projects in Africa are often funded by highly concessional debts from DFIs at rates that bear no relation to market terms. This particularity is due to many African countries' low level of development, which provides access to highly concessional resources. Nevertheless, these resources are limited and call for optimal allocation across all economic sectors, but also among generation, transmission and distribution within the power sector itself.
- One point in common between these two models remains the importance of competitive bidding by operators (IPPs) and constructors (PPO), which is obviously necessary to secure the most competitive rates and costs.
- The case studies conducted find no significant difference between PPO and IPPs in terms of investment costs (Engineering, Procurement and Construction – EPC – costs). This appears to be due to the fact that the EPC firm is generally hired by structured competitive procedures in both cases.

- The production cost of solar power is closely correlated with the cost of capital due to its highly capital-intensive nature (high investment costs and low operating costs). Financing costs therefore considerably raise the tariff for the energy generated by an IPP solar PV power plant. This is due to both the remuneration of private equity (real internal rate of return [IRR] after tax of between 10% and 15%, where 10% is attained with a high level of competition) and the cost of debt contracted by project firms, which is higher than the cost of concessional financing accessible by governments and, depending on their financial situation, national public utilities.
- Financial simulations were conducted for a given medium-sized project (30 MW for both development models). In terms of average energy cost, the real production cost is between 28% and 46% lower for the PPO scenario than for the IPP scenario, depending on the situation considered. This comparison is made by way of an illustration, since the costs of debt and capital can vary considerably from one country to the next.

Government net lending capacities need to be considered to move beyond the hypothetical debate on the merits of public debt for the development of solar PV power.

- It is advisable **not to take an approach based on the assumption** that a solar project cannot be developed by PPO purely because it would impact on public finances at a time when developing countries' debt levels are increasing.
- A PPO set-up implies a higher level of direct government commitments than the IPP set-up. Nevertheless, the IPP set-up represents a total commitment that has to take into account both direct and conditional government commitments, even though conditional commitments cannot be considered to be on a par with direct commitments.

- The decision-making process between a PPO development model and an IPP development model needs to consider their respective impacts on the national offtaker utility's cash flow requirements and ultimately on the current state budget if the national utility is subsidized. Financial simulations discounting public entities' consolidated cash flows at a rate of 6% find a differential in favor of PPO ranging from 22% to 39% depending on the hypothesis.[4]
- Note also that these economic advantages associated with PPO in Africa are subject to the availability of highly concessional resources from the DFIs which, limited by nature, also need to be used for the other sectors key to development. The use of PPO, although advantageous in a number of respects, is therefore also constrained by the availability of these resources and by government borrowing capacities.
- Lastly, it is probably worth examining the long-term sustainability of the development financing model using private finance with strong government guarantees, conceptualized as the Wall Street Consensus (WSC).[5]

Development timeframes are more or less the same for PPO and IPPs. The timing of the development stages under PPO facilitates capture of the decrease in solar PV prices.

- The case studies show that development timeframes for PPO and IPP solar PV projects often fall quite far behind the provisional schedules, without there being a clear advantage to one or the other model. Nevertheless, it is clear that one of the keys to staying close on schedule in both cases is the level of political priority accorded the program or project, by both the government and public parties in charge of the sector, and the DFIs involved.

4 This comparison is made by way of an illustration, since debt and capital costs can vary considerably from one country to the next.

5 *The Wall Street Consensus*, Daniela Gabor (UWE Bristol), https://osf.io/preprints/socarxiv/wab8m/

- Even in the case of competitive tenders, the start of work in a PPO set-up is nearer to the date of the conclusion of the contract, enabling the public utility to directly capture the decrease in PV costs. This is due to the fact that the funding period is upstream of the conclusion of an EPC contract in a PPO set-up, whereas it is downstream of the signing of a power purchase agreement under an IPP. Nevertheless, in the case of IPP competitive tenders, bidders would appear to factor the provisional commissioning dates into their EPC contract quotes, thereby enabling the public party to capture at least part of the PV cost decrease.

Countries still need to upgrade their skills in this "new" energy source.

- Solar PV technology and its associated contracts call for public administration capacity-building and upskilling to give governments all the tools they need to scale up their deployment. Setting up a PPO operation builds their technical capacities.
- Tried-and-tested experience in constructing PV power plants under PPO definitely helps public parties better prepare and oversee future projects by independent producers.
- One key point that PPO and IPP structures have in common is that they assist and upskill national private players so that conducting PV projects is not entirely dependent on international companies.

The recommendation on the strength of this analysis is to combine the two types of structures to scale up the development of solar power in Africa.

- Where independent power producers are able to deploy solar power on a greater scale while limiting direct government commitments, PPO can *(i)* leverage more competitive production costs, *(ii)* limit cash flow constraints, and *(iii)* build the public utility's capacities.
- The purpose of these different elements of appraisal of PPO and IPP development models is not to make an exclusive choice between one or the other model. Projects developed with independent producers and projects developed by a public utility in PPO mode can coexist within one and the same solar development program, especially small- to medium-capacity projects which appeal less to the private sector.
- In the case of a program defined in keeping with the sector plan to develop a number of projects in a relatively short space of time (e.g. five years), the coexistence of projects developed under PPO with projects developed by IPPs can hence be an effective way to deploy the entire program.

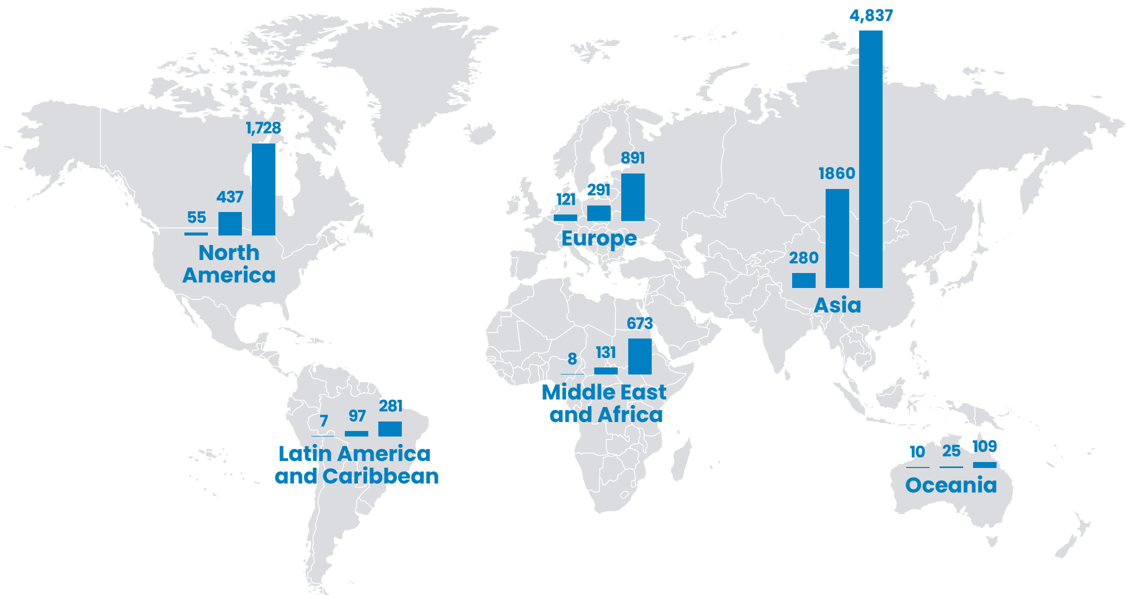
Introduction

Scaling up the construction of solar photovoltaic (PV) power plants in Africa

In 2019, the total installed capacity of solar PV energy in Africa stood at nearly 7,500 MW, with 80% in the "South Africa-Egypt-Morocco-Algeria" group and 20% in the rest of Africa.[6] Africa hence lags behind the other continents with approximately 1.6% of global installed capacity.

Although Asia, North America and Europe will remain the dominant markets looking ahead to 2030 and 2050, IRENA forecasts that growth will be the strongest in Africa with 131 GW of installed capacity in 2030 (+1,500% between 2018 and 2030 as opposed to +140% for Europe and +560% for Asia).[7] Total installed capacity could therefore reach 673 GW by 2050.[8]

Map 1 - Solar PV installed and projected capacities (2018, 2019 and 2020)



Source: IRENA (2019).

6 IRENA (2020), Renewable capacity statistics 2020, International Renewable Energy Agency, Abu Dhabi.

7 IRENA (2019), *Future of Solar Photovoltaic: Deployment, investment, technology, grid integration and socio- economic aspects* (A Global Energy Transformation: paper), International Renewable Energy Agency, Abu Dhabi.

8 *Ibid.*

Since African countries opened up the generation segment to private investors which have been highly active in solar energy over the last decade, a significant share of high-capacity PV power plants have been built by the "independent power producer" (IPP) model.

However, most African countries' electricity sectors present both technical and financial fragilities, which are putting a brake on both the development of independent power producers and investments by public operators.

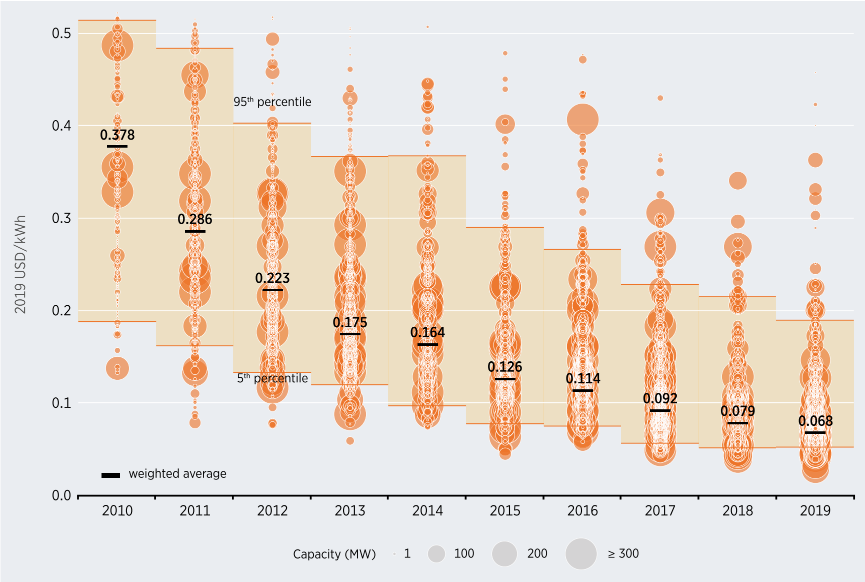
In this general setting, we need to look into how to speed the pace of the construction of solar PV power plants making best use of the different electricity generation development models.

Considering public and private development models for solar PV power plants in developing countries

The steady decrease in costs observed over the last decade has made solar PV power plants among the most competitive on-grid means of generation while continuing to have one of the lowest levels of greenhouse gas (GHG) emissions.[9]

9 Even if the recent increase in solar panel costs due to the combined effect of the health crisis triggered by the COVID-19 pandemic (break in supply chains) and inflation driven by the crisis in Ukraine raises the production cost of the electricity generated, it is not expected to undermine the competitiveness of solar power over thermal power.

Figure 1 - Installed capacity and average long-term cost for solar PV power plants



Source: *IRENA (2020).*[10]

Solar power generation is therefore logically set to become a major pillar of developing countries' energy transition (ET) policies, strongly supported (financially and technically) by the international financial institutions (IFIs).

Moreover, the last four decades have seen the development of private producers in connection with energy sector liberalization policies gradually applied worldwide, and in the developing countries in particular, mainly in the generation segment.

Both cause and effect of this underlying trend, successive public policies have sought to overhaul the national and regional legal and institutional frameworks to facilitate private power production projects. The IFIs have strongly supported these reforms while diversifying their intervention tools to minimize the financial and commercial risks taken by the private sector. The private sector has hence played a major role in the development of on-grid solar PV power plants with what is known as the "independent power producer" (IPP) model.

10 IRENA (2020), *Renewable power generation costs in 2019*, International Renewable Energy Agency, Abu Dhabi.

Regarding sector reforms, no African country has put in place an unbundled and fully liberalized electricity sector model. Many countries have a situation whereby electricity is sold by one or more public operators without there being a market allowing for free competition among the different power producers. Such is the case with most of the developing countries. This is why the development of power generation projects (including solar PV power plants) by private operators is currently based almost entirely on long-term power purchase agreements with a public utility, which can moreover make the system inflexible in terms of transferring to a wholesale market (ESMAP, 2020).

The objectives of AFD's new "energy transition" strategy clearly frame the debate by aiming to "accelerate the energy transition in developing countries in the direction of efficient, resilient and low-carbon energy services for all". The choice of solar PV project model meets the aims of speed of commissioning and long-term performance of the power plant while ensuring a real scale-up and seeking to minimize its impact on the sector's financial equilibrium and maximize its economic benefits for the end user and for the State.

To properly understand the question of a public or private model, or even "hybrid" public-private model, for a solar project, note that the optimal development of a system of generation at national grid scale cannot be based solely on private or public initiatives. Choosing between one or the other model calls for a sound understanding of their legal, institutional, financial, technical and organizational repercussions. An analytical framework for public policymakers is proposed to facilitate the development of PV power by one or the other of the models. A brief presentation of this framework is given in this policy paper.

1. General presentation of the public and private development models for solar PV power plant projects

1.1 – Optimal development of the means of production

African power systems have all seen sharp growth in demand and consequently their needs for generation, transmission and distribution infrastructures. Yet, even though demand exceeds supply, there are very few "energy markets" where private producers would be prepared to build and finance production units taking a commercial risk in this market. The commercial standard remains the long-term power purchase agreement. The contract models generally used to date provide for neither producer intermittence management commitments nor the billing of intermittence management services provided by operators, even though they are starting to develop with projects including storage.

In this environment, public authorities have to optimally plan investment needs for the electricity sector by means of multi-year programming aligned with the objectives of the Paris Agreement. Different planning outlooks can be adopted: *(i)* a very long-term horizon (20 to 30 years) for the electricity sector (sector policy guidelines), and *(ii)* a cost-effective "low-carbon" grid development plan covering at least generation and transmission in the medium or long term (10 to 20 years), part of which could be specified in a detailed short-term (five-year) investment program.

Within this multi-year programming for the electricity sector as a whole, public authorities need to determine the total volume of solar PV projects they plan to develop in the short term (five years) and the maximum injectable capacities per sub-station. Breaking down the solar PV power plants program into different projects shows how maximum capacities can be deployed project by project.

1.2 – Understanding the options available to governments to develop solar PV power plants

Once the PV growth goals have been set, what options are available to governments to construct grid-connected solar PV power plants (subject to national legal provisions)? Governments in the vast majority of countries on the African continent can select private independent power producers or choose PPO to build power plants, often working with public utilities.

Independent power producer (IPP) projects are mainly developed, built, operated and owned by the private sector and are, as a rule, privately financed.[11]

In developing countries, the feasibility and competitiveness of an independent power producer project often depend on substantial commitments that the public party must be prepared to make, over and above the market risk (energy yield purchase obligation clause), to cover the commercial risk (state guarantee and/or financial institution guarantee to cover payment default by the offtaker), the exchange and convertibility risk, and the political risk.

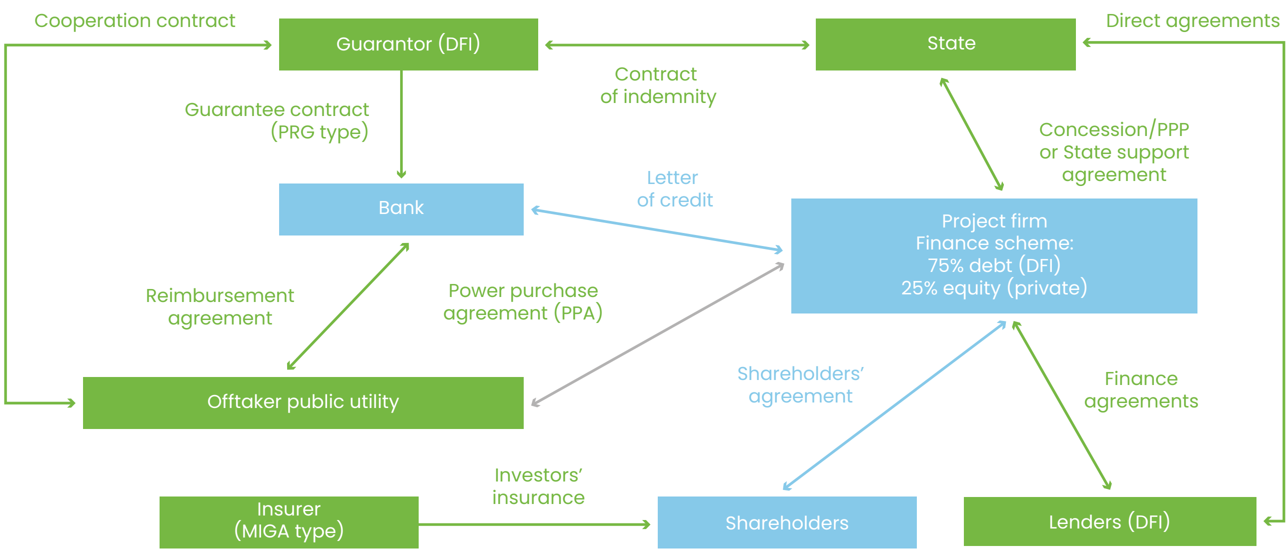
In the case of solar PV power, with initial investment costs representing approximately 80% to 90% of the tariff (return on initial investment and finance costs), these investment funding constraints are particularly critical to the project's general economy.

Moreover, with the exception of South Africa, funding for IPP-developed projects in Africa makes little use of the commercial banks. Now and then, and generally for large projects, provision can be made for a share of financing in local currency. The commercial banks are also involved in setting up liquidity mechanisms (escrow accounts and letters of credit). Nonetheless, their involvement remains marginal: the USD/EUR liquidity and regulatory constraints (limited maturity) weighing on the local commercial banks prevent them from offering maturities compatible with concession and sales contracts. Other "impacting" parameters are the commercial banks' restricted expertise in limited-recourse financing and lack of inclination to take risks.

Long-term debt is therefore very often raised from development finance institutions (DFIs) for IPP-developed solar PV power plant projects. DFIs offer longer maturities and are more inclined to take risks than commercial banks. DFI involvement in financing IPP solar power plants is illustrated in Diagram 1.

11 Eberhard A., K. Gratwick, E. Morella and P. Antmann (2016), *Independent Power Projects in Sub-Saharan Africa: Lessons from Five Key Countries, Directions in Development – Energy and Mining*, World Bank, Washington, D.C.

Diagram 1 - Public and private players characteristic of an IPP solar power plant project in Africa



■ Private entity
■ Public entity

MIGA: Multilateral Investment Guarantee Agency
PPP: Public-Private Partnership
PPA: Power Purchase Agreement
PRG: Partial Risk Guarantee

Source: Nodalis

The contractual and financial engineering is much simpler for projects set up under public project ownership (PPO): a public entity (generally the national electric utility in charge of generation) concludes the design-build contracts and – where appropriate – the power plant operation and maintenance agreement. In the African context, the public entity often has access to sovereign finance on concessional terms (either raised by the government itself, which on-lends them to the entity, or raised directly against a sovereign guarantee). If the public entity has the capacity to incur debt, it can borrow from DFIs on a non-sovereign basis. This presupposes that the State or the public entity has the capacity to take on debt and, in the case of sovereign debt, that the state decides to allocate this debt to the power generation segment.

In this model, an EPC contract (covering both design and build) is generally concluded between the public generation utility and a firm hired by competitive bidding (CB). Although procurement is well-prepared and monitored (often with DFI support), a fundamental question concerns the strategy adopted for the operation and maintenance of the power plant once it is up and running. The EPC firm is generally asked to provide operation-maintenance support at the start of the operating period, but particular attention needs to be paid to PPO projects with respect to the maintenance strategy throughout the power plant's operation.

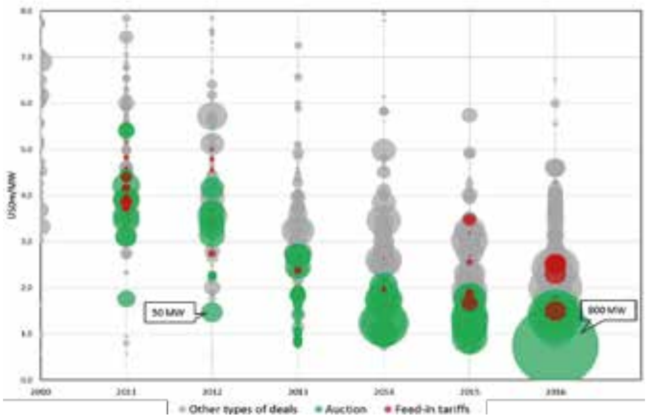
There are different ways of putting together "hybrid" forms of these development models. Hybrid financing models can be found, for instance. One example of this is the MASEN model (Moroccan Agency for Sustainable Energy). This model uses concessional financing on-lent to project firms developing innovative renewable energy (RE) projects. In some countries, a public institution partners with the project firm's shareholders (which may be a regulatory requirement or government decision). Lastly, from a more technical point of view, a project may be developed partly in IPP mode (solar PV power plant) and partly in PPO mode (secure access to the site, general site development, connection lines, etc.) along the lines of the solar park model.

2. Understanding the issues and implications of public and private models

2.1 – Basic factors in common: competitive bidding and project preparation

The first point in common between the two models is competitive bidding by operators (IPPs) and constructors (PPO), which is obviously required to secure the most competitive rates and costs, as shown by Figure 2.

Figure 2 - Investment costs for solar projects in Africa, by selection method



Source: Dobrotkova Z. (2016), Price of Solar PV Electricity in Developing Countries, World Bank, Washington, D.C.

Secondly, irrespective of the model chosen, the public party needs to meticulously prepare the project(s) upstream of selection of the operator or constructor. This entails costs and the use of suitable expertise: choice of grid injection points, land access arrangements, environmental and social impacts, impact on the grid, choice of selection method, technical, economic and financial feasibility study, etc.

These project preparation stages, associated with the general programming approach described in the paragraphs above, are sometimes overlooked by directly negotiated IPP-PV projects. Such an oversight can undermine the sound integration of intermittent energy sources on the grid and have negative impacts on project development timeframes and costs.

These project preparation stages call for resources often obtained from IFIs, which generally show an interest in assisting governments and national electric utilities with preparing these projects.

2.2 – The public party's capacities form an important selection criterion

Solar PV power plants developed by the public party under PPO call for strong technical program and project management capacities, especially during the design-build-operate phases. Otherwise, it would be hard to raise funds from the DFIs, which could hold up the operationalization of the power plants.

The solar PV power plants developed by independent producers, on the other hand, require strong capacities to prepare the private operator hiring transaction and conduct negotiations. They call for specific legal and financial skills to attain "financial closure" for the project. It is of note that the period between the contract conclusion and "financial closure" is a critical period for many IPP-developed projects.

Although the question of the public entities' capacities in one or the other development models is important, it is not a disqualifying element in the choice of development model if suitable assistance has been put in place for these entities. Moreover, a public party with tried-and-tested experience in constructing solar PV power plants under PPO will definitely be more capable of adequately preparing and overseeing projects assigned to independent producers.

2.3 – Different development timeframe constraints

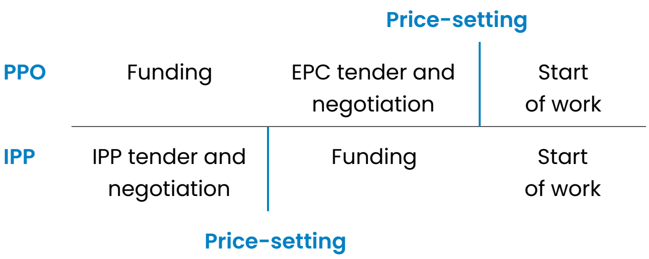
The case studies conducted for our discussion show that the development timeframes for PPO and IPP solar PV power plant projects often fall quite far behind the provisional schedules, and that one of the keys to staying on schedule is the level of political priority accorded the program or project, by both the government and public parties concerned and the donors involved.

In the case of an IPP project, the legal and regulatory framework also has a significant effect on project progress. The case of the Scaling Solar program in Senegal is interesting in this respect: even in the case of a program prepared with structured legal, technical and financial means, the extent and range of formalities to be conducted and authorizations to be obtained[12] to develop an IPP project and the large number of national institutions and, where applicable, regional institutions involved makes it hard to keep on schedule, even in a country with sound experience in conducting IPP projects.

Moreover, the delivery deadlines set in the power purchase agreements and the financing agreement provide a strong incentive to respect the deadlines for conducting the work by the IPPs: count approximately one year between the start of work and commissioning, when the reception and test phase alone upstream of the operationalization of PPO power plants can take several months. It can therefore quite certainly be considered that the construction timeframe once the EPC contract has been signed is shorter for an IPP set-up than PPO.

Lastly, even in the case of competitive tenders, the start of work is nearer to the date of the conclusion of the contract in a PPO set-up than in an IPP set-up. Price setting will therefore be conducted nearer to the start of construction. This is due to the fact that the funding period is upstream of the conclusion of an EPC or construction contract, whereas it is downstream of the signing of a power purchase agreement under an IPP. Nevertheless, in the case of IPP competitive tenders, bidders would appear to factor the provisional commissioning dates into their EPC contract quotes, thereby enabling the public party to capture part of the solar power cost variations.

Diagram 2 - Price-setting timing by model



Source: Nodalis

2.4 – Relatively similar technical costs for both models

There is no consolidated database available to assess the difference in technical costs observed between the IPP and PPO models. However, the case studies conducted find no significant difference between IPPs and PPO in terms of investment costs (EPC). This appears to be due to the fact that the EPC firm is hired – directly or indirectly – by a well-structured competitive procedure, whether conducted by a private developer or a public authority.

12 Set-ups can call for authorizations to open offshore accounts, commitments in terms of covering the risk of transferability and convertibility or managing the exchange risk, tax treatment, etc.

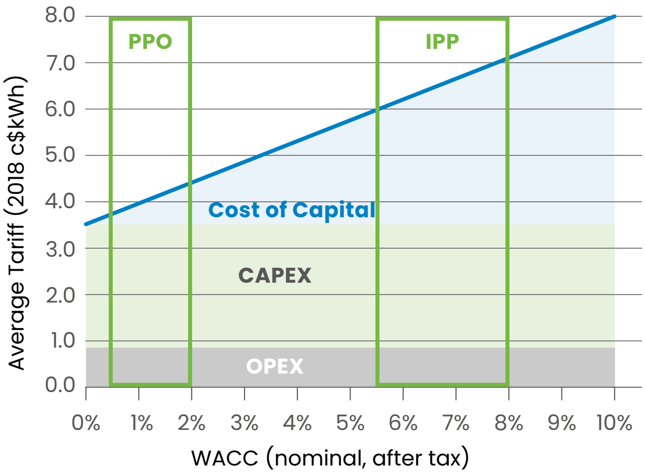
Another important question often raised is whether investment cost overruns are observed more in PPO projects than in IPP projects. In the absence of consolidated databases to allow for comparisons, it can be noted that solar power plants are fairly standardized infrastructures whose cost depends mainly on the equipment, and that the structure of a "turnkey" EPC contract is generally relatively robust to cost slippages. The fact remains, however, that the project construction schedule is often longer for the PPO option once the EPC contract has been signed, which does have an impact on EPC costs.

2.5 – Substantially higher average financing costs with IPPs

Financing costs considerably raise IPP tariffs. This is due to *(i)* the remuneration of private equity (real internal rate of return after tax estimated at between 10% and 15%, where 10% is attained with a high level of structured competitive bidding), and *(ii)* the higher cost of debt contracted by project firms compared with the concessional financing accessible by governments and, depending on their financial situation, national public utilities, despite concessional funds also being available for private projects.

Figure 3, adapted from an IPP project feasibility study for AFD, illustrates the weight of financial costs in IPP solar power projects. The "PPO" and "IPP" zones represented on the chart identify the weighted average cost of capital brackets typically found for solar power projects in Africa (see the main hypotheses in Box 2 in the appendix).

Figure 3 - Real average tariff and breakdown between technical cost and financial cost



Source: Nodalis

2.6 – Comparison of the impact of two development models on total project cost and public finances

A comparison of the two development models is particularly complicated, since it has to use cost and performance hypotheses in the absence of a database on projects conducted, and generate relevant comparative metrics for the public party in order to inform its choice.[13]

As discussed above, solar PV power plant projects in Africa are heavily supported by DFIs, irrespective of the development model (IPP or PPO).

So the scenarios to be compared need to take into account this particular support. In PPO mode, this support consists in having the entire project cost (solar PV power plant and connection) borne by a sovereign loan on-lent to the national electric utility. In IPP mode, it takes the form of assisting with project preparation (technical feasibility studies conducted and land secured) and then providing a "financing package" for the bidding documents (BDs) in order to secure financing and shorten the financial closure timeframe (this

13 A comparative analysis of the two development models (IPP vs PPO) for a given project is generally required by the regulations to justify the use of a public-private partnership (PPP).

"financing package" may take the form of terms and conditions for different financial instruments offered by these institutions).[14]

The simulation exercise conducted by way of an illustration[15] compares these different scenarios to "standard" scenarios. In the PPO scenario, the national electric utility takes out debt from a DFI while self-financing part – admittedly marginal – of the project (raising the costs of financing the project). In the IPP scenario, most of the project development and preparation costs are borne by the private developer, without structured competitive bidding secured by an integrated financing package.

2.7 – A production cost strongly affected by the cost of financing the project

One of the main points that differentiates a PPO model from IPP development is the production cost of the electricity. This difference can be due to two causes: a difference between the technical costs generated in one or the other of the models, and financial cost differentials.

The following table presents the results of the comparative scenarios focusing on the combination of the impact of the chosen technical and financial hypotheses. In terms of average energy cost (including the alternative energy source due to late commissioning in the PPO scenario), the real production cost is between 29% lower (first comparison) and 45% lower (second comparison) for the PPO scenario than for the IPP scenario.[16]

Table 1 - Comparisons of average cost prices by type of structure

	1ST COMPARISON (MINIMUM DIFFERENTIAL)		2ND COMPARISON (MAXIMUM DIFFERENTIAL)	
Scenario	**Standard PPO**	**IPP with integrated DFI support**	**PPO with integrated DFI support**	**Standard IPP**
Average production cost (cEUR/kWh)	3.7	5.2	3.5	6.4

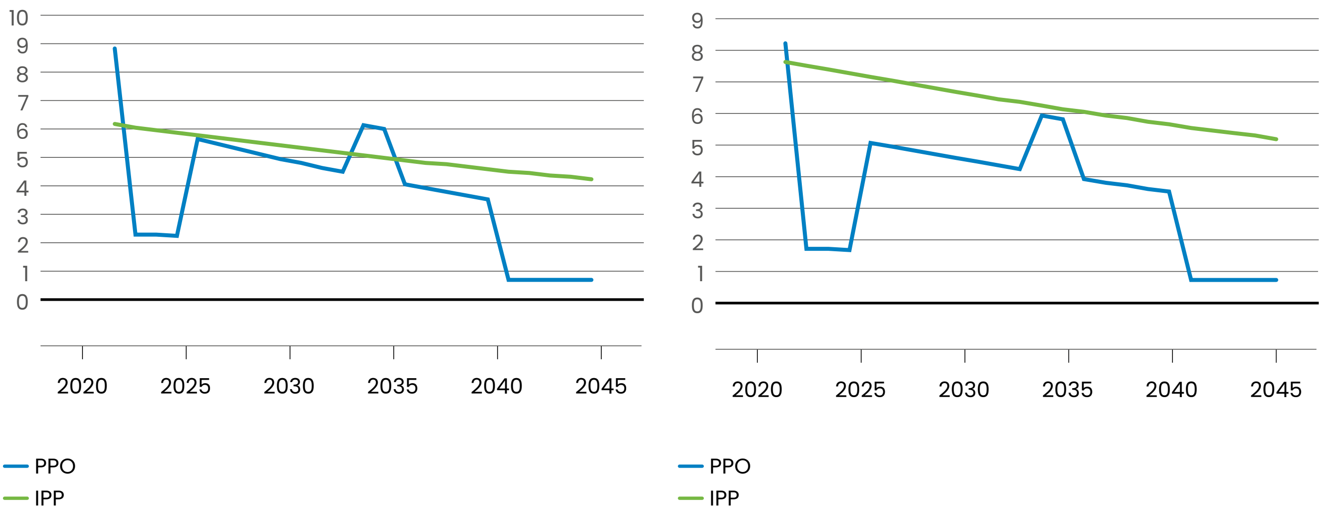
Source: Nodalis

14 See Box 2 (appendix) for more detailed hypotheses regarding the scenarios considered.

15 In the following, we discuss the financial and budgetary impact of the PPO and IPP development models. In order to provide framing figures, two comparative exercises were chosen for the development of a 30 MW power plant in the report that served as the basis for this paper, the main hypotheses for which are presented in Box 1 (appendix).

16 The variability in production cost in PPO mode is due to the inclusion of: *(i)* additional costs for the purchase of an alternative energy source in the first year, *(ii)* the grace period for the debt principal, and *(iii)* costs of renewing inverters midway through solar panel lifespan.

Figure 4 - Energy cost for the 1st comparison (left) and for the 2nd comparison (right)



Source: Nodalis

Note that a key factor to make these gains in terms of production cost is for the public operator of the solar power plant to put in place a maintenance strategy to reach a level of performance comparable to a private operator. This is why we have taken the hypothesis that operational expenditure (OPEX) is not lower for a PPO structure so that the possibility of outsourcing the power plant's operation and maintenance (at least at the start of the operating period) can be taken into account. This point is fundamental and must be taken into consideration for any potential development using a PPO model.[17]

2.8 – An analysis of budget sustainability needs to include "conditional" government commitments

The purpose of studying an investment project's budget sustainability is to determine the impact on government commitments of the different project development contracts and agreements concluded with private operators. These commitments are generally broken down into "direct" commitments, corresponding to firm government financial contributions earmarked for the project's development, and "conditional" commitments, corresponding to financial contributions subject to the accomplishment of certain circumstances or events.

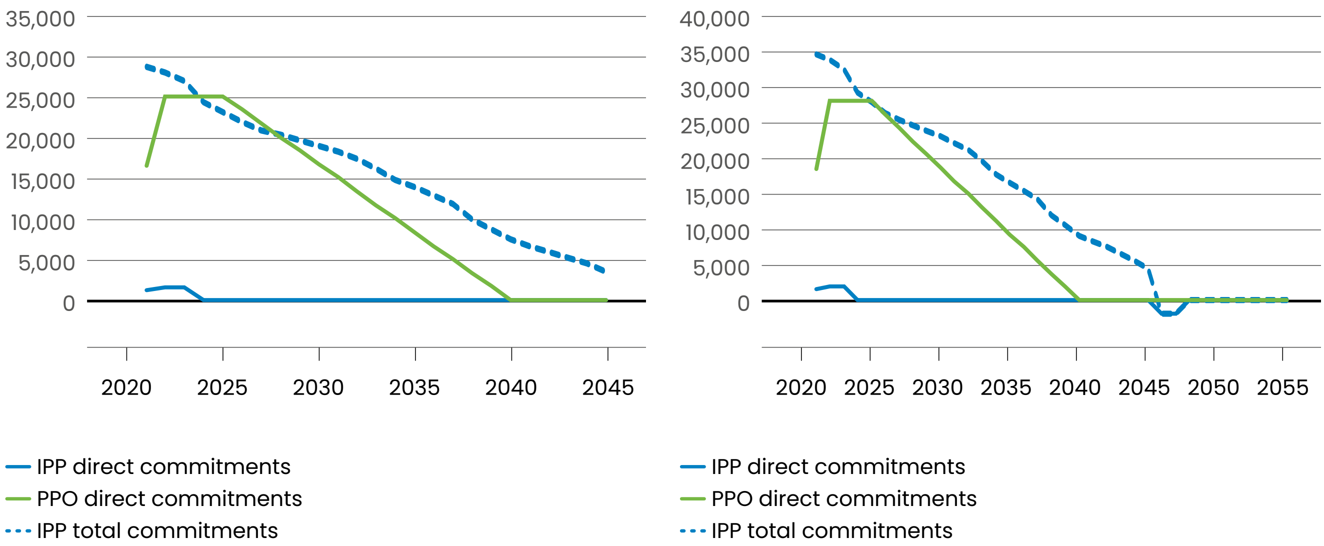
"Direct" government or national electric utility commitments in a PPO model are generally fairly small: project preparation costs cover expenditure during the project development period (transaction costs, hiring consultants, etc.); an investment subsidy may sometimes be provided for in highly specific and increasingly rare cases to cover connection costs, for example.

Government commitments are therefore mainly "conditional" and may, for example, be associated with guaranteeing the offtaker's payments or compensation for termination of the contract concluded with the independent producer. Some of these "conditional" commitments can be entered in the government balance sheet, while the others need to be reported in non-accounting reports in keeping with International Monetary Fund (IMF) recommendations.

17 The practice for PPO projects is an O&M (operation and maintenance) agreement for a maximum period of two to five years and not for the entire duration of the project. It is as yet too soon to be able to compare the quality of operation and operational performance over long periods of time.

It can therefore be seen that PPO is associated with a higher level of "direct" commitments than the IPP set-up. Note also that although "conditional" commitments cannot be considered to be on a par with "direct" commitments and do not, therefore, weigh in the same way on public debt, the IPP structure represents a higher total level of commitments in view of both "direct" and "conditional" commitments.

Figure 5 - Impact on state commitments for the 1st comparison (left) and for the 2nd comparison (right)



Source: Nodalis

2.9 – Potential impact of projects on subsidies paid to the national electric utility

National electric utilities play a central role, because they are either offtakers of the energy generated (IPP model) or borrowers (PPO) and, in all cases, handle transmission and distribution. Both development models therefore have a direct impact on their financial situation.

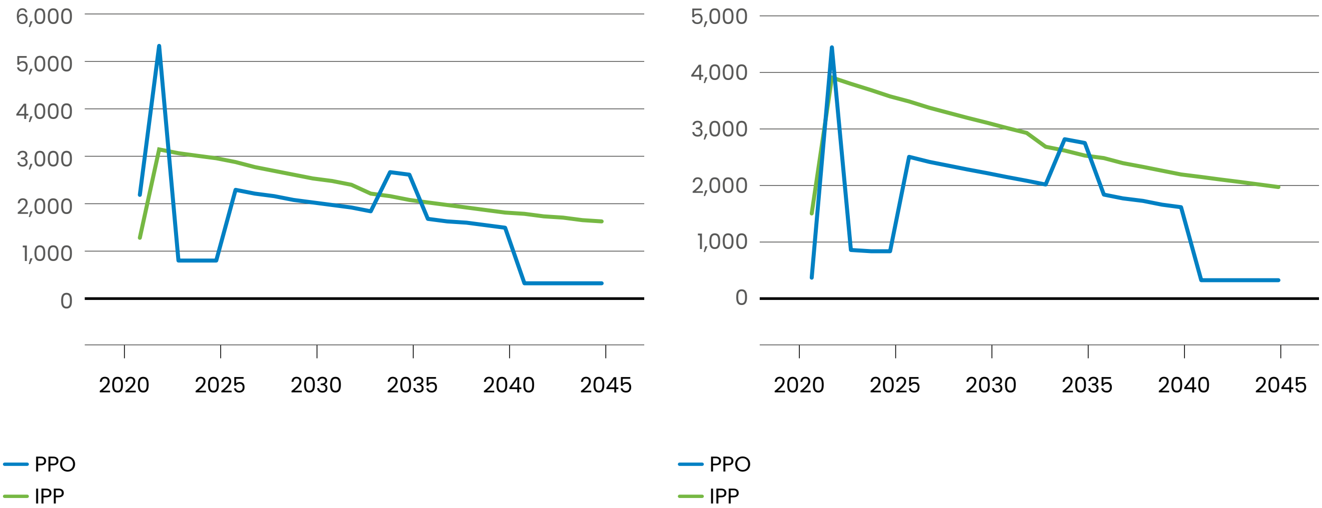
The classic budget sustainability approach does not necessarily take proper account of the specific case of national electric utilities in Africa. These utilities often present chronic operating imbalances, which are offset by direct or indirect government subsidies: national electric utilities' current expenditure is consequently financed in part by the taxpayer.

Therefore, the decision-making process between a PPO development model and an IPP development model needs to consider their respective impacts on the national electric utility's cash flow requirements and, ultimately, on the current state budget if the national utility is the subject of support measures in the form of operating subsidies, for example.

The results of the comparisons presented in Figure 6 hence illustrate total costs for the public utility and the government, net of revenues associated with the project.[18] Discounting these flows at a rate of 6% finds a differential in favor of PPO, ranging from 22% for the first comparison to 39% for the second comparison.

18 For example, tax revenues for an IPP project or dividends received in the case of a PPO project with the injection of public capital.

Figure 6 - Net costs for the public utility and the State for the 1st comparison (left) and for the 2nd comparison (right)



Source: Nodalis

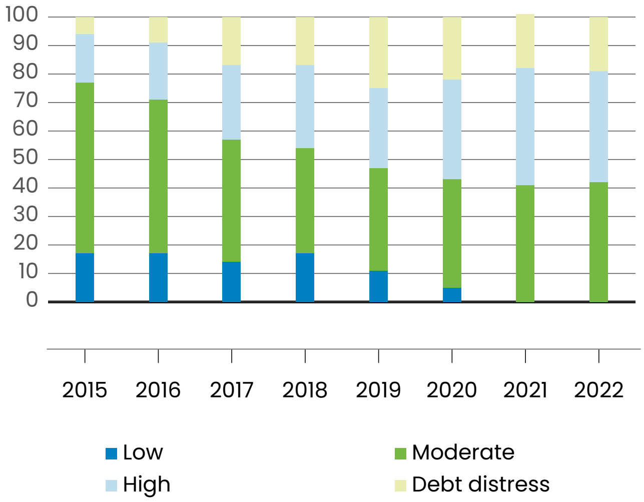
Note that the main negative impact of PPO is found in the alternative energy cost if the solar power plant is delivered later than in an IPP scenario. Otherwise, only renewals can occasionally give an IPP structure an advantage. If the cost difference cannot be borne directly by the national electric utility (and hence ultimately by the electricity tariff), then it is borne by the government by means of subsidies granted to the public utility, which is not generally taken into account in the budget sustainability studies. The IPP set-up will therefore weigh more on the current state budget than PPO, irrespective of this model's impact on the government's borrowing capacity to finance these investments.

2.10 – What links between a country's fiscal capacity and the type of solar power plant model?

At the macroeconomic level, a country's net lending capacity in a timeframe constrained by the urgency of the energy transition has a strong influence on public investment versus private capital debates.

IMF data estimate that the proportion of Sub-Saharan African countries at "high" risk of or in external debt distress rose from 23% in 2015 to 58% in 2022 (see Figure 7). In addition, countries' fiscal capacities vary immensely by levels of development, ranging from 18% of GDP for the least developed countries to over 50% for certain developed countries. Public investment using budget resources is consequently immediately constrained by what is an already high level of debt for many developing countries and by their low fiscal capacity. In these circumstances, massive public investment strategies for the energy transition will be up against short-term barriers without any increase in fiscal capacities.

Figure 7 - Analysis of debt sustainability in Sub-Saharan Africa (percentage)



Source: IMF

On the basis of these arguments, the main solution generally proposed for the energy transition in developing countries is to turn to private investment flows.

This would generally give development banks more of a role to play in aligning private financial flows with the objectives of the Paris Agreement and the SDGs than in promoting sovereign public investment in the infrastructures. With the blended finance initiatives, this would mean no less than replicating the construction of a shadow banking system,[19] referred to here as ESG (Environmental, Social and Governance) finance, for the developing and emerging countries. This is what Daniela Gabor[20] calls the culmination of three separate dynamics.

First, many IMF-led initiatives have supported the formation of local financial markets in developing and emerging countries, in particular with the development of local currency bond markets. Second, the World Bank's Maximizing Finance for Development initiative has driven the creation of homogeneous financial securities corresponding to the different SDGs, especially in infrastructures. This reorientation of financial flows also normalizes development projects to meet the standardization required by financial investors and hence facilitate transactions.

The regulators' aim to transform shadow banking into resilient market-based finance could ultimately be achieved, at least in appearance, by the convergence of these abovementioned initiatives. Nevertheless, developing and emerging countries bear additional risks for investors compared to developed countries, risks for which the development banks will see a new role take shape for themselves. The goal therefore becomes to put in place the conditions for investments to become stable and reliable sources of earnings for international investors.

In concrete terms, the role of a government is therefore to put in place a framework that will give these investments an acceptable risk profile for investors and lenders: in addition to any structural reforms required, the government sets up a contractual structure (e.g. a PPP) to give investors peace of mind with respect to the many perceived risks (political risk, exchange risk, demand risk, etc.). DFIs, for their part, are asked to contribute to derisking projects by taking on the risks that the governments cannot adequately cover by means of insurance or guarantee instruments, in effect creating ever-more complex financial engineering projects. As seen in the previous sections, this risk-sharing can have repercussions on public finances, which may be leveraged should one of these risks materialize.

Prior to the COVID-19 pandemic, this sustainable development strategy appears to have predominated based on the combined use of market mechanisms, ESG taxonomies signaling virtuous investments and guarantees provided by public authorities, and the development banks in particular, to limit the additional risks taken by the private sector. Public statements for green recovery, combined with developing countries' public finance difficulties and urgent measures by central banks to guarantee liquidity, appear to have temporarily guaranteed a place for these strategies. Yet recent monetary tightening by developed countries' central banks could well considerably compromise this model and further increase financial

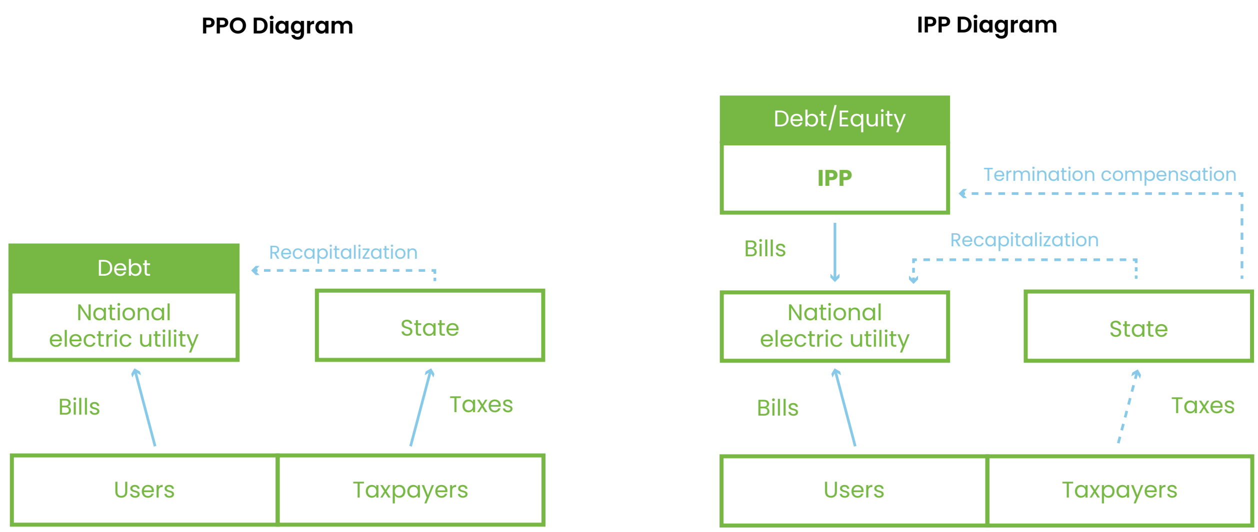
19 Shadow banking is a term used to describe entities and activities that contribute to financing the economy outside of the traditional banking system.

20 Gabor D. (2020), *The Wall Street Consensus*.

fragility in the developing countries. From this point of view, PPO could be seen as an opportunity to define and calibrate investment projects to more specifically meet a country's needs. Consider, for example, the question of the minimum size for a "bankable" solar PV project under an IPP development model (without "packaging" with other similar projects). Here, international donors are involved more as direct project financers rather than deriskers for the financial assets generated by PPPs. This is the developmental public bank model found in a Green New Deal[21]. At the European level, for example, the European Green Deal launched in September 2019 by Ursula von der Leyen, President of the European Commission, explicitly provides for a review of State aid rules and gives a key role to European and national public banks. The European Investment Bank (EIB), billed as "the climate bank", plans to release up to €1 trillion in investments in climate action and sustainable development over the decade. Here, public development banks (PDBs) have the role of creating new markets and driving the emergence of new techno-economic paradigms.

Note, also, that irrespective of their development model, the costs of renewable energy projects are always ultimately covered by the users of the national electric utility offtaking the generated power in the form of electricity bills, and not by the states' tax resources. Consequently, these projects do not entail any major public finance constraints where national electric utilities are solvent (Diagram 3) and, in particular, call for no direct commitment by the state, whether in PPO or IPP mode.

Diagram 3 - Illustration of project impact on public finances – case of a solvent public utility



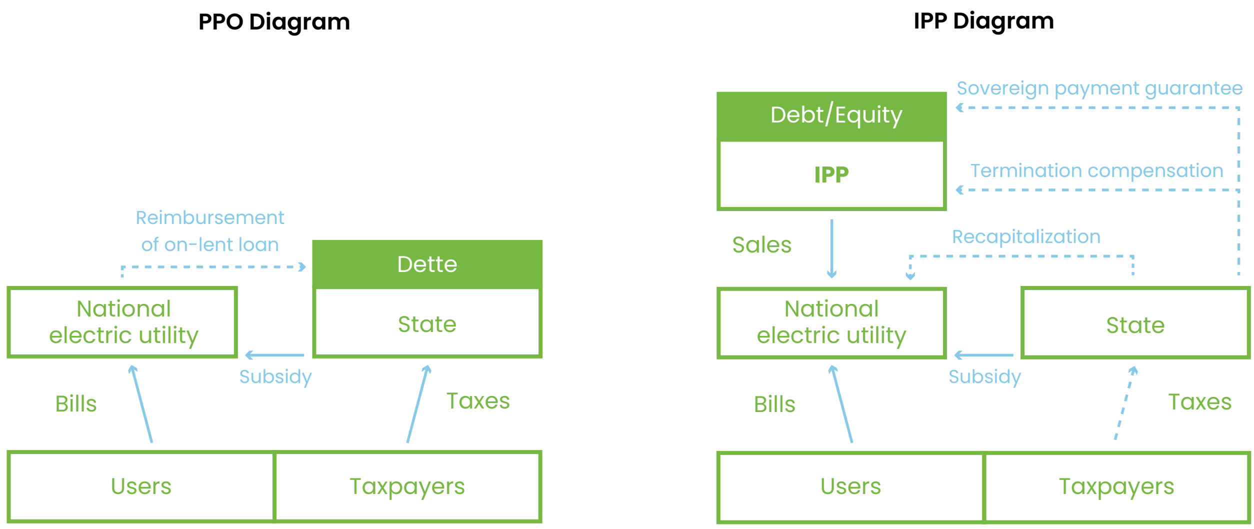
Source: Nodalis

However, as already mentioned above, a good number of national electric utilities are not able to raise debt and receive operating subsidies from the government. In this case (Diagram 4), the higher the average power supply costs, the higher the sum of subsidies to be disbursed. This affects the share of current government expenditure earmarked for the electricity sector. It is at this point that the question arises as to government net lending capacities, and especially its accounting form, when governments have to borrow to finance the project and on-lend the loan contracted to the national electric utility (PPO) or grant more direct subsidies if not recapitalize, in addition to providing a sovereign guarantee that would only come into effect should a risk materialize (IPP).

21 UNCTAD (2019), *Trade and Development Report 2019: Financing a Global Green New Deal.*

Nevertheless, the question of subsidies paid to the energy sector in general, and national electric utilities in particular, needs to be analyzed as a whole: the addition of solar capacities virtually always reduces the LCOE – Levelized Cost of Energy (IPP or PPO) – due to the competitiveness of solar power, even though the reduction is less with an IPP (although the latest tenders in Africa have brought rates down to very low levels). The subsidy "gain" from the trade-offs to be made in terms of allocation of debt and public monies, and any crowding-out effect exerted on other sectors or electricity sector segments, consequently need to be analyzed on a case-by-case basis.

Diagram 4 - Illustration of project impact on public finances – case of a government-subsidized public utility



Source: Nodalis

It is therefore advisable not to take an approach based on the assumption that a solar PV power plant project cannot be developed by PPO purely because it would impact on public finances at a time when developing countries' debt levels are increasing. An approach based solely on private investment creates conditional commitments for the State which are not always well identified and could result in projects being defined and sized to represent good financial instruments.

The different quantitative analyses presented in this paper consider the impact of the development model for a project or program on: *(i)* the average cost of electricity generation, *(ii)* budget sustainability, and *(iii)* the national electric utility's cash flow situation.

Conclusion

Choosing the most suitable solar PV power plant development model and diversifying

The purpose of these different elements of appraisal to be taken into consideration to compare PPO and IPP development models is not to make an exclusive choice between one or the other model. Projects developed with independent producers (IPPs) and projects developed by a public utility in PPO mode can coexist within one and the same solar power program.

A national program based exclusively on PPO could be complicated if it were to call for human and financial resources that are unavailable or too hard to leverage to prepare the bidding documents, monitor the design and build phases, and then operate and maintain the solar power plants. Concessional public funds are limited and grants prioritize the basic social sectors such as health and education. In addition, the public utility and/or government's debt limits need to be taken into account to properly gauge the volume of projects that can be developed by PPO.

Conversely, an exclusive shift to IPP development would weigh heavily on the public electric utility's supply costs and would entail considerable constraints for energy flow management as long as agreements are concluded with "take or pay" clauses[22] (which remains the dominant practice for intermittent power). Furthermore, in-depth knowledge of the technical aspects of building and operating a solar power plant can only be attained by the offtaker company if it has acquired at least one experience of PPO.

22 Obligation on the offtaker to pay for all (or virtually all) of the power plant's energy yield, irrespective of whether or not the power is effectively offtaken or not. Note that, for a PPO project, the borrowing company undertakes to reimburse the contracted loan irrespective of whether the power plant produces power or not.

In the case of a solar power deployment program able to sustain the development of a number of projects in a relatively short space of time (e.g. five years), the coexistence of projects developed under PPO with projects developed by IPP can hence be an effective way to deploy the entire program. Where independent power producers (IPPs) are able to deploy solar power on a greater scale while limiting the direct government commitments, PPO can leverage more competitive rates, limit cash flow constraints and build the public utility's capacities.

If there is no change in countries' public debt constraints and the availability of public concessional resources, more use will surely be made of IPPs to attain the scale of investment needed in solar power. Governments and public entities therefore need proper support to ensure a balanced allocation of risks. Over and above upstream assistance with project preparation, absolutely key to this are planning support and assistance with the negotiation stages of the legal agreements that embody the commitments made directly or indirectly. Last but not least, given the major challenges of building grids and intermittence management capacities, donor support will also be decisive in this segment that remains mainly the responsibility of the public entity.

Appendices

Box 1. Summary of case studies

- Recently commissioned solar PV power plants were chosen on the African continent (Egypt, Kenya, Senegal and Burkina Faso) to provide elements for a concrete analysis and comparison of the PPO and IPP development models. As regards the method of selection, competitive tenders appear to be more systematic for PPO (single-stage tender with pre-selection), whereas direct negotiations are more usual for IPPs, even though direct negotiations are on the downturn.
- A strategy found in a number of countries was to develop the first solar PV power plant project(s) in PPO mode with a view to building capacities. The IPP set-up then enables countries to conduct more projects for higher generation capacities.
- General project construction timeframes are more or less the same for PPO and IPPs, even though the work phase is relatively shorter for IPPs than PPO. No significant difference is found in EPC costs between PPO and IPPs. However, the IPP set-up entails high development costs (compared with total project investment costs), especially in the case of direct negotiations where the private player bears the entire cost of development.

Box 2. Main hypotheses for the financial simulations

- The following table presents a summary of the main hypotheses on which the comparative exercises are based.[23] The first and second comparisons find respectively maximum and minimum production cost differentials between the two development models (PPO and IPP).

Main hypotheses for the comparative exercises

			1ST COMPARISON (MINIMUM DIFFERENTIAL)		2ND COMPARISON (MAXIMUM DIFFERENTIAL)	
	Hypotheses	Benchmark	Standard PPO	IPP with integrated DFI support	PPO with integrated DFI support	Standard IPP
Technical	CAPEX	845 EUR/kWp	+10%	+0%	+10%	+20%
	Timeframe	12 months	+6 months	+0 months	+6 months	+0 months
	Annual OPEX	1.5%* CAPEX	+0%	+0%	+0%	+0%
Financial	Equity share		10%	25%	0%	25%
	Real IRR		6%	10%	0%	12%
	WACC[24]		1.9%	5.5%	1.5%	6.0%

Source: Nodalis

23 Details on the hypotheses for both scenarios and detailed results are presented in the report which served as the basis for this paper. In particular, the benchmark technical costs and timeframes were based on market costs and timeframes. Note that a grid connection cost was also included in CAPEX for both set-ups and that this cost is included in the €845/kWp value given in the table, which also includes the design-build costs.

24 Weighted Average Cost of Capital (WACC). Note that this indicator is merely an imperfect reflection of the differences in financing conditions, since the financial cost profiles for the PPO and IPP scenarios vary a great deal over time (as can clearly be seen in Figure 4).

- The comparative scenarios take the hypothesis that EPC costs are 10% higher in the PPO option. The standard IPP option includes a 20% additional cost compared with the optimized IPP option, since projects based on less prepared competitive tenders or direct negotiations generally present a higher development risk profile, which developers usually factor into the development costs and the proposed IRR.
- Note that the timeframe differences are valued at the cost of the alternative energy that needs to be generated during the additional period.

Box 3. An analytical framework for public policymakers to choose the best development model

- An analytical framework is proposed to help decision-making for the deployment of a solar project program. This analytical framework focuses on the most significant aspects to guide development model choices for the different program projects.
- The main parameters included in this decision-making support framework are as follow:
  - **Legal framework** applicable to the IPP development model (the legal framework for PPO is generally well covered by the public procurement regulations) and investment framework;
  - **Program characteristics:** program included in sector planning, program deployment established as a policy priority, and program deployment scale and timeframe;
  - **Offtaker and government financial situations:** The offtaker's financial situation determines the conditions for the design of the financing plan and the level of government involvement in the financing package in the two scenarios (PPO and IPP);
  - **Project's tariff and budget impact:** A simplified financial tool which, based on simplified hypotheses that can be tailored to each country's situation, provides approximations of the tariff impact of a choice of development model for a project and the potential budget impacts for government. This enables a strategy to be defined at the program level with a preliminary overview of its impact in terms of tariff and budget.

- **Track record for the public institutions:** A lack of experience in PPO or IPP project development is never a disqualifying factor, but it is always interesting to have a precise view of the PPO projects that have already been developed by the company which might take charge of a PPO development project, and the existence of past projects set up with independent producers is a criterion to be taken into account to establish the model's successes and limitations in the country considered;
- **DFI support:** This support significantly improves the quality and hence the success of a PPO or IPP project. Although the intervention of a DFI generally lengthens the project preparation phase, it significantly reduces the tariffs and costs proposed by private partners, including in the case of direct negotiations. Some DFIs have more experience in one or other of the development models (PPO or IPP), and this factor should also be taken into account.

• In a setting where private production is often presented as the only suitable structure for the development of solar power projects in Africa, this decision-making support framework combines qualitative and quantitative criteria to inform the choice of the best IPP or PPO, or even "hybrid", set-up when developing a solar program strategy.

Box 4. Context for the development of solar PV power plants by PPO – the cases of the Zagtouli power plant in Burkina Faso and the Kom Ombo power plant in Egypt

- *Zagtouli solar PV power plant (Burkina Faso)*
- The Zagtouli solar PV power plant (33 MW) went into operation in 2018: it is one of the very first grid-connected solar power plants in West Africa.
- Project development started in 2010, when a first preliminary study was launched with European Union (EU) funding to help the Burkinabe authorities assess the potential and place of renewable energy sources (RES) in the energy mix.
- As the study confirmed the economic potential of solar power in Burkina Faso, the EU approved a grant to the Burkinabe government to develop and build the Zagtouli power plant. The prospect of highly attractive financing right from project launch and the stated purpose of national electricity company SONABEL to position itself in this technology served as the basis for discussions on the advisability of developing this first solar power project in PPO mode. The financing plan was rounded out by a concessional sovereign loan from the Agence Française de Développement (AFD).
- In Burkina Faso, the success of the Zagtouli project has built SONABEL's solar PV generation technology capacities and provided it with power at an exceptionally low cost; the Burkinabe government has since launched consultations to recruit independent producers for other PV solar power plants taking a PPO-IPP diversification approach.

- *Kom Ombo solar PV power plant (Egypt)*
- The Kom Ombo solar PV power plant (26 MW) is the first grid-connected solar PV power plant project developed in Egypt, as well as the first project developed by the New and Renewable Energy Authority (NREA) using the technology. It was commissioned in June 2020.
- An agency for the promotion and development of RE (solar and wind power) projects, the NREA, was established in Egypt in 1986. In 2010, on the strength of previous experience developing wind power projects and operating wind power stations, the NREA launched a technical feasibility study for the construction of a national grid-connected solar PV power plant in the Suez Gulf region.
- The development of the Kom Ombo solar power plant project was initiated by the NREA upstream of the 2012 Egyptian Solar Plan, the first national solar power plan. The Solar Plan aims to install 3.5 GW of solar power by 2027. The Egyptian government has shared out the efforts to reach this target, with one-third allocated to the public sector (NREA) and two-thirds to the private sector (IPP). The private sector was previously absent from renewable electricity generation in Egypt.
- Renewable Energy Law 203/2014 introduced a certain number of measures to promote the production of renewable energies, including a competitive bidding process run by the NREA for the construction of RE production units under EPC contracts. The construction of the Kom Ombo solar power plant is one outcome of these measures.

- In 2014, the NREA had already developed six wind power projects (for a total capacity of 1,140 MW) and was operating all the wind power stations and a hybrid CSP[25] power plant. The NREA was already renowned for its technical expertise with its consultancy and certification services and its public project ownership (PPO) role in RE projects. Despite some delays, the Kom Ombo solar PV power plant project has been a success.
- In addition to the Kom Ombo project, the Egyptian example provides a good illustration of different factors for success with the development of RE projects under PPO: the creation of a dedicated public entity, different RE production incentive mechanisms governed by legislation, and a programming approach blending PPO and IPP development.

25 Concentrating Solar Power.

Acronyms and abbreviations

°C	Degree Celsius
AFD	Agence Française de Développement
BD	Bidding Documents
BN	Billion
CAPEX	Capital Expenditure
CB	Competitive Bidding
CEUR	Euro Cent
CSP	Concentrating Solar Power
DFI	Development Finance Institution
EIB	European Investment Bank
EPC	Engineering, Procurement and Construction
ESG	Environmental, Social and Governance
ESMAP	Energy Sector Management Assistance Program
ET	Energy Transition
EU	European Union
EUR	Euro
GHG	Greenhouse Gas
GW	Gigawatt
IEA	International Energy Agency
IFI	International Financial Institutions
IMF	International Monetary Fund
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
IRR	Internal Rate of Return
KEUR	Thousands of euros
KWH	Kilowatts per hour
LCOE	Levelized Cost of Energy
LIC	Low-Income Country (World Bank ranking)
MASEN	Moroccan Agency for Sustainable Energy
MIGA	Multilateral Investment Guarantee Agency (World Bank Group)
MW	Megawatt
O&M	Operation and Maintenance Agreement
OPEX	Operational Expenditure

PDB	Public Development Bank
PO	Project Ownership
PPA	Power Purchase Agreement
PPO	Public Project Ownership
PPP	Public-Private Partnership
PRG	Partial Risk Guarantee
PV	Photovoltaic
RES	Renewable Energy Sources
SDGS	Sustainable Development Goals (UN)
SDS	Sustainable Development Scenario (IEA)
USD	United States Dollar
WACC	Weighted Average Cost of Capital
WEO	*World Energy Outlook* (IEA)
WSC	Wall Street Consensus

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Design and production Luciole

Legal deposit 4th quarter 2022
ISSN 2680-5448 | **Digital ISSN** 2680-9214
Printed by the AFD Reprographics Department

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