

## **Environmental and Social Impact Assessment (ESIA) Summary**

Project name : **KivuWatt Power Project**  
Country : Rwanda  
Project number : P-RW-FGO-001

### **1. Introduction**

Lake Kivu is located in the East African Rift Zone between Rwanda and the Democratic Republic of Congo (DRC); the border between the two countries bisects the lake. The lake contains high concentrations of naturally occurring methane and carbon dioxide gases. The highest concentrations of these dissolved gases are located in the "resource zone", extending from a depth of 270 meters to the bottom of the lake at a depth of nearly 500 meters. The gases remain sequestered because the lake waters are stratified along stable density layers. The upper waters of the lake, referred to as the "biozone", are oxygenated and form a stable layer from the surface to a depth of 60 meters that supports the lake's biology.

Both Rwanda and the DRC have been engaged in a process of partnership and dialogue surrounding the joint exploitation of the lake since 1975. In 1990, they established SOCIGAZ, a bilateral entity responsible for governing the exploitation of Kivu's methane reserves. In 1999, SOCIGAZ was reformed to explicitly allow both states to have the right to assign concessions for their territory. The first GCA for the extraction of methane gas from Lake Kivu for power generation was awarded by GoR in March 2005 to the Kibuye Power 1 (KP1) project. In 2007, a Memorandum of Understanding (MoU) was signed to form a new/additional governance structure for sharing the lake's resources. The MoU outlined the steps to be taken in the establishment of the bilateral institutional framework for monitoring Lake Kivu, for the safety of the population and for the environment. An Expert Working Group of scientists and technicians was formed to develop rules and regulations for safe gas extraction from Lake Kivu resulting in the Mandatory Guidelines (Ministry of Infrastructure, Republic of Rwanda and Ministry of Hydrocarbons, Democratic Republic of Congo. Lake Kivu Gas Extraction: Basic Principles, Mandatory Requirements and Guidelines for the Concessioning, Design and Operation of Gas Extraction Plants.

### **2. Project Description and justification**

#### **a. Project description**

The KivuWatt Ltd concession is located wholly within Rwandan territory. The proposed project is the construction and operation of a facility to extract methane gas from Lake Kivu and generate 100 MW of electrical power in two phases. It comprises the construction and operation of four offshore Gas Extraction Facilities barges (GEF's), an onshore Power Plant and an onshore Marine Landing Site (MLS) that will be utilized in the fabrication and launching of the GEFs. The project will be implemented in two phases.

The Sponsor, ContourGlobal (CG), is seeking \$82 million in debt financing to fund construction and development for Phase I (25MW) of the Lake Kivu integrated-methane gas extraction and production facility (the Project or KivuWatt). The total project cost is USD 127.58 million and will be financed by USD 44.65 million in equity (35%) and USD 82.93 million in debt (65%). The African Development Bank has been requested to participate in the debt financing and proposes to provide up to USD 20 million for phase 1.

FMO and EAIF are co-lead arrangers and their combined USD 50 million investment along with the AfDB investment of up to USD 20 million will finance Phase 1. The sponsor, ContourGlobal (CG), has applied for a MIGA guarantee of up to USD 81 million for a period of up to 20 years against the risks of expropriation, transfer restriction, war and civil disturbance, and breach of contract.

Phase I will produce 25 MW of power from one GEF with a connecting semi-submerged pipeline of approximately 13km and methane fueled gas engines operating at the Power Plant. Construction of Phase I infrastructure has already commenced with clearance of the site and civil works for the MLS. The first power will be distributed as currently scheduled during the first quarter of 2012.

Phase II will provide an additional 75 MW of power to give a total of 100 MW through the addition of three GEFs and a similar configuration of methane fueled gas engines at the Power Plant. Construction of Phase II is scheduled to begin in the third quarter of 2012 and full production capacity is programmed to be achieved in 2014. The project is designed in a modular way and allows for design changes identified during the initial operation of the Phase I GEF. The current power plant site is sized to accommodate both Phase I and Phase II generation including the necessary area for a new 220 kV switch yard which will be constructed on the site to support the interconnection to the planned 220kV transmission system.

The output will be sold to the Rwandan state-owned utility, Electrogaz, through a 25-year Power Purchase Agreement (PPA). Phase I output will be connected to the national grid via a new dedicated 11 kV transmission line installed by Electrogaz. According to Electrogaz, the EIA is being prepared and will be completed before the end of this year for review.

Phase II will be connected to the existing 220 kV transmission system via two new transformers to be installed by KivuWatt Ltd, an indirect subsidiary of ContourGlobal LP.

The on-shore Power Plant will comprise a series of gas engines that will convert the methane to electricity which will then be supplied to the grid. The location of the Power Plant near Kibuye is a direct function of the Gas Concession Agreement (GCA) with the Government of Rwanda (GoR) and represents the most practically feasible location from which to exploit the gas resource available in the gas concession area. The Power Plant site was designated specifically as an industrial zone in the approved Kibuye Master Plan.

The MLS, which will be used for construction of the four GEFs, will consist of workshops, a slipway, a fit out platform, offices and will include a generator and water and sewage treatment facilities. The main GEF fabrication workshop will be erected over the upper portion of the slipway. The shed will be a steel portal frame with apex roof and the structure will be open on all sides for crane/plant access. Other smaller workshops will be formed from shipping containers as required. The workers compound will be set up by the GEF fabrication contractor and will be in close proximity to the fabrication site. It will be constructed of pre-fabricated housing modules complete with food service, dispensary and sanitary facilities.

Some components of the GEFs will be fabricated in Mombasa, Kenya by the contractor and transported to the site. Final erection, however, will take place at the MLS in Kibuye. Each GEF will be assembled on a covered slipway. The covering will be an open sided shed. Once completed the GEF barge will be launched into the lake and then moored at the barge outfitting area or quay for installation of the top side equipment. Once the outfitting is completed, the GEF barge will be towed to its permanent mooring place where the marine outfitting or installation of the sub surface equipment will take place, including the installation and hook up of the sub surface export pipeline that will carry the process gas ashore to the power plant. Upon completion of the outfitting and marine work, the GEF will undergo startup, commissioning and testing prior to sending the processed methane gas ashore. When all of the planned GEF's

are constructed and into operation, the MLS site will be handed back over to the Government of Rwanda for use as a general port and for boats used for security patrols for KivuWatt Ltd.

## **b. Project justification**

- (i) Lake Kivu is currently estimated to contain 300 billion cubic meters of carbon dioxide and 60 billion cubic meters of methane in its lower density layers. Without intervention, the gas concentrations are estimated to approach saturation and produce a cataclysmic gas release within a range of 50 to 200 years.
- (ii) Gas extraction will be conducted in compliance with the “Lake Kivu Gas Extraction: Basic Principles, Mandatory Requirements and Guidelines for the concessionary Design and Operation of Gas Extraction Plants” (version 10 published 18th February 2008) – “the Mandatory Guidelines”. These guidelines were produced jointly by the governments of Rwanda and the Democratic Republic of Congo and were established by a panel of international experts that determined the restrictions that should apply to the Kivu Pilot 1 (KP1) project, the first methane gas extraction project in Kivu, that is currently operating at Gisenyi. Whilst the Mandatory Guidelines are a legally binding requirement of the Concession Agreements, revisions to the document have been prepared since 2008 culminating in “Management Prescriptions for the Development of Lake Kivu Gas Resources” (17 June 2009). The project will meet those elements pertaining to lake stability and the environment in both documents.
- (i) Rwanda suffers from a serious energy deficit which is constraining economic development. As of 2008 only 6% of the population had access to electricity. By the year 2020, Electrogaz, intends to extend coverage to 36 or 40 percent of the country’s households and the KivuWatt project will play an important part in meeting that target.
- (i) The KivuWatt project presents an opportunity for generation of 100MW of low cost electricity that compares favorably with generation from other sources.

## **3. Policy, legal and Administrative Framework**

This ESIA was elaborated in compliance with:

- Rwandan policy and legal requirements;
- IFC guidelines and performance standards: EHS Guidelines for thermal Power Plants (2008), Performance Standards 1, 3, 4 and 5; and
- OPIC 2004 Environmental Handbook that defines the format and content of the report and the monitoring plan. It also obliges compliance with host country laws and regulations as well as the appropriate IFC standards.

The following AfDB Standards are applicable:

- Environmental and Social Assessment Procedures
- Policy on Involuntary Resettlement
- Gender Policy
- Policy on Information Disclosure
- Policy on Consultation with Civil Society.

The Framework for environmental law in Rwanda is the Organic Law on Environmental Protection, Conservation & management (2005), supported by a series of statutory instruments and subsidiary legislation as follows:

- REMA General Guidelines and procedures for EIA (2006).
- REMA Environmental Impact Assessment Regulations (2007).

Other relevant regulations include:

- The Bukavu Agreement (1975). This established the Société de Contrôle de l'Exploitation du gaz Méthane du Lac Kivu (SOCIGAZ), a company owned jointly by the Governments of Rwanda and Congo for Lake Kivu Gas. This was further developed in 1998 for the determination of concessions to exploit Lake Kivu gas;
- Labour Law (2001) covers health and safety at work and requires training of staff in safe working practices;
- Organic law 08/2005 Determining the use and management of land in Rwanda (2005);
- Law 47 on the Organization of Forestry (1988);
- Decree on easements in relation to the abstraction and use of underground and surface waters (1952);
- Order No 221/116 on bathing water quality which was established for the protection of lakes and rivers;
- Order RUO 5520/97 which prohibits seine fishing in all lakes except Lake Kivu;
- Order No RUO 52/160 which regulates fishing;
- Order No 51/162 which prohibits the import, possession, cultivation, propagation, sale or transport of *Eichhornia crassipes* (water hyacinth).

The Rwandan Environment Management Authority (REMA) is mandated by law to organize and approve EIA and for monitoring implementation of environmental protection measures recommended by EIA studies.

#### **4. Description of the project environment:**

##### **a. The biological environment**

Rwanda has a very diverse and rich biodiversity with high endemism. However, despite Rwanda's overall high levels of biodiversity there are no important or protected ecological areas in or close to the site. The nearest protected area is the Nyungwe forest which is almost under 20km south of the site. The Power Plant site itself was formerly bush but has been stripped of vegetation. The MLS was degraded wetland used for subsistence farming but has also been cleared. Given the absence of existing ecological data and the fact that all vegetation and habitat were stripped from these areas, site ecological issues are not considered significant. Unlike most of the African Great Lakes, aquatic biodiversity is low due to the unique nature of the lake and its origins. There are only 30 species of fish, five of which have been introduced. However the lake's ecosystem sustains fisheries that are a major local economic activity and an important source of protein for riparian communities.

##### **b. Lake stability**

Lake Kivu has a range of very unusual features many of which relate to its origins and which require some understanding before any potential impacts can be properly assessed. The geographical location, geological formation, hydrological regime and nearby vulcanicity all play a part in making Lake Kivu a unique environment. The waters of the lake are stratified to an unusual degree with very little vertical mixing either by wind forcing or differential cooling of warm surface waters in the winter. This is partly due to the venting of carbonated water of volcanic origin into the lake creating a dense lower layer that is difficult for any conventional mixing mechanism to disturb. The high levels of carbon dioxide in the vent water increases the density of the lower lake water and maintains the stratification. Because there is no mixing, the deeper layers have become anoxic leading to an oxygen debt. The upper waters of the lake between the surface and some 60m on average are, however, well mixed and this is due to the effect of the wind. These waters are well oxygenated and able to support the lake's biology, which despite the overall poor diversity of the lake nevertheless supports an important local fishery. This layer is also stable and is referred to as the biozone.

The stability of the lake is demonstrated by the marked zoning and the zones are defined by a number of density gradients. Clearly any attempt to exploit the methane from the lower resource zone in the very deepest waters of the lake must be done without risking destabilisation of these zones and without affecting the sensitive, and extremely restricted, biozone. The integrity of the lake stability layers must be maintained in order to prevent lethal gases escaping to the atmosphere, or contaminating the biozone. Maintaining this integrity is also essential to reduce the risk of explosion to a minimum.

### **c. Fisheries**

Of the current socio-economic uses of the lake the most prominent is fishing. The current catch is estimated at around 3,300 Mt per year and the overwhelming majority of the catch (3,000Mt) comprises the small freshwater herring *Limnothrissa miodon*, known locally as isambaza. This species was introduced from Lake Tanganyika around 1960 and exploits the open waters of the lake. The remainder of the catch is riparian in nature and is dominated by *Tilapia*. Fish farming is underdeveloped around the lake although there are proposals to increase the contribution of farmed fish in the coming years.

The fisheries sector in the Karongi district and in Kibuye in particular, is considerably well organised as fishermen have formed cooperatives and associations. These organisations facilitate the communication between its members and with the authorities.

There are two main fisheries: Fishermen in dugouts operate close to shore, use gillnets and their most valuable catch is tilapia. Fishermen on the larger boats operate offshore, using large purse seine nets to catch isambaza. They operate at night using light to attract the fish shoals to the boats. The monthly average income of an individual fisherman is around \$25 USD (or approximately 15,000 RWF).

The majority of the landings take place in the morning so that the catch can be taken to the markets and sold on the same day. Losses are high as there is no means of preservation. However, fish that are not sold are processed, i.e. frozen or sun dried and either sold for fish meal or, in the case of isambaza, sold directly for human consumption in Kigali at a premium. The near shore fishery, although less important economically, is still an important source of protein and provides a degree of food security for the local community.

### **d. The Human environment**

Kibuye is the 9<sup>th</sup> largest town in Rwanda with a population of 45,000 people. 44% of the population is below the age of 15 and there are high levels of poverty, illiteracy and HIV/AIDS. 66% of the economically active population has an income equivalent to US \$ 18 per month and the Province is one of the poorest in the country. The majority of household derive their income from fishing and/or farming.

In the region around Kibuye, the Kivu Lake borders, and the proposed site the soil is shallow clay loam and of good to excellent agricultural value. However, current agricultural practice is said to be poor with low yield crop and has led to land degradation high unemployment. This is further exacerbated by uncontrolled urban expansion into prime agricultural areas. The area around Kibuye and also part of the MLS is under intensive cultivation for subsistence farming and for cash crops. Where land is expropriated, the Rwandan Land Law (2005) allows for the harvesting of crops before the land is taken.

## **5. Project alternatives:**

Project alternatives considered include the utilization of methane in comparison with other energy sources, design options and “do nothing” scenario.

(i) The energy market is constrained by the low incomes and purchasing power of a large proportion of the population particularly in rural areas. Other potential sources of energy include renewable, biomass and geothermal although there are constraints associated with each including limited wind potential, high cost of solar power (in comparison with e.g. the use of methane), possibility for hydro power is limited to small-scale generation in rural areas, the growing of biomass for power generation will compete with current high land use for agriculture, the use of heavy fuel oil (HFO) will generate emissions and the current use of power generated from diesel fuel oil is expensive in comparison with the use of lake methane. The KivuWatt project presents an opportunity for generation of 100MW of low cost electricity that compares favorably with generation from other sources.

(ii) During the preliminary design of the gas extraction installations, different physical arrangements were taken into consideration:

- a. Offshore installation, with the gas scrubbers and gas – liquid separator located offshore, on a floating platform;

- b. Onshore extraction and liquid separator located onshore, and;
- c. Semi-offshore installation with the gas scrubbers located onshore and the gas liquid separator located off-shore, on a floating platform.

(iii) The “do nothing” scenario is not an option in this case due to the need to reduce gas levels in the lake in order to avoid the hazardous consequences of a spontaneous future gas eruption with the possibility of a large number of fatalities.

## **6. Potential Impacts and Mitigation/enhancement measures:**

### **a. Social Impacts**

Approximately 250 workers will be employed during peak construction activities for both the power plant and GEF construction, while a total of 116 personnel of various skill levels are expected to be employed when Phase II of the project is fully operational. Accommodations for expatriate workers will be provided in an appropriately developed workers camp to be constructed in the vicinity of the MLS that will house approximately 150 people at full capacity. Laborers recruited within the surrounding communities are expected to live locally.

During Phase I, opportunities will exist for local contracting and employment opportunities. It is estimated that seventeen local staff (out of a total of 61) will initially be employed. KivuWatt Ltd intends to replace expatriate staff gradually over time. An extensive training program to be developed in cooperation with both public and private educational institutions both within and outside of Rwanda will provide the basis of training to give the locally recruited workers the opportunity to obtain the necessary skills to both operate and maintain the GEF and power plant. The program is expected to be implemented in such manner to have local staff fully trained within six years of operation after Phase II. It is estimated that local staff numbers will be 103 (out of a total of 116), including eleven in management or administration, 34 in technical roles, 14 in Power Plant operations and 44 on GEFs and boat crew.

Permanent staffing of the GEF and Power Plant facilities to perform the operations and maintenance is expected to take place 6-8 months prior to the Commercial Operation Date. Prior to this time, KivuWatt Ltd and ContourGlobal LP HR departments will develop HR policies consistent with national law and international standards that will address worker relations, terms of employment, work rules, health and safety, grievance mechanism, and non-discrimination. During the initial construction phase however, KivuWatt Ltd will not have its own employees, aside from a Marine Construction Manager.

### **b. Land Acquisition and Resettlement**

Impacts on subsistence agriculture in the MLS include the loss of 1 ha of agricultural land and the economic displacement of 27 farmers. The MLS land was also used by the Gasura Primary School for growing cattle fodder for the school cow and this practice has also ceased due to the land expropriation. Data provided by MININFRA (Ministry of Infrastructure) lists the amount of compensation paid to each of the affected farmers, fourteen of whom were female. The total compensation paid was 23,954,252 RWF. Compensation paid by MININFRA in line with Rwandan Law varied from individual payments of 3500 RWF to 100,000 RWF except for the school which received 200,000 RWF. Eleven farmers were paid compensation equal to a month's wages and six farmers were paid compensation equal to half a month's wages, based on an average daily rate of 500 RWF for agricultural labor.

KivuWatt Ltd will supplement governmental efforts in order to bring the mitigation/compensation measures into line with MIGA's PS5. A preliminary survey of the farmers' gender, plot size, nature of farming (subsistence or sale) and crops grown has already been performed. A RAP is being prepared, in consultation with the farmers, to restore livelihoods on a sustainable basis and establish a grievance mechanism for receiving and resolving complaints. The

plan will review what additional targeted assistance and transitional support is needed to restore pre-displacement conditions. It is unclear how significant the scale of the impact is until the scope of other landholdings is known and what proportion of livelihood has been lost. The farmers have fragmented land holdings and the MLS only comprised a part of their farms.

Because of the scarcity of available land, making land replacement unlikely, potential options include: improving productivity and added value at the farmers other land holdings; supporting alternative livelihood options; and providing job opportunities on the project itself.

### **c. Pollution Prevention and Abatement**

Expected impacts from gas extraction activities include emissions to air from flaring and operation of gas engines, as well as potential impacts to the biozone from the routine discharge of wash water. Construction and operation of the MLS and Power Plant are expected to have impacts to air, noise, soil, waste and water.

Impacts arising from operation of the GEFs have been assessed, evaluated through modeling and mitigated through project design.

**Flaring and gas engines:** The GEFs will each contain two gas engine driven compressors, two gas engine driven electrical generators and a diesel engine driven black start generator. The gas engines will be operated from the produced high purity methane gas. The engines will be subject to World Bank Group EHS Guidelines air emission limits. Flaring is also expected during extraction process start up and shut down and upset conditions. The flue gas emissions are expected to be relatively small and disperse over the lake. Although the system has been designed to avoid flaring where possible, limited flaring is expected to occur from a 25 meter high vent. These emissions have been determined to be negligible and were not assessed. Continuous or unplanned flaring can be halted through the closure of the production separator gas outlet valves.

**Wash water:** Wash water is used to remove the impurities (mainly carbon dioxide and hydrogen sulfide) from the methane gas. As a result, the discharge of hydrogen sulfide and carbon dioxide containing wash water into the lower biozone could create conditions of oxygen depletion and acidification. However, the potential impact is mitigated by several factors. Hydrology modeling results indicate that any plume dispersion of the gas laden stream essentially remains at or near the same elevation as the discharge depth of 60 meters, and is not expected to impact areas in the upper bio-zone. The discharge plume is also contained within the GEF exclusion zones of 500 meters. Additionally, fish populations in the vicinity of the GEFs will be monitored per the EMMP.

Expected air, noise, soil, waste and water impacts from construction and operation of the MLS and Power Plant are addressed in the EMMP.

**Air:** Fugitive dust from construction related vehicles and equipment and emissions of nitrogen oxides, particulate matter and carbon dioxide from Power Plant operations will be mitigated through: best practices for dust mitigation and compliance with World Bank Group EHS Guidelines air emission limits, developing an ambient air quality management plan and instituting a monitoring program for Power Plant emissions. Power Plant carbon dioxide emissions will be calculated on an annual basis.

**Noise:** The project will comply with the World Bank Group EHS Guidelines noise limits. Noise impacts from construction and operation of the Power Plant and MLS are expected to be small due to the distance and acoustic screening between the project site and nearest residences. Construction noise levels will be monitored at the property

boundaries and mitigated through equipment selection, maintenance and abatement devices. Noise from Power Plant operation will be mitigated through incorporating noise reduction measures into the building design. Noise levels will be monitored every three years.

**Soil:** The project site is immediately adjacent to the lake. Construction activities are expected to be completed during the dry season, minimizing soil erosion and runoff. Proposed mitigation measures, should construction continue into the rainy season or during heavy rainfall, include: limiting excavation to shallow soil removal during the dry season; replacing soil as quickly as possible; halting excavation during heavy rain; and identifying high erosion risk areas of the project site.

**Waste:** There are presently no waste disposal sites in Kibuye. Construction activities are expected to generate significant volumes of waste and debris, while operations are expected to generate waste oil, sludge, filters and hazardous waste streams. A Waste Management Plan will be developed to identify waste streams, re-use and reduction strategies, on-site storage requirements, accidental release mitigation measures, available carriers and transport, and final waste treatment requirements and standards. Hazardous wastes will be stored in secondary containment and transferred to a company that specializes in the recycling, regeneration or disposal of those materials.

**Water:** Water used during construction will be extracted from the lake, during operation water will either be extracted from the lake or received from the public network. Phase I construction peak water demand is expected to be 45 cubic meters per day. Operational demand for the GEFs and Power Plant is expected to be approximately 145 cubic meters per day, with about 1 cubic meter per day expected of oily, sanitary and sewer wastewater discharges. Construction and operation impacts are expected from surface runoff, groundwater seepage, hazardous material spills, vessel maintenance and discharges of wastewater from concrete mixing, equipment washing, dust suppression, oily water and sanitation. All discharges will meet World Bank Group EHS Guidelines effluent limits. Sanitary wastewater will be treated in septic tanks followed by biological treatment, while potentially contaminated wastewater will be treated in the oily water treatment unit. Low risk equipment refueling and maintenance areas will be designated. Hazardous materials storage and generators will have secondary containment to avoid risk of spills. Monitoring will be performed in compliance with World Bank Group EHS Guidelines. Ongoing audits and reviews will be conducted.

The EMMP has identified additional community health and safety risk reduction and mitigation measures related to air, water, noise, waste and traffic.

**Air:** Fugitive dust generated during construction will be mitigated through application of best practices. Power Plant operating emissions will be mitigated through compliance with World Bank Group EHS Guidelines air emission limits, development of an ambient air quality management plan and instituting a monitoring program. Flue gas and flaring emissions from GEF operations were considered negligible, however the GEF gas engines will be subject to World Bank Group EHS Guidelines air emission limits and continuous or unplanned flaring can be stopped through project design.

**Water:** The impairment of surface and ground waters from discharges, runoff and spills during construction and operation of the MLS and Power Plant will be mitigated through equipping all "risk zones" and hazardous material storage areas with secondary containment and treating all aqueous discharges to meet World Bank Group EHS Guidelines effluent limits.

**Noise:** Construction and noise impacts are expected to be negligible, however the project will meet World Bank Group EHS Guidelines noise limits. Construction will only be performed during daylight, noise levels will be monitored and equipment-related mitigation strategies will be deployed. During operation, noise reduction measures will be incorporated into Power Plant design and monitoring will be performed.

**Waste:** Waste minimization is a necessity because there is no formal system waste collection or designated landfill sites. A Waste Management Plan will be developed. Local re-use opportunities will be identified for construction waste and debris. Hazardous wastes will be stored in secondary containment and transferred to a specialized company.

**Traffic:** Traffic impacts during construction include circulation and road safety, particularly related to expected frequent heavy truck movements between the MLS and Power Plant site. Community safety measures will include the implementation of a Traffic Safety Plan to identify traffic, parking and pedestrian zones; vehicles inspections; limiting vehicle speeds on public roads; and using safety stewards at crossing points during busy times. Heavy hauls or the transportation of large size loads will be coordinated with local authorities, as applicable.

**Disease:** An HIV/AIDS Framework for Action will be developed that defines the scope of the problem, identifies risk factors and includes an HIV/AIDS policy and education and awareness programs. The community initiatives will focus on long-term HIV/AIDS mitigation and reduction strategies through supporting local organizations and initiatives that can provide sustainable efforts. Program success will be gauged through a monitoring and evaluation program.

### **Biodiversity and Resource Management**

The primary water resource impacts are to lake fisheries. There are currently 104 registered fishing boats in the district of Karongi, according to MINAGRI (Ministry of Agriculture and Animal Resources). Boat owners generally join one of five existing fishing cooperatives, with a total of 353 registered fishermen in these cooperatives. 94 operate small fishing boats, generally dugouts, while the remainder operates the larger fishing boats. Fishermen in the dugouts use gillnets and operate close to shore targeting tilapia. Fishermen on the larger boats operate offshore, using large purse seine nets to target isambaza (*Limnothrissa miodon*).

A large share of all isambaza caught within and around the project area is landed in Kibuye, making the local economy greatly dependent on the lake's fisheries. However, because fishery management on Lake Kivu is still nascent, there is presently a scarcity of reliable information concerning catches and landings at the various locations around the lake. Fisheries monitoring will commence during the construction period with the establishment of a baseline. In the unlikely case of adverse impacts on fisheries directly related to the project, KivuWatt Ltd will compensate fishermen for livelihood restoration consistent with national law.

Currently, all earth works are completed for both the power plant site and MLS with no effect on the water quality in the lake. Erosion control gabions are in place at the power plant site to prevent soil erosion. Proper erosion control measures will be implemented by the power plant contractor during the building of this facility. As for the MLS construction for GEF fabrication shed and quay, impacts are expected to result from concrete and fill work behind sheet piling structures and could result in dispersion of sediments into near shore lake waters, especially during the construction of the slipway. The resulting increase in turbidity around the construction area could impact the near shore ecosystem, affecting tilapia. While no modeling has been conducted of sediment behavior, the lack of strong currents in the lake supports a relatively fast settling rate for suspended particulate material making this impact likely to be limited in both time and extent. While the effects are considered minor in the context of the lake fishery, the planned implementation of the fisheries monitoring plan will address future impacts.

Additional near shore construction impacts will consist mainly of potential spills of products used during the assembly of the GEFs or any other structures/equipment. The contractors will be required to implement the necessary anti-spill policy and disposal rules.

During gas extraction operations, impacts resulting in changes to the chemistry of the biozone are of concern due to the potential effect on fisheries, either as a result of impacts to primary food sources (phyto and zooplankton) or directly to the fish species themselves. The potential acidification of the biozone as a result of the discharge of wash water would create conditions that reduce the availability nutrients for phytoplankton. Additionally, while isambaza are considered a robust and adaptable species, they are not known to occur in lakes with acidic waters. These impacts are not considered significant, because modeling results indicate that any pH effects would be extremely localized to the area immediately around the discharge pipe and inside the GEF exclusion zones and there is also the potential for seasonal mixing within the biozone itself.

The accidental release or ingress of deep waters from the resource zone into the biozone would be expected to result in nutrient enhancement from ammonia, iron and phosphates, causing eutrophication. The design of the gas extraction process mitigates the risk by returning degassed water from the lower resource zone to the upper resource zone. Restratification of the degassed water in the upper resource zone is confirmed by modeling results. Risks of accidental release scenarios, such as reverse flow and rupture of the raw water riser, have been reduced and mitigated through project design such as conformance to strict material specifications by the suppliers of the riser and downcomers pipes; implementation of strict QA/QC plans during the assembly of the pipes; and the incorporation of a LMP to detect leaks which then provide for shut down of the systems by both automatic and manual means. The real time LMP will also include monitoring of key parameters, including vertical nutrient profiles as called for in the EMMP. Additionally, operational procedures will address emergency shutdown and notification provisions.

It is possible that light emitted from the GEFs and gas pipeline could attract a large number of fish. The GEF exclusion zones could also act as Fish Attracting Devices because of the prohibition on fishing. The overall effects of this impact must be investigated further to determine if light will affect the dynamics of the fish populations. This could also have human impact as fishermen could see reduced catches due to the lower availability of the fish in surrounding areas. Conversely, the exclusion zones could provide positive benefits through assisting in the conservation of lake fisheries.

Noise and vibration may also be considered stressors to which fish could potentially be sensitive. Similarly an artificial magnetic field may also impact the ecosystem dynamics. Further investigation should be carried out into this issue in order to quantify the potential overall effects.

A water resources protection and management plan will be implemented to verify the compliance of discharges from the site into the natural environment. A fisheries monitoring program will be implemented on surveys and the results of these surveys will be used to produce biomass estimates for specific fish species. The program will: meet GoR lake fishery monitoring requirements; monitor Phase I and pipelines impacts; monitor whole project impacts; and combine fisheries catch and landing data collected by the government.

## **7. Environmental Hazard Management**

### **Community Health and Safety**

Potential community health and safety impacts are principally associated with the risk of lake eruption, gas release, explosion and fire related to operation of the GEFs, gas pipeline and Power Plant. Additional expected community health and safety impacts related to construction and operation include fugitive dust, water quality, air quality, noise, waste management, traffic and communicable disease.

The principal community health and safety hazards identified in the HAZOP Plan relate to possible impacts on lake stability as a result of reverse flow in production separators or discharges of gas and water at the wrong depth. The majority of risks identified relate to potential changes in the level or direction of flow through extraction, separation

and reinjection processes. Other potential identified risks could arise from loss of liquid levels or corrosion effects. Risk reduction and mitigation measures incorporated into project design in response to the HAZOP analyses include: project design and operating manual changes; the implementation of a maintenance and inspection programs; the deployment of gas detection systems; and the use of appropriate materials.

Additional safety measures incorporated into project design include: instituting automated detection, warning and shut down systems in the event of gas releases or other risks; creating 500 meter exclusion zones around each of the GEFs and reinjection points; and marking the location of the submerged pipeline with buoys and lights. For security, the GoR takes the overall responsibility of security outside of the permanent facilities. They are, through the Rwanda army, in a process of acquiring necessary facilities for this purpose. KivuWatt Ltd will develop a protocol with GoR for security purposes. Inside the fence, KivuWatt Ltd will contract private unarmed security personnel. The facilities will be properly fenced with a security gate and a posted guard 24 hours per day. During the construction of the facilities, the various contractors will arrange for security inside their fenced construction areas including a guarded entry gate. A protocol between the GoR and KivuWatt Ltd will be developed on security principles and procedures.

Potential occupational health and safety hazards identified during construction activities include: falls and slips, failures of support systems and/or platforms, noise and vibration, collision with mobile plant or vehicles, exposure to dust and to hazardous materials, fire and burns, exposure to gas releases or asphyxiation, crushing by heavy plant or collapse of structures, falling debris and communicable disease. These hazards will be mitigated through a contractor implemented OHS Plan and a comprehensive OHS Management System, based on the requirements of ISO18001 for Occupational Safety and Health Management Systems. An HIV/AIDS Framework for Action, including a workplace policy and prevention and education initiatives, will also be developed.

The OHS plan provides a framework for the administration of health and safety activities; defines health and safety responsibilities, policies and objectives; provides a process for performance measurement and reporting; establishes inspection and review protocols for identification, elimination or control of potential risks; and develops compliance and communication interfaces. The OHS Plan will be reviewed by management every six months.

Potential occupational health and safety hazards arising during operation include: lake eruption, gas release and asphyxiation, explosion, fire and burns, exposure to hazardous materials and noise. These risks will be addressed through: LMP, HAZOP analysis; SOP's; an ERP; Fire Safety Plan; and OHS Management System.

The HAZOP plan also provided for recommendations for operator requirements to be implemented into the Fire Safety Plan. The Fire Safety Plan, as part of the SOP's will address specific areas of concern and methods for extinguishing fires and minimizing risks associated with the handling of hazardous materials. Current designs for the GEFs and Power Plant will incorporate provisions for fire prevention, detection and suppression. Both facilities will have equipment installed, including gas detection, heat sensors, manual pull stations and audible alarm system, in the event of fire and will include event notification systems and feature regular training.

The ERP will be developed prior to commissioning of operations and include systems for warning and safe evacuation of staff as a result of lake eruption, gas release, explosion and fire hazards. The ERP will include: the identification and location of potential risks and emergency scenarios; risk mitigation strategies; alarms and warning systems; procedures to identify and account for all workers and visitors; the establishment of escape routes and evacuation systems including regular drill practice for all staff; the establishment of an onshore emergency organization, control centre and Emergency Response Team; a search and rescue plan for workers; a manifest detailing the location, description and purpose of all emergency response equipment; training and awareness programs for workers; and regular ERP reviews.

## **8. Monitoring program:**

Monitoring will reinforce the design and mitigation measures. A monitoring program will be executed and include:

- Air
- Water
- Lake stability
- Fisheries
- Waste
- Noise
- Safety
- Resettlement activities

Roles and responsibilities for monitoring of the Project will be shared by the Bilateral Regulatory Authority (BRA) and the Rwandan governmental authorities and by the Project team. Both REMA and KivuWatt Ltd are responsible for environmental monitoring and auditing. It is expected that KivuWatt Ltd will undertake self-monitoring, record keeping and reporting and submit this information to REMA annually. REMA will be responsible for review and, on occasion, verification of reports and data submitted and for periodic inspections as needed.

## **9. Public Consultations and Public disclosure**

The GoR EIA regulation of 2005 set out requirements for stakeholder consultation. In particular REMA, in conjunction with the Rwandan Development Board, initiated a public meeting on November 27, 2009, pending the notification of receipt of an EIA. The meeting was open to members of the public as well as governmental and other agencies, all of whom participated and commented on the EIA and the proposed development. The EIA Certificate, dated January 18, 2010 was issued to KivuWatt Ltd on behalf of the Rwandan Development Board.

Community consultation for the project was also undertaken as summarized below:

- By Green and Clean Solutions (GCS) during the production of the April 2009 ESIA.
- By SKM during the production of October 2009 ESIA.
- By KivuWatt Ltd at a consultation workshop held on 11th and 12th August 2009.

Consultation with the local community and other stakeholders (e.g. Rwandan Government officials, local businesses) was undertaken in August 2009 where the details of community health and safety risks related to the project were discussed and specific comments received. The outcomes of the community consultation were accounted for in assessing impacts and developing mitigation measures. There is an overwhelming level of support for the project both locally and nationally and an expectation of the contribution to economic development. There are also high expectations of the project and in particular the benefits that will accrue from job creation, training and the provision of a secure supply of low cost electricity. However there is also the interest that this project be done without incurring unacceptable environmental and social impacts. Consultations and community dialogue will continue with regards to risk and mitigation, including engagement with the community in the development of the ERP.

A grievance mechanism will also be established as part of the project community consultation program. Company and community stakeholders will be involved in the design of the program which will be part of the ongoing communications program established for both local and external stakeholders.

An Environmental and Social Review Summary was disclosed in the MIGA web site since 26<sup>th</sup> of April 2010 at: [http://www.miga.org/projects/index\\_sv.cfm?pid=827](http://www.miga.org/projects/index_sv.cfm?pid=827).

The SKM ESIA October 2009 is available at the Rwanda Development Board.

## 10. Complementary Initiatives

Additional action plans have or will be prepared like a Social management Plan, a Community Development Plan (CDP) and a HIV/AIDS Framework for Action.

- (i) In line with international best practice, ContourGlobal KivuWatt Ltd will develop a **Social Management Plan (SMP)**. The SMP will recommend feasible and cost-effective measures to prevent or reduce significant negative social impacts to acceptable levels, a mechanism for monitoring the success of these mitigation measures and a Public Consultation and Disclosure Programme (PCDP). In order to successfully attend to the various tasks and responsibilities contained in a SMP, including the Public Consultation and Disclosure Programme, a Community Relations / Liaison Officer will be employed by ContourGlobal KivuWatt Ltd.
- (i) Based on the needs and capacities analysis, the policies of the client and the development plans (and budget) of local / regional government, a **Community Development Programme (CDP)** will need to be generated. This will include the areas / sectors of proposed assistance (e.g. health, agriculture etc), the description of various projects in these areas (aims, objectives and strategies), and the identification of agencies responsible for their implementation, as well as an evaluation procedure for each project. The programme should be integrated such that each sector targeted complements rather than conflicts with other initiatives to create development synergies. The CDP should also facilitate government development agendas and not be in conflict with or contradict them. The proposed CDP would be discussed with the local communities before its implementation to ensure it is compliant with their needs and expectations.
- (i) **HIV/AIDS Action Plan:** While workplace policies are a key step in combating HIV/AIDS, comprehensive HIV/AIDS workplace programmes are required to put policy into practice. ContourGlobal KivuWatt Ltd should consider a '*workplace education and care programme*'. These programmes, include, for example, workplace education programmes, provision of treatment for STIs, invite peer counsellors to educate about prevention, encourage voluntary counselling and testing (VCT), provide medicinal care for HIV/AIDS related opportunistic infections, and promote a healthy lifestyle.

## 11. Conclusion

An ESIA (October 2009) was prepared for the entire project for both phases. The ESIA analyzed the following issues related to both project construction and operational phases: air emissions and noise, waste management, lake stability and protection, land use, socioeconomic impacts, community and worker safety.

The Environmental Management and Monitoring Plan (EMMP) provides:

- the framework for planning and implementation of activities during both the construction and operational phases of the project. It is prepared in accordance with legal and regulatory requirements of Rwanda and the IFC Performance Standards and the World Bank Group Environmental, Health and Safety (EHS) Guidelines. The engineering design parameters of the project have been formulated to comply with the *Mandatory Guidelines*, a requirement of the GCA;
- And the means to monitor the predicted impacts, to provide reassurance as to compliance with legal, corporate and international requirements and to allow detection of emerging issues. The EMMP addresses anticipated impacts with respect to air, noise, water, soil, waste, lake stability, community consultation, and socioeconomic welfare and worker safety. The EMMP references the relevant standards and regulations (Rwandan and AfDB/MIGA/IFC) that will apply to all phases of the project and includes the roles and responsibilities of the different parties involved in the design and implementation of the project.

Additional action plans and procedures need to be prepared that address both the construction and operation of the GEF's and accompanying power plant:

- Brief Resettlement Action Plan (BRAP),
- Social Management Plan (SMP),
- Community Development Plan (CDP),
- HIV/AIDS Framework for Action,
- Occupational Safety and Health (OHS) Management Systems and OHS Plan,
- Emergency Preparedness and Response Plans (ERP),
- Fire Safety Plan,
- Traffic Safety Plan and
- Waste Management Plan.

## **12. References and Contacts:**

The primary document reviewed by AfDB is the KivuWatt Project Environmental and Social Impact Assessment (ESIA) including the Environmental Management and Monitoring Plan (EMMP), authored by Sinclair Knight Merz Ltd on behalf of KivuWatt Ltd., October 2009.