OMNICANE ETHANOL PRODUCTION LTD

Installation and Operation of a Distillery and Concentrated Molasses Solids (CMS) Fertilizer Blending Plant

at Omnicane Sugar Cluster - La Baraque

Environmental Impact Assessment

Chapter 6: Environmental Management Plan

6. General

This section reviews the environmental impacts as well as the impacts on the built environment, particularly with regard to demand on the existing infrastructure (road, electricity, water supply, etc.) due to the implementation of the Distillery and Fertilizer Blending Plants at La Baraque

These impacts are analysed within the framework of an Environmental Management Plan at various stages during the Project cycle, namely at conceptual development, construction and operation stages.

6.1 Objectives of the Environmental Management Plan

The objectives of the Environmental Management Plan are:

- The identification of potential impacts resulting from the activities associated with the installation and operation of a Distillery and the Fertilizer Blending Plants, and the mechanism of these impacts
- The identification of Impact Receivers
- The assessment of the negative impacts and mitigation measures proposed

Negative impacts can be generated during the Construction Stage, as a result of:

- The execution of engineering works (construction, excavation, earth-moving, etc.,)
- Production of effluents at the Site staff facilities during Construction Stage and thereafter
- Production of wastes on Works Site during Construction Stage and thereafter
- Noise generation during the Construction Stage and thereafter

Negative impacts can also be generated during the Operational Stage, as a result of:

- Raw materials and chemical spills;
- Release of untreated process effluents with significant organic and inorganic loads;
- Solid waste generation;
- Gaseous pollutant emissions;
- Noise pollution, etc.

Hence the main environmental objective of the Environmental Management Plan is therefore to eliminate or abate the negative impacts of the Project on the ecological integrity of its Natural Environment, as well as on its Built Environment. Mitigating

Measures deemed necessary to eliminate/mitigate impacts on the Project Environment at Construction and operational phases are reviewed in this Chapter.

6.2 Sources of Impacts

Impacts, in general, could be generated by the Project:

- At conceptual level
- By Engineering / Environmental interactions during the Plant Construction Phase
- By Activity / Environmental interactions during Operational Phase

They will be identified and assessed in this Chapter.

The Promoters have presented plans to address these impacts to ensure that the proposed project will, upon implementation of the specific measures agreed, comply with applicable laws and regulations. The information about how these potential impacts will be addressed by the Promoters is described in this section.

6.3 Impacts at Project Conceptual Stage

Positive impacts will result from:

- The safe guard of the future of the sugar industry in Mauritius by the implementation of the road map elaborated jointly by the Government and the private sector,
- Reducing the impacts associated with the substantial decrease in the guaranteed price from the sale of sugar under the EU Protocol,
- The closure of the Alcodis Distillery at Rose Belle that operates on imported fossil fuel (Heavy fuel oil) that is a disadvantage both on the economics of product costs as well as on the environment due to emission of carbon dioxide,
- The creation of employment opportunities not only for trades, technicians at Construction Stage, but also for the administration, operation and maintenance of the Distillery, CMS Fertilizer Blending Plants and the Carbon Dioxide Bottling Plant,
- Production of food grade carbon dioxide[45], a by product of the fermentation stage of the Distillery for the local market as well for the regional market, thus reducing the emissions of GHG and reducing the import of diesel for production of the beverage grade CO_2 as is presently the case,
- Foreign currency earnings through the exportation sales of fuel grade ethanol (bioethanol) and/or foreign currency savings due to decrease in the import of fossil fuel by part substitution with anhydrous ethanol to produce a fuel blend of kerosene/ethanol.

6.3.1 Site selection, history and Present Status

The proposed Distillery will be located within the sugar cluster at La Baraque, L'Escalier. Development will not result in economic displacement neither will it affect sites of ecological or cultural significance.

The site location of the Distillery is dictated by the source of raw material (molasses) that will be provided by the sugar mill continuously during the crop season and the availability of steam from CTSAV Power Station.

[45] It must be noted that at present the local soft drink industry uses carbon dioxide produced by the burning of fossil fuel, hence the production of carbon dioxide from the Distillery will result in a reduction of the current practice.

The land is leased/owned by Omnicane Ethanol Production Ltd and a full range of services (electricity, access, industrial and potable water supply) already exists within the La Baraque Industrial cluster, adjacent to the Project Site. Furthermore the installation of the Distillery complex [46]will not result in the loss of natural habitats or result in economic displacement or resettlement.

Development of the Distillery at Omnicane is in conformity with the centralisation blue print and the MAAS strategy for the sugar sector.

6.3.2 Aesthetics and Visual Impacts

At present, the Site forms part of the sugar cluster that includes the sugar mill, the sugar refinery and its Plantation white sugar storage shed, CTSAV Power station and its associated infrastructure (including the high voltage electricity transmission lines).

The Distillation building is at a height of about 18m. This height is to be compared with the height of the adjacent buildings (sugar factory with a maximum height of 30m, the CTSAV building at a maximum height of 35 and the two stacks of CTSAV 1 and 2 at a height of 56m, the sugar refinery building at a height of 32m).

The Distillery process equipment are designed for outdoor operations. Only the distillation and pre fermentation process equipment will be housed inside a building, the former in a building with four platform levels and the latter with a ground level. The building is in metallic frame steel clad sheets. The height of the building will be 18m as compared to the adjacent Refinery building with a maximum height of 32m.

Hence the landscape will change marginally with the proposed Distillery.

At present, the Site does not have any wilderness quality or any species of flora or fauna that would have been at threat or any invasion of any natural habitats as such. In the near vicinity of the Site, there is no unspoilt environment: terrestrial and freshwater. Land in the surrounding vicinity is under cane cultivation mainly at present.

6.4 Impacts at Construction Phase

The expected interactions between the Civil and Structural Engineering activities and environmental components during the Construction Phase are investigated below. There are four major impacts that can be identified from the construction activities and these can be classified in the following groups:

- Noise;
- Dust;
- Effluents; and
- Solid wastes.

[46] Distillery complex means: The Distillery Plant, the CO_2 bottling Plant and the CMS Fertilizer Blending Plant including the associated infrastructure.

6.4.1 Noise Generation

During the construction phase, the use of construction equipment and vehicles (cranes, pay loaders, excavators, Lorries, etc.) will increase the noise level of the immediate surroundings.

Construction works will involve:

- Excavation of top soil and backfilling;
- Construction of concrete platforms for the various sections of the Distillery;
- The erection of metallic structures;
- New foundations to support the metallic structures;
- Construction of concrete buildings;
- Roof and building cladding;
- Construction of CMS storage Ponds involving earthworks and liners; and
- The erection of process equipment (distillation columns, fermentation tanks etc.)

The construction of the civil works, erection of metallic structures and installation of process equipment will last about twelve (12) months.

6.4.1.1 Nature and Intensity of Impact

Increase of the noise level due to construction equipment and vehicular traffic will be intermittent and occurring mostly during daytime.

6.4.1.2 Impact Receptors

The impact receptors are:

- The nearby residents, and
- The site workers.

6.4.1.3 Mitigating Measures

Noise generation during construction works (civil works and site metallic structures principally) due to the movement of heavy vehicles and operating equipment (cranes, etc.) will be limited in duration (12 months). Nevertheless it is recommended that such works be carried out during daytime so as to minimise disturbances to the nearby residents.

For the site workers, those that work close to the equipment are usually equipped with ear muffles.

Noise reduction will also occur due to geometric *cum* atmospheric attenuation. It is established that a noise field loses intensity at the rate of at least 6dB each time the distance from the source is doubled. In the present case, the distillery complex will be located at a distance of 200m from the nearest estate quarters and 0.75km from the nearest residence in L'Escalier, thus acting as a buffer for noise attenuation.

6.4.2 Dust Generation

During site preparation for the construction of the Distillery complex the land will be excavated and backfilled with sound material. Moreover some site levelling may be

required. The use of heavy equipment will generate dust. During the construction of the Distillery complex, vehicular traffic (Lorries etc.) to and from site may also cause dust emissions; these will need to be controlled.

Furthermore stockpiling of building materials such as rock sand, cement, etc. may generate dust plumes.

6.4.2.1 Nature and Intensity of Impact

Dust emissions during the site preparation and constructional phases can occur in the event of dry climatic conditions. Dust emissions, if any, will also occur intermittently.

6.4.2.2 Impact Receptors

The impact receptors are:

- The site workers
- The cultivated sugarcane fields,
- The Omnicane staff living in the residential quarters

Excessive dust on a site can be health hazard for the site workers while the local inhabitants of L'Escalier Village who are furthest from these sources are not expected to be affected.

6.4.2.3 Mitigating Measures

Dust emissions can be minimised by the control of vehicular speed and good management of materials stockpiles. The latter should be shielded from the wind. Significant concrete batching will not be carried out onsite as premixed concrete will be used. Limited concrete batching will be used mainly for small concrete works for mortars. Building aggregates and rock sand should be stored in bunkers with walls that extend beyond the piles.

6.4.3 Water Pollution from Equipment and Site Staff

Polluting effluents may be generated by

- on-site sewage disposal
- servicing of machinery on site

During construction of the Distillery complex, it estimated that seventy (75) Site workers will be present on Site and generation of sewerage must be expected. The daily rate of sewerage production will evidently depend upon the number of workers present any day of Site, but from past observations, an average of 2 to 3 m^3/d can be expected.

6.4.3.1 Nature of Impact

Uncontrolled discharges of domestic effluents generated by Site workers during Construction can result in the addition biological pollution and of organic matter and nutrients to the local ground and surface water. To appreciate the impact, reference is made to Table 3.14.1.1, which gives the typical composition of raw domestic sewerage. Sewerage besides adding considerable organic, nutrient and biological contaminating loads will generate foul smells, attract vermin and is a potential source of infectious diseases.

Oils, lubricants and other hydrocarbons from machinery, particularly as a result of leaks or onsite repairs and maintenance may infiltrate into the soil

6.4.3.2 The Impact Receptors

The major impact receptor will be the Natural Environment, as the aquifer and surface waters may ultimately be contaminated by contaminant-loaded percolation and runoff

6.4.3.3 Intensity of Impact

The impacts expected will be insignificant considering the relatively low amounts of pollutants likely to be discharged.

But since they can be easily avoided with proper Site Management, the necessary mitigating measures must be taken.

6.4.3.4 Mitigating measures

6.4.3.4.1 Mitigating Biological Pollution

No connection of Site amenities to a regional sewer network is possible due to the absence of the latter. This can result in the discharge of organic matter and nutrients to the underground water through surface runoff and leaching.

Mitigating measures will involve the provision and maintenance, by the Contractor, of appropriate septic tanks/leaching field system during the duration of the Works.

The effluents ultimately released from the leaching field will have the quality described in Table 6.4.3.4.1.1 below.

Table 6.4.3.4.1.1: Typical Domestic Effluent Composition at Various Stages of Disposal[47]

Pollution Parameters	Units	Influent to Septic Tank	Effluent from Septic Tank	1.0 m below Leaching Field
COD	mg/ℓ	250 - 450	90 – 120	<20
Total Kjedahl Nitrogen (TKN)	mg/ℓ	25 - 45	20 – 40	< 5
NH_3 Nitrogen	mg/ℓ	10 - 25	20 – 40	Trace
Total Phosphate	mg/ℓ	3 - 7	3 - 7	Trace to 1
Total Suspended Solids (TSS)	mg/ℓ	127 - 187	40 –60	Trace
pH		6.6 - 7.7	6.0 – 7.2	6.0 – 7.2
Coliform	MPN/100ml	10^6 - 10^8	10^4 - 10^6	0-10^1

6.4.3.4.2 Mitigating Pollution from Plant/Equipment servicing on Site

Servicing of mobile plant on site will as far as possible not allowed on site. In case of emergency servicing or repairs is warranted on site, it will be carried out at a

[47] **Source**: adapted from *Ministère de L'Environnement, Cahiers Techniques de la Direction de la Prevention des Pollutions* No 5, 1981

specifically assigned location on Site. This will be a condition of the Works Contract and hence will form part of the Contractor's responsibility.

6.4.4 Solid Wastes and Excavated Spoils

Solid wastes and excavation spoils will be produced during site preparation prior to construction as well as during the construction phase. During site preparation, preliminary estimates indicate that about 3,000 m^3 of green and excavated debris will be generated.

During the construction phase, solid wastes include:

- Concrete spills, wood and plastic (used for equipment protection), metal and non-putrescible wastes,
- Construction wastes such as rubbles from site clearing and construction
- Packaging materials from new equipment
- Normal daily refuse from the construction workers

6.4.4.1 Nature and Intensity of Impacts

The solid waste generated during the construction of the buildings can be considered to be non-hazardous waste and as such does not require specific conditions for storage. Type of solid wastes expected are: construction wastes such as rubbles from site clearing and construction, packaging materials from new equipment and normal daily refuse from the construction workers.

6.4.4.2 Impact Receptors

The impact receptors are:

- The natural environment, namely through visual impact of the local landscape and the leachate from the degradable organic wastes percolating to the water table or flows to the irrigation networks,
- The built environment, also through visual impact and proliferation of mosquitoes, rodents and other vermins,
- Road traffic through increase in road traffic estimated at 45 lorry trips over a period of 5days or 9 lorry trips over a period of 8hours per day.

6.4.4.3 Mitigating Measures

Green and organic debris will be carted away from Site to the Mare Chicose landfill.

During construction, other rubbles as well as packaging materials will be sent directly to Mare Chicose Land fill site by authorised waste lorries. These tasks will be specified as part of the tasks to be executed by the Contractor on Site.

Control of littering should be rigorously enforced by the contractors and sub-contractors and monitored by the Site Engineer or Site Agent. All disposal trips should be registered in a logbook and made available on Site at all times. Recording of the logbook should be the responsibility of the Site Engineer or Site Agent.

Mess leftovers will be stored in appropriate bins fitted with tight lids, which will be carted away to disposal by an agreed Waste hauler.

6.4.5 Import of Back fill materials

For the CMS storage tanks, the construction methodology (see Section 3.16.4.3) involves the removal of top soil and excavation to about 1.5m below existing ground level and the creation of embankment of about 2.0m above existing ground level. The amounts of materials that will be excavated are estimated as follows:

- Top Soil: 1950m^3
- Excavate materials: 4000m^3

The top soil and excavated materials will be reused in the construction of the embankments. Moreover it is estimated that about 14 200m^3 of materials (selected excavated earth/rocks) will be needed and will have to be imported.

A borrow pit will be located within a radius of 5km from the proposed site.

6.5 Impacts during Operation Phase

6.5.1 Gaseous emissions

The Distillery process operation will generate carbon dioxide as the main greenhouse gas from the fermentation section. Steam losses as well as volatile organic compounds losses can be expected but should be minimal.

No Particulate matter *per se* will be generated during the Distillery operation.

6.5.2 Preliminary Environmental Risk Assessment

Ethanol is a flammable product and hence its manufacture and storage requires a risk screening. On site storage of ethanol

Ethanol is a compound that:

- Is flammable but needs external ignition or heat source to burn;
- Exerts pressure if burn in enclosed spaces;
- If burnt completely produces non-toxic by products;
- If burnt partially, could produce carbon monoxide

Risk screening consists of three stages:

- Preliminary and chemical risk screening;
- Chemical risk screen for major hazards;
- Standards and physical risk screen.

6.5.2.1 Preliminary and chemical risk screening

The preliminary risk screening indicates that ethanol distillery process and the raw materials are used at distilleries that operate in Mauritius already. The Promoters will benefit from the experience and expertise of Alcodis Ltd and its personnel who will be involved in the operation of the Distillery. Moreover ethanol manufacture from cane

molasses is carried out worldwide. Furthermore the ethanol production in Mauritius has already been the object of a strategic environmental assessment. The expected benefits from the project have been identified already in the MAAS.

6.5.2.2 Chemical Risk Screen Major Hazards

The proposed Ethanol Distillery will produce mainly fuel grade alcohol, that is a flammable compound.

However on the plausibility of catastrophic event that could occur, the following information shows that operation of such project type pose a minor risk. No major accident has been reported. Safety and emergency procedures are available to respond and counter consequences of major accidents.

6.5.2.3 Chemical Risk Screen: Standards

The whole Distillery Installation design is risk- based engineering design. Operation and maintenance standards are also incorporated in the design. Furthermore the project site avoids specific risks to local populations and natural systems.

6.5.2.4 Physical Risk Screen

Physical risks pertain to transportation, flooding hazards, natural disasters and other onsite and offsite hazards.

- Transportation risks
  At construction stage, transport of construction materials and distillery plant and equipment to site will be by trucks. Movement of construction workers to and from site will require private utility vehicles (vans, bus) or/and public transport (bus). The increase in vehicular traffic will be minimal as the traffic situation on the local roads is considered to be light and moderate.

- Flooding hazards
  The Site is not prone to flooding and project implementation will not cause any flooding hazard.

- Natural disasters
  The principal natural disaster that can affect the site is cyclone during the period from November to April. Infrastructure, outdoor structures as well as buildings are designed to withstand cyclonic gusts of up to 280km/h.

- Other on site and off site hazards
  The Distillery working environment is not exposed to hazards such as high temperatures, pressures, radiation etc. Furthermore there are no high speed machineries in the proposed Distillery.

6.5.2.5 Hazard Analysis

Ethanol is not a listed compound in the Ecological Risk Assessment Screening threshold based on chemical toxicity by the USEPA. However under the Basel Convention, ethanol is included in the list of Substances with Hazardous Characteristics

because of its flammability. In Mauritius, ethanol is a regulated compound under both the Dangerous chemical Act (2004) and the Hazardous Act (2001).

6.5.2.6 Emergency Plans

The risk associated with bulk storage of alcohol is flammability. Well designed storage tanks and pipe lines should be provided with containment to collect any spillage. It has to be fitted with spillage detection and spill collection system.

The safety set up of the Distillery Plant will include *inter alia*:

- Fire detection system
- Fire fighting equipment; and
- A trained emergency response team

Emergency plans have been implemented at Alcodis Plant and are attached in Appendix J. These plans will be reviewed and training programmes before start of Distillery operation.

6.5.2.7 Conclusions

The technologies in ethanol manufacture and treatment of waste by products are considered as mature technologies which do not require complex procedures nor necessitate complex tasks. Moreover Distilleries have been in operation successfully for several decades in Mauritius. The Design of transport and storage facilities for ethanol has been the subject of constant improvements worldwide over the years. Hence the risks associated with construction material failure have been eliminated.

With all precautionary measures in place, the construction and operation of the Distillery Plant will be a low risk undertaking. It is recommended that a detailed risk assessment be carried out taking into account the other operating entities within the industrial cluster namely the power station, sugar refinery and sugar mill.

6.5.3 Impacts of Generation of Vinasse

6.5.3.1 Origin and Impact

Vinasse is a by product of molasses fermentation and distillation. The rate of production of Vinasse is $30m^3/h$ and the characteristics have been reported in section 3.8 and can be summarised as follows:

- Low pH of around 3.0;
- High COD and BOD_5 concentration;
- Presence of nitrogen and phosphate as well as potassium that make Vinasse attractive for reuse as a fertiliser

The application of vinasse to the sugar cane fields is limited to the cane harvest period and since vinasse will be produced by the Distillery also during the inter-crop season.

Storage and reuse of vinasse (as is) produced as a fertiliser cannot be stored for extended period without some form of vinasse treatment. Since vinasse can upon uncontrolled

fermentation generate foul odours with the production of odorous compounds such as butyric and propionic acids in sufficient concentrations to influence the surroundings and cause odour nuisances.

Moreover due to its high concentration of biodegradable matter, Vinasse can affect aquatic life and cause eutrophication of a water receiving body.

6.5.3.2 Mitigating Measures

Several mitigation measures have been identified in the Management of Vinasse including its prolonged storage; these are described below.

6.5.3.2.1 MMV1: Elimination of Odour Generation from Vinasse

As indicated previously, Vinasse is potentially the main source of foul odour due to its propensity to produce odorous compounds such as butyric and propionic acids among others under anaerobic conditions.

To eliminate the risks of Vinasse fermentation, Vinasse will be processed into CMS as it is being generated during the distillation process (see section 3.8). Vinasse from the Distillation column is pumped to the Vinasse tank that feeds the Evaporator Unit.

The Evaporator unit consists of five evaporators with four-duty and one in cleaning in place. Furthermore all pumps have standby units and consequently the evaporator unit is kept functional during the ethanol manufacture. Hence Vinasse is not kept in storage for processing for more than 2-3 hours.

6.5.3.2.2 MMV2: Stop the Operation of the Distillation Section

In the event that there is any mechanical failure with the Evaporator Unit, the distillation process is stopped.

The above measures in effect avoid prolonged storage of Vinasse and eliminate the risks of generation of odorous compounds.

6.5.3.2.2 MMV3: Transformation of Vinasse in CMS for use as a Material input for the CMS Fertilizer Blending Plant

Vinasse will be processed into Concentrated Molasses Solids (CMS) through an evaporation process to reduce the water content from 95% to 50%. The production rate of CMS will be 288m^3/d and 86400m^3/y[48].

The CMS is an important source of Potassium (K_2O) and will be blended with other nutrients such as N and P in the CMS fertilizer Blending Plant to produce a fertiliser for reuse in the sugar cane fields. Production of CMS and Blending Plant are already in operation at Alcodis Distillery and the same process plant equipment will be used at La Baraque.

[48] Based on a Distillery operation of 330days per year.

The use of CMS as a fertiliser will reduce the import of K_20 and hence reduce the import of chemical fertiliser with savings in foreign currency.

Since fertiliser to the sugar cane fields during the harvest season, provision is made for the storage of CMS in two storage tanks each with a capacity of about 8,500 tonnes. The stored CMS is then used at the start of the following harvest season.

6.5.4 Management of the CMS storage Tanks

6.5.4.1 Origin and Nature of Impact

The CMS storage tanks will contain concentrated molasses solids (CMS) throughout the year. The characteristics of CMS have been given in section 3.8.3.

The concentration of vinasse through the evaporation process to produced CMS in effect removes the volatile acids which reappear in the acid condensates. Removal of volatile acids reduces or eliminates the propensity of CMS to generate foul odours. The CMS contains organic matter and compounds with high associated organic pollutants that can in the long term contaminate ground or receiving waters if there is a direct discharge.

6.5.4.2 The Impact

Organic and inorganic pollutants associated with CMS can rapidly deplete the available oxygen of the receiving waters and has adverse effects on fish and other aquatic life. Contamination of the underground water can occur if a prolonged seepage takes place in a porous substratum.

6.5.4.3 Mitigating Measures

The design features of the CMS storage tanks as well as the construction methodologies are central to minimise the negative impacts identified above. A detailed description of the CMS storage tanks is given in section 3.16.4.

The following measures have been incorporated in the design of the CMS storage tanks as mitigation measures:

- **Ingress of storm water in the lake**

  Each tank is fitted with a floating cover made of HDPE with water collection drains. The water is then pumped to the existing irrigation water channel via a flexible hosing piping network

- **Air evacuation system**

  The emptying and filling of the tanks with CMS will cause movement of air entrapped under the HDPE cover. Air chimneys will be placed along both lengths of the HDPE cover to allow movement of entrapped air. The air chimneys will consists of vertical PVC pipes of diameter 90mm fitted with fine wire mesh.

- **Installation of Leak Detectors**

  Leak detectors will be installed below the Aquatan bottom impermeable liner in a slotted PVC pipe and embedded into a sand bedding liner.

  The incorporation of a leakage detection systems helps to overcome any potential problems of robustness and durability of the Aquatan bottom liners for the two tanks.

  The leak detector system will be installed over a specified area so that the location of any leaks can be zoned.

  These detectors will give an instant warning of the failure of the impermeable membrane and hence appropriate remedial action can be taken. Due to the high viscosity of 3000-3500 cSt (c.f. viscosity of water at 20^{o}C: 1cSt), the infiltration rate will be very low and hence movement into the soil will be very slow if any. This feature will allow reasonable time for remedial actions to be taken.

6.5.5 Odours

6.5.5.1 Origin and Nature of Impact

In a Distillery volatile organic compounds (VOC) are generated during the various processes. The main possible sources of odorous emissions are:

Fermentation:
Emissions during fermentation process that could cause odours are ethanol and several trace volatile organic compounds (VOC). Carbon dioxide (CO_2) produced during fermentation can act as a carrier for the organic compounds.

Distillation
Emissions during the distillation process that could cause odours are ethanol, Aldehydes and several trace volatile organic compounds (VOC).

Storage and ethanol loading:
Ethanol and VOC odours could come from the storage and ethanol loading facilities. However these emissions would be minimal and are unlikely to have significant odour impacts.

Storage of vinasse
As indicated in the section 6.5.3, vinasse has a propensity to generate odorous compounds due to biological reactions such as fermentation.

The main odorous compounds as well as their odorous threshold limit (OTL) are given in Table 6.5.5.1.1 below.

Table 6.5.5.1.1: List of Odorous compounds and their threshold limits

COMPOUND	OTL (mg/ℓ)	COMPOUND	OTL(mg/ℓ)
Ammonia	3.55×10^{-3}	Skatole	1.0×10^{-4}
Acetic acid	2.49×10^{-3}	p-Cresol	4.5×10^{-6}
Hydrogen sulphide	6.39×10^{-6}	Iso-butyric acid	2.97×10^{-2}
Propionic acid	3.08×10^{-2}	Trimethylamine	2.00×10^{-6}

The relevancy of the above data should be taken within the context of the proposed activity.

6.5.5.2 Mitigation Measures

For odour control, the design of various processes has either included equipment per se or additional processes to minimise odorous compounds.

- **Fermentation Equipment**

Nearly 50 percent of the carbon dioxide gas produced daily by the fermentation section will be further processed into food grade carbon dioxide and bottled in the CO_2 Bottling Plant.

The rest of the carbon dioxide will be released to the atmosphere via a scrubber which removes VOC as well as ethanol from the exhaust CO_2.

- **Distillation**

All distillation columns are equipped with condensers that in effect condense vapours (including organic compounds) to the liquid state. Hence releases of vapours are unlikely during normal operation.

- **Storage of vinasse**

As indicated in sections 6.5.3 and 6.5.4, to reduce the risks of odour generation from fermentation of vinasse, a CMS Evaporation Plant will be installed as part of the Distillery to convert vinasse into concentrated molasses solids (CMS). CMS will be stored in storage tanks fitted with a floating cover. The CMS will be converted into CMS fertilizer during the crop season (see later).

In the event of a prolonged break down of the CMS Evaporation Plant, the Distillation process will stop so as to prevent any prolonged accumulation of vinasse.

6.5.6 Impacts of Process Effluents

6.5.6.1 Origin

Sources of process effluents have been identified in section 3.13. Moreover the quality of the combined process effluents has been measured at the existing Alcodis Distillery and is given in Tables 3.13.2.1 and 3.13.2.2 in section 3.13.

6.5.6.2 The Impact

Organic and inorganic pollutants associated with process effluents of the Distillery can rapidly deplete the available oxygen of the receiving waters and has adverse effects on fish and other aquatic life. Odour nuisances can also result if anaerobic conditions develop with release of noxious gases such as hydrogen sulphide.

6.5.6.3 Mitigating Measures

Several mitigating measures have been identified and are described below.

6.5.6.3.1 MMPE1: Direct Reuse of Process Effluents

As described in Section 3.13, the design of the Distillery processes has incorporated the direct reuse of process effluent streams. Table below summarises the process streams that will be recycled directly and the process streams that will reappear as process effluents.

Item No	Source	Flow m^3/day	Temp ^{o} C	Composition	Comments
1	Cleaning of evaporators (1 effect daily), 2 rinses	40	60-65	Acid condensate, Vinasse & CMS residues	Recycle of acid condensate
2	Cleaning of Fermentors & prefermentors	10	60-65	Acid condensate, beer & yeast residues	Effluent reused as process water for fermentation
3	Cleaning of evaporator platforms	10	60-65	Acid condensate, Vinasse & CMS, nitric acid & caustic soda residues	Recycle of acid condensate – reappears as effluent
4	Acid Condensate	526	70	Volatile acids	Reappears as effluent
5	Flegmasses – water from rectifier	176	100	7 – 9 pH.	Re appears as effluent
6	Cleaning of spills	10	30	spills residues	Recycle of acid condensate – reappears as effluent
7	CO_2 Scrubber water	24	35	water with about 0,2% alcohol.	Reuse as process water for fermentation
8	Vacuum water	2	30	Water containing alcohol	Reappears as effluent
TOTAL EFFLUENT FLOW		**704**		(item 4 +item 5+ item 8)	

Direct Reuse of process streams will reduce *inter alia*:

- The water demand for the Distillery;
- The risks of pollution through discharges;
- Losses of ethanol;
- Acid and alkali requirements for cleaning purposes;
- The combined flow of process effluents

As a result of the direct reuse of some process effluent streams, the anticipated quality of the combined process effluent will be reduced considerably with respect to the pollutants such as COD, BOD_5, volatile organic acids as shown in Table 3.13.3.1 and reproduced below.

Design characteristics for Combined Process Effluents

Parameter	Unit	Value
Temperature	^{o} C	70
Volatile Organic Acids	mg/l	3125
COD	mg/l	4700
BOD5	mg/l	2400
Total Dissolved Solids	mg/l	<100
pH		2.5-3.5
Oil & Grease	mg/l	<dl[49]

6.5.6.3.2 MMPE2: Treatment of Combined Process Effluents

As stated in Section 5.8, the Distillery effluents will be combined with the effluents from the sugar mill and the sugar refinery. The wastewater treatment strategy is also given in the said section. The strategy will be implemented in several phases as follows:

6.5.6.3.2.1 Implementation of Phase I (Crop season 2011)

Phase I of the treatment strategy will be implemented during crop season 2011 and consist of:

- **The Segregation and separate Conveyance system of non contaminated water and process wastewater streams.**

  Process wastewater will be segregated from storm water/non contaminated water. A dedicated wastewater canal will be constructed for conveyance of wastewaters only. The wastewater will be transferred to the equalisation tank.

- **The construction of a Sunday washing cleaning storage tank**

  Sunday washing of evaporators and other process equipment generates high COD loads, including caustic soda effluents from the cleaning equipment should be separated from the rest of the wastewater and stored in a buffer tank (capacity 800m^3) and gradually released with the other effluents over 3days (i.e. about 250m^3/d). This tank shall be kept aerobic at all times as it will have a propensity to release odorous gases due to uncontrolled fermentation.

- **Construction of a homogenization and pre treatment unit**

  This tank will receive 100-125 m^3/hr of effluents from the process and refinery drains. It will also receive over week days the effluent from the Sunday washings collection tank at the rate of 10 – 15 m^3/h.

  This unit will be designed for an average flow of 150m^3/h and will also cater for the Distillery effluent.

6.5.6.3.2.2 Implementation of Phases II & III

The results of the characterization study for crop season 2011 will allow the determination of the feasibility of various options for the pollution abatement and the

[49] dl: below detection limit

establishment of the water quality of the treated effluent in conformity with the local regulations.

Depending on the characteristics of the wastewater and their associated pollutant loads (COD, BOD5, etc.), two main options will be investigated:

- Anaerobic digestion with production of renewable energy from biogas generation with or without Aerobic polishing of the effluents so that the treated effluent conforms to its reuse for irrigation or
- Anaerobic digestion without production of renewable energy from biogas generation with or without Aerobic polishing of the effluents so that the treated effluent conforms to its reuse for irrigation

For the same flow, the concentration of influent COD of the wastewaters will confirm the energy recovery component of the strategy. Hence the wastewater characterization study of crop 2011, will confirm the feasible option.

6.5.6.3.3 MM3: Monitoring of the water quality of the treated Effluent

Although there will be no discharge of treated effluent from the Distillery, it is recommended that the quality of the process effluent streams be monitored daily so as to ensure that the plant produces consistent effluent quality. A water quality monitoring plan will be elaborated for the combined process effluent. The parameters that need to form part of the water quality monitoring are: COD, BOD_5, total kjedahl nitrogen, phosphorus, total suspended solids, total dissolved solids, temperature and pH. The frequency of monitoring shall be at least once daily when plant is operational.

A monthly analysis by an independent laboratory shall also form part of the monitoring plan.

6.5.7 Biological Pollution of Surface and Underground Water

During its operation, the Distillery, the CO2 Bottling Plant and CMS fertilizer Blending Plant will employ **55** persons and assuming that the per capita daily water consumption is of the order of 50ℓ, to account for sanitary, messing, etc. the daily production of wastewater will amount to about 2.2m^3.

The quality of the wastewater is typical of domestic sewerage and is described in Table 6.4.3.4.1.1 above, at various stages of disposal.

6.5.7.1 Nature of the Impact

Negative impacts on the local surface and underground waters may result from domestic effluents, if these are allowed to reach the local water table and surface waters with their inherent pollution loads.

With reference to the Recommendations for Quality Limits of Effluents for discharge in the water table or surface, discharge of untreated sewerage will not be allowed. This impact must therefore be mitigated.

6.5.7.2 Mitigating Measures

The simplest way of eliminating biological pollution would be to treat the sewerage produced by means of a septic tank with the appropriate retention time and with correctly dimensioned and designed leaching fields. Thus the effluents ultimately released from the leaching field will have the quality described in Table 6.4.3.4.1.1 above.

The above system will operate efficiently as long as regular maintenance of the system is also carried out. Maintenance consists mainly of ensuring that there is no/little sludge carry over to the leaching field; hence a desludging of the septic tank at least once every year will be required.

6.5.8 Noise from Distillery

6.5.8.1 Origin and Nature of Impact

Noise generated in the Distillery during its operation is not significant and below ambient noise levels. The main sources of industrial noise in the site vicinity at present are from the sugar factory during the crop season (June to December), the sugar refinery, nearly all year round and the CTSAV Power Station (nearly all year round).

As the Distillery consists of only pumps and fans as moving equipment the resulting ambient noise level will be below the maximum permissible levels. However the Project Site is within an industrial cluster where the generation of noise is significant such as the power station.

Noise surveys are regularly conducted around the industrial cluster as given in Section 5.7.

6.5.8.2 Intensity of Impact

Noise levels as sound pressure, dBA takes into account the varying sensitivity of human hearing or sound at different frequencies. Sound pressure levels are not additive, the mean square of the pressures are added and then reconverted to sound pressure level values. If there are any differences in the sound levels from two sources the combined level will exceed the higher of the two levels but always by less than 3 dBA[50].

As indicated in section 5.7 the noise levels at stations closer to the stacks did not exceed 70 dB(A) in the case of any other area and at any time as stated in the standard.[51]

The noise level at station ST5[52] (residential area) is also below the maximum permissible limit (For residential areas, the maximum permissible limit during both day and night times[53] are 60 and 55dBA respectively).

6.5.8.3 Mitigation Measures

Most of the process equipment of the Distillery (e.g. compressor for the CO_2 bottling Plant) will be housed inside an enclosed building and this will attenuate the noise level generated by the processing equipment.

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[50] Community Noise level. World Health Organization (1995)
[51] GN No.115 of 2003 Power Station Noise
[52] ST5: located at the nearest residence in the village of L'Escalier on the western escarpment of River Tabac near the cascade and Bassin Canon and 560m west of CTSAV stack
[53] Environment Protection (Environmental Standards for Noise) Regulations 1997

The plant is located even further away from the residential areas of L'Escalier thereby contributing in spatial attenuation of any noise from the site.

At design stage measures will be taken into account to attenuate the noise level such as the use of noise proofing measures (such as Flexible couplings to dampen transmission of engine shaft torsional vibration, Flexible hoses and bellows for connection to external piping networks, adopt anti-vibration mounts, sound deadening casings and silencers for noisy machinery particularly those located outside of buildings

As part of the environmental monitoring plan, noise monitoring will be carried out inside and outside the Distillery at commissioning stage.

At operational stage, noise survey will be carried out around the Distillery twice per year (crop and inter crop).

It must be noted that as part of the Environmental Monitoring Plan, Noise survey is conducted regularly around the sugar cluster (Sugar refinery, Power Station and sugar mill).

6.5.9 Impacts of loaded Storm runoff

6.5.9.1 The Impact

Some of the Plant and Equipment of the Distillery will be located on concrete platforms and occupied by buildings with water collecting structures like roofs, paved areas, etc. Storm water build-up contaminated with dust, hydrocarbon spillage from traffic (Lorries and other heavy vehicles) on paved (asphalted) accesses and parking areas, etc.

6.5.9.2 Mitigating Measures

The Site will be provided with a peripheral drain, to intercept all runoff. All loaded runoff, induced by rainfall or not, will be intercepted, collected and treated before release to the environment. The discharge of the storm water will be in the existing drain.

The treatment process will involve placing a hydrocarbon separator, a mud/silt trap and trash rack in the runoff collector prior to discharge the said drain.

6.5.10 Impact on Public Road Infrastructure

6.5.10.1 Origin and Mechanism of the Impact

The implementation of the Distillery, CO_2 Bottling Plant and CMS Fertilizer Blending will increase the road traffic in the vicinity of the Project Site.

However with regard to the Distillery Plant, the traffic due to the movement of molasses will not change as the molasses produced by the sugar mill (about 45,000 tonnes per milling season) will be used by the Distillery but an additional 45 000tonnes of molasses will need to be transported to the Distillery from other sugar factories. Hence the traffic due to movement of molasses will not change.

Additional traffic at operational stagewill be due to the road transport of:

- Transport of employees to and from Site
- Other Distillery consumables
- Movement of ethanol tankers from La Baraque to the Alcodis Storage Plant in Port Louis Harbour;
- Movement of CO_2 tankers from La Baraque to Port Louis Harbour;
- Delivery of raw materials for the CMS Blended Fertilizer and the delivery of the CMS Blended fertilizers to sugar cane fields.

6.5.10.2 Intensity of the Impacts

Transport of employees to and from the proposed Distillery complex will entail a maximum of six mini bus trips over 24hours.

Movements of raw materials for the Distillery and CMS Plants will be on average 4 daily trips for the chemicals to be used for blending in the CMS Fertilizer Blending Plant.

Delivery of CMS Blended Fertilizers will be by lorry bowsers of 35tonnes and will take place during the harvest season mainly, i.e., from May to December (180 days). On average it is estimated there will be 12 trips per day one way.

The estimated additional traffic generated by the Distillery and CMS Fertilizer Blending Plant is summarised below.

	Trips/day	**2-way**
Delivery of ethanol products from La Baraque to Port Louis Harbour	4	8
Movement of raw materials (chemicals, yeast etc.) for the Distillery	0.2	0.4
Delivery of CO_2 refrigerated tankers from La Baraque to Port Louis Harbour	1	2
Movement of Personnel	6	12
Movement of raw materials for the CMS Plants	1	2
Movement associated with delivery of CMS Fertiliser[54]	8	16
Movement (miscellaneous)	2	4
TOTAL	22.2	44.4

6.5.10.3 Mitigating Measures

The additional traffic due to the operation of the Distillery complex will not have significant negative impacts on the regional network. With regard to the traffic generated by the movement of ethanol products and molasses from the south part of the island to the Port Louis Harbour, there will be no significant change as the traffic route for the Alcodis Plant at Rose Belle is along the same route i.e. via the M1 motorway from the South to Port Louis.

[54] Note that the bulk of CMS Fertilizer delivery is during the harvest season from May to December.

Furthermore the traffic along the access route from the La Barraque Road (B8) to the proposed Distillery site avoids the built areas (L'Escalier etc.), as shown in Figure 3.19.1.1.

6.5.11 Impacts due to Chemical and other hazardous material handling, management and disposal

6.5.11.1 Source and Origin of Impact

Chemicals will be used in the Distillery complex processes as well as for cleaning of Plant and Equipment. Some of these chemicals (acids, alkalis) are classified as dangerous chemicals[55].

Chemicals represent a health and safety hazard to employees and if discharged into the environment can cause impairment on the quality of the receiving medium.

6.5.11.2 Mitigation Measures

In the immediate, the priority shall be focussed on the development of a Chemical Management Plan. The Plan should take also the provisions in the Dangerous Chemicals Control Act 2004 particularly identification, handling, storage, disposal, health and safety measures, etc.

All chemicals shall be stored in a locked chemical storage room, which will be designed to contain any spills that might occur. The chemicals will be transferred manually from this room directly to the particular section of the plant where they are used, thereby eliminating the possibility of large spills in the main processing areas. Passive/active ventilation will be installed in the room.

A Spill Prevention and Management Plan will be developed and implemented in chemical storage areas.

An inventory sheet shall accompany all chemicals brought into the plant. Copies of all inventory sheets shall be kept in key locations throughout the factory, and these include the Material Safety Data Sheets (MSDSs) for each chemical. The MSDSs provide handling and treatment information in the event of an accident or spill. Plant employees shall receive training on the chemical inventory sheets, as well as the function and hazards of each chemical used in the factory.

Chemical supplies shall be handled appropriately to minimise hazards. Health and safety is handled appropriately throughout the plant, with proper equipment guarding and use of personal protective equipment (PPE).

For all chemicals, warning labels on containers and Material Safety Data Sheets (MSDSs) in English are required with delivery of chemicals. Precautions described in the MSDSs shall be incorporated into the hazard assessment described above.

[55] As per The Dangerous Chemicals Control Act 2004

Hazardous materials management procedures will be incorporated into the more general safety procedures described above. A Hazardous materials audit shall be carried out.

Hazardous or toxic chemicals will be stored and handled in accordance with manufacturer's recommendations. Material Safety Data Sheets will be used to monitor and control the use of all chemicals.

Suppliers of equipment and raw materials will be involved in the development and presentation of training on the safe use of all equipment. Equipment and raw material suppliers will be consulted during the commissioning of the plant to ensure that equipment is properly installed and operated.

6.5.12 Greenhouse gas Emissions

The Alcodis Project at Rose Belle produces direct Green house Gas emissions from the fermentation process as the burning of heavy fuel oil to produce process steam.

With the closure of Alcodis and its relocation at La Baraque, the availability of process steam from CTSAV Power Station (see section 3.11) will result in the avoidance of gaseous pollutants from the combustion of fuel oil to produce steam.

The carbon dioxide produced during the fermentation process is released to the atmosphere at Alcodis Plant. It is estimated that the release of CO_2 during the fermentation process is between 64 to 65 tonnes CO_2 per day (see section 3.6.2.7). With the implementation of the proposed Distillery with its carbon dioxide bottling plant at La Baraque, nearly 40percent of the carbon dioxide (8 250 tonnes CO_2/year) will be recuperated and transformed into food grade carbon dioxide for the soft drink industry both for the local and international market.

This new source renewable source of carbon dioxide for the local soft drink industry will also have a positive impact as presently the carbon dioxide used by the local soft drink industry (estimated at 2 000 tonnes/year) is generated by the combustion of fossil fuel.

The introduction of blended gasoline (E10) for the local market will reduce the greenhouse gas emissions from the local transport sector as the net emissions from biofuels are generally less than petroleum[56] This is because, rather than digging up a source of carbon dioxide which has remained sequestered for millions of years, biofuels are produced from plants, which have only recently taken carbon dioxide out of the atmosphere. And since the feedstock (sugar cane) harvested to produce biofuels are replanted, those plants should take a comparable amount of carbon dioxide out of the atmosphere, reducing the net amount of greenhouse gases emitted.

[56] (U.S. Environmental Protection Agency [EPA], 2007a).

6.5.13 Refrigerants

6.5.13.1 Source and Origin of Impact

Ammonia as refrigerant will be used in the compressor unit of the CO_2 Bottling Plant. It is estimated that about 500kg of ammonia will be required.

Ammonia leaks may occur due to faulty seals at compressors, valves etc. Ammonia has a low threshold detection limit (3 to 5ppm) and can be detected by smell due to its pronounced and distinguishable odour.

6.5.13.2 Potential Impacts

The effect on the respiratory system is violent and only very small quantities can be breathed safely. About 0.35 volumes per 100 volume of air are the strongest concentrations one can sustain for any length of time. Hence any release of ammonia represents a potential negative impact for human beings.

6.5.13.3 Mitigating Measures

The risks of ammonia release in sufficiently large volume are minimal. This is so because ammonia technology for refrigeration is well established. Process Control to prevent such release from occurring, is considered as the state-of-the art in process control. Similar process control will be implemented at the proposed facility.

Process Control includes ammonia leak detectors and automatic safety valves. Moreover a preliminary contingency plan is described in Appendix J to cater for any accidental release of ammonia.

In the event of small leakages of ammonia, breathing apparatus and special outfits are available to workers, particularly when repairs are undertaken.

On the natural environment ammonia release has no direct impact.

6.5.14 Demand on Public Utilities and Infrastructure

6.5.14.1 Impact on Regional Potable Water Supply

The extra daily demand imposed on the regional potable water network will be of the order of about $3m^3/d$.

Considering the daily production of the regional system, about 7 $000m^3/d$, the impact of the extra demand is insignificant.

6.5.14.2 Impact on Electricity Supply

The electrical and steam requirements if Distillery including Vinasse Evaporation into CMS, CO_2 bottling and CMS Fertilizer Blending Plants will require for its operation have been estimated in chapter 3 and summarised below.

Type of Energy	Units	Distillery including CMS	CO_2 Bottling	CMS Fertilizer Blending
Electrical	GWh	11.88	2.38	0.8
Steam	GWh	118.8	NIL	NIL

6.5.14.2.1 Nature of Potential Impacts

The potential impacts of installing and operating the Distillery complex at La Baraque are evaluated with the simultaneous closing of the Alcodis Distillery at Rose Belle.

The Alcodis Plant at Rose Belle generates its steam using fuel oil, an imported fossil fuel and purchases its electrical power from the public network through the CEB.

The proposed Distillery at La Baraque, steam and electricity will be supplied by the Power Station operating on bagasse, a renewable source of energy during the crop season and coal, a fossil fuel during the intercrop season. Thus during an operating year (330 days), the proposed Distillery will use energy produced from a renewable source 50 percent of the time as more renewable energy from bagasse will be generated at CTSAV with the closure of Union St Aubin Sugar Factory[57].

Hence it can be concluded that operating a Distillery at La Baraque will in effect have an overall positive impact compared to the same Distillery operated by Alcodis at Rose Belle.

Direct potential positive impacts associated with the closure of the Alcodis Distillery and replacing it with a new Distillery at La Baraque are:

- Net decrease in foreign Currency Expenditure on import of fossil fuel (with ten percent of the annual gasoline import can be substituted);
- No extra burden on the public network for the supply of electricity as steam and electricity requirements are met from the Power Station as defined in the Power Purchase Agreement between CEB and CTSAV;
- Decrease in indirect impacts generated by the combustion of less fossil fuel (50%), mainly in terms of Acidification of the Atmosphere and the Greenhouse Effect;

6.6 Decommissioning of the Distillery and CMS Fertilizer Blending Plant at the end of Project Cycle

Decommissioning, admittedly, must be envisaged when the Distillery operation has come to an end for various reasons and include *inter alia*:

[57] The extra Bagasse which will be produced at La Baraque subsequent to closure of Union St Aubin Sugar Factory will in fact result in the production of 100 KWe per tonne of cane equivalent as opposed to 48KWe per tonne of cane equivalent at Union Saint Aubin. This is achieved due to the bagasse transformation into energy at CTSAV is done through State of the Art Equipment as opposed to old inefficient equipment at USA. Hence the additional bagasse mass will allow an extra amount of renewable energy of 20GWhr per crop season. (Source: Omnicane Milling Operations Ltd-Environmental Impact Assessment – Closure of Union St Aubin Sugar Mill. June 2011).

- Economic: Reduction in availability of molasses due to a national shift in policy towards ‘no cane sugar’ and the need to outsource Molasses with the cost implications so that the Distillery’s operation becomes uneconomical, etc;

- The Plant Lifetime guaranteed is complete and technology is obsolete;

As a consequence of the plant decommissioning the following direct impact sources will then no longer exist:

- Chemical consumption
- consumption of water resources

Visual impacts from an abandoned Distillery complex Plant will also be eliminated as the plant will be dismantled and sold as scrap metal; this exercise accounted for in the estimate of residual value of the Project.

The Site, owned by the Promoters may then be reinstated to agricultural usage of any other usage that they may then decide.

Another scenario is if the Plant and Equipment are not at the end of their life cycle, the Distillery complex is sold as is, dismantled and shipped for reinstallation elsewhere. An example of this scenario is the sale of sugar factories and their installation in Africa.

The Distillery could also be decommissioned and turn into a museum as illustrated by Beau Plan Sugar Factory which is now a tourist attracting sugar museum, "La Route du Sucre", Bel Ombre derelict stone walls and obsolete flywheels and machinery, forms the back ground of the Telfair Golf and Spa Resort.

6.7 Positive Economic Impacts at Operational Phase

6.7.1 National Economy

The best way to illustrate the economic impact is probably by studying the relative importance in the National Economy, of the major revenue earners, namely:

- *Mauritius Sugar Industry* (MSI)
- *Mauritius Export Processing Zone* (EPZ)
- *Mauritius Tourism Industry* (MTI)

Their historical contributions to the National Economy as sector contributions to gross foreign currency earnings are shown in Table 6.7.1.1detailed hereunder.

Table 6.7.1.1: Sector Contributions to Gross Foreign Currency Earnings (MRs[58]).

Sectors	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sugar	9057	8246	9118	10351	10464	10495	9393	9000	8289	7728
EPZ	16,555	15,774	15,865	14,851	13,436	14584	16804	14908	18640	19200
Tourism	18,166	18,328	19,415	23,448	25,704	31942	40687	41213	35693	39456

From Table 6.7.1.1, the constantly increasing positive contributions of the Mauritius Tourism Industry to the National Economy, is undeniable whereas the EPZ Sector has stabilised recently after continuous decline since 2000.

With the drop in the price of sugar of 36% under the Sugar Protocol, the revenue from the sugar sector has declined since 2007 but with the production of Granulated Refined Sugar, the earnings per tonne of sugar produced will increase but the total earnings is also affected by the decrease in sugar cane production.

The implementation of a Distillery at La Baraque will:

- Provide added value to the sugar sector by converting one of its by product molasses, into ethanol (a value added product) thereby increasing revenue;
- Produce a biofuel, that potentially can be utilised for the production of a fuel Blend (E10)locally subject to a policy decision of the Government of Mauritius, with a concomitant reduction in foreign currency from import of fossil fuel;

- Consolidate the centralisation of the sugar industry in Mauritius

6.7.2 Impact on Employment

The centralisation of the sugar industry has been associated with a reduction of jobs in the sector. Table 6.7.2.1 shows the past sector contribution to Employment.

Table 6.7.2.1: Past Sector Contributions to Employment[59]

	2004	2005	2006	2007	2008	2009
Sugar Sector	17108	16037	15805	13997	11363	10661
EPZ	68022	65159	56314	58271	57898	47956
Tourist Sector	22613	25377	21341	22245	24565	22909

From the above Table, it is observed that:

- Employment opportunities have increased continuously in the Tourism Sector and should continue this trend on account of the stated policies of the Government with regard to tourism development.

[58] Central Statistics Office
[59] Central Statistics Office

- The Tourism Industry appears to be the only sector that can absorb 'massed' labour with a low level of skills when compared to other emerging sectors (Information technology, etc.).

- Employment in the Sugar and EPZ sectors have been decreasing continuously over the years due to the centralisation in the former and the closure of foreign owned textile factories in the latter.

The Distillery complex will generate a net direct employment of fifty five (55). The trained personnel of Alcodis (ten) will be re-employed and will be responsible for the operation of the Distillery but additional employment opportunities will be generated by the CMS Fertilizer Blending Plant and the CO_2 Bottling Plant.

6.7.3 Production of Blended Gasoline (E10) for the local transport Sector

The production of anhydrous ethanol will provide an alternative renewable fuel that can be used for blending with gasoline as all gasoline-powered vehicles can run on a blend of 10% ethanol, 90% gasoline (E10).

The amount of gasoline imported yearly for the last five years for the local transport sector is given in Table 6.7.3.1.

Table 6.7.3.1: Total Imports of Gasoline[60]

	2006	2007	2008	2009	2010
Quantity (TOE)[61]	97 000	107 000	110 000	121 000	128 000

Based on present demand of gasoline for the local market, the amount of anhydrous ethanol required is approximately 15million litres/year to produce the blended fuel (E10). The production of this amount of anhydrous ethanol will require 65,000 tonnes of Molasses based on present demand.

The positive impacts of production of blended fuel (E10) are:

- Added value to the sugar sector by converting one of its by product molasses, into ethanol (a value added product) thereby increasing revenue;
- Reduction of 10 percent of the imports of gasoline, with a concomitant reduction in foreign currency expenditure from import of fossil fuel.

6.7.4 Concentrated Molasses Solids (CMS) as an alternative to Mineral Fertilizers

Vinasse and hence Concentrated Molasses Solids (CMS) contains potash (K_2O) which is a key element for all crops. Potash is added to sugar cane fields as potassium chloride (KCl). This inorganic fertilizer is imported and hence CMS is an alternative and renewable source of potash.

[60] Source: Central Statistics Office
[61] TOE: Tonne of Oil Equivalent

CMS has several advantages when compared to mineral fertilizers, namely:

- It contains organic matter that improve soil quality properties
- It contains additional nutrients
- It has low chloride ions
- It can produce homogenous blends and allows accurate application
- It reduces nitrogen volatilization

Thus CMS enriched with nitrogen and phosphate in various proportions can meet crop requirements and can replace totally the potash requirement of crops.

Ng Kee Kwong and Paul (1997)[62] has studied the use of vinasse as a potassium fertilizer for sugarcane and concluded that:

- Despite the high acidity of vinasse, its application did not alter the pH of the soil;
- The growth of the cane, including the plant cane was not adversely affected by the use of vinasse in the furrows at the time of planting;
- Rate of application of vinasse of up to 15 000L per hectare is feasible;
- No differences in cane and sugar yields were found when the potassium source was either vinasse or muriate of potash;
- There is little risk of deterioration of the chemical condition of the soil when vinasse is applied to sugarcane fields;
- Vinasse enhances the K nutritional status of the cane land and is as effective as muriate of potash in supplying K to sugar cane;;
- Vinasse is an alternative K source to sugar cane particularly as the price of imported K fertilisers continues to increase;
- Application of 2 500L and 15 000L of vinasse in the furrows of 1 ha of sugar cane field gave similar yield as 100 and 600 kg of KCL applied in the same way, whether applied each year or in one dose at planting for 6 years crop[63].

CMS Fertilizer blends are already been applied to sugar cane fields since 2006.

[62] Ng Kee Kwong KF and Paul JP (1997). Vinasse as a Potassium Fertilizer for Sugar cane. *Revue Agricole et Sucrière de l'île Maurice* Vol 76 No 2 Mai - Août pp 34-37.