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# **Ex-post Evaluation of the Additionality of a Clean Development Mechanism Cogeneration Project in Uganda: the significance of changes in project financing and background economic conditions**

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## **Abstract**

In this paper I evaluate the additionality of a Clean Development Mechanism (CDM) bagasse cogeneration project at Kakira Sugar Works (KSW) in Uganda using what I refer to as an *ex-post* comparative baseline approach that accounts for how background economic conditions and project financing evolved over the project's 7 year crediting period from 2008-2014. The CDM project claims that CDM financing was necessary for the expansion of bagasse cogeneration capacity, the surplus electricity from which has been exported to displace emissions associated with Uganda's national grid. Evaluation of the conditions of background additionality led to the identification of important changing incentives for cogeneration: the introduction of Uganda's renewable energy feed-in-tariff, which by 2011 equalled tariff rates originally requested by KSW for expansion, as well as rising domestic sugar prices. At the same time, emissions associated with Uganda's national grid came down because large hydroelectric generating capacity came online around 2011-2012 while the actual amount of electricity that KSW was able to generate was found much reduced compared to their *ex-ante* assessments. In terms of project finance additionality, the firm received considerable financing from the World Bank and other donors before and during the CDM crediting period which was not reported in the CDM project's baseline. Bringing these evaluations of the two dimensions of additionality together in a quantitative manner, the CDM is found to have accelerated the capacity of KSW to reduce emissions associated with Uganda's national grid, but not at the rate claimed in the CDM project documents—only about one-third of carbon credits claimed under the CDM were found genuine. The conditions of additionality can change significantly over the course of a CDM project in a way that undermines project environmental integrity because the CDM rules do not accommodate changing baseline conditions. I recommend that a reformed CDM, NAMA or other new market mechanism adopt some of the elements of the approach used here including use of comparative performance benchmarks, an additionality risk management tool and engaging donors in the development of "ODA-baselines" for climate mitigation projects which combine carbon finance and development assistance.

## Introduction

This paper offers a detailed evaluation of the additionality claim of a Clean Development Mechanism (CDM) bagasse cogeneration project in Uganda using what I refer to as an *ex-post* comparative baseline approach. The primary concern with the CDM is that carbon credits are not truly fungible with emission reductions in developed countries against which they are traded. This issue is discussed in the climate policy literature under the term “additionality” (Purdon and Lachapelle, 2012). According to the UNFCCC, “A CDM project is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity” (UNFCCC, 2001:para.43). The real difficulty in the evaluation of additionality is determining an appropriate baseline against which the emission reductions of a CDM project are measured (Dutschke et al., 2006; Gillenwater, 2011; Meyers, 1999; Shrestha and Shrestha, 2004). The baseline is to “reasonably represent” the emissions scenario if the CDM project did not exist, which requires that the project developer adhere to a sector specific baseline methodology (UNFCCC, 2001:para.43). In practice, these methodologies typically require that additionality be assessed at only project inception through a counterfactual exercise that identifies a baseline scenario of what emissions would have been without the CDM intervention. But because this counterfactual scenario is defined by project developers themselves, there is concern that information regarding the baseline is misrepresented and that, in reality, many projects would have been implemented “anyway” in the absence of the CDM (Lohmann, 2005; Wara, 2008; Wara and Victor, 2008).

The present study is unique in that the additionality of a CDM bagasse cogeneration project in Uganda, the Kakira Sugar Works Ltd. (KSW) Cogeneration Project (CDM-PDD, 2007), is evaluated *ex-post* over the project’s crediting period using information obtained through field-based observation and detailed policy analysis. Essentially, the conditions of additionality were evaluated by comparing the baseline conditions claimed in the CDM project documents with new baselines informed by investigation of how CDM project financing and background economic conditions changed over its crediting period from 2008-2014. Such empirical research into CDM projects is scarce. Despite the attention the CDM has received, most research into additionality has relied on information presented in CDM project documents (Alexeew et al., 2010; Au Yong, 2009; Ganapati and Liu, 2008; Michaelowa and Purohit, 2007; Schneider, 2007)—the author knows of only one study that has sought empirical evaluation of additionality (Zhang and Wang, 2011). But CDM project documents are prone to information asymmetries which problematizes the evaluation of additionality claims (Wara, 2008; Wara and Victor, 2008). It is difficult to justify the evaluation of additionality based on information presented in CDM project documents because it is precisely the information which they contain that is held in question. The lack basic empirical research into CDM additionality frustrates our understanding of the conditions under which CDM or similar carbon finance instruments are effective and why. In the CDM project investigated here, KSW claimed CDM financing was necessary for the expansion of bagasse cogeneration capacity, the surplus electricity from which has been exported to Uganda’s national grid where it is claimed to have displaced 378,793 tonnes of emissions—largely from fossil fuel power generation (CDM-PDD, 2007: 2-3, 15). This is based on (i) the export of 12-14 MW of electricity from the KSW cogeneration plant to Uganda’s national grid per year assuming (ii) that this displaced an average of 54,113 tCO<sub>2</sub>e of emissions per year from

Uganda's national grid, a figure itself derived from an estimate that KSW produced 103,606 MWh of electricity per yr and associated with a grid expansion factor of 0.5223 tCO<sub>2</sub> per MWh per year (see CDM-PDD, 2007: 24-25).

Yet the investigation here demonstrates that only approximately one-third are genuine. I estimate that 31% of credits claimed are bogus because of changes in background economic conditions that affect additionality. These include Uganda's renewable energy feed-in-tariff (REFIT), which by 2011 equalled tariff rates originally requested by KSW for expansion, as well as rising domestic sugar prices. At the same time, emissions associated with Uganda's national grid are found reduced because of considerable hydroelectric generating capacity coming online around 2011-2012 while the actually amount of electricity that KSW was able to generate was considerably lower than their *ex-ante* assessments. I estimate that 35% of the claimed carbon credits are bogus because of violations of the conditions of project finance additionality. Though KSW indicated argued that project financing was a major obstacle, the firm actually received considerable official development assistance (ODA) from the World Bank and other donors before and during the CDM crediting period which should have been incorporated in the CDM project's baseline. Donor financing before the CDM project allowed KSW to export 5-7 MW of electricity; this means that the CDM project really only enabled KSW to export an additional 7 MW to Uganda's national grid—not the 12-14 MW claimed in the CDM project documents (CDM-PDD, 2007: 2-3). Altogether, the analysis suggests that the CDM has accelerated the capacity of KSW to export renewable electricity and reduce emissions on Uganda's national grid, but not at the rate claimed in the CDM project documents

## Methods

### Project Selection and Field Effort

Fieldwork to investigate the KSW CDM cogeneration project was undertaken during May-June 2009, including a site visit to KSW sugar factory in Jinja district in eastern Uganda. At this point, KSW was actively pursuing the project under the CDM. The firm withdrew from the CDM process in 2011, ostensibly because of changes in the CDM methodology that have reduced the amount of carbon credits the project could generate (Naus, 2010: 91). Only one other CDM bagasse cogeneration project was taking place in Uganda in 2009, at the Kinyara Sugar Factory (CDM-PDD, 2008). However, logistical constraints prevented visit to this project, which is located in northwestern Uganda.

Fieldwork included semi-structured interviews with key informants as well as the identification of important policy documents. District-level interviews included discussion with individuals in government, the private sector and NGOs during which I sought to understand district administrative procedures affecting the CDM project and evaluate the KSW cogeneration project in relation to other district development efforts (n=12). National-level interviews with individuals in the government, private sector, NGOs and amongst donors focused on climate change and development policy (n=22). The technical evaluation of additionality proceeded through 2014, drawing on information obtained during fieldwork and updated regularly through review of relevant policy documents.

## Ex-Post Comparative Baseline Approach

I examined additionality claims using what I refer to as an *ex-post* comparative baseline approach. A comparative approach helps resolve two issues with the CDM. First, are concerns about the counterfactual baseline scenario against which carbon credits are claimed. Given asymmetric information between project developers and those charged with monitoring the claims they make in CDM project documents, it is difficult to assess the validity of the counterfactual scenario (Lohmann, 2005; Wara, 2008; Wara and Victor, 2008). Comparative approaches are superior to counterfactual approaches because “All causal analysis also requires comparison. Without comparison, there can be no counterfactual: what would have happened to outcome (Y) if there were no intervention (X) or if the intervention (X) had been different?” (Langbein and Felbinger, 2006: 59). Basically, comparison allows us to make better inferences about what the counterfactual actually would have been. Comparative methods have a strong tradition in the natural and social sciences—for example, Galileo’s demonstration of gravity (Gamow, 2002 [1962]: 22-25).<sup>1</sup> One apparent reason that the CDM architects preferred counterfactuals is that data for comparative performance benchmarking has been largely unavailable in developing countries and its acquisition would significantly increase the CDM’s transaction costs.

Second, the *ex-post* comparative baseline approach allows investigation of how socioeconomic conditions have changed over a project’s crediting period. Almost all CDM methodologies allow project developers to use what I call a frozen baseline approach, whereby historical emissions at the point of the CDM project’s inception are “frozen” and expected to remain the same for the duration of the project’s 7-10 year crediting period (IEA, 2009: 69-93; Purdon, 2009: 60-62). There have been three approaches to the selection of the most plausible CDM baseline scenario—the reference to “Paragraph 48” in CDM project documents (UNFCCC, 2005: para 48(a-c)). These included baseline approach 48(a), “Existing actual or historical emissions, as applicable,” and baseline approach 48(c), “The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category.” Both baseline approach 48(a) and 48(c) have the effect of freezing the *ex-ante* baseline scenario over the entire crediting period.<sup>2</sup> The “additionality tool” for the latest version of the CDM consolidated methodology permits the continued use of frozen baselines.<sup>3</sup> For the

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<sup>1</sup> Galileo’s demonstration of gravity famously involved comparing the speed of two balls of the same size but different weight, dropping them from the Leaning Tower of Pisa. One was made of metal and the other wood. Note that Galileo did not ask what would have been the speed of the metal ball if it had been made of wood.

<sup>2</sup> Baseline approach 48(b) anticipated “Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment”; however, this baseline approach has been used in few CDM projects.

<sup>3</sup> Paragraph 20 of the *Tool for the demonstration and assessment of additionality, Version 07.0.0* (UNFCCC 2012) reads “Identify realistic and credible alternative(s) available to the project participants or similar project developers that provide outputs or services comparable with the proposed CDM project activity. These alternatives are to include: (a) The proposed project activity undertaken without being registered as a CDM project activity; (b) Other realistic and credible alternative scenario(s) to the proposed CDM project activity scenario that deliver outputs services (e.g. cement) or services (e.g. electricity, heat) with comparable quality, properties and application areas,

project investigated here, KSW actually failed to define its baseline approach but it is clear that it had opted for existing actual or historical emissions (48(a)). For example, the project developers used approved consolidated baseline and monitoring methodology ACM0006 (Version 06, Sectoral Scope 01) which is based on a grid emission factor based on data for the three years prior to the project’s inception, 2005-2007 (CDM-PDD, 2007: 18-22; CDM EB, 2006: 27-34). The use of frozen baselines has important implications when it comes to changing policy conditions that offer incentives for low-carbon development. With the intention of reducing conflicts of interest between the generation of carbon credits and domestic policies that also have the effect of reducing emissions, the CDM Executive Board decided in 2005 that changes in government policy during a CDM project’s crediting period would not be counted as a change in baseline conditions (CDM EB, 2005). Thus if a renewable energy subsidy were implemented during a CDM project’s crediting period, the CDM project developer can use the original baseline emissions scenario without the subsidy—which it is in their interests to do as this allows them to claim more emission reductions. The reason the CDM architects decided in this manner was to avoid generating a perverse incentive for government to retain polluting policies—and thus benefiting CDM project developers. But as some observers have noted, this has meant that the CDM Executive Board “disabled their own additionality criteria” (WFC, 2009: 4). While the goal of generating favorable investment conditions is worthy, there has been insufficient research to gauge whether the current design is appropriate. Research presented here seeks to fill this gap.

### ***KSW’s Original Additionality Claim***

Before describing the two elements of my ex-post comparative background approach in detail, it is worth considering KSW original additionality claim. This has been based on the grounds that carbon finance was necessary to incentivize KSW to produce additional, renewable electricity for Uganda’s national grid. More specifically, KSW claimed in the CDM project document that the cogeneration project would result in 378,793 tCO<sub>2</sub>e in emission reductions over the 2008-2014 CDM crediting period (Table 1). How well does this additionality claim stand up to scrutiny? To examine this additionality claim, I break it down into a number of elements referring to conditions of background economic additionality and project finance additionality.

**Table 1: Original Carbon Credits Schedule in CDM-PDD**

Year	Total Generation Capacity	In-House Capacity	Export Capacity	Estimation of Baseline Emission Reductions
	MW	MW	MW	tCO <sub>2</sub> e
2008	16-18	4	12-14	46,025
2009	16-18	4	12-14	46,025
2010	16-18	4	12-14	57,349
2011	16-18	4	12-14	57,349
2012	16-18	4	12-14	57,349
2013	16-18	4	12-14	57,349
2014	16-18	4	12-14	57,349
Total				378,793

\*Source: (CDM-PDD, 2007: 24-25)

taking into account, where relevant, examples of scenarios identified in the underlying methodology; (c) If applicable, continuation of the current situation (no project activity or other alternatives undertaken).

In terms of conditions of background economic conditions, economic factors such as electricity tariffs or rising sugar prices are not discussed in the CDM project document. KSW further claimed that the energy generated from bagasse would enter the Uganda electricity grid and *displace* fossil fuel consumption from thermal generators: “The export of bagasse-based power will displace equivalent power from the grid where the Government’s recent expansion has come largely from fossil fuel based power stations” (CDM-PDD, 2007: 3). However, this is based on an *ex-ante* estimation of the amount of electricity KSW would have produced as well as the emissions associated with Uganda’s energy mix.

In terms of project financing, the CDM project developers argued that securing financing through traditional private sector channels was not possible because Uganda “has limited access to global capital markets while local banks charge high interest rates” (CDM-PDD, 2007: 14). KSW continued that “Although there are international banks that offer loans in Uganda, the process to get such loans is long and complex, since foreign banks are generally not willing to lend for long terms in the country without significant levels of guarantees and secured currency” (*Ibid.*). This led the firm to conclude that “the high cost of borrowing would make this [CDM] project very expensive and would make it unlikely to be implemented without [carbon] revenues” (*Ibid.*). KSW also pointed out that the “proposed project activity is the ‘first of its kind’ in Uganda;” consequently, “Since these technologies are not typically used in a sugar factory in East Africa, their use becomes a technological barrier” (CDM-PDD, 2007: 15). Because KSW would “have to acquire new knowledge and expertise regarding these issues. The incentives of the CDM would help to ease the acquisition of this knowledge” (*Ibid.*).

There is good deal of truth to claim that private financial resources were not available to KSW for the project. In its *Rural Electrification Strategy and Plan 2001-2010*, the government targeted a rural electrification rate of 10% by 2010 and the establishment of the Rural Electrification Agency (REA) to see the target reached (MEMD, 2002b). Uganda posts some of the lowest electricity usage rates in East Africa which, in 2009, stood at 9% nationally and 2% in rural areas (ERA, 2010a: 6). The REA has sought to spur investment in the sector by offering the private sector subsidies if investing in amongst rural electrification projects the agency has identified (REA, 2006: 31-38). However, due to a lack of private sector interest, attributed to “perceived risks and low returns,” the REA has recently shifted its focus “to sector agencies and development partners and a number of projects have been funded by the Government of Uganda and development partners” (OAG, 2011: 17-18).

KSW followed a similar strategy: as I demonstrate below, despite a lack of private sector financing, KSW has been able to obtain significant donor support. Nonetheless, KSW has stated in the CDM project documents that “There is no [developed country] public funding in the Uganda KSW Cogeneration project activity...The project shall not make use of Official Development Assistance (ODA), nor result in the diversion of such ODA” (CDM-PDD, 2007: 8). As discussed earlier, such a statement is required to address issues surrounding donor financing.

### ***Background Economic and Project Finance Baseline Conditions***

The first step of the *ex-post* comparative baseline approach was to compare baseline conditions used in the CDM project documents with conditions informed by investigation of how CDM



project financing and background economic conditions changed over the project's crediting period. In reality, both financial incentives and background economic conditions can change over the 7-10 year window during which a CDM project can claim credits.

### **Background Economic Baseline Conditions**

Background economic baseline conditions refer to conditions that are driven by political and economic events outside the control of a CDM project developer. Evidence of changing background economic baseline conditions proceeded by first considering how the CDM cogeneration project compared with similar cogeneration efforts underway in Uganda but not claiming carbon credits and how the presence or absence of non-CDM cogeneration projects changed over time. In other words, a project's additionality claims was evaluated by considering a project within its development context—something that the CDM architects refer to as “common practice analysis” (CDM EB, 2007b).

Second, I considered factors that might explain sector-wide changes in the presence (or absence) of cogeneration projects. Important incentives for cogeneration include Uganda's REFIT as well as a rise in sugar policy—however, this could only be validated through a detailed review of project financing for KSW's expansion. As explained in more detail below, the expansion of cogeneration has relied on a combination of electricity tariff rates, donor financing and the CDM. There is thus some overlap between the analysis of changes in background economic baselines and project financing.

A third element of background additionality is the amount of emission reductions resulting from new cogeneration capacity. Evaluation of this element focused on changes to the amount of renewable energy generated by KSW and the grid expansion factor which is used to convert KSW's generating capacity into reductions on Uganda's national grid—both derived from power generation data acquired *ex-post* through 2013 and extrapolated for 2014. This contrasts to the method used in the CDM project document where such data is frozen to the period 2005-2007 (CDM-PDD, 2007: 17).

The grid emissions factor itself is calculated as a complex weighted average of emissions per MWh per year from facilities across Uganda. The grid emissions factor effectively describing the amount of emissions associated with electricity generated in the country, though restricting these calculations to data acquired 2005-2007. The CDM project documents describe this process in detail, which is based on the calculation of a “combined margin” itself consisting of an “operating margin” (OM) and “build margin” (BM). See appendix for a more technical description of this method. For the CDM project, the average OM emissions factor was calculated *ex-ante* using data from 2005-2007 (CDM-PDD, 2007: 17); while the BM emissions factor used the so-called “Option 1” accounting rule which allowed the project developer to calculate BM based on only the most recent information (CDM EB, 2007a: 13)—in this case, data available in 2007 when the project was conceived (CDM-PDD, 2007: 18). Notably, an *ex-post* accounting rule for BM is a second option under this CDM methodology (CDM EB, 2007c: 4), though the CDM methodology leaves the selection of the *ex-ante/ex-post* approach to the project developer.

In recalculating the grid emissions factor, I used a tool developed by Praher (2008) for the Ugandan context as well as appropriate conversion factors found in the CDM project document itself. The tool facilitates the conversion of power generation into emissions based on type of

power producer (large hydro, thermal or renewable energy), fuel consumption and fuel type (heavy oil, diesel or natural gas).

### **Project Finance Baseline Conditions**

Project finance additionality is concerned with the financial barriers that would have prevented a project from proceeding if not for the support provided by the CDM. Financing is not the only barrier to the implementation of a CDM project—technological barriers and barriers due to prevailing practice are also recognized (CDM EB, 2011b)—but it is by far the most important. In this study, we established a project finance baseline by reconstructing the financial history of the expansion of KSW’s cogeneration capacity in order to determine if funding sources not reported in the CDM project documents were used. New financial opportunities that arise over the course of a project’s crediting period can complicate the evaluation of additionality because they alter the initial baseline.

Because many CDM projects are also attractive targets of donor financing, the focus of the investigation has been on ODA and the identification of what Asuka (2000) refers to “ODA-baselines”—though also noting the importance of Uganda’s electricity tariff rates, which have interacted with ODA in an important way in this project. The CDM’s initial rules emphasized “that public funding for clean development mechanism projects from [developed countries] is not to result in the diversion of ODA and is to be separate from and not counted towards the financial obligations of [developed countries towards ODA]” (UNFCCC, 2001: preamble). Developing countries sought such a provision because of their concern about the diversion of ODA towards the generation of carbon offsets, which was already in the interests of developed countries as a way of reducing their compliance costs with the Kyoto Protocol. However, there are good reasons to combine ODA and CDM financing, particularly the promotion of projects in areas in least developed countries (World Bank, 2009b). In this regard, the OECD decided in a controversial decision that ODA could be used for everything except the final purchase of CDM carbon credits (OECD, 2004).

However, in practice distinguishing between carbon finance and ODA has proven difficult. The CDM simply requires that the project developer affirm that “any public funding does not result in a diversion of ODA and is separate from and is not counted towards [ODA commitments of developed countries]” (UNFCCC, 2005: Appendix B, para(f)). Developed countries have specific rules about reporting on their ODA contributions. Many observers find the language of the CDM rules to be unclear—particularly the purposes to which ODA can be legitimately allocated and from which it is not to be diverted (Dutschke and Michaelowa, 2006). As the results presented here suggests, project developers often interpret the rules to mean that ODA *cannot* be used in CDM projects—thus leading to the under-reporting of the use of ODA.

### **Quantitative Evaluation of Additionality**

After evaluating the conditions of background additionality and project financing, the second step of the comparative baseline approach was to quantitatively evaluate how these changing additionality conditions affected the amount of genuine carbon credits generated. All CDM project documents quantify *ex-ante* emissions associated with the counterfactual baseline scenario as well as those anticipated with the CDM project scenario—indeed, it is the difference between these two from which carbon credits are derived.

The quantitative evaluation of additionality relied upon the specification of *ex-ante* emissions in the CDM project documents, which offers a short-cut for modeling additionality over time. First I converted *ex-ante* emission reductions to reflect changing background additionality conditions derived from my *ex-post* analysis of KSW's actual energy production and Uganda's grid emissions factor. Second, was to incorporate findings from my evaluation of changes in the conditions of project finance additionality. This required a method for disentangling emission reductions due to ODA and Uganda's REFIT from the CDM. First, I determined the amount of KSW's generating capacity due to ODA and the REFIT, again accounting for changes over time. This was derived from a detailed reconstruction of the financial history of the different stages of the KSW cogeneration project and the generating capacity associated with each stage. Second, I estimated the share of emission reductions claimed by the CDM that are really due to these other interventions—a share which I describe as a financial additionality emissions factor ranging from 0 to 1. For example, because ODA is responsible for 5-7 MW of the 12-14 MW that KSW exports onto Uganda's national grid, I assign it a financial additionality emissions factor of 0.5 (5-7 MW  $\approx$  one-half of 12-14 MW).

There is a certain limitation in the *ex-post* modeling approach as it was based on fieldwork undertaken in 2009 and subsequent analysis through early 2014, while the crediting period of the KSW CDM cogeneration project is scheduled to come to a close at the end of 2014. Nonetheless, the period covered in my investigation includes almost all significant changes in baseline conditions for this project.

## **Additionality Evaluation**

### **Background Economic Baseline Conditions**

I begin our investigation of the conditions of background economic additionality with a brief review of Uganda's sugar sector. Recall that KSW based part of its additionality claim on the fact that the project was a "first of its kind", which is true given that in 2007 none of the other five existing sugar factories had developed capacity for cogeneration for export—though the Sugar Company of Uganda Ltd. (SCOUL) was exploring it (CDM-PDD, 2007: 15). Indeed, in 2005, SCOUL sought to expand its operations and export 3 MW but was unable to secure a sufficiently high tariff (Mutambi, 2010: 6). A third sugar factory exporting electricity, Kinyara Sugar Ltd, is claiming credits under the CDM on a basis similar to that of KSW (CDM-PDD, 2008). However, a simple common practice analysis of sugar sector finds that by 2013, two other sugar factories were exporting electricity to the national grid, including the most recent project—Sugar & Allied Industries (Table 2). Also important is the fact that from towards 2011 a number of new sugar factories have been granted licenses. These trends suggest that conditions have become more favorable towards the establishment of sugar factories and cogeneration projects since the time of the CDM project's inception.

The increasing number of cogeneration projects can largely be explained by an important rise in background economic incentives: a progressive REFIT as well as rising sugar prices. However, changing incentives are not the only background economic conditions of importance. Thus in my evaluation of the conditions of background economic additionality, I start with analysis of KSW generating capacity and grid expansion factor before moving to discussion of Uganda's REFIT

and rising sugar prices, which constitute a good segue into subsequent analysis of the conditions of project finance additionality.

**Table 2: Common Practice Analysis of Sugar Factories Across Uganda**

	Commission Year	Sugar Cane Production Capacity	2011 Annual Sugar Production**	Total Power Generation	Power Generation for Export	District
		Tonnes Cane per Day	Tonnes	MW	MW	
<b>Existing Sugar Factories*</b>						
Sugar Company of Uganda Ltd. (SCOUL)	1924	na	38,006	16	7.4	Buikwe
Kakira Sugar Works	1930	6,000	132,679	48-51	32-34	Jinja
Sango Bay Estates	1930	na	15,000	na	na	Rakai
Kinyara Sugar Ltd.	1969	na	88,725	35	22	Masindi
GM Sugar	NA	200	2,500	na	na	Jinja
Mayuge Sugar Ltd.**	2005	2,500	5,000	9	na	Mayuge
Sugar & Allied Industries	2013	2,000	NA	12	8	Kaliro
<b>Newly Licensed Sugar Factories as of 2011†</b>						
Tirupati Development Uganda	In development	2,500	na	na	na	Nakasongola
Mukwano sugar industry	“”	2,500	“”	“”	“”	Masindi
Uganda Crop Industries	“”	200	“”	“”	“”	Buikwe
Kafu Sugar	“”	800	“”	“”	“”	Masindi
Kamuli Sugar	“”	200	“”	“”	“”	Kamuli
Kenlon Sugar	“”	500	“”	“”	“”	Namasagali
Bugiri Sugar company	“”	500	“”	“”	“”	Bugiri

\* Wikipedia (2014)

\*\* (M&P Group of Industry, 2011)

† (Sanya, 2011; 2013; SugarOnline, 2012)

## ***KSW Generating Capacity and Grid Expansion Factor***

In the CDM project documents, KSW claims that the 12-14 MW of renewable electricity acquired through the CDM project would directly lead to reductions by displacing the use of dirty electricity produced for Uganda’s national grid. The CDM methodology used equates renewable energy produced by KSW with emissions reductions (CDM-PDD, 2007: 16-17). There are two components to this claim: the amount of electricity produced by KSW as well as the grid emissions factor. Crucially, as discussed earlier, the specific methodological approach used in the CDM project document calculates these two components for the entire 7 year crediting period using data from only 2005-2007.

First is the amount of bagasse-based renewable electricity that KSW would actually produce during the CDM project’s crediting period. The CDM project developers over-estimated—CDM critiques might say inflated—the amount of electricity that KSW would generate on an annual basis. In the CDM project document, KSW based its emissions reductions on the generation of 103,606 MWh per year (CDM-PDD, 2007: 24), though actual average generating capacity is estimated at only 76,224 MWh per year from 2008-2014 (ERA, 2010f; 2014b).

Second, is the grid emissions factor. It is true that thermal generating capacity was expanding at the time the CDM project was initiated in 2007, as is claimed by KSW in the CDM project documents. A severe drought in the region between 2004-2006 reduced water flow into Lake Victoria (Karekezi et al., 2009: 30), with the result that hydroelectric power generation plummeted from 450,000 MWh to 200,000 MWh (see Figure 1). The short-term strategy to

address the power shortage, developed in 2005, was to build emergency thermal power plants (UETCL, 2008: 39).<sup>4</sup> But for government, thermal power generation was only a second best option, given delays to the flagship Bujagali large-scale hydroelectric station (UETCL, 2008: 39).<sup>5</sup>

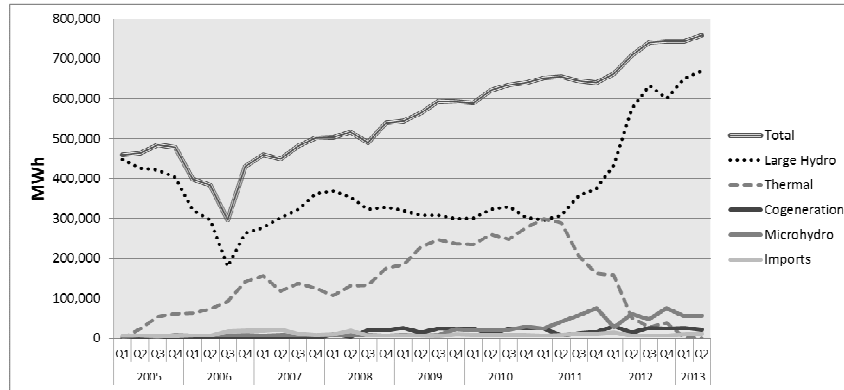
Despite the 2004-2006 drought, the Ugandan government has sought continued expansion of hydroelectric generating capacity: the 250 MW Bujagali hydroelectric plant came fully online in 2012 (Bujagali Energy Ltd., 2010; Kasita, 2012) and a 650 MW Karuma hydropower project is expected by 2016 (John, 2011). Significantly, with Bujagali coming online, most of the thermal power facilities installed during the drought were closed. This is demonstrated by a fork in generating capacity, shown in Figure 2 below, between large hydro and thermal electricity around 2011-2012.

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<sup>4</sup> *Ugandan Government Officer, Kampala, Interview UN20, 12 May 2009.*

<sup>5</sup> *Ugandan Government Officer, Kampala, Interview UN20, 12 May 2009.*

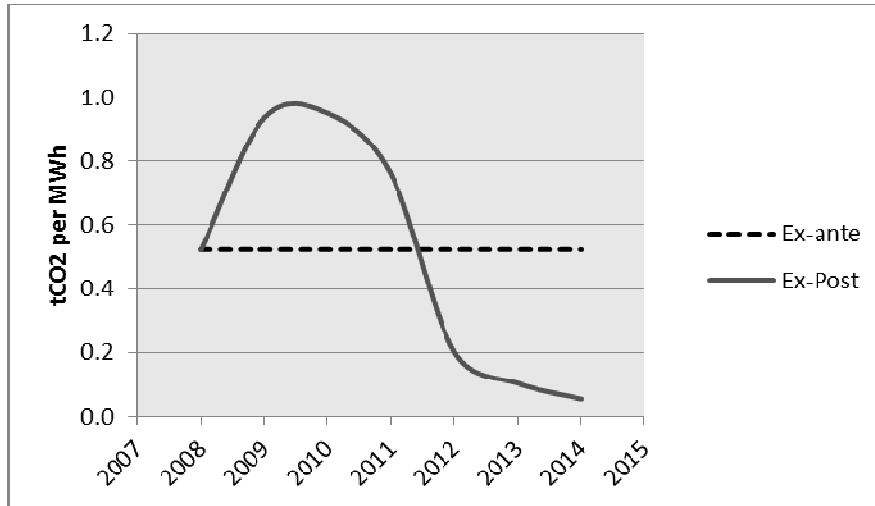
**Figure 1: Change in Power Generation in Uganda, 2005-2013 (MWh)**



Sources: ERA (2010a: 24 & 26; 2010f; 2014b)

These changes in Uganda’s power mix affect the grid emissions factor in an important way. With data on power generation similar to that above, I modeled Uganda’s grid emissions factor *ex-post* using the tool developed by prior Praher (2008) discussed earlier. Figure 2 presents the *ex-ante* grid emissions factor from the CDM project in contrast to the *ex-post* grid expansion factor modeled. The average grid expansion factor estimated over the CDM crediting period stands at 0.5038 tCO<sub>2</sub>e per MWh which is slightly below the 0.5223 tCO<sub>2</sub>e per MWh set in the CDM project document (CDM-PDD, 2007: 24). However, there are important changes over time that are masked by the average: the *ex-ante* baseline grid emissions factor tends to under-estimate baseline emissions until 2011 as Uganda became more reliant on thermal power; however, as the Bujagali large-scale hydroelectric plant came fully online in 2012 (Kasita, 2012), the emissions factor then comes to over-estimate actual grid emissions. Because of interaction with KSW actual export generating capacity, the variation captured in the figure below comes to have an important effect on the amount of genuine carbon credits generated.

**Figure 2: Uganda’s grid-based emissions during the CDM crediting period, as modeled *ex-ante* and *ex-post***



### **Uganda’s Renewable Energy Feed-in-Tariff (REFIT)**

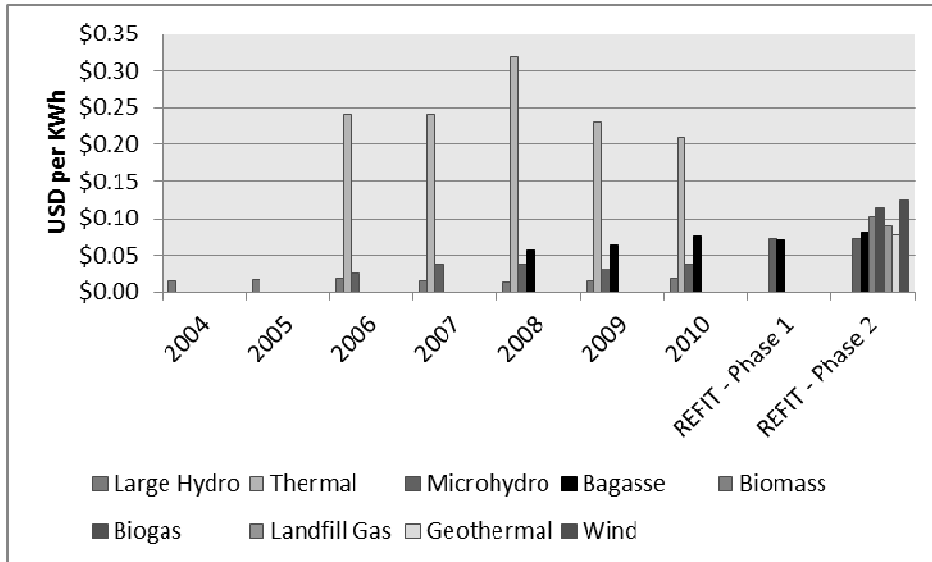
The grid emissions factor is not the only variable that changed significantly during the CDM project’s crediting period; so too have incentives for power generation—including a REFIT. It is helpful to understand the role that tariffs play in Uganda’s power system. There are three types of tariffs in Uganda’s electricity generation, all which are regulated by government through its Electricity Regulatory Agency or ERA: consumer tariffs, bulk supply tariffs and generation tariffs (ERA, 2006: 9-14). The ERA itself is the product of liberal economic reforms in Uganda’s energy sector, which saw privatization of the Uganda Electricity Board in 1999 and subsequent development of the *2002 Energy Policy for Uganda* (Engurait, 2005: 113-118; Ezor, 2009: 12-14; MEMD, 2002a). Though all electricity tariffs are set by the ERA, they require approval of the Ministry of Finance, Planning and Economic Development (UETCL, 2008: 39).

Generation tariffs are of most interest for the additionality of the CDM, as it is the the energy purchase price paid for power generated and delivered to the grid by the generation companies. As early as 2006, government differentiated power producers through a variable tariff structure including different tariffs for large hydro, thermal electric, microhydro *and* bagasse cogeneration (Figure 3). Such generating tariffs are adjusted on a quarterly basis to allow for changes in fuel prices, inflation and exchange rates (ERA, 2006: 4). Generation tariffs are also ripe for interventions such as REFITs. A first phase REFIT was released in 2007 by the Ministry of Energy & Mineral Development offering to buy bagasse cogenerated power at \$0.070 per KWh (MEMD, 2007: 113). A more comprehensive second phase REFIT has released for 2011-2016 (ERA, 2011b: 15; 2014a: 27; Gipe, 2011), which set a tariff for bagasse at \$0.081 per KWh. Significantly for the CDM project, the REFIT targets 120 MW of bagasse cogeneration by 2016, the third most incentivized technology after hydro and wind (ERA, 2014a: 27). For reasons I provide in my analysis of CDM project finance additionality below, I interpret the 2011 tariff to



have provided sufficient incentive for KSW to expand cogeneration for export in the absence of the CDM.

**Figure 3: Historical Generation Tariffs, including recent renewable energy feed-in-tariff, 2004-2013**

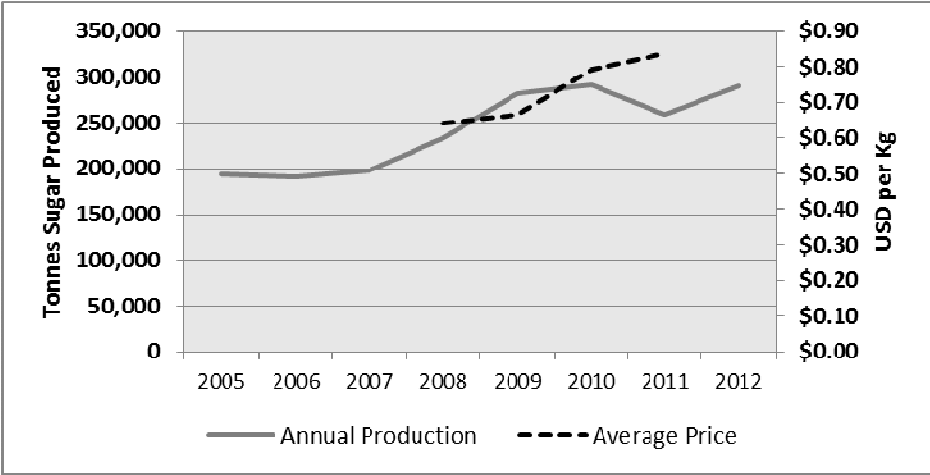


**Sources:** Generating tariffs for 2006-2008 (ERA, 2010g); 2010 (ERA, 2010b; c; d; e; 2011a); REFIT Phase 1 (MEMD, 2007); REFIT Phase 2 (ERA, 2011b; 2014a); historical conversion rates UGX-USD obtained from [www.xe.com](http://www.xe.com)

### Sugar Policy in Uganda

Rising renewable energy tariffs are not the only reason that more sugar factories are being established in Uganda. An additional incentive has been the rising costs of sugar in Uganda. Historically, sugar prices were set by the Sugar Industry Unit under the Ministry of Trade and Industry, but this was one of the first targets of liberal economic reform in the 1990s (World Bank, 1996: 7). Despite such reforms, or perhaps because of them, the country has been buffeted by sugar shortages and price spikes (Busharizi, 2011; Mukasa, 2011) which has required loosening rules about its importation (USCTA, 2010b) Until quite recently, domestic sugar production has been rising along with domestic sugar prices (Figure 4). However, the latest trends suggest that prices may be coming down as new, domestic supply enters the market (Nassuna, 2013).

**Figure 4: Change in Sugar Production and Prices, 2005-2012**



Sources: USCTA (2009; 2010a; 2011; 2012)

The government developed a *Sugar Policy* in 2010 (MTTI, 2010), largely to address concerns about fair prices for outgrowers, food security and sugar smuggling between rival sugar factories (Anonymous, 2011a; Ssempijja, 2010). The government does not intend to set sugar prices; rather, “Market forces shall determine sugarcane as well as its products’ prices” (MTTI, 2010: 12). Government will seek to cultivate local demand by regulating the importation of sugar through an “appropriate” tariff regimes, monitoring importation of sugar, and promoting the use of locally produced sugar by Uganda’s food industry (*Ibid.*: 15).

It should be borne in mind that government interest in cultivating a domestic sugarcane industry has generated a significant amount of environmental controversy in southern Uganda, where much of the sugar industry is located. This is exemplified through controversies surrounding Butamira Central Forest Reserve (Manyindo et al., 2001; Tumushabe and Bainomugisha, 2004)

and more recently Mabira Central Forest Reserve (Anonymous, 2011b; Bareebe, 2011; Child, 2009; Kasita, 2007).

## **Changes in Project Finance Baseline Conditions**

Having reviewed how background economic conditions have evolved over the CDM project's crediting period, I move on to consider conditions of project finance additionality. Recall that KSW claimed that local and international banks were unwilling to fund the project and other sources of support were unavailable. However, KSW actually received considerable donor financing both before and during the CDM crediting period, while the REFIT has since 2011 risen to a level sufficient to have incentivized KSW to expand cogeneration capacity in the absence of the CDM. I discuss the financial history of KSW's expansion in detail below, information which is summarized in Table 3.

**Table 3: Summary of changes in project finance baseline conditions**

Year	Intervention	Total Generation Capacity	In-House Capacity	Export Capacity	Tariff	Donor Support	Financers	Original CERs	Financial Additionality Factor
		MW	MW	MW	\$/KWh	\$million		tCO2e	
Late 1990s	In-House	4	4	0	NR	Unknown	Unknown		
1998	(KSW Expansion)	(22)	(4)	(18)	(\$0.080)	(\$0)	(0)		
1999									
2000									
2001									
2002									
2003	KSW Expansion 1	18-19	11-14	5-7	\$0.049	\$23.6	WB & Netherlands		
2004									
2005									
2006									
2007	CDM	25-26	11-14	12-14	\$0.062	\$3.3	CDM/WB		
2008								46,025	0.5
2009								46,025	0.5
2010	Cogen for Africa	28-29	14-17	12-14		Unknown	UNEP-GEF	57,349	0.5
2011	RE Feed-in-Tariff				\$0.075		GofU	57,349	0.5
2012								57,349	0.5
2013								57,349	0.5
2014	KSW Expansion 2	48-51	14-17	32-34			KSW	57,349	0.0
Total Emission Reductions 2008-2014								378,793	

## ***In-House Sugarcane Expansion and Cogeneration***

KSW has long been a significant recipient of donor financing, going back to the 1980s when the company sought to re-establish itself after the expulsion of Asians by the dictator Idi Amin in 1972 and the subsequent turmoil of Uganda's civil war (Wardrop, 2004: i; World Bank, 1996: ii). This began with a \$62 million World Bank led sugar rehabilitation project initiated in 1988 (World Bank, 1996: ii). Partially due to this donor support, KSW was producing 735 tonnes cane per day in 1990, rising to 2,000 tonnes cane per day in 1995 and 3,500 tonnes cane per day in 2007 (CDM-PDD, 2007: 2; World Bank, 1996: iii & 27). As discussed in more detail below, the CDM project has involved an increase in sugarcane crushing capacity from 3,500 to 6,000 tonnes cane per day—the additional cane sourced from surrounding smallholder farmers (CDM-PDD, 2007: 2-3). Most recently, in early 2014, KSW has stated it will increase its capacity to 7,000 tonnes cane per day (KSW, 2014).

The firm has consistently sought to implement cogeneration at the same time as expanding sugarcane production in order to efficiently use waste bagasse. As early as the late 1980s, KSW stated that “Future plans [for KSW] also include proposals for usefully disposing excess bagasse resulting from continuing expansion of cane production” (World Bank, 1996: iv). In the mid-1990s, a French consulting firm suggested cogeneration as an integral part of disposing additional bagasse resulting from expansion (World Bank, 1996: Plan for the Operational Phase of the Project). Subsequently, in 1998, a feasibility study of expansion *and* cogeneration was funded by a US development agency (Payne, 1998). Most recently, KSW asserted in the CDM project documents that the “[w]ith the support of the Government, KSW will expand its existing bagasse cogeneration capacity in accordance with the planned expansion of its sugar factory” (CDM-PDD, 2007: 2).

By the late-1990s, KSW was producing 350,000 tonnes of bagasse annually (Wardrop, 2004: 12, 83). Two-thirds of this bagasse was used to fuel two turbogenerators capable of generating 4 MW of electricity for in-house power consumption; the remaining 113,000 tonnes were dumped and burned (Wardrop, 2004: 12; World Bank, 2001: 62). The logical next step would be to harness the bagasse not being used to export electricity to Uganda's national grid.

## ***Cogeneration for Export***

KSW's initial efforts to secure financing to acquire technology necessary to generate and export additional electricity were unsuccessful: private lenders proved unwilling nor did the Uganda government agree to the tariff rate that KSW sought. In 1998, KSW submitted a proposal to the Ministry of Energy & Mineral Development to sell 18 MW of electricity to the national grid at a tariff of \$0.080 per KWh (GEF, 2007: 37; Mutambi, 2010: 4). However, the government decided not to pursue this proposal because it was expecting that cheaper hydroelectric capacity would soon come online—the 250 MW Bujagali hydroelectric (GEF, 2007: 37; Mutambi, 2010: 4). See Figure 3 above. Thus, as late as 2000, KSW's excess bagasse remained largely unused.

The government's decision to rely on the Bujagali project proved problematic because the large-scale hydroelectric project came to face serious delays. Aware of this setback, in 2001 KSW submitted a revised version of the cogeneration project to the Uganda government to supply 7 MW of power. It won the contract in 2003, but only at a tariff of \$0.049 per KWh (Mutambi,

2010: 4). While this was more than double the prevailing generating price paid for hydroelectricity at the time (see Figure 3), it was well below the \$0.080 per kWh rate that KSW originally proposed in 1998 (GEF, 2007: 37). I submit that the firm only agreed to the low tariff rate because of donor involvement—described below.

KSW found support for exporting electricity to Uganda's national grid through the World Bank's Energy for Rural Transformation (ERT) programme (Wardrop, 2004: i). The ERT programme anticipated two phases for KSW's expansion (GEF, 2001: 61-62), which KSW has implemented over 2004-2008 and 2010-2014 (KSW, 2010a). For the first phase, 14-15 MW of generating capacity was added through the refurbishing of KSW's existing boilers, installation of two new 20 bar boilers and the addition of a new turbo generator (GEF, 2001: 62; Kayizzi, 2004; Mufumba, 2005; Wardrop, 2004: 23-27). However, of this additional capacity only 5-7 MW were to be exported to the national grid (KSW, 2010a; Mufumba, 2005; Wardrop, 2004: 23). This is of key importance to the evaluation of CDM financial additionality: the 5-7 MW scenario is the appropriate historical, pre-CDM financial baseline scenario for the CDM project—though it is not reported in the CDM documents. KSW implies in the CDM project documents that no electricity was able to be exported in its absence—that export capacity was effectively 0 MW. This first phase of KSW's expansion is reported to have cost a total of \$30.6 million of which at least \$23.6 million was derived from external financing delivered over the period 2003-2005: \$11-12 from the ERT as well as \$11.7 million from the Netherlands Development Finance Institution (Juuko, 2004; Mufumba, 2005). Of these, about \$14 million was directed to the cogeneration project (GEF, 2001; Juuko, 2004; Kayizzi, 2004; Mufumba, 2005). Two disbursements were made under the ERT programme. First, a \$3.3 million tariff subsidy—compensating in effect for the \$0.049 per kWh tariff that the government offered—was allocated in 2003 through the REA using funds from the GEF (Kalyango, 2004; Kayizzi, 2004; MEMD, 2004: 10). The second disbursement was for an additional \$7.7-\$8.6 million through the Energy for Rural Transformation Refinance Fund (ERTRF)—the re-financing mechanism of the ERT programme. This took place as a loan to KSW from the East African Development Bank backed by the Bank of Uganda (Juuko, 2004; KSW, 2010a; World Bank, 2009a: 76).

### ***The Role of CDM Financing***

A challenge with determining the CDM's contribution to emission reductions is to separate project elements financed through donors above from those financed by the CDM. Efforts towards financing cogeneration under the CDM were initiated in 2005 (Naus, 2010: 91) and an emission reductions purchase agreement signed in 2007 with the World Bank's Community Development Carbon Fund for \$3.6 million for 320,000-440,000 tonnes carbon credits (CFU, 2008: 30; Katoomba Group, 2007). Similar to the WB ERT programme, the CDM made the purchase of such additional electricity affordable by subsidizing the purchase price agreed between KSW and the government-owned electricity transmission company (CFU, 2008: 30; Katoomba Group, 2007). CDM funds compensated KSW for a tariff of US\$0.062 per kWh offered by government, which was still less than the \$0.110 per kWh price that KSW sought (Mutambi, 2010: 4). It would be noted that the \$3.6 million in CDM financing contrasts with the \$23.6 million in combined financing from World Bank and the Netherlands for KSW's first phase expansion.

In the CDM project documents, KSW claims that the main elements of the CDM project are the two new “45 bar boilers, turbine, generator, new Kakira sub-station and the start of the new distribution line to the Ugandan national grid” (CDM-PDD, 2007: 3). Based on interpretation of the available evidence, I conclude that the only new project elements financed through the CDM were two new 45 bar boilers (replacing older 20 bar ones), which have allowed for an increase in sugarcane crushing capacity from 3,500 to 6,000 tonnes cane per day. This has allowed KSW to increase the power generating capacity of the *existing* turbo generator from the initial 5-7 MW of the first phase expansion to 12-14 MW. For example, consultants involved with the first phase expansion wrote “the system as proposed would accommodate an increase in generation of up to 9 to 10 MW [which in the CDM project documents is reported as 12-14 MW] without significant additional capital investment” (Wardrop, 2004: 30). In other words, the CDM project is an extension of KSW’s first phase expansion by adding 7 MW of generating capacity for export though the CDM project documents claim all 12-14 MW.

### **Post-CDM Expansion**

Further complicating the evaluation of CDM additionality is that KSW has continued to expand cogeneration capacity after the conclusion of the implementation of CDM project though still falling within the project’s crediting period. This expansion has long been planned: originally the World Bank anticipated that a second phase of KSW’s expansion would export 20-25 MW to the national grid (GEF, 2001: 63). Costs for this expansion were initially estimated at \$25 million (AFREPREN/FWD, 2009).

Two elements of this post-CDM expansion are noteworthy. First is the augmentation of in-house generating capacity through UNEP-GEF’s *Cogeneration for Africa* project (AFREPREN/FWD, 2009; GEF, 2007). Under this project, GEF funded a 3 MW turbo alternator, which became operational in 2010, and has also supported a feasibility study for further expansion (AFREPREN/FWD, 2012; UNEP, 2011). However, the increase of 3 MW in generating capacity is only going to in-house consumption and is not exported to the grid (KSW, 2010a). Second, in early 2014, KSW has indicated that it will increase cane supply to 7,000 tonnes cane per day and total generating capacity to 46 MW—with 32-34 MW to be exported to the grid (KSW, 2014). This is the result of a \$65 million investment that has resulted in a further cane production expansion (through outgrowers) as well as the installation of a new power set (including a 160 tonne per hour boiler, 30 MW of turbines and alternators), a new export line to supply power to the grid and expansion of the cane yard to handle additional cane (KSW, 2010b; 2013; 2014). According to government statements, this second phase of KSW’s expansion has been completed in early 2014 (*Ibid.*).

It is not entirely clear what has spurred this second phase expansion, though indications are that it is a result of Uganda’s 2011 Phase 2 REFIT. This offered a tariff of \$0.081 per kWh for bagasse co-generation which is close to the original tariff rate of \$0.080 per kWh originally proposed by KSW in 1998. The company has dryly noted elsewhere that: “had the government accepted Kakira’s original [1998] proposal to sell 18 MW to the grid, the cogeneration plant using a more efficient design would have been completed and already selling power to the grid” (GEF, 2007: 37). There is a short delay in the effects of the Phase 2 REFIT, which was announced in 2011, and the commissioning of the 32-34 MW of additional electricity for export

in 2014. This is something considered in the quantitative additionality evaluation which I undertake below.

## Quantitative Additionality Evaluation

I combine insights from the review of changes in the conditions of additionality here in order to provide an estimate of their effects on the amount of genuine carbon credits claimed. I begin first with background economic conditions, replacing *ex-ante* measures of KSW's generating capacity and Uganda's grid emissions factor with *ex-post* measures identified above. This transformation alone results in a reduction of carbon credits expected over the crediting period 2008-2014 from 378,793 to 261,692 tCO<sub>2</sub>e—a reduction of approximately 31 percent (Table 4). This is because KSW produced much less electricity than expected while the grid emissions factor is slightly reduced on average. While part of my evaluation of the conditions of background economic additionality, the 2011 REFIT is considered in my analysis of CDM project finance additionality below because of the important interaction between it and donor financing for the project. In order to be conservative in my evaluation, however, I do not consider rising sugar prices to directly affect the conditions of additionality. Rising prices could also result in greater sugar production that is simply disposed of, without being used for generating electricity.

Quantitative evaluation of changing project finance conditions required determination of an appropriate financial additionality emissions. First, given donor support, the appropriate historical emissions baseline for the project is actually 5-7 MW and not the 0 MW implied in the CDM project documents—meaning that emission reductions associated with the project were only 7 MW and not the 12-14 MW claimed. Accordingly, I assign the project a financial additional emissions factor of 0.5 for the years 2008 through 2013, meaning that only half of the emissions originally claimed in each year are due to the CDM project. But things have changed in 2014, which is the final year of the CDM project's crediting period. The 32-34 MW expansion achieved by KSW in 2014 demonstrates that the the 7 MW expansion claimed by the CDM in 2007 would have, in fact, been achieved before the end of the CDM crediting period “anyway”. For 2014, I have assigned the project a financial additionality emissions factor of zero—none of the emissions claimed that year are due to the CDM. Finally, the combination of *ex-post* evaluation of background and financial additionality finds genuine carbon credits reduced to 128,600 tCO<sub>2</sub>e—a reduction of nearly two-thirds of that originally estimated. Overall, my findings suggest that the CDM has accelerated KSW's capacity to export electricity and reduce emissions on Uganda's national grid, though not at the rate claimed in the CDM project documents. Some of this capacity was secured “anyway” in the CDM's absence. Discussions with those familiar with the project support this interpretation. The project manager at KSW explained:

*As a matter of fact this whole project was conceived without any carbon credit funding. I don't know if I'm shooting myself in the mouth, because it has certain commercial implications, but it is the truth. Reality is reality... We are already making money out of the power we are generating. Obviously we are trying to fight with the state utility for a higher tariff, but that is a different issue. But [the CDM's] role is more like a catalyser, more like an encourager. It's not as if without [the CDM], the world will not go on.<sup>6</sup>*

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<sup>6</sup> Business Manager, Kakira District, Interview UD1, 8 June 2009.



The above quote is illuminating because it suggests that projects are neither additional nor non-additional; rather, the CDM can make emission reduction technology available earlier than it would have been, though this does not mean that this technology would never have appeared. This argument is corroborated through an interview with a representative at the Ministry of Energy and Mineral Development (MEMD):

*The issue is that [CDM renewable energy projects] would [have gone] ahead but at a very high price. A very high tariff. So when they get their carbon financing, they have a fair tariff to charge to the consumer.”<sup>7</sup>*

Here it is worth observing that a similar cogeneration project in Uganda was grounded because the company behind it could not secure an adequate tariff rate. In 2005, the Sugar Corporation of Uganda sought a tariff of \$0.076 per kWh to expand its operations and generate 3 MW for export (Mutambi, 2010: 6). However, the government did not accept this price and the cogeneration project was delayed for several years.

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<sup>7</sup> Ugandan Government Officer, Kampala, Interview UN20, 12 May 2009.

**Table 4: Calculation of genuine carbon credits after combined financial and emissions additionality evaluation**

Year	Ex-Ante Additionality			Ex-Post Background Additionality			Ex-Post Financial Additionality		
	Ex-ante Generating Capacity	Ex-Ante Emissions Factor	Original CERs	Ex-Post Generating Capacity	Ex-Post Emissions Factor	Ex-Post Background CERs	Financial Additionality Emissions Factor	Ex-Post Background & Financial CERs	
	MWh		tCO2e	MWh		tCO2e		tCO2e	
2008	103,606	0.5223	46,025	55,100	0.5209	28,703	0.5	14,351	
2009	103,606	0.5223	46,025	87,900	0.9332	82,025	0.5	41,012	
2010	103,606	0.5223	57,349	80,300	0.9499	76,276	0.5	38,138	
2011	103,606	0.5223	57,349	57,900	0.7601	44,009	0.5	22,005	
2012	103,606	0.5223	57,349	85,300	0.2037	17,376	0.5	8,688	
2013	103,606	0.5223	57,349	84,646	0.1041	8,812	0.5	4,406	
2014	103,606	0.5223	57,349	82,420	0.0545	4,491	1.0	0	
Genuine Carbon Credits			378,793				261,692	128,600	
% Genuine							69%	34%	

## Conclusion

This investigation of the KSW co-generation CDM project in Uganda has offered an important window into how the CDM is functioning in developing countries. The main conclusion that emerges from the study of this CDM bagasse cogeneration project in Uganda is that CDM projects are neither additional or non-additional; rather, additionality is something that changes over time as financial incentives and background economic conditions change over a project's crediting period. I argue that key to reviving confidence in the CDM and similar market mechanism is accommodating such changing conditions.

Overall, only approximately one-third of the carbon credits claimed by KSW in its CDM project document are genuine. I estimate that 31% of credits claimed are bogus because of changes in background economic conditions, including an increase Uganda's renewable energy feed-in-tariff, which by 2011 equalled tariff rates requested by KSW for expansion, as well as changes in emissions associated with Uganda's national grid and over-estimation of the actually amount of electricity that KSW was able to generate. I estimate that an additional 35% of the claimed carbon credits are bogus because of violations in the conditions of project finance additionality. Though KSW argued that project financing was a major obstacle, the firm actually received considerable financing from the World Bank and other donors both before and during the CDM crediting period which should have been incorporated in the CDM project's baseline.

These findings allow us to address questions about the robustness of the CDM regulatory system. Can project developers game the system? While such scheming possible, in agreement with Zhang and Wang (2011), I conclude that it is not necessarily fraudulent activity on the part of project developers that is often to blame for violations of the condition of additionality; rather "it is the current CDM baseline methodology that fails to predict future emissions in a fast changing economy" (p.49). The CDM's frozen baseline approach means that the CDM is incapable of accommodating change. At current market prices, carbon finance is often only a very small financial layer in a firm's overall business plans and mistakes about project baseline were largely due to unforeseen changes in the development context that really drive their profitability. As for financial additionality, rules on how to include donor financing in the CDM have been very unclear, which likely explains why KSW did not report on donor financing. This is not to exonerate KSW but point out the shortcomings of the regulatory structure of the CDM. The CDM appears to have been designed on the premise that a global price for carbon would be high enough that its effects would be relatively easy to observe. The reality is that a more sophisticated regulatory system is needed to restore confidence in carbon credits generated.

Baselines can deviate substantially from *ex-ante* efforts based on historical approaches and warrant consideration of dynamic baselines that address changes in financial incentives and background economic conditions over time.

Another challenge is parsing out the different factors affecting the financial additionality of CDM projects. Such parsing is difficult but, as demonstrated here, not impossible. Part of the problem has been inaccurate reporting on project financing. In this case, the World Bank inconsistently reported on its involvement in both the carbon market (through its Community Development Carbon Fund) as well as through traditional donor channels such as its ERT programme. At the same time, none of the

ODA financing is described in the CDM project documents, which is misleading in light of the other financial support being offered to KSW co-generation. There is a temptation to criticize KSW in the firm's attempts to obtain CDM financing while also seeking donor financing. Cynics might argue that KSW had long planned the project's expansion and concomitant cogeneration project—that the entire project would have happened “anyway”. The difficulties with reporting on ODA support actually points to a fundamental problem with the CDM's design. Without an accounting option to accommodate ODA baselines and thereby combine ODA with CDM financing, the CDM has actually promoted obfuscation of financial accounts. As it stands, project developers believe that they have to either claim no ODA was used or render themselves ineligible for the CDM.

## Policy Recommendations

Uganda's electricity regulator has expressed frustration with regards to KSW's experience with the CDM:

*The Clean Development Mechanism (CDM) created under Kyoto protocol has not been a successful project financing mechanism for small renewable projects. It has been found to be complicated and questionable in terms of carbon dioxide emissions. Kakira Sugar Works has been pursuing the carbon credits for over three years and has not yet succeeded (Mutambi, 2010).*

It would also be recalled that KSW has formally withdraw from the CDM process—though it has still be able to proceed with the project's implementation. In order to shore up confidence in the emission reductions claimed under the CDM, I recommend that the UNFCCC and other carbon standard consider move away from an approach to additionality that only entails a counterfactual assessment based on conditions at project inception and, instead, use elements of the *ex-post* comparative baseline approach used here.

Specifically, three remedies can help improve the monitoring of additionality: the use of sectoral performance benchmarks, the development of an additionality risk management tool and the inclusion of ODA in the development of project baselines. If the current CDM counterfactual regulatory approach is a magnifying glass, the remedies I suggest constitute a microscope to detect an even smaller price signal. Yet when providing the recommendations below, it is also important to recognize that the UNFCCC must deal with the realities of the limited availability of data necessary for establishing an *ex-post* comparative approach, particularly in least developed countries. And of course the costs for such measurement must be balanced with the ultimate aims of the climate change regime to reduce emissions.

First, regarding background economic conditions, a comparative approach where information for an entire sector is collected, rather than on a project-by-project basis, would enable baseline conditions to be more accurately observed. While data availability for the construction of such sectoral benchmarks will remain a challenge in developing countries, the UNFCCC's elaboration of sector specific standardized CDM baselines is a promising step in acquiring the necessary information for comparative analysis (CDM EB, 2011a; Michaelowa, 2008; UNFCCC, 2010). Second, a tool for managing the risk of violating additionality (see Meyers, 1999) might be devised to accommodate changing baseline conditions. Project developers would likely object to an *ex-post* additionality evaluation as undertaken here because it submits their investment returns to changing economic factors beyond their control. Yet the management of uncertainty has been successfully tackled in other areas.

Indeed, an additionality risk management tool might draw inspiration from a system to manage the non-permanence of carbon credits issuing from forest and agriculture projects (Diaz, 2010; VCS, 2011). For additionality, an *ex-ante* additionality risk analysis would be used to assign the project an additionality risk score which would indicate the amount of carbon credits that need to be deposited in a pooled additionality buffer account. Building on the comparative approach to the monitoring of baseline conditions described above, an evaluation of project additionality would be executed *ex-post* on a regular basis in order to establish a dynamic baseline. Carbon credits in this account would only be issued upon an *ex-post* additionality evaluation at the end of the crediting period, with the exact amount of credits issued depending on the degree to which additionality has been violated or not.

An alternative solution is shorter crediting periods, favored by many reformers of the CDM. The 7-10 year window for CDM projects would be reduced, which would arguably increase the accuracy of additionality assessments. This is because a shorter time horizon reduces uncertainties surrounding changes in the conditions additionality. But results presented here demonstrate that such changes can occur rapidly. An *ex-post* approach captures this change. While understanding the need to foster investment, a revised CDM or other climate finance instruments should shift its focus towards boosting consumer confidence in carbon credits.

An additionality risk management tool may also help resolve the challenge of how to incentive governments to adopt green policy while also awarding private sector action. The CDM is currently designed such that the introduction of green policy measures during a CDM project's crediting period is not counted as a change in baseline conditions. But this only solves half the problem: removing the perverse incentive for governments to retain dirty policies though still allowing CDM project developers to benefit from these policies in terms of defining their counterfactual emissions baselines. But if government were allowed to claim carbon credits held in the additionality buffer account when implementing green policy, they would have more incentive to do so while the economic shock to CDM project developers would be abated. Such a system would better reward those responsible for emission reductions, whether it be government or individual project developers. Of course, such a system cannot replace a full accounting for emissions reductions in an economy—that is best addressed through a cap-and-trade system or similar approach. But for developing countries without the information infrastructure to track all emissions, such an approach would improve on the current CDM arrangement. Third, with regards to project finance additionality, I recommend that donors be involved in the modeling of ODA-baselines against which emission reductions associated with CDM are compared. The CDM currently encourages firms to misrepresent ODA contributions because of the lack of clarity about how to combine ODA with CDM financing. We recommend that donors estimate the emission reductions associated with their contributions in order to model ODA-baselines for inclusion in any carbon crediting scheme. Here it should be observed that the CDM may be transforming into what are being called NAMAs—nationally appropriate mitigation actions (Okubo et al., 2011; South Pole Carbon, 2011). In an important departure from the CDM however, NAMAs are also expected to allow the combination of private and public financing.

Given the complexity that such provisions might add to the administration of carbon offset systems such as the CDM, some may question if it is not better to search for

alternative means of engagement with developing countries on climate change mitigation (Paulsson, 2009; Wara, 2008). One alternative in particular, so-called climate funds which are delinked from carbon markets, has been gaining ground since 2009. Because climate funds do not aim to generate carbon credits for international carbon markets, their measurement, reporting and verification (MRV) requirements have actually been more relaxed compared to the CDM (Purdon, 2013). Yet it is unclear that more relaxed MRV is warranted: it is important that climate funds are able to demonstrate that they are effective in reducing emission reductions even if these instruments are not aiming to generate carbon credits. It is also far from clear if climate funds represent “new and additional” resources as agreed in the Copenhagen Accords. Rather they likely represent a repackaging of traditional donor financing (*Ibid.*). Given these challenges, future research should consider the effectiveness of different types of climate finance instruments, including carbon markets and climate funds.

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## Calculation of Grid Emissions Factor<sup>8</sup>

The spatial extent of the project boundary encompasses the project plant, existing sugar factory (where bagasse will be produced) and cogeneration plant at the project site (where bagasse will be burnt inefficiently in the absence of the project activity), and all power plants connected to the Ugandan national grid (since it is the electricity system to which the cogeneration project plant will be connected and will receive the surplus bagasse-based electricity generated by the project activity).

The project activity mainly reduces CO<sub>2</sub> emissions through substitution of power generation with fossil fuels by that from biomass residues. The emission reduction  $ER_y$  by the project activity during

a given year  $y$  is the difference between the emission reductions through substitution of electricity generation with fossil fuels ( $ER_{\text{electricity},y}$ ), the emission reductions through substitution of heat generation

with fossil fuels ( $ER_{\text{heat},y}$ ), project emissions ( $PE_y$ ), emissions due to leakage ( $L_y$ ) and, where this emission source is included in the project boundary and relevant, baseline emissions due to the natural

decay or burning of anthropogenic sources of biomass residues ( $BE_{\text{biomass},y}$ ), as follows:

$$ER_y = ER_{\text{electricity},y} + BE_{\text{biomass},y} - PE_y - L_y \quad (1)$$

Where

- $ER_y$  Emission reductions of the project activity during the year  $y$  (tCO<sub>2</sub>/yr)
- $ER_{\text{electricity},y}$  Emission reductions due to displacement of electricity during the year  $y$  (tCO<sub>2</sub>/yr)
- $BE_{\text{biomass},y}$  Baseline emissions due to natural decay or burning of anthropogenic sources of biomass residues during the year  $y$  (tCO<sub>2</sub>e/yr)
- $PE_y$  Project emissions during the year  $y$  (tCO<sub>2</sub>/yr)
- $L_y$  Leakage emissions during the year  $y$  (tCO<sub>2</sub>/yr)

Based on ACM0006/Version 06, KSW was able to assume that  $BE_{\text{biomass},y}$ ,  $PE_y$  and  $L_y$  are all equal to zero. Accordingly, the equation is simplified to :

$$ER_y = ER_{\text{electricity},y}$$

### (2) Emission reductions due to displacement of electricity ( $ER_{\text{electricity},y}$ )

$$ER_{\text{electricity},y} = EG_y \cdot EF_{\text{electricity},y} \quad (8)$$

Where:

- $ER_{\text{electricity},y}$  is emission reductions due to displacement of electricity during the year  $y$  (tCO<sub>2</sub>/yr)
- $EG_y$  is the net quantity of increased electricity generation as a result of the project activity during the year  $y$  in MWh
- $EF_{\text{electricity},y}$  is the CO<sub>2</sub> emission factor for the electricity displaced due to project activity during the

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<sup>8</sup> The calculations presented here are derived from CDM-PDD (2007): 16-19.

year in tons CO<sub>2</sub>/MWh

**Step 1. Determination of  $EF_{electricity,y}$**

The project activity displaces electricity from other power generation sources connected to the Ugandan grid. The emission factor for the displacement of electricity should correspond to the grid emission factor ( $EF_{electricity,y} = EF_{grid,y}$ ).

$EF_{grid,y}$  is determined as per the ACM0006 methodology (p.28): if the power generation capacity of the project plant is of more than 15 MW,  $EF_{grid,y}$  should be calculated as a combined margin (CM). CM was consisted of combination of average Operation Margin (OM) and Build Margin (BM) factors. The average OM emission factor for KSW Cogeneration project was originally calculated using ex-ante data for 3 years from 2005 – 2007.

**(a) Calculate the Average Operating Margin**

$$EF_{grid,OM-ave,y} = [\sum FC_{i,m,y} * NCV_{i,y} * EF_{CO2,i,y}] / \sum EG_{m,y}$$

Where

- $FC_{i,m,y}$  is the amount of fossil fuel  $i$  (diesel) in a mass or volume unit consumed by relevant power sources  $m$  in year(s)  $y$ ,
- $m$  All power sources delivering electricity to the grid, including low-operating cost and must-run power plants
- $y$  the three most recent years for which data is available at the time of submission of the PDD
- $EG_{m,y}$  is the net electricity (MWh) generated and delivered to the grid by power source  $m$
- $NCV_{i,y}$  is the net calorific value (energy content) per mass or volume unit of fossil fuel  $i$  in year  $y$  (GJ/mass or volume unit)
- $EF_{CO2,i,y}$  is the CO<sub>2</sub> emission factor of fossil fuel  $i$  in year  $y$  (tCO<sub>2</sub>/GJ)

**(b) Calculate the Build Margin**

Build Margin emission factor  $EF_{grid,BM,y}$  was originally determined using *Option 1* – i.e., ex-ante calculations based on the most recent information available on power plants already built for a sample group  $m$  at the time of PDD submission for DOE validation.—2007. The sample group  $m$  constitutes the set of five power plants that have been built most recently.

$$EF_{grid,BM,y} = [\sum EG_{m,y} * EF_{EL,m,y}] / \sum EG_{m,y}$$

Where:

- $EG_{m,y}$  is the net quantity of electricity generated and delivered to the grid by power unit  $m$  in year  $y$  (MW h)
- $EF_{EL,m,y}$  CO<sub>2</sub> emission factor of power unit  $m$  in year  $y$  (tCO<sub>2</sub>/MWh)
- $m$  power units included in the build margin
- $y$  most recent historical year for which power generation data is available

**(c) Calculate the Combined Margin Emission Factor  $EF_{grid,CM,y}$**

$$EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM}$$

Where  $W_{OM}$  and  $W_{BM}$  are weighting of operating margin emissions factor (%) and weighting of build margin emissions factor (%), respectively. The weights originally used in the PDD are  $W_{OM} = 0.5$  and  $W_{BM} = 0.5$  for the first crediting period.

## Step 2: Determination of $EG_y$

$EG_y$  corresponds to the lower value between the following:

- The net quantity of electricity generated in the new power unit that is installed as part of the project activity ( $EG_{project\ plant,y}$ ) and;
- The difference between the total net electricity generation from firing the same type of biomass residues at the project site ( $EG_{total,y}$ ) and the historical generation of the existing power plants ( $EG_{historic,3yr}$ ), based on the three most recent years, as follows:

$$EG_y = MIN \left[ \begin{array}{l} (EG_{project\ plant,y}) \\ (EG_{total,y} - EG_{historic,3y}) / 3 \end{array} \right] \quad (13)$$

Where:

- $EG_y$  Net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year  $y$  (MWh/yr)
- $EG_{project\ plant,y}$  Net quantity of electricity generated in the project plant during the year  $y$  (MWh/yr)
- $EG_{total,y}$  Net quantity of electricity generated in all power units at the project site, generated from firing the same type(s) of biomass residues as in the project plant, including the new power unit installed as part of the project activity and any previously existing units, during the year  $y$  (MWh/yr)
- $EG_{historic,3yr}$  Net quantity of electricity generated during the most recent three years in all power plants at the project site, generated from firing the same type(s) of biomass residues as used in the project plant (MWh)