EDFI energy evaluation 2012

Summary Document

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The full report is available on request.

Contents

Dalberg Global Development Advisors

Acronyms

ACP	African, Carribean and Pacific Group of States
BWSC	Burmeister & Wain Scandinavian Contractor
CAPEX	Capital Expenditures
CDM	Clean Development Mechanism
CEC	Copperbelt Energy Corporation
CSR	Corporate Social Responsibility
DEG	Deutsche Investitions- und Entwicklungsgesellschaft
DFI	Development Finance Institution
DRC	Democratic Republic of Congo
EAIF	Emerging Africa Infrastructure Fund
EDFI	European Development Finance Institution
EFP	European Financing Partners
EPP	Emergency Power Provider
ESG	Environmental, Social and Corporate Governance
FMO	Nederlandse Financierings-Maatschappij voor Ontwikkelingslanden (Netherlands Development Finance Company)
GPR	Corporate-Policy Project Rating
IFU	Industrialisation Fund for Developing Countries
IPP	Independent Power Provider
IRR	Internal Rate of Return
OECD	Organisation for Economic Co-operation and Development
PPA	Power Purchasing Agreement
PROPARCO	French Development Finance Institution
ROML	Rabai Operations and Management Ltd.
SHE	Safety, Health, And Environment
ZECI	Zambia Energy Corporation (Ireland)
ZESCO	Zambia Electricity Supply Corporation Limited

Executive Summary

This is a synthesis of findings from in-depth evaluations of three EDFI energy infrastructure investments in sub-Saharan Africa. The evaluation focussed on understanding the development impact and distilling lessons learned for the energy sub-sector. The investments evaluated are Copperbelt Energy Corporation (CEC) in Zambia, and two Kenyan power plants, Olkaria III and Rabai Power.

We evaluated the projects using both the infrastructure version of DEG's Corporate Policy Project Rating (GPR) methodology and a customized cost-benefit analysis methodology. The OECD-DAC Criteria for Evaluating Development Assistance (DAC criteria) were also used to organize and summarize the findings of each project assessment.

Through the EFP cooperation and financing arrangement, EDFI and EIB have financed three financially sustainable energy projects that are making important contributions to development outcomes in two energy-constrained countries in sub-Saharan Africa. The most important findings from the study are centred on four main themes: (i) relieving constraints to growth; (ii) the role of IPPs; (iii) employment effects and (v) the role of DFIs.

1. Relieving constraints to growth

- At the time of the Kenya investments (and still today) economic growth was constrained by load shedding and soaring energy costs due to a high reliance on costly emergency power. The electricity generated by the Kenya IPP projects reduced the supply shortage and now generates national cost savings of 20 mn and €59 mn in 2011 for Rabai and Olkaria III respectively.
- In Zambia, the management buyout of CEC, a mining-sector electricity transmission company, has helped ensure reliable power supply to a key industry, and set the stage for more impactful local investments to come, directed by its new Zambian ownership.

2. The role of IPPs

- The evaluations served to reinforce the importance of independent power producers as a valuable complement to the government's role in power generation. The first IPP deals in a country are typically the most difficult, and DFIs can help foster their success using their connections and experience. After the first PPAs have been signed and have proven successful, new project developers and financiers are likely to enter the market.
- Kenya IPP environment has been cited as the most advanced sub-Saharan African country, having progressed farther on energy reform programs than most other countries on the continent.
- The benefits of IPPs illustrated by these evaluations include: (i) an increase in investments that enable faster infrastructure development; (ii) knowledge transfer due to the introduction and adaptation of advanced technologies to local context; (iii) raising standards for quality and reliability and enhancing competition, spurring public providers to improve their operations.

3. Employment effects

- Job creation is often considered the holy grail of private sector development investments, however there is no common methodology to calculate induced effects by energy investments. For the sake of our evaluations, we have conducted a conservative analysis to estimate the number of jobs supported by 1 GWh of energy produced, i.e. it was estimated that 1 GWh produced supports 464 jobs in Kenya. Based on this figure, we estimate that Olkaria III and Rabai support 190,000 and 256,000 jobs respectively.

4. The role of DFIs

- Energy infrastructure projects can provide very high development returns on investment, due to the potential for high multiplier effects, and there is a clear role for EDFI financing in the private provision of such infrastructure on the African continent.
- EDFI financing and associated environmental and social requirements appear to have a strong positive effect on their borrowers' local impact. All investments were marked by high levels of environmental and social sustainability and minimization and mitigation of any negative effects.
- The EFP mechanism has several advantages: it supplements to total financing raised, which is important due to the size of infrastructure projects; it enables broader participation and at the same time streamlines processes, prevents duplication of effort, and thus increases efficiency.
- There appear to be added benefits to DFI's taking an equity stake in projects financed as it ensures a greater alignment with the sponsor on development goals, and provides greater opportunities for DFIs to add value to their clients.

1. Introduction and methodology

The European Development Finance Institutions (EDFIs) seek to support economically, environmentally, and socially responsible development by fostering the growth of the private sector in developing countries, and do so by providing capital for long-term investments. EDFI member institutions often join forces to finance larger projects which will serve their clients while achieving higher development impact. The European Financing Partners (EFP) initiative, established in 2004, is an example of one such collaboration involving the European Investment Bank and 12 DFIs to promote private sector development in Africa, Caribbean and Pacific (ACP) countries specifically. Approximately €375 million has been approved for 26 projects under the EFP through 2011, 20% of which has been committed to power or energy projects. On the individual projects, this funding is complemented by additional financing coming directly from EDFIs, often totalling greater than the EFP contribution.

This study assesses the effects of three individual energy projects in sub-Saharan Africa and distils lessons learned for the energy sub-sector more generally. EFP evaluations have not previously included energy infrastructure investments. Findings from this study should provide the EDFI Working Group on Development Effectiveness with insight into the experience of EFP operations in the region, and lessons for future funding processes and evaluation approaches for both EDFIs and other interested stakeholders. The three investments evaluated are Copperbelt Energy Corporation (CEC), a transmission company in Zambia's Copperbelt region; Olkaria III, the first geothermal independent power producer (IPP) in Kenya; and Rabai Power, an efficient thermal IPP in Kenya. The lead promoters for these three projects were FMO, DEG, and PROPARCO, respectively.

The Dalberg team conducted extensive desk and field research in order to produce this report. Each of the project evaluations rely on analysis of project (and external) data and documents, and in-person interviews with a wide range of stakeholders, including project staff, owner/investors, local community members, local and national government officials, power-purchasers, CSR funding recipients, and expert observers.

Firstly, we assessed the projects using the infrastructure version of DEG's Corporate Policy Project Rating (GPR) methodology. The GPR tool is an assessment tool developed by DEG, and used by a number of EDFIs, to rate investments across a number of dimensions. This standardized tool enables comparison across a heterogeneous mix of portfolio projects, and balances both financial sustainability and development impact.

Secondly, we developed and applied a customized cost-benefit analysis methodology to each of the projects, which includes a comprehensive mapping and assessment of potential effects, and proposes an economic rate of return (ERR) estimation approach. For the categorization and identification of the potential effects, a "theory of change" was constructed, which is a form of logical framework that describes how the EDFI inputs should translate into overall development impacts via a number of primary channels, each defined by a linked set of outputs and outcomes. These "impact channels" provided the structure used to identify the project indicators, including primary and secondary benefits, and any unintended costs to be considered alongside the investment cost.

Thus the theory of change provides an impact storyline to explain how the investment inputs should lead to outputs that achieve specific development outcomes that contribute to a targeted overall impact. Even though proper attribution of impact typically requires experimental or quasi-experimental methods beyond the scope of this study, we can focus on measurement and estimation of outputs and outcomes, and still assess the importance and contribution of these outcomes to development impact, supported also by insights from the academic literature. Our data collection, measurement and analysis were based on this theory of change.

As a supplement to the full project evaluations, we also developed a metric, the *economic rate of return* (ERR), to help quantify the development returns associated with each project and estimate the impact of the project. The ERR uses an internal rate of return (IRR) calculation to provide an aggregated and monetized estimate of the major development-related project outcomes in relation to the size of the investment. It focuses especially on efficiencies that are not captured by private agents, and those that are easily attributable to the project. By virtue of the calculation, the ERR metric prioritizes large-scale regional and country effects; those occurring at a small scale (such as funding of local CSR programs) can be included in the calculation but will not greatly affect the result. Note that the ERR does not include any of the financial returns from the investment, but measures only additional development effects.

2. Overview of the Kenyan and Zambian energy sectors

2.1 Kenya

Kenya has historically relied heavily on hydropower with approximately half of the country's generation capacity coming from hydropower plants. Hydropower is one of the cheapest forms of power, but it is also highly volatile as it is dependent on hydrological conditions. In times of drought or low rainfall, the plants cannot operate at optimal capacity. Consequently, even though Kenya's on-paper generation capacity exceeds peak demand by ~20%, emergency power is still required. Kenya has relied on emergency power procured from Aggreko to deal with such shortfalls. The cost of emergency power is quite high (~$0.30/kWh in recent years), but the cost of unserved power in Kenya is much higher ($0.84/kWh)[1], hence the preference to use emergency power to meet the energy demand. In this context, the need for additional power generation was very clear.

The demand for electricity in Kenya has been on an upward trend over the last few years, and is projected to keep growing. Between 2004 and 2010, demand grew at an average annual rate of slightly over 5%. The greatest increase was that of 8.7% from 2005/2006 to 2006/2007. The Ministry of Energy projects that energy demand going forward will grow at more than 8% per annum, driven

[1] As cited in Kenya's Least Cost Power Development Plan 2011, we have not been able to obtain its derivation.

by high economic growth and increased energy access.[2] Power consumers in Kenya pay a fixed connection fee, a demand charge set to recover the capital costs of the transmission and distribution network in an area, and a variable energy cost (per kWh). On top of this there are additional pass-through costs of fuel oil and foreign currency, which increase with increased emergency power production. The pass-through fuel cost makes up a significant portion of total tariffs. For example, the 2010/11 average effective tariff was $0.146/kWh, of which $0.054/kWh (37%) was pass-through fuel costs, and this was a relatively good year for hydro production.[3]

More Independent Power Producers (IPPs) coming on line, including Rabai and Olkaria III, combined with improved rainfall, reduced the need for emergency power significantly. This will have positive ramifications for the consumer because of the reduction of costs. The relatively high emergency power load factors observed, serve to confirm the assertion that if the Olkaria III and Rabai investments had not taken place, the alternative would have been more costly emergency power, at best.

2.2 Zambia

In contrast to Kenya, Zambia is not yet supply constrained, though it still has a need for investment. In particular, the country has tremendous potential to grow its energy production, especially hydro, with the aim of exporting power to other countries. As such, the long term marginal costs of supply for Zambia are low enough to generate large regional efficiency gains from Zambia exporting power.[4] This will require additional investment in transmission interconnector projects and generation.

The Government in Zambia still plays the primary role in all the parts of the energy sector value chain: generation, transmission and distribution. There is currently only one IPP in the country. Six additional potential IPPs are expected to add between 1200 MW – 2150 MW to the country's capacity. With the exception of emergency backup power, Zambia is entirely reliant on hydropower, though plans for new coal generation facilities are underway.

Mines in Zambia account for 50-60% of all energy used in the country. Mines get a lower electricity tariff than households and commercial customers since they purchase power in bulk. The tariffs to mines have been increasing over the last few years to reach cost reflectivity. Since 2006, two tariff increases have raised the wholesale effective tariff for CEC to the current level of around $0.042/kWh (in 2011). CEC transmits about 80% of the power used by mines in the country. The price charged to the mines is now approaching $0.053, compared to an average for other customers of around $0.06/kWh.[5]

Electricity is a major cost to mines, accounting for about 10-20% of operational costs. Reliable electricity is vital to mining operations, some of which use electric pumps continually to keep mine shafts from flooding. A system-wide outage, even for an instant, could cost at least 2 hours of lost production valued at about $1.1 million based on 2010 prices.[6] With copper at a high price, it is expected that mines will continue to expand their operations, and will require timely transmission infrastructure construction, and eventually increased generation capacity, to increase productivity.

[2] LCPDP 2011
[3] Total fuel costs were actually 22% less than 2009/10; Source: Kenya Power annual reports
[4] Rosnes and Vennemo, 2008
[5] Based on data from mines and ERB (see http://www.erb.org.zm/viewpage.php?page=ndtls&nid=39)
[6] Based on mine interviews, 2010 output of 820,000 tonnes (http://online.wsj.com/article/SB10001424052970203476804576614214163979424.html) and price of $7,539/tonne (http://www.resourceinvestor.com/2011/02/11/copper-mart-deficit-seen-running-through-2012)

3. Project assessment

3.1 CEC

3.1.1 Project description

The Copperbelt Energy Corporation (CEC) transmits power to all mines in Zambia's Copperbelt region. The transmission infrastructure is CEC's primary asset dates to 1956, and has passed in and out of private and government ownership. Re-privatization in 1997 marked the first time the power supply to the mines was fully separated from the mines themselves, and the official creation of CEC as it is today. In 2006, FMO and other DFIs financed a management buyout of CEC and thus enabled Zambian investors to obtain a majority stake (77%) in this long-standing transmission operation. This transaction was made possible through a $56 million mezzanine loan and a $4 million equity investment to Zambia Energy Corporation (ZamEn) through its parent company Zambia Energy Corporation (Ireland) (ZECI). Close to $50 million of this $60 million was paid out as dividends to the previous owners of CEC, who were mostly American and British investors. A year later, CEC also received a $35 million CAPEX loan for upgrades and expansion from the EDFIs– both through a $10 million loan from DEG and a $25 loan from Citibank of which FMO provided a $15.6 million guarantee. In January 2008 CEC listed on the Lusaka Stock Exchange by floating 25% of its shares to the public and its employees. The proceeds from the listing were used to pay off part off the acquisition loan.

3.1.2 DFI additionality

The EDFIs were not the only investors available to finance the CEC acquisition, but the debt financing from the DFIs was preferable to other options, e.g. the EDFIs could provide loans with a 10-year duration, which was needed to make the leveraged transaction feasible, while commercial lenders could only provide loans with maturities up to 7 years.[7] Without this leverage, the Zambian owners-to-be would not have been able to take as much equity in the company. From a development impact perspective, this might have defeated the whole purpose of the transaction, which was to transfer ownership of this important asset to those who had a greater stake in the country's future.

The additional CAPEX loan from the EDFIs, along with a few smaller loans from other investors, came at a critical time for CEC. Much of CEC's infrastructure was nearing the 40-50 year mark, and would have to be replaced if operations were to proceed efficiently. Because a large part of the acquisition funding was paid out as dividends to the previous owners of CEC, there was no other funding that could have been used for the required refurbishment of CEC transformers and transmission lines.[8] Furthermore, the small equity stake taken by FMO and Aldwych played a useful role for CEC. Aldwych sits on the board of CEC and is positioned to advise CEC on expansion into power generation based on its own experience as a project developer. Since the 2006 deal, CEC has been exploring several other areas of the energy value chain. FMO, through its stake in Aldwych is indirectly represented in both management of CEC and corporate governance.

CEC believes that EDFI's financial reporting process has also added value. CEC's Director of Corporate Finance explains that the EDFIs helped CEC understand how to balance all their lenders, and used their expertise in project finance to provide valuable advice. Lastly, the EDFIs had stricter safety, health and environmental requirements than commercial lenders, but CEC saw the value in these standards and continues to use them for their core business and new operations.

[7] "Overview ZECI Transaction," July 2011, confirmed through interviews.
[8] Interview with C8

3.1.3 Output and outcome assessment

1. Improving mining sector productivity: CEC supplies power exclusively to seven mining companies. It supplies 80% of the total power consumed by Zambian mines. As such CEC is important to the continued success and operations of the mining industry, which employs ca. 50,000 workers. CEC's mining clients generally expressed strong satisfaction with the service they get from CEC, but we did not identify any perceived difference in reliability of power as a result of CEC's acquisition by Zambian investors in 2006. That said, CEC has taken concrete actions since the investment to maintain quality supply and foster mining expansion. CEC's ability to expand quickly along with the mines can be partly credited to their customer-financing model whereby the mines finance the expansion, and are repaid out of future electricity sales.

2. Delivering hydro-related environment and cost efficiencies: The new owners are exploring projects in generation that the older owners would most likely never have pursued. The main example is a 40MW hydro plant in Kabompo Gorge. Capacity in Zambia has not kept pace with the growth in demand and significant power shortages are foreseen in the absence of action to increase capacity. The new Zambian owners of CEC have taken an aggressive stance toward addressing this need, and are exploring a number of generation projects.

3. Benefits of (Zambian-owned publicly listed) private provider: Since the management buy-out, CEC is investing more aggressively in Zambia and the region and is expanding operations beyond traditional activities. This includes the exploration of new generation projects, biofuel production and wholesale and retail delivery of high-speed data, e.g. CEC has spun off two telecoms companies, captured a 50% market share in wholesale data sales, contributing to a 64% reduction in data prices. At the time of listing, the CEC IPO was the largest transaction that had ever taken place on the Lusaka Stock Exchange. It was the first IPO that had been initiated by a private company and the largest Employee Share Ownership Plan (ESOP). It was also the first time a preferential offer was targeted at Zambian institutional investors and the first IPO of a company in the electricity sector. As such the CEC public listing had a demonstrative effect that will hopefully result in more IPOs with similar benefits for Zambians and employees.

4. Benefits for workers and investors: CEC has seen a 6% growth in employment since the EDFI investment, partly due to its expansion activities. The employees are housed close to the plant and the company provides amenities such as a gym and fitness centre, a wellness centre and a generous health insurance scheme. Salaries at CEC have increased in line with inflation. The average basic salaries of staff at CEC are significantly higher than the Zambian minimum wage for different ranks. The company places a high value on safety (including the safety of external evaluators) and employees are consistently trained before they have to carry out any potentially dangerous assignments.

5. Community / social outcomes: CEC enjoys a strong relationship with the local community and a commitment to social impact. CEC has workplace and CSR programs that benefit the greater community. The projects which are likely to be most impactful for the community/best known include health projects, school programs, funding of the local football team and infrastructure investments.

3.1.4 Estimating impact

We use an economic rate of return (ERR) calculation to generate an impact estimate that attempts to quantify the major effects of the investment provided its interpretation is handled with appropriate caution. The conceptual key to estimating impact is determining the counterfactual, which in case of CEC is the situation without Zambian ownership. Taking into account cost savings to mines

and telecoms savings, we calculated an **ERR** on the investment of **19%** over 20 years, this drops to 15% if the telecoms savings are not included. Note that most of the benefits in this model are those that would likely have accrued without the DFI-financed acquisition and many of the benefits that are more attributable to the acquisition are still pending. Thus this ERR provides a rough estimate.

3.1.5 Conclusion / DAC criteria

On the DAC assessment criteria, on scale of 1 to 4 (1 = low, 2 = medium, 3 = high, 4 = very high or "exemplary") we rated CEC as follows: relevance (2.75), efficiency (3), effectiveness (3), impact (2.67) and sustainability (3.5):

Component	Rating	Rationale
Relevance of project	Medium/ High	Zambian ownership will increase investment in the country and local use of profits; however, argument that acquisition itself was critical to the mining sector is not fully convincing based on evidence
Relevance of EFP inputs	High	Commercial lenders available, but unlikely to have produced type of transaction needed to ensure local control; EDFIs also helped offer some non-financial advisory support
Efficiency of implementation	High	Implementation of financing arrangements, public listing, went according to plan
Efficiency of operations	High	CEC continues to be run efficiently, professionally, profitably; mining companies satisfied, though request faster emergency response
Effectiveness	Medium	Some small effects by helping mines expand operations, but largest effects are still to come: hydro project has taken some time, DRC interconnector still on hold
Impact, national	Medium/ High	Before/after difference for mines may be small, but ownership transition has set in motion a number of large impacts: localization of profits, telecoms investment, future power generation
Impact, local	High	Plays key role in Copperbelt as the only part of the former ZCCM to be Zambian owned; a large employer, active in supporting the community
Sustainability (operational, financial, environmental)	High/ Very high	Financial sustainability increased by diversification; operational sustainability supported by investment in system upgrades; strong labor and environmental standards

3.2 Olkaria III

3.2.1 Project description

Olkaria III is a 52 MW geothermal power station located in Hell's Gate National Park on the south western slopes of Olkaria hill, 60 km from Naivasha town. It is operated by Orpower 4, a wholly owned subsidiary of ORMAT International. The station has been operational since 2000 and is the sole geothermal Independent Power Producer (IPP) in Africa. It was also the fourth IPP in Kenya. The generated power is sold to Kenya Power under a 20 year Power Purchase Agreement (PPA). The plant occupies 11.9 km square within the park, in an area gazetted by the government for geothermal development. Olkaria I (45 MW) and Olkaria II (70 MW) are other geothermal plants located in the same area, and run by the majority-government-owned KenGen. Given the plant's location within the National Park, OrPower has a Memorandum of Understanding (MoU) with the Kenya Wildlife Society (KWS) that guides the company's activities in the park.

Olkaria III was commissioned in 1998 following a tender award to build, own and operate ("BOO") a geothermal facility by the Government of Kenya (GoK), which was looking to develop the geothermal power potential of Kenya in addition to diversifying power sources in the country. Phase I, the early generation facility, had an 8 MW capacity (upgraded to 13 MW) that was operational by July 2000. Phase II, which brought on DEG's involvement, expanded the capacity to 48 MW and was completed at the end of 2008, financed initially by OrPower while DFI financial close was delayed. The DFIs then

refinanced both Phases I and II in March 2009. OrPower is currently in discussions with OPIC for the financing of Phase III, which will increase its capacity to 100MW. Drilling of 5 additional wells is on-going with a target to commission the expansion in mid-2014.

3.2.2 DFI additionality

From OrPower's perspective, the role of EDFIs was important but not critical in the expansion of Olkaria III. OrPower completed construction for phase II in 2008 using its own capital, before the financial close. While conversations with DEG to arrange Phase II's financing commenced in 2005, financial close only happened in March 2009. Part of the delay was due to lengthy negotiations between OrPower 4 and Kenya Power on tariff levels and technical designs, which resulted in the signing of an amended PPA in 2007. In addition, there were political disruptions including the 2007 post-election violence. Despite the delays in assessing finance, OrPower 4 made a decision to proceed with the expansion in 2007. Two key factors informed the decision: (i) the restated PPA was not conditioned on OrPower 4 being able to access financing, and (ii) the incremental cost of expansion did not include drilling costs, as all the drilling had been completed in phase I, thus making the expansion affordable. The EDFI/EFP involvement allowed for the refinancing of both Phases I and II, where commercial financing would have been difficult to obtain. The refinancing provided some additionality as it allowed Ormat to free up capital to finance other projects in developing countries, though it is not possible to pinpoint the exact projects. The refinancing also helped reduce Ormat's exposure in Kenya, thus reducing its overall risk exposure.[9]

Again, it would have been difficult for OrPower 4 to find commercial lenders who were willing to lend without fuller backstopping of Kenya Power, and also offer the terms provided by DEG, and other EFP partners, such as long term financing (upwards of 8 years)[10]. OrPower also suggested that DEG positioned itself in a manner that made it easy for the company to work with DEG. In particular, DEG was understanding of the Kenyan situation, including the risks and potential project disruptions, and was willing to accommodate those in the financing.[11]

3.2.3 Output and outcome assessment

1. Economic benefits from lower costs and higher reliability: In Kenya's constrained environment, Olkaria III has added 3.5% in capacity; is currently supplying 6% of Kenya's energy consumption; and helped reduce load shedding in the country. Since the expansion of the plant, Olkaria III has always averaged over 96% availability, and has been dispatched at an average of 92%. These are numbers that are virtually unachievable by thermal plants. Assuming that the production of 1 GWh supports 464 jobs[12], Olkaria III supports **190,000 jobs** based on a 90% average load factor at its current capacity of 52 MW. The cost of Olkaria III power is approximately $0.09/kWh, versus $0.28/kWh for the lowest cost emergency power provider at 2011 prices. For the quantity of energy sold by Olkaria III in 2011, this would translate into annual economic savings of $59 million. Olkaria III's total 52MW of power has a direct effect on consumer tariffs by reducing the fuel surcharge that is passed through by Kenya Power. Geothermal use also positively affects the country's Balance of Payments as it results in reduced fuel imports. If OrPower's 2011 output had been produced by an emergency power producer, it would have required $57 million in additional foreign imports.

[9] Interviewee O1
[10] Interviewee O1
[11] Interviewee O2
[12] The number of grid-connect jobs (Kenya's total labor force * electrification rate = 3.4 million) divided by the total energy produced for the country (7,273 GWh) = 464 jobs/GWh

2. Shift to private generation: Olkaria III was the first private geothermal generation company, and the third active IPP, in Kenya. As such, OrPower's negotiations and PPA with Kenya Power form a model for PPAs to be used by other geothermal IPPs in the country. Furthermore OrPower uses binary/pentane technology which is more efficient and reliable and requires less maintenance and repairs compared to a unary system. KenGen engineers now visit the OrPower Plant to learn about the technology, and engineers from both firms work closely on ongoing maintenance issues.

3. Reducing environmental impact: Geothermal power produces near-zero greenhouse gas emissions. OrPower is currently receiving CDM credits for 177,000 tCO_2e emission reductions annually since 2010. The nearby flower Farm, Oserian, uses the minimal additional CO_2 from Olkaria III in its greenhouses to improve its productivity. OrPower's technology is highly sustainable – with a >95% reinjection rate. While this is may come at greater cost, it prolongs the sustainability of the project.

4. OrPower 4 stakeholder income: OrPower permanent staff appears to be compensated fairly and in fact may enjoy a relatively higher standard of living than similar workers elsewhere. This is due to an array of benefits that includes free housing, medical and school funding. The operations manager notes that "turnover over the last 2 years has been zero – the compensation package and overall motivation has improved". One of the primary requests of the local Maasai community has been for more jobs at OrPower. However, they typically lack the necessary education for the permanent positions at the plant. They do benefit as sub-contracted workers – working as guards, for example, making just over $100/month – but believe that they would be better off as direct employees.

5. Community / social outcomes: KWS reports that OrPower's presence has helped in its conservation efforts – it increases the number of people on the ground which acts as a deterrent to activities such as poaching and charcoal burning. OrPower's initiatives with the community have helped improve goodwill with the local Maasai community, which helps KWS in its efforts to reduce community/wildlife conflict. OrPower also has a working relationship with the local Maasai community, estimated at 1000-3000 people, and has been involved in a number of projects, which include: supporting Narasha Primary school through buildings, teacher salaries, and feeding programs; providing bursaries for bright students; purchasing two posho mills for the womens' groups; and providing transport on the company vehicle to the local Maasai. A health facility project, co-funded with KWS, has been planned but not yet implemented.

3.2.4 Estimating impact

We used an ERR calculation to generate an impact estimate. In case of Olkaria III we calculated the ERR based on the counterfactual of emergency power as well as unserved power. At the core of the ERR calculation are the net costs savings to the country compared to the counterfactual over the lifespan of the project. Starting with the 2008 investment of 182.7 million, we calculated the ERR of the stream of costs and benefits through 2028, yielding an **ERR** for the project ranging from **27%** if the alternative were emergency power, to **89%** if the alternative were unserved power.

3.2.5 Conclusion / DAC criteria

On the DAC assessment criteria, on scale of 1 to 4, we rated Olkaria III as follows: relevance (2.5), efficiency (3.25), effectiveness (3.5), impact (3.33) and sustainability (3.12):

Component	Rating	Rationale
Relevance of project	High	Addressed clear constraint of Kenya's energy sector during a time of significant energy shortages.
Relevance of EFP inputs	Medium	Project construction was completed prior to DFI/EFP financing. OrPower self-financed, but DFI/EFP re-financing allowed it to free up capital for other developing-country projects and commercial lenders would likely not have participated
Efficiency of implementation	High	Project completed on schedule and has been repaying its loans on time
Efficiency of operations	High/Very High	Olkaria III is efficiently run, and is ranked among the top most efficient power stations in Kenya; utilizes high efficiency technology
Effectiveness	High/Very High	The most immediate intended outcome of the investment has been the addition of low cost and reliable geothermal energy to the country
Impact, national	Very high	Every additional MW of capacity is critical to Kenya meeting escalating demand, and buffering against shocks; price savings over thermal plants/ EPP are considerable
Impact, local	Medium	While OrPower has engaged in some community initiatives, it lacks a clear forward-looking strategy to its CSR; potential to do more exists
Sustainability (operational, financial, environmental)	High	Sustainability supported by professional management and oversight, international expertise, and environmental diligence. Project utilizes environmentally friendly resources and technologies and is receiving CDM credits

3.3 Rabai

3.3.1 Project description

Rabai Power is a 90 MW heavy fuel oil power plant financed at €111.3 million by EFP and the Emerging Africa Infrastructure Fund (EAIF) in 2008. The plant became operational in September 2009 and commenced full commercial operations in May 2010. The project was developed by Aldwych, a UK power project developer and Burmeister & Wain Scandinavian Contractors (BWSC), a contractor for diesel and gas engine power systems. These were joined as equity partners by FMO and IFU, and debt was supplied by PROPARCO, DEG, FMO and EAIF. After 20 years of operations, Rabai Power has to transfer ownership of the plant to Kenya Power, which, if desired, could continue to contract Rabai Operations and Management Ltd (ROML) to run the plant.

Rabai Power Plant can generate 83.5 MW from 5 diesel engines and an additional 6.5 MW through heat capture using a steam turbine. Due to its design, it is the most fuel efficient thermal plant in the country. In development, the plant experienced a few delays due to a change in location of the planned plant, a lawsuit against Kenya Power and post-election violence. It finally came online just as Kenya's need for such power was starkly highlighted by nationwide power rationing. Additional power plants and a transmission line bottleneck have since lowered the dispatch rate of the plant to 48%, but with growing demand and the anticipated completion of the Mombasa-Nairobi transmission line in 2013, Rabai's dispatch rate is likely to increase to 70%. This will ensure that Rabai plays a critical role in Kenya's power supply throughout its 20 year lifespan.

3.3.2 DFI additionality

From the perspective of Rabai Power, the role of EDFIs was critical in the development and launch of the power station. Commercial lenders were not fully comfortable with the relatively new IPP model in Kenya and were looking for backstopping of Kenya Power before committing funds. In contrast, the DFIs (Proparco, DEG, and FMO) and EAIF were able to lend without this backstopping. This willingness to take on risk was especially important given the political instability that was occurring in the 2008 run-up to financial close, and the global financial crisis. For overcoming these and other hurdles, and responding well to the pressure created by the country's severe power deficit at the

time, the project was awarded African Power Deal of the Year 2008 by Project Finance magazine. Referring to DFI financing as opposed to commercial, project co-sponsor BWSC confirms that "in 2008, there were no other alternatives."

The equity participation of IFU and FMO was as important as the debt financing, if not more, according to the sponsors. Aldwych, though comprised of experienced individuals, was itself a relatively new entity with a limited track record. The presence of the DFIs as equity partners helped improve the overall credibility of the project. The sponsors also note that FMO played an important lead role in bringing together and maintaining the coalition of funders in a turbulent year.

While sponsors feel that "using DFIs and their lawyers cost 25% more overall"[13] in getting to financial close, they consider the cost worth the added value provided. This added value included support in communications with the government, which sped up the development process. The sponsors also express appreciation for the stronger environmental standards of the DFIs, and support in resettlement and CSR activities, which FMO continues to provide.

3.3.3 Output and outcome assessment

1. Improving / diversifying Kenya's power supply: Rabai Power came online at a critical time with country-wide load shedding. Initially, the plant reached a dispatch rate of 89%, however, a number of factors have since resulted in a lower than anticipated dispatch of Rabai's power: (i) the end of the drought and greater availability of cheaper hydropower, (ii) the subsequent addition of the 120MW Kipevu III thermal plant on the Coast, and (iii) the delay in upgrading the transmission line to Nairobi that currently acts a bottleneck preventing power generated on the coast from reaching the city. Even at half capacity (48%), Rabai Power is currently supplying 6.3% of Kenya's energy and is likely to support 256,000 jobs[14] at a 70% load factor. Even though Rabai Power consumes costly heavy fuel oil, it generates considerable cost savings of $0,07/kWh over the EPP alternative. For the quantity of energy sold by Rabai in 2011, avoiding this alternative translates into annual electricity cost savings of $20 million. The savings in fuel consumption and fuel price positively affects the country's balance of payments as it results in reduced fuel imports. Rabai's 90W of additional capacity should improve consumer tariffs, especially after completion of the Nairobi transmission line, by reducing the use of emergency power and the fuel surcharge that is passed to consumers.

2. Increasing private (IPP) generation: During the PPA negotiations, Rabai Power introduced updates to the PPA template that served as a starting point for other thermal IPPs. The Rabai team worked closely with Kenya Power in the process and believe that they have elevated its capacity to partner with IPPs. All of these outputs should have helped pave the way for future IPP investment, and indeed 3 new IPP thermal plants are scheduled to be operating by Dec 2012. Rabai was the first diesel plant in the country to use a steam turbine to generate power from waste heat; this method is part of the design of at least one of the new thermal IPP plants.

3. Reducing environmental impact: Rabai Power does not use a green production technology, yet demonstrates a strong commitment to minimize its environmental impact. Its exhaust-powered steam turbine enables it to be the most fuel efficient thermal plant in the country. Rabai complies with all World Bank environmental standards (Dec 2011). ROML has developed an advanced water treatment and recycling system that conserves fresh water in a region where it is scarce. Its water management techniques have reduced consumption by 25%. To address issues with the quality of its

[13] Interviewee R1

[14] Based on 464 jobs/GWh (Kenya's total labor force * electrification rate = 3.4 million) divided by the total energy produced for the country (7,273 GWh)

effluent, Rabai has installed a miniature biological sewage treatment plant for sewage water treatment. On completion of the biological treatment process the sludge is later drained by an exhauster before being released to the environment.

4. Benefits for workers and investors: ROML seeks to expose its staff to international best practices, for example using visits from BWSC or manufacturer technicians as learning opportunities. ROML has a regionally competitive package of salary and benefits and has seen no staff turnover since 2009. Rabai undergoes regular audits related to safety, health, and environment (SHE) issues, and a typical recommendation from these audits is that Rabai should establish more formalized processes, e.g., through a comprehensive risk assessment, and better documentation of SHE management approaches. The auditors express satisfaction with Rabai's responsiveness to their recommendations.

5. Community / social outcomes: Despite initial resistance from the community to its arrival, Rabai has engaged in purposeful and effective outreach to the community. This has resulted in a transformation of the relationship and clear benefits to the local population. Rabai's strategy for community engagement appears to include three main components: (i) establishment of clear channels of communication by organising regular forums and open days as well as engaging with the Rabai Advisory Committee; (ii) fast response to community-raised concerns; and (iii) strategic spending of CSR funding on beneficial projects such as school classrooms, scholarships, health facilities and provision of clean water. What sets Rabai apart is its strategic approach to planning and selecting CSR projects.

3.3.4 Estimating impact

We used an ERR calculation to generate an impact estimate. In case of Rabai Power we calculated the ERR based on the counterfactual of emergency power as well as unserved power. At the core of the ERR calculation are the net costs savings to the country compared to the counterfactual over the lifespan of the project. We projected these savings outward to 2026, and added projected tax revenues for each year. Then starting with the 2008 investment of 111.3 million, we calculated the ERR of the stream of costs and benefits through 2026, yielding an ERR for the project ranging from **16%**, if the alternative were emergency power, to **112%** if the alternative were unserved power.

3.3.5 Conclusion / DAC criteria

On the DAC assessment criteria, on scale of 1 to 4 we rated Rabai as follows: relevance (3.25), efficiency (3.25), effectiveness (2.5), impact (3.17) and sustainability (3):

Component	Rating	Rationale
Relevance of project	High	Addressed clear constraint during a time of obvious energy shortages
Relevance of EFP inputs	Very High	EDFIs provided support and finance amidst global and local crises, as well as assistance with government relations, environmental management, and CSR
Efficiency of implementation	High	Project implementation on budget, and full commercial operations only 18 days past target date despite engine failures in interim operations
Efficiency of operations	High/Very High	Most fuel-efficient thermal plant in Kenya, with innovative water recycling system; still training staff but costs well managed
Effectiveness	Medium /High	Was immediately effective at addressing power shortages, but is now operating at <50% capacity (since May 2011) because of redundancy and transmission line delay; should return to target capacity by end of 2013
Impact, national	High	Every additional MW of capacity is critical to Kenya buffering against shocks and meeting escalating demand; price savings over EPP are considerable; temporary transmission bottleneck should be resolved by next year
Impact, local	High/Very High	Clearly committed to achieving full potential for local impact; have already begun to see some results
Sustainability (operational, financial, environmental)	High	Sustainability supported by professional management and oversight, international expertise, and environmental diligence

4. Portfolio level findings and conclusions

4.1 On energy investments

Addressing constraints to growth

At the time of the Kenya investments (and still today) electric power was a constraint on growth. A 2009 World Bank study suggests significantly improving electricity generation capacity could increase Kenya's annual GDP growth rate by 1.7 percentage points.[15] Perhaps the most obvious signal of the need for additional energy capacity in Kenya is the fact that Kenya has required emergency power producer generation every year since at least 2005. Due to the addition of new IPP plants (including Rabai and Olkaria III) as well as improved rainfall, the need for emergency power was reduced from 146 MW to 60 MW.

The CEC assessment provides another valuable illustration of the impact of energy infrastructure. The transmission infrastructure owned by CEC delivers 80% of the power to the copper mining sector that provides 50,000 jobs and accounts for 10-15% of Zambia's GDP.[16] If CEC experiences a system-wide outage, even for an instant, it would cost at least 2 hours of lost production valued at about $1.1 million based on 2010 prices.[17] In addition, if CEC were to delay transmission system expansions, it could significantly hinder production. The fact that CEC has delivered quality service has helped to minimize these types of losses.

Role of IPPs

The evaluations served to reinforce the importance of independent power producers as a valuable complement to the government's role in power generation. To some degree, Kenya has been a testing ground for IPP policies, and from the response of the off-taker, Kenya Power, and the government energy agencies, the experiment has been working. Some of the benefits of fostering IPPs cited or illustrated by these evaluations include: (i) an increase in investments that enable faster infrastructure development; (ii) knowledge transfer due to the introduction and adaptation of advanced technologies to local context; (iii) raising standards for quality and reliability and provide healthy competition that spurs public providers to improve their operations. Kenya has been cited as the most advanced sub-Saharan African country when it comes to the environment for IPPs, having progressed farther on energy reform programs than most other countries on the continent.

Understanding employment effects

Job creation is often considered the holy grail of private sector development investments, but direct employment effects of energy infrastructure projects are a poor reflection of their overall impact. A power plant might support hundreds of times as many jobs as it directly creates. However, quantifying this effect is challenging. We identified the channels through which energy infrastructure leads to jobs. Power generation (or transmission) capacity can affect employment in one or more of three ways, by improving power (i) quantity, (ii) quality and (iii) price. Profitability from price and quality improvements is a direct effect of new power capacity that may lead to new jobs, but is not tracked. For the sake of our evaluations, we have conducted a conservative analysis to estimate the number of jobs supported by 1 GWh of energy produced, i.e. it was estimated that 1 GWh produced supports

[15] Calderon, 2009. Measures GDP growth associated with reaching level of the Africa infrastructure leader Mauritius in MW of capacity/worker.
[16] Range of estimates includes 9.2% (http://allafrica.com/stories/201201110631.html) and 1/6th (ACT SA et al, 2007)
[17] Based on mine interviews, 2010 output of 820,000 tonnes (http://online.wsj.com/article/SB10001424052970203476804576614214163979424.html) and price of $7,539/tonne (http://www.resourceinvestor.com/2011/02/11/copper-mart-deficit-seen-running-through-2012)

464 jobs in Kenya[18]. Based on this figure, we estimate that Olkaria III supports 190,000 jobs (52 MW), while Rabai Power will support 256,000 jobs at its targeted load factor of 70%.

4.2 On the role of DFIs

In the three investments evaluated, the role and importance of finance from DFIs ranged considerably. For Rabai, the project might have never been completed without DFI finance, whereas for CEC, the acquisition arrangements would likely have been sub-optimal without DFI finance. As the financing for Olkaria III took so long, the developer used its own resources first and then refinanced the project with DFI funds. To ensure additionality, it is important for DFIs to keep asking the questions: "Could someone else be doing this? If someone else can finance it, will their terms or approach take away somehow from the development impact?" If not, maybe that is the time to look elsewhere. Not every high-impact project needs a DFI, and there are some that really do.

EDFI financing and associated environmental and social requirements appear to have a strong and positive effect on their borrowers' local impact. Especially in countries like Kenya and Zambia where the private sector is not known for its exemplary corporate citizenship, EDFI-financed firms appear to stand out as examples of businesses committed to mitigating any negative effects of their operations and improving the community in which they find themselves. The sponsors of Rabai expressed appreciation for the stronger environmental standards of DFIs, CEC and Aldwych mentioned that the higher standards of EDFIs were a benefit rather than a challenge of working with DFIs.

The project review also illustrates a few of the advantages of the European Finance Partner mechanism. Firstly, EFP financing supplements the total finance raised, which may potentially enable EDFIs to invest in larger projects. This is important because many energy infrastructure projects require economies of scale to be bankable. Secondly, EFP financing enables broader participation by a range of DFIs without requiring significant dedication of additional administrative resources. Thus DFIs that are not promoting partners can still share in the credit and lessons from EFP investments. Lastly, the pre-commitment of funds and use of due diligence from the promoting partner helps streamline processes, prevent duplication of effort, and thus increase investment efficiency.

4.3 On methodology

In this study, we applied a cost-benefit-analysis using the theory of change and an ERR calculation. The theory of change helped the team form hypotheses in advance of the research that could be tested through our data collection and interviews. The challenge of a comprehensive framework, however, is the danger of data overload, given the long and varied list of indicators. The rigor with which we applied our cost-benefit analysis methodology may not be replicable for every project in the DFIs' portfolios. The ERR methodology should be further tested and refined before applying it to project comparisons, especially dissimilar projects, and it is not to be seen as a single metric that captures the full results of the cost-benefit analysis. But the ERR can serve to generate a deeper understanding of project impacts.

[18] Calculated as follows: Kenya's total labor force * electrification rate (= 3.4 million) divided by the total energy produced for the country (7,273 GWh) = 464 jobs/GWh

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