RESEARCH PROPOSAL

ENERGY PRODUCTION – SUSTAINABLE SOLUTIONS TO URBAN WASTE/REFUSE IN DEVELOPING COUNTRIES

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Introduction

With the world's population topping 7 billion, cities in the fastest growing regions of the world are bursting at their seams. It's not just the increase in human population that strains the infrastructure of cities. The retail network that supports the consumer oriented lifestyle in cities balloons as people jockey for middle class status. While the rise of the middle class is a positive result of development there is an ugly side to this trend. The most graphic illustration of the darker side of development is the increase in waste.

Urban Refuse tarnishes developing regions largely because of the way humans process it. Waste doesn't have to be stockpiled in un-slightly landfills or, worse yet, contaminate neighborhoods. It can be an engine for enormous good. From new jobs to clean energy, garbage represents an opportunity for governments, non-profits, entrepreneurs, small businesses, and the unemployed. Most conversation about mitigating the visual and environmental pollution associated with garbage focuses on the gigantic projects that capture methane at monstrous landfills. Sealing landfills and capturing methane is a valuable but marginal improvement to the waste/refuse problem.

While methane capture projects may pencil for developed countries that have existing landfills [and regulations] to contend with, they may not represent the best approach for LDC's. By their very nature, cities in developing countries are positioned to deal with garbage in a more organic fashion. They can build facilities that treat garbage as a nutrient; simultaneously transforming waste into building materials plus other consumer goods and generating energy that helps fuel economic growth and regenerates the environment. This paper examines one strategy for achieving this type of growth.

Research Question:

The strategy for sustainable energy production is based on the utilization of an incinerator developed by researchers under Professor Marcio Martins[1] at Brazil's Universidade Federal de Vicosa. A facility that houses the incinerator reduces unavoidable waste to powder, captures all the emissions from the process, and generates [clean] energy [A unit at peak capacity can incinerate 2000 kilograms per hour and generate 320 Kva of energy]. This main objective is to analyze the waste profile of LDC's using international databases and to explore the financial viability of a "Waste to Energy" scheme and to quantitatively and qualitative explore the impacts of socio-economic improvement, social and health improvement, and sustainability benefits of this type of technology.

The main hypothesis is that this schema of "Waste to Energy" program will have not only financial, but also social, environmental, and economic improvement to the areas where it is deployed. Clean energy programs have the potential to qualify for CDM credits, and to generate all of the power needed for areas

[1] Marcio Aredes Martins; Universidade de Vicosa, Minas Geraes, Brazil (2010)

where energy cost is prohibitive and often inaccessible. Positioning the facilities close to neighborhoods reduces transportation costs and simplifies the logistics of transmitting the energy to households and businesses.

This research will analyze employment and revenue opportunities associated with this strategy. Examining the number of waste collectors in a region is one indicator of job creation. Estimating revenue generated for municipalities (or entrepreneurs depending on the model) through the sale of building materials and recycled products helps flesh out the complete profit picture especially when it is combined coupled with revenue earned from generating energy.

Quantifiable improvements in water quality, air particulates, and soil quality may also be measured. Most importantly, the design of this prototype allows for expansion of the network of facilities in tandem with population growth providing renewable energy on a scalable program/initiative.

This research aims to contextualize a case study of this prototype within the larger landscape of urban development in the global south. It discusses several of the opportunities and barriers to widespread adaptation of this practice. While the barriers are significant, they are local issues. Huge financial investments and international agreements are not prerequisites to success. And the promise of clean energy, clean cities, and employment are powerful motivators.

The prototype for this development may be a smaller scale, distributive approach to waste/refuse collection. The incinerator is the mechanical component to a holistic treatment of the waste stream. The unit is simple enough to be manufactured at machine shops around the world. This is one opportunity to build manufacturing sectors in developing areas. Sorting organic and recyclables out of the waste stream at the facility before waste enters the incinerator represents another employment opportunity. The social benefits of growing the local workforce extend far beyond the facility.

Renewable Energy Needs and Potential Outcomes:

Waste/Refuse profiles vary by countries and by regions. Our findings show that cities that deploy the prototype would divert waste from landfills, recycle 85% more avoidable waste, profit from sales of repurposed building materials, and generate energy both for the recycling plant/facilities operation and for the community where the "Waste to Energy" facility is located. On November 1st of 2011, the UN Secretary-General presented a Vision Statement on "*Sustainable Energy for All*". The strategy outlined in this research aims to outline a prototype for energy production that can be scaled to help bring energy to many urban centers in the developing world and help create a paradigm shift in resource conservation and energy generation world-wide. With the multitude of benefits one needs to look at the barriers to entry and work with the local jurisdictions and institutions in order to scale the facilities on an international scale.

Prototype for Waste to Energy Deployment in LDCs

The University of Vicosa and RISAM, an engineering firm, are developing a facility in Vicosa, Brazil that is a model for the sustainable use of municipal waste. 100% of the material brought to the facility will be used to generate energy, repurposed construction materials, and fertilizer for agriculture, all while guaranteeing 100% sustainability in the process and treatment of residues. This prototype has potential to employ 15 individuals for every 10,000. inhabitants generating waste in a given municipality without any costs to the governing body.

The University of Vicosa, RISAM, and Professor Marcio Aredes, PhD hold the patent for the vertically integrated process of waste treatment hereby called Eco Plant™. The objective of this enterprise is to convert all of a community's waste into raw materials and energy.

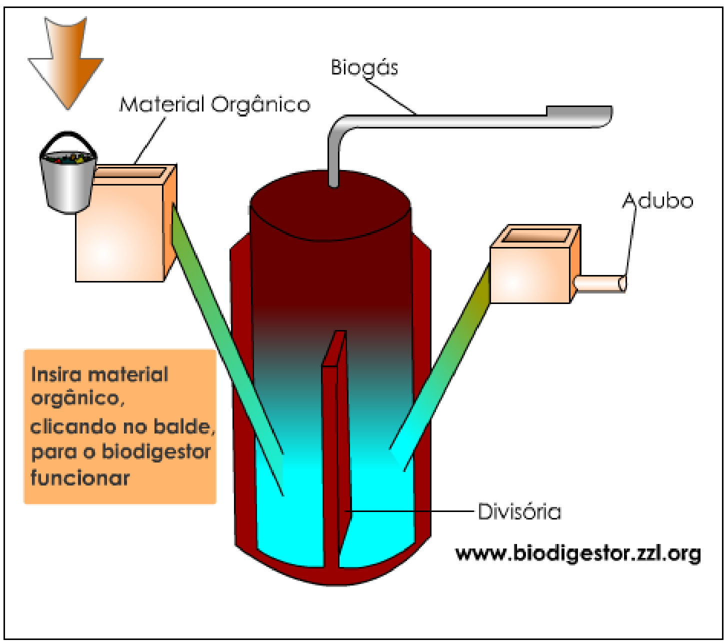
DESCRIPTION OF INPUTS AND OUTPUTS GENERATED BY Eco Plant™

Total area needed for installation of the factory prototype is 10.000 m2

1. Waste Receiving Facility: separation of recyclables, unusable waste, organic material, vegetable oils, landscape waste, construction waste, e waste, and tires, et.

2. Processing of recyclables: separation by class, cleanliness and compression potential.

3. Bio digestion of organics: processing of all refuse in bio-digester for extraction of biogas and bio-fertilizer. The bio digester processes a great part of the domestic waste which if left untreated pollutes the soil, water, and air.



The biogas generated is then used as fuel to incinerate unusable waste. In addition to biogas, another product from the bio digester is bio-fertilizer which in this form is best suited for small scale agricultural production in developing countries.

4. Transformation of oil waste into alternatives to industrial solvents for cleaning.

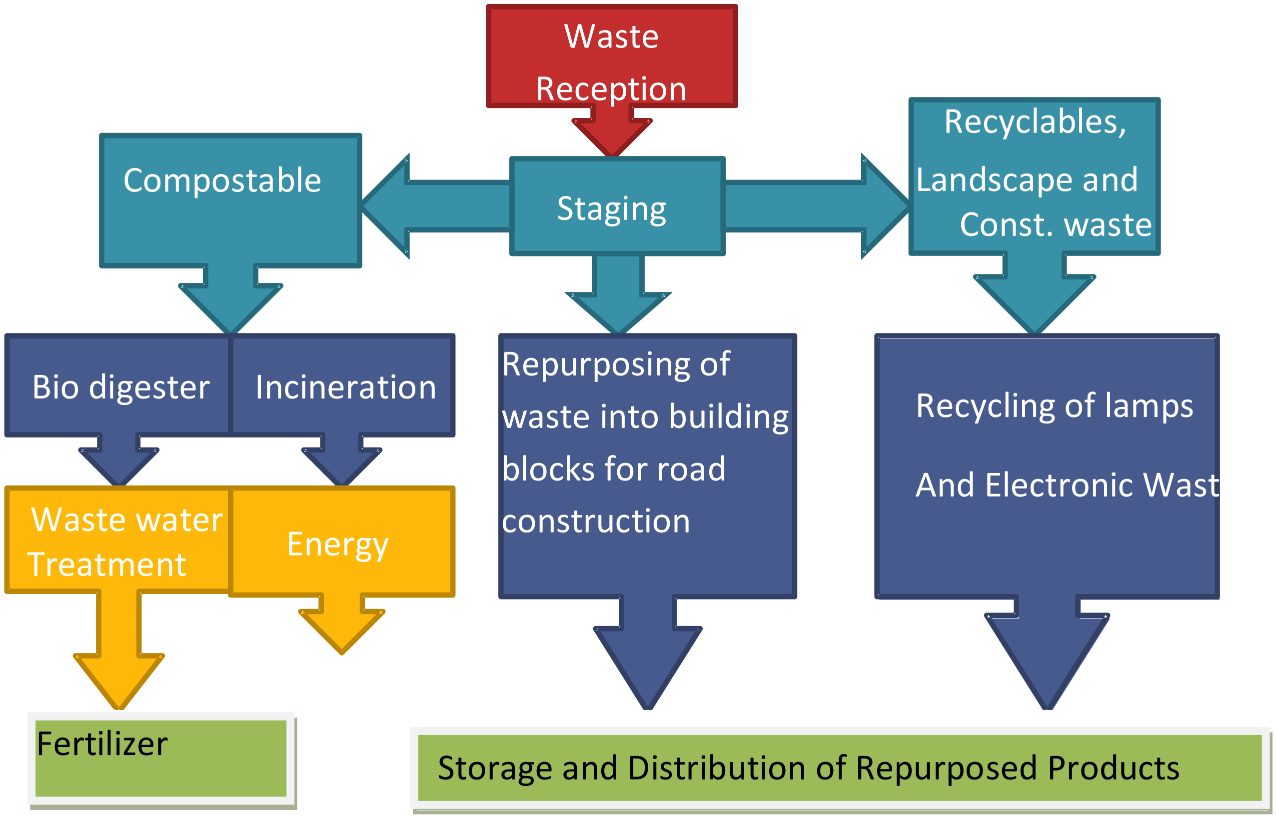
5. Processing of unusable waste (from Step 2):

- Drying of refuse
- Incineration of refuse using biogas produced in Step 4
- Capturing the steam

In the Eco Plant™ there is a boiler which captures all of the steam from the incineration process. The steam powers an electric generator that supplies all of the Eco Plant's™ power needs.

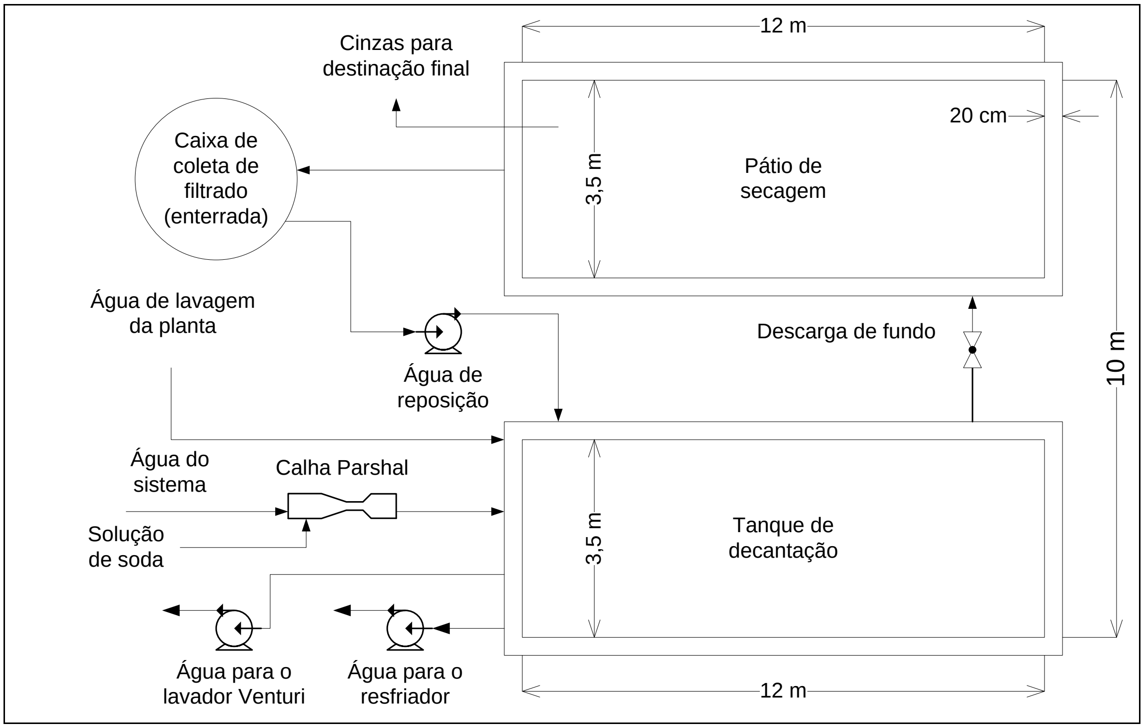
6. Transformation of wood into briquettes
7. Incinerating construction waste to create new construction material such as building blocks and road curb
8. Repurposing and salvaging e waste and appliances.

Diagram of Waste to Energy Transformation



9. Water Treatment

The main water source is from drying the unusable waste in Step 6. Another source is water reclaimed from the Eco Plant™ activities. Water is treated through the addition of a sodium solution and filtration through a Venturi system, which once treated enters the settling tank. The sediment is sent to the drying field and usable water us used for cooling and washing.



Recyclable Waste:

Recyclable material is sent to other facilities for re-purposing the recyclable waste that cannot be repurposed is kept on site for various treatments. For example, construction waste is turned into building blocks for roadway construction which is a source of revenue for the factory.

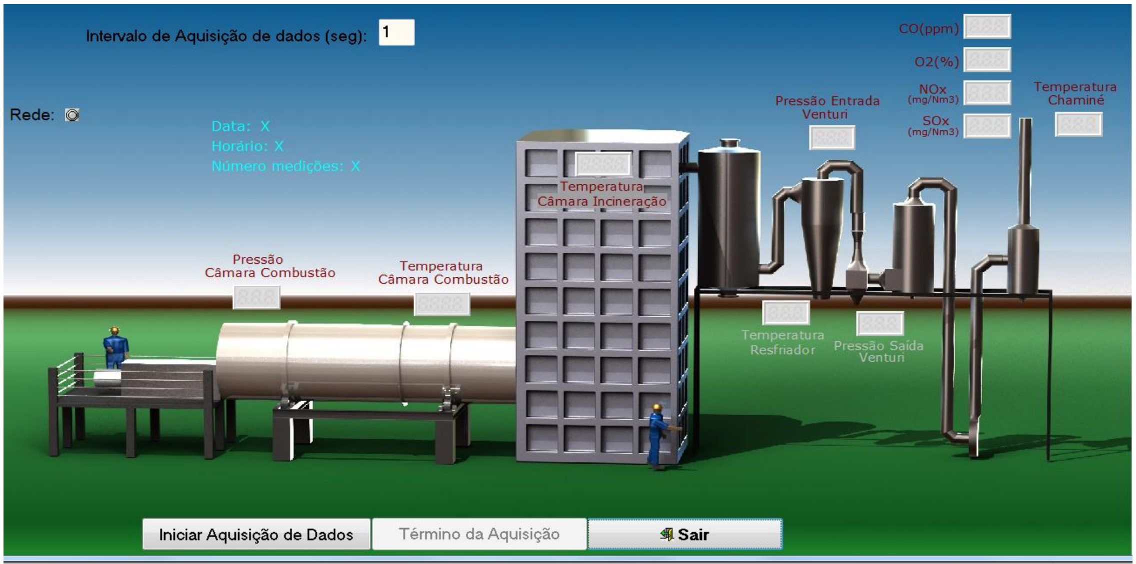
Unusable Waste:

Unusable waste which is a larger category is incinerated via thermal process, which reduces its volume by 98%. All gases and effluent generated during this process are captured and not allowed to pollute the atmosphere.

System Capacity:

The incineration and co-generation system can burn up to 2000kg of waste per hour. This system will generate up to 320 Kva of energy. The system is designed to comply with Brazil's environmental legislation. In its current form the Eco Plant ™ generates 1Mw of energy which is sufficient to power the Plant. This system is designed to maximize the economic output for Brazil where recycling and repurposing materials is profitable.

Schematic of Waste to Energy Processing Plant



CURRENT FINDINGS

The Eco Plant™ model has the potential for rapid deployment in a variety of urban environments and offers many benefits because of its compact size and easily deployed patented and replicable technology. The benefits we have cited but highlight here are:

1. Waste is diverted from polluting landfills
2. Job creation and formalizing informal waste collection schemes
3. Size of Eco Plant™ is easily deployed in compact urban centers: it is the size of a futebol field.
4. Energy generated to power plant is net zero
5. Recyclables from appropriate sorting is repurposed and generate income for Eco Plant™ entrepreneur

The first Eco Plant™ is currently being deployed by RISAM and University of Vicosa in Vicosa, State of Goias, Brazil in Summer 2012. One important aspect of this deployment is the City of Vicosa's adoption of legislative mandate to require waste to be properly disposed of and diverted in response to Brazil's Waste Disposal Regulation. There is a potential to deploy the same time of Waste to Energy concept in many LDCs as many developing countries do not have appropriate waste collection and proper disposal. The informal economy generated by collectors who are not employed by an agency or government, if diverted has the potential to generate significant income to waste processing facilities like the Eco Plant™ and formalize employment and benefits to people marginalized segments of the population. Our goal is to develop South/South partnerships and to deploy Eco Plant™ improve the social conditions, alleviate environmental harm created by landfills.

References

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