Job Creation Impact Study: Bugoye Hydropower Plant, Uganda

Final Report

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Acronyms

BCI	Business Climate Index
BHPP	Bugoye Hydro Power Plant/Project
BPC	Bugoye Participatory Committee
CDM	Clean Development Mechanism
CDTS	Community Development Through Sports (Ibanda-based NGO)
CER	Carbon Emissions Reductions
COBE	Census of Business Establishments
CSR	Corporate Social Responsibility
DFI	Development Finance Organisation
DRC	Democratic Republic of Congo
EAIF	Emerging Africa Infrastructure Fund
EDFI	European Network of DFIs
EPRC	Economic Policy Research Centre
ERA	Electricity Regulatory Authority
IFC	International Finance Corporation
I:O	Input-Output (table)
GoU	Government of Uganda
GWh	Giga Watts per hour
IFC	International Finance Corporation
KCCL	Kasese Cobalt Company Limited
KIL	Kilembe Investment Ltd.
kWh	kilowatt hour
KDLG	Kasese District local Government
MEMD	Ministry of Energy and Mineral Development
MW	Megawatt
MWh	Mega Watts per hour
NGO	Non-Governmental Organisation
NORAD	Norwegian Agency for Development Cooperation
ODI	Overseas Development Institute
PIDG	Private Infrastructure Development Group
PMU	Programme Management Unit (of the PIDG)
PSD	Private Sector Development
REA	Rural Electrification Agency
REB	Rural Electrification Board
REF	Rural Electrification Fund
RESP	Rural Electrification Strategy and Plan
TCC	TronderPower Communications Committee
TPL	TronderPower Limited
UBOS	Uganda Bureau of Statistics
UEB	Uganda Electricity Board
UEDCL	Uganda Electricity Distribution Company Ltd.
UEGCL	Uganda Electricity Generation Company Ltd.
UETCL	Uganda Electricity Transmission Company Ltd.
UGX	Ugandan Shilling

Executive summary

The Private Infrastructure Development Group (PIDG) seeks to understand the impact of the projects it supports and to this end commissioned ODI to conduct a pilot study of the job creation impact of the Bugoye Hydro Power Project (BHPP) in Uganda. The purpose of the study is to enable the PIDG to understand the impact that the project has had on jobs and to help develop a methodology for similar studies on other projects. The study was undertaken between November 2012 and January 2013, including a visit to Uganda.

Bugoye Hydro Power Project (BHPP) is a 13 MW run-of-river hydro plant, located in Kasese District, western Uganda. The plant is owned and operated by TronderPower Ltd (TPL), who are in receipt of a 15-year loan from the Emerging Africa Infrastructure Fund (EAIF) amounting to US$ 31.7 million. Equity investment by Norfund and TrønderEnergi, the shareholders of TronderPower, totals US$ 19.7 million. The Government of Norway provided a grant of US$ 8.9 million to Uganda to construct the transmission line that links BHPP to the national grid. BHPP began operating in October 2009, ahead of schedule, and has since supplied a total of 240,536 MWh to the grid.

The study assessed the net direct, indirect and induced employment effects of the project, following an approach modelled on a methodology developed by the International Finance Corporation (IFC). This methodology was adapted to the circumstances of Uganda and of the project, in particular to take account of limitations in the quality and availability of data.

The job creation impacts of BHPP estimated by the study are summarised in the following table.

Effect	Result	
Category 1 jobs (construction and operation phases)		
	Jobs	**Person years***
Direct	1,079 jobs	2,335
Indirect	191 – 199 jobs	4,782 – 4,983
Total	**1,270 – 1,278**	**7,128 – 7, 318**
Category 2 jobs (created as result of more/better power supply)		
	Jobs	**Person years**
Induced	8,434 – 10,256	210,850 - 256,400
Total		
GRAND TOTAL	**9,704 – 11,534**	**217,967 - 263,718**

* Number of jobs times duration of jobs, expressed in years.

Given the limitations of the data, the accuracy of the figures for indirect and induced employment effects need to be treated with caution. The estimates are, however, consistent with the findings from recent IFC research (2013) which show a significant employment multiplier effect for investment in the power sector.

The study also considered the wider effects of BHPP on the electricity supply in Uganda, expenditure by households and firms, and effects on government revenue and expenditure. BHPP supplied an average of 2.9% of Uganda’s power between September 2009 and December 2012. The plant has provided 4% of the additional generation capacity over this period and, at least locally, has reportedly contributed to a reduction in outages. However, despite the addition of BHPP to the grid, power interruptions due to faults and maintenance shutdowns, as well as voltage instability, have prevailed and continue to be a significant problem for consumers.

BHPP has had no effect on electricity consumer prices because tariffs are set centrally, and there is no evidence of an effect on the number of connections (energy access). In Kasese District, 90% of power consumption is by 6 large industrial consumers, who have been the main beneficiaries of BHPP's contribution to a more reliable power supply. Employment by these industrial consumers has not been materially affected by BHPP's operation, though they have experienced cost savings from reduced consumption of diesel for stand-by generators.

The principal effect of BHPP on government expenditure and revenue has been income from VAT charged on the sale of power generated by the plant, estimated to be approximately US$ 2 million a year. A notional avoided subsidy (i.e. reduced government expenditure) can also be estimated by assuming that BHPP's power would otherwise have been provided by thermal generators. This would amount to US$ 9-13 million a year, but would be relevant only for the period to 2012 when an increase in generating capacity significantly reduced the dependence on thermal power.

BHPP has demonstrated that, with the co-operation of sources of finance, a private sector operator can successfully finance, build and operate a small hydropower plant in Uganda, where there is potential for more such schemes. The project's emphasis on high standards of social and environmental performance and, in particular, its participatory and consultative approach to implementation is already being looked to as a model for other projects in Uganda.

The study has successfully estimated direct, indirect and induced employment effects where there are significant limitations in the data. The approach followed may be relevant elsewhere, but for indirect and induced employment effects in such a context there will inevitably be concerns about the accuracy and reliability of the figures. The study also highlights that the impacts of infrastructure projects are not limited to job creation.

1 Introduction

The Private Infrastructure Development Group (PIDG) seeks to understand the impact of the projects it supports and to monitor these projects to ensure they are on track to achieve their expected development impacts. The PIDG Programme Management Unit (PMU) identified job creation, during both construction and operation, as a key indicator for monitoring and impact assessment. To this end, PIDG commissioned ODI (Overseas Development Institute) to undertake a pilot impact study of the Bugoye Hydropower Plant (BHPP) in Uganda, which PIDG supports through the Emerging Africa Infrastructure Fund (EAIF).

The purpose of the BHPP job creation impact study is to enable the PIDG to understand the impact that the Bugoye project has had on jobs and to help develop a methodology for similar studies on other projects they support. This includes assessment of the net direct, indirect and induced job creation which can be attributed to the construction and operation of BHPP. The study also considered the impact of BHPP on the power sector in Uganda, wider economic and social impacts, and the importance of EAIF's involvement in the project. The full terms of reference can be found in Annex 9.6.

Approach

The study broadly followed the methodology for the assessment of job creation impacts proposed by the International Finance Corporation (IFC, 2012). The study was undertaken in the UK and Uganda in three stages by a team from ODI comprising Andrew Scott, Emily Darko, Prachi Seth and Juan Pablo Rud.

The first stage, beginning in November 2012, involved the review of key documents (on the BHPP project, similar projects and studies of job creation analysis, wider economic and energy context in Uganda), the development of a hypothesis for the job creation causal chain, and development of a detailed work plan. A draft Inception Report was discussed with the PIDG PMU and EAIF on 16 November 2012, and subsequently revised.

The second stage involved information collection and a visit to Uganda. Project documents and records held by PMU, BHPP and other stakeholders were reviewed and structured interviews held with staff at BHPP, key power users and key informants. Some interviews were undertaken by telephone from the UK, and two members of the study team, Andrew Scott and Emily Darko, visited Uganda between 14 and 22 January 2013, accompanied by Alexia Santallusia from the PIDG PMU. Interviews in Uganda were conducted at the project site, in Kasese District and in the capital, Kampala. A full list of those interviewed can be found in Annex 9.5.

In the third stage, the study undertook analysis of the quantitative and qualitative information. The quantitative analysis was carried out in the UK and used econometric tools to assess employment effects using available online datasets supplemented by data collected in Uganda during the second stage.

Structure of the report

This report on the study's findings begins with a description of the project, its context and the EAIF's role. We then provide an overview of the importance of reliable electricity for Private Sector Development (PSD) (Section 3) and present the conceptual model of the job creation effects which guided the study (Section 4). The job creation effects of BHPP are presented in Section 5, followed by the wider effects (Section 6). In the Section 7 we summarise the impacts of BHPP and draw lessons for the methodology which might be used in future similar studies.

2 Description of the Bugoye Hydropower Project

2.1 History of the BHPP

Norwegian firm SN Power, a company co-owned by Statkraft and Norfund, received a licence to develop the BHPP project in 2004. SN Power conducted pre-feasibility studies and commissioned Norplan to undertake a feasibility study, completed in March 2006. The following year, SN Power withdrew from the project on the grounds of financial viability and a change in company strategy (Among, 2007; Celis, 2011). In order to continue the project, Norfund approached TrønderEnergi, a Norwegian utility company with an interest in developing operations abroad. In July 2007 the project was transferred to TrønderEnergi, who together with Norfund established the company TronderPower Limited (TPL) in Uganda. Construction of the plant by the main contractor, Noremco, began in March 2008. Noremco had been selected through a competitive bidding process for its high standards and quality of delivery. The plant was completed ahead of schedule in September 2009 and commissioned on 7th October 2009. BHPP is to be operated and maintained by TPL for the first 25 years of service and then it will be handed over to the Ugandan Government. TPL was also responsible for the construction of the 6 km transmission line that connects the plant to the national grid at Nkenda sub-station (Celis, 2011).

2.2 The power sector in Uganda

Electricity generation and transmission

At the end of 2012 the installed electricity generation capacity of Uganda was an estimated 800.28 Mega-Watts (MW). This represents an increase of 264.38 MW (49%) since construction of BHPP began in 2008, including the 250 MW added during 2012 with the commissioning and full operation of Bujagali Energy Limited.[1] (See Table 1 below for a complete list of currently operating power schemes). Hydropower capacity dominates, accounting for 88% of the total. Thermal and biomass cogeneration plants account for 8.9% and 3.6% respectively. In terms of network infrastructure development, there are 1,115km of 132kV high-voltage transmission lines and 54km of 66kV lines in Uganda. Distribution facilities include 3,258km of 33kV lines, 3,443km of 11kV lines and 6,496km of low-voltage lines (Tumwesigye et al., 2011).

Table 1: Installed Capacity in Uganda

Plant/Source	Capacity (MW)	% Contribution	Type	% Contribution by type
Jacobsen Namanve	50	6.29%	Thermal	8.86%
ElectroMaxx Tororo	50	2.52%	Thermal	
Kiira	200	25.18%	Hydro	87.51%
Nalubaale	180	22.66%	Hydro	
Kilembe Mines Ltd (Mubuku I)	5.0	0.63%	Hydro	
Bugoye	13	1.64%	Hydro	
Ishasha/Kanungu	6.5	0.82%	Hydro	

1 http://www.newvision.co.ug/news/632935-bujagali-now-generating-250mw-of-power.html

Mpanga	18	2.27%	Hydro	
Bujagali	250	31.47%	Hydro	
Kasese Cobalt Co Ltd (Mubuku III)	9.9	1.76%	Hydro	
Kuluva*	0.12	0.02%	Hydro	
Kisiizi*	0.06	0.01%	Hydro	
Gwere Luzira*	0.0005	0.00%	Hydro	
Kakira Sugar Works Ltd**	12	2.52%	Cogeneration	
Kinyara Sugar Works**	4.0	0.88%	Cogeneration	3.63%
Lugazi (SCOUL)*	1.7	0.21%	Cogeneration	
TOTAL	**800.28**	**100.00%**		**100.00%**

* Does not supply to the national grid. ** Capacity supplying to the national grid.

Source: Ministry of Energy and Mineral Development (2012); communication from ERA.

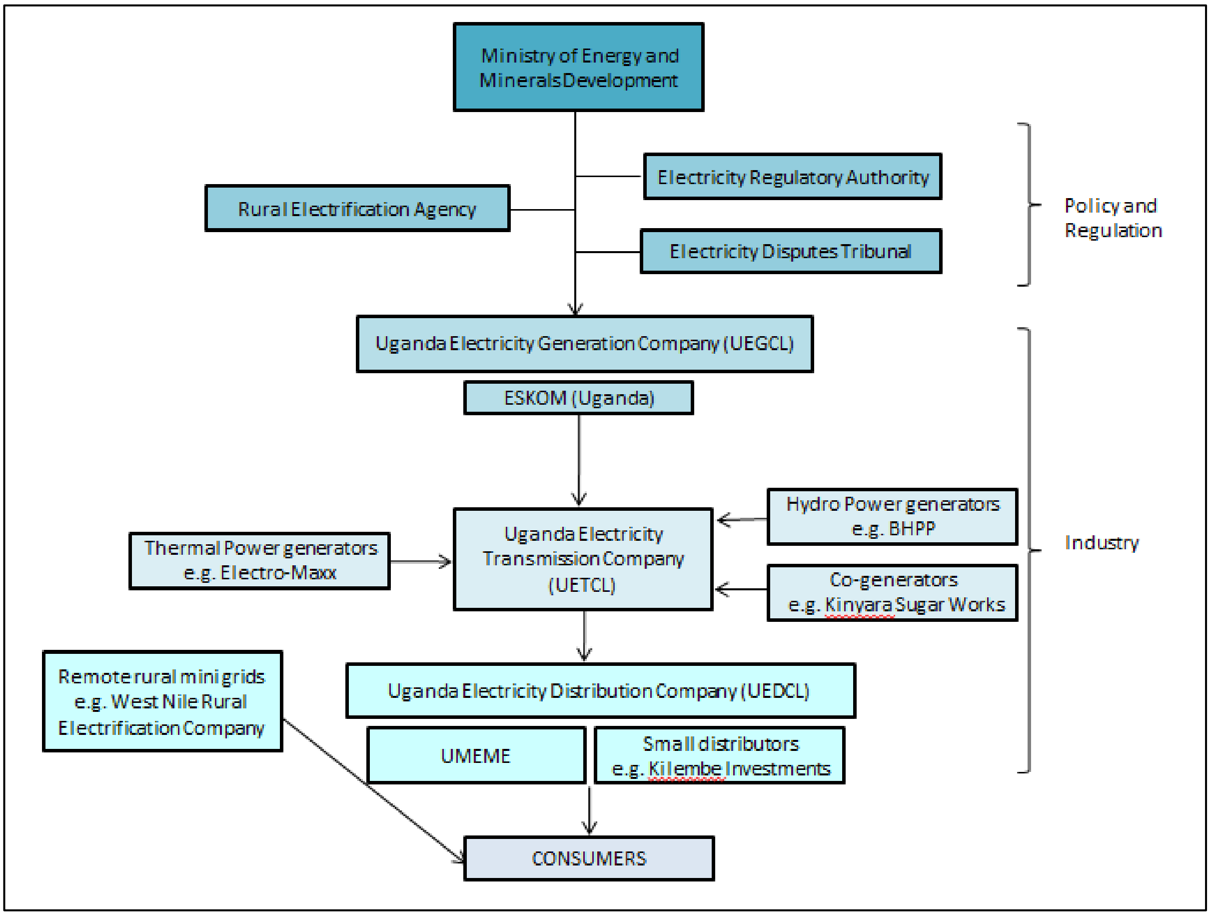
Role of small hydropower plants in Uganda

Small and mini hydro systems account for 7.8% of Uganda's power generation capacity, a total of 61.68 MW. This represents a considerable increase since 2007 when the Electricity Regulatory Authority (ERA) estimated the capacity of such schemes at 18 MW (ERA, 2007). The total potential of identified sites is estimated at 210 MW. Compared to large hydropower projects, small hydro schemes are financially and technically less demanding, and therefore quicker to build. They also help stabilise the grid, and can be developed off-grid to serve remote rural communities (Ministry of Energy and Mineral Development, 2012). However, small hydro projects are estimated to be less cost-effective over time than larger scale projects, incurring similar transaction and management costs (Ministry of Energy and Mineral Development, 2012).

Institutional structure and policy framework

The **Electricity Act of 1999** established the Electricity Regulatory Authority (ERA), which is responsible to the Ministry of Energy and Mineral Development (MEMD), and provided for the division of the former Uganda Electricity Board into three state-owned companies, Uganda Electricity Generation Company Limited (UEGCL), Uganda Electricity Transmission Company Limited (UETCL), and Uganda Electricity Distribution Company Limited (UEDCL). Figure 1 below depicts the structure of electricity operations in Uganda. Since 2002, Eskom has operated the Nalubaale and Kiira power stations at Jinja under lease from UEGCL. High voltage transmission is the responsibility of UETCL, which remains in the public sector and purchases power from private sector power generation companies, such as TPL. The principal electricity distribution company is Umeme Ltd., who purchase from UETCL and lease infrastructure from UEDCL. The ERA provides oversight of these different stakeholders, sets tariffs and issues licences for studies, electricity generation, transmission and distribution.

Figure 1: Structure of Organisations involved in the Supply of Electricity in Uganda



Source: adapted from Graduate School of Business (year unknown)

The overall goal of **Uganda's Energy Policy (2002)** is to meet the energy needs of the population for social and economic development in an environmentally sustainable manner. The Government has also sought to keep electricity affordable. Until 2005, the majority of Uganda's electricity was generated by the two main hydropower schemes at Jinja (with a combined capacity of 380MW). In 2006 an abrupt drop in the water level of Lake Victoria led to a chronic power shortage which forced the Government to commission high cost emergency thermal power plants running on diesel. This required the Government to subsidise consumers by covering the difference between the cost per unit of thermal generation and the end-user consumer tariff, to prevent further increments to the tariffs. At the beginning of 2012, the high cost of these subsidies[2] led to tariff increases of 36% for domestic consumers and 69% for large industrial consumers. The policy now is to recover costs through the tariffs.

In 2007, **the Renewable Energy Policy** set out the intention to secure 61% of generation capacity from renewable technologies by 2016 (MEMD, 2012), citing the need for large hydropower plants and increased private participation, as well as broader use of small scale power plants[3] and a programme to increase rural electrification through subsidies.

The **Rural Electrification Agency (REA)** was created in 2001 to implement the Rural Electrification Strategy and Plan (RESP) which aimed to achieve a rural electrification rate of 10% by 2012. REA is responsible for the Rural Electrification Fund (REF) which subsidises investment in grid-based systems (including isolated grids) and solar-PV systems, bringing down the high capital costs to make these investments more attractive to private sector investors. Though there has been

2 The subsidy cost was UGX 400 billion in 2011, and by 2012 had reportedly totalled UGX 1.048 trillion (c. US$ 395 million).
3 The government with a grant from development partners, plans to construct 10 mini hydro power plants in the country. The construction of the mini hydro power plants will be coordinated by Uganda Energy Credit Capitalisation Company (UECCC), a state-owned company using funds from the Dutch ORIO Infrastructure Fund (Ssekika, 2013).

private sector investment in generation, rural electrification has depended on public finance (MEMD, 2012), including through the multi-stakeholder Electricity for Rural Transformation (ERT) programme. To date a total of 38 projects have been or are being implemented under the auspices of the REA, including grid extensions, connections for key economic and social facilities and connections for district headquarters.

Consumption by business and households

During the first half of 2012, a total of 425,000 residential consumers accounted for about 23% of the electricity consumed in Uganda, while 387 large industrial consumers took 48%. Further details on the numbers of consumers are shown in Table 2.

Table 2: Average Number of Consumers 2009-2012

Consumer category	2009	2010	2011	2012 (Jan-Jun)
Residential: Umeme Residential: Ferdsult	286,642 1,845	325,896 3,848	384,611 4,891	419,595 6,150
Commercial: Umeme Commercial: Ferdsult	22,665 63	27,429 132	32,963 208	37,145 205
Medium industry	925	1,102	1,436	1,725
Large industry	187	263	342	387
Street lights	270	198	269	308

Source: Electricity Regulation Authority

The World Bank 2005/6 enterprise survey highlighted that around 90% of Ugandan firms surveyed cited a lack and/or poor quality of power to be a "major" or "very severe" constraint to doing business. Manufacturing firms in the survey reported up to 30 power outages in a month whilst retail and IT firms reported up to 20 outages, some lasting up to 24 hours. Manufacturing firms estimate loses to sales of up to 12% due inadequate power supply, and for the service sector it is 25%.

Nationally, an estimated 12% of the population has access to electricity. The majority of consumers are in urban areas, with only 5% of the rural population having access (MEMD, 2012). In Kampala, less than 40% of the population has access.[4]

Uganda has one of the lowest per capita electricity consumption rates in the world. Per capita consumption is 69.5 kWh; several times lower than the average for Africa, 578 kWh (MEMD, 2012).

Household expenditure on electricity is low as well. Based on the household survey (2005-06), households spent only 0.4% of their monthly income on electricity whilst biomass accounted for 4.4% of their monthly expenditure (Bacon et al., 2010).

During 2010-2011, the country's electricity supply continued to struggle to meet demand. By May 2011, peak demand was estimated at 443 MW against actual generation of 399 MW, resulting in regular, prolonged load shedding (up to 24 hours) affecting both domestic and industrial consumption.[5]

Trends and challenges

Emphasis on hydro power is set to continue, although it will need to grow very quickly to keep up with demand. Bujagali does not seem to have met expectations in terms of its impact on the price and reliability of power supply. Demand continues to grow rapidly and progress with

4 Estimates of the population with access do not equate directly with the number of residential consumers and can include off-grid access. District level estimates of access are unavailable. Though Umeme provides the number of customers by Umeme district office, these districts do not match administrative districts.
[5] Figures supplied by ERA based on UETCL's System Summary report for May 2011.

the next major plant at Karuma (capacity 600 MW) has been delayed by irregularities in tendering and the resultant litigation. Smaller hydro plants will not be adequate to keep pace with demand, although they have the advantage of being comparatively quick to establish. Generation is not the only problem: much of the transmission infrastructure is old and struggling to cope with increased supply and demand. Further, due to the recent increase in tariffs and end to high subsidies (particularly for rural connection fees), electricity remains out of reach for most Ugandans.

2.3 Overview of the Kasese/Bugoye project area

Geography

BHPP is located on the Mubuku River in Bugoye sub-county, Kasese District, in the Western region of Uganda, about 400 km from Kampala and 10km from the Democratic Republic of Congo (DRC). Bugoye is around 15km north of Kasese town and sits in the foothills of the Rwenzori Mountains. Crater lakes on top of Mount Rwenzori provide water supply to the Isya and Mubuku Rivers, feeding BHPP. The district is covered by wetlands, water and savannah vegetation with mountainous terrain and flat plains – almost one third is national park land. It receives an average rainfall ranging between 900-1,600mm annually. The district has many water sources, both lakes and rivers.[6]

Structure of local economy

The local economy is predominantly agricultural, mostly for local consumption (green bananas, cassava, maize) but also with some cash crops (coffee, cotton). Most work is done by women and the level of mechanization is low. There are several mills for cassava, millet and maize, a cotton ginnery, and some coffee is processed locally (Ndyabarema et al, 2006, Henry Lubega, interview). Uganda has a few areas where irrigation is practiced, but agriculture is mainly rain-fed due to relatively high levels of precipitation (Ranganathan & Foster, 2012).

Kasese District has two mining-based operations[7] and one of the country's largest cement factories, Hima Cement. There are also a range of micro enterprise and service industries. Tourism at the national parks of Rwenzori and Queen Elizabeth has been increasing over recent years.[8]

Population

The projected mid-2012 population of Kasese District was 747,800, including 77,000 in Kasese Town Council area and 30,800 in Hima Town Council (Uganda Bureau of Statistics (UBOS), 2012). Neighbouring Kabarole District, which is also served by the Nkenda sub-station, had a mid-2012 population of 415,600, including 47,800 in the town of Fort Portal.

Energy sources and consumption

Based on a 2006 survey in the Bugoye area (Byamugisha, 2006), average household weekly expenditure on energy is around UGX 6,957 (c. US$ 2.62). Most households use biomass as their main energy source, and only 2.5% of households had access to grid electricity. Umeme has 5,127 residential consumers served by its Kasese district office (September 2012) and Kilembe Investments has 1,283 residential consumers (January 2013). This suggests that in Kasese District around 5% of households have a grid connection.[9]

There are a few major commercial enterprises (mining, cement, agri-business – tea estates and a cotton ginnery) in the area. Though the 2010/11 Census of Business Establishments found 7,711 businesses in the District, Umeme has only 6 consumers in the Large Industry

6 Kasese District Information Portal, 2013.
7 Kilembe Mines Ltd. mined copper until 1982, and Kasese Cobalt Company Ltd. (due to close in 2013) processes the tailings from an old mine; Hima Cement also mines limestone on site.
8 In 2010, Queen Elizabeth and Rwenzori National Parks visitors totalled 77,566 (Uganda Wildlife Authority, 2011) and 89,662 in 2011 (Uganda Bureau of Statistics, 2012).
9 This estimate, which echoes national estimates, assumes that Umeme's Kasese district coincides with the administrative district and average household size is 6.

category, 16 in the Medium Industry category and 561 in the Commercial category. Their consumption (MWh) in 2011 is summarised in Table 3.

Table 3: Electricity Consumption in Kasese District 2011

	Domestic	Commercial	Medium Industry	Large Industry
Total electricity consumption (MWh)	4,231	3,889	2,039	94,988
Average consumption per customer (MWh)	0.83	6.93	127.37	15,898.21

Source: Electricity Regulatory Authority

2.4 Technical description of the scheme

BHPP is a run-of-river mini-hydropower scheme, with an installed capacity of 14.28 MW and maximum annual production of 82 GWh (based on 6,308 annual operating hours). The scheme accounted for 2.3% of Uganda's total installed generation capacity in 2011. The electricity generated is fed into the national grid at Nkenda Substation, 6 kilometres from Bugoye, via a 33 kV transmission line.

The Mubuku River has three hydropower plants. Upstream of BHPP is Mubuku I, owned by Kilembe Mines Limited (5 MW), and downstream of BHPP is Mubuku III, owned by Kasese Cobalt Company Limited (KCCL) (9.9 MW) (CDM, 2012; Celis, 2011). The BHPP scheme diverts water from the Mubuku River via a 1 km canal to the Isya River, where it is joined by tailrace water discharged from the Mubuku I hydropower scheme. (See maps in Annex 9.1.) The water is then taken by a 4 km long canal to Bugoye's 950 m penstock, which feeds the power station. The rated head is 160 metres. Two Francis turbines (7.228 MW each) and two generators (7.140 MW each) generate electricity from the water, which re-enters the Mubuku River via a tailrace canal.

Normally it is possible to operate one turbine while the other is under maintenance, but water cannot flow through the turbines when no power is being generated. An 80 kVA emergency diesel generator is installed to cover non-operation of the turbines and only used in exceptional periods, for example when the grid is down and onsite loads cannot be self-supplied.

In 2010, the supply from BHPP was reconfigured along with that from Mubuku I and Mubuku III to be able to supply a local network (or mini-grid) when there is an outage on the national grid – a system known as "Island Mode".[10] The area served by Island Mode operation includes Kasese District and the Fort Portal area (in Kabarole District). More recently the 18 MW Mpanga scheme in Kamwenge District, has been included in this mini-grid. Since October 2010, Island Mode has been used a total of 59 times for a total of 391 hours (about 2% of total operating hours). BHPP generated at less than half maximum capacity 23 times during Island Mode operation, and if Island Mode is used when water levels are low in the Mubuku River there may not be enough power to meet demand on the mini-grid. The maximum capacity of the three Mubuku River hydropower plants is about 28 MW, and Hima Cement the largest consumer in the area requires 18 MW.

2.5 Financing of the project

A total of US$63.6 million has been invested in BHPP (including the transmission line to Nkenda). The sources of this investment are summarised in Table 4, below. The two shareholders of TPL, TrønderEnergi and Norfund, made equity contributions of US$ 13.4 million and US$6.3 million, respectively, giving them 68% and 32% ownership shares in TPL. The Norwegian Government made a grant of US$ 8.9m, improving the attractiveness of the

10 UETCL are very keen to encourage new hydro power plants to build in the technical capacity to work in Island Mode as the scheme is seen as having been very effective.

investment for the commercial investor (Devfin Advisers, 2010). Almost half of the total investment (US$ 31.7 million) was provided by the EAIF through a 15-year senior loan.

Table 4: Breakdown of BHPP Investment Sources

Investment sources	Amounts (US$ million)	Funding Type	Percentage
Ugandan domestic sources	3.3	Cash back from sales	5.19%
Norwegian government	8.9	Grant	13.99%
EAIF	31.7	Loan	49.84%
Norfund	6.3	Equity	9.91%
TrønderEnergi	13.4	Equity	21.07%
Total	**63.6**		**100,00%**

Source: EAIF Bugoye Hydro Power Case Study (EAIF), (PIDG, 2012)

The financing of BHPP depends on income from the sale of electricity. This non-recourse approach, avoiding the need for further equity investment, called for measures to guarantee income and reduce risks (Celis, 2011; Devfin Advisers, 2010). As well as using US$ 3.3 million from the revenue from electricity sales as equity (counted as domestic investment in project reports), the project negotiated a Power Purchase Agreement (PPA) with UETCL and the Government of Uganda containing guarantees about income if supply to the grid is prevented (e.g. by technical faults) and UETCL fails to pay. Guarantees were also secured to reduce risks during construction and the risk to income from low water flow.

A further element of the financing package is income from the sale of Certified Emission Reductions (CERs), which were viewed as important for the overall viability of the investment. The project's registration under the Clean Development Mechanism (CDM) recognises the additionality of income from CER sales. In 2011 BHPP provided a net total of 50,385 tonnes CO_2 reductions (CERs) (Monitoring Report, 2012). The Government of Uganda obtains 60% of the revenue stream from CERs and TPL the remainder 40%, after the CDM project development cost is deducted.

EAIF involvement

The Emerging Africa Infrastructure Fund (EAIF)[11] agreed to support the project in 2008. The contract for their loan was not signed until construction was well-advanced, but confidence in EAIF allowed Norfund to pre-finance the construction. According to Norfund, who had been involved in the project since its inception, EAIF were prepared to provide debt finance when others were unwilling or unable to do so. EAIF worked with TrønderEnergi and Norfund to finalise the project development, and their involvement was felt to have improved the project agreements and insurance package.[12]

2.6 Corporate Social Responsibility

BHPP is widely recognised for its high standards of Corporate Social Responsibility (CSR) and the quality of community engagement during construction and operation, although it is perceived to have higher levels of expenditure than is typical for CSR activities in Uganda. TPL has sought to address a range of issues which the plant's construction and operation have affected in some way, with large initial support in the first few years of construction and operation, and a smaller budget set to continue throughout the project's 25 year life-cycle.

[11] The Emerging Africa Infrastructure Fund (EAIF) is a Public Private Partnership, established in 2002 at the instigation of PIDG. EAIF provides long-term (up to 15 years) senior debt or mezzanine finance on commercial terms to finance the construction and development of private infrastructure in sub-Saharan Africa.
12 Mark Davis, Norfund, quoted by PIDG (2012a).

Compensation, resettlement and livelihood restoration

During construction, a Ugandan consultancy firm, New Plan (initially in collaboration with SN Power), was engaged to prepare BHPP's compensation, resettlement and livelihood resettlement plan, which was intended to ensure minimum disruption and loss of income for the 917 local residents affected by the plant. New Plan prepared a livelihood monitoring report (New Plan, 2009) and solicited bids for implementation of a livelihood restoration programme.

Josephine was resettled within Bugoye. She lives with 10 family members and is happy with the size and quality of her new home. She was resettled before her old home was destroyed and given the same amount of land as well as cash compensation for lost crops. She said this money fell short of what the family needed, particularly because of the time it took to grow new coffee trees from seed. She would like to have electricity, but can't afford to connect to the grid.

Households losing less than 20% of their land received cash compensation, while households losing more than 20% have been given replacement land. The large majority of resettled households have been relocated to sites in proximity to their original land. The resettlement houses are bigger and of better quality than the original houses (Arntsen, 2008). There was a preference for cash compensation among households due to be resettled, but they were encouraged to take land rather than cash. Affected households received compensation for standing crops lost. The project used a government valuation scheme based on prices at that time, so a few people were unhappy because prices had increased substantially by the time they had regrown crops.[13]

The livelihoods restoration programme did not begin until 2012, delayed by the identification of an affordable implementing organisation. When the programme ran in 2012, in partnership with Kasese Youth Polytechnic, people affected by the project were sponsored to attend vocational training to equip them with long term skills to help them generate incomes.

CSR activities

Water

TPL contributed 200m UGX worth of extension pipes to community taps in Bugoye and the nearby trading centre of Ibanda (TronderPower, 2012), and constructed water collection points along the headrace canal. In addition, TPL conducted a water baseline study in 2008 to identify the affected population and collect data for impact monitoring) (Arntsen, 2009).

CDTS supports young people with education and rehabilitation through sport. With TPL funding it has increased programmes, including running HIV and malaria programmes, as well as distributing exercise books.

Health care

In 2011, TPL signed an MOU with Bugoye Health Centre to contribute towards its electricity bills for 2 years (TronderPower, 2012). TPL and Norfund supported the construction of new buildings at the health centre (out-patients' department, maternity ward and pit latrines) and the procurement of new medical equipment. Kasese District Local Government were responsible for recruiting 6 additional staff, which has yet to happen.

TPL organises a few HIV and malaria testing events, and funds a local non-governmental organisation (NGO) - Community Development Through Sport (CDTS) - to deliver health programmes (see box). Another local NGO was initially given money by TPL to carry out HIV programmes, but did not deliver any programmes despite receiving the money.

13 One man had 5 bee hives, harvesting around 20kg honey. The bees migrated when the hives were moved and it took almost 2 years for him to return to the previous level of production, and even with compensation he made a loss. However, around 95% of the households moved were happy with the resettlement programme (interview with Henry Lubega, journalist).

Rural Electrification

TPL have contributed 70m UGX (c. US$ 26,375) to support local extension of the electricity grid by Kilembe Investments Limited, through the Government's Rural Electrification Programme (TronderPower, 2012). The Rural Electrification programme requires that communities contribute a proportion of the necessary funds for grid extension, and it is to this payment that TPL have contributed. This first phase of extended electrification in the Bugoye area is expected to be completed in May 2013, covering an area upstream of Ibanda[14] trading centre. During the field trip in January 2013, it was confirmed that funding to subsidise connections was no longer available, meaning that additional connections to the extended grid (at a cost of 450,000 UGX, compared to the subsidized cost of 150,000 UGX) are likely to be few in number.

Community engagement and dispute management

TPL has delivered community sensitisation about hydropower in local primary schools (TronderPower, 2012) and holds annual open days at the plant. There is a community liaison group known as the Bugoye Participatory Committee (BPC), led by Teddy Walinah, a female community elder who worked on the District Land Board at the time of construction. The BPC met weekly during construction, with some participants working daily during the compensation phase. During construction, the group consisted of 13 members made up of the Executive Committee with 6 members and chairpersons from all the affected villages. In the operation phase, the group is called the TronderPower Communications Committee (TCC). They meet at least once a month and can be called upon whenever needed. The group is still headed by Ms. Walinah and comprises 3 additional members and representatives from TPL.

3 Review of the importance of reliable electricity supply for private sector development

This section reviews existing literature on the importance of a reliable electricity supply for Private Sector Development (PSD). It addresses the importance of an electricity supply at two levels: in developing countries generally, drawing upon global, and particularly African, literature on the effects of access and reliability of electricity for PSD; and, secondly, electricity and PSD in Uganda, using both literature and qualitative information obtained during interviews with businesses and business organisations.

PSD is of course not synonymous with job creation, however it is reasonable to assume that improved private sector operating environments might lead to increased private sector productivity, which over time might result in skill increases, income increases and job creation.

PSD is affected by a wide range of issues, from the operating environment (physical and governance infrastructure, availability of finance, legal framework including labour market regulation) to the national economic structure, a country's geography, political circumstances, and social situation (e.g. education and skills levels, and healthcare). PSD can be measured in terms of growth, employment creation, investment, economic structure and firm-level change, so this review considers analyses of the impact of electricity on all of these factors as proxies for PSD.

Infrastructure, such as electricity, has deep and far reaching impacts on social and economic development – the provision of electricity contributes to healthcare provision, education, water and sanitation (Ianchovichina et al., 2012) not least through equipment and resources, but also ability to recruit and retain staff (especially in remote, rural areas). Better education and therefore employable skills, higher levels of health so less absenteeism, all contribute to PSD, as they do to economic growth.

[14] Ibanda is a community close to Bugoye – see maps in Annex

3.1 The relationship between PSD and Electricity

Electricity is widely recognised to be important to development in general and PSD in particular. Until recently, however, little evidence existed to support a causal relationship between the two. Recent papers have sought to establish causality, and have also reviewed the impacts of electricity on rural poverty incidence, micro and SMEs, and on women, in all cases considering the livelihood impacts. Examples of evidence are provided below.

Sub-Saharan Africa's low infrastructure development is estimated to be responsible for a 2% shortfall in economic growth per country (Bernard, 2010). Establishing a correlation between electricity and economic development is straightforward: "no country has achieved a high level of per capita income and welfare without a functioning electricity system" (Lockwood, 2012). However, only a few recent studies show a causal relationship between the provision of electricity and development, or more specifically, PSD, by measures such as income and employment. One is Altinay and Karagol's study in Turkey (2005) which found strong evidence for unidirectional causality running from electricity consumption to income. Dinkelman's 2008 study found that female wage employment in South Africa rose with electrification. A few studies show that it is growth of income that creates demand for electricity, not the reverse (Bernard, 2010). Yet few enterprises of any scale can operate without access to an electricity supply (Hunt et al, 2012), and electricity allows for increased productivity of home businesses (World Bank, 2006).

The reliability of the electricity supply, as well as its availability, is also important for PSD. More than a third of economies in the developing world cite the lack of reliable electricity as the principal constraint on enterprise growth (Practical Action, 2012). In a study of the economic cost of power outages in Nigeria, Adenikinju (2005) found that power outages imposed significant costs on business, and small-scale operators were the most heavily affected (Foster and Steinbuks, 2009). In sub-Saharan Africa electricity supply interruptions result in average losses of 3 months' production time each year. Businesses lose more than 6% of their sales due to outages, and for informal sector enterprises these losses can be as much as 16% of sales (Foster and Steinbuks, 2009). The IFC estimates that a reliable power supply could increase annual job growth in low-income countries by 4-5% (IFC, 2013).

While lack of access to modern energy is often characterised as a barrier, removing this barrier does not necessarily result in economic development (Meadows et al, 2003). Hunt et al. (2012) found that expanding energy access is not sufficient for growth and employment creation at firm level: several steps connect energy access to employment, including the uptake of appliances and equipment, improvements in enterprises, increased income generation and only then, expansion and hiring new staff. Growth can have a negative job creation effect and particularly in the absence of market access, access to technology and skills, access to finance, and economic and social stability, energy access is not necessarily converted into jobs in the short run (Hunt et al, 2012). Analysis by the IFC (2013) suggests that higher productivity is associated with faster employment growth in subsequent years.

3.2 The importance of electricity for PSD in Uganda

Commercial and industrial enterprises consume almost two-thirds of the electricity supply in Uganda. The majority of industrial enterprises use electricity as their principal source of energy and, on average, electricity accounts for 15.3% of production costs (much more in some sectors) and back-up sources another 6.7% (ERA, 2006).

Electricity was, by far, the largest concern of businesses in the 2005/6 Enterprise Survey. However, Uganda was experiencing an extreme energy crisis at this time. In 2012, the September-December quarterly Business Climate Index (BCI), published by the Economic Policy Research Centre, showed that business executives continue to perceive the cost of electricity (40% of businesses surveyed) as the single most burdensome challenge in doing business, followed by recent inflationary pressures (33%), increased competition (29%) and other factors[15] (Mawejje and Nampewo, 2012). Interviews during the project trip in 2013 confirmed how important electricity supply is in relation to other factors affecting PSD, citing it as one of the most – if not the most – important factors affecting large businesses in Uganda (followed by infrastructure, skills and operating environment). For smaller businesses, the cost of power was mentioned with far more frequency than reliability, and lack of capital seemed to be a very significant issue.

Unreliable energy was cited by micro-entrepreneurs in Uganda as one of a number of common energy-related problems encountered (Kyokutamba, 2000). Others include unstable voltage (necessitating use of voltage stabilizers), non-transferable power connections (resulting in new tenants inheriting previous tenants' bills), paying bribes to get connected, assumption of ownership by the utility company of infrastructure (and subsequent connection of others who did not invest in the poles initially) and high tariffs (Meadows et al., 2003).

Interviews in Uganda with multinational businesses and business organisations revealed that reliability of electricity is particularly important to bigger firms, some of whom would even be prepared to pay higher tariffs to ensure a reliable supply. Many large firms in Uganda generate their own power (mainly using expensive diesel generators) to ensure their energy supply. Not only does lack of regular electricity from the grid affect profits, because of the high cost of alternatives, but outages and voltage fluctuation damage equipment. Even a momentary voltage fluctuation can cause continuous process production lines in big factories to be shut down for hours.

3.3 Lack of access to electricity, and impacts on household and micro enterprise

Although most studies find a significant demand for electricity, households perceive it as a consumption good rather than a productive investment and in the past, promotional campaigns have been required to explain potential benefits of rural electrification (Bernard, 2010) (Peters, Harsdoff, & Ziegler, 2009). Upfront costs of connection are often prohibitive, and in some instances wood fuel is more cost effective (Clancy and Dutta, 2005). Similarly, rural electricity provision is often not financially viable for private sector electricity distribution companies. Most use of electricity in rural areas is for lighting and entertainment, with limited use for agriculture and agro-processing, handicraft or services activities (Bernard, 2010). Only a small proportion of households with electricity use it for home-based microenterprise, because of the lack of capacity to acquire appliances for productive uses (Clancy & Dutta, 2005). Sub-optimal use of electricity might be explained by the fact that electricity alone cannot kick-start local growth as other factors, such as access to capital, are necessary for more productive use of electricity (Bernard, 2010). However, it should be noted that 'productive' uses of electricity are not synonymous with 'income-generating' uses (Cabraal et al., 2005) – for example, lighting might not generate direct income to the owner of the light but by offering night time security, can increase productivity (e.g. in Kasese area, local drivers of motorbike taxis known as *boda boda* continued work later into the night as a result of increased street lighting, some of which is from private residences). Lighting can be a direct income generator when it allows small businesses to operate for longer hours.

15 Others are poor transport infrastructure (26%), exchange rate fluctuations (25%), inadequate skills for technical and managerial staff (16%), financial constraints and inadequate capital (14%), high interest rates (13%), and competition from cheaper substandard products (11%).

Two factors influencing the prevalence and impact of electrification are 'placement bias' – that electricity tends to be installed in priority to richer villages (in the case of the Ugandan REA scheme, this could be because communities must contribute to the REA scheme to access rural electrification subsidies), and 'self-selection bias' – where only richer households are able to afford connection fees and tariffs (Bernard, 2010).

"Using quantitative firm-level data on 200 micro-enterprises complemented by qualitative case studies we find that modern energy increases the importance of electricity-using capital and alters the sectoral distribution of economic activities. By contrast, we find no evidence for an expansionary effect of electrification on firm profits or worker remuneration. […] Qualitative information, however, suggests that a positive indirect impact of electrification on firm performance is induced by the overall expansive effect electrification has on local demand. The demand increase can be partly assigned to people moving into the electrified community from surrounding non-electrified areas. We conclude that if productive energy promotion policies are put in place they should address drawing up thorough business plans to enable local entrepreneurs to take informed connection and investment decisions"

Sven Neelsen and Jörg Peters (2011) Electricity usage in micro-enterprises: Evidence from Lake Victoria, Uganda, Energy for Sustainable Development*, vol. 15, issue 1, 21-31.*

Electrification rates are correlated with SME uptake in South Africa, according to Prasad and Dieden (2007), where two-thirds of SMEs are found in households connected for more than five years. Time lag is another factor. A study in South Sudan showed that the introduction of electrical and mechanical power supplies may create relatively few new jobs in the first few years, mainly in the provision of the service itself, but contribute strongly to improving existing employment over time (Hunt et al, 2012).

In a study in rural Vietnam, Khandker et al. (2008) found that electricity led to an increase in farm income, although not in other sources of income, which they attributed to the use of electric pumps for irrigation. They also find that returns are higher for early connectors in terms of income (although there is no difference in terms of schooling outcomes). A study in the Philippines found that household heads with relatively higher levels of education are more likely to start a home business, as are household heads with low wages and many school-age children (Joint UNDP/World Bank, 2002).

In conclusion, whilst electricity is a requirement for sustainable PSD, it is not necessarily the first priority as evidence indicates that electricity only bolsters livelihoods and economic development in contexts where other factors (infrastructure, finance, skills and capacity) are already present. More affluent communities, firms and household with access to other PSD enhancing factors are likely to be able to make better use of electricity in the short-term (not least because they will be most able to afford it). Communities can benefit from electricity being present in an area, e.g. through street lighting, or a small number of businesses being able to offer longer hours of service or high quality or more efficiently produced products. Poorer communities with lower levels of existing PSD support structures require higher levels of subsidy and complementary activities to build local market opportunities, in order for electricity to provide tangible benefit to livelihoods and economic development.

3.4 Reliable electricity and jobs in the electricity sector itself

Creation of new jobs in the energy sector itself has been a relatively under-appreciated but important feature of the contribution of energy access to growth and employment, especially in Africa where there are currently very low levels of energy access (Hunt et al., 2012). Much of the electricity sector in Uganda has been privatised, so expansion of electricity has a direct impact on the development of businesses to cater for this, such as the Kasese-based distributor, Kilembe Investments Limited. Kilembe Investments, established in 1997, are reliant on the REF for investment in rural electrification through grid extension. They are seeking to diversify into the supply of solar home systems to meet the demand for electricity where grid extension is not expected in the near future.

4 Conceptual Framework

4.1 Overall approach and definitions of key terms

This study of BHPP seeks to demonstrate and test an approach to assessment of the employment effects of similar infrastructure projects, building on existing methodologies and the experience of ODI's team in related work. The study broadly follows IFC methodology (IFC, 2012), addressing direct and indirect employment effects from the plant itself and induced effects of increased and more reliable power supply to both firms and households, at national and local level.

The Terms of Reference identify four kinds of employment effect – direct, indirect, induced and displaced. For the purposes of the study, two principal sources or causes of these employment effects can be identified. The first is the construction and operation of BHPP, labelled Category 1. The second is consumption of the electricity supplied by BHPP, labelled Category 2.

Table 5: Definitions of Key Terms

Category 1 jobs	Direct and indirect jobs – all jobs created from the plant's existence, rather than its outputs
Category 2 jobs	Induced jobs, jobs created as a result of electricity produced by the plant
Direct jobs	Jobs created at BHPP, directly involved in the plant and usually located at the site, including jobs for which people are directly employed by TPL and also jobs on site which have been contracted out (i.e. people are employed through contractors)
Indirect jobs	Jobs created as a result of BHPP's existence – supplier jobs, jobs created as a result of spending in the economy from increased wages from direct jobs and from supplier jobs, jobs created in the electricity sector from the increased supply of electricity from BHPP
Induced jobs	Jobs created through the increased availability and reliability of electricity caused by the presence of BHPP
Jobs created	Jobs that would not have existed without BHPP. Relates to job roles, not people – so it is possible that the same person could hold 2 of the jobs counted, having conducted the work at different times, for example during the construction phase
Jobs sustained	Jobs that might have existed without (or did prior to) BHPP, but are being sustained by the presence of BHPP. The job potentially could exist without BHPP.
Person Years	Jobs multiplied by the time period in years. Number of jobs created and sustained provides a snapshot of jobs. It does not indicate the longevity of employment and therefore is of limited value in establishing the substantive employment effect. Person years' of employment gives a better idea of how much work results from a given context.
Quality power	A supply of electricity that is not subject to voltage fluctuations
Reliable power	An uninterrupted supply of electricity, i.e. supply that is not subject to outages due to load shedding or technical faults

The direct and indirect employment effects of BHPP derive from the construction and operation of the plant, and are therefore in Category 1 only. **Direct employment** comprises employment at the plant, during the construction and operation phases. This includes jobs in contractors which are wholly dedicated to the operation of BHPP (e.g. security guard positions). **Indirect employment** effects are due to BHPP expenditure on suppliers, CSR activities supported by TPL, and job creation in electricity transmission and distribution due to the supply of power from the plant. Indirect employment effects in this study also include the second order job creation resulting from the additional incomes of those employed directly or indirectly feeding into the economy and stimulating additional production.

The Category 2 job creation effects, through the benefits of more power and improved reliability of power, are what the IFC labels "secondary effects" (IFC, 2012). In this study they are regarded as **induced employment** effects. This includes job creation resulting from increased productivity and reduced costs amongst electricity consumers, and second order effects from these gains. It also includes employment effects resulting from macro-effects such as changes in government revenue and expenditure.

Displaced employment effects are negative indirect and induced employment effects.[16] These could arise, for example, if electricity consumers increase mechanisation of their operations or electricity substitutes for other fuels. The overall indirect and induced job creation figures presented here are taken to be net of these negative effects, though the data available have not allowed for any meaningful estimation of displaced employment. However, it is noted below that all enterprises do not expand employment when the reliability of supply is improved. Given the overall demand for electricity and other forms of energy in Uganda, including considerable suppressed demand, and in a context of overall GDP growth, any displaced employment effect is likely to be small.

The causal chain for these employment effects is depicted in Figure 2. Table 6 summarises the different employment effects and the method to estimate them.

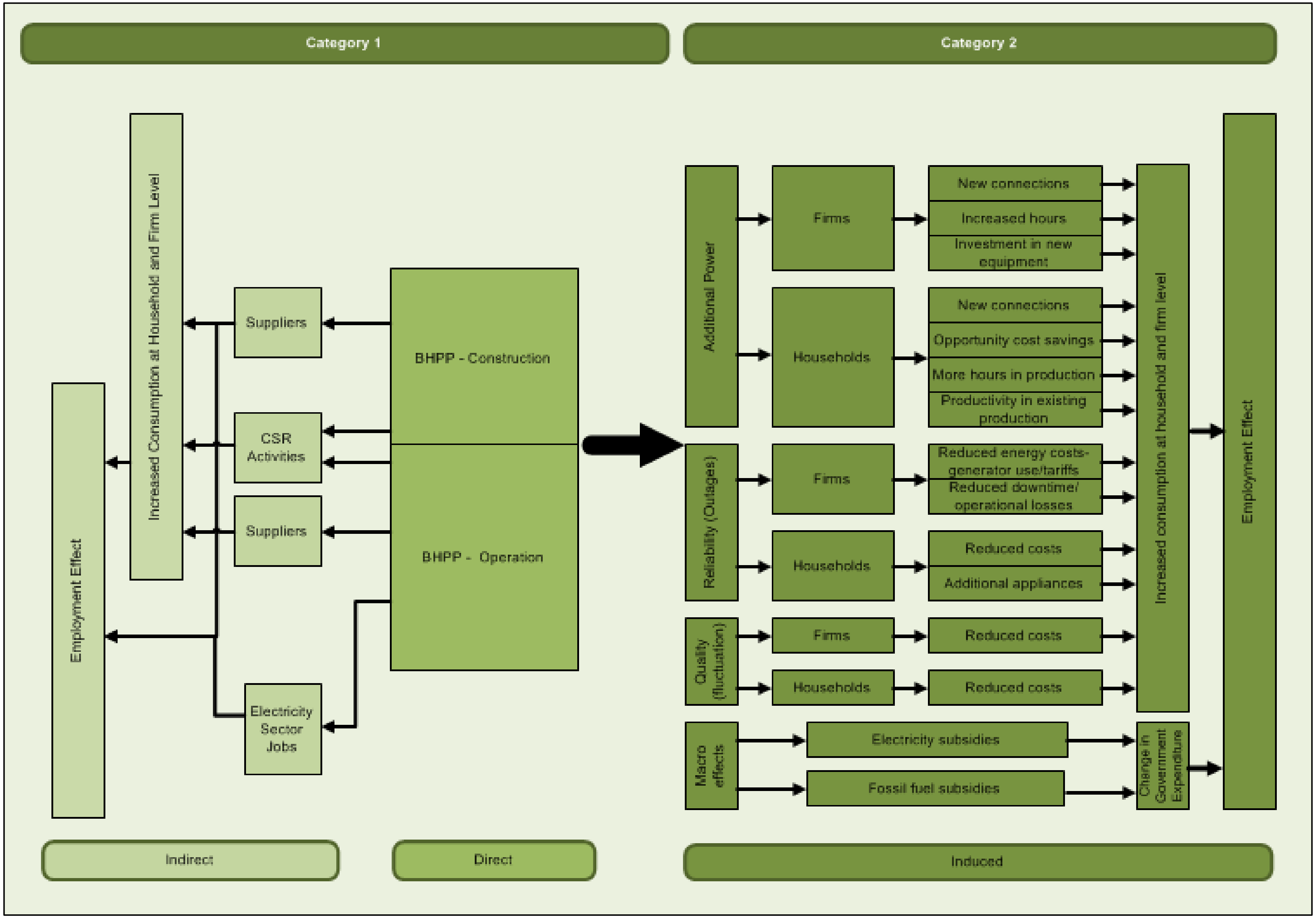
Table 6: Method for Job Creation Calculation

Effect	Result	Method
Category 1 jobs (construction and operation phases)		
Direct	X jobs (X person years) + displaced jobs	Interviews and project data
Indirect	X person years (estimate of # jobs) + displaced jobs	Interviews, project data and employment multipliers based on enterprise survey, household data and macro-economic data Estimate additional number of workers, estimate additional spend (and location of spend, e.g. local, national, foreign) using enterprise and household survey data.
Total	X person years (estimate of # jobs)	
Category 2 jobs (created as result of more/better power supply)		
Impact of increased power supply	At firm level: XX jobs across XX years + displaced jobs	Analysis of: new connections; increased hours of work and increases in productivity; investment in new equipment/increase in complex manufacturing. Using: Enterprise Survey (2006), Energy Use Survey (2008), tariff information (by region, sector and size/tariff band), business surveys and qualitative information from business, macro level data.
	At household level: XX jobs across XX years + displaced jobs	Analysis of: new connections; opportunity cost savings; increased hours in production; new production activities; increased productivity in existing activities. Using: household survey data, information from the distributer on connections/published energy data, plus qualitative evidence e.g. from district councils, anecdotal evidence from BHPP staff.
Impact of more reliable power supply	At firm level: XX jobs across XX years + displaced jobs	Analysis of: reduced energy costs – using generators/decreased tariffs; reduced downtime/operational losses; improved quality of supply (fewer power surges) Using: Enterprise Survey (2006), Energy Use Survey (2008), business surveys and qualitative information from business, macro level data.
	At household level: XX jobs across XX years + displaced jobs	Analysis of: reduced downtime; consumption (e.g. increased purchase of appliances) Using: household surveys, SME data, literature, data on appliance sales, brief qualitative additions through interviews with district councils, anecdotal evidence from BHPP staff.
Impact of better quality power supply	At firm level: XX jobs across XX years + displaced jobs	Analysis of: reduced costs Using: Enterprise Survey (2006), Energy Use Survey (2008), business surveys and qualitative information from business, macro level data.
	At household level: XX jobs across XX years + displaced jobs	Analysis of: reduced costs Using: household surveys, SME data, literature, data on appliance sales, brief qualitative additions through interviews with district councils, anecdotal evidence from BHPP staff.
Macro- effects	XX jobs across XX years + displaced jobs	The results of the macro effects study (above) will inform impact of electricity and fossil fuel subsidies, and government revenue

16 Since BHPP is a new project, owned and operated by a new company, TPL, there are no direct jobs displaced.

The **quality of employment** or a job is an important factor for people on low incomes, affecting their financial, psychological, physical and emotional well-being. Job quality could therefore be measured in a range of ways: by looking at the criteria for recruitment and recruitment outcomes (e.g. in terms of gender and education levels); analysis of employee contract terms and conditions (e.g. remuneration, holidays, sick leave and redundancy policies); company human resource practices (e.g. training and development, fringe benefits, unionisation); and management culture and the working environment (e.g. consultation, overtime practices, work location and physical conditions). Of these job quality factors, gender, education level and change in remuneration from previous job were considered during interviews with staff employed directly by TPL. The study team did not seek details of their employment terms and conditions, although some information about training and remuneration was volunteered by some interviewees.

Figure 2: Conceptual Model of the Net Job Creation Effects of BHPP



5 Assessment of the employment effects of BHPP

The core purpose of this study is to establish the employment effects of BHPP, both job creation and job displacement. Given the PIDG's mission to assist developing countries in providing infrastructure for economic growth and poverty reduction, the research focuses on Ugandan jobs and, as far as possible, seeks to exclude all expatriate jobs in calculations. Following the conceptual framework, employment effect calculations are done at three levels: direct, indirect and induced employment effects. The methodology seeks to combine two sets of information about employment effects – firstly to quantify the net number of jobs created and secondly to provide a more qualitative picture of the employment effects of BHPP. For the former, the study attempts to capture not only the number of jobs created, but also to estimate the person years' worth of jobs created – in order to better reflect the overall employment effect and to consider in jobs displaced by BHPP. The latter refers not just to the number of jobs created, but to factors enhancing employment prospects – skills creation, impact on livelihoods that do not necessarily manifest themselves as jobs (such as home-based micro enterprise), as well as a wider set of reasons affecting productivity.

5.1 Category 1 Jobs

Direct employment effects

This section seeks to calculate direct employment effects, meaning people employed or contracted by TronderPower (or TrønderEnergi during the construction phase). There are two phases of direct job creation at the Bugoye plant – the first is the construction phase (2008-9) and the second is the operational phase of the plant (to 2034). In addition to overall job numbers, this research has disaggregated employment data for direct jobs by gender and type of work (i.e. whether people are employed on temporary or permanent contracts).

Direct job creation during the construction phase

BHPP was constructed between March 2008 and October 2009 and during this time a few staff were hired directly by TronderPower but the majority of the labour in constructing the plant, digging the canal and carrying out resettlement and CSR activities was carried out by contractors.

Table 7: TronderPower Direct Employment during Construction

	TPL Jobs	Month Started	Duration of Job (# Months)	Person years
	1	Mar-08	19	1.58
	2	Aug-08	14	2.33
	3	Nov-08	11	2.75
TOTAL	**6**			**6.66**

Source: TronderPower General Manager interview, 2012
N.B. TPL staff from construction phase are not counted included in job numbers to avoid double counting with operation phase figures

We identified three sources of information for construction phase contractor employment figures. The first (Norplan/TronderPower Ltd, end-construction review of environmental and social programmes, 2009) gave a total figure of 314, the second (the PIDG 2012 Results Monitoring sheet) gave a figure of 472 and the final figure, from New Plan, gave a total of 1,006 created at peak periods. The last figure includes construction of the plant, CSR activities during construction (e.g. water pipes, health centre) and construction of resettlement houses and provides a breakdown by contractor name, task, number of jobs and time frame, and are assumed to be the most accurate (see Table 8 below). It is assumed that the two lower figures cited above are formed from averages of peak and off-peak working patterns. All contractors except Noremco and ABB were Ugandan.

Table 8: Employment through Contractors during Construction

Company	Time frame	Total Duration (Months)	Peak Period (months)	Off-Peak Period (months)	Jobs - Peak Period (#)	Jobs - Off Peak Period (#)	Person Years
Subcontractors for plant construction							
Noremco**	Jan 08-May 10	29	7	22	320	160	480.00
AA& BB	May – Dec 09	8	0	8	0	9	6.00
Mejaruda	Jan - Dec 09	12	3	9	160	20	55.00
Nail & Wood	Jan 08 -Mar 10	27	0	27	0	3	6.75
Steel Works Limited	Jan – Mar 09	3	0	3	0	6	1.50
Victoria Pumps	Apr-09	1	0	1	0	3	0.25
Transport Suppliers	May 08 – Mar 10	23	7	16	20	12	27.67
ABB***	Jan - Oct 09	10	1	9	6	3	2.75
Meridian	May – Sep 09	5	0	5	0	30	12.50
Construction of resettlement houses							
Robtex Kasese Enterprises	Nov 07- Jul 09	21	6	15	100	20	75.00
Kasese Civil and Building Contractors	Nov 07- Jul 09	21	4	17	50	15	37.92
Kule William & Sons	Nov 07- Jul 09	21	4	17	90	15	51.25
Mubya Engineering Contractors Limited	Nov 07- Jul 09	21	4	17	45	15	36.25
Mbamba & RMC	Apr 08 –Jul 08	4	0	4	0	20	6.67
CSR Projects							
Robtex Kasese Enterprises	Dec 08- Apr 10	17	9	8	40	3	32.00
Mejaruda	Jul - Oct 09	4	2	2	80	20	16.67

CDTS	Jul 08- Aug 09	13	0	13	0	10	10.83
Bugoye HC	Apr 08- Aug 09	17	0	17	3	3	4.25
Kisinga Construction Company	Mar 08 - Oct 09	20	3	17	80	10	34.17
Consultants							
New Plan Limited	2007 - 2009	32	8	24	12	8	24.00
TOTAL					**1,006**	**385**	**921.42**

Source: Figures were provided by New Plan (Irene Kokseter), 2013. They were also corroborated with Robert Kisembo, Director of Robtex.
*Relates to number of jobs, it is possible that one individual held more than one of these jobs.
** Noremco is a Swedish construction firm
***ABB is a Norwegian company with a subsidiary in Uganda.

Contractors were encouraged to use local labour as far as possible and to employ women. Priority was to be given to households affected by the construction, in particular to resettled households (Ndyabarema et al., 2006). In addition, skills training (particularly by the main contractor, Noremco) provided local contractors and their staff with new, valuable skills which have contributed both to the high quality construction of the plant, and to facilitating individuals in seeking further jobs once their work at BHPP was complete. Their skills have also assisted the contractors to expand their businesses.

Prior to their involvement in BHPP, Kasese-based contractor Robtex has no qualified engineer and only around 10 regular contracted staff. Robtex took on around 150 labourers for the BHPP construction work and now employs 7 permanent technical staff and has around 150-200 contracted labourers. Robtex sources labourers locally to jobs so while some of the people used for BHPP may have had temporary work with Robtex since, many have not been employed throughout the post-construction period.

Table 9: Direct jobs in Construction Phase by Gender and Contract Type

Direct Jobs – Construction phase (March 2008 - October 2009)	Number of direct jobs created: 1,006 Person years: 922.42	Gender breakdown
		Female: Between 9-15%
		Male: Between 85-91%

Direct job creation during the operational phase

For the operational phase of the plant, a time horizon of 25 years is used to calculate work days created per year, based on the date the plant will be handed over to government control.

Direct job creation during the operational phase at BHPP is comprised of a management team, support staff (e.g. drivers), engineers and other technical staff. Canal maintenance, security and catering staff are contractors. Additional labour is sought on a contractual basis to deal with ad hoc manual labour requirements, such as repairing rainy season flood damage.

Since 2010, TPL has directly employed 22 permanent staff, 7 of whom were female (including the Plant Manager). A company called Askar provides security for the plant and its facilities, hiring 16 people (2012), all of whom are male. Another company called Mejaruda Enterprise

Ltd. supplies manual labourers to assist with maintaining the plant facilities and surrounding area, hiring 12 people of whom 5 are female. Ad hoc repair and maintenance work is contracted, estimated at 20 jobs per year for 3 months full time equivalent, comprising 15 men and 5 women. There are also 3 contracted catering staff at the plant, working part-time; a man and 2 women. The total number of permanent jobs from directly employed and contracted staff is 73, of whom 19 are female (26.03%).

Table 10: Direct Employment during Operation Phase

Company	Total Jobs	Male	Female	Jobs - Full time equivalent	Person Years*
TPL	22	15	7	22	550.00
Askar	16	16	0	16	400.00
Mejaruda Enterprise Ltd.	12	7	5	12	300.00
Casual labour	20	15	5	5	125.00
Catering	3	1	2	1.5	37.50
TOTAL	**73**	**54**	**19**	**56.5**	**1,412.50**

*Full time equivalent times 25 years operation period

Table 11: Direct jobs in Operational Phase by Gender and Contract Type

Direct Jobs – operation phase (2010-2034)	Number of direct jobs created: 73 Person years: 1,412.50	Gender breakdown	Contract type
		Female: 19	Directly employment, permanent: 22
		Male: 54	Contractor, temporary: 51

TPL staff have not only benefitted from jobs (and, based on 4 staff interviews, salary increases compared to previous positions), but they have also had both promotion opportunities, salary increases whilst employed at TPL and the opportunity to develop skills, particularly through technical skill sharing by TrønderEnergi, especially during their annual maintenance visit.

Table 12: Total Direct Employment

Direct Jobs – total	Number of direct jobs created: 1,079 Person years: 2,334.92 Gender: Between 9-15% female, 85-91% male Contract type: Almost 98% of jobs are on a short-term basis, either during the finite construction phase or because they are ad hoc (e.g. casual labour during operation phase)
	Displaced jobs: It is not possible to quantify direct jobs displaced by BHPP construction. However, some livelihoods in the construction area where adversely affected in the short-term because of resettlement. It is also possible that, due to skills increases, more skilled workers from outside the region are displaced, though the only evidence of this affects Norwegian TrønderEnergi staff who have trained local Ugandan TPL staff.

The study did not systematically collect data relating to the quality of direct jobs, such as length of employment, salaries, employment contract terms and conditions, recruitment policy and practice, training and development, unionisation or workplace norms (e.g. unpaid overtime). TPL is a relatively new company and the number of people employed there quite small, so presentation of job quality analysis would risk breaching personal and commercial confidentiality. Through interviews with informants in the direct job category employed by TPL, the study concluded that women and men hired by the plant appear to be satisfied with their jobs, evidenced by information volunteered to the study team about higher salaries at TPL than in previous employment and salary increases while at BHPP, by staff engaging in training programmes to deepen their responsibility levels, and perceived low staff turnover. Staff receive a nutritious daily lunch and are provided daily with free return transport by the company to their residences in Kasese town. In addition, the company employs a Health and Safety Officer and has a comprehensive CSR programme, suggesting that staff well-being and engagement are important to the business. The study concluded that TPL appears to be a company which seeks to offer good remuneration and working conditions to attract and retain staff, illustrated by TPL's recruitment of some key technical personnel from Hima Cement, at higher salaries.

Job quality factors were less well covered during interviews with contractors. No junior staff were interviewed and no information was collected about the salaries or working conditions of contractor companies. It can be noted that one contractor interviewed promoted hiring local staff and there is a reasonably high female to male ratio for unskilled manual labour. During the construction phase, the project provided additional value through the requirement to provide skills training for a proportion of the workforce. Information from informants suggests that this has helped people who were employed during the construction phase to gain higher-skilled employment subsequently.

Indirect jobs and displacement

Calculating indirect employment effects

Indirect employment effects are those created as a result of BHPP's existence – supplier jobs, jobs created as a result of spending in the economy from increased wages from direct jobs and supplier jobs, and jobs created in the electricity sector from the increased supply of electricity. The indirect jobs calculation is composed of:

- BHPP impact on supplier employment and supplier impact on wider economy
- CSR activities' impact on employment
- Indirect employment effect of BHPP jobs
- Electricity sector employment and impact on wider economy

The employment effects are calculated in three ways:

- Jobs created by BHPP expenditure with suppliers or in support of CSR activities, based on turnover[17] /expenditure to staff ratios (i.e. by increasing suppliers' turnover BHPP creates or sustains jobs).
- Jobs created by BHPP's need for services provided by the electricity sector (using statistics on generation to staff ratios, and BHPP's generation capacity as a proportion of national capacity).

17 Where sales figures are available this is more appropriate than turnover.

- Employment multipliers using estimates of additional disposable income (i.e. the impact of increased disposable income from jobs created as a result of BHPP), and consequent expenditure in the economy, and this expenditure in turn leading to job creation.

Annex 9.2 provides full details of the employment multiplier used for the study, which is generated using enterprise survey, household and macro-economic data to roughly estimate the employment effect from increased spend by skilled and unskilled workers. The enterprise survey and macro-economic data return different figures for manufacturing and service sector expenditure, hence a band is provided in the final calculations. Increased spend is either based on data provided about salary information and employee work patterns, or estimated using sector-level wage data. The wage data used as a proxy for additional income is the difference between average agricultural and manufacturing sector incomes (UBOS, 2009), which is 40,100 UGX/month (approximately USD$15.11).

BHPP impact on supplier employment and supplier impact on wider economy
Estimates of job creation from supplier purchase by TPL are made on the basis of assuming that the proportion of jobs created by TPL is the same proportion as the supplier's annual sales due to TPL purchases. This uses a crude assumption of direct correlation between turnover and job creation, which does not take into account productivity and salary increases or use of technology, and is thus likely to overstate the employment effects of BHPP.

As it was not possible to obtain information from all suppliers, a proxy is used based on information provided by the supplier of hardware equipment to the plant, Robtex. The method uses Robtex's annual turnover (for 2012) divided by total jobs at Robtex to provide a figure for the TPL spend needed to create/sustain one supplier job. This ratio (76,923,077 UGX to 1 job) is used across all of TPL's Ugandan supplier expenditure to estimate the employment effect. The final figures for jobs and person years, points 1 and 2 of Table 15, are based on 67.8% of the total 2011 O&M TPL expenditure figure (UGX 4,400,051,040), this proportion being the non-foreign origin supplies[18]. All 38.78 BHPP supplier jobs are categorised as unskilled for the purpose of the employment effect multiplier calculation, and the salary increase is estimated using the UBOS (2009) agriculture and manufacturing sector average wage differential detailed above.

CSR activities impact on employment
There are two levels of indirect employment effects from CSR activities – the first is the employment effect in organisations contracted to deliver CSR activities, the second are employment effects as a result of the CSR activities themselves. The latter is not quantified in the study.

The team has used data from NGO CDTS to calculate the first employment effect in organizations contracted or funded to deliver CSR activities. Based on actual 2012 and committed 2013 TPL funding to CDTS we can forecast expected TPL funding for CDTS throughout operation to be 15.92m UGX/year (see Table 13). With regard to jobs, in 2012 CDTS contracted 11 Full Time Equivalent (FTE) staff[19]; so using 2012 CDTS expenditure data one FTE job is generated per 5m UGX of spend. This means that an average of 3.18 jobs a year will be sustained by TPL, totalling 79.6 person years (Table 13).

Table 13: Breakdown of CDTS Job Creation Calculations

CDTS - Job calculations							
Total CDTS Spend 2012 (m UGX)	TPL Funding 2012 (m UGX)	TPL Funding 2013 (m UGX)	Estimated TPL funding rate average for operation period (m UGX)*	Total CDTS Jobs 2012	Total FTE jobs 2012	Average FTE jobs from TPL	Person Years

18 The remaining amount being Norwegian-sourced.
19 i.e. 22 people working for an average of 20 hours a week each.

55.00	38.00	15.00	15.92	22	11	3.18	79.60

*based on average of 1 year at 38m, 24 years at 15m

Using the 2013 CSR budget, about 68% of TPL expenditure, based on allocation categories, could result in indirect job creation (i.e. improving sanitation and support to CDTS) (Table 14. Excluding CDTS to avoid double counting, this TPL CSR expenditure could mean 2.4 jobs and 60 person years using the same calculation for job creation as for expenditure at CDTS. This is a rough estimate and likely to overstate employment effect the future nature and scale of CSR activities and spend could not be confirmed. See points 3 and 4 of Table 15.

Table 14: 2013 TPL CSR Budget

2013 CSR Budget (UGX, millions)	
Improving Sanitation in schools (construction of a three stance pit latrine at Bugoye primary school)	12.00*
Strengthening BHC III (Monthly Electricity Bills)	0.60
Contribution to Rwenzururu Kingdom	5.00
TCC Allowances	7.20
Support to CDTS	15.00*
TOTAL	**39.80**

*These activities are estimated to result in indirect job creation

The impact of CSR activities such as health and education provision have likely had positive effects on the productivity of the local work force, from reduced days lost to ill-health, and increased skills and likelihood of sourcing and creating income-generating opportunities. But there is no accurate way of calculating an estimate of job numbers based on the limited data available. There is also a possibility that CSR activities displace jobs, although there is no indication that the services provided by TPL-funded CSR activities would have been conducted in TPL's absence.

Second order job creation from CSR is estimated in points 5 and 6 of Table 15. This calculation is based on the salaries of CDTS's 16 skilled staff being considered as additional income (as this information is available). Salaries of the remaining 6 CDTS staff are not included in the multiplier calculation[20]. The total is 1,311,947 UGX/year.

For other CSR jobs (for improving sanitation in schools), UBOS (2009) wage data – the difference between average agricultural and manufacturing sector income figures is used to estimate additional income of 96,240 UGX/year, based on 2.4 jobs.

Indirect employment effect of BHPP jobs

This component seeks to capture the employment effect of increased direct job salaries at BHPP (staff and contractors). Based on 4 interviews with staff, all TPL employees had jobs before being recruited by TPL, and all those interviewed had received salary increases, equating to an estimated average increase in monthly salary of 225,000 UGX, and therefore an annual additional staff salary of 59,400,000 UGX (before tax) across TPL. This average salary increase is used to estimate additional income, to which the employment effect multiplier is applied. It should be noted that this income increase assumption is likely to overstate the

20 The 16 CDTS staff work 20 hours a week, supplementing this with other work, so it is assumed that without CDTS they would only have the other work. CDTS also uses 6 drivers, who it is assumed would supplement their income in the absence of CDTS, so no additional income is added for them.

contribution to the local economy, as increased income may lead to increased savings rather than expenditure. Based on education levels, all but 2 of BHPP's staff are categorised as skilled, while all 51 contractor jobs (see Table 10) are categorised as unskilled. The difference between average agricultural and manufacturing sector incomes, from UBOS (2009) wage data, is used to estimate additional income. See points 7 and 8 of Table 15.

BHPP undertakes annual maintenance in February, for 2 weeks. Fewer personnel from Norway visit each year for maintenance as they have been training local staff (3-4 people will come in 2013, up to 6 came in previous years: across the operational phase it might be estimated that an average of 2 staff will visit). However, these visitors stay in hotels in Kasese spending a likely 10m UGX in the local economy on accommodation and subsistence. Using World Travel and Tourism Council (WTTC) figures for 2012, this could equate to 0.94 jobs per year just for accommodation (WTTC, 2012)[21], point 9 of Table 15. Based on this 0.94 jobs, a multiplier effect of 0.03 jobs (0.75 person years) is calculated based on the same agricultural to manufacturing wage difference used above, and assuming the 0.94 jobs to be semi- or unskilled (see point 10 of Table 15). For the purposes of this particular study, the employment effect is obviously negligible, but the calculation is included to illustrate a possible methodology for other projects.

Electricity sector employment creation

Data are available to give a reasonably accurate number for jobs in electricity transmission and distribution in relation to total sales of electricity. There are limited data on changes as sales increase, although broadly speaking jobs increase proportionately slower than sales, meaning that the following figures overstate employment effect. Based on sales and employment figures from two electricity distributors for 2011 (one large – Umeme; one small - Ferdsult)[22], divided by BHPP sales figures, it can be estimated that 54.62 jobs are created and/or sustained for distributors by BHPP. A proportional average of Umeme and Ferdsult figures is used; Ferdsult employs a far higher number of staff per MWH distributed so this method potentially slightly understates jobs as the remaining distribution in Uganda, albeit a fraction of total distribution, is through small distributors like Ferdsult. UETCL is the sole transmission body in Uganda, it employs 521 people, so based on BHPP supplying 2% of electricity transmitted by UETCL, this equates to a maximum of 10.42 jobs. So, the total jobs created by BHPP in the electricity sector are 65.04.

To estimate the additional income from these jobs in order to calculate an employment multiplier effect, the UBOS 2009 agricultural labour to manufacturing labour earnings differential is used (total 31,299,074 UGX/year.) At UETCL in 2013, 37.35% of jobs were unskilled, so this proportion has been used across job creation in the electricity sector (i.e. 40.75 skilled jobs giving 19,609,058.62 UGX/year, and 24.29 unskilled jobs giving 11,690,016 UGX/year). See points 11 and 12 of Table 15.

Table 15: Indirect Employment Effect

Source of indirect employment effect	Jobs	Person Years	Additional Expenditure Estimates (UGX)*
1. BHPP Supplier jobs	38.78	969.55	18,660,936/year
2. BHPP Supplier multiplier effects	13.92 - 14.79	347.65 - 369.72	
3. CSR Activities – CDTS jobs	3.32	82.92	1,910,575/year
4. Other CSR first order jobs	2.40	60.00	96,240/year

21 1.9tn UGX spent in 2012, 522,500 jobs (direct and indirect) in tourism nationally, giving 1 job per 3.7m UGX spent. A hotel in Kasese is approximately 125,000 UGX/night so 3 people for 14 nights equates, very roughly, to 1.4 jobs.
22 Umeme – 2011 figures were 1,139.75 jobs and 1,731,976 MWh sales; Ferdsult had 36 staff, 9,512MW sales for the same period.

5. CSR job multiplier effects	1.02 - 1.16	25.54 - 28.90	
6. CSR activity effects	Difficult to quantify – include increased standards of health and education, higher productivity levels over time		
7. BHPP jobs multiplier effects (TPL, skilled jobs)	29.53 - 33.57	738.34 - 839.32	59,400,000/year
8. BHPP jobs multiplier effects (contractors, un/semi-skilled jobs)	18.29 - 19.45	457.20 - 486.22	24,541,200/year
9. Expat staff spend in local economy	0.93	23.25	37,694/year
10. Expat staff spending multiplier effect (unskilled)	0.03	0.70 - 0.75	
11. Electricity sector jobs (skilled and unskilled jobs)	65.04	1,626.10	31,299,074/year
12. Electricity sector job multiplier effects	18.46 - 20.35	461.53 - 508.68	
TOTAL	**191.28 – 199.34**	**4,782.02 – 4,983.63**	

*This is the total value of additional income through jobs created indirectly by BHPP, to which the employment multiplier is applied.

No information was collected about the quality of indirect jobs within the supply chain, and it is not possible to assess the quality of jobs estimated through multiplier effects. Some information is available about the quality of indirect jobs created or supported through CSR. Staff employed by CDTS work on flexible hour arrangements to allow them to fit in additional work or work that had previously been their sole source of income. CDTS is also supporting its staff to seek subsequent jobs beyond CDTS as part of a non-formalised approach to staff development.

Displaced jobs

Displaced job are very limited due to high unemployment in the region and the limited uptake of power locally. In relation to production, possible national impacts might be on kerosene and diesel sellers, as well as suppliers of generators. However, total kerosene and diesel consumption in Uganda increased between 2008 and 2011, and there is no evidence of a job displacement impact at present. Kerosene is bought from power plants and resold – those furthest away are likely to pay most so there is greatest benefit from electricity in most remote areas.

5.2 Category 2 Jobs

Induced job creation

Induced employment effects were defined by the terms of reference as

- Effects of more, cheaper and better quality electricity supply on the survival and growth of firms (e.g. reduced power outages) and hence firm employment through reduced costs of energy service, more reliable energy services (especially locally) and less pollution (the productivity effects can subsequently be translated into employment effects).
- Effects of more, cheaper and better quality electricity supply on households in terms of less expenditure on energy services (compared to the alternative), which would allow for (i) spending on other activities which has employment effects; (ii) starting new employment generating activities by households; and (iii) providing households with time for important activities.

- Effects on job creation through a better macro-environment brought about by (i) demonstration effects of the BHPP on similar projects (as well as providing more economies of scope); (ii) fiscal space through reduced fuel subsidies, increased tax receipts and better macro-economic stance (e.g. reduced fuel imports; higher GDP growth).

The study, therefore, proceeded to assess induced employment from BHPP in accordance with the approach shown in Table 6. In practical terms, for this study, the induced employment effects of electricity supplied to firms and households are through two main routes, improved reliability of electricity and increase in the overall quantity of electricity supplied. The effects of improved reliability were estimated through the effect of reduced outages on production by firms and households.

Induced employment at the firm level

At the time of 2005 Enterprise Survey the great majority of firms reported being affected by outages almost three times a week, for periods of 10-11 hours on average (Table 16). The ERA survey of the impact of electricity on industry (2006) found a similar frequency and duration of outages, 70% of which were due to load shedding and 30% to technical faults. Annually this level of outages amounts to around 1,400 hours without grid power. In 2010, ERA reported a total of 3,549 hours lost to load shedding and in the first three quarters of 2011 outages totalled 1,226 hours (equivalent to 1,635 hours a year).

Table 16: Summary of Outages experienced by Firms in the 2005 Enterprise Survey

	Manufacturing	Retail & IT Services	Other Services	Micro-enterprises
% reporting outages	94%	95%	97%	88%
No. outages per month	11	12	11	11
Mean duration of outage (hours)	11	10	10	11

To calculate induced employment, first, a **production function** from national Enterprise Survey data was estimated[23] which allowed assessment of the effect on output (sales) of reduced outages, distinguishing between manufacturing firms, service sector firms and microenterprises. This followed the approach adopted by Arnold et al. (2006), running a regression of log sales on log inputs (capital and labour) and on a set of characteristics that might affect productivity (e.g. industry indicators, export status, foreign ownership). Most importantly for this study, this included an indicator of self-reported average outages per day at the firm level. The coefficient associated with outages was then used to estimate how a reduction in outages affects sales. A similar regression of sales per worker on the measure of outages was also run, to estimate how labour productivity might change after an improvement in the reliability of electricity provision. This regression provides an estimate of how much sales per worker in an average firm would change in response to changes in outages. This regression, together with the self-reported loss in sales per firm, allowed estimation of the employment effect. For example, if a firm reports high sale losses, we calculated, using average sales per worker, the number of employees that the firm would hire to match the extra expected sales following a reduction in outages. See Annex 9.3 for further details.

23 The sample size was too small to allow estimation of separate production functions for enterprises at sub-national (e.g. Kasese District) or sectoral level. See Annex 9.3 for details about the survey data.

Hima Cement

Hima Cement is a Ugandan subsidiary of the Lafarge group with a factory near Kasese, producing 780,000 tons of cement in 2012. About 2 years ago, Hima doubled capacity in response to extremely high levels of national demand. Employment also increased to around 300 direct staff, plus about 500 contractors. 90% of contractors are local to the area, compared to only about 50% of staff. The plant Electricity Manager confirmed that since BHPP has been operating in Island Mode, Hima have benefitted from fewer outages and voltage fluctuations, although they still reported 500 stoppages last year due to interruptions in power supply. Fluctuations are almost as big a problem as outages, and the main motor at the plant was lost for this reason in December 2012. Hima is almost the exclusive recipient of Island Mode power, yet power supplied during island mode does not always cover the plants entire energy needs – it is still dependent on diesel generators. 70% of a cement plant's expenses are fuel and electricity, and at 3.4bn UGX Hima's monthly energy bill represents 8% of Umeme's total sales.

For **manufacturing** firms, the main consumers of electricity in Uganda, a reduction in outages of 4 hours a day would increase total sales by between 2 and 12% (depending on the control variables included in different regressions). This is consistent with the self-reported losses declared by firms, with around 75% of manufacturing firms declaring losses between 0 and 12%. On average, the increase in sales would result in a 3.5% increase in employment in the manufacturing sector. This employment effect is experienced in 25% of manufacturing firms. Since nationally, manufacturing firms (with 5 or more employees) employ 140,000 people (25% women) (COBE), an increase of 3.5% due to reduced outages, would imply a total of 4,900 additional manufacturing jobs.

In the **services** sector the effect of reducing outages by 3 hours a day (the mean) would be an increase in sales per worker between 7% and 16%. Losses from outages greater than this were reported by 21.5% of firms in the Enterprise Survey. The average firm in the services sector therefore would increase employment by between 2.7% and 5.0%. This amounts to an increase in employment nationally by between 21,416 and 39,660.[24]

Analysis of Enterprise Survey data for **microenterprises** suggests that a reduction in outages may not have a significant effect on sales per worker. However, the mean estimate of the effect on total factor productivity suggests an impact of around 8%, or 0.3 jobs for the average microenterprise. Nationally this suggests an increase of 58,000 jobs (based on the number of firms estimated in the COBE).[25]

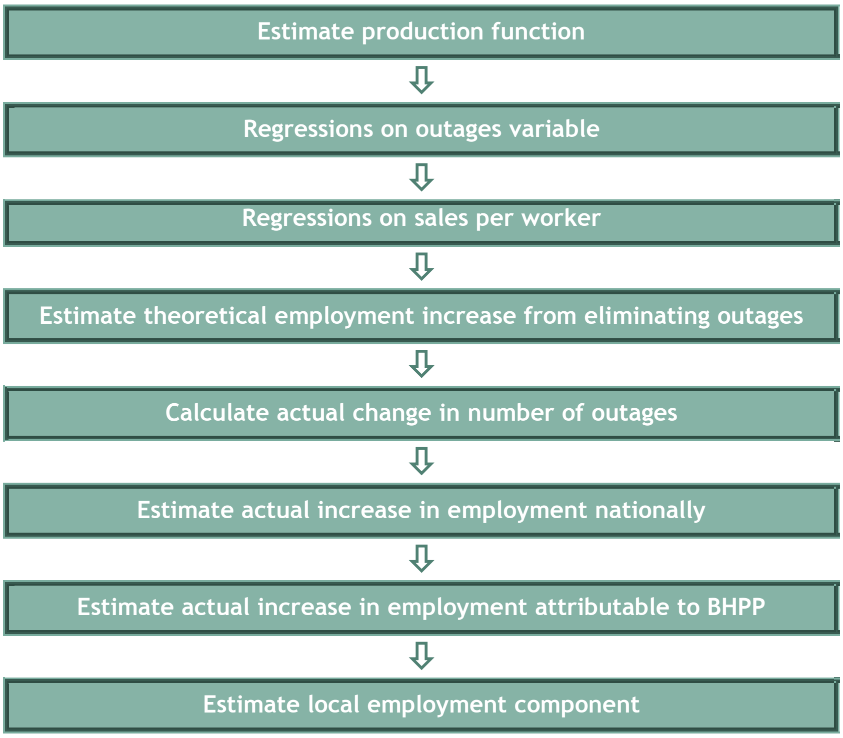
24 Based on figures from the COBE (trade, transport and storage, accommodation and food services, information and communications, finance, real estate and recreation and personal services. Total employment 793,203 (49% women).
25 Microenterprise data is less reliable than for larger firms because the standard surveys do not cover them well.

Table 17: Summary of Employment Effect of Reduced Outages

	Manufacturing	Services	Microenterprises
Hours per day reduced outages	4	3	3
Average increase in sales/ worker	12.0%	7.0-16.0%	0.0%
Percentage increase in total number of jobs	3.5%	2.7% - 5.0%	9.0%
Increase in total number of jobs	4,900	21,416-39,660	58,000
Job creation in person years (over lifetime of BHPP)	82,500	200,000 – 375,000	1,450,000

Having shown that there is a **theoretical positive impact on employment from a more reliable power supply** (i.e. reduced outages), the study then considered whether there have indeed been reduced outages since BHPP came into operation and how much of this could be attributed to BHPP. The steps followed for this are summarised in Figure 3.

Figure 3: Steps to Estimating BHPP's Induced Employment Effect



Informants in Kasese District reported a reduced number of outages, because a local mini-grid served by the Nkenda sub-station is operated when the national grid goes down. Island mode operation was in use 59 times for a total of only 391 hours during the period from October 2010, i.e. 2% of total operating time.

UETCL data on outages at the Nkenda sub-station suggest that there **has been little significant change in interruptions since 2009**. Load-shedding outages at Nkenda, increased between 2009 and 2010, and between 2010 and 2011, but fell between 2011 and 2012. However, there has been little improvement in the number of technical faults. The 3 or 4 hour reduction assumed in the analysis above is equivalent to completely eliminating outages. Load-shedding outages decreased in number by 75% between 2011 and 2012, but were not completely eliminated, and outages due to faults and maintenance remained unchanged.

Overall the load lost in 2012 was 55% of the load lost in 2011, so the effects of outages on production were reduced by approximately half. In other words, the maximum employment effect from reduced outages would be no more than half of the 3.5% increase estimated econometrically assuming zero outages (i.e. 2,450 jobs in manufacturing, 2,144 – 3,966 in services and 29,000 in microenterprises).

Table 18: Outages at Nkenda Sub-station 2009-2012

	2009		2010		2011		2012	
Cause	**Number of times**	**Load lost**	**Number of times**	**Load lost**	**Number of times**	**Load lost**	**Number of times**	**Load lost**
Day Load-shedding	0	0.0	2	72.0	5	261.0	8	323.0
Emergency Load-shedding	4	367.0	5	123.0	11	811.0	0	0.0
Evening Load-shedding	3	85.0	7	174.0	44	3,106.0	9	348.0
Faults	108	2,926.2	153	4,278.0	206	9,316.1	201	5,457.4
Shutdown Emergency	5	225.0	2	60.0	0	0.0	4	33.6
Shutdown Maintenance	125	2,892.5	82	1,586.1	88	3,049.2	126	3,061.8
Under-Frequency Load-shedding	3	0.0	3	6.0	5	194.0	0	0.0
Constrained hydrology	1	102.0	0	0.0	0	0.0	0	0.0
Sectionalise	0	0.0	0	0.0	2	0.0	1	42.0
Other	0	0.0	0	0.0	4	112.0	0	0.0
TOTAL	**249**	**6,597.7**	**254**	**6,239.1**	**365**	**16,849.3**	**317**	**9,265.8**

Source: UETCL Interruption Database 2009-2012.

How much of this increase from reduced outages can be attributed to BHPP?

BHPP contributed 13.5% of the increase in total generating capacity during the period from September 2009 to mid-2012.[26] BHPP contributed 25% of the additional power purchased by UETCL between 2009 and 2011.[27] The overall number of (Umeme) consumers increased by 41.3% between September 2009 and June 2012. Proportionally the largest increase was amongst large industrial consumers. Average consumption by large industrial consumers was 580.38 MWh per quarter in mid-2012, 23% lower than in September 2009. Taking the mid-2012 level of consumption, the total additional consumption from these new large industrial consumers was 114,433 MWh per quarter. BHPP's annual output is equivalent to around 20% of this.

26 Total installed generating capacity increased by almost 96 MW between 2009 and mid 2012 (when Bujagali at 100 MW).
27 Purchases by UETCL increased by 358 GWh between 2009 and 2011. Total additional power purchased was 643.9 GWh.

So, nationally, BHPP's employment impact through reliability route could amount to approximately 20% of the total from reduced outages (i.e. 490 jobs in manufacturing, 2,144-3,966 in services and 5,800 in microenterprises). (See Table 19 below.)

The local employment effect in Kasese District was also assessed, because during island mode operation power continues to be supplied when there is an outage on the national grid. With the reasonable assumption that the effective elimination of lengthy outages in the District, reported by informants there, would be due largely to BHPP and the whole of any local employment effect from operation in island mode could reasonably be attributed to BHPP.[28] To estimate the local employment effect from the elimination of outages in the District,[29] the same coefficients as for national figures were assumed, and (formal) employment in Kasese District (16,174 according to COBE) was assumed to be in the same sectoral proportions (i.e. industry and services) as for the Western Region. Applying the same percentage employment effect from reduced outages at national level to Kasese District, the reduction of outages leads to the notional creation of 74 manufacturing jobs and between 351 and 649 service jobs (mostly trade) in the District.[30] (Microenterprise data for the District are unavailable, though the UNDP baseline report suggested that few households in Bugoye have a home-based enterprise.)

This estimate for a local induced employment effect should be regarded as an over-estimate, however, and needs to be treated with some caution. Island mode operation has been quite limited[31] and outages due to faults have continued at previous levels. It was not possible, therefore, to estimate a local employment effect based on an assumption that all of BHPP's power is consumed locally for significant periods of time. Moreover, we know that 90% of the power consumed in the District goes to only 6 large industrial consumers, which suggests that the national coefficients may not apply to the District. The employment levels of the 6 large industrial consumers are determined more by factors other than outages.[32]

For new commercial and industrial consumers there are likely to be second order employment effects resulting from reduced energy costs. Similarly, existing consumers who no longer need to use stand-by generators will have lower energy costs, which can have a second order employment effect. For BHPP, the main source of this kind of induced employment effect is from reduced expenditure on diesel by large industrial consumers, the total savings being estimated at US$ 162,419 in 2012.[33] Using the approximation of a multiplier developed by the study (see Annex 9.2), this level of cost savings could lead to a maximum of 14,550 jobs.

Table 19: Summary of Notional Employment Effect of Reduced Outages in Kasese District

	Manufacturing	Services	Microenterprises
Hours per day reduced outages	4	3	3
Percentage increase in total number of jobs	3.5%	2.7% - 5.0%	9.0%
Number of jobs in Kasese District (COBE) (16,174 total)	2,128	12,988	n/a
Increase in total number of jobs in Kasese District	74	351-649	n/a

28 Mubuku I, Mubuku III and, more recently, Mpanga all supply power during island mode. However, BHPP has the largest capacity and island mode was only introduced because of BHPP.
29 Though informants reported their perception that there had been an effective elimination of outages, the data from UETCL suggest that this was not the case.
30 Island mode operation also includes the Fort Portal area, so these figures are underestimates of the total.
31 Power supply during island mode operation accounted for about 1% of the total power supplied by BHPP, and island mode was used for 2% of total operating time.
32 Interviews with 2 of these companies, Hima Cement and Kasese Cobalt Company, revealed that BHPP has had virtually no impact in their numbers of employees.
33 The saving per unit of power (kWh) consumed is the difference between the tariff for large industrial consumers (US$0.127/kWh (Umeme)) and the cost of electricity generated by a small diesel generator (US$0.30/kWh). Assuming all of the power produced by BHPP provides a saving, the total value of savings in 2012 was US$162,419.

Induced employment at the household level

There is no evidence that an increase in the availability of power for domestic consumers will have a noticeable employment effect. The average consumption of domestic consumers is too low for productive uses. Analysis of the household survey suggests that in households with electricity, non-head members of the family are less likely to be in employment.

The employment effects of reduced outages or improved electricity access on household productivity are more difficult to assess than for enterprises. Around 13% of households have access to electrified power and those households are systematically different from non-electrified households. For example, electrified households are more likely to have greater levels of expenditure and are less likely to be poor. They also spend more on durable goods (in absolute terms and as a share of expenditure). These systematic differences do not allow inference of how access to electricity changes employment outcomes. Note, for example, that in electrified households, employment among non-heads is very low, a result not likely to be explained by access to electricity.

In addition, the quantity of electricity consumed by average household is quite low, and unlikely to allow use for productive activities. This is reinforced by findings that the number of households in Kasese with microenterprise activity is low (Byamugisha, 2006). Though there may be some second order employment effects from existing consumers of electricity reducing expenditure on energy (e.g. kerosene), including for the few who have generators, the data do not permit second order effects to be estimated.

The employment effect of an increased power supply and consumption of the additional electricity available can only be estimated when the relationship between power consumption and employment has been established econometrically. This is not possible with the data currently available for Uganda. With aggregate time series only for some years it is difficult to establish causal effects. For example, the demand for electricity and for labour would move together if the economy is growing, for reasons unrelated to the performance of the electricity sector. Higher employment might be made possible by the availability of electricity, and it might increase the level of demand for electricity. The causal relationship between employment and electricity supply is difficult to determine even with good time series data. Access to more disaggregated data on the electrification of regions or firms over time would be more suitable, even though causal relations could only be uncovered if exogenous sources of electrification can be found.

Table 20: Summary of Induced Employment Effect

	Manufacturing	Services	Microenterprises
Hours per day reduced outages	4	3	3
Percentage increase in total number of jobs	3.5%	2.7% - 5.0%	9.0%
Theoretical maximum increase in jobs	4,900	21,416 – 39,660	58,000
Actual maximum increase in jobs	2,450	10,718 – 19,830	29,000
Increase in number of jobs attributable to BHPP	490	2,144 – 3,966	5,800
Person years from jobs attributable to BHPP	**12,250**	**53,600 – 99,150**	**145,000**

6 Wider effects

6.1 Quantity of power

BHPP supplied 240,536 MWh to the grid between September 2009 and the end of 2012. Over the period to mid-2012,[34] BHPP provided an average of 2.9% of the total power supplied to the grid.

The total quantity of power supplied to the grid increased from 194,179 MWh a month in the last quarter of 2009 to 233,827 MWh a month by June 2012, an average of 1.6% per month over this period.[35] Taking September 2009 as the base, the additional power supplied during this period totalled 417,283 MWh, with BHPP accounting for 46% of this additional power.[36]

The contribution of BHPP to the national supply can also be considered in terms of the increase in overall generating capacity. In 2009 total installed generating capacity was 492 MW. By mid-2012 (before Bujagali became fully operational) this had increased to 635 MW, a 29% increase. The rated capacity at BHPP is 13 MW, equivalent to 9% of this increase in capacity. However, in 2010 and 2011 BHPP accounted for a larger proportion of the capacity added since 2009 (30.0% and 17.6%, respectively).

6.2 Reliability of power

According to data provided by UETCL the number of interruptions to the power supply across the country increased between 2009 and 2012, from an average of 40 per day to 75 per day. Faults and shutdowns for maintenance were together the cause of a little over 70% of these interruptions. This compares with the findings of an ERA study in 2006 which found that 70% of outages were due to load shedding. BHPP, by adding to generation capacity and helping to increase the total amount of power generated, might have some effect on load shedding, but it has little effect on the frequency of faults or maintenance requirements across the grid.

The introduction of island mode operation in 2010, allowing the operation of a mini-grid for the Kasese and Fort Portal areas when the national grid is down, has improved reliability in these areas. Since October 2010, 'island mode' operation has been used 59 times, for an average of 7.4 hours.[37] In 2012, this amounted to a total of 167 hours or 2% of operating time, suggesting the gain in reliability through island mode is outweighed by continuing interruptions due to faults and network maintenance. Any benefit in increased reliability from island mode operation goes mainly to Hima Cement and the other large industrial consumers.

6.3 Quality of power

Voltage fluctuations are a significant problem for large industrial consumers, particularly those operating a continuous process, such as Hima Cement. The repeated stopping and starting, when fuses or machinery trip, causes losses in production and damage to equipment. These interruptions to the power supply are caused mainly by faults in the Transmission and Distribution (T&D) system, and highlight the importance of investment in T&D as well as generation to deliver reliable electricity services.

34 Though we have BHPP output to the end of 2012, the total for Uganda is available only to the end of June 2012.
35 This average monthly rate of increase disguises fluctuations and should not be interpreted as a steady increase.
36 Extending the period of analysis to December 2012 when the data become available would likely reduce the proportion of additional power which has been supplied by BHPP because the Bujagali plant became fully operational during the second half of 2012.
37 Based on data provided by TronderPower Ltd.

6.4 Electricity prices

The price consumers pay for electricity is determined by the ERA, in principle, following public consultation. BHPP makes a marginal difference to average costs of generation and has no demonstrable effect on consumer prices.

Approximately 70% of the tariff covers generation and 30% transmission and distribution (Umeme data). Except for those who consume very small amounts of electricity (for which the tariff is UGX 100/unit for the first 15 units), these tariffs have increased substantially since BHPP came into operation. In January 2012, tariffs increased by an average of 42%, and the tariff for large industrial consumers increasing by 69%. Tariffs are due to increase again in 2013 with the intention to eliminate the subsidy to consumers. Though tariff increases may affect the consumption of individual consumers, there continues to be an increase in overall consumption nationally.

Prices paid to generators by the transmission company, UETCL, are set through power purchase agreements which reflect the particular circumstances of each generator company. The price currently received by BHPP, at US$ 0.144/kWh (TronderPower Financial Report, October 2012), is lower than the US$ 0.24/kWh cost of power from thermal generators, but higher than some other hydropower producers (US$ 0.09/kWh for Mpanga and US$ 0.03 for Eskom) and higher than the published Feed-in-Tariff for hydropower schemes of this size (US$ 0.079). The costs of financing, including risk reduction factors, account in part for actual prices in PPAs varying from the published tariffs.

6.5 Access to electricity

The total number of electricity consumers nationally increased by 145,687 over the three years since September 2009.[38] Proportionally, the largest increase was amongst large scale industrial consumers (see Table 21). Household (domestic) connections during this period have totalled 130,241, and overall access to electricity has reached 12% of households (5% in rural areas) in Uganda. BHPP has had no direct effect on the number of consumers, nationally or locally, as its operations are confined to power generation only.

Table 21: Number of Electricity Consumers 2009-2012

	2009	2010	2011	2012	% change
Consumer Category	Q4	Q3	Q3	Q3	2009-12
Domestic	292,348	338,491	406,112	422,595	44.6%
Commercial	23,654	27,968	35,263	37,991	60.6%
Medium Industrial	983	1,120	1,591	1,853	88.5%
Large Industrial	200	287	359	349	74.5%
Street Lights	209	182	328	293	40.2%
Total	**317,394**	**368,048**	**443,653**	**463,081**	**45.9%**

Source: Umeme Ltd.

In Kasese District, Umeme has a total of 7,726 customers and Kilembe Investments (KIL) a further 1,700. In Bugoye sub-county (served by KIL from Ibanda) there are 134 consumers in total. However, 90% of the power consumed in Kasese District is consumed by 4 large industrial consumers (including Hima Cement).

A key determinant of access to electricity is its physical availability through a distribution line. The REA is currently building a line from Bugoye to Nyakalegija to supplement the existing line

38 These figures are for Umeme consumers, which account for 97% of the total.

from Ibanda (Mubuku I). TPL has contributed to the capital cost of the new line, which will allow new connections in the Bugoye sub-county.

The cost of a connection and the tariff are the main factors influencing a household decision to have an electricity supply. Unsubsidised, these costs[39] are likely to prevent access for most families.

6.6 Household expenditure

As a consequence of BHPP having no effect on tariffs we conclude that there has been no effect on household expenditure by existing domestic consumers of electricity, nationally and locally. Similarly, the absence of any effect on the number of connections suggests that, though households report savings in expenditure on energy when they acquire a connection, these savings cannot be attributed to BHPP.

6.7 Firm expenditure

As with households, the absence of an effect from BHPP on tariffs for commercial and industrial electricity consumers suggests no material effect on overall expenditure by firms nationally. In Kasese and Kabarole, where island mode operation has reportedly reduced outages, the reduction in use of diesel stand-by generators reduces the costs of electricity by the difference between the tariff and the cost of diesel-powered electricity, i.e. US$ 0.173/kWh.[40] For the total quantity of power supplied by BHPP during 2012, this amounts to an estimated total saving for the year of US$ 162,419. These savings accrued to Hima Cement and the other large industrial consumers in the District, but they have had negligible effect on employment (despite a theoretical effect noted in section 5.2).

6.8 Government revenue and expenditure

The effect of BHPP on government revenue derives from the annual licence fee for operating the plant (US$ 20,000), income from VAT charged on the power sold, and income from the CERs which are due as a result of CDM registration. An approximate estimate of the VAT revenue (18% on sales) is US$ 2 million a year.[41]

The Government is entitled to 60% of the revenue from sale of validated CERs generated by the project. The PDD estimated emission savings at 54,349 t CO_2 per annum, though the first monitoring report recorded 50,385 t CO_2. As well as variation in emission savings there is variation in the price of CERs, which is currently below US$ 1.00/tonne. This suggests that the total revenue to Government of Uganda (GoU) from this source is unlikely to be higher than US$ 30,000 a year.

As mentioned above, the Government has been subsidising electricity consumers since 2006. Power from the large diesel thermal generators cost US$ 0.24-0.29/kWh. Taking the difference between these costs and the 2012 tariff for large industrial consumers, multiplied by the total MWh actually supplied by BHPP, we can obtain an approximation of the subsidy theoretically avoided through the availability of electricity from BHPP: US$ 27-39 million in total or US$ 9-13 million a year.[42]

It has not been possible for the study to estimate the induced (net) employment creation effect of these changes in government revenue and expenditure. To do so requires data on the employment effects of government expenditure generally (e.g. through I:O tables). Use of the

39 Kilembe Investments can no longer provide subsidised connections and will now charge UGX 450,000 (US$167).
40 The Umeme tariff for large industrial consumers is US$ 0.127/kWh and the cost of diesel-powered electricity from a small generator is estimated at around US$ 0.30/kWh.
41 This estimate is based on 18% of BHPP revenue from sales. The actual net figure received by GoU depends on consumption by different consumers.
42 A more precise estimate would take account of changes in tariffs over this period and differences in tariffs between consumer categories.

study's rough multiplier (Annex 6.2) would be inappropriate as this is based on household expenditure patterns.

7 Conclusions

7.1 Bugoye Hydro Power Project Findings

Significance of EAIF in financing the project

EAIF was the only source of debt finance for the project, providing 49.8% of the total invested. The project's completion and commissioning would have been significantly delayed mid-construction, had this loan not been approved. Confidence on the part of the two investors (TrønderEnergi and Norfund) that EAIF's loan would eventually be approved allowed Norfund to pre-finance the construction. Although they felt that the transaction costs to secure the loan were high and resulted in a lengthy process, it is by no means certain that these would be any lower with another lender, had there been an alternative in prospect. EAIF's involvement has not only been critical for implementation of BHPP, but key stakeholders view their involvement as having added to its quality.

Effects on the power supply

BHPP has a small and quite limited impact on national power supply, generating 2-3% of the country's electricity. Generation is affected by variations in water levels, and has seasonal peaks and lows. The project's contribution to reducing the gap between peak demand and generation capacity has been more significant than this, but with the commissioning of Bujagali (250 MW) in 2012, the proportional contribution of BHPP to the grid has now reduced. Locally, in the Kasese and Fort Portal areas, it was reported that there has been a more significant effect because of operation in island mode when the national grid goes down. Island mode operation mainly benefits a handful of large industrial consumers, especially Hima Cement. However, there is a negative effect on power output from Mubuku III (KCCL) when the national grid fails, due to interruption in water flow in the Mubuku River when BHPP's turbines stop.[43]

BHPP has no impact on consumer prices of electricity, because consumer tariffs are set centrally. The plant accounts for a small proportion of total purchases by UETCL, and does not materially affect their average purchase price. However, the price negotiated in the Power Purchase Agreement is higher than for other small hydro power schemes and the published Feed in Tariff.

BHPP has no real effect on the level of transmission and distribution faults nationally. These remain a significant cause of outages even if load shedding is eliminated, and reflect under-investment and maintenance of the T&D infrastructure.

Voltage fluctuations are perceived as a significant problem nationally by industrial consumers, who consume around 50% of Uganda's electricity. BHPP and other small hydro plants contribute to stabilising the grid, but have had limited effect on voltage fluctuations.

Employment effects

The estimated total employment effect of BHPP is between 9,704 and 11,534 jobs (depending on assumptions). Over the 25-year life of the project this amounts to between 217,967 and 263,718 person years of employment. Significantly more jobs are created through the effects of improved reliability of electricity supply than directly or indirectly from the construction and operation of the plant. This finding is consistent with similar estimates by the IFC (IFC, 2013).

43 Interview with KCCL. Reportedly US$ 1.5 million lost over 18 months.

Table 22: Employment Creation Effects

Effect	Result	
Category 1 jobs (construction and operation phases)		
	Jobs	**Person years**
Direct	1,079 jobs	2,335
Indirect	191 – 199 jobs	4,782 – 4,983
Total	**1,270 – 1,278**	**7,128 – 7, 318**
Category 2 jobs (created as result of more/better power supply)		
	Jobs	**Person years**
Induced	8,434 – 10,256	210,850 - 256,400
Total		
GRAND TOTAL	**9,704 – 11,534**	**217,967 - 263,718**

The methodology for comprehensive estimation of employment effects was constrained by a lack of data. In particular, the lack of Input-Output tables for Uganda, which are being produced in 2013, but not in time for this study, limited the study's ability to estimate second and further order employment effects. An Input-Output matrix would allow for a more reliable estimation of how additional electricity might affect total production per sector and, ultimately, employment. Direct employment effects were relatively straightforward to calculate, although consistent information for contractors was more of a challenge to obtain.

Wider effects

Government expenditure and revenue: BHPP generates revenue for the Ugandan government through (a) an annual licence fee ($20,000), (b) payment of VAT on power sales to UETCL, and (c) sales of CERs (60% of the income received). Annually this amounts to a little over US$ 2 million a year, predominantly from VAT revenue.

By adding to the total power generated, BHPP might be considered as contributing to reducing the requirement to pay subsidies to thermal power generators. The value of subsidies theoretically avoided is estimated to have been US$ 9-13 million a year (depending on the price of diesel). However, the effect is hypothetical as peak demand remained above capacity for the first two and a half years of BHPP's operation, and additional capacity from Bujagali (250 MW) now dwarfs BHPP's (14 MW) contribution. Government measures to reduce the subsidy burden, through higher consumer tariffs, have been the main reason for lower subsidy expenditure and any benefit from BHPP has been overtaken by a policy not to subsidise generation costs.

Expenditure by firms

Industrial consumers in the Kasese and Fort Portal areas have been able to reduce diesel consumption for stand-by generators during island mode operation. During island mode operation (from October 2010 to December 2012) 2,509 MWh were supplied by BHPP, equivalent to estimated total savings in 2012 of US$ 162,419.

Household expenditure

BHPP has had no real effect on household expenditure on energy. The project has not affected electricity prices, which have increased substantially since the plant began operating (with the exception of the lifeline tariff). We cannot attribute any new connections directly to BHPP, which could result in savings on household energy expenditure.

Demonstration effects

The project offers two areas of demonstration effect. First, with regard to the plant, it is the first commercial private sector Independent Power Producer (IPP) in Uganda. The combination of financial and technical stakeholders presents a potential model for bringing such projects to completion.

Secondly, the project's emphasis on high standards of social and environmental responsibility, and in particular its implementation approach, combining effective communications and participation by the local community, are already being looked to in Uganda as a model for other development projects. The institutions established to facilitate community participation and liaison were novel to the area, but have proven very effective.

7.2 Implications for assessing job creation

To understand the job creation impact of the infrastructure investments it supports, the PIDG requires a cost-effective approach to the assessment of direct, indirect, induced and displaced jobs resulting from these investments. Such an assessment might be needed at project appraisal and after implementation. The BHPP study has attempted the latter and offers some lessons for how job creation assessments on other energy projects might be undertaken in the future.

The model for this study has been the IFC methodology, particularly as applied in India on the Powerlinks Transmission Project. This used a combination of Input Output (I:O) models, econometric analysis of time series data and a step by step estimation model on survey data. Bacon and Kojima (2011) note that surveys undertaken specifically for assessment of indirect and induced job creation would be prohibitively expensive, and I:O models offer an alternative, where they are available. In practice, as with the Powerlinks project, a combination of methods will be needed.

A key limitation of the BHPP study has been the absence of reasonable quality and up-to-date I:O tables. This has prevented estimation of employment multipliers, as was done for the Powerlinks project. The IFC (2012) found from a review of 35 studies that employment multipliers of energy projects are usually quite large and that the combined level of indirect and induced employment for an energy project is likely to be larger than the direct employment.

Limitations of the BHPP study also derive from the limitations of the Enterprise Survey data that are available for Uganda. Firstly, the size of the sample (563 enterprises) was too small to allow econometric analysis below national level (e.g. at district and sectoral level). Secondly, enterprise survey data for Uganda covers small, medium and large enterprises, but has limited coverage of micro- and informal sector enterprises. The Census of Business Establishments (COBE) 2010/11, for example, covers formal businesses employing 1.45 million people out of a labour force of over 11 million, and estimates 36-40% to be in formal employment.

A third limitation of this study is that it was unable to assess the long-term employment effects of changes in the quality of employment and the skills of workers which were due to BHPP. For example, during the construction phase a significant number of people were provided with skills training, which potentially improved their long-term employment prospects. However, the numbers involved and the lack of recorded information prevent statistical analysis of the effects of these qualitative improvements.

In the light of these limitations, which are likely to be experienced in most low income countries, we can conclude from the BHPP study that assessment of direct and indirect first order employment impacts will be relatively straightforward for most projects. Information about direct employment can be obtained from the generating, transmission and/or distribution company (or companies) involved. Indirect employment information can be obtained from the same companies and from their main suppliers. Information to assess indirect employment effects in the electricity sector can be obtained from the key institutions (e.g. the regulator). For most renewable energy projects there will be no significant goods and materials purchases during operation, and in many countries the more sophisticated (and expensive) equipment will be imported.

Direct and indirect jobs information should be disaggregated by gender. To aid assessment of second order effects, information about the difference in income between current employment and previous should also be obtained. This could be done, for example, through baseline studies at project inception.

For assessment of second order indirect employment and induced employment, the latter likely to be the greatest job creation impact, I:O tables and firm level data to estimate production function and multipliers should be used. Where such data is limited, the assessment may be limited to bivariate analysis (e.g. before and after or with/without comparisons) and interviews.

Attribution of induced employment creation is difficult where the power generated is fed directly into the grid and adds only a small proportion to the total. This is likely to be the case for most small power projects. The value of detailed and time-consuming analysis of project impact may be limited for them. Significance can be assessed by considering the contribution to closing any gap between peak demand and generation capacity. In such cases assessment based on or inferred from broader analysis of the effects of power supplies on employment may be sufficient.

The BHPP project demonstrates that the social and environmental impact of a company in the energy sector can be significant when it places emphasis on staff training, CSR and high environmental performance standards. Finally, the capacity building effects of a project should be assessed through the measurement of qualifications, salaries and employment of personnel before and after investment. In the case of BHPP, these include the training given to the workforce during construction and the institution building within the community to facilitate participation in the project and provide a vehicle for effective communications between the company and the community.

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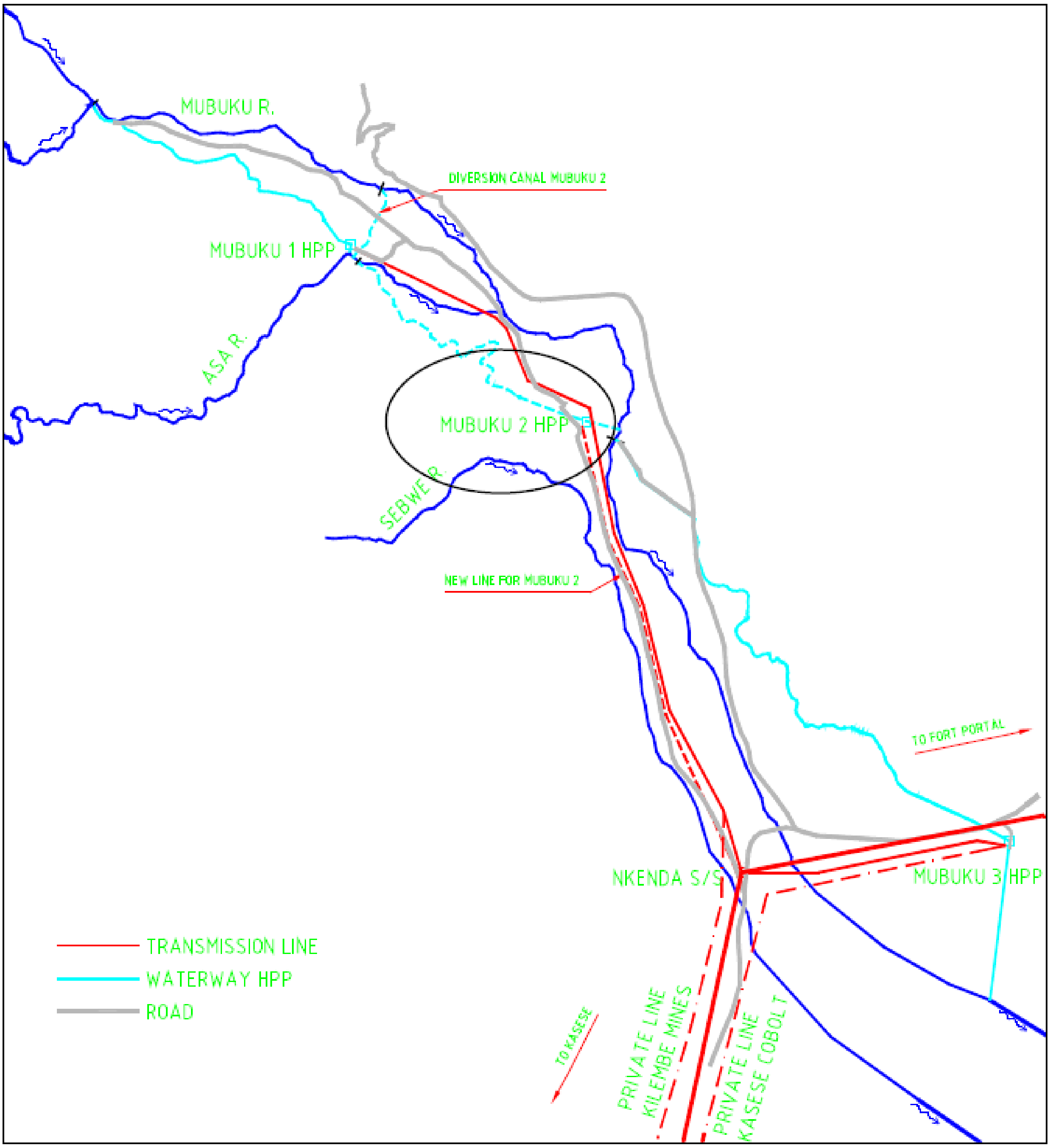
9 Annex

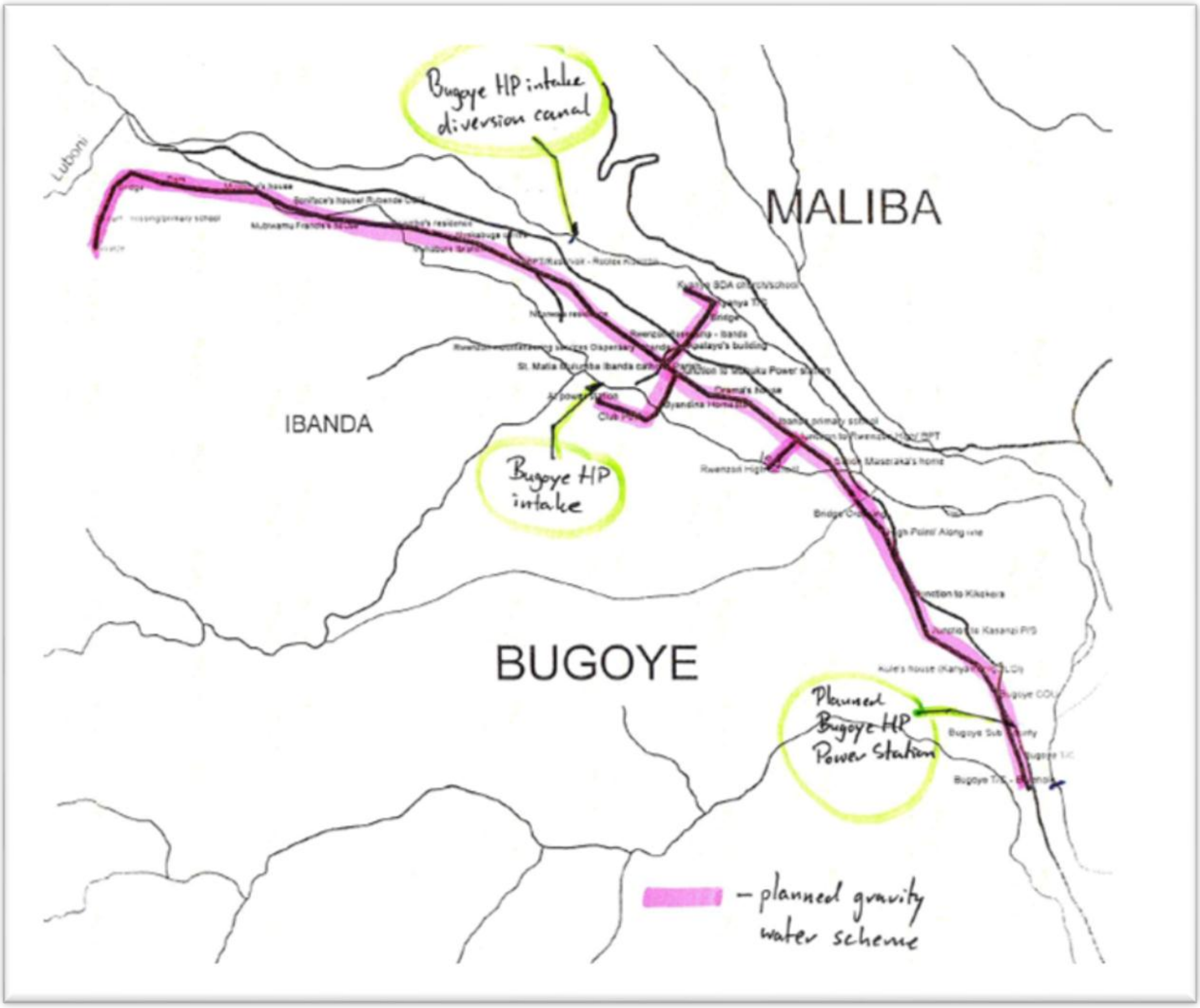
9.1 Maps

Figure 4: Mubuku 1, 2 and 3 locations



Source: CDM Executive Board (2008).
(BHPP is Mubuku 2)

Figure 5: Map of BHPP plant area, including canal



Source: Arntsen, 2008

Figure 6: Uganda Power Sector Development Operation

Source: http://siteresources.worldbank.org/EXTINSPECTIONPANEL/Resources/UGA35424.pdf

9.2 Employment effect multiplier calculations

In the absence of Input:Output tables to allow estimation of the employment effects due to changes in incomes and expenditure the study has used an approximate multiplier based on available data for sales per worker and proportions of expenditure given to different sectors (food, manufactures and services). This multiplier was devised as follows.

- Average sales per worker in the manufacturing sector in 2005 were UGX 30.38 million per employee (Enterprise Survey 2005/06). Adjusting for inflation to 2012, gives UGX 62.64 million per employee.

- Average sales per worker in the services sector in 2005 (million UGX per employee) were UGX 47.13 million per employee. Adjusting for inflation to 2012, gives UGX 97.21 million per employee.
- Because workers are much more productive in manufacturing and services than agriculture, more additional expenditure is necessary to create further jobs in these sectors.
- To estimate sales per worker in the food (agriculture) sector 'back of the envelope' calculations, take total GDP UGX 42,000,000 million and the GDP share from agriculture (23%), to estimate total sales, approximately UGX 9,660,000 million. The labour force in Uganda totals 16 million people, of which 82% are in agriculture, i.e. 13.12 million people. Sales per worker in the agricultural sector are thus estimated at UGX 0.74 million.
- A similar breakdown using GDP and employment data (rather than Enterprise Survey data, which might over-represent large firms) gives output per worker in manufacturing (23% of GDP, 5% of employment) at UGX 12.93 million and UGX 7.82 million in the services sector (13% of employment, 48% of GDP), i.e. lower than the estimate based on Enterprise Survey data.
- According to the 2010 Uganda National Household Survey (UNHS), using data for Western region only:
    - For unskilled workers, expenditure shares are: 55% food, 10% manufactures, 35% services.
    - For skilled workers, expenditure shares are: 36% food, 13% manufactures, 51% services.
- Take the additional expenditure in the economy for unskilled and skilled workers which is due to the direct employment effects;
- Assume all of this is spent (i.e. none is saved – an optimistic estimate); and
- Assume sales per worker in Western region stay the same in all sectors as nationally.
- To illustrate, assume an increase of UGX 100 million in the expenditure of **unskilled workers**. This results in additional employment as follows:

	Share of UGX 100m	**Sales per worker (UGX million)**	**Additional workers from UGX 100 million additional expenditure**
	A	B	A/B
Food	55	0.74	74.0
Manufactures (Ent Survey) **Manufactures (GDP share)**	10	62.64 12.93	0.16 0.77
Services (Ent Survey) **Services (GDP share)**	35	97.21 7.82	0.36 4.48
Total (Ent Survey) **Total (GDP share)**	100		74.52 79.25

- Similarly, assume an increase of UGX 100 million in the expenditure of **skilled workers.** This results in additional employment as follows:

	Share of UGX 100m	**Sales per worker (UGX million)**	**Additional workers from UGX 100 million additional expenditure**
	A	B	A/B
Food	36	0.74	49.0
Manufactures (Ent Survey) **Manufactures (GDP**	13	62.64 12.93	0.2 1.0

share)			
Services (Ent Survey) **Services (GDP share)**	51	97.21 7.82	0.52 6.52
Total (Ent Survey) **Total (GDP share)**			49.72 56.52

9.3 Findings from evaluation of Enterprise Survey data (2005/6)

Firm level data: (Enterprise Survey 2005-06)

Description of the data

The Uganda Enterprise Survey is one of a number of country surveys conducted by the World Bank to create indicators that benchmark the quality of the business and investment climate. The samples are consistently defined in all countries and include the entire manufacturing sector, the services sector, and the transportation and construction sectors. Public utilities, government services, health care, and financial services sectors are not included.

The 2006 Enterprise Survey of Uganda covered 307 manufacturing enterprises, 129 retail and IT enterprises, 127 other service sector enterprises and 100 microenterprises. The tables below summarise the survey's findings relating to electricity.

Is Electricity an obstacle in the current operation of your establishment?

	Manufacturing		Services: Retail & IT		Services: Other		Micro-enterprises
Electricity	Number of firms	% of the sample	Number of firms	% of the sample	Number of firms	% of the sample	Number
No	6	1.95	4	3.10	6	4.72	4
Minor	9	2.93	6	4.65	6	4.72	4
Moderate	14	4.56	17	13.18	10	7.87	14
Major	50	16.29	25	19.38	31	24.41	21
Very severe	228	74.27	77	59.69	74	58.27	57
Total	307	100.00	129	100.00	127	100.00	100

Ranking of Obstacles

	Manufacturing		Services: Retail & IT		Services: Residual		Micro-enterprises
Main Obstacle	Number of firms	% of the sample	Number of firms	% of the sample	Number of firms	% of the sample	Number
Electricity	228	74.27	71	55.05	74	58.27	53
Access to finance (availability & cost)	27	8.79	10	7.75	5	3.94	15
Tax rates	15	4.89	24	18.60	11	8.66	7
All Others	37	12.05	24	18.60	37	29.13	25
Total	307	100.00	129	100.00	127	100.00	100
Second Obstacle (if electricity is not the main one)	Number of firms	% of the sample	Number of firms	% of the sample	Number of firms	% of the sample	Number
Electricity	41	51.90	8	13.79	20	37.74	16
All Others	38	48.10	50	86.21	33	62.26	31
Total	79	100.00	58	100.00	53	100.00	47

Power Outages and Use of Generators

MANUFACTURING

	Number of firms	Mean	SD	Min	Max
All of 2005					

Experienced outages (%)	307	94.14	23.53	0	1
How many times per month (if had a power outage)	289	10.94	4.85	2	30
How long (in hours)?	289	11.16	6.28	1	24
Losses (% of sales)	229	11.68	11.82	0	50
Own a generator?	307	27.69	44.81	0	1
What % of electricity came from generator?	85	29.85	18.65	0	80
Last month					
Experienced outages (%)	307	91.53	27.78	0	1
If yes, how many times?	281	14.18	4.24	1	30
Own a generator?	307	28.6	45.29	0	1
What % of electricity came from generator?	88	35.36	20.11	0	90
Power from generator more expensive than from grid	88	96.59	18.25	0	1

RETAIL & IT

	Number of firms	Mean	SD	Min	Max
All of 2005					
Experienced outages (%)	129	94.57	22.74	0	1
How many times per month (if had a power outage)	122	11.78	4.27	3	20
How long (in hours)?	122	9.90	5.58	0	24
Losses (% of sales)	122	9.98	10.33	0	45
Last month					
Experienced outages (%)	129	92.24	26.84	0	1
If yes, how many times?	119	14.76	3.83	2	31
Own a generator?	129	32.55	47.04	0	1
What % of electricity came from generator?	42	48.55	17.70	20	100
Power from generator more expensive than from grid	42	85.71	35.41	0	1

OTHER SERVICES

	Number of firms	Mean	SD	Min	Max
All of 2005					
Experienced outages (%)	127	96.85	17.53	0	1
How many times per month (if had a power outage)	123	10.53	4.77	3	30
How long (in hours)?	123	9.75	5.88	0.5	24
Losses (% of sales)	97	11.33	11.78	0	45
Last month					
Experienced outages (%)	127	96.06	19.52	0	1
If yes, how many times?	122	13.34	4.61	1	30
Own a generator?	127	50.39	50.20	0	1
What % of electricity came from generator?	64	42.28.	17.51	2	100
Power from generator more expensive than from grid	64	98.43	12.5	0	1

MICRO-ENTERPRISES

	Number of firms	Mean	SD	Min	Max
All of 2005					
Electricity Connection (%)	100	88	32.66	0	1
Experienced outages (%)	88	90.91	28.91	0	1
How many times per month (if had a power outage	79	11.32	4.027	3	20
How long (in hours)?	79	10.55	6.18	2	24

Losses (% of sales)	66	10.56	7.81	0	35
Own a generator?	100	18	38.61	0	1
What % of electricity came from generator?	18	44.11	25.00	14	100
Last month					
Experienced outages (%)	88	94.31	23.28	0	1
If yes, how many times?	80	13.76	4.12	2	20
Own a generator?	100	18	38.61	0	1
What % of electricity came from generator?	18	44.11	25.00	14	100
Power from generator more expensive than from grid	18	83.33	37.29	0	1

Definitions:

Experienced outages (%): percentage of firms with an electrical connection that replied "yes" to the question "In 2005 did your establishment experience power outages?" Question also asked for "last month".
How many times per month (if had a power outage): "If yes, how many times in an average month?"
How long (in hours): "How long did each occurrence last on average?
Losses (% of sales): "What were your total losses for the year as a result as a % of total sales?"
Own a generator: "In 2005, did your establishment own or share a generator?" (also for "last month")
What % of electricity came from generator? "If yes, what percentage of your electricity came from your owned or shared generator(s)?"

Production: inputs and output

MANUFACTURING

	Number of firms	Mean	SD	Min	Max
Labour force					
Workers (Total)	307	51.64	239.53	5	4000
Share of Production Workers (%)	307	79.11	14.87	30.77	100
Share of Unskilled among PW	307	43.88	32.50	0	100
Output (Millions of UGX)					
Sales	307	2573.20	12734.7	4.2	136900
Inputs (Millions of UGX)					
Materials	307	1336.67	7588.2	0.1	103000
Electricity	307	28.56	119.57	0	1365
Value of machinery and equipment	307	981.21	6679.42	0.5	108100

RETAIL & IT

	Number of firms	Mean	SD	Min	Max
Labour force					
Workers (Total)	129	7.34	9.29	1	90
Output (Millions of UGX)					
Sales	129	843.82	3255.41	7.5	28000
Inputs (Millions of UGX)					
Electricity	129	4.29	23.79	0	264
Value of rental land, building, machinery and equipment	129	16.19	64.71	0	600

OTHER SERVICES

	Number of firms	Mean	SD	Min	Max
Labour force					
Workers (Total)	123	17.56	33.52	1	300
Output (Millions of UGX)					
Sales	127	1167.98	5057.99	3	53000
Inputs (Millions of UGX)					
Electricity	127	17.18	91.72	0	1000
Value of rental land, building, machinery and equipment	125	106.57	1077.88	0	12050.74

MICRO-ENTERPRISES

	Number of firms	Mean	SD	Min	Max
Labour force					
Workers (Total)	100	3.31	1.01	1	4
Output (Millions of UGX)					
Sales	100	126.95	640.27	3	6000
Inputs (Millions of UGX)					
Materials	100	62.62	320.41	1	3000
Electricity	100	1.54	4.13	0	36
Value of machinery and equipment	100	14.89	22.26	0	120

Productivity and outages

To determine the relationship between productivity and outages at the firm level we used the same procedure as in Arnold et al. (2006), and the same variables. Two specifications were used for manufacturing firms, with and without materials, because the value of materials explains around 90% of the variation in value of sales. When controlling for capital and labour, there is therefore little residual variation to test whether anything else affects the value of sales. Arnold et al.'s exercise was undertaken in one step rather than two, but the results are qualitatively the same. Rather than running output on inputs and then the residual on firm characteristics, we ran sales on inputs and characteristics simultaneously.

Given the small sample size we cannot estimate input coefficients for each manufacturing sector. We therefore assume that the coefficients on capital, labour and materials are the same across sectors. Trying other categorisations of manufacturing firms (e.g. dividing them into capital- or electricity-intensive industries) does not generate different results.

The same regressions were run for service enterprises, for which information is available only for sales and employment.

Firm characteristics were used as controls in the regressions, as in Arnold et al. (2006). These characteristics included "Export status", "firm size" (a variable equal to 1 for firms with more than 50 employees and 0, otherwise), and "foreign" when ownership is at least 10% foreign capital share, and location (a variable equal to 1 for firms located in Kampala). These variables were used to obtain comparisons between firms with different exposure to outages that take away differences due to these characteristics. For example, large firms might be more exposed to outages and at the same time more productive. The difference in productivity due to size is captured by the variable "size" and if that characteristic is what matters (and not outages), then the coefficient (magnitude and significance) on outages is affected by that.

"Industry dummies" are a set of variables taking the value 1 when a firm belongs to a given industry and 0, otherwise. For example, a firm in the garment sector will have a value of 1 for the dummy variable "Garment" and a value of 0 for all other industries (e.g. Food, IT, etc.). These variables are used to capture difference in average productivity between industries. If firms in some industries are more productive than in others and at the same time they are less exposed to outages that might bias the results. With industry dummies, the regression exploits variation within industries, i.e. differences due to outages, not industry characteristics.

As a measure of labour productivity, "output per worker" was used.

Manufacturing						
	TFP (w/o materials)		TFP (with materials)		Output per worker	
Outages (hours per day)	-0.028 (0.014)**	-0.023 (0.014)*	-0.005 (0.007)	-0.005 (0.007)	-0.037 (0.016)**	-0.029 (0.016)*
Generator	0.427 (0.176)**	0.333 (0.174)*	0.032 (0.054)	0.014 (0.056)	0.927 (0.165)***	0.53 (0.17)***
Firm controls	No	Yes	No	Yes	No	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes

Observations	307	307	307	307	307	307
R-squared	0.71	0.73	0.96	0.96	0.19	0.27

Services				
	TFP		Output per worker	
Outages (hours per day)	-0.054 (0.032)*	-0.034 (0.033)	-0.055 (0.032)*	-0.039 (0.033)
Generator	0.524 (0.204)***	0.512 (0.211)**	0.412 (0.198)**	0.357 (0.211)**
Firm controls	No	Yes	No	Yes
Industry Dummies	Yes	Yes	Yes	Yes
Observations	246	246	246	246
R-squared	0.29	0.32	0.13	0.15

Microenterprises		
	TFP (with materials)	Output per worker
Outages (hours per day)	-0.027 (0.013)**	-0.059 (0.163)
Generator	-0.067 (0.111)	0.441 (0.379)
Firm controls	No	No
Industry Dummies	Yes	Yes
Observations	78	78
R-squared	0.94	0.34

Who is affected by outages? A descriptive analysis (multivariate regressions do not show enough variation to report).

Manufacturing Sector

	Outages per month	Outage hours per day	Electricity most serious Obstacle (%)	Electricity major or very severe obstacle (%)	Has a Generator (%)
Industry					
Food	11.25	4.81	87.78	95.56	27.78
Garments	7.16	1.82	66.67	83.33	66.67
Textiles	6.25	3.83	50	50	50
Machinery & Equipment	9.4	3.07	100	100	40
Chemicals	9.75	5.64	62.5	87.5	75
Non-metallic minerals	8.25	3.45	58.33	66.67	33.33
Wood, wood products & furniture	10.48	4.54	67.39	88.04	11.96
Metal & Metal products	10.36	4.14	73.58	96.23	20.75
Other Manufacturing	9.49	3.55	67.57	89.19	54.05
Size					
Small	9.89	4.21	74.48	90.10	9.90
Medium	11.10	4.59	73.33	92.22	46.67
Large	10.84	4.25	76	88	96
Other characteristics					
Female	10.85	4.85	68.91	89.19	37.83
Male	10.15	4.16	75.97	90.98	24.46
Non-Exporter	10.39	4.45	74.72	91.45	21.29
Exporter	9.79	3.45	71.05	84.21	73.40

National (90% or more)	10.35	4.46	74.30	92.09	20.95
Foreign (10% or more)	10.17	3.72	74.07	83.33	59.26
Kampala	10.14	4.18	71.71	89.64	27.49
Rest of Uganda	11.13	4.96	85.71	94.64	28.57

Services Sector

	Outages per month	Outage hours per day	Electricity most serious Obstacle (%)	Electricity major or very severe obstacle (%)	Has a Generator (%)
Industry					
Retail	10.90	3.64	53.28	77.87	31.15
IT	13.71	5.06	85.71	100	57.14
Construction & Transport	8.96	2.94	41.67	75	50
Hotels & Restaurants	10.89	3.55	64.47	86.84	52.63
Others	9.37	3.24	55.56	77.78	44.44
Size					
Small	10.82	3.74	53.68	78.94	31.58
Medium	10.50	3.20	65.51	86.20	68.97
Large	7.13	1.33	62.5	87.5	75
Other characteristics					
Female	10.78	3.53	52.53	78.79	36.36
Male	10.53	3.55	59.24	82.17	44.59
Non-Exporter	10.65	3.58	57.42	81.12	41.77
Exporter	10.14	2.22	28.57	71.42	28.57
National (90% or more)	10.99	3.75	56.02	80.09	37.96
Foreign (10% or more)	8.68	2.46	60	85	60
Kampala	10.53	3.16	55	79	40.50
Rest of Uganda	11	4.93	62.50	87.50	44.64

Micro-enterprises

	Outages per month	Outage hours per day	Electricity most serious Obstacle (%)	Electricity major or very severe obstacle (%)	Has a Generator (%)
Industry					
Food	12.66	3.11	80	80	40
Garments	10	2.90	42.86	57.14	28.57
Other Manufacturing	11.6	4.09	50.94	75.47	11.32
Retail	12	5.88	55.56	88.89	14.81
Other services	8.63	1.67	50	75	50
Size					
1 employee	9	1.97	25	75	12.50
2 employees	11.44	4.35	50	81.25	6.25
3 employees	10.33	4.25	38.46	69.23	23.08
4 employees	11.73	4.45	60.32	79.37	20.63
Other characteristics					
Female	11.72	4.06	41.93	74.19	12.90
Male	11.17	4.29	57.97	79.71	20.29
Kampala	11.11	3.69	50	68.18	13.64
Rest of Uganda	12.46	6.90	53.85	80.77	19.23

Estimating employment effects

Manufacturing sector

Take coefficients for TFP (-0.028 to -0.005): a one standard deviation reduction in the number of hours of outages per day (a reduction of 4 hours per day) would increase sales by between 2 and 12%. This is consistent with the self-reported losses declared by firms: around 75% of firms declare to have lost between 0 and 12%.

Whether employment increases if sales increase depends on whether labour becomes more productive (i.e. firms increase their sales per worker) or whether firms keep their sales-worker ratio constant and employ more workers. The results suggest that a decrease by one standard deviation in hours of outages per day would increase sales per worker by around 12%.

This suggests that for 75% of firms the increase in the quality of electricity provision might not result in additional employment. For the remaining firms, there is a scope for additional employment that will match the increase in sales (above 12%) with the increase in sales per worker (12%). For this group of firms, the mean sales loss from outages is 26%. Average sales are 4,355 and the average number of employees is 48 (i.e. sales per employee=88.8). So for the average firm, a 26% increase in sales would give sales of 5,487.3. An increase of 12% in sales per employee takes this ratio to 101.6. This means an increase in employment for the average firm of 6 employees, or 11%. (Excluded from this analysis is a firm with 4000 employees, which is 10 times more than the second largest firm in the sample.)

This increase in employment of 11% applies only to the 25% of firms that declare sales would improve more than improvements in labour productivity. Total employment in the sampled manufacturing firms was 8,015 for the unaffected group of firms and 3,719 for the group of firms that would increase employment by 11%. This equates to an increase of 3.5% in total employment in the manufacturing sector.

According to the Census of Business Establishments, manufacturing firms of 5 or more employees employ around 93,000 people. An increase of 3.5% would imply 3,300 more manufacturing jobs from removing outages.

Services Sector

For the services sector, using the coefficients from the first two regressions, the effect of reducing outages per day by one standard deviation (i.e. 3 hours per day) would be an increase in sales of between 7% and 16%. The average increase in sales per worker is also between 7% and 16%.

Around 21.5% of service sector firms declare having a percentage loss of sales greater than this. For this group, the mean sales loss is 26.7%, mean sales are 637, and mean employment is 20. An increase of between 7% and 16% in sales per worker and an increase of 26.7% in sales would imply an increase of around 2-4 employees for an average service sector firm (between 10% and 20% in employment).

The increase applies only to the 21.5% of firms that declare higher losses. Doing a similar analysis as before, this would imply an increase of between 2.7% and 5% in total employment for firms in the service sector.

According to the Census of Business Establishments, firms in the service sector with 5 or more employees employ around 302,000 people. An increase between 2.7% and 5% implies an increase of between 8,000 and 15,000 employees.

Microenterprises

The coefficient linking outages to sales per worker amongst micro-enterprises is not significantly different from zero. This suggests that reductions in outages may not have an impact on employment. However, the mean estimate of total factor productivity (TFP) suggests an impact of around 9%, which is similar to the median and mean of self-reported losses in sales due to outages (i.e. around 10%).

If sales per worker do not change, but sales go up, the average impact on employment is around 9% for microenterprises. For a firm at the mean of the employment distribution, that is an additional 0.3 worker. In the sample of 100 firms, that means 30 extra workers.

According to the Census of Business Establishments, there are 428,100 microenterprises, employing 642,895 employees. The average is 1.5 employees per microenterprise, which is significantly lower than in the Enterprise Survey, which tends to over-sample firms with 4 and under-sample firms with 1 employee (8% v 42%). Using these numbers, a 9% increase in microenterprise employment would imply a total increase of around 58,000 workers.

9.4 Summary findings from analysis of Uganda National Panel Survey of Households 2009/10

In the absence of an exogenous determinant of electrification, the analysis focused on establishing conditional correlations. This was carried out by doing regressions running "share (or value) of energy/electricity expenditures" on the measure of electrification (i.e. a dummy =1 if the hh is electrified) and controlling for characteristics to account for these systematic differences: urban/rural, household expenditures, district (or region) fixed effects, household size, and head characteristics (level of education, gender age, industry of occupation, employment status).

The regression results are summarised below.

Electrified households spend more (absolute and relative) on energy.

- Share of energy in total expenditure (region fixed effects)
- Share of electricity in total expenditure (region fixed effects)
- Log Electricity expenditure (region fixed effects)
- Log energy expenditure (region fixed effects)
- Share of energy in total expenditure (district fixed effects)
- Share of electricity in total expenditure (region fixed effects)
- Log electricity expenditure (district fixed effects)
- Log energy expenditure (district fixed effects)

Non-head members spend less hours in non-labour market activities (not true for heads).

- These regressions: all household members (alternate region and district fixed effects and non-labour-time measured in hours and log hours)
- These regressions: heads of household only (alternate region and district fixed effects and non-labour-time measured in hours and log hours)
- These regressions: non-head members of the household (alternate region and district fixed effects and non-labour-time measured in hours and log hours)

NON-heads in electrified HH are less likely to work unpaid or self-employed and more likely to be an employer (heads are more likely to be employers).

EMPLOYMENT: regressions measure the probability for non-heads and heads in electrified households of being in unpaid work, being an employee, an employer or self-employed (relative to non-heads/heads in households without electricity). Use district fixed effects.

NON-heads (less likely to be unpaid or self-employed, more likely employer)

- Non-heads: unpaid work?
- Non-heads: employees?
- Non-heads: employer?
- Non-heads: self-employed?

Head: more likely employer is the only non-zero result

- Heads: unpaid work?
- Heads: employee?
- Heads: employer?
- Heads: self-employed?

If they work, non-heads are more likely to work in non-agricultural jobs. However, they are more likely NOT to work (probably kids study, and I find that spouses don't work).

Regressions measure the probability for non-heads and heads in electrified households of being in non-agricultural jobs (relative to non-heads/heads in households without electricity). Use district fixed effects.

Head: no difference

- Non-head: more likely to be in non-agricultural job
- Non-heads: less likely to work in electrified households (non_work increases)

Heads: no difference in probability of being in work.

- Non-Heads: all employment results discussed above do not change if I focus on 15-64 years old only
- Spouses: more likely to NOT work in electrified households

Electrified households are more likely to have greater levels of expenditure and less likely to be poor.

- A measure of welfare (used by Uganda Bureau of Statistics to measure poverty, probably linked to real expenditure per adult equivalent in the household) is greater in electrified households
- Log Total Expenditure is greater in electrified households
- Probability of being poor is lower in electrified households (this is a poverty headcount at the household level: "poor" is equal to 1 if the measure of welfare used above is below a threshold.

They also spend more in durable goods (in absolute terms and as a share of expenditure) even when controlling for total expenditures (that is, if we compare 2 households with same characteristics and level of expenditures, the electrified one spends a higher share of expenditures in durable goods)

- More expenditure on durables (share and absolute in logs, respectively) in electrified households

9.5 People interviewed for the study

Plant, financers and partners		
Norfund	Mark Davis	Investment Director - Renewable
TrønderEnergi AS	Jon Einar Værnes	Vice President International Business
New Plan	Irene Kokseter	Former New Plan researcher
Electricity Sector		
Umeme	Charles Chapman	Managing Director
	Florence Nsubuga	Chief Operations Officer
	Simbiso Chimbima	Chief Technical Officer

UETCL	Valentine Katabira	Manager – Operations & Maintenance
Electricity Regulatory Authority	James-Philip Sembeguya	Statistician
	Isaac Kinhonhi	Principal Economist (Planning
	Vianney Mutyaba	Project Manager
	Juliet Mugoya	Engineer
Kasese area		
Community Development through Sports	Chairman	Stephen Pritchard
Bugoye sub-county	Chairperson	Bwambale Aprawale
Trønder Power	Annicent Busingye	General Manager
	Losio Lemuresuk	Operations Manager
TrønderEnergi	Inge Stolen	Managing Director
Hima Cement	Brice Houeto	Commercial Manager
	Peter Robson	Plant Manager
	Henry Munyweza	Electricity Manager
Kilembe Investments Ltd	Augustine Tsongo	Electrical Engineer
	Rhouben Mwahulhwa	Board Chairman
Kasese Cobalt Company Ltd (KCCL)	Rob Jennings	General Manager
Robtex Kasese Enterprise	Robert Kisembo	Managing Director
National businesses and business associations		
EABL, Uganda Breweries	Patrick Ngolobe	Human Resources Director
MTN	Joachim Masagazi	Performance & Reward Manager
	Paul Akugizibwe	Learning & Development Manager
Uganda Allied Chamber of Commerce,	Mwesingwa Didas	Director – membership services
Federation of Uganda Employers	Douglas Opio	Policy & Research Officer
Government, experts and other stakeholders		
Royal Norwegian Embassy	Kristin Waeringsaasen	Energy Counsellor
Africa Institute for Energy Governance	Dickens Kamugisha	Researcher
DFID	Sutapa Choudury	Economic Advisor
Uganda Bureau of Statistics	Imelda Musana	Director, Business & Industry
	Samuel Echoku	Principal Statistician

	Vincent Ssennono	Principal Statistician

9.6 Terms of Reference

Background

a) The Private Infrastructure Development Group ("PIDG") is a coalition of donors committed to mobilising private sector investment in infrastructure in developing countries and promoting economic growth. It has established, amongst others, The Emerging Africa Infrastructure Fund Limited ("EAIF"), which provides long-term loans to private sector infrastructure projects in sub-Saharan Africa.

b) One of the key tasks of the PIDG Programme Management Unit ("PMU") of the PIDG is to monitor PIDG-supported projects to ensure that they are on track towards achieving their expected defined development impacts. For that reason, the PMU's development impact team has developed a range of measures to track the impact of PIDG-supported projects. As part of this, direct job creation, both during project construction and operations phases, is an important indicator.

c) The purpose, activities, distinguishing characteristics, membership, achievements and governance structure of PIDG are described in some detail in Appendix A of these Terms of Reference.

Purpose, Objectives and Scope of the Study

a) The PMU requires further understanding of the impact of PIDG-supported projects, in particular in relation to direct, indirect and induced job creation. To this end, PIDG has commissioned a pilot, micro-level impact study focusing on job creation in a PIDG-supported project ("the Study").

b) The Study shall examine the employment impact of the Bugoye hydropower project (BHPP) in west Uganda, which is financed by EAIF (amongst others). Renewable energy is a growing percentage of the overall PIDG project portfolio. A project such as BHPP distinguishes itself from other investments such as manufacturing through the importance of indirect effects. Please refer to Appendix B (Background Paper) for further information on the Bugoye project and the types of employment effect assessment studies being undertaken by other DFIs.

The Consultant shall address the following issues in the Study:

c) A brief description of BHPP (on the basis of available project documents, publicly available information and interviews on-site), in particular to include an assessment of the additionality arising from EAIF's involvement in the project

d) A schematic causal-chain that describes the main routes through which the project has the potential to affect employment (distinguishing between different types of jobs, including the gendered impact):

- Direct effects
- Indirect effects
- Induced effects
- Displacement effects

e) A detailed assessment of the effects of the project on the quality, quantity and price of power supply, locally regionally and nationally (using on-site interviews particularly with project managers and key electricity off-takers, and analysis of available project documents), and its effects on the quantity of power outages. The relative importance of each of these effects must be set out.

f) A commentary on the importance of lack of reliable electricity supply for private sector development on the basis of the available literature on growth diagnostics (e.g. WB CEM), investment climate indicators (WB) and the academic literature.

g) An assessment of the overall approximate (macro) effects of an increase in the renewable energy power supply in terms of reduced fuel subsidies, increased people served and reduced firm and household level spending;

h) An assessment (quantitative but supported by qualitative evidence where appropriate) of the direct, indirect and induced employment effects of BHPP, distinguishing where possible by gender, occupation and job conditions. A suggested methodology for assessing direct, indirect and induced employment effects is listed below

Suggested Methodology for assessing direct, indirect and induced employment effects

a) This section should be read in conjunction with Appendix B to the TOR, which contains further information on these issues.

b) Direct job creation - these are jobs directly employed by BHPP. This shall be assessed through on-site interviews with project staff and management, and through available project documentation

c) Indirect job creation – these are jobs that supply BHPP through outsourcing. This shall be assessed through on-site interviews with project staff and management (to determine the scope of services provided to BHPP), and by using the IFC-proposed methodology (see Appendix B to the TOR for more details). This should also include any employment generated from CSR schemes (if applicable)

Displaced jobs – these are jobs that have been lost due to the development of BHPP, both directly (for example from electricity replacing traditional fuel supplies) and indirectly (through the movement of jobs from other areas to those where BHPP power is provided)

d) Induced job effects – this is the effect of BHPP on job creation through more, cheaper and better quality provision of clean energy. This shall be estimated through the following:

- Based on the latest enterprise survey for Uganda, undertake an econometric study by estimating a Cobb-Douglas function (taking into account the latest techniques) and regressing the residual (an estimate of Total Factor Productivity) on a number of explanatory variables including power outages (duration and costs)
- Examine which type of firms (small; employment intensive; sector; gender of ownership) tend to be affected most by lack of good quality electricity supply;
- Assess the effect of more reliable power supply on employment by using the effect on productivity and convert investment / output effects into an employment effect using the estimated coefficients (and/or estimate the effects directly, as a labour demand equation);
- Use (secondary) household level data to examine the induced job effects of cheaper electricity.
- Assess macro effects through reduction in government spending, demonstration effects and more stable production, express in terms of GDP, and use a national level production function approach to examine employment effects;
- Based on the above, combine the estimated effects of BHPP on the quantity, quality and costs of electricity generation, with the estimated effects of lack of reliable electricity on productivity and hence employment effects in firms through the above routes as well as other appropriate channels, to obtain an induced employment effect.

e) Throughout the Study, quantitative analysis shall be complemented by qualitative analysis based on in-depth interviews. These shall take place with project management and staff; key power offtakers in the region, including firms such as Hima Cement; suppliers to BHPP during the construction phase; and firms and/or households that are affected indirectly through forward linkages.

Outputs

The Study has two phases. **Phase 1** is the development of an Inception Study based on an extensive desk review. **Phase 2** is the delivery of a First Draft Study, following a site visit of one week, and a Final Study.

Phase 1: Desk Review

On contract signature, the PMU and the Consultant shall arrange an inception meeting (if the Consultant is not based in London, a telephone/video conference call is preferred). This meeting will help the PMU and the Consultant to align expectations and discuss any outstanding issues. Within one week of the inception meeting, the Consultant must submit an Inception Study (max. 7 pages) with a detailed workplan and an outline of the initial understanding of the Study.

The Consultant will then undertake the desk review phase of the Study. This will include background research and analysis from existing secondary literature. It will enable the development of a schematic causal-chain that describes the main routes through which BHPP has the potential to affect employment along with a detailed methodology detailing the proposed techniques to assess and quantify the job creation effects of the BHPP.

Key deliverable: Inception Study

Phase 2: Site Visit and Study

On approval by the PMU of the Inception Study, the Consultant will carry out the site visit and draft the Study. The PMU will support the Consultant in in setting up interviews with key stakeholders. The site visit to the BHPP will last a maximum of one week. The Consultant is expected to collect relevant data to carry out the Study and to undertake structured interviews with BHPP staff as well as with key stakeholders (e.g. sponsors/investors, beneficiaries, selected government officials).

The First Draft Study will be produced by the Consultant following the site visit, incorporating qualitative findings from the site visit as well as the quantitative results of the Study, for review by the PMU. The Second Draft Study, incorporating comments from the PMU, shall be shared with the PIDG General Council members for their review and comments.

Key deliverables: First Draft Study, Second Draft Study and Final Study

9.7 Job Creation Effects

In this study we have attempted to simplify description of the various categories of job creation effect that arise from investment in energy infrastructure (Section 5). Bacon and Kojima (2011) list 12 different "components of employment" which might be used in the analysis of employment effects. This is indicative of the potential complexity of assessing the job creation effects of an investment, as well as the different reasons for undertaking an assessment.

There are 2 key categorisations in assessing the employment effects of electricity infrastructure. The first distinguishes between employment due to the infrastructure itself and employment due to the consumption of the electricity delivered by the infrastructure. In this report, and in the report *Estimating Employment Effects of Powerlinks Transmission Limited Project in India and Bhutan* (IFC, 2012), these are labelled Category 1 and Category 2.

The second categorisation distinguishes between where in the value chain employment effects take place, and between including initial employment effects and second order effects (called multiplier effects in this report) due to initial employment. The *IFC Jobs Study* (IFC, 2013) uses four kinds of employment effect: direct, indirect, induced and secondary. The last is the same as Category 2, but the rationale for the categorisation is different. In this study, we have emphasised the distinction between Category 1 and Category 2 effects.

The table below shows how these categorisations relate to each other.

	Direct	Indirect	Induced	Secondary
Category 1	✓	✓	✓	✗
Category 2	✗	✗	✗	✓

In most of the literature, categorisation is limited to direct, indirect and induced employment. We summarise below how these categories are defined in relevant publications.

Source	**Direct**	**Indirect**	**Induced**
Bacon R. and Kojima, M. (2011) *Issues in estimating the employment generated by energy sector activities*, World Bank.	"The extra employment created or destroyed within a given sector as it responds to an increase in the final demand for its product."	"The total extra employment created or destroyed as other sectors expand their outputs in order to supply the inputs required for the output of the given sector, the employment created by yet other sectors as they respond to the demand for their outputs from the sectors supplying the given sector, and so on."	"The employment created or destroyed to meet the extra demands from all sectors arising from spending from the higher household incomes created by direct and indirect effects, following the initial increase in final demand for the given sector."
ILO (2013) *Methodologies for assessing green jobs*, Policy brief, ILO.	"Investment in sustainable sectors will result in an expansion of production and the generation of a number of *direct jobs*."	"Expanded production invariably leads to a higher demand for inputs, resulting in an increase in *indirect jobs* in supplier industries."	"The increased consumer spending of those in these newly created direct and indirect jobs will also create a number of *induced jobs*."
American Council for an Energy-Efficient Economy (nd) *How does energy efficiency create jobs?* Fact Sheet.	"Jobs generated from a change in spending patterns resulting from an expenditure or effort (e.g. construction jobs for a retrofit project)."	"Jobs created in the supply chain and supporting industries of an industry that is directly impacted by an expenditure or effort."	"Jobs generated by the re-spending of received income resulting from direct and indirect job creation in the affected region."
IFC (2013) *IFC Jobs Study: Assessing Private Sector Contributions to Job Creation and Poverty Reduction*,		"Employment changes in suppliers and distributors."	"Jobs resulting from direct and indirect employees spending more and increasing consumption."
IFC Development Impact Department (2012*) Estimating Employment Effects of Powerlinks Transmission Limited*	"Jobs that were created by PTL employing additional labor and professional staff (permanent and temporary) to build	"The construction and O&M of the power transmission lines in India requires supplies from other sectors like cement	"The additional workers in PTL and also in firms supplying to it, now spend more on household consumption items

Project in India and Bhutan, IFC.	(over 5 years) and later operate the transmission (over project life for 20 years)."	and cables. The additional jobs created in the supply chain (backward linkage) are the *indirect* effects."	like groceries, curtains, furniture etc. –which creates additional employment in various other sectors throughout the economy, creating a multiplier of further demands. This spillover effect is called *induced* effect."

To enable comparison with other studies, within the limitations of the analysis here, the estimated employment effects of BHPP using the IFC classifications are presented in the table below.

	Number of Jobs	Number of Person Years
Direct	1,079	2,333.92
Indirect	109	2,678.37
Induced	82 – 90	2,054.21 – 2,256.84
Secondary	8,434 – 10,256	210,850 – 256,400
Total	**9,704 – 11,534**	**217,967 – 263,718**

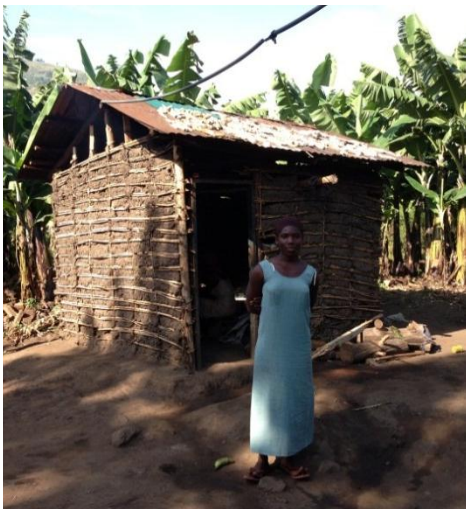
9.8 Interviews with electricity users

The study did not attempt a systematic sampling of electricity consumers locally or nationally to gauge the effects on them of BHPP's supply of power to the grid. At around 4%, the electrification rate in Kasese District is currently the same as the national average. The 2006 baseline study for the project found 2.5% of households electrified in the Bugoye area (ref). Kilembe Investments Ltd., the electricity distributor in the area, reported the number of consumers in the Bugoye sub-county to be 134. The local employment effects of electricity consumption and of changes in the reliability of the supply would be correspondingly small. Given the time available for the study a systematic assessment of consumers would not have been cost-effective. The study did, however, seek qualitative information about the use and benefits of electricity from a number of households (4), businesses (7) and community leaders (3) in the neighbourhood of the plant. This Appendix summarises the comments from these informants.

As background to the informant interviews, it can be noted that nearly every household in the area is engaged in agriculture as a source of income. The baseline study found 37.5% of households also earning income from wage or salaried employment, and almost half engaged in trading. Interviews with community leaders confirmed this general pattern of incomes. The baseline study found the number of micro- and small enterprises to be low, occurring in 2% of households, and of these fewer than half used electricity.

One household which had had an electricity connection for nearly 2 years reported using electricity for lighting, phone charging and heating water. Neighbours also benefit by being able to charge their mobile phones. The male head of the household is in wage employment as a taxi driver, and his wife (pictured left) is a farmer. She is thinking about starting a small food processing business (e.g. making and selling popcorn), using electricity. The family has found electricity to be less expensive than using kerosene. One concern is the cost of travelling to Kasese town (USh 6,000) to purchase credit for the electricity (USh 10,000 each time).

In another electrified household, where the male household head is a school teacher and his wife a farmer, the power is used for lighting, television and phone charging. One of their daughters (pictured below) is a student nurse, who reported that having electricity had helped her education, allowing greater flexibility in when to study and opportunity to study longer.



The female head of a resettled household interviewed for the study, whose income is mainly from farming, reported that though she would like to have an electricity connection, she could not afford the connection charge. Unlike the electrified households interviewed this resettled family did not have a wage earner in the family.

A bar owner at Ibanda trading centre (pictured below left) reported using electricity for lighting and television. Electricity was not having a significant impact on the business because the cost increased when responsibility for distribution was transferred to Kilembe Investments Ltd. (from Kilembe Mines). On the other hand, a nearby drinks store said that being able to run a fridge and to operate longer hours is good for business. Electricity was reported as less expensive for the business than kerosene. Similarly, a general store at Ibanda was able to increase turnover by being able to open longer hours, thanks to having electricity.

The manufacturing businesses in the Bugoye and Ibanda area which use electricity are engaged in cassava milling, coffee husking, carpentry and welding. Elsewhere in Kasese District are coffee processing and maize milling enterprises. A carpentry business at Ibanda (pictured above right) previously operated by one self-employed carpenter, has invested in additional machinery (a lathe and a planer) and is now employing 3 additional people following an electricity connection. A cassava mill visited at Ibanda has had electricity for some time and has not experienced any changes since BHPP was commissioned. For one welding business the increased cost of electricity is limiting profits.