Cost Benefit Analysis of Power Sector Reform in Haiti

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Academic Abstract

This paper argues that to improve the power sector in Haiti, which now constitutes a critical constraint to economic growth, it would be necessary to carry out a significant regulatory and utility governance reform; without these reforms, any physical investment program would be ineffective and unsustainable. Haiti has the most underdeveloped and inefficient power sector in the Americas. Numerous past attempts to reform it have failed due to lack of political will. In this paper, we consider a multi-phase program of reform and assess its feasibility. In the first phase, the Government of Haiti (GOH) carries the corporatization of units of Electricité d'Haïti (EDH); introduces management contracts, leases, and concessions; and privatizes EDH units as appropriate. If the first phase succeeds we propose proceeding to later phases that would support EDH. Costs have been estimated based on a similar program implemented in Afghanistan by the United States Agency for International Development (USAID). Our estimation of economic benefits is based on a projected reduction in technical losses, valued at the retail price of electricity for average consumers; net gains in consumer surplus resulting from servicing high value customers are excluded from the model due to lack of reliable data to support a quantitative estimate. Furthermore, the analysis is conducted based on a 50% chance of success for the reform. At these conservative measures of costs and benefits, the project is found to be economically and financially viable (Economic IRR: 15%, Economic NPV: 11 Million 2017 USD, Financial IRR: 28%, Financial NPV: 78 Million 2017 USD).

Acronyms

ATC&C	Average Technical, Commercial and Collection Losses
CBA	Cost Benefit Analysis
DABS	Da Afghanistan Breshna Sherkat
DISCOS	Distribution Companies
EDH	Electricité d'Haïti
EIRR	Economic Internal Rate of Return
ENPV	Economic Net Present Value
GOH	Government of Haiti
IDB	Inter-American Development Bank
IRR	Internal Rate of Return
IPP	Independent Power Producer
KESIP	Kabul Electricity Service Improvement Program
MDB	Multilateral Development Bank
MW	Megawatt
MWh	Megawatt Hour
NPV	Net Present Value
PPA	Power Purchase Agreement
USAID	United States Agency for International Development

Summary and Conclusions

Introduction

This paper argues that to improve the power sector in Haiti, which now constitutes a critical constraint to economic growth, it would be necessary to carry out a significant regulatory and utility governance reform; without these reforms, any physical investment program would be ineffective and unsustainable. All bilateral donors and multilateral development banks should coordinate closely to ensure that all assistance to the power sector is conditioned on tangible and verifiable steps to reform the sector.

An eminent panel convened by the Copenhagen Consensus Center and that included an economics Nobel Prize winner reviewed the paper and ranked it number one among 85 separate submissions[1]. We believe the main reasons that this proposal was ranked number one include: lack of power being a key development issue in Haiti, and using best practices to address sources of past failures in Haiti by all major international donors. The proposed design provides incentives for performance and contains a credible approach to ensure sustainability.

Background

Haiti has the least developed power system in the Western Hemisphere. This is due in part to a weak institutional framework, where several actors interact in an unclear regulatory framework with a lack of strategic coordination and leadership. The Ministry of Public Works Transportation and Communication is the lead government agency in charge of the energy sector, as there is no dedicated Ministry of Energy. Decrees reorganizing the power sector published in January 2016 have called for the creation of a regulatory agency, however, as of the writing of this paper, these decrees have yet to be enforced. The electric utility, Electricité d'Haïti (EDH) runs more than 10 separate, unconnected distribution networks that have average technical, commercial, and collection losses (ATC&C) of 70%. These grids have daily blackouts that have forced most businesses and many households to install generators on their premises as a means of coping. Many observers consider the lack of power one of the most significant constraints to economic growth. Efforts have been made by multiple donors to improve the power system, including the US Agency for International Development (USAID), the Inter-American Development Bank (IDB), and the World Bank, but these attempts have been largely unsuccessful. Lack of success is the result of a failure to reform EDH, which in turn is a result of lack of political will and alleged corruption.

The interventions proposed in this paper would have a systemic effect in the entire country by reducing a key constraint to economic growth. Direct beneficiaries would include present customers of EDH, who will have access to higher quality power and would suffer less unscheduled blackouts. As the EDH units are strengthened, additional customers would be

[1] http://www.copenhagenconsensus.com/haiti-priorise/haiti-priorise-eminent-panel-findings

served. The government of Haiti would also benefit from a decreased need to subsidize EDH. The utility currently receives a US$200 million subsidy annually, a sum which amounts to 10% of annual government budget expenditures.

Proposed Interventions

We propose two types of interventions as part of a package of reforms:

1. **Interventions to improve the legal regulatory framework**. These would be in support of the ministry in charge of energy and a regulator that eventually will become autonomous and accountable. These interventions will initially support the corporatization of EDH and establish the basis for management contracts, leases, concessions and privatization of the different units of EDH. Adequate performance by the GOH during the first three years will trigger a continuation of the program. Potential donors would include USAID and other bilateral donors such as Canada and France. An upper bound for costs for five years would be US$20 million.
2. **Interventions to improve the efficiency of EDH**. These interventions will support the different units of EDH with technical assistance and equipment, mostly meters. It is envisaged that the different units will be managed through management contracts with incentives for performances, leases, concessions, and that the Jacmel utility would be privatized. The IDB and World Bank, as well as bilateral institutions, could be potential donors. Estimated costs for a five-year program would be US$38 million.

The analysis conducted here is based on 50% chance of success for the first phase of the program – intervention to improve the legal regulatory framework. Sensitivity tests show the expected economic net present value would still be greater than zero if the chance of success drops to 8%. Given that the investment in technical support of EDH is conditional on the success of the regulatory and legal reforms, the chance of success will not affect the financial viability of the project for EDH.

Benefits

The most difficult aspect of a project such as this is the estimation of benefits. For these interventions, we have estimated the potential reduction in ATC&C losses using data for a USAID-funded project that supported the energy distribution company in Kabul, Afghanistan (DABS). For the case of Haiti, we have assumed that the reduction in losses would take twice as long, ten years as opposed to five. For the economic benefits, we only valued the reduction in technical losses at the price paid by consumers.

Sustainability

Presently GOH subsidies exceed US$200 million per year. If EDH is strengthened those would be reduced very significantly and maybe would be eliminated, thus allowing the finance of the regulatory costs. Additionally, a small fee on the total revenue of the DISCOS (say 0.3%) would be sufficient to pay for the costs of regulation. Funding the regulator with fees is considered a "best practice" as it reinforces independence of the institution.

Key Milestones.

Milestones for the proposed reform program are shown in Table 1.

Table 1 - Milestones for Haitian Electricity Reform Program

Target	Baseline	Year 3	Year 4 - 13	Year 14 - n
PPP units established	0	5 – 10*	No change	No change
ATC&C losses	70%	70%	Gradual reduction	25%

* Five would be the minimum and 10 the maximum. If the minimum milestone is not met, the program would be terminated.

Precedent

USAID and other donors have been successful in implementing programs like this in other countries. A USAID-funded study that analyzed Public Private Partnerships (PPPs) for infrastructure and concluded that they can only succeed if control is fully vested in new managers through management contracts, leases, concessions, or full privatization. A previous attempt by USAID to improve the operations of EDH failed when the GOH changed the proposed management contract to a purely technical assistance contract. Because of this poor performance, USAID significantly reduced programs supporting the power sector in Haiti and concentrated efforts in Caracol, where an on-going program has demonstrated that ATC&C losses can be reduced to under 10% if competent management is introduced. USAID is now developing the bidding documents to grant a 30-year concession for Caracol. Success with this would validate the institutional feasibility of the main recommendations of this paper.

Risks

Benefits and costs were estimated using conservative assumption. The main risk is that lack of political will and corruption can derail the interventions. Table 2 lists the costs and benefits of the intervention, assuming a 50% chance of success, a commercial loss target of 18% and a technical loss target of 8%.

Table 2 - IRR and NPV from alternative perspectives

Criteria	100% chance of success	50% chance of success
Economic NPV (ENPV) @ 12%	87 Million 2017 USD	40 Million 2017 USD
Economic IRR (EIRR)	18%	17%
Financial NPV (NPV) @ 12%	391 Million 2017 USD	195 Million 2017 USD
Financial IRR	28%	28%

Conclusions

The proposed project would be feasible from the financial and economic points of view. But feasibility depends most importantly on the willingness of the Government of Haiti to implement the proposed reforms. We have been informed that the President of Haiti accepted in principle the recommendations of this paper and that he has named a point person to further discuss next steps. This presents a golden opportunity to reduce or even eliminate a most significant constraint to economic growth. Successful implementation will also require excellent coordination by international donors.

USAID played a key role in introducing CBA in the agricultural and rural road sectors in Haiti. Additionally, USAID funded a training program for GOH officials that included financial, economic, and beneficiary analysis, and project design; as a result, Haiti now has a cadre of very well trained professionals in these areas. USAID should consider introducing CBA for power sector projects in Haiti and elsewhere as an intrinsic component of project design, as was done in the case of the Feed the Future Initiative.

Introduction

This paper deals with Cost Benefit Analysis (CBA) of a project designed to strengthen power sector regulation and improve the efficiency of Electricité d'Haïti (EDH), a state-owned utility.

It is important to note that the authors first had to design a project and then carry out the CBA. They did this using the experience of this paper's lead author in designing development projects at the World Bank, Inter-American Development Bank (IDB), and the US Agency for International Development (USAID). Designing projects like this is usually an iterative process that involves multi-disciplinary teams that include, inter alia, engineers, project design specialists, lawyers, financial analysts and economists. Additionally, and most importantly, this would include a thorough process of consultation with the relevant authorities, officials of EDH, users, etc. Given resource limitations, only very limited consultations were carried out.

Economic development institutions follow a project cycle that begins with a strategy for the sector, identification, pre-feasibility analysis, feasibility analysis, project approval, and monitoring and evaluation. This CBA analysis was carried out using secondary data and represents the level of analysis that would be carried out at the identification stage. Results obtained indicate that a project to strengthen EDH and reduce generation costs would be viable from the economic and financial points of view. If a donor encountered similar results in the real world, the next step would be to fund the necessary studies to move the project through the project cycle. The greatest risks this project would face stem from a lack of political will, and possible corruption driven by those who benefit from the present system.

Several donors have been involved in a multitude of projects designed to improve the operations of EDH but these projects have largely failed or have resulted in minor improvements given the level of resources expended. These projects have been somewhat timid in terms of the reforms or were weakened after approval because of political pressure. For example, a USAID-funded project to strengthen EDH initially contemplated a quasi-management contract, with incentives for performance, where the consulting firm would have significant control of EDH, including hiring and firing of staff. But eventually the Government of Haiti (GOH) converted this contract to technical assistance contract, where the consulting firm was limited in its role to providing advice to the management of EDH and supporting the procurement of some equipment. Improvements of efficiency under this contract were minor. Because of this poor performance, USAID reprogrammed more than $100 million originally intended for the power sector in Haiti, to other sectors in Haiti and to other countries. The USAID-funded program was one of a multitude of efforts by many donors, including also the World Bank and the IDB. It is alleged that a main reason for the failure of programs to strengthen EDH has been corruption and specifically that EDH officers benefit personally from commercial and collection losses.

A more recent and very important initiative has been USAID's support for the Caracol Power Plant. USAID initially provided funding for the construction of 10 MW diesel-fired plant and distribution network. Afterwards, USAID funded a management team under the National Rural Electric Cooperative Association (NRECA) and now ATC&C losses are under 10%, and all other efficiency indicators also have improved. USAID also supported the analysis to estimate costreflective tariffs for Caracol. Presently, USAID is providing funding to develop the necessary bidding document for the award of a 30-year concession for the Caracol Power Plant. If successful, this would validate to some extent the main recommendation of this paper.

USAID has carried out financial analysis of a possible concession and this is being refined by a management-consulting firm hired by USAID. It does not appear, however, that USAID has carried out any cost benefit analysis (CBA) of a multitude of investments in the power sector. This contrasts with the USAID-funded rural road program and agricultural development programs in Haiti, which have been subjected to rigorous financial, economic, and beneficiary analysis.

Power Sector Background

Haiti has one of the least developed power systems in the Western Hemisphere. The electric utility, Electricité d'Haïti (EDH) runs more than 10 separate, unconnected distribution networks that are characterized by very large average technical, commercial and collection losses (ATC&C) and by daily blackouts that have forced most businesses and many households to install generators on their premises; many observers consider the lack of power one of the most significant constraints to economic growth. As discussed above, efforts by multiple donors to improve the power system, including the US Agency for International Development (USAID), the Inter-American Development Bank (IDB), and the World Bank have been largely unsuccessful. Lack of success is the result of a failure to reform EDH, which in turn is a result of lack of political will and alleged corruption.

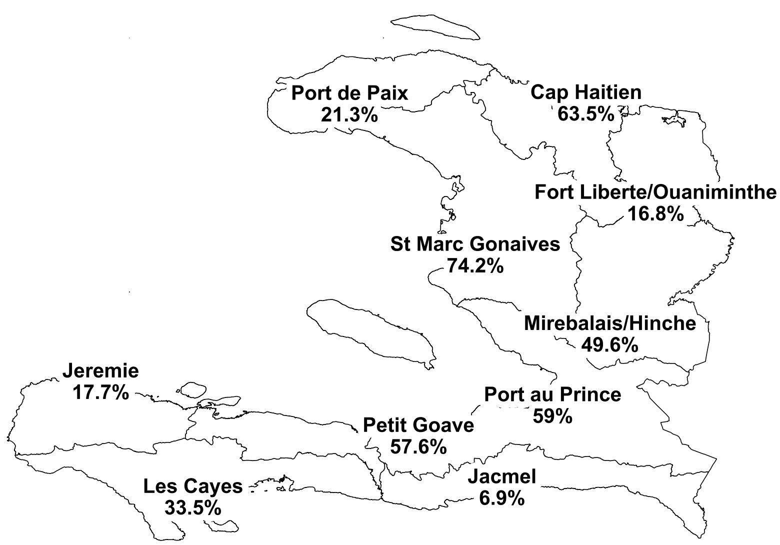

Figure 1 - Haiti grids and the associated ATC&C losses

Installed capacity is about 320 MW, of which 260 comes from generators that burn liquid fuels and 60 MW comes from hydropower. This makes the country highly vulnerable to variations in petroleum prices. Of the 320 MW of installed capacity, only about 55% are available for generation (176 MW). There are independent power producers (IPPs) that signed power purchase agreements (PPAs) through direct negotiation rather than through competitive bidding procedures. EDH rates are on average around $0.30 per kWh, which is relatively high compared the average rates in the Caribbean. Even at these high rates, EDH requires over $200 million per year from the Government of Haiti to enable it to pay for its obligations.

Haiti's power sector faces numerous challenges. Some of the main ones include:

- As discussed above, ATC&C losses are very high and have averaged in recent years around 70 % of total electricity generated; commercial and collection losses account for 70% of total losses or around 49% of total energy produced.
- The electrification rate is one of the lowest in the world. Only about 12% of the population is connected to the grid officially, while an equal percentage are connected illegally.
- There are daily blackouts and customers receive only between 5-15 hours of electricity per day. Therefore, even small businesses and many households must have their own generators and/or batteries and this constitutes an important constraint to economic growth.

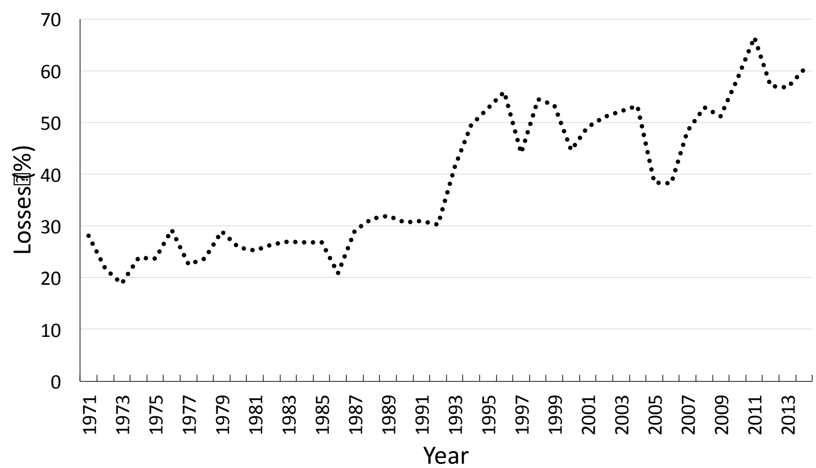

Figure 2 - Average Technical, Commercial and Collection (ATC&C) Losses in Haiti by Year - World Bank (2017)

Context/Literature Review

Haiti's economic condition both influences, and is influenced by, its failing electricity market. Only 35 % of Haitians have access to electricity through grids. In rural areas that figure is 11 % (World Bank, 2015). Per capita consumption of electricity in Haiti is significantly lower than other Caribbean countries, and is only two percent of the neighboring Dominican Republic (World Bank, 2015, p.5).

The inability to access electricity has serious implications for all Haitians, but is especially harmful for commercial and industrial enterprises. The lack of reliable electricity supply is cited by business owners as the most binding constraint to private sector development (World Bank, 2015, p.5). Businesses in Haiti also face some of the highest costs for electricity in the region, making it hard for them to operate competitively. Households also suffer from lack of available power, and are forced to adopt coping strategies such as using small diesel generators to power household appliances, or burning kerosene oil for light. Those Haitians that do have access to electricity through grids face shortages, and it is estimated that those with connections only have electricity for 5-9 hours a day (Worldwatch Institute, 2014, p.26).

Haiti's electricity sector is also a serious financial burden on Haiti's economy. EDH requires a transfer that averages US$200 Million each year to cover operating costs. This is equal to 10% of the national budget or 2% of GDP (World Bank, 2015, p.68). EDH's significant financial losses are partly due to high levels of commercial and technical losses in the electrical grid which prevent EDH from collecting revenue. If EDH could reduce technical losses sufficiently and improve the collection of payments for electricity that is consumed, it is possible that they could operate in a more financially sustainable way and reduce their burden on GOH. Reforming EDH could make other interventions on both the supply and demand side of Haiti's electricity market (which we discuss in other papers we have written as part of Haiti Priorise) more feasible.

While it is hard to predict exactly how reform will play out in Haiti, there is a precedent of large benefits being achieved through power sector reform in other parts of the developing world. The reforms we propose are heavily inspired by the Kabul Electricity Service Improvement Program (KESIP) implemented by USAID in Afghanistan (USAID, 2017). Like Haitians, only 30% of Afghans have access to electricity. Before KESIP, commercial and technical losses were also very high at around 60%, like Haiti. KESIP focused on reforming Da Afghanistan Breshna Sherkat (DABS), the national electrical utility incorporated in 2008. With a bundle of reforms that included commercialization of the utility, changes to the governance structure, installation of smart meters, changes to the procurement processes, performance management and removing illegal connections, DABS saw AT&C losses drop from 60% to 24% in under five years. While it would be unlikely that Haiti would be able to replicate the exact success of KESIB, even a fraction of this level of improvement could make reform feasible.

Other countries have shown the potential benefits of power reform. Kozulj and Di Sbroivacca (2004) looks at electrification rates before and after sectoral reform in Argentina, El Salvador and Peru and finds large increases in all cases. In interviews with colleagues at USAID, it was noted that reforms involving smart meters in Brazil, India and other countries lead to significant drops in non-technical losses, in some cases by as much as 96%.

Theory

Power projects for existing markets can be classified in three types: policy and institutional reform projects, supply projects, and demand side projects. This CBA will be focused on a policy and institutional reform project designed to enhance the power sector policy and regulatory environment and to improve the efficiency of the main off taker of power, Electricité d'Haïti (EDH).

Benefits included in the evaluation of an electricity project fall under two broad categories: (i) reductions in the cost of supplying electricity and, (ii) value of improved access to energy. For instance, if investment in generation results in replacing an inefficient power plant with a more efficient one, then the main source of benefit is the saving that results from efficiency gains. However, if the investment increases the total generation resulting in increased access or improved reliability, then the benefits will mainly result from the value of access or improved reliability for consumers. It is also common to have projects that result in both types of benefits.

Institutional reform of EDH, if successful, can result in a range of benefits listed below.

- Reduction in technical losses;
- Reduction in commercial losses;
- Reduced market risk for IPPs resulting from financial stability of the off taker.
- Reduction in EDH operating costs (improved institutional efficiency); and

Given the inadequate supply of electricity from EDH and the prevailing market trends in distributed generation for consumers of all classes, it is reasonable to assume that any reduction in technical losses should be valued from the perspective of consumers. A reliable estimate for the value of additional electricity in this case would be the coping cost of consumers per unit of electricity obtained from sources other than EDH. To estimate the value one needs to learn about how, on average, consumers of each class use solar panels, batteries, inverters, small diesel, candles, kerosene, or other sources of energy to cope with unreliable supply of power from EDH.

The reduction in technical losses could be valued higher than the market price of electricity if it results in expanding access to high-value consumers who are not currently served. However due to lack of supporting data for a quantitative estimation of additional benefits, they are not included in the model.

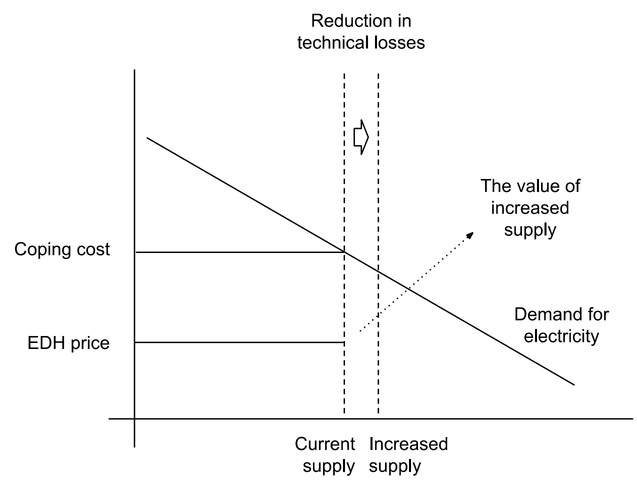

Figure 3 - Impacts of Decreasing Technical Losses

A reduction in commercial losses would not, however, translate to such savings. Commercial losses reflect electricity that is consumed but not paid for to EDH. Consumption comes at a value even if it does not translate to a financial payment to EDH. Therefore, majority of what EDH gains from a reduction in commercial losses is a transfer away from consumers or resellers who do not pay for electricity. One could argue that the value of a unit of electricity consumed and not paid for can be on average lower than the value of a unit of electricity that is consumed and paid for. In other words, consumption will be at inefficient levels when the price is zero. This however can be ignored in this case since the difference is on the margin, and anecdotal evidence reflect that a considerable share of commercial losses result from non-paying resellers of the electricity.

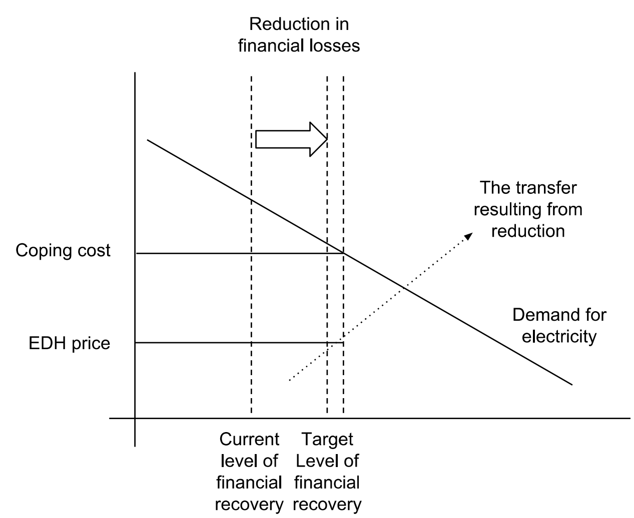

Figure 4 - Impacts of Decreasing Financial Losses

Reduction in commercial losses can result in financial independence and sustainability of EDH, and, in the long-run, reduce the risk for IPPs that EDH is unable to pay for the power. Such risk reduction would reduce the cost of generation from IPPs and the overall cost of electricity to the economy. This benefit is however not included in the model as its estimation process relies on weak evidence.

Overall, a reduction in commercial losses is treated as a pure transfer in this study, maintaining a conservative level of benefits. Similarly, reduction in operating costs of EDH is excluded from the analysis.

The main benefits of the project are a reduction in losses. In terms of CBA, Average Technical, Commercial and Collection losses (ATC&C) can be divided into technical and non-technical. A reduction in technical losses is clearly an economic benefit. In the case of Haiti where there is excess demand for power, a reduction in losses would increase power available to consumers by, among other things, reducing the length and duration of blackouts. The entire reduction in ATC&C losses is a financial benefit for EDH. While a reduction in Commercial and Collection losses would likely result in a reduction of consumption by those users who would start paying for power, we assume in our model that revenue will not decline because there is significant unfulfilled demand in Haiti.

Calculation of Costs and Benefits

Introductory Comments

Financial vs. Economic Analysis

We have carried out both economic and financial analysis. In this and other projects we normally carry out financial analysis from different points of view to ensure that all economic agents have adequate incentives to participate in the project. Financial analysis is also important to ensure sustainability. For the financial analysis of this project, we have included as benefits the entire reduction in ATC&C losses and the costs in direct support of EDH.

Economic analysis allows us to determine if an investment will be advisable from the point of view of the society. For the economic analysis of this project, we only included as a benefit the reduction in technical losses and as costs we included all the costs included in the financial analysis plus the costs of regulation. It is important to note that while some of the costs will be paid by foreign grants, we include these costs in their totality as they could be used to fund alternative investments in Haiti.

Sustainability

Proposed program envisages a combination of foreign expatriates and locals so that eventually there would be no or minimal requirement for expatriate support. Eventually, the regulator should charge fees to the regulated enterprises based on the value of power at the consumer level; this is considered a "best practice".

Investment Criteria and the Chance of Success

The analysis conducted in this model results in two streams of net cash (resource) flow. The first one is the financial net cash flow from the perspective of EDH, and the second one is the economic net resource flow from the point of view of the country. The reduction in commercial and collection losses is not included as a benefit from the economic point of view as it represents a transfer. However, from EDH's perspective reduction in all ATC&C losses translate to increased financial earnings. The economic resource flow will also include the costs associated with the regulatory and legal reform which sets up the environment outside EDH during the first phase of the program. The benefits and costs of both net cash (resource) flows in the second phase of the program will depend on the chance of success. To estimate the expected investment criteria, we introduced a parameter called the “chance of success”, which is shown as α in the formula and is used to adjust the costs and benefits of the second phase (C_2 and B_2 respectively). Alternative criteria can be reported using these net cash (resource) flow statements including the net present value (NPV) and internal rate of return (IRR).

$$\boldsymbol{Expected\ NPV = \alpha B_2 - C_1 - \alpha C_2}$$

In this formula $B2$ represents the benefits of the second phase, $C1$ represents the costs of the first phase, and $C2$ represents the costs of the second phase. Please note that the first phase itself has no benefits as it is only about building the infrastructure to enable the environment for the second phase. In other words, the costs of the first phase are the costs associated with having the opportunity to conduct the second phase. Each of these criteria can be estimated for the financial net cash flow or the economic net resource flow.

Project Costs

We have carried out a CBA of a project that has two distinct sets of activities and 2 phases. In our proposed intervention, Phase I would last three years (years 0 to 2) and would develop the minimum conditions for the success of Phase II. Given all the past failures of donor-funded projects, if the Government of Haiti (GOH) does not demonstrate commitment to reform, Phase II would not be supported. The second phase is focused on supporting EDH units in charge of generation, transmission, and distribution of electricity. Table 3 details the assumptions behind the costs of each phase II by category.

The cost assumptions are based on USAID programs funded in Haiti and in other countries. It is assumed that an international management consulting firm will be engaged in the beginning, so the costs include overhead and profit. The costs will later drop for both activities as the staffing composition transitions from international staff to local hires to ensure sustainability.

Table 3 - Costs across time by activity

Years	0-2	3-4	5-7	8-9	10-12	13-22	23-32
Regulatory and legal costs	2.80	2.80	0.3	0.3	-	-	-
EDH Support	-	7.6	7.6	1.6	1.6	1.1	0.6
Total cost	2.8	10.4	7.9	1.9	1.6	1.1	0.6

The flow of is also presented in the figure below.

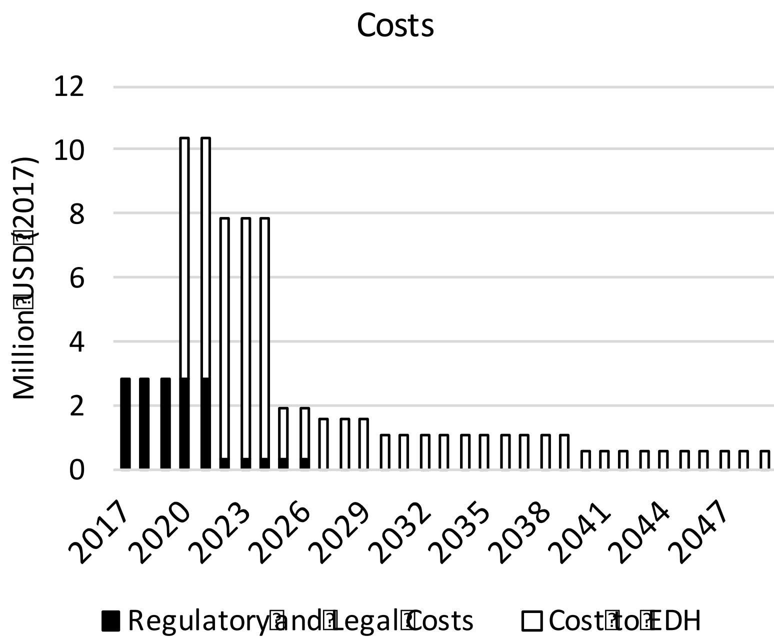

Figure 5 - Costs over time

Costs of Strengthening the Regulatory Capacity of the GOH

Significantly more private participation in the sector would likely be the main instrument to improve performance. To achieve this, it would be necessary to enhance the regulatory capacity of the GOH. It is estimated that a team of five expatriate during five years and five Haitian during ten years would be needed. We also consider that training under the National Association of Regulatory Utility Commissioners (NARUC) be provided. These foreign and Haitian professionals would lead the institutional reform of EDH and develop the privatization and concession terms for different units of the utility. It is envisaged that, given the small market in Haiti, the scheme used would be "regulation by contract" rather than more sophisticated market designs followed by most countries in Latin America.

Costs of EDH Support Component

In the past, USAID financed a project to strengthen EDH but that project essentially failed. The main reason for the project's failure is that actual implementation did not follow the initial project design. USAID originally agreed to fund a quasi-management contract whereby a team of consultants would administer EDH with full powers to take management decisions, including developing a corporate strategy, and hiring and firing staff, as necessary. Eventually, because of political pressure, the contract was changed to a technical assistance type of contract where the consultants provided support to the management of EDH but had no power to take key management decisions. During this USAID-funded project, numerous issues were identified. The main ones were:

- Political interference. Several directors have been replaced after short tenures and many projects undertaken were not justified from the economic or financial points of view.

- Alleged administrative corruption. It has been alleged that EDH employees collude with clients to enable them to avoid paying for power consumed.
- Overemployment of unqualified staff. A significant proportion is unqualified and lacks sufficient basic knowledge to be able to benefit from training programs.
- Lack of knowledge and skills in information technology (IT). Lack of basic IT skills makes it very difficult to modernize billing and financial management.
- Poor donor coordination. Many donors implement programs in isolation, without considering what other donors are doing, thus wasting resources.

Given the problems discussed above, a classical investment project to support EDH, such as funding meters and Information Technology (IT), would not be very effective. Similar projects have indeed been recently carried out with the support of the World Bank and did not lead to significant results toward reductions in ATC&C losses. We have carried out the CBA of EDH activities under the basic assumption that the Government of Haiti (GOH) will introduce greater private participation in the 10 units of EDH. Given that the different units have widely different levels of efficiency, as measured by ATC&C losses, the solutions for each would vary. We believe there is scope for a management contract with incentives for performance, leases, concessions, and full privatization. These options are very tentative and are presented for illustrative purpose. The next step would be to hold in-depth discussions with the GOH and potential donors. The options are summarized in the table below.

Table 4 - Proposed Management Structures

Publicly Owned & Managed	Publicly owned & managed	Publicly owned; managed by private firm under management contract with incentives for performance	Lease	Concession	Privatization
No technical assistance	Technical assistance to state managers; investment in technology including meters	Management contract with incentives for performance	Private firm operates & maintains; investment funded by public sector	Private firm operates & maintains; investment by private firm	Private ownership & management
	USAID-funded project failed to improve performance of EDH	--Port Au Prince --Petit Goave --St Marc Gonaive --Cap Haitien --Mirabalais/ Hinche	--Les Cayes	--Fort Liberte --Port de Paix --Jeremy	--Jacmel

For this scheme to work properly, it is also necessary to carry out a reform of the sector. Most importantly would be to establish an independent and accountable regulator.

Project Benefits

Estimating potential reductions in ATC&C is, obviously, highly speculative. We will use data from a USAID-funded project (KESID) with the energy distribution company in Kabul, Afghanistan (DABS) as a benchmark for estimating those reductions in losses in EDH. Before the USAID-funded project, losses in DABS were 60%, like EDH, and there was political interference, lack of trained staff, and many of the other problems presently faced by EDH. Below are the estimated losses in DABS (Kabul).

Table 5 - Estimated DABS ATC&C losses

	Year 1	Year 2	Year 3	Year 4	Year 5
Losses	60%	53%	31%	28%	24%
Benefits	0%	7%	29%	32%	36%

While improving the operation of DABS in a highly conflictive and corrupt environment was very challenging, it might be more difficult to achieve similar results in Haiti. Therefore, we will assume that the rate of improvement of the ten units of EDH will take twice as long as the improvement in DABS. Total losses in EDH would decline steadily from 70% to 25% in ten years starting in Phase II; technical losses would decline during the same period from 21% to 8% and commercial and collection losses drop from 49% to 18%. This drop is illustrated in Figure 6.

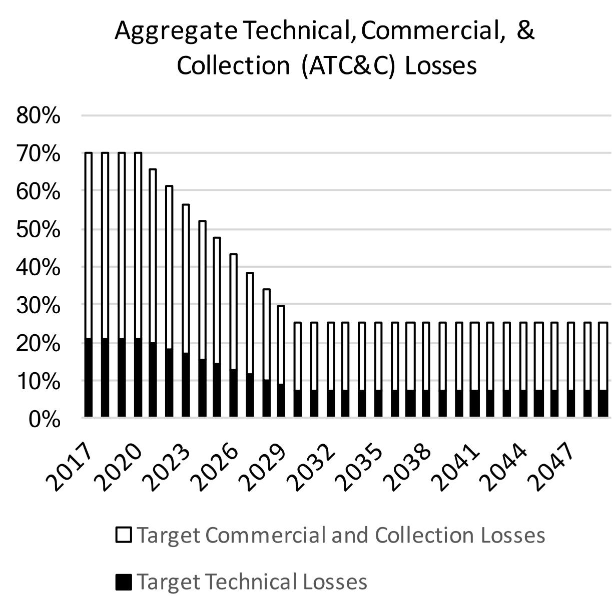

Figure 6 - Aggregate ATC&C losses over time

The reduction in losses are valued at US$0.30 per kWh. Knowing the amount electricity generated by EDH (875,000 MWh per year), the value of the averted losses is presented in . Please note that this is a conservative estimate as it assumes no growth in generation.

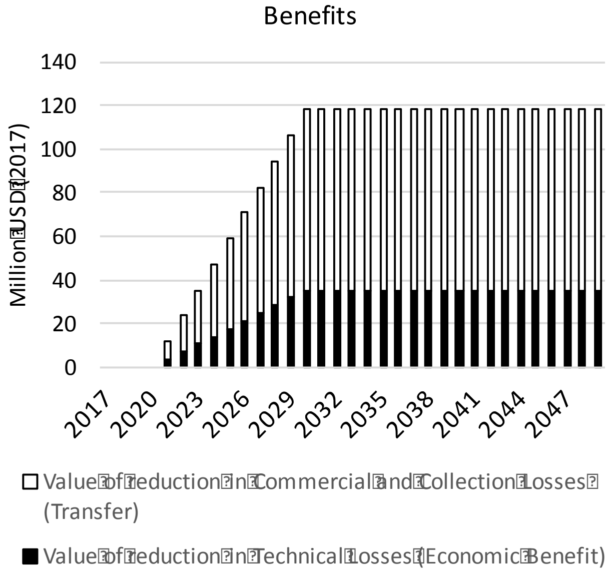

Figure 7 - Value of averted ATC&C losses

Summary of Costs and Benefits

The net cash (resource) flow is illustrated in Figure 8 based on 100% chance of success. Table 6 summarizes the investment criteria estimates under 100% chance of success as well as 50% chance of success.

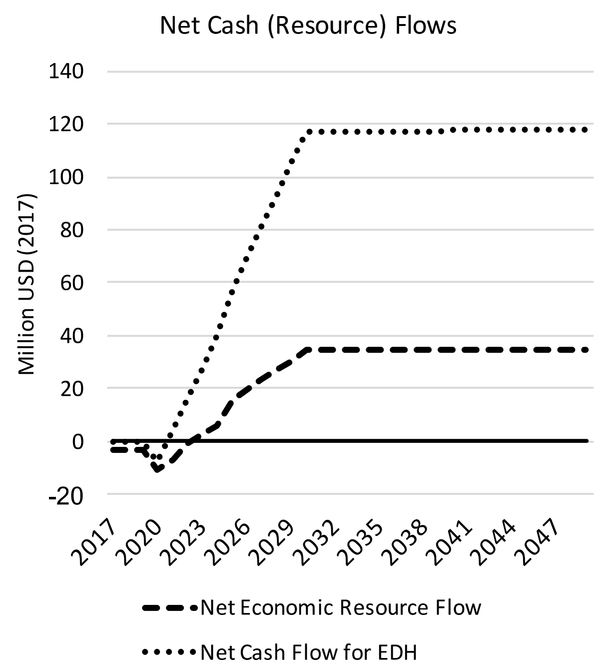

Figure 8 - Net Cash (Resource) Flow over time

Please note that the IRR in Table 6 is estimated using the modified IRR function at 12% reinvestment and financing rates.

Table 6 - Summary of investment criteria

Criteria	100% chance of success	50% chance of success
Economic NPV (ENPV) @ 12%	87 Million 2017 USD	40 Million 2017 USD
Economic IRR (EIRR)	18%	17%
Financial NPV (NPV) @ 12%	391 Million 2017 USD	195 Million 2017 USD
Financial IRR	28%	28%

Sensitivity Analysis

The tables in this section summarize the sensitivity of the expected NPVs and IRRs (based on the chance of success) to various parameters. These parameters include the chance of success (Table 7), discount rate (Table 8), target for collection and commercial losses (Table 9), and target for technical losses (Table 10).

Table 7 - Sensitivity of expected results to chance of success

	ENPV	EIRR	FNPV	IRR
1%	(7)	5%	4	28%
8%	0	12%	31	28%
50%	40	17%	195	28%
70%	59	18%	274	28%
100%	87	18%	391	28%

Table 8 - Sensitivity of expected results to discount rate

	ENPV	FNPV
5%	142	559
10%	57	257
12%	40	195
15%	23	134
20%	8	76

Table 9 - Sensitivity of expected results to target level of collection and commercial losses

	ENPV	EIRR	FNPV	IRR
7%	40	17%	244	29%
12%	40	17%	221	29%
18%	40	17%	193	28%
25%	40	17%	161	27%
30%	40	17%	137	27%

Table 10 - Sensitivity of expected results to target level of technical losses

	ENPV	EIRR	FNPV	IRR
4%	56	18%	212	28%
6%	47	17%	202	28%
8%	37	17%	193	28%
10%	28	16%	184	28%
15%	5	13%	161	27%

We may also wish to consider a scenario where multiple variables deviate from our estimates, a worst-case scenario so to speak, to see if the project is expected to generate a positive net benefit. Such a scenario can make the following assumptions:

1. A target of 30% for commercial losses;
2. A target of 15% for technical losses; and
3. A 10% probability of success.

The results of this scenario are summarized in Table 11.

Table 11 - Results under the worst-case scenario

ENPV	EIRR	FNPV	IRR
3	13%	40	28%

As one case see, the results are robust even under a conservative estimate with worst-case assumptions.

Conclusion

The proposed interventions would be highly beneficial to the Haitian economy. Using conservative estimates of costs and benefits, the economic NPV (ENPV) would be 40 Million USD 2017 (assuming a discount rate of 12%). The greatest risk to reform is that lack of political will and corruption will impede the actions necessary to improve the efficiency of EDH. This risk is high, as past efforts by all main international donors, including USAID, the World Bank and the IDB have failed. To mitigate that risk, we have proposed that donors impose strict conditions to fund the full program. Specifically, we believe that unless some key reforms are implemented during the first three years of the proposed program, all future activities not be supported. The analysis was done without consultation with key stakeholders and could be considered less than what a donor would do at the identification stage in the project development cycle. The next step would be to discuss with the GOH, potential donors, and all other main stakeholders.

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