



Affordability Review

PIDG Summary and Response

PIDG Affordability Review

The Private Infrastructure Development Group's (PIDG) purpose is to combat poverty in the poorest and most fragile countries through pioneering infrastructure to help economies grow and change people's lives. .

Measurement of PIDG's development impact is integral to this in two ways:

- 1. Accountability**

PIDG must provide robust evidence to account for and justify the use of public funding. In this, PIDG is accountable to its owners, host Governments, and to the communities it seeks to serve.

- 2. Learning, improving and demonstrating**

Impact measurement provides PIDG with data that can be used to improve performance and guide our strategy. Sharing knowledge with the wider market also supports PIDG's work to crowd in more investment and promote effective models for infrastructure in low-income countries.

We view independent reviews and evaluations as particularly important tools for accountability and learning. Independent reviews are intended to provide PIDG, our Owners, and other stakeholders with a fresh and objective view on areas of critical importance to PIDG's strategy for delivering positive impact. Independent reviews are advisory, and do not represent PIDG policy, strategy or results reporting.

In 2017, PIDG commissioned Castalia to conduct an independent review on the Affordability of infrastructure in lower income countries. The review addressed the question:

How do we ensure that commercially viable infrastructure projects support the delivery of services that are affordable for low-income and poor people?

Improved access to infrastructure has, to date, been PIDG's most important indicator of positive impact. PIDG companies collect data on the expected number of people gaining access to new or improved infrastructure before a deal is closed, after a deal is closed and once the infrastructure becomes operational. These figures often rely on estimates and conversion methodologies where it is unrealistic to track end users of services directly. Within the energy sector, for example, we calculate the number of people served based on the proportion of grid capacity delivered by a project.

Infrastructure typically serves a very wide range of people and businesses. However, poor and low-income households are less likely to be able to cover the costs of electricity or be in a position to take full advantage of free to use infrastructure such as roads. This represents a particularly important challenge for PIDG.

PIDG commissioned an independent review of our approach to measuring and supporting affordable, pro-poor infrastructure. This review sought to find solutions for measuring the affordability of infrastructure services, and to provide recommendations to make PIDG projects affordable for end users, in particular poor and low-income people. This is central to PIDG's core

goal of poverty alleviation through better infrastructure. The review includes case studies of our Cabeolica, Coc San, Kalangala Infrastructure Services, Tobene, Tower Aluminium and Zambia Power projects.

The review findings have been used to inform an updated PIDG strategy, as well as PIDG's monitoring, evaluation and learning plan.

Selected conclusions and recommendations

The review finds that PIDG is capable of structuring projects that serve the poor as end users. However, our focus on commercial viability, which is fundamental to PIDG achieving lasting impact at scale, limits PIDG's ability to serve the poorest of the poor. The review also finds that PIDG is currently at risk of under-reporting on improved access for poor people in some cases, and may have some opportunities to extend the potential pro-poor impacts of projects.

Recommendations put forward by Castalia that PIDG is prioritising include:

- Build up sources of market data on infrastructure access rates and constraints for lower income populations, and consumer preferences and ability to pay (including research via PIDG Development Impact, to provide an information service to PIDG companies)
- Use international poverty lines and thresholds for financial hardship in place of the national poverty lines currently used on data.pidg to provide a more consistent and relevant definition of poor and low-income groups served by PIDG projects
- Establish impact cases for pipeline projects, including trialling economic cost benefit analysis
- Update policies and criteria for ensuring best value solutions for projects
- Look at ways to broaden project origination and screening to find more opportunities to deliver services direct to poor people.
- Identify ways to reduce costs, and in particular upfront connection fees for low-income consumers where served directly or via partners within project sphere of influence.

PIDG will also publish further analysis on affordability and access for lower income populations in 2019.

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Affordability Review

**Report to The Private Infrastructure
Development Group**

March 2018

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Executive Summary

The Private Infrastructure Development Group (PIDG) exists to mobilise private investment in infrastructure, in order to increase service provision for the poor, boost economic growth and alleviate poverty in the world's poorest countries. Affordability of infrastructure was identified by PIDG Members and Companies as a priority research topic during consultation and agreement of a new PIDG wide evaluation programme in 2016. PIDG hired Castalia to provide solutions to measure and monitor if PIDG projects deliver affordable infrastructure services, and to provide recommendations to make PIDG projects affordable for end users. This report is designed to provide research and evidence on how PIDG might create benefits for the poor through direct access to infrastructure services.

In the literature there is no consensus on the best way to measure or define affordability, and common definitions and measures of affordability used in the literature are not useful in measuring if the poor are able to access infrastructure services. We recommend that PIDG adopts the following definition: **an infrastructure service is affordable if people are willing and able to buy it without incurring financial difficulties.** This definition enables PIDG to focus on identifying who are the poor among PIDG project beneficiaries and to focus on implementing strategies that will result in more poor people buying and using infrastructure services. The proposed definition of affordability helps PIDG to meet one of its objectives “increasing infrastructure services to poor people.”

There are **constraints inherent to PIDG's model that limit the possibility to do more projects that deliver infrastructure services directly to the poor.** Namely PIDG must engage in projects that are commercially viable to attract private participation in infrastructure. This condition limits the ability to serve very poor customers. Also, **PIDG faces barriers to better demonstrate that projects serve the poor.** PIDG operates in countries that have limited information, and PIDG must take a proportionate approach to collecting the market information required to know if the customers of the projects are poor. However, there are ways in which PIDG can overcome those barriers and mobilize finance for rapid expansion of networks and services to relatively low-income households and areas, and for projects that foster efficient service delivery and reduce the cost of service for poor households with access to existing infrastructure services.

PIDG is capable of structuring projects that effectively serve the poor. It is important that PIDG facilities measure the number of poor people served by projects in a robust and defensible way, to the extent that they can do so. This is essential firstly to maintaining credibility amongst funders, governments and civil society, and secondly to ensuring that effective projects maximize their demonstration effect for future projects. This should lead to a greater number of projects delivering effective infrastructure services to poor people, and thus a greater developmental impact from PIDG and its facilities.

There are four strategies that PIDG facilities can consider for increasing the number of poor people served by a given project. These strategies include:

1. ensuring the type of service matches poor people's needs and ability to pay,
2. minimizing the cost of service,
3. financing up-front costs of connection, and
4. mobilizing government or donor resources to reduce charges to poor people.

These strategies are not available to all PIDG facilities, or to all PIDG projects. For example, facilities that have a limited role in developing projects will have a limited ability to adapt the type of service provided by a project to match poor people's needs and ability to pay. However, when preparing projects all facilities should consider if and how they are able to implement the strategies to ensure that infrastructure services reach the poor.

Furthermore, **PIDG facilities should consider broadening their origination and screening strategies to engage in more projects that directly serve the poor.** This could lead to more economical projects that deliver infrastructure services directly to end-users, as opposed to the large-scale projects often proposed by governments. A way to screen for these projects includes preparing well-founded impact cases to provide a baseline of what the project seeks to achieve.

In addition to actively seeking more projects that serve the poor, **PIDG facilities can adopt some new methods to better demonstrate their impact on the poor.** First, it is important that PIDG facilities have an effective definition of affordability as well as an effective threshold for low-income users. We offer alternative thresholds that take into account financial hardship, and/or international poverty lines, as opposed to PIDG's current method of relying upon national poverty lines. Second, in order to measure the impact of a power project, PIDG facilities must have information on the service area, the population within it, and electrification rates for the poor. Equipped with this information, PIDG facilities can do a better job measuring the impact of power projects.

PIDG projects may also benefit poor people through the provision of infrastructure that stimulates inclusive economic growth and job creation. This second route to impact was not assessed in-depth in this study, however **PIDG can improve impact measurement and management through economic cost benefit analysis of projects.** This report also lists criteria for assessing whether projects are least cost solutions and offer net economic benefits. **Cost benefit analysis should be prioritized for projects that do not serve poor users directly.**

Other innovations that PIDG can employ to improve its measurement of impact include doing customer surveys (either directly or sub-contracted) to check the impact of operational projects that deliver infrastructure services directly, adopting KPIs on service to the poor, and allocating more resources for market research, monitoring and evaluation.

Ultimately, **PIDG can serve the poor better by innovating new approaches to develop more projects that directly serve the poor.** Innovation could come from the use of innovation working groups, the creation of a venture capital type fund focused on small and scalable projects, and increased partnerships with social impact funds and NGOs.

As part of this report we analyzed six PIDG supported projects; one project that delivers infrastructure services directly to end-users¹, four on-grid energy generation projects², and one project that has an indirect impact on infrastructure affordability by supporting a local

¹ Kalangala Infrastructure Services (KIS), PIDG Facilities InfraCo Africa (IAfD) and Emerging Africa Infrastructure Fund (EAIF), Uganda.

² Cabeolica Wind Farm, IAfD, Cape Verde; Coc San Hydro, InfraCo Asia (IAsD), Vietnam; Tobene HFO, EAIF (Senegal); Zambia Solar, DevCo, Zambia

business³. We concluded that it is difficult to implement affordability strategies when projects do not deliver infrastructure services directly, as is the case in wholesale power projects. When projects deliver infrastructure services directly, their impact on affordability is more readily measurable, as is the case in Kalangala Infrastructure. Although all the projects we analyzed implemented strategies to minimize the cost of service, the impact of that strategy on affordability was more difficult to ascertain for the wholesale generation projects.

³ Tower Aluminium, GuarantCo, Nigeria

1 Introduction

The Private Infrastructure Development Group (PIDG) hired Castalia to provide solutions to measure and monitor if PIDG projects deliver affordable infrastructure services to people, and to provide recommendations to make PIDG projects affordable to poor and low-income people. Section 1.1 explains the methodology we used to complete this assignment, and Section 1.1 describes the structure of the report and summarizes our advice to PIDG.

This report is designed to provide research and evidence on how PIDG might create benefits for the poor through direct access to infrastructure services for households. PIDG's own theory of change indicates that its activities may also create benefits for the poor through a second route - providing infrastructure that supports economic development. This report does not explore this second route and therefore does not consider the affordability of infrastructure to business, nor how PIDG's investments affect that.

In providing recommendations, this report considers the constraints that PIDG faces in delivering infrastructure services directly to the poor. Therefore, we identify strategies to address affordability that PIDG facilities can implement while acting as market players that increase private investment in infrastructure.

1.1 Methodology

To provide solutions that help PIDG measure and monitor affordability for households, and increase its ability to deliver affordable services to the poor, we took the following steps:

- Conducted a literature review on affordability to provide a definition of affordability that PIDG can use to measure and monitor its impact on delivering infrastructure services to the poor directly.
- Analyzed the PIDG Results Monitoring Database (RMD) information to identify how PIDG measures and monitors affordability, and to assess if PIDG projects have an impact on delivering infrastructure services to the poor directly.
- Prepared case studies on a sample of PIDG projects, to assess how specific PIDG interventions contribute to affordability for households and how PIDG projects measure the impact on the poor.

1.2 Structure of the Report

In this report we use the following definition of affordability for households —an infrastructure service is affordable if poor people are willing and able to buy the service (Section 2). The proposed definition allows PIDG to overcome the conceptual difficulties of defining and measuring affordability discussed in the literature and allows PIDG to focus on measuring and monitoring if PIDG projects are delivering infrastructure services directly to the poor (Section 0). In section 2.2 we propose alternative definitions of poverty that PIDG can use to identify who are the poor customers of infrastructure services to better measure and monitor affordability for households.

We analyze if PIDG projects are serving the poor and if they are adequately measuring if poor people are being served, by reviewing the PIDG Results Monitoring Database and by analyzing 6 PIDG projects in detail. The RMD shows that a minority of PIDG projects report on serving poor people directly. In Section 3 we identify constraints that limit the

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ability of PIDG to do more projects that directly serve the poor, and to better measure and demonstrate the impact that the projects have on the poor.

In Section 4, we present solutions for PIDG to do more projects that serve more poor people directly. First, we describe strategies to address affordability that are available to PIDG. Then, we describe how PIDG can broaden its project origination considering the barriers inherent to the PIDG model to better serve the poor.

In Section 5 we describe how PIDG can improve methods for demonstrating the impact of PIDG projects on the poor. Finally, Section 6 offers some innovative strategies that PIDG can use to develop more projects that serve the poor directly.

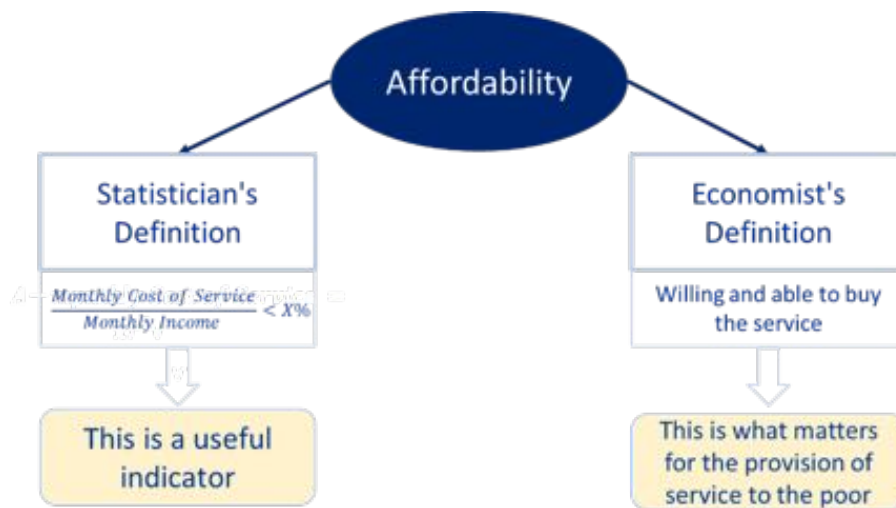
2 PIDG Needs an Effective Definition of Affordability for Households

Common definitions and measures of affordability used in the literature are not useful in measuring if the poor are able to access infrastructure services. In this report we propose a definition of affordability that can effectively measure if the poor are willing and able to buy infrastructure services.(Section 2.1).In order to apply this definition of affordability to PIDG’s projects, we propose ways to better measure who are the poor (Section 2.2) that benefit from those projects. This will enable PIDG to report more clearly on whether its projects result in more poor people directly accessing and using infrastructure services⁴ (Section 2.3).

2.1 An Effective Definition of Affordability for Serving Poor People

The literature does not provide a single definition of affordability of infrastructure services, and highlights that affordability is a subjective concept that is hard to define⁵. Figure 2.1 describes two alternative definitions of affordability discussed in the literature. The statistician’s definition provides a useful indicator to measure affordability but has conceptual limitations (Section 2.1.1). As an alternative, the economist’s definition considers that an infrastructure service is affordable if people are willing and able to buy it without incurring financial difficulties. We recommend this definition for PIDG use.⁶ (Section **Error! Reference source not found.**).

Figure 2.1: Affordability: Alternative Definitions in the Literature



⁴ PIDG’s Objectives from “Results Monitoring Handbook.” Revised September 2013, Pg. 6

⁵ Estache A, Wodon Q, Loma K, 2014. Infrastructure and Poverty in Sub-Saharan Africa. World Bank

⁶ The Treasury of New Zealand, “Affordability of Housing: Concepts, Measurement and Evidence.” Published March 2006. Accessed November 2017 at: <http://www.treasury.govt.nz/publications/research-policy/wp/2006/06-03/01.htm>

2.1.1 Commonly used Indicators to Measure Affordability for Households

In the literature there is no consensus on the best way to measure affordability for households⁷. However, a common approach is to measure affordability as the percentage share of the household expenditures on an infrastructure service relative to the average household budget or to the median household income, and whether it exceeds a set threshold⁸. For example, in the water sector if the monthly bill of water services as a percentage of monthly household income is more than 5 percent, then the service is considered unaffordable.

There is no scientific basis for setting the thresholds, however based on experience with actual household expenditure patterns and results of willingness to pay surveys, certain thresholds are widely used by practitioners. **Error! Reference source not found.** lists some of the common affordability thresholds that can be useful in providing a snapshot of the burden of expenditure for an infrastructure service.

⁷ Robinson, Mark. 2006 Affordability of Housing: Concepts, Measurement and Evidence. New Zealand Treasury

⁸ Sudeshna Ghosh Banerjee, Elvira Morella. 2011 Africa's Water and Sanitation Infrastructure: Access, Affordability, and Alternatives. Directions in development. Infrastructure World Bank

Table 2.1: Indicators to Measure Affordability

Sector	Area	Measure of Ability to Pay	Threshold of Affordability
Water and Sanitation	Total utility charge	Monthly bill as % of household income	5% of household income ⁹
Transport	Public Transport ¹⁰	Actual spending as % of household income	At most 10% of households spend more than 15% of income on work-related trips ¹¹
Telecoms ¹²	Internet	% of income per capita for monthly bill	2% to 5% of income per capita
	Mobile Phone	% of household income for monthly bill	5% of household income
Housing ¹³	Mortgage	Total price of house as % of annual household income	3 to 5 times household income
	Rental	Rent as % of household income	30% of household income
Agriculture ¹⁴	Irrigation	Cost as % of income per capita, per ha per year	Average for Sub-Saharan Africa is about 1.5%
Energy	Off-Grid ¹⁵	Monthly bill as % of household income	20% of per capita household income ¹⁶
Energy ¹⁷	On-Grid ¹⁸	Monthly bill as % of household income	5% of per capita household income ¹⁹

⁹ WHO

¹⁰ The World Bank, “Affordability and Subsidies in Public Urban Transport: What Do We Mean, What Can Be Done?”, 2007

¹¹ South Africa uses the threshold of no more than 10% of households spend more than 10% of income on work-related trips.

¹² UN Conference on Trade and Development. “Information Economy Report 2010”, 2010. And, Alliance for Affordable Internet. “Affordability Report 2015/16”, 2016.

¹³ The World Bank, “Stocktaking of the Housing Sector in Sub-Saharan Africa: Summary Report.”, 2015.

¹⁴ The World Bank, “Fertilizer Use in Africans Agriculture: Lessons Learned and Good Practice Guidelines”, 2007, and “Enabling the Business of Agriculture”, 2017.

¹⁵ The World Bank, “Power Tariffs: Caught Between Cost Recovery and Affordability”, 2011

¹⁶ The World Bank, “Power Tariffs: Caught Between Cost Recovery and Affordability”, 2011

¹⁷ The same measure of ability to pay can be used for traditional on-grid electric as well as mini-grids where payments are still made to a utility company entity on a regular basis. Where mini-grids are meant to be self-sustaining and removed from all traditional electricity infrastructure, they should use off-grid measures of ability to pay.

An inherent problem with the measuring affordability following the approach in Table 2.1, is the need to invoke a benchmark of the “threshold of affordability” for which there is no objective definition. For example, a household in a very dry region may be willing and able to spend 7 percent of its income on water services but using the benchmark for water services in Table 2.1 that service would be considered unaffordable.

Other limitations of common measures of affordability result from using average household budget or median household income to estimate the share of household expenditures in an infrastructure service, because:

- The median household income, or household budget are poor indicators of economic distress and bear little relationship to poverty or other measures of economic need within a given population.
- This does not capture impacts across diverse populations. If a population has income levels that are not clustered around the median, then the economic hardship associated with paying for an infrastructure service can be concentrated in a few lower-income households within a population.
- They are snapshots that do not account for the historical and future trends of a community’s economic, demographic, and/or social conditions.
- They do not fully capture household economic burdens. Economic burdens are commonly measured by comparing the costs of basic needs to available household income. For example, a population may experience unusually high costs of basic needs or may have a distribution of household income that differs significantly from that in most communities within a population.
- They often ignore differences in cost related to quality and accessibility of a particular service.

2.1.2 Better Measures of Effective Affordability

There is no single measure that can definitively indicate whether a population is unable to afford an infrastructure service²⁰. However, more accurate measures of affordability try to provide a detailed picture of a population’s economic and social characteristics to identify its ability to afford a service. With more detailed information of actual customers, there are better chances of determining if customers are willing and able to buy a service at a given price, and therefore it is easier to establish if a service is affordable.

Consumer surveys reveal what people are willing and able to pay for infrastructure; and thus, define true affordability for the population surveyed. These surveys can be catered specifically to low-income households, which helps PIDG meet its objective of serving the poor. Survey data in which households report their income and the amount they spend on a service in a given period is considered the best way to reveal affordability.

In addition to consumer surveys, market comparisons can be very useful for measuring what people are willing and able to pay. Market comparisons indicate what people are currently

²⁰ Water Environment Federation. “Affordability assessment tool” 2013

paying for an infrastructure service that meets a specific need. If that service can be replaced with one that is the same or better for the same or lower cost (with income unchanged) then the new service can be understood to be affordable. This understanding comes from the fact that the service was already being paid for at that price by the customer.

Consumer surveys are often required to do market comparisons. For this reason, market comparisons shouldn't always be considered a separate indicator, but rather a complementary indicator to consumer surveys.

There are instances in which market comparisons could be carried out independently of consumer surveys. For example, prices in local stores would effectively indicate what the local population pays for goods. The price of kerosene could possibly indicate what a low-income household typically pays for lighting services.

2.2 Defining Poverty to Identify Who are the Poor Benefiting Directly from PIDG Projects

For consumer surveys and market comparisons to be useful on projects that directly serve customers, PIDG must define who are the beneficiaries, and who among them are poor. We suggest that PIDG adopt a consistent measurement of poverty among all PIDG projects that identifies poor beneficiaries as the percentage of people living under US\$3.2 dollars per day.

2.2.1 Current Issues with PIDG's Method of Counting the Poor

PIDG defines poor populations as those living below the national poverty line. For example, if a project provides power to an island with 100,000 residents, and under the assumption that all residents are connected to the grid, and the national poverty line is 20 percent, PIDG reports that the project provided new or improved power services to 20,000 poor people. These are the issues with this method, which may:

- Underestimate the number of poor people being served in some circumstances. For example, if the region receiving the service has a higher proportion of poor residents, this value may underestimate the number of poor being served
- Overestimate the number of poor people being served in energy projects. Poor households are less likely to be connected to the energy grid; meaning that unconnected poor households are counted as receiving improved service, while they may not be receiving any benefit at all
- Underestimate the number of poor people served in poorer countries. People counted as below the national poverty line can vary significantly from country to country (or from region to region within a country) because of differences in purchasing power (the relative cost of goods). For example, Table 2.2 shows that in Sierra Leone (one of Africa's poorest countries) people with a GNI between US\$1380 and US\$490 are not considered poor, while people between that income range in Ghana are considered poor. Therefore, many people considered poor in Ghana may not be considered poor in Sierra Leone:

Table 2.2: Defining the Poor in Ghana vs Sierra Leone

Country	GNI Per Capita	GNI Per Capita for Poor
Ghana	\$4,150	\$1,380
Sierra Leone	\$1,320	\$490

Source: The World Bank, “Poverty & Equity Data Portal.” Accessed November 2017 at <http://povertydata.worldbank.org/poverty/country/SLE>

2.2.2 Alternative Measures of Poverty for PIDG to Use

Table 2.3 lists alternative poverty measurements that can help to fix the shortcomings of current poverty measurements used by PIDG facilities.

Table 2.3: Alternative Measures of Poverty for PIDG to Use

Current Problem with PIDG Measurement	Alternative Measurement that Fixes Problem	Justification
Inconsistent measures of poverty across PIDG target countries	Poverty headcount ratio at US\$1.90 or US\$3.20 per person per day at 2011 PPP (percentage of population)	Ensures a degree of consistency for PIDG projects. Offers greater stability than national poverty lines that may be adjusted or subject to currency fluctuations.
Underestimation of the number of poor people in poorer countries	Percentage of households in the bottom 40 percent of Income Distribution	Avoids missing poor households who may technically be counted as above the poverty line, like in Sierra Leone (Table 2.2)
Inconsistent representation of well-being in different countries	Percentage of households living with an equivalized disposable income below 60 percent of the national median equivalized disposable income.	The proposed measure considers relative poverty instead of absolute poverty, this allows view poverty in terms of the standard of living of the society in question

Source: Feng, Juan, “How Should We Measure Poverty?” World Economic Forum, 2014, Accessed November 2017 at: <https://www.weforum.org/agenda/2014/11/how-should-we-measure-poverty/>
 The World Bank, “Defining Welfare Measures.” Accessed November 2017at: <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTPA/0,,contentMDK:20242876~isCURL:Y~menuPK:492130~pagePK:148956~piPK:216618~theSitePK:430367~isCURL:Y,00.html>

Among the alternatives, we recommend that PIDG measures the number of poor beneficiaries for its projects using the poverty threshold of US\$3.2 dollars per day (2011 PPP). The proposed measure is easy to implement using World Bank data. This proposed measure will also result in a consistent measure of poverty across all PIDG projects and will not underestimate the number of poor beneficiaries in the poorest countries.

To illustrate the impact of switching to this measurement, Table 2.4 estimates the number of poor beneficiaries in Ghana and Sierra Leone for a hypothetical project with 100,000 beneficiaries. Switching to this measure creates an estimate that more accurately reflects the number of poor people served by a project.

Table 2.4: Number of Poor People in a Project serving 100.000 Beneficiaries in two African countries

Country	National Poverty Line (% of Population)		Poverty Headcount Ratio at US\$1.9 a day (% of Population)		Poverty Headcount Ratio at US\$3.2 per day (% of Population)	
	%	No. People	%	No. People	%	No. People
Ghana	31.9 (2005)	31,900	13.6 (2011)	13,600	34.9 (2012)	34,900
Sierra Leone	52.9 (2011)	52,900	52.3 (2011)	52,300	81.3 (2011)	81,300

Source: World Bank, Global Poverty Working Group. Data are compiled from official government sources or are computed by World Bank staff using national (i.e. country-specific) poverty lines.

As this table illustrates, using US\$3.2 per day as the threshold for poverty reveals that the number of poor beneficiaries is much greater, as a percentage basis, in countries with comparatively high rates of poverty. Switching to this measurement revealed that the hypothetical project had nine percent more beneficiaries in Ghana, but 54 percent more beneficiaries in Sierra Leone than when using the national poverty rate.

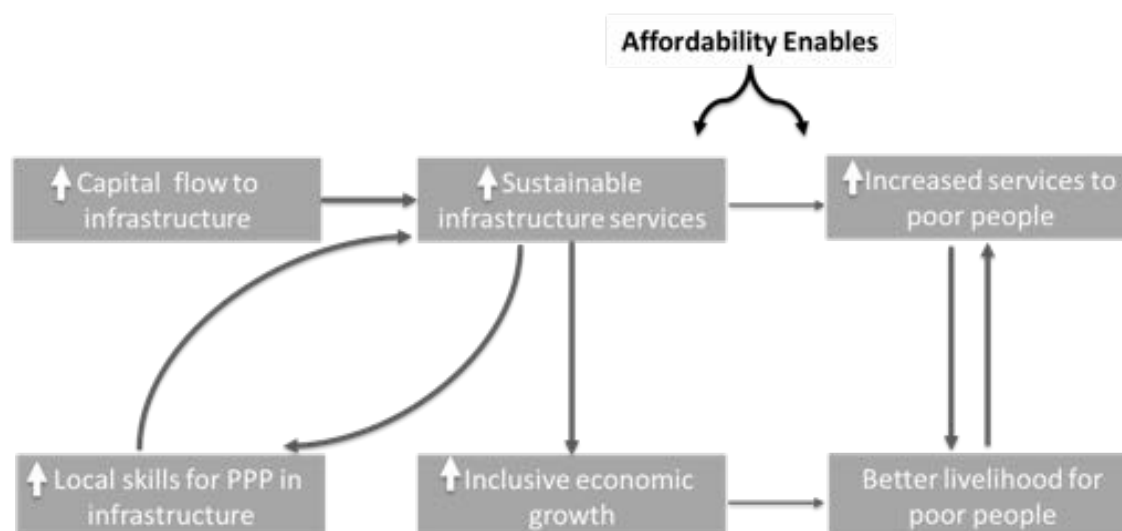
2.3 Affordability Works Towards PIDG's Objectives

As illustrated in Figure 2.2, PIDG's ultimate goal is to improve livelihoods for people in the world's poorest countries. To achieve this goal, PIDG's specific objectives include mobilizing private capital for infrastructure projects that:

- Increase infrastructure services to poor people: for example, projects that deliver water and sanitation services directly to the poor. These projects must be affordable to poor households.
- Promote inclusive growth in poor countries: for example, projects that increase generation capacity or transport reliability, enabling improved productivity and job creation. These projects must be affordable to businesses.

Within PIDG's specific objectives, affordability directly contributes to; increasing infrastructure services to poor people (Section 2.3.1), and to ensuring that infrastructure services are sustainable (Section 2.3.2).

Figure 2.2: PIDG's Objectives and Affordability



Source: PIDG Results Monitoring Handbook

2.3.1 Increasing the Number of Poor People Able to Access and Use Infrastructure Services

According to the PIDG Results Monitoring Handbook, one of PIDG's objectives is "increased numbers of poor people able to access and use infrastructure services."²¹ Accomplishing this objective is directly linked to making infrastructure services affordable. Examples of how affordability is integral to consumption of an infrastructure service can be found in projects that incorporate pro-poor tariff subsidies. This includes Coc San Hydropower in which the Vietnamese government subsidized power for low-income households, and Kalangala Infrastructure Services in which a TAF OBA grant subsidized ferry use. In both cases it was not enough that the infrastructure was built; it needed to be affordable for poor people to use it.

2.3.2 Ensuring that the Provision of Infrastructure Services is Sustainable

PIDG's first listed objective, also in the PIDG Results Monitoring Handbook, is "enhanced provision of sustainable infrastructure services (quality and quantity)." An infrastructure service cannot be sustainable if it is not affordable. If an infrastructure service is not affordable to individuals or businesses, people will not use it, and the service provider will not be able to cover its expenses. The government may be forced to bail out the project or provide unanticipated subsidies at the expense of other social services.

- For example, the privately financed M1/M15 motorway connecting Budapest to Vienna in the mid-1990s failed in large part because drivers did not want to pay tolls they considered too high. Because the tolls were higher than people were willing to pay, people did not use the road. In fact, traffic volumes were only 46 percent of the forecasted figures, and revenues were insufficient to cover the project's costs. Ultimately, a project that cost EUR 280 million to build needed to

²¹ PIDG, "Results Monitoring Handbook." Revised September 2013, Pg. 6

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be nationalized by the Hungarian government. Hungary has since then been more hesitant to use PPP structures for infrastructure projects.²²

- It is nevertheless important to note that infrastructure can only be sustainable if it is delivered at a price which covers the cost of providing the service. For PIDG, the challenge is to ensure that its infrastructure projects serve the poor (either directly or through enabling economic growth and employment) at a price which ensures commercial viability. This is addressed in Section 3.1 below.

²² World Bank Group; Public Private Infrastructure Advisory Facility, “M1/M15 Motorway, Hungary.” Updated March 2009. Accessed November 2017 at: <https://ppiaf.org/sites/ppiaf.org/files/documents/toolkits/highwaystoolkit/6/pdf-version/hungary.pdf>

3 PIDG Needs More Projects That Demonstrably Serve the Poor

PIDG data shows that few of its projects deliver infrastructure services directly to the poor, and that projects that deliver improved or new access to services do not always reach the poor. According to the Results Monitoring Database (RMD), an estimated 11 percent of the people with new or improved access to infrastructure services are poor, and 24 percent of PIDG projects report serving poor people directly. The evidence from the RMD can be explained by one or a combination of the following reasons:

- There are not enough projects serving the poor
- Benefits to the poor are under reported or not demonstrable
- PIDG projects are achieving other objectives, such as inclusive economic growth or job creation

Below, we propose solutions that increase the number of projects directly serving the poor. Also, we propose solutions to better measure and demonstrate the impact of PIDG projects on the poor. The solutions follow our analysis of the barriers that constrain PIDG from better serving the poor (Section 3.1), and of how those existing barriers can be overcome to better serve the poor and better measure and demonstrate the impact on the poor (Section 3.2).

3.1 Commercial Viability Constrains Possible Solutions for Serving the Poor Directly

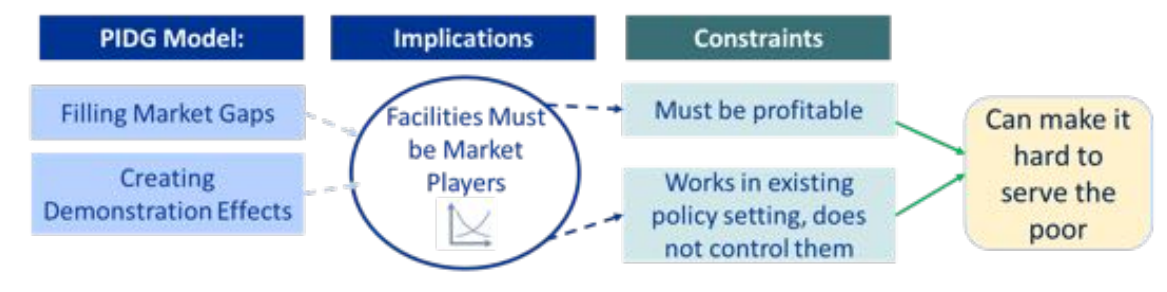
PIDG’s mission is to “mobilize private-sector investment (PSI) to assist developing countries to provide infrastructure vital to boost their economic growth and combat poverty.”²³ As a result, the PIDG model requires that facilities act as market players to promote private sector participation in infrastructure to increase the provision of infrastructure services. In acting as a market player, however, PIDG faces constraints to increasing the number of projects serving the poor (Section 3.1.1). Furthermore, PIDG’s mandate is to work in low income and fragile states that lack reliable information on the income level of project beneficiaries, thus making it difficult to measure the impact of projects on the poor (Section 3.1.2).

3.1.1 PIDG facilities must be market players

Figure 3.1 describes the relationship between the PIDG model and the constraints to serve more poor people.

²³ PIDG Results Monitoring Database Handbook. 2015

Figure 3.1: Constraints to Serve More Poor People



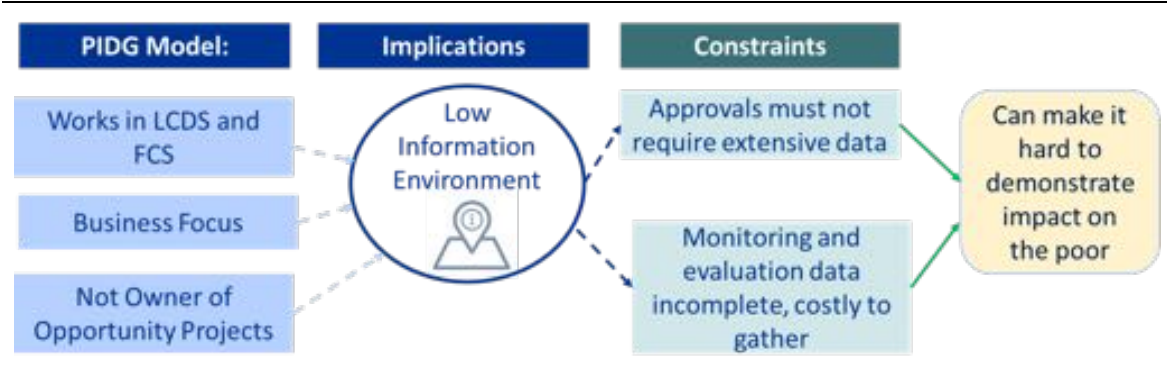
Most of the strategies proposed by the literature to impact affordability for households focus on policy or institutional responses.²⁴ Some examples of strategies to impact affordability include subsidies, pro-poor tariffs, and regulation of service providers. Policy and institutional responses to expand and improve affordability to serve more poor people are generally not available to PIDG, since its facilities must act as market players and take policy, institutional, and market conditions as given.

In addition, PIDG must engage in projects that make a profit in order to attract private participation in infrastructure. This condition limits the ability to serve very poor customers that will not be able to buy services at a price that makes projects financially viable.

3.1.2 PIDG has limited information on the markets in which it operates

PIDG operates in countries that have limited information. Also, PIDG has a business focus that limits the time and resources that facilities can spend collecting market information required to know if the customers of the projects are poor. Furthermore, some PIDG facilities such as GuarantCo engage in projects that they do not develop, and as a result they may have limited access to information about the income level of the project beneficiaries. Figure 3.2 illustrates the relationship between the PIDG model and the constraints to measuring the impact on the poor.

Figure 3.2: Constraints to Measure Impact on the Poor



To measure direct impacts on poor individuals and households using the economist’s definition of affordability as described in Section 2.1, it is necessary to collect information on

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the income level of expected customers of infrastructure services, to identify poor customers. PIDG faces the following constraints to access data:

- In the countries where PIDG operates, robust national and regional household data is scarce
- It can be costly to gather the data necessary to demonstrate an impact on the poor. This is especially true for projects providing an input to offaker/distributors, and when the income level of expected customers is not publicly available or easy to obtain from service providers (such as water or electricity utilities). When income-information is not publicly available, it is necessary to conduct surveys among a sample of expected customers from a given project.
- It may take a long time to obtain information of income-level of customers when there is limited publicly available data on income level of customers.
- Furthermore, the data for monitoring and evaluation is often incomplete in the markets where PIDG facilities operate. Therefore, conclusions drawn about low-income users can be difficult to substantiate, even after a project is operational. This is especially difficult given the fact that PIDG facilities must use estimates about the end-users before the project is operational.

In this regard it is important for PIDG facilities to distinguish between projects that serve the customers directly and those that do not, such as generation projects. Projects that do not serve people directly will have limited information on the income level of potential beneficiaries.

3.2 PIDG Can Overcome Barriers to Serving the Poor by Broadening Networks, Skill Sets, and Mind Sets

There are constraints to serving more poor people within the PIDG model. However, the literature indicates that private participation in infrastructure can contribute to serving more poor people in three main ways:

1. Through mobilization of finance for more rapid expansion of networks and services; including extension to relatively low-income households and areas
2. Through efficiency gains that translate into a reduced cost of service for poor households with access to existing infrastructure services
3. Through the freeing of government funds that were previously used to subsidize inefficient infrastructure services; funds can be reallocated to cover the difference between tariffs that cover the reasonable cost of service and the tariffs that the poor are willing and able to pay²⁵.

By broadening existing networks, skill sets, and mind sets **PIDG can overcome barriers to serve the poor directly.**

²⁵ Brook, Penelope; Smith, Warrick 2001 Improving Access To Infrastructure Services By The Poor: Institutional And Policy Responses Washington, DC: World Bank

Table 3.1: Barriers That Can Be Overcome

Barriers to increasing the number of poor people served:		
Barrier	Solution	How it Contributes to Serve More Poor People
Bias in the origination process toward projects that are: <ul style="list-style-type: none"> ▪ Large ▪ Government Directed ▪ Internationally Sponsored 	Broadening Origination and Screening Strategy	Mobilization of finance for projects that expand network and services to the poor
No incentives in the origination or screening process to favor projects that serve more poor people	Introduce key performance indicators on service to the poor, linked to performance incentives (See Section 4)	Efficiency gains, translating into a reduced cost of service for the poor Release of government funds needed to subsidize inefficient service providers
Barriers to measuring impact on the poor:		
Barrier	Solution	
Limited information on income levels of customers/beneficiaries	Prepare Well Founded Impact Cases Check number of actual poor people being served with consumer surveys for projects that serve people directly Use new methods to measure impact on the poor for wholesale generation projects or other projects that do not serve people directly	

4 Strategies to Increase the Number of Poor People Served by PIDG Projects

To increase the number of poor people being served, PIDG should implement strategies that impact affordability. This will translate the benefits of private participation in infrastructure into increased numbers of poor people being served (Section 4.1). Also, PIDG should broaden its origination strategy and screening criteria to increase the number of projects that directly serve the poor (Section 4.2).

4.1 Strategies to Impact Affordability for Households Available to PIDG

Table 4.1 provides a summary of the affordability strategies that PIDG facilities can implement. These strategies are available to private sector participants, and thereby relevant to PIDG facilities since they are constrained to function as private sector actors. Also, these strategies exclude institutional or policy responses to address affordability.

In the sections below, we provide a detailed description of each strategy and actions to implement them.

Table 4.1: Types of Strategies Available to PIDG Facilities

Strategy	Conditions Needed to Implement Strategy	Open to PIDG Facilities
Ensure type of service matches poor people's needs and ability to pay	Participation in early stages of project design	<ul style="list-style-type: none"> ▪ DevCo - Project identification ▪ InfraCo Africa and InfraCo Asia - Project identification and project design ▪ TAF - Provide technical assistance grants (feasibility studies)
Minimize cost of service of chosen infrastructure alternative to meet infrastructure need	Tariffs are cost-reflective	<ul style="list-style-type: none"> ▪ DevCo - Run competitive procurement processes ▪ InfraCo Africa and InfraCo Asia - Develop projects that seek to minimize cost of service ▪ GuarantCo - Provide guarantees to lower cost of capital ▪ EAIF - Reduce cost of capital
Finance up-front costs of connection	Participation in project design	<ul style="list-style-type: none"> ▪ InfraCo Africa and InfraCo Asia - Influence project design
Mobilize government and donor resources to reduce charges to poor people	Information about total cost of service and how much poor customers are able to pay	<ul style="list-style-type: none"> ▪ TAF - Provide capital grants ▪ InfraCo Africa and InfraCo Asia - Mobilizing donor money into infrastructure projects

Below we go into detail for what each of these strategies mean and how they can be implemented.

4.1.1 Ensure the type of service matches poor people's needs and ability to pay

Many alternative types of service can meet an infrastructure need. For example, to provide clean and safe water a project can deliver water either through pipes or by building a standpipe. Both projects would meet an infrastructure need, however the cost to the customer, and by extension the affordability, differs.

Different PIDG facilities are equipped for different roles in infrastructure projects. Facilities like InfraCo Africa and InfraCo Asia are better able to influence project development and decide on the appropriate type of service, as demonstrated with Kalangala Infrastructure Services, while EAIF is more focused on making projects financially viable by helping to lower the cost of capital. Both types of facilities, however, should prioritise projects that offer a type of service that is consistent with poor people's needs and poor people's willingness and ability to pay.

To do this, facilities should ensure that projects conduct the following tasks:

- Carry out a proper analysis of demand and willingness of customers to pay for different types of services
- Develop a range of service delivery options that meet the demands of the low-income community
- Review service standards to ensure they are relevant to providing services to low income communities; and revise them if they are not. (Formal technical and service standards are often designed for middle and high-income areas; these standards are wrongly assumed to be the same for servicing the needs of low-income communities)
- Consider activities of informal or alternative service providers that already deliver services to the poor; this could lead to previously unconsidered infrastructure solutions that poor people are actually willing and able to buy

Box 4.1: Type of Service Example: Cabeolica Wind Farm

Cape Verde is a 10-island nation that lies in the path of the northeasterly trade winds of the Atlantic. Its location means that it consistently receives high-speed winds. In fact, the wind conditions are considered perfect for wind power generation; constant, strong, and monodirectional. Yet until recently, Cape Verde imported expensive fossil fuels for power generation. When Cape Verde was targeted by InfraCo Africa to enhance domestic power generation capabilities, wind power was the right type of service. It could be delivered cheaply to the islands, and work towards a more secure and independent energy matrix. Wind now supplies nearly a quarter of the nation's energy, and it does so at an affordable price.

Source: Brown, Ann "Cape Verde's 'Staggering' Success in Wind Energy." Accessed Nov. 2017 at: <http://www.africatrictlybusiness.com/news-analysis/cape-verde%E2%80%99s-%E2%80%9Cstaggering%E2%80%9D-success-wind-energy>

4.1.2 Minimize cost of service

The total cost of service includes the cost of development, the cost of operation and maintenance (O&M), and the cost of capital. PIDG facilities can enhance affordability directly by contributing to a minimized cost of the service. To ensure that projects deliver least cost service:

- Use competitive bidding to ensure that the project developer selected is the least cost option
- Establish bidding parameters which ensure that potential project developers are competent and experienced, thereby reducing the chances of development delays and cost overruns (which ultimately raise the cost of service).
- Put incentives in place that help to reduce O&M expenses
- Limit the amount of O&M expenses that can be passed-on through higher prices to end-users: this will incentivize the project operator to keep O&M expenses low, because under these conditions lower O&M expenditure translates into higher profits.
- Compare cost of capital to that of similar projects
- If cost of capital isn't comparable, explore alternative financing methods that bring down the cost of capital.

Box 4.2: Minimize Cost of Service Example: Tower Aluminium

Tower Aluminium is the largest producer of aluminum products in West Africa. Following the financing of a new facility, the financial crisis of 2008, and a steep devaluation of the Nigerian Naira, Tower's financial viability became strained. To strengthen and diversify its



finances, Tower decided to issue corporate bonds but needed access to a higher credit rating. Without the higher credit rating, Tower would have had a very high cost of capital. This high cost of capital would in turn force them to raise the prices of their goods; aluminum roofing that is essential to affordable housing for poor people in Nigeria. GuarantCo thus stepped in, using its local AAA credit rating and a NGN2.2bn local currency guarantee, to enhance the rating of Tower's bond issue. This minimized Tower's cost of capital

and facilitated a 7-year Naira-denominated credit-enhanced corporate bond; which ultimately helped to bring down the cost of their aluminum roofing.

Source: PIDG

4.1.3 Finance up-front costs of connection

When considering the affordability of infrastructure services to the poor, it is important to include both the tariff (actual cost for use) and the cost to access that service. Although the tariff may be affordable to poor users, the cost to access that service may be unrealistic for them—whether they must pay for travel to reach the service or pay for household improvements to connect them to it. For example, in the electricity sector, the high up-front charges the customer must pay for grid connection, including the cost of house wiring and the connection charge payable to the utility, might deter the user from accessing the service.

Some options to finance or lower up-front costs of connection paid by poor users are:

- Spread out over time the cost of connection for low income customers, instead of charging a lump-sum to be paid at the time of connection
- Count connection fees as part of the operating expenses of providing the service; dispersing the cost of connection proportionately through all the customers' monthly tariffs.
- Lower the technical specifications of connection required for low-income users. For example, low-income households generally have lower electricity demands than high-income users. For this reason, the technical specifications required to connect the house of a high-income user to the grid will not be the same as the technical specifications required to connect a low-income household; making the

low-income household adhere to the higher standard can be unnecessarily burdensome and expensive.²⁶

- Offer prepaid and pay-as-you go options for customers with irregular incomes. Payments can be made as the customer uses the service, in contrast to paying at regular time intervals. Examples include buying mobile phone minutes on an as-needed basis. In addition to removing the risk of disconnection for customers this mitigates credit risk for service providers.
- Provide subsidies to cover all or a part of the connection charges
- Base programs on results-based financing or output-based aid (OBA), which often emphasizes targeting low-income households²⁷

Box 4.3: Financing Connections Example: Kalangala

Bugala Island in Uganda lacked much of the basic infrastructure required to facilitate economic growth. InfraCo Africa, along with other PIDG facilities, designed and financed multisector infrastructure projects known as Kalangala Infrastructure Services (KIS) and Kalangala Renewables (KR). KIS and KR improved transportation infrastructure and



provided much needed water and energy to the island. TAF provided an output-based aid (OBA) grant that directly subsidized power and water connections to 2,000 poor households on the island. These connections ensured that poor people had access to the new infrastructure services, and could actually

benefit from them.

Source: PIDG

4.1.4 Mobilize government and donor resources to reduce charges to poor people

One of the most straightforward ways to make infrastructure services affordable to poor people is to reduce their charges. This can effectively be accomplished through pricing strategies that use subsidies provided by government and/or external donors. PIDG facilities can work with governments and donors to mobilize their resources as part of the end-user pricing strategy. This can most effectively be accomplished by PIDG facilities when they free fiscal space for governments, allowing them to afford the provision of subsidies, or when

²⁶ Golumbeanu,R., and Barned, D, “ Connection Charges and Electricity Access in Sub-Saharan Africa”, Policy Research Working Paper, The World Bank, Accessed at <https://openknowledge.worldbank.org/bitstream/handle/10986/15871/WPS6511.pdf?sequence=1>

²⁷ Golumbeanu,R., and Barned, D, “ Connection Charges and Electricity Access in Sub-Saharan Africa”, Policy Research Working Paper, The World Bank, Accessed at <https://openknowledge.worldbank.org/bitstream/handle/10986/15871/WPS6511.pdf?sequence=1>

they do capacity building with governments to help them structure the tariffs in such a way that subsidies are affordably built in.

Box 4.4: Mobilizing Government Resources Examples: Coc San Hydropower and Kalangala

InfraCo Asia invested considerable time and effort in the Coc San Hydropower Project due to its significant developmental impact. However, despite increased efficiencies and cost reductions due to InfraCo's intervention, the project remained financially unviable. A TAF grant of US\$5 million allowed the project to close the financial viability gap, and earn a reasonable rate of return for investors



The subsidy made the project itself financially viable, without affecting the tariffs paid by the poor. The Vietnamese power utility could purchase the power at a price point that had no impact on the tariff paid by low-income households, at a subsidized retail rate of 993VND/kWh for up to 50kWh of supply per month.



In the case of Kalangala, PIDG facilities advised the Ugandan government on how to structure tariffs for the infrastructure. This capacity building freed fiscal space that allowed the Ugandan government to subsidize ferry use for poor people coming from and going to Bugala Island.

Source: PIDG

4.2 Broaden Origination and Screening Strategy to Include More Projects Serving the Poor

Changes in the origination and screening strategy can help PIDG include more projects that focus on serving the poor. Broadening the origination strategy means moving away from a model of primarily supporting projects that were already within the project pipeline of a host government. These old origination projects are often large scale, high visibility, and can be designed with political motivations in mind.

A broader origination strategy could allow PIDG to consider more projects that:

- Serve the poor directly; e.g. rental electric bicycle transport in urban and rural areas
- Deliver practical and affordable alternatives that go directly to the end user, are smaller in scale, and may circumvent the need to build large costly infrastructure (transportation solutions, off-grid energy including franchises for mini-grids).

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- Improve existing infrastructure for example by reducing system losses (which could translate into lower tariffs) and/or improving quality.
- Use new, unconventional, or alternate technologies. Advantages to using new technologies are that they may have the potential to be disrupters and 'game-changers' in delivering infrastructure services to the poor. For example, concentrated solar power, Biofil Box sanitation, complete LV-DC power systems
- Enable mobile billing and innovative payment structures

5 Solutions to Better Demonstrate That PIDG Is Serving the Poor

According to the Results Monitoring Database, only a quarter of PIDG projects in operation serve the poor directly. In part, this is due to underreporting of the benefits of projects, in particular for power generation projects. This can be seen in the six case studies we prepared to assess how PIDG is delivering service to the poor.

At the time of writing, PIDG is not using reliable methods to estimate if its projects are serving the poor. **Error! Reference source not found.** shows the methods used to estimate access to the poor in five PIDG projects (case studies for these projects are available in the Appendix Section). Out of six projects, only the Kalangala Infrastructure Service (KIS) project used a reliable method to estimate access to the poor. For the KIS project, the increase in access was based on the number of connections to the network. The remaining five projects did not use a reliable method to estimate access to the poor. In other cases, such as the Zambia Solar, Tobene, and Cabeolica projects, the benefits of energy generation projects are underreported, because the default is to report zero people as having benefitted from energy projects.

Table 5.1: Methods Used to Estimate Access to the Poor in Selected Case Studies

Name of Project	Poor People with Access (new or improved; actual)	Method to Estimate Access to the Poor		
		Consumer Survey	Other Reliable Method	Non-Reliable Method
Kalangala Infrastructure Services	4,200		✓ (Number of connections)	
Coc San Hydropower	11,784		(For benefits other than electricity service)	
Zambia Solar	0			✓
Tobene HFO plant	0			✓
Cabeolica Wind Farm	0			✓
Tower Aluminum Group Limited	297,000			✓

The following sections propose methods that can be used to estimate access to the poor for generation projects. Some of the proposed solutions to better demonstrate PIDG's impact include:

- Preparing well-founded Impact Cases (Section 5.1),
- Checking the number of actual people being served after a project is operational using consumer surveys for projects serving people directly (Section 5.2)

- Using new methods for measuring actual impact on the poor by wholesale generation projects (Section 5.3)
- adopting KPIs on service to the poor for results monitoring (Section 5.4), and
- providing resources for monitoring and evaluation (Section 5.5).

5.1 Prepare Well-Founded Impact Cases to Provide a Baseline

We recommend that PIDG should prepare Impact Cases that justify and provide information on how a project will benefit the poor. An Impact Case provides the justification for undertaking a project. It describes why the project is needed and compares the project's benefits, costs, and risks to alternative options. PIDG can justify undertaking a project by preparing an Impact Case that identifies how the proposed project fits within PIDG's objectives (as set out in Figure 2.2), including inclusive economic growth and mobilization of private capital (which are not discussed in this report), and, in particular, its objective to increase infrastructure services to the poor. The Impact Case should state why the project is needed, what kind of infrastructure need the project will be providing, and why the proposed project is the preferred project over other alternatives.

A well-founded Impact Case should present the following four components to assess, and therefore justify, if a project will benefit the poor as end-users of infrastructure:

- **Number of expected beneficiaries**—This refers to the total expected number of customers that will benefit from the project. This number is easier to estimate for projects that serve people directly. For example, the Impact Case for a housing project can easily identify the number of expected customers by calculating how many people are expected to live in the housing developments. Also, the Impact Case for an electricity distribution project that delivers service directly to end-users can identify the number of additional customers or additional connections.
 - For projects that do not serve people directly, this number is harder to estimate because the information might not be publicly available or the information available is not reliable. For example, an Impact Case for a generation project would require access to the off-takers' customer information to identify the number of people who will benefit from the project.
 - For projects focused on the potential for the infrastructure to deliver economic growth and employment, estimated the number of customers (end-users of infrastructure) also presents a challenge. For example, the Impact Case for a transport project that is focused on improving infrastructure services for commercial users would need to establish a plausible link between increased commercial activity and positive impact for the poor.
- **Income level of the beneficiaries**—An Impact Case should include information on the customers' income levels. For electricity generation projects, obtaining information on the customer's income levels is harder because it requires access to the information regarding the income distribution of the off-taker's customers (see section 5.3)

- **Current Service used**—An Impact Case should assess the current service and the amount of service used by the customers. For example, an Impact Case on increasing people’s access to electricity for lighting uses would compare the expected service level delivered by the project to the current service used. The case would identify what other services are currently used for lighting (kerosene lamp, solar-powered electric lights, or others) and how much the customers are using to meet their current energy needs. For example, a typical household kerosene lamp is used three to four hours per day with weekly fuel consumption of about one liter²⁸
- **Current service spending**—An Impact Case should assess what is the spending on the current service used by the customers to meet their infrastructure need. For example, for a project expanding lighting services, the Impact Case should identify the amount customers are spending on lighting services. For example, a poor household in Rwanda is expected spend over \$8 per month on kerosene²⁹. Current service spending should also account for non-monetary costs such as time spent traveling or collecting, health costs from household air quality, and safety costs.

Information on end-users

Obtaining information on end-users for projects that do not serve people directly is not as straightforward as projects that do serve people directly. However, there are available sources that can be used to access information on end-users. For energy generation projects, the following information on household end-users can be obtained through the off-taker:

- **Income level of customers of the off-taker**—If the off-taker has information on the income levels and the current service used by its customers. This information is relevant to assess the current service used (in kWh consumed per a specific timeframe) and the current service spending. In both developed and developing nations, such as the United States³⁰ and Colombia³¹ respectively, it is common for utilities to adjust pricing based upon the income levels of their customers.
- **Tariff schedules of the off-taker**—These tariff schedule provide useful information when the off-taker is a utility that offers differentiated tariff levels based on the customers income levels or socio-economic categorization. To identify the benefit of the project to the poor, it is necessary to identify how many customers are paying the lowest subsidized tariff offered by the utility³².

²⁸ Lights for life <http://www.lightsforlife.org/need>

²⁹ Lights for life <http://www.lightsforlife.org/need>

³⁰ ASU Energy Policy Innovation Council. “A National Survey of Electric and Gas Utility Rate Structures for Low-Income Customers.” September 2013. Accessed at: <https://energypolicy.asu.edu/wp-content/uploads/2013/12/National-Survey-of-Low-Income-Utility-Rates.pdf>

³¹ UN-Water International Conference; Avenadano, Ruben. “Pro-poor financing and tariffs in Medellin, Colombia.” October 2011. Accessed at: http://www.un.org/waterforlifedecade/green_economy_2011/pdf/session_7_lac_cases_colombia.pdf

³² Some sources include IBNET for water utilities, local regulators , LAC SER for Latin America

5.2 Check Number of Actual People Being Served Using Customer Surveys for Projects Serving People Directly

Customer surveys gather information essential for measuring if poor people are receiving service, namely income level of customers, current service used, current service spending, and customer satisfaction. The information gathered for the consumer survey is similar to the information gathered for the Impact Case (Section 5.1).

Preparing Impact Cases and carrying out consumer surveys are useful ways to have information on the service to the poor before and after the project. The Impact Case provides the baseline for customers' income levels, current service used, and spending, while the consumer surveys confirm the benefits of the project for each of the components included in the Impact Case (Table 5.2).

Table 5.2: Complementarity Between the Impact Case and the Consumer Surveys

	Impact Case	Consumer Surveys
Objective	Provide a baseline	Provide information on the actual impact of the project
Information on	<ul style="list-style-type: none"> ▪ Estimated Customer Income Levels ▪ Estimated Current Service Level ▪ Estimated Current Service Spending 	<ul style="list-style-type: none"> ▪ Actual Customer Income Levels ▪ Actual Current Service Level ▪ Actual Current Service Spending ▪ Customer Satisfaction

5.3 Use New Methods for Measuring Actual Impact on the Poor by Wholesale Energy Projects

Wholesale energy projects account for over a third of the PIDG portfolio. The current approach to measuring the impact of energy generation projects does not fully capture all the benefits to the poor. Improved measurement could support PIDG's work with partners (including NGOs, Government, Donors, Impact Investors), and ensure optimal use of PIDG funds.

Energy generation projects have an impact on the poor in two ways, by increasing the number of poor people who have direct access to electricity, and/or by boosting inclusive economic growth³³ that contributes to reduce overall poverty. Therefore, to better demonstrate the impact of energy generation projects on the poor, PIDG should estimate:

- The number of poor people that have access to electricity. For this the first step is to identify if an energy generation project effectively increases the number of people with direct access to electricity because of the additional generation capacity. (Section 5.3.1)

³³ Karekezi, S., S. McDade, B. Boardman and J. Kimani, 2012: Chapter 2 - Energy, Poverty and Development. In Global Energy Assessment - Toward a Sustainable Future, Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria, pp. 151-190. Accessed at, http://www.iiasa.ac.at/web/home/research/Flagship-Projects/Global-Energy-Assessment/GEA_Chapter2_development_hires.pdf

- If the energy generation project does not serve the people directly, estimate the expected economic benefits of increased generation (Section 5.3.2).

5.3.1 Check if the project meets criteria for serving the poor directly

A wholesale generation project supported by PIDG that provides services to people and households, as opposed to industry or commercial segments, can have one or two main purposes:

- 1 Increasing the number of people that receive service
- 2 Improving the service provided to people.

Table 5.3 describes the conditions that have to be in place for a generation project to either increase access or improve access. For example, a project that improves service to the poor is a project where there is already a high electrification rate, and the additional capacity results in fewer power cuts or load shedding.

Table 5.3: How to Measure If Wholesale Generation Project Serves Poor People

	Effect of the Energy Project	
	Increase access to people	Improve service to people
Conditions	<ul style="list-style-type: none"> ▪ Project produces energy for residential consumption ▪ There is a credible and consistent plan to expand electrification access to the poor ▪ Energy uptake is increasing or high 	<ul style="list-style-type: none"> ▪ Project produces energy for residential consumption ▪ High electrification rate in the country (Appendix G) ▪ Customers suffer load shedding or power cuts
How to measure if project serves poor people	<ul style="list-style-type: none"> ▪ Estimate the energy available for residential consumption ▪ Estimate the number of poor customers 	
How to communicate project is serving the poor	<ul style="list-style-type: none"> ▪ The power project will generate (<i>amount of electricity generated</i>) kWh for residential consumption. The project is expected to supply power to (<i>number of poor people</i>) people 	<ul style="list-style-type: none"> ▪ The power project will improve services by (<i>reducing power cuts/ load shedding</i>) to approximately (<i>number of poor people</i>) poor people served by the grid

Measuring how a wholesale energy project serves poor people

To estimate the number of poor people that have access to electricity we suggest implementing the Alternative 1 presented in Table 5.4. To use Alternative 1 it is necessary to obtain information from the off-taker on the number of existing residential connections. In absence of reliable information on the number of residential connections, we suggest using the Alternative 2 presented in Table 5.4.

Table 5.4: How to Estimate that a Project Serves Poor People

Component	Process or Formula	Source
Energy available for residential consumption (in kWh)	$\text{Energy for residential consumption} = \text{Total energy produced} - \text{Technical and nontechnical losses} - \text{energy for industrial and commercial consumption}$	Utility
Alternative 1 - Information Available from Off Taker		
Component	Process or Formula	Source
Estimating the number of poor customers (in number)	<ul style="list-style-type: none"> ▪ Estimate the number of residential customers served by the grid (number of connections) ▪ Determine which residential customers are considered poor. <ul style="list-style-type: none"> – $\text{Number of poor customers} = \text{Total number of connections} * \text{electrification rate for the poor}$ (on-grid electrification rate is ideal but likely unavailable) ▪ Determine the number of poor people served <p>It is possible to estimate the total number of people by multiplying the total number of customers (connections) by the average household size.</p> $\text{Total number of people served} = \text{Total number of residential customers (connections)} * \text{average household size}$	<p>Utility (Off-taker)</p> <p>World Bank, IEA, others (see 6.1.3Appendix G)</p> <p>Utility and National statistics department</p>
Alternative 2 - Information Available from Off Taker		
Component	Process or Formula	Source
Estimating the number of poor customers (in number)	<ul style="list-style-type: none"> ▪ Determine number of people in service area ▪ Estimate the number of people with connections $\text{Total number of people served} = \text{Number of people in service area} * \text{take up rate}$ ▪ Estimate the number of poor people served $\text{Population with connections} - \text{population above poverty line in service area} = \text{Number of poor people served}$ <p>Assume take up rate correlates with income distribution (e.g. if take up rate is 40%, this is the top 40% of the local population by income).</p>	<p>National statistics department</p> <p>World Bank, IEA, others (see 6.1.3Appendix G)</p> <p>National statistics office, World Bank</p>

5.3.2 Check if the project meets criteria for having net economic benefits, if not do a cost benefit analysis

A wholesale energy project can be justified on the grounds of boosting economic growth, rather than providing people with increased access to energy. Where projects do not meet

the criteria for providing services directly to people and households (Section 5.3.1), they may be justified if they provide net economic benefits and are least cost.

Least cost projects that have net economic benefits meet the following basic conditions:

- The project is part of an integrated resources plan,
- No subsidies are required for implementing the project
- The project has been contracted through a competitive procurement.

When those conditions are met, PIDG can argue that the generation project has net economic benefits. However, if these conditions are not met, a cost benefit analysis (CBA) to assess the project's net economic benefits could provide justification for the project.

5.4 Adopt KPIs on Service to the Poor for Results Monitoring

The current logical frameworks that PIDG facilities use do not have indicators that reflect PIDG's mission and objectives related to service to the poor. The four indicators currently used are:

- 1 Increased responsible private sector participation in sustainable infrastructure in poorer developing countries through increased flows of private capital and expertise,
- 2 Percentage of private sector investment arising from PIDG supported projects in DAC I and II countries and "poorer" Indian states and post-conflict or fragile states,
- 3 Increased availability/improved quality of infrastructure services in poorer developing countries; and
- 4 Positive fiscal impact from successfully closed projects each year.

Adopting KPIs on service to the poor can help PIDG better demonstrate that its projects are benefitting the poor. KPIs can be used to measure the performance of PIDG projects and PIDG facilities. They can also be used to assess if the PIDG facilities are meeting their targets and to evaluate PIDG's success of developing projects that serve poor people. Table 5.5 lists some proposed KPIs that could be used to assess if a PIDG project is serving the poor, the result or outcome that would be measured with each KPI, and the sources that can be used to obtain the information to calculate the KPIs. For example, the "number of poor people served per USD dollar of donor money spent" shows how efficiently the project uses donor resources to serve the poor. KPIs can also be introduced for other major routes to impact people's livelihoods set out in PIDG's theory of change.

It is important to note that KPIs taken into account before project completion, as part of the Impact Case, will be predicted figures. Consumer surveys, or alternative methods to estimate actual number of poor people being served will only be useful, from an impact measurement perspective, after a project is operational.

Table 5.5: Proposed KPIs for Service to the Poor Target

Key Performance Indicators	Outcome	Source
Number of poor people served by completed projects	Quantity	Consumer Surveys
Number of poor customers satisfied by completed projects	Quality	Consumer Surveys
Number of poor people served per USD dollar of donor money spent	Efficiency	Consumer Surveys and PIDG Accounts
Number of projects that directly serve the poor achieving financial close	Scope & Diversity	Facility Reporting
'Demonstration rating' for projects achieving financial close	Replicability	Expert Assessments

5.5 Provide Resources for Monitoring and Evaluation

Effective monitoring and evaluation (M&E) requires resources beyond those already employed by the Central Management Office (CMO). We recommend PIDG creates, or contracts out, an M&E team whose sole responsibility is monitoring and evaluating the costs and impacts of operational PIDG projects. We also recommend assigning tasks at the facility level to support the M&E of operational projects to better demonstrate impact on the poor.

The additional activities that the M&E team and the facilities will have to complete are:

On the facility level, facilities should be preparing the Impact Cases described in Section 5.1. Creating this baseline will facilitate M&E goals and expectations once a project is operational. These Impact Cases can be prepared by facility management with guidance from the PIDG funded M&E team.

Furthermore, cost-benefit analyses conducted by facility management to assess potential projects can also receive support from the M&E team.

The M&E team can contract out consumer surveys to local experts in the countries of the projects in question. This will help to save money while also leveraging local expertise and local information networks. It can also help to mitigate language or cultural barriers.

The M&E team will ultimately have responsibility for assessing the effectiveness of PIDG's infrastructure investments in delivering affordable service to poor people, among other responsibilities. Even if such a team is responsible for M&E across all PIDG facilities, we estimate that they can be funded with US\$200,000 per year. We calculated this figure using the following assumptions:

- M&E Team Fixed Costs = US\$180,000 per year
 - Includes salaries of a 3-person team who design surveys, aggregate data, assist facilities in Impact Case design, and disseminate information across all the facilities
 - M&E Surveyor Costs = US\$18,000 per year

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- 1 local national surveyor can conduct 15 surveys per day, at a cost of US\$60 per day
- 150 surveys per infrastructure project would thus cost US\$600
- Users of the 90 operational PIDG projects should be surveyed once every 3 years, meaning 30 projects should have consumer surveys each year
- $30 * US\$600 = US\$18,000$
 - Note: Surveyors can be trained via Skype, so there is no need for the M&E team to spend resources traveling to and from project sites
- M&E Survey Material Costs = US\$2,000 per year
- Surveyors will need basic materials to conduct surveys
- Survey forms, pencils, postage

6 PIDG can Serve the Poor Better by Innovating

PIDG is not static, it is an organization that welcomes innovation. This innovation is driven by the need to identify new opportunities to further achieve its objectives. PIDG's history is one of developing new facilities to address specific challenges in infrastructure development. Each facility was designed to fill a need. When effects from the financial crisis rippled to impact infrastructure financing in developing countries, PIDG created the Infrastructure Crisis Facility-Debt Pool (ICF-DP).

Infrastructure service provision is complicated and costly, and in many cases the replication of large power facilities doesn't improve affordability or access for poor people. PIDG should therefore consider innovating further by considering new types of facilities, new approaches to projects, and new partnerships. Innovation and reinvention can help ensure that PIDG remains well positioned to serve poor people for years to come.

6.1 Innovative Approaches PIDG Could Use to Develop More Projects That Directly Serve the Poor

There are four innovative approaches readily available to PIDG and its facilities to develop more projects that directly serve the poor. These new approaches include greater knowledge sharing across facilities in the form of innovation working groups (Section 6.1.1), the development of nimbler and more innovative funds (Section 6.1.2), increased partnerships with social impact funds and NGOs who may have better access to information resources in local environments (Section 6.1.3), and welcoming participation in competitive tenders (Section **Error! Reference source not found.**). Below we explain in greater detail the advantages of these new approaches and how PIDG can implement them.

6.1.1 Innovation Working Group

An innovation working group brings together experts to collaborate on achieving specified goals, often to solve persistent problems or repeated setbacks. For PIDG, an innovation working group could be an annual meeting between facility managers to answer an explicit question; "how to improve and increase service delivery to poor people?"

The groups could begin by discussing lessons learned from the previous year, such knowledge and experience sharing is known as vicarious learning. Vicarious learning can help to prevent the repetition of mistakes across facilities. But in addition to reviewing what could've been done differently, managers can share with one another what was successful, and they plan to do again in the future.

Perhaps the greatest value of an innovation working group for PIDG is the opportunity for managers to field new ideas on how to improve service to the poor. Some may have experience with ideas offered by others and can provide insights on how to improve execution. Managers may also be able to build upon each other's new ideas to develop something actionable.

6.1.2 VC Fund and Types of Projects a VC Fund could support

A VC (venture capital) Fund could have an investment mandate that seeks to support either new business models or new technologies that have the potential to scale to serve at least 50 million poor people. This fund could be more nimble than other PIDG facilities by partnering with local entrepreneurs who have "on the ground" understanding of the needs

and means of local communities. By focusing on scalable (replicable) projects, PIDG could also potentially get more impact out of less spending.

The main advantage of a VC Fund is that it could be better suited to find and implement the new sorts of projects that PIDG should include in a broader origination strategy, as explained in Section 4.2. And once these projects are identified, the VC Fund could be well positioned to facilitate the scaling and replication them elsewhere.

Mobile networks currently serve 235 million poor people in Africa. This is an example of a rapidly scaled infrastructure service where innovation brought service to the poor. The penetration of mobile service into low-income populations in Africa illustrates how service provision to the poor can be simple, low cost, and replicable with the right structures in place.

6.1.3 Partner with Social Impact Funds and NGOs

PIDG can benefit by partnering with social impact funds and NGOs who may have local support networks, and thus access to better information about poor people receiving, or not receiving, infrastructure services. Social impact funds and NGOs may have a more realistic understanding of which sorts of projects are needed to improve the lives of poor people; and PIDG could invest in these opportunities. These partnerships could save PIDG facilities money by reducing how much they need to spend on information.

For example, the Bill and Melinda Gates Foundation partnered with the Asian Development Bank (ADB) to capitalize a fund with \$28 million for piloting innovative non-sewered sanitation and septage management infrastructure in South Asia.³⁴

Possible social impact funds and NGOs to consider include:

- Shell Foundation
- Bill & Melinda Gates Foundation
- Ashden
- Novastar Ventures
- The Rockefeller Foundation
- Energy Access Ventures
- AGA Khan Foundation

³⁴ GatesFoundation.org, “Three New Projects Receive Funding Across Asia to Improve Safe Sanitation.” March 2014. Accessed November 2017 at: <https://www.gatesfoundation.org/Media-Center/Press-Releases/2014/03/Three-New-Projects-Receive-Funding-Across-Asia-to-Improve-Safe-Sanitation>

Appendix A Coc San Hydropower Case Study

A.1 Coc San Hydropower Project Description

The Coc San Hydropower Project is a 29.7MW run-of-river plant located in Lao Cai province, Northern Vietnam. Coc San Hydropower received a \$7.5m equity investment from InfraCo Asia Development, a bridge loan of US\$1.8m followed by a US\$10m term loan from InfraCo Asia Investments, and a \$5m Viability Gap Funding (VGF) grant from TAF, that altogether comprised 77.9 percent of Viet Hydro—the majority shareholder of the project company.

Table A.1 summarizes the key development indicators for Coc San Hydropower.

Table A.1: Key Development Indicators for Coc San Project

Indicator (Actuals)	Number	Comments
Total Investment Committed	US\$44.5 million	
Private Sector Investment	US\$30.6 million	
People Served	87,289	Improved access to power
Poor People Served	11,784	13% (national poverty rate) of 87,289
Fiscal Impact	N/A	5-year tax holiday
Jobs Created	298 and 35	Short-term and Long-term

Source: PIDG Results Monitoring Database

A.2 Coc San Used Two Available Strategies to Deliver Affordable Service to the Poor

The project relied upon two main strategies to deliver affordable service to poor people in Lao Cai province. The first strategy was to minimize the cost of service by bringing down the cost of capital and the cost of project development. The second strategy was to use Viability Gap Funding (VGF) to make the project financially and commercially viable; this in turn allowed the Vietnamese government to procure power from the plant at a price point that allowed them to maintain their subsidization of prices for low-income end-users.

Although both strategies were executed well, neither can have a direct impact on service provision for end-users. This is because the customer of the project is the Vietnamese power utility, who sets the price of power for end-users. Despite PIDG facilities executing these strategies, because there is no direct connection to end-users there is no guarantee of impact on affordability for poor people.

Table A.2 summarizes which affordability strategies were used by PIDG facilities in the Coc San Hydropower Project.

Table A.2: Strategies Used by PIDG for Coc San

Strategy	Was Strategy Used?	How?
Ensuring type of service matches poor people's needs and ability to pay	No	InfraCo Asia participated in the project after it was designed and initiated; and project was driven as part of the Vietnamese government's development plans
Minimizing the cost of service	Yes	InfraCo Asia used a cost of equity that was reasonable and compared development costs to similar projects
Financing up-front costs to consumers	No	The project is not delivering service directly to end-users; but external initiatives (e.g. government policy) supporting connections to low-income households could help fulfill this strategy
Mobilizing government and donor resources to reduce charges to poor people	Yes	Mobilized VGF to provide the service without increasing the cost to the off-taker; this allows the government to maintain low tariffs for the poor (Vietnam offers subsidized electricity tariffs for low-income users)

A.3 11,784 Poor People Served is Likely an Understatement

PIDG calculated the number of poor people served by multiplying the estimated total number of Coc San customers by the national poverty rate in Vietnam. This is 87,289 total customers, times a 13 percent poverty rate, which equals 11,784 poor people served.

At the time of the project was developed, Lao Cai province had a much higher poverty rate (approximately 40 percent in 2010) than the national average. This meant that 11,784 could have been an understatement; since 40 percent of 87,289 is 34,915. Since then, however, the poverty rate in Lao Cai has fallen precipitously, to 12.11 percent in 2015; mirroring the national rate.³⁵

In power generation projects in developing countries, without extensive customer surveys, it can be difficult to know who the end-users are. It is important, therefore, to consider the electrification rates of the country and/or region. Since rural Vietnam has an electrification rate of 98.9 percent, it can be assumed that many of the end-users of the power will be poor.

³⁵ Vietnam News Agency, "Lao Cai seeks measures to optimize poverty reduction aid." 29 November 2017. Accessed at: <https://en.vietnamplus.vn/lao-cai-seeks-measures-to-optimise-poverty-reduction-aid/122537.vnp>

To accurately measure if a wholesale power generation project serves poor people there are certain conditions that must be met:

- Project produces energy for residential consumption (unknown for Coc San)
 - To validate this condition the off-taker should provide information about the expected costumers of the project. There is a high electrification rate in the country (98.8 percent in rural Vietnam)

With these conditions met, PIDG can estimate the energy available for residential consumption and the number of poor customers.

A.4 Coc San Achieved Two Other PIDG Objectives

PIDG achieved two main objectives with the Coc San Hydropower project; increasing capital flow to infrastructure and increasing sustainable infrastructure services.

Northern Vietnam currently imports expensive, and unreliable, power from China. The Coc San Hydropower Project seeks to lessen this reliance on imported power, lower electricity costs, and support the growth of local iron, copper, and fertilizer industries. By developing this project, PIDG facilities are lessening the region's reliance on unreliable and expensive power and thus meeting the objective of increasing sustainable service—which the PIDG Results Monitoring Handbook defines in terms of quality and quantity.

The Coc San Hydropower Project, and PIDG, increased the availability infrastructure by adding 100 GWh per annum of additional energy. This will help Vietnam meet its growing electricity demand, which is increasing at a rate of 15 percent annually. PIDG involvement made this project viable, and thus had a positive impact on the improvement of electricity service in a poor region of Vietnam. By providing a VGF grant to make Coc San viable, PIDG facilities provided a vital capital flow to this needed infrastructure.

The pro-poor strategy of Coc San was rooted in the developmental add-on projects. PIDG reports that the local development plan will improve the economic prospects for 3,266 local individuals. Although these add-ons are commendable, they may have adverse demonstration effects. They demonstrate that these sorts of projects can be even more profitable without the add-ons and corporate social responsibility initiatives. It is important that the project has pro-poor development effects that are intrinsic to the service being delivered, and whenever possible to reduce the cost of service to an extent that it allows poor customers to afford the service.

To demonstrably serve the poor better, wholesale power generation projects like Coc San must have information about the end-users. This includes who is consuming the power, how many poor households there are, and what are the electrification rates for these poor households.

Appendix B: Kalangala Infrastructure Case Study

B.1 Kalangala Project Description

Kalangala Infrastructure Services (KIS) and Kalangala Renewables (KR) are multisector infrastructure projects on Bugala Island in Uganda. KIS is comprised of two ferries providing passengers and vehicles transport to and from the island, an upgrade of the island's main road, and the installment of solar-power water systems that will supply fish landing sites. KIS is complemented by Kalangala Renewables (KR), which is comprised of a 1.6MW renewable energy mini-grid, a low voltage distribution system, the installation of prepaid metering systems throughout the community, and the installment of over 2,000 domestic connections.

InfraCo Africa was the prime mover of this project. Using eleQtra as the principal developer, working with USAID, InfraCo Africa catalyzed investment for the project. InfraCo Africa committed US\$7.72m and US\$4.04m in equity to KIS and KR respectively. EAIF loaned US\$4.56m and US\$2.44m in debt to KIS and KR respectively, while TAF funded an OBA grant (output based aid) for both projects (US\$1.7m to KIS and US\$3.3m to KR) that ultimately subsidized use of their services.

KIS and KR are integrated projects that were developed together. Therefore, in the case study that follows, all figures represent a combined total between KR and KIS.

Table B.1 summarizes the key development indicators for Kalangala.

Table B.1: Key Development Indicators for Kalangala Project (KR + KIS)

Indicator (Actuals)	Number	Comments
Total Investment Committed	US\$48.72 million	
Private Sector Investment	US\$15.01 million	
People Served	35,000	Beneficiaries of improved access to transportation, power, and water
Poor People Served	4,200	Function of national poverty rate
Fiscal Impact	US\$1.97 million	First 5 years of operation
Jobs Created	250 and 98 ³⁶	Short-term and Long-term

Source: PIDG Results Monitoring Database

³⁶ 250 = 175 for KIS + 75 for KR

98 = 74 for KIS + 24 for KR

B.2 Kalangala Used Four Available Strategies to Deliver Affordable Service to the Poor

InfraCo Africa, TAF, EAIF, and GuarantCo did an excellent job executing four main strategies to improve affordability of infrastructure from KR and KIS. When designing the project, PIDG facilities ensured that the type of service matched poor people’s needs and ability to pay. The development of the project also took into account minimizing cost of service by subsidizing prices. PIDG also effectively financed up-front costs by directly subsidizing the building of domestic connections for poor households. Finally, capacity building to help the government structure tariffs allowed the government to subsidize prices for end-users.

These four strategies directly impacted affordability for poor people. PIDG was able to accomplish this because its facilities were involved with every stage of the project. They designed the project so that it directly served end-users.

Table B.2 explains which strategies were used by PIDG to improve the affordability of infrastructure for end-users of services supplied by Kalangala.

Table B.2: Strategies Used by PIDG for Kalangala

Strategy	Was Strategy Used?	How?
Ensuring type of service matches poor people’s needs and ability to pay	Yes	Water service to beach areas was designed with the needs of end-users in mind; road improvements reflected actual throughput of island; power provision through mini-grid was right sized for local demand
Minimizing the cost of service	Yes	PIDG facilities provided the debt and equity that made this project viable; the OBA went towards subsidizing the costs of the services
Financing up-front costs	Yes	The OBA went directly towards increased access by helping locals afford connections to the services; 2,000 domestic connections were installed
Mobilizing government and donor resources to reduce charges to poor people	Yes	PIDG facilities advised the Ugandan government on how to structure tariffs for the infrastructure; this capacity building freed up fiscal space that allowed the Ugandan government to subsidize the ferry service

B.3 4,200 Poor People Served May be an Understatement

PIDG calculated the number of poor people served by multiplying the population of Bugala Island times the national poverty rate. This assumes, likely correctly, that the entire

population of Bugala Island benefits from the new infrastructure services. This is 35,000 people, times a national poverty rate of 12 percent³⁷, which equals 4,200 poor people served.

This method for coming up with 4,200 is unreliable however, and reveals little about the actual number of poor people benefiting directly from the project's infrastructure services. We know that 2,000 poor people are benefitting directly because the project included their domestic connections. Beyond this figure, we would need more information about who is actually using the infrastructure and what their income levels are.

As a rural region, Bugala Island likely has a higher poverty rate than the national average. This would mean that more than 4,200 poor people on Bugala Island are benefiting from the infrastructure services. Furthermore, the national poverty line (see footnote 37) is not the same as the World Bank's international extreme poverty line, \$1.90 (2011 PPP); which counts 24.5 percent of Uganda's population as poor³⁸. Using this poverty threshold doubles the count of poor people being served to 8,575. Applying the World Bank's poverty line for lower and middle-income countries, \$3.20 (2011 PPP), 66.6 percent of Uganda's population are poor, which would equate to 23,319 poor people served.

Despite the fact that rural residents of Uganda only have an electrification rate of 10.3 percent (versus 51.4 percent for urban dwellers³⁹), Kalangala contained a credible plan to expand electrification access to the poor. This is an essential condition for serving the poor in power generation projects; which was a component of Kalangala.

Ultimately, due to Kalangala's multisector approach, the best way to know who is benefiting from the project is to use consumer surveys. This method can check the number of actual poor people being served by the new road, the ferries, and the provision of water and power.

B.4 Kalangala Also Achieved Four Other PIDG Objectives

Kalangala is demonstrably serving poor people. Household connections and subsidized service demonstrate that the project delivers affordable infrastructure services to the poor

In addition to being pro-poor, it achieved four other PIDG objectives; increasing capital flow to infrastructure, increasing sustainable service, improving livelihoods for poor people, and promoting inclusive economic growth.

Economic growth on Bugala Island has been constrained due to a lack of basic infrastructure services. The improvements to transportation on, to, and from the island, along with the additional water and electricity supply, should be a multiplier for existing palm oil and fishing industries. This accomplishes both objectives of inclusive economic growth and better livelihoods for poor people.

It should also be noted that the Bugala fishing industry accounts for 7 percent of Uganda's total catch. This new infrastructure that directly serves the needs of the fishing industry should help to grow this local economy.

³⁷A 12% poverty rate has been applied. This data comes from the UNHS, which is a survey that has been carried out every three years in Uganda - 2002-3, 2005-6, and 2009-10. The data is not district specific.

³⁸ World Bank, living on less than \$1.90 per day

³⁹ World Bank Sustainable Energy for All Database, Accessed November 2017 at <https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS>

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By designing and financing the project, PIDG facilities increased the capital flow to infrastructure in Uganda. And because the services delivered were ‘right-sized’ for the needs of island (e.g., two ferries and a gravel road) they are sustainable in their service delivery and use.

Appendix C: Tobene Power Case Study

C.1 Tobene Power Description

The Tobene Power Project is comprised of two HFO power projects, Tobene I and II. The Tobene Power Project seeks to add capacity to the Senegalese power system, replace generation from expensive emergency power, stabilize the energy grid, meet peak hour demand, and meet growing energy demand. Tobene I is a 96MW HFO power plant near Dakar, Senegal, developed under a build, own, and operate contract. It became operational in 2016. Tobene II, or the ‘Tobene Expansion Project’, refers to a power expansion project that seeks to add an additional 19MW engine to the existing 96MW Tobene I Plant.

EAIF served as a lender for the development of Tobene I and II, providing US\$39.45 million (approximately 20 percent of the funds).

Table C.1 summarizes the key development indicators for Tobene I and Tobene II Power Projects .

Table C.1: Key Development Indicators for Tobene Power Project

Indicator (Actuals)	Number	Comments
Total Investment Committed	US\$135.43 million and US\$36.7 million	Predicted for Tobene I, and TIC for Tobene II
Private Sector Investment	US\$30.26 million and US\$8.3 million	Tobene I and Tobene II
People Served	3,475,251	Improved access
Poor People Served	N/A	RMD reports 0
Fiscal Impact	N/A	RMD reports 0
Jobs Created	198 and 87	Short-term and Long-term

Source: PIDG Results Monitoring Database

C.2 Tobene Used Two Available Strategies to Deliver Affordable Service to the Poor

PIDG facilities used two strategies to deliver affordable service to the poor; ensuring the right type of service was used, and minimizing the cost of that service. By selecting HFO plants that could be converted to natural gas in the future, PIDG focused on power generation that can be delivered at an affordable price point for poor people. Also, by agreeing to a lower margin in the project development, the developers allowed for a lower cost to the off-taker.

Initially, these strategies had a limited impact on affordable service provision for end-users, since the project had no impact on the tariff paid by the end-users. However, upon completion of the project Senegal implemented tariffs that are cost-reflective. As a result, the

project contributed to deliver more affordable service to end-users by reducing the cost of generation to the off-taker. .

Table C.2 summarizes which strategies were used by PIDG to improve the affordability of power for end-users of electricity supplied by Tobene Power.

Table C.2: Strategies Used by PIDG for Tobene Power

Available Strategy	Was Strategy Used?	How?
Ensuring type of service matches poor people's needs and ability to pay	Yes	HFO plants were chosen to increase capacity and provide stability to the grid because they are affordable and reliable; the Tobene plants can also be converted to natural gas in the future
Minimizing the cost of service	Yes	Lenders (including EAIF) agreed to a lower margin for the upsizing due to the brownfield nature of financing
Financing up-front costs	No	The project is not delivering service directly to end-users. EAIF does not have control over this strategy
Mobilizing government and donor resources to reduce charges to poor people	No	

C.3 More Needs to Be Done to Determine Number of Poor Served

PIDG does not report the number of poor people who are expected to receive new or improved access to electricity from the Tobene power projects. It reports that the projects should improve access to power for 3,475,251 people, but does not specify how many of these people are poor.

The goal of Tobene Power is to increase the country's domestic energy with affordable power. But to understand if this will actually increase service to poor people several conditions must be met. Wholesale power generation projects will only serve the poor if:

- The project produces energy for residential consumption
- There is a credible plan to expand electrification access to the poor
 - Then, to calculate how many poor people are being served we must estimate the number of poor customers. Important indicators to consider include;
 - Households with access to the grid : 57 percent⁴⁰

⁴⁰ World Bank Transmission Expansion Project in Senegal, 2016. Accessed January 2018 <http://documents.worldbank.org/curated/en/333951487720106404/pdf/PID-Appraisal-Print-P147921-02-21-2017-1487720103132.pdf>

-
- Population of Country Below World Poverty Line⁴¹: 46.7 percent
- Electric Power Consumption Per Capita⁴²: 223 kWh , of this 33 percent is consumed by residential customers connected to the grid⁴³
 - This is an estimate, but the correct figure would be the average household consumption reported by SENELEC.
- If we can obtain information revealing the electrification rates and what share of energy generated is going to residential consumers, we can build a credible case for the number of poor people served by this project. The information is available using the estimates indicated above. However, the preferred source for reliable information on customer data should be provided by the off-taker.

C.4 But, Tobene Power Still Achieved Two Other PIDG Objectives

Tobene power increases the Senegalese power capacity by 14 percent, and adds supply that is lower cost than the current average. This accomplishes two other PIDG objectives; increasing the capital flow to infrastructure and increasing sustainable service.

Tobene power increases people’s access to improved and reliable electricity service. The project allows the off-taker to replace expensive emergency power and old high-consuming thermal plants with reliable less-expensive baseload power. The expansion of Tobene helps SENELEC lower its supply costs following the reduction in the overall PPA for Tobene I and Tobene II. These lower supply costs, and increased capacity, should translate into lower power costs for millions of Senegalese electricity customers.

These lower supply costs also free fiscal space for the Senegalese government, making the provision of service more sustainable. This occurs because the Senegalese Government provides revenue compensation to SENELEC based on the difference between revenue requirements reviewed by the regulator and actual tariffs. In addition, further indirect subsidies to the sector are in place in the form of unpaid taxes by SENELEC. While Senegal has moved towards tariffs that are more cost reflective, full cost-recovery tariffs are still not in place⁴⁴

⁴¹ World Bank, living on less than \$1.90 per day

⁴² World Bank

⁴³ EIA Senegal Energy Outlook Accessed at:<https://www.africa-cu-renewables.org/market-information/senegal/energy-sector/>

⁴⁴ World Bank Transmission Expansion Project in Senegal, 2016. Accessed January 2018 <http://documents.worldbank.org/curated/en/333951487720106404/pdf/PID-Appraisal-Print-P147921-02-21-2017-1487720103132.pdf>

Appendix D: Tower Aluminium Case Study

D.1 Tower Aluminium Description

Tower Aluminium is a Nigerian company and the largest producer of aluminum products in West Africa. Following the financing of a new facility, the financial crisis of 2008, and a steep devaluation of the Nigerian Naira, Tower's financial viability became strained. To strengthen and diversify its finances, Tower decided to issue corporate bonds but needed access to a higher credit rating. GuarantCo thus stepped in to enhance the rating of Tower's bond issue.

The developmental justification for GuarantCo's involvement is that Tower is a major manufacturer of aluminum roofing, which is a common component in housing for poor people in Nigeria. By strengthening the financial position of Tower, GuarantCo is helping to ensure poor people in Nigeria have access to local and affordable housing materials.

Table D.1 summarizes the key development indicators for Tower Aluminium.

Table D.1: Key Development Indicators for Tower Aluminium Project

Indicator (Actuals)	Number	Comments
Total Investment Committed	US\$30 million	
Private Sector Investment	US\$30 million	Refinancing of Tower Aluminum debt
People Served	540,000	Actually benefit from housing materials
Poor People Served	297,000	Function of national poverty rate
Fiscal Impact	US\$2.5 million	Combined taxes paid up to 2012
Jobs Created	0	

Source: PIDG Results Monitoring Database

D.2 Tower Used Two Available Strategies to Deliver Affordable Service to the Poor

Affordable housing is an essential infrastructure service for the poor. PIDG's assistance to Tower translates into delivering affordable housing to poor people in Nigeria. To this end, two strategies were used; ensuring the right type of service and minimizing the cost of that service. Tower Aluminium was selected because their product, aluminium roofing, is an affordable housing material for poor people. Helping to restructure Tower's debt lowered the company's cost of capital, and a lower cost of capital should, in principle allow the company to charge customers a lower price for goods.

Due to the nature of this project (debt market facilitation) there is no way to guarantee that poor people are actually benefitting from these strategies. PIDG has no control over the end prices for the housing materials, nor any say over who gets them.

Table D.2 explains which strategies were used by PIDG to improve the affordability of infrastructure for end-users of housing supplied by Tower Aluminium.

Table D.2: Strategies Used by PIDG for Tower Aluminium

Available Strategy	Was Strategy Used?	How?
Ensuring type of service matches poor people's needs and ability to pay	Yes	GuarantCo selected Tower Aluminium because it was a local business that provided an essential housing component for poor people.
Minimizing the cost of service	Yes	Facilitating Tower's bond issuance ensured that Tower was able to minimize its cost of capital, which should directly translate into lower prices for end-users
Financing up-front costs	No	PIDG facilities that are not involved in project design or development have limited ability to implement this strategy. An alternative in this project is for facilities to play a more active role ensuring that end-users of the housing materials have access to credit products that enable purchase of housing products by low-income customers.
Mobilizing government and donor resources to reduce charges to poor people	No	

D.3 297,000 Poor People Served is Difficult to Substantiate

PIDG estimated the number of poor people served by first translating factory output into total customers served. They did this by determining how much production went towards housing materials, and divided that number by the housing needs for an average Nigerian family. This comes out to 540,000 total people served.

To calculate the number of poor people being served PIDG multiplied this 540,000 by the national poverty rate, 55 percent, which equals 297,000 poor people. This is an unreliable calculation that tells us little about how many poor people are actually benefitting from the project.

The number could be understated if only poor people buy aluminum roofing, according to PIDG project documents aluminum roofing costs less than traditional steel roofing and is a key component of low-cost housing mostly for the poor.. If this is true, the number of poor people served may be closer to the full 540,000. On the other hand, this number could be an overstatement if there are middle-men selling the roofing at a constant price and absorbing the lower production costs through higher profits.

Consumer surveys are the only way to know who the end-users of the product are and what they are paying. Once that information is obtained, conclusions can be drawn about how many poor people are benefiting from this project.

D.4 But, Tower Aluminium Still Achieved Two Other PIDG Objectives

Although the Tower Aluminium project does not demonstrably serve the poor, it functions as a capital markets project and thus accomplishes another PIDG objective; increasing the capital flow to infrastructure.

The main goal of GuarantCo's involvement in this project was to help build the capacity of Nigerian capital markets through demonstration effect. Stronger capital markets in Nigeria means that more local businesses will have access to affordable capital, and thus be able to grow faster, hire more employees, and offer goods at lower costs to local customers. Furthermore, in the context of infrastructure, reliable bond markets are significant catalysts for greater local involvement.

Another effect of this project was directly strengthening Towers financial position, thus helping to preserve and grow an important industry in Nigeria. Because this industry provides affordable infrastructure to poor people, in the form of housing materials, this accomplishes another PIDG objective; increased services to poor people.

Appendix E: Cabeolica Wind Farms Case Study

E.1 Cabeolica Wind Farms Description

Cabeolica is a 25.5MW wind farm across four islands in Cape Verde. Cape Verde has some of the best access to potential wind power in the world, but was unable to attract private partners to develop a commercial scale wind farm prior to Cabeolica. Upon completion Cabeolica became the first commercial-scale PPP wind farm in Sub Saharan Africa, and it is expected to supply a quarter of the country's energy needs.

InfraCo Africa served as the main project developer and invested US\$7.88 million and then a further €2.3 million in the project. TAF also participated through two grants that totaled US\$395,000 for technical and environmental studies.

Table E.1 summarizes the key development indicators for Cabeolica Wind Farms.

Table E.1: Key Development Indicators for Cabeolica Project

Indicator (Actuals)	Number	Comments
Total Investment Committed	EU€60.9 million	
Private Sector Investment	N/A	Results Monitoring Database reports 0
People Served	372,000	Improved Access
Poor People Served	138,000	Improved Access, Function of national poverty rate
Fiscal Impact	N/A	Results Monitoring Database Reports 0
Jobs Created	100 and 10	Short-term and Long-term

Source: PIDG Results Monitoring Database

E.2 Cabeolica Used Two Available Strategies to Deliver Affordable Service to the Poor

PIDG used two main strategies in the Cabeolica Wind Farm project; ensuring the right type of service and minimizing the cost of that service. Because Cape Verde is an archipelago in the Atlantic Ocean, it has excellent access to wind power. For this reason, wind power was selected; it is cheap, plentiful, and can replace expensively imported fossil fuels. Furthermore, InfraCo Africa and TAF participation lowered development costs and the cost of capital; ensuring that the cost of service was ultimately minimized.

As seen in other power generation projects, however, neither of these strategies can have a direct impact on service provision for end-users. This is because the customer of the project is the Cape Verdean power utility, who sets the price of power for end-users. Despite PIDG facilities executing these strategies, the disconnect to end-users means there is no guarantee of impact on affordability for poor people.

Table E.2 summarizes which strategies were used by PIDG to improve the affordability of power for end-users of electricity supplied by the Cabeolica Wind Farms.

Table E.2: Strategies Used by PIDG for Cabeolica

Available Strategy	Was Strategy Used?	How?
Ensuring type of service matches poor people's needs and ability to pay	Yes	Cape Verde has large wind power potential yet imports expensive fossil fuels for power generation; developing this project helps leverage a clean and affordable domestic power source
Minimizing the cost of service	Yes	InfraCo Africa and TAF participation lowered the cost of project development, which ultimately lowers the cost of end prices
Financing up-front costs	No	The project is not delivering service directly to end-users; therefore the facility is not directly involved with facilitating connection of end-users including poor households.
Mobilizing government and donor resources to reduce charges to poor people	No	

E.3 18,500 Poor People with New Access May be an Overstatement

PIDG estimated the number of poor people receiving new access to power from the Wind Farm Expansion to be 18,500. This number was calculated by first estimating a total number of people expected to receive new access (50,000) and then multiplying it by the national poverty rate of 37 percent. Unfortunately, this method for calculating how many poor people are served is unreliable and bears little relationship to a desired end-state.

The 50,000 people with new access is based upon an assumption that improved stability and predictability in the power system will bring additional people into the national electricity system. It is also based upon an assumption that the government will succeed in its plan to increase connections from 90 to 95 percent of the population by 2015. Unfortunately, a World Bank report on electrification rates in Cape Verde reveals that as of 2014, electrification rates remained around 90 percent.⁴⁵ Considering that electrification rates for poor households are likely much lower, the figure of 18,500 looks even more unrealistic.

The goal of the Cabeolica Wind Farm is to increase access to power by increasing the country's domestic energy capacity with a clean and affordable energy source. But to

⁴⁵ World Bank Sustainable Energy for All Database, Accessed November 2017 at <https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS>

understand if a wholesale power generation project actually increases service to poor people, a few conditions must be met:

- Project produces energy for residential consumption (unknown for Cabeolica)
 - This can be revealed in the Impact Case as a prediction baseline and then through survey data after the project is operational. Information from the Impact case is enough if there is information from the off-taker that indicates that the grid serves residential customers.
- There is a credible and consistent plan to expand electrification access to the poor
 - Although a plan was in place for Cape Verde, it did not yield measurable results
- With these conditions met, PIDG can estimate the energy available for residential consumption and the number of poor customers.

E.4 But, Cabeolica Still Achieved Three Other PIDG Objectives

PIDG participation in this project accomplished three other PIDG objectives; increased capital flow to infrastructure, sustainable infrastructure service, and building local skills for PPP in infrastructure.

Cabeolica is expected to provide 25 percent of the country's energy at 20 percent less than the previous cost of power. This will help to reduce oil imports significantly, leading to cleaner energy generation, a more stable energy matrix, and saving the country at least EUR12 million per year. This accomplishment works towards a sustainable infrastructure service for the country.

Another benefit of the Cabeolica project is that has established a model for large-scale renewable power projects with private investment. This should have a demonstration effect that leads to a greater number of similar projects throughout Sub Saharan Africa. By succeeding in this demonstration effect, local skills for PPPs in infrastructure are developed.

Appendix F: Zambia Solar Case Study

F.1 Zambia Solar Project Description

The Zambia Solar project consists of the development of one 34MW and one 41MW solar PV project in Zambia. This project was executed by Zambia's Industrial Development Corporation (IDC). The projects are intended to directly benefit end-users connected to ZESCO's grid (the national grid) by improving the reliability, quality and quantity, and cost paid for the electricity services provided. The IDC engaged the International Finance Corporation's (IFC) Advisory Services division, acting through DevCo, to act as transaction advisor for the development and installation these two solar projects.

Table F.1 summarizes the key development indicators for Zambia Solar.

Table F.1: Key Development Indicators for Zambia Solar Project

Indicator (Actuals)	Number	Comments
Total Investment Committed	US\$82.5m	This is predicted, not actual
Private Sector Investment	Unreported	
People Served	Unreported	
Poor People Served	Unreported	
Fiscal Impact	Unreported	
Jobs Created	Unreported	

Source: PIDG Results Monitoring Database

F.2 Zambia Solar Used Two Available Strategies to Deliver Affordable Service to the Poor

PIDG used two main strategies in the Zambia Solar project; ensuring the right type of service and minimizing the cost of that service. DevCo conducted an extensive study to ensure that the project was executed the right way, in the right location, and with the lowest possible cost. This ensured the right type of service and when joined with competitive auction ultimately minimized cost of service.

But because this is a power generation project, neither of these strategies can have a direct impact on service provision for end-users. The customer of the project is the Zambian power utility, who sets the price of power for end-users. Despite DevCo executing these strategies, the disconnect to end-users means there is no guarantee of impact on affordability for poor people.

Table F.2 explains which strategies were used by PIDG to improve the affordability of power for end-users of electricity supplied by Zambia Solar.

Table F.2: Strategies Used by PIDG for Zambia Solar

Available Strategy	Was Strategy Used?	How?
Ensuring type of service matches poor people’s needs and ability to pay	Yes	To ensure the right type of project delivery, DevCo recommended the project site to optimize the land lease and the tax incentives offered
Minimizing the cost of service	Yes	Competitive auction for the project was used, and DevCo created a risk allocation strategy to mitigate all project risks
Financing up-front costs	No	The project does not deliver service directly to end-users; but supporting connections to low-income households could have help fulfill this strategy
Mobilizing government and donor resources to reduce charges to poor people	No	

F.3 More Needs to Be Done to Determine Number of Poor Served

The PIDG Results Monitoring Database states, “given that is a generation project, the number of new users is unknown.” This is a realistic insight and reveals that wholesale power projects on their own cannot expand or improve service for poor people directly. If certain conditions are met, however, they can. These conditions include:

- Project produces energy for residential consumption (unknown for Zambia Solar)
 - This can be revealed through survey data after the project is operational
- There is a credible and consistent plan to expand electrification access to the poor
 - Then to demonstrably improve affordability of service to the poor, further indicators must be taken into account. These indicators include:
 - How many poor households are connected to the power grid
 - This is unknown in Zambia, but we do know that 27.9 percent of the population has access to electricity and 59.3 percent of the population is below the world poverty line⁴⁶
 - What the average consumption of energy is for poor households

⁴⁶ World Bank, living on less than \$1.90 per day

- This is unknown for Zambia as well, but we do know that the country-wide electric power consumption per capita⁴⁷ is 707 kWh
- Furthermore, consumer surveys after the project is operational that reveal how many poor people are connected to the grid, how much energy they are consuming, and what they pay for energy, should help to reveal whether access and affordability for poor people were impacted by the project.

F.4 But, Zambia Solar Still Achieved Three Other PIDG Objectives

Despite not being focused on poor people, the Zambia Solar project accomplishes three other PIDG objectives; increasing capital flow to infrastructure, increasing sustainable service, and improving local skills for PPPs in infrastructure.

The project is estimated to generate 94 GWh of electricity per year on average over 25 years from non-fossil fuel sources, moving the Government of Zambia closer to meeting its energy gap and replacing emergency power generation. Zambia Solar also increases people's access to a more reliable electricity service. Load-shedding is expected to reduce and allow the off-taker to replace expensive emergency power with reliable and less-expensive intermittent power. The economic benefits of this power generation can be measured through the partially avoided costs of emergency electricity imports. This all directly works towards improved sustainability in infrastructure services for Zambia.

DevCo and the IFC have also established a goal with the Zambian government, and other Sub Saharan African governments, to increase capacity from solar power. The successful execution of this project, and low cost of power generation, is expected to have strong demonstration effects for PPPs in the region.

⁴⁷ World Bank

Appendix G Electrification Rates

G.1 Regional Electrification Rates

Table G.1: Electricity access in 2014 - Regional aggregates

Region	Population without electricity (millions)	Electrification rate (%)	Urban electrification rate (%)	Rural electrification rate (%)
Developing countries	1,185	79%	92%	67%
Africa	634	45%	71%	28%
<i>North Africa</i>	1	99%	100%	99%
<i>Sub-Saharan Africa</i>	632	35%	63%	19%
Developing Asia	512	86%	96%	79%
<i>China</i>	0	100%	100%	100%
<i>India</i>	244	81%	96%	74%
Latin America	22	95%	98%	85%
Middle East	18	92%	98%	78%
Transition economies & OECD	1	100%	100%	100%
WORLD	1,186	84%	95%	71%

Source: IEA, World Energy Outlook 2016

G.2 Electrification Rates in Africa

Table G.2: Electricity access in Africa - 2014

Region	Population without electricity (millions)	National electrification rate (%)	Urban electrification rate (%)	Rural electrification rate (%)
Africa	634	45%	71%	28%
Sub-Saharan Africa	632	35%	63%	19%
<i>Angola</i>	16	33%	69%	6%
<i>Benin</i>	7	29%	57%	9%
<i>Botswana</i>	1	53%	69%	32%
<i>Burkina Faso</i>	14	18%	58%	1%
<i>Burundi</i>	10	5%	28%	2%
<i>Cameroon</i>	9	62%	96%	23%
<i>Cabo Verde</i>	0	96%	100%	89%

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<i>Central African Republic</i>	5	3%	5%	1%
<i>Chad</i>	13	4%	13%	1%
<i>Comoros</i>	0	69%	89%	62%
<i>Congo</i>	3	42%	56%	16%
<i>Côte d'Ivoire</i>	8	62%	88%	31%
<i>Democratic Republic of Congo</i>	62	18%	42%	0%
<i>Djibouti</i>	1	42%	54%	1%
<i>Equatorial Guinea</i>	0	66%	93%	48%
<i>Eritrea</i>	3	32%	86%	17%
<i>Ethiopia</i>	73	25%	85%	10%
<i>Gabon</i>	0	89%	97%	38%
<i>Gambia</i>	1	45%	66%	13%
<i>Ghana</i>	8	72%	91%	50%
<i>Guinea</i>	9	26%	53%	11%
<i>Guinea-Bissau</i>	1	21%	37%	6%
<i>Kenya</i>	36	20%	60%	7%
<i>Lesotho</i>	2	17%	43%	8%
<i>Liberia</i>	4	10%	8%	11%
<i>Madagascar</i>	21	13%	22%	8%
<i>Malawi</i>	15	12%	46%	5%
<i>Mali</i>	13	26%	53%	9%
<i>Mauritania</i>	3	29%	47%	2%
<i>Mauritius</i>	0	100%	100%	100%
<i>Mozambique</i>	16	40%	67%	27%
<i>Namibia</i>	2	32%	50%	17%
<i>Niger</i>	16	15%	62%	4%
<i>Nigeria</i>	98	45%	55%	36%
<i>Réunion</i>	0	99%	100%	87%
<i>Rwanda</i>	8	27%	72%	9%
<i>Sao Tome and Principe</i>	0	59%	70%	40%
<i>Senegal</i>	6	61%	88%	40%
<i>Seychelles</i>	0	98%	98%	98%
<i>Sierra Leone</i>	5	14%	33%	1%
<i>Somalia</i>	9	15%	33%	4%
<i>South Africa</i>	8	86%	87%	85%
<i>South Sudan</i>	12	1%	4%	0%
<i>Sudan</i>	24	40%	67%	26%
<i>Swaziland</i>	0	65%	84%	60%
<i>Tanzania</i>	36	30%	57%	18%
<i>Togo</i>	5	27%	35%	21%
<i>Uganda</i>	31	19%	52%	12%

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<i>Zambia</i>	<i>11</i>	<i>28%</i>	<i>62%</i>	<i>5%</i>
<i>Zimbabwe</i>	<i>7</i>	<i>52%</i>	<i>78%</i>	<i>40%</i>
North Africa	1	99%	100%	99%
<i>Algeria</i>	<i>0</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>
<i>Egypt</i>	<i>1</i>	<i>99%</i>	<i>100%</i>	<i>99%</i>
<i>Libya</i>	<i>0</i>	<i>100%</i>	<i>100%</i>	<i>99%</i>
<i>Morocco</i>	<i>0</i>	<i>99%</i>	<i>100%</i>	<i>97%</i>
<i>Tunisia</i>	<i>0</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>

Source: Source: IEA, World Energy Outlook 2016

G.3 Electrification Rates in Asia

Table G.3: Electricity access in Developing Asia - 2016

Region	Population without electricity (millions)	National electrification rate (%)	Urban electrification rate (%)	Rural electrification rate (%)
China	0	100%	100%	100%
India	244	81%	96%	74%
Southeast Asia	102	84%	94%	74%
<i>Brunei</i>	<i>0</i>	<i>100%</i>	<i>100%</i>	<i>99%</i>
<i>Cambodia</i>	<i>10</i>	<i>34%</i>	<i>97%</i>	<i>18%</i>
<i>Indonesia</i>	<i>41</i>	<i>84%</i>	<i>96%</i>	<i>71%</i>
<i>Laos</i>	<i>1</i>	<i>87%</i>	<i>97%</i>	<i>82%</i>
<i>Malaysia</i>	<i>0</i>	<i>100%</i>	<i>100%</i>	<i>99%</i>
<i>Myanmar</i>	<i>36</i>	<i>32%</i>	<i>59%</i>	<i>18%</i>
<i>Philippines</i>	<i>11</i>	<i>89%</i>	<i>94%</i>	<i>85%</i>
<i>Singapore</i>	<i>0</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>
<i>Thailand</i>	<i>1</i>	<i>99%</i>	<i>100%</i>	<i>98%</i>
<i>Vietnam</i>	<i>2</i>	<i>98%</i>	<i>100%</i>	<i>97%</i>
Rest of developing Asia	166	66%	84%	56%
<i>Bangladesh</i>	<i>60</i>	<i>62%</i>	<i>84%</i>	<i>51%</i>
<i>DPR Korea</i>	<i>18</i>	<i>26%</i>	<i>36%</i>	<i>11%</i>
<i>Mongolia</i>	<i>0</i>	<i>90%</i>	<i>98%</i>	<i>73%</i>
<i>Nepal</i>	<i>7</i>	<i>76%</i>	<i>97%</i>	<i>72%</i>
<i>Pakistan</i>	<i>51</i>	<i>73%</i>	<i>90%</i>	<i>61%</i>
<i>Sri Lanka</i>	<i>0</i>	<i>99%</i>	<i>100%</i>	<i>98%</i>
<i>Other Asia</i>	<i>29</i>	<i>35%</i>	<i>66%</i>	<i>24%</i>
Developing Asia	512	86%	96%	79%

Source: IEA, World Energy Outlook 2016

G.4 Electricity Take-Up for Populations living under the Grid in Africa

In addition to availability of energy by increased generation access to on-grid generation depends on demand side constraints. Take-up rates indicate how many are high in a few countries (South Africa, Nigeria, Gabon, and Cameroon), and they are very low and often below 50 percent in other countries (Malawi, Liberia, Uganda, Niger, and Sierra Leone).⁴⁸

Table G.4: Estimated Electricity Take-Up for People Living Under the Grid

Country	%
Malawi	35
Uganda	45
Niger	46
Liberia	47
Sierra Leone	48
Burundi	53
Tanzania	54
Kenya	55
Burkina Faso	59
Mozambique	62
Guinea	62
Zambia	63
Madagascar	64
Lesotho	66
Swaziland	67
Namibia	67
Botswana	67
Benin	71
Togo	72
Zimbabwe	73
Senegal	75
Sudan	80
Mali	80
Sao Tome and Principe	81

⁴⁸ World Bank “Africa’s Pulse” 2017 Volume 2. Accessed December 2017
<http://documents.worldbank.org/curated/en/348741492463112162/pdf/114375-REVISED-4-18-PMWB-AfricasPulse-Sping2017-vol15-ENGLISH-FINAL-web.pdf>

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Ghana	82
Cote d'Ivoire	82
Cameroon	88
Gabon	90
Cabo Verde	92
Nigeria	94
South Africa	95

Source: Adapted from World Bank "Africa's Pulse" 2017 Volume 2. See reference 42.

G.5 Grid-electricity poverty, access, and subsidy statistics for monthly consumption of 30 kWh

Table G.5: Grid-electricity poverty, access, and subsidy statistics for monthly consumption of 30 kWh

Country	% Poverty		Access (%)	30 kWh as % of HH Income	Subsidy required as % of			Subsidy (\$, millions)	
	Gap	Head-count			QFD	Cash Collected	GDP	Urban	Rural
Madagascar	30	71	11	9.6	2.6	6.4	0.06	0	0
Rwanda	27	63	11	8.9	7.3	6.3	0.08	0	1
Burkina Faso	24	60	11	8.8	7.2	3.5	0.07	14	58
Togo	15	39	34	6.9	2.6	0.9	0.04	1	2
Sierra Leone	9	33	13	5.1	2.7	3.4	0.02	0	1
Zambia	7	24	22	4.1	0.3	0.2	0.00	0	1
Uganda	7	22	9	4.4	-2.1	0.1	0.02	10	60
Botswana	5	12	43	3.7	0.0	0.0	0.00	0	1
Senegal	2	8	53	2.9	0.1	0.1	0.00	0	0
Niger	2	10	10	3.6	1.8	0.7	0.01	0	1
Swaziland	2	3.2	38	1.9	0.0	0.0	0.00	0	7
Mozambique	1.4	4.6	15	2.3	0.1	0.1	0.00	0	0
Cote d'Ivoire	0.9	2.5	57	1.8	0.0	0.0	0.00	5	61
Malawi	0.6	2.9	9	2.2	0.1	0.1	0.00	0	0
Tanzania	0.6	2.5	16	1.9	0.2	0.0	0.00	1	4
Ghana	0.3	1.1	66	1.4	0.1	0.0	0.00	2	10
South Africa	0.2	0.9	87	1.2	0.0	0.0	0.00	1	1

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Ethiopia	0.2	0.8	19	1.3	0.0	0.0	0.00	0	0
Sao Tome and Principe	0.2	0.9	56	1.7	0.0	0.0	0.00	0	0
Mali	0.1	0.4	22	1.4	0.0	0.0	0.00	4	15
Nigeria	0.0	0.0	56	0.3	0.0	0.0	0.00	6	44
Angola	0.0	0.0	41	0.1	-	-	-	1	12

Source: Kojima, Masami; Trimble, Chris, "Making Power Affordable for Africa and Viable for Its Utilities," World Bank Group, 2016.

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