CASE

Organic binder from alcohol production (Eco Biosis S.A., Veracruz, Mexico)

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Supporting case for Business Model 9	
Location:	Veracruz State, Mexico
Waste input type:	Vinasse waste (from alcohol production)
Value offer:	Clean water and chemical additive (for cement)
Organization type:	Private
Status of organization:	Established in 2011, business operational since March 2013
Scale of businesses:	Pilot plant for Mexican domestic market
Major partners:	Client and supplier of vinasse for plant, Universidad del Medio Ambiente (UMA), Gecco Corp., Industrias ADVIEE, San Jose de Abajo distillery, BiD Network, Green Momentum, New Ventures Mexico.

Executive summary

Eco Biosis S.A (Eco Biosis) is a private Mexican company established in 2011 that has patented an innovative process for producing a chemical additive, an organic binder (BioDisperSis VC®) from the vinasse waste generated in alcohol production. It has launched its pilot factory in March 2013 in Veracruz Ignacio de la Llave in Mexico and is providing BioDisperSis VC® to the construction industry for use as a plasticizer in cement. The Eco Biosis plant is situated alongside an alcohol distillery that provides the vinasse waste remaining after sugarcane alcohol distillation. Eco Biosis receives the vinasse from the distillery free of charge because it offsets the cost of disposal. By utilizing the vinasse waste, Eco Biosis has a significant positive impact on both the local community and environment, reducing the pollution associated with run-off and improper disposal by the refineries into local rivers and lakes. Furthermore, all water extracted from the vinasse during the Eco Biosis process is fed back to the distilleries, thereby reducing overall water usage. This will help the distilleries to earn an environment-friendly enterprise certificate.

KEY PERFORMANCE INDICATORS (AS OF 2014)						
Land use:	Pilot Plant: approx. 300 m^2; Expansion plant: approx. 3,000 m^2					
Water requirement:	The water used in open circuit cooling system, cleaning system for evaporator and 2 t/hr steam and condensation system is recycled; small quantities of make-up water to recoup losses is used by the plant					
Capital investment:	Pilot plant: USD 150,000 for installation of rented equipment and other process equipment and capex (additional USD 700,000 required to buy the plant); Expansion plant (Q2 2015): approx. USD 1,200,000					
Labor:	Pilot plant: 12 full-time employees; Expansion plant: 14 full-time employees					
O & M cost:	Pilot plant: USD 123,000 per annum; Expansion plant: USD 900,000 per annum					
Output:	BioDisperSis VC® production; Pilot plant: 600 tons per annum; Expansion plant: 9,000 tons per annum					
Potential social and/or environmental impact:	Employment generation (for 12 employees in pilot plant, 14 in the expansion plant and up to 35 in stage 2 of expansion plant); Reduced water pollution (previously caused by improper vinasse waste disposal into local rivers); Reduced use of water by distillery (as water extracted from vinasse is returned to plants); Substitution of a non-eco-friendly product used today by the cement industry; Simplified logistics result in lower carbon footprint					
Financial viability indicators:	Payback period:	1.5 years	Post-tax IRR:	34%	Gross margin:	22%

Context and background

The alcohol industry in Mexico produces approximately 650 million L of alcohol per year. It also produces about 15–17 L of liquid waste, known as vinasse, for every litre of alcohol produced. Vinasse is the residual effluent left after distillation of the ethanol from fermented wines. It has a low solid content of less than 10% undissolved solids but high content of dissolved solids, organic matter and ashes and has high viscosity, very acidic pH (3.5–6) and very high BOD (17,000–50,000 mg/L). In most cases, it is discharged at very high temperatures (around 90 °C). Vinasse is a potentially highly-polluting effluent that can cause serious health issues, diminish aquatic life, affect productivity of land, contaminate aquifer found lands, and emit methane into our atmosphere if not managed properly.

It is very difficult and costly to treat and dispose of vinasse. Different forms of utilization, treatment and final disposal have been sought for the economical and environmentally-sustainable treatment and disposal to avoid environmentally negative impacts of vinasse. Because of the large quantities of vinasse produced, alternative treatments and uses have been developed, such as recycling of vinasse in fermentation, concentration by evaporation and yeast and energy production. Physical and chemical treatment options of the residue have not been very successful until now, though the high organic content of the residue make it well suitable for biological treatment, especially for anaerobic fermentation. There has been limited success due to the high cost of treating the vinasse before it can be processed. It has unfavourable carbon to nitrogen ratio, lack of important trace elements (like nickel, copper, zinc, etc.) and high content of sulphur reducing the conversion of organic materials into biogas.

The on-site disposal of vinasse by combustion and incineration has also been tried. It generates potassium-rich ash which can be sold commercially. However, it requires considerable amount of energy during pre-evaporation and has difficulties of foaming, salt crystallization and ash fusion. It has been used as organic fertilizer in the cane plantations but can cause salinity problems. Vinasse at lower concentrations may also be used as fodder or as a compost ingredient. In higher concentrations, its chemical properties may affect negatively soils, rivers and lakes if frequently discharged over a longer period of time.

There is no simple, existing way to get rid of vinasse. For this reason, many members of the alcohol industry in low and middle-income countries have chosen to set the problem aside and dispose its waste in an unlawful manner, dumping it into rivers, sewage pipes and land and causing often grave social and/or environmental problems. Thus, green approaches are in demand to address the challenge, building on the hidden resources vinasse offers.

In 2009, Eco Biosis started working on the technology to treat vinasse in collaboration with the Universidad del Medio Ambiente, New Ventures, Fundacion E. and Green Momentum. In 2011, Eco Biosis submitted the patent for a multi-stage dehydration process for treating vinasse and converting it into a commercially valued product, called BioDispersis that is easy to handle and distribute. It acts as a natural dispersing and plasticizing agent that can be used as a substitute for lignosulfonates. The main by-product of the process is clean water, which can be reintegrated in the alcohol production process, helping it achieve greater sustainability standards.

In March 2013, Eco Biosis completed the construction of its pilot plant and began converting vinasse to BioDisperSis VC® (BioDispersis). It expects to operate at 100% capacity producing up to three tons per day for 25 days a month (approx. 600 tons per annum). This is the first of a series of plants the company anticipates building to use its patented technology. Eco Biosis's plant is located in eastern Mexico in the Veracruz state, one of the leading sugarcane-producing and alcohol-refinery states in Mexico. The plant is situated within the site of a sugarcane refinery plant, which produces up to 250 m^3 of vinasse on a daily basis. The refinery provides water, air, electricity, steam and vinasse free of charge to Eco Biosis, because Eco Biosis offers a cost-effective way to dispose of unwanted waste.

Market environment

The organic binder (chemical additive) being produced by Eco Biosis is an ecological substitute for lignosulfonates, water-soluble anionic polyelectrolyte polymers that have a broad range of applications across many industries including cements, agriculture, pesticides, mining, leather tannery, crude industry, livestock, concrete, binding and adhesive and dyes and pigment industries.

The annual global consumption of lignosulfonates in 2013 was approximately 1.24 million tons and grew annually by about 1.5% during the last 13 years. The construction sector leads in demand for lignosulfonates, which are used as a plasticizer for concrete, allowing the concrete to be made with less water while maintaining the ability to flow. In Mexico, the consumption of concrete lignosulfonate is 55,000 tons per annum, which is expected to continue growing by about 2.5–4.5% per annum. Eco Biosis anticipates operations producing 600 tons of lignosulfonates from the pilot plant or approximately 1% of the Mexican market and up to 5,000 tons by 2014 or roughly 10% of the market.

The competitive landscape in Mexico is dominated by Norwegian company Borregaard LignoTech, which has over 60% of the market and produces speciality chemicals for the agro and construction industries. The other key players are Tembec and WestRock (created by merger of Mead Westvaco and RockTenn) which produce lignosulfonates using wood as the primary raw material. The Eco Biosis lignosulfonate substitute, however, has competitive advantages of indigenous supply at fraction of the cost and its green credentials as all of Eco Biosis' competitors use non-sustainable timber as their primary raw material.

Macro-economic environment

The alcohol industry is expected to exceed USD 1 trillion in 2014, with market volume expected to reach approximately 210 billion litres, according to market research firm Market Line. Mexico alone

produces over 10 billion litres of vinasse annually, which must be disposed of in accordance with government requirements. Due to the quantity of vinasse produced and high disposal costs, a large amount of run-off ends up in the lakes and rivers causing a significantly negative environmental impact. The regulation around vinasse waste disposal has therefore tightened in recent years, increasing the disposal cost for alcohol distilleries and reducing operating margins. Due to which the domestic alcohol production has fallen in recent years and import of ethanol has increased.

Only a handful of the largest alcohol refineries in Mexico are disposing of vinasse legally, which has led to significant investment into R&D to improve disposal methods. The most common method for disposing of vinasse is through the use of anaerobic reactors and burning the gas or utilizing filtration systems and landfill; however these methods are costly and/or not effective. The Eco Biosis technology provides a profitable solution to disposal methods used by alcohol refineries, in addition to producing a versatile chemical additive that can be used in a number of different industries. Eco Biosis' model provides a solution to vinasse disposal that can be easily replicated on a global scale.

Business model

The key value proposition of Eco Biosis (Figure 110) is to produce lignosulfonates substitutes with superior environmentally-safe moieties from vinasse waste generated during alcohol production, and in the process save water and reduce environment pollution. After spending initial years in developing technology to process vinasse waste to lignosulfonate substitutes, Eco Biosis is running a pilot plant in partnership with an alcohol distillery. Lignosulfonates has multiple applications and Eco Biosis can target multiple customer segments such as concrete, cement, chemical, mining and energy companies. At the time of the interview, Eco Biosis has a contract with a multinational company to supply 100% of BioDisperSis produced during the next six years starting after 2014.

Value chain and position

The key players in the Eco Biosis value chain are alcohol producers as supplier of vinasse, water, utilities and infrastructures, partners for developing technology and business development and clients who will buy BioDisperSis (Figure 111). The San Jose de Abajo distillery provides vinasse for the pilot plant and provided land to Eco Biosis to construct its plant within its factory premises. The distillery's gas, electricity and steam supply are provided free of charge to Eco Biosis operations. Earlier, the distillery was dependent upon water from sugarcane to dilute the waste for its operations, and it had to stop its distillery operations after every harvest. Incorporating the Eco Biosis plant into the distillation process allows the distillery to continue production uninterrupted throughout the year as water recovered from treatment of vinasse by Eco Biosis is sent back to the distillery, therefore positively impacting the profitability of the business. For the expansion plant, Eco Biosis is in negotiations with a number of businesses and hopes to secure a larger and more stable source of vinasse.

Developing the process of treating vinasse to produce lignosulfonate substitute required Eco Biosis to consult with different agencies for technical assistance, product development, use of equipment to start the plant and refine the process. In addition, it also received business development assistance from incubation programs such as BiD Network, New Ventures, Green Momentum and UMA, and in the process gained exposure to investors/funding and overcome legal issues.

Eco Biosis' one key client is committed under contract for the next six years (starting 2014) to buy the entirety of the production of BioDispersis. Eco Biosis is also in advanced conversations with a number of other potential clients who are interested in their product in the long run.

FIGURE 110. ECO BIOSIS BUSINESS MODEL CANVAS

KEY PARTNERS

- Universidad del Medio Ambiente
- Gecco
- Industrias ADVIEE
- San Jose de Abajo distillery
- BiD Network
- Green Momentum
- New Ventures Mexico
- Mexican national Council for Science and Technology (CONACYT)

KEY ACTIVITIES

- BioDisperSis VC° production, storage and sales
- R&D of the product
- Quality control

KEY RESOURCES

- Land
- Capital
- Skilled labor
- Agreement with distillery for supply of vinasse and utilities
- Patent-protected IP
- Green brand image

VALUE PROPOSITIONS

- Producing environment-friendly lignosulfonate substitute from alcohol distillation by-product waste and reduce environment pollution

CUSTOMER RELATIONSHIPS

- Direct interaction with user industries

CHANNELS

- Appropriate agreement and self-interaction

CUSTOMER SEGMENTS

- Construction and chemical companies
- Agricultural companies (in future)
- Livestock feeding companies
- Specialized product-distributing companies
- Mining companies
- Energy companies

COST STRUCTURE

- Investment cost (land, building, machines)
- Operational cost (fuel, labor, utilities, maintenance cost)
- Marketing & sales cost
- R&D
- Patent maintenance costs (substantial: approx. 250,000 over the lifetime of a worldwide patent)

REVENUE STREAMS

- Sale of BioDisperSis (lignosulfonate)

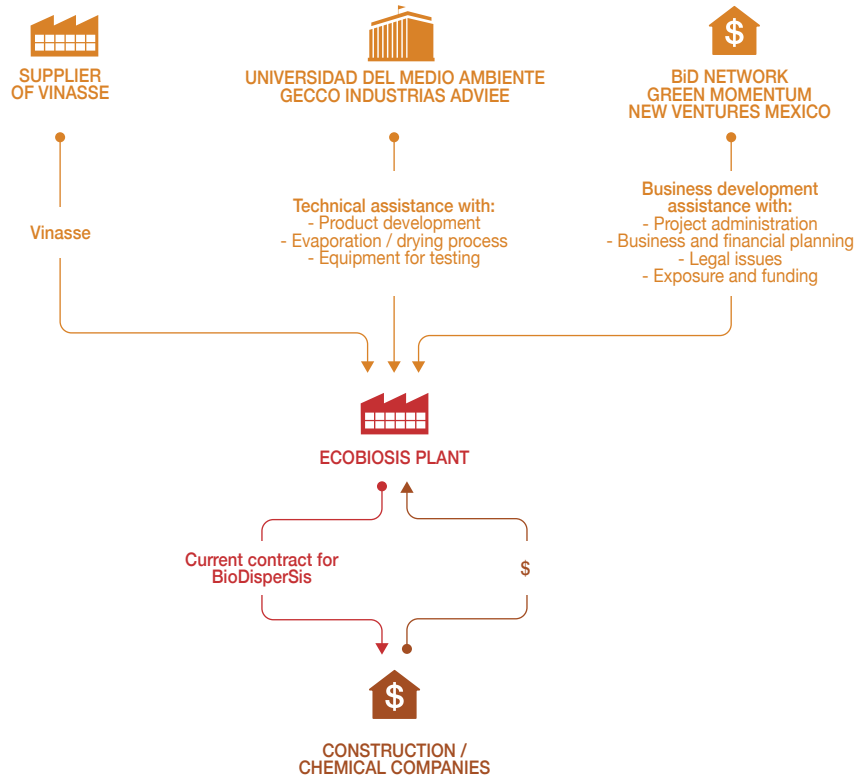
SOCIAL & ENVIRONMENTAL COSTS

- Possible risk of water pollution and environmental hazard if the removal of pathogens and pollutants during the process is not complete and it is discharged into the open

SOCIAL & ENVIRONMENTAL BENEFITS

- Job creation
- Environmental benefit through processing vinasse which can otherwise cause water, land and air pollution
- Environmental benefit from consuming BioDisperSis rather than lignosulfonates made from wood pulp
- Carbon footprint reduction from the local purchase of lignosulfonates instead of importing them

FIGURE 111. ECO BIOSIS VALUE CHAIN



Eco Biosis business has supplier power prominence as the source of vinasse is dependent upon the San Jose de Abajo distillery continuing to supply it to the Eco Biosis plant, in addition to funding the operational costs of the plant. However, supplier prominence is weakened if Eco Biosis plant reduces the operational costs of the distillery. Buyer power prominence and substitutes exist as there is an established market for lignosulfonates. Eco Biosis' hopes to counter it by pricing its product 70% lower than its competitors. The threat of new entrants, using the same process, is limited due to patent protection; however, there are other existing methods of treating vinasse, which could compete with Eco Biosis.

Institutional environment

Prevention and management of waste: Mexico is working on environmental waste reduction to achieve better management of waste through an environmental policy. The president has made policies to reduce global warming a special and personal issue of his administration. In spite of the attention given to the issues, Mexico continues to face serious environmental challenges largely because even when anti-pollution legislation exists, much of it is not being applied and enforced. The Mexican Department for Environmental Affairs implemented a law in 1996 restricting the contamination of national water bodies (NOM-001-ECOL-1996), which proposed a set of contaminant limits for liquids being disposed of. The sample analysis of sugarcane vinasse done by Eco Biosis indicated a total suspended solids content 50 times higher than that specified by the contaminant limits.

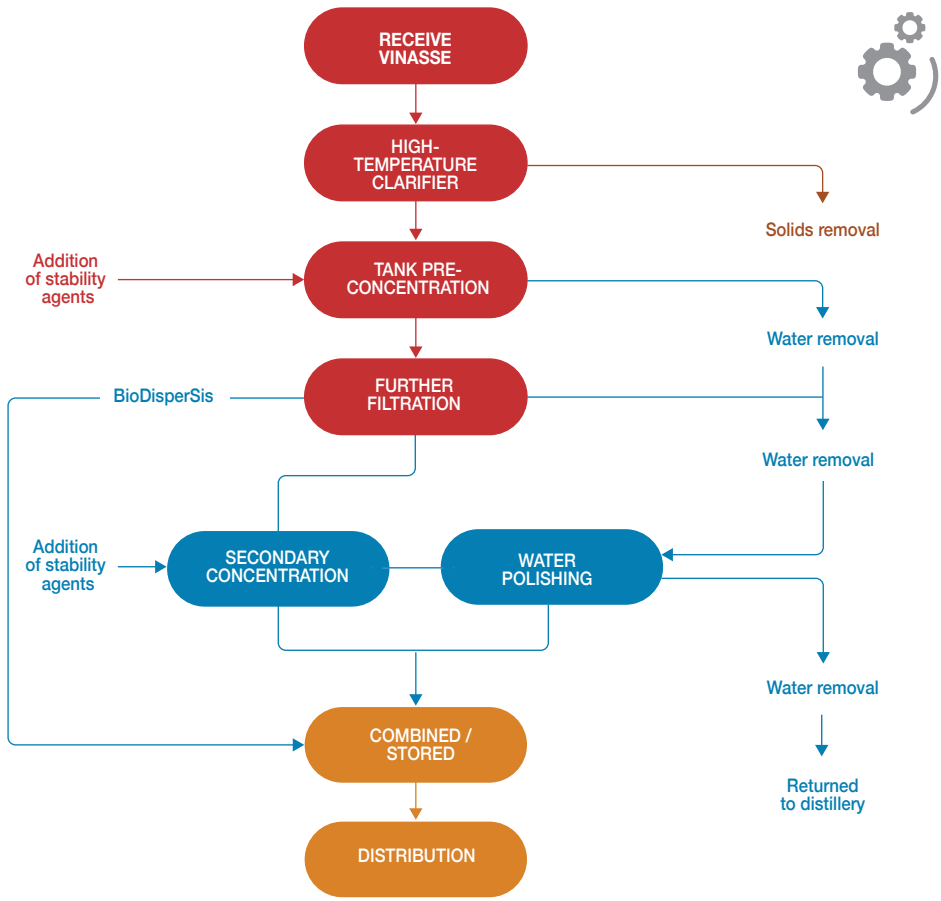
Because the technology is untested on an industrial scale, Eco Biosis has encountered certain resistance within the government to build the pilot plant. Eco Biosis has opted not to be classified as a waste treatment service provider, but rather decided to register as a manufacturing company subject to manufacturing sector regulations. Eco Biosis is therefore subject to a different frequency of operating audits than it would otherwise be under the waste treatment classification and has to obtain different more practical permits prior to initiating production.

Technology and processes

Eco Biosis initiated the patenting process for manufacturing BioDisperSis in 2011. Patent approval is pending. Figure 112 presents the process involved in production of BioDisperSis.

Vinasse is received into the plant through a pipeline from the distillery and is passed through a high-temperature clarifier to extract suspended solids (fibres, mud and yeast) before being stored in a tank to start the pre-concentration process. During the pre-concentration process, water is removed and stability agents are added for required physical properties needed for BioDisperSis. The solution then goes through a further filtration process to extract any remaining water. Three products are

FIGURE 112. PROCESS DIAGRAM OF ECO BIOSIS



derived from this process: water, BioDisperSis and vinasse that needs to go through an additional process of concentration. Water extracted is treated to improve its quality before being returned to the distillery for reuse in the alcohol distillation process. The vinasse passes through an additional low temperature concentration process where other agents are added to the solution before it is ready to be stored and dispatched. The vinasse batch that has gone through the secondary concentration and the BioDisperSis are re-combined and a number of chemical agents are added to the liquid in order to preserve the product quality and durability. The remaining BioDisperSis is then checked for quality control, stored under the appropriate conditions and distributed via the Eco Biosis fleet of distribution trucks.

Funding and financial outlook

The implementation and construction cost for the pilot plant was approximately USD 150,000 and 100% funded by the directors, one other private angel investor and the Mexican National Council for Science and Technology. The total amount spent on the pilot plant does not, however, reflect a standalone build-out of the plant as Eco Biosis utilized second-hand and rented machinery, in addition to renting out the plant, which would have otherwise cost an additional USD 700,000 to acquire (Table 31). The most significant expense items were machinery (USD 80,000), installation (USD 25,000), vehicles (USD 25,000) and electrical costs (USD 10,000). The total investment to date has been approximately USD 400,000; however, the vast majority of this has gone into product R&D. The pilot plant is expected to make a small profit of approximately USD 35,340 on an annualized basis, with revenues of about USD 158,000. The key operational costs for the pilot plant are machinery rental, chemical process and labor, contributing to approximately 79% of the total running costs.

TABLE 31. ECO BIOSIS FINANCIAL SUMMARY

PILOT PLANT FINANCIAL SUMMARY									
USD/MONTH	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7-12**	**Y1**	**Y2**
Initial Investment	(13,333)	(13,333)	(13,333)					(40,000)	
Revenue (Unit: USD 240)				13,205	13,205	13,205	79,230	118,845	158,460
Costs									
Labor				(1,843)	(1,843)	(1,843)	(11,058)	(16,587)	(22,116)
Chemical Process				(3,850)	(3,850)	(3,850)	(23,100)	(34,650)	(46,200)
Evaporator: Rent				(2,400)	(2,400)	(2,400)	(14,400)	(21,600)	(28,800)
Telephone				(189)	(189)	(189)	(1,134)	(1,701)	(2,268)
Plant Rental and Petty Cash				(1,137)	(1,137)	(1,137)	(6,822)	(10,233)	(13,644)
Distribution				(841)	(841)	(841)	(5,046)	(7,569)	(10,092)
Total Costs				**(10,260)**	**(10,260)**	**(10,260)**	**(61,560)**	**(92,340)**	**(123,120)**
Net Margin				**2,945**	**2,945**	**2,945**	**17,670**	**26,505**	**35,340**
Payback period from pilot plant: 4.5 years									
IRR*: 34%									

*IRR only taken for first 2 years as the pilot plant is not intended to be run on a continual basis but used as a model on which to launch the expansion plant

The pilot plant is being used to prove the quality of BioDisperSis and secure a number of larger-scale contracts in order to start construction of the expansion plant. Eco Biosis is therefore looking to expand (Table 32) from this in two key phases: 1) an initial expansion plant with production capacity of 9,000 tons in 2015–2016 and 2) a full expansion plant coming on-stream in 2017–18 with production capacity of 27,000 tons. Eco Biosis will invest USD 2.6 million in the expansion plant, which will have revenues of USD 1.7 million and breakeven at approximately 45% production capacity. The fully-operational plant will require a further investment of USD 5.4 million and increase potential revenues by up to 300%, with breakeven production of approximately 55%.

TABLE 32. ECO BIOSIS FINANCIALS PROJECTIONS

EXPANSION PHASES FINANCIAL SUMMARY							
USD	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Investment	2,587,589		5,368,968				
Revenue		1,668,734	1,768,265	6,332,350	6,710,043	7,110,264	7,534,355
EBITDA		780,143	839,613	3,316,631	3,556,095	3,811,249	4,083,077
Net Profit		**368,120**	**406,656**	**1,324,082**	**1,430,042**	**1,663,888**	**1,909,755**

Eco Biosis has already secured approximately USD 0.8 million in funding for its expansion plant from a number of developmental agencies.

Socio-economic, health and environmental impact

From an environmental perspective, the technology has a significant positive impact as it reduces the contamination of local water bodies through converting unused vinasse into lignosulfonate substitute, and in addition, indirectly improves the livelihood of the local population. Furthermore, Eco Biosis has a negative net water usage as it extracts more water from the vinasse received than it uses in the conversion process, thereby returning water for reuse to the alcohol distilleries and preserving an already scarce supply of potable water. Eco Biosis provides employment to 12 local workers in the pilot plant; however, this will increase to approximately 14 in the expansion plant and up to 35 in the fully-operational plant which is planned to come on-stream in 2018.

Scalability and replicability considerations

The key drivers for the success of this business are:

- Patented technology and process for making BioDisperSis from vinasse.
- Partnerships with alcohol distilleries, allowing extreme low-cost sourcing of inputs.
- Viable lower-cost alternative for vinasse treatment in compliance with regulatory requirement.
- Awareness and market for clean technology solutions.
- Higher-priced substitutes (Lignosulfonates are imported).
- Tightening vinasse disposal regulations.

The Eco Biosis pilot plant feasibility is from multiple factors. Most important is the plant's location within an existing distillery, and in addition receiving services free of charge which would otherwise have had a significant impact on the operational costs. Operational cost savings incurred assist in making a small-scale pilot plant viable. The two key considerations for scaling Eco Biosis are: 1) availability of vinasse as a raw material and 2) demand for lignosulfonate substitute. With continued support of anti-pollution legislation in Mexico, Eco Biosis provides a cost-effective approach to disposing of vinasse legally and can therefore secure significant quantities of the vinasse waste at relatively low cost, enabling it continued domestic expansion.

On a global scale, the alcohol industry continues to grow strongly, expecting to reach USD 1 trillion in 2014, representing almost 210 billion litres. This represents a significant opportunity for the Eco Biosis technology to be utilized in other countries to counter the pollution from vinasse. The demand for lignosulfonate substitutes will continue to grow in the construction industry as it provides an environmental-friendly alternative to wood-pulp-derived lignosulfonates. Furthermore, Eco Biosis can export its product to foreign markets demanding lignosulfonates.

Summary assessment – SWOT analysis

The key strengths of Eco Biosis are the benefits drawn by alcohol distillery and an environmentally-friendly alternative for producing lignosulfonates substitute from vinasse in comparison to mainstream methods of using wood pulp as key input (Figure 113). The weakness of Eco Biosis is high investment required for its expansion. In its future expansion, Eco Biosis might require to alter its process based on the quality of raw material input and could further increase its investment costs. Eco Biosis once has commercially proven and has successfully run its operations for few years. It has strong opportunities to expand both domestic and overseas.

FIGURE 113. ECO BIOSIS SWOT ANALYSIS

	HELPFUL TO ACHIEVING THE OBJECTIVES	HARMFUL TO ACHIEVING THE OBJECTIVES
INTERNAL ORIGIN ATTRIBUTES OF THE ENTERPRISE	**STRENGTHS** ▪ A proprietary cost-effective solution to significant global environmental problem ▪ Patent pending that will reduce threat of competition ▪ Beneficial for distilleries as disposing of unwanted waste and getting clean water back ▪ BioDisperSis price competitive with other lignosulfonates ▪ Lignosulfonates are used in a broad range of industries mitigating potential market risk ▪ BioDisperSis is a green alternative to mainstream wood-pulp-derived lignosulfonates ▪ Low water usage throughout process and water extracted from vinasse is returned to distilleries	**WEAKNESSES** ▪ Reliance on operating pilot plant and operating cost subsidies ▪ Have inherent risks with expansion ▪ High level of investment required to launch expansion plant ▪ Have only developed one product with vinasse – BioDisperSis – therefore, significant R&D is still required to open up new markets and process vinasses of different qualities ▪ Capacity of the plant has to be linked to the capacity of the alcohol distillery as transport of vinasse would not be cost effective
EXTERNAL ORIGIN ATTRIBUTES OF THE ENVIRONMENT	**OPPORTUNITIES** ▪ Domestic and overseas expansion as significant supply of vinasse waste that is not being exploited ▪ Source raw material from a number of other vinasse producing industries, e.g. bread making ▪ Expand product line to open up new markets and industries ▪ Growing popularity for sustainable products globally	**THREATS** ▪ Supply of raw material is not secured ▪ Change in quality of raw material will alter the solution properties and slow process ▪ Patent not yet granted

Contributors

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Cinthya Pajares, I-DEV International
Eco Biosis S.A.

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Case descriptions are based on primary and secondary data provided by case operators, insiders, or other stakeholders, and reflects our best knowledge at the time of the assessments (2015–2016). As business operations are dynamic, data can be subject to change.