Rethinking US Development Policy

Maximizing Access to Energy: Estimates of Access and Generation for the Overseas Private Investment Corporation's Portfolio

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Summary

We conservatively estimate that more than 60 million additional people in poor nations could gain access to electricity if the Overseas Private Investment Corporation were allowed to invest in natural gas projects, not just renewables.

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Policy Context

Boosting energy access is a major development objective and a policy priority for the United States. More than 1 billion people worldwide and the majority of people living in sub-Saharan Africa lack access to even basic electricity. This energy poverty affects health (household air pollution from solid fuels used for lighting, heating, and cooking contribute to 3.5 million premature deaths per year), education (most African schoolchildren attend school with no electricity and cannot study effectively in the dark), and jobs (lack of reliable and cost-effective electricity is among the top constraints to growth).

President Obama's Power Africa initiative, launched in June 2013, aims to increase electricity generation and access to modern energy services in six low-income countries. The success or failure of this effort will be determined in large part by the investment decisions of a dozen or so US government agencies that may be operating under potentially conflicting mandates. The Overseas Private Investment Corporation (OPIC), the main US development finance institution, will play a central role. How it selects projects will affect outcomes in Africa for the Power Africa initiative and OPIC's activities in other low-income countries.

A critical policy question for the administration is how the fuel mix in OPIC's portfolio might affect the generation and access targets for the world's poor. In this note, we draw on publicly available data from the International Energy Agency (IEA), the Congressional Research Service (CRS), the US Department of Energy, and OPIC, to provide a rough estimate of the tradeoffs as an input to the fuel-mix debate. We focus specifically on the effect that allowing investment in natural gas would have.

There has been a general bias toward using OPIC to invest principally in solar, wind, and other low-emissions energy projects as part of the administration's effort to promote clean energy technology. An explicit policy capping the total greenhouse gas emissions in OPIC's overall portfolio has further pushed the organization's investments heavily toward renewables. Indeed, over the past five years, OPIC has invested in more than 40 new energy projects and all but two (in Jordan and Togo) are in renewables.

The 2014 omnibus appropriations legislation lifts the greenhouse gas restriction on OPIC's portfolio for projects in low-income countries for the current fiscal year, but the medium-term policy is under debate. Congress will also likely consider a version of the Electrify Africa Act again in 2014. Meanwhile, many African countries have significant natural gas deposits and have declared their desire to utilize that resource for domestic power generation. Of the six countries in Power Africa, four are already producing or developing natural gas and two are exploring its use (see annex A).

## Energy Investment Tradeoffs: Additional Access and Generation Simulations

Figure 1 shows estimates of access based on the allocation of a $10 billion portfolio (what OPIC might reasonably commit over multiple years given modest additional administrative budget) to a mix of natural gas and renewable energy projects. A natural gas–only portfolio could provide electricity access to 90 million people versus 20–27 million people with a renewables-only portfolio. Thus, we estimate that more than 60 million additional people in poor nations could gain access to electricity if OPIC is allowed to invest in natural gas projects, not just renewables.

Figure 1. Tradeoff Between Access to Electricity and Focus on Renewable Energy
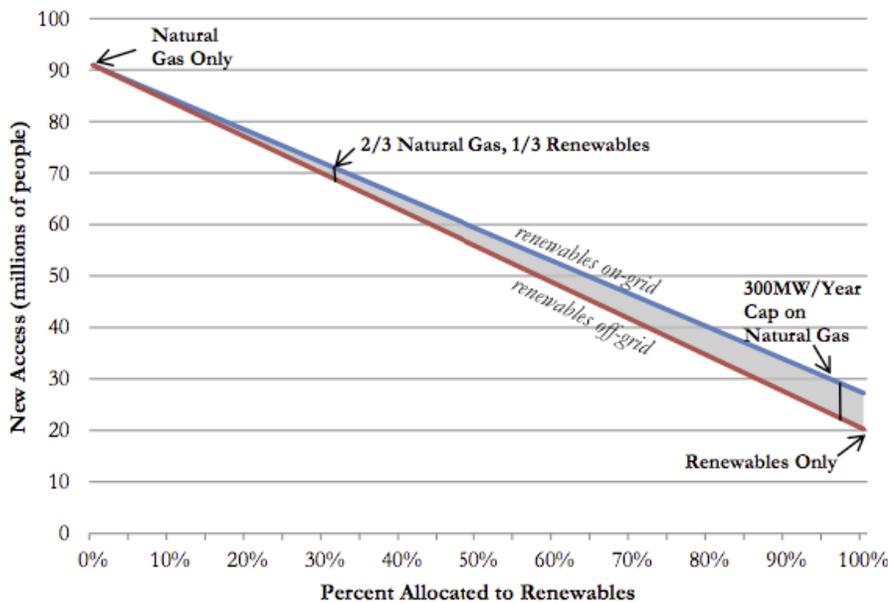
The result is driven principally by the higher private investment leveraging ratios of natural gas projects (5:1 versus 1.5:1 based on OPIC's historical portfolio). Projections of deploying on-grid and off-grid options are based on IEA estimates ($550 and $740 per person, respectively). Additional methodological information is contained in Annex B.

Figure 2 shows estimates of additional generation capacity based on the allocation of the same $10 billion portfolio to a mix of natural gas and renewable energy projects. A natural gas–only portfolio could provide an additional 42,000 MW of electricity versus 4,200 MW in a renewables-only portfolio. Thus, we estimate that about 38,000 MW of generation is at stake. This is equivalent to about three times the entire installed capacity of all six countries in the Power Africa initiative (see annex A).

Figure 2. Tradeoff between Capacity Additions and Focus on Renewable Energy
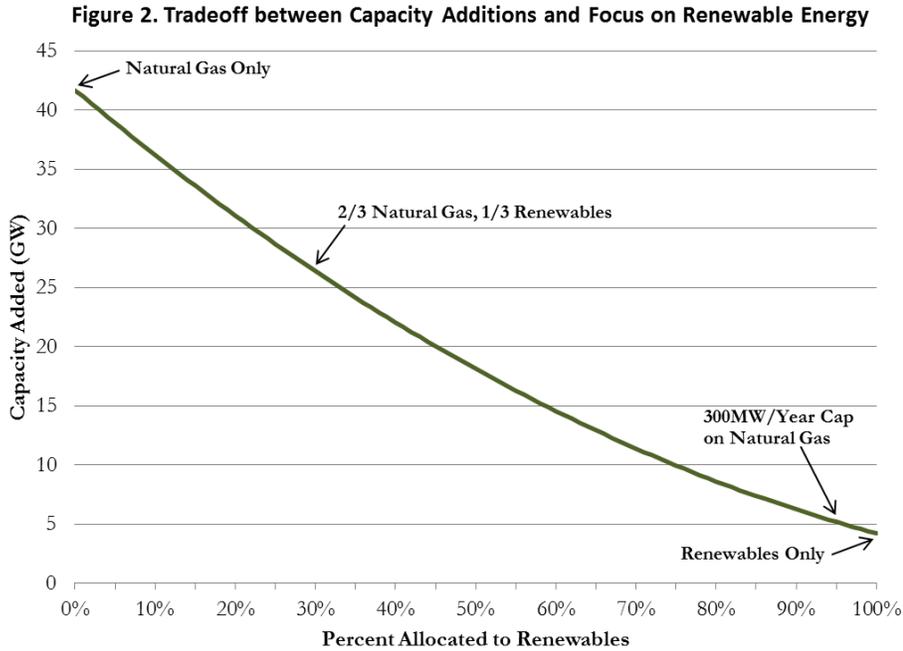
The result in this case is driven by both higher private investment leveraging ratios for natural gas projects and conservative estimates of capital costs per megawatt ($1.2m/MW for gas and $3.5m/MW for renewables). Additional methodological information is in annex B.

Potential Policy Compromise: Balancing Renewables and Access Objectives

A potential policy compromise, which is highlighted in both graphs, could support both OPIC's continued investment in renewable energy and substantially boost access for the poor. A targeted mix of two-thirds gas and one-third renewables would increase access for 70 million people and generate approximately 25,000 MW of additional capacity. (By comparison, the United States uses coal and gas for two-thirds of its own power, with the balance principally hydro and nuclear.) Reaching this two-thirds natural gas target for OPIC, however, would require additional policy flexibility, including a revision of the emissions cap or how it is calculated.

There are other reform options, which may enable expanded access while also continuing to encourage OPIC to invest in the next generation of renewable energy. These options are the subject of a forthcoming paper.

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Annex A

	Access to electricity	Millions w/o access	Installed capacity (MW)	Estimated demand (MW)* 2010	2030	Gas production
Liberia	0.5%	3.9	200	1118	1787	Exploring
Tanzania	14.8%	38.3	840	10916	20362	Producing 30 Bcf; new discoveries estimate reserves of 28.7 Tcf
Kenya	18.1%	33.5	1700	9908	16886	Exploring; small initial discoveries
Ethiopia	23.0%	67.1	2060	18933	32828	Estimated reserves 4 Tcf; beginning to develop gas fields
Nigeria	50.3%	79.4	5900	24139	55296	Producing 1.1 Tcf; 182 Tcf proven reserves (10th largest globally)
Ghana	60.5%	9.6	1990	3241	6263	800 Bcf proven reserves; building pipeline

Sources: WDI, US EIA

*Demand is estimated using average consumption levels for Tunisia (1260 kWh per capita). See http://www.cgdev.org/blog/how-much-power-does-power-africa-really-need for full explanation of estimation.

Annex B

Table 1: Access and Capacity of $10 billion in OPIC Investment in Power

Scenario:	Total capital ($bn)	New Access (million people)	Capacity Additions (MW)*
(1) Renewable only	15.0	20-27	4,200
(3) Renewable 1/3, Gas 2/3	38.3	67-70	25,000
(2) Natural Gas only	50.0	90	42,000
(4) Cap Only 1500MW gas	16.3	22-30	5,600

Based on conservative estimates from CRS study

Table 2: Incremental Access Efficiency Estimates

Type	Annual Investment ($ bn)	People Gaining Access annually (m)	$/person gaining access
On-grid	11.0	20	550
Mini-grid	12.2	19	642
Off-grid	7.4	10	740

Source: IEA, World Energy Outlook, 2011, pg. 31.

Methodology

$$New\ Access = Investment * \left[\frac{(\%\ on\text{-}grid * multiplier_{on}) + (\%\ off\text{-}grid * multiplier_{off})}{efficiency_{on}} \quad \frac{}{efficiency_{off}} \right]$$

I. Investment: Assume a baseline OPIC investment of $10 billion.

II. New Access per Dollar of Investment (efficiency): The International Energy Agency estimates that the amount of investment required to achieve access to electricity for all households. Their estimates of annual investment needed by type (on-grid, mini-grid and off-grid), along with their projections of the number of people this would give access to, yields a simple per capita average cost of extending access (see table 2 above). Because reaching the last million people without energy access will almost certainly cost more than the first million, using an average cost provides a conservative estimate. The IEA incorporates this diminishing returns principle in their estimates for cost per person gaining new access (see IEA World Energy Outlook 2011, pg. 31, for details).

III. OPIC Leveraging Ratios (multiplier): Based on past and current energy projects for which data is available, OPIC has historically financed on average 20 percent of the total cost of natural gas projects and 60–70 percent of renewable energy projects. Assuming ratios of 1/5 and 2/3 for natural gas and renewable energy respectively yields crowding-in multipliers of 5:1 and 1.5:1. Following the IEA's

assumption that on-grid investment will be 2/3 fossil fuel, 1/3 renewable, we estimate a leveraging ratio for on-grid of 3.83 [equal to 5(2/3)+1.5(1/3)] and for off-grid (presumed, as per IEA, to be only renewables) of 1.5.

Table 3: Overnight Capital Costs per MW by Technology (USD/MW)

Average	Sample of OPIC historical portfolio	DOE Meta-Study	CRS Estimates (US sample)
Natural Gas	591,909	768,750	1,200,000
Renewables (weighted average)*	3,726,049	3,650,250	3,567,000
Wind	1,383,333	1,700,000	2,100,000
Geothermal	8,260,000	3,825,000	3,200,000
Solar Thermal	5,650,892	4,883,333	3,400,000
Solar PV		6,000,000	6,600,000
Hydro	na	na	na
Biomass	2,952,976	3,012,500	3,000,000

Sources: CRS, DOE, author calculations based on public data from OPIC.

*Weighted renewables average calculated using IEA predictions for renewables mix most suited for extending energy access (28% wind, 36% solar, 21% biomass, 8% hydro, 7% others). Weights adjusted to account for lack of data on hydro technologies.

IV. Capacity Additions per Dollar of Investment: We examined three different estimates of cost per MW of additional capacity, both on aggregate and by energy source: averages from OPIC's own energy project portfolio, a Congressional Research Service (CRS) study on power plants, and a Department of Energy (DOE) meta-study.* For the projections included in table 1 and model in figure 2, we use the most conservative assumptions as contained in CRS.

*Stan Kaplan, "Power Plants: Characteristics and Costs," Congressional Research Service Report, November 13, 2008; Tidball, Rick, Joel Bluestein, Nick Rodriguez, and Stu Knoke, "Cost and Performance Assumptions for Modeling Electricity Generation Technologies," National Renewable Energy Laboratory, Department of Energy, November 2010; OPIC estimates based on author calculations using available data from OPIC.gov.