La Perseverancia: Solid Waste To Generate Electricity With A Social Benefit In Cuautla

Region	**Latin America and the Caribbean**
Award Scheme	**Guangzhou Award**
Themes	**Energy** **Waste Management**
Sustainable Development Goals	**Goal 11 - Make cities and human settlements inclusive, safe, resilient and sustainable**

Summary

In a traditionally oil-producing country, it is difficult to conceive municipal waste as a source of energy. However, the current energy situation motivates the search for alternative sources of energy that are characterized by being renewable, sustainable and compatible with the environment.

Background and Objective

The waste landfill"La Perseverancia"receives an average of 950 tons of waste per day from the municipalities of the state of Morelos and a small fraction of the capital of the country, Mexico City. This waste is deposited in cells that carry an engineering job to guarantee compliance with Mexican regulations. The degradation of organic waste involves a generation of biogas which is composed of methane and carbon dioxide which are considered as greenhouse gases that, if not controlled, could be released into the atmosphere, however thanks to innovation and technology with which it is counted in the facilities it is possible to use biogas as a fuel for the generation of a clean and sustainable energy. BACKGROUND INFORMATION The initiative is developed under a legislative framework at the federal, state and municipal levels. At the federal level, the Standard that governs a sanitary landfill is NOM-083-SEMARNAT-2003, which establishes environmental protection guidelines and specifications. At the state level, the Solid Waste Law for the State of Morelos establishes that municipalities must assume the faculties and responsibilities regarding waste. Finally, the Municipal Development Plan of Cuautla establishes the lines of Action for the final disposal site of the waste. ORIGINS The production and consumption of resources and services inevitably generate waste. At a global level, the problem of the final disposal of waste is extremely important and can be seen from different perspectives, depending on the particular situation of each city. In Mexico, the best solution for the final disposal of urban solid waste is landfills. Inevitably landfills represent a contamination when burying solid waste, however what is sought from these sites is the application of measures established in Mexican regulations to minimize the environmental impact generated by this activity. Currently, the city of Cuautla, Morelos has a waste landfill called"La Perseverancia", which receives solid waste from 13 municipalities in the state of Morelos, as well as a small fraction of the waste generated in the capital of the country. The challenges that the waste landfill"La Perseverancia"has had to face are related to the ignorance on the part of the society of the procedures for the final disposition of the solid residues, which got to cause a rejection of the community by the installation of this place, for this reason it was necessary to create a campaign of dissemination and participation of the private industry with the municipal sector to publicize the environmental and social benefits that this place generates. The social benefits that have been generated by the establishment of this site are: the employment opportunities for people with different academic degrees, the participation of the academy and the private sector in the opening of collaboration agreements for the incorporation of students in the realization of professional practices in the waste landfill. In addition to carrying out an international cooperation between Mexico and Colombia in the exchange of experiences of solid waste management. On the other hand, the environmental benefits that are generated in this place are related to the capture and destruction of biogas generated by the degradation of organic waste, which is reflected in a reduction of greenhouse gases and a generation of sustainable electricity. It is expected to reinforce the learning and cooperation of thecitizens of Cuautla with the purpose of creating an environmental awareness by making it known that it is important to educate the population in the separation and reuse of their waste to give the landfill a longer useful life. In addition, to show the waste landfill not only as an alternative for the final disposal of the waste that is generated every day, but also to show that the technology that is available is helping to generate electricity and thus be one of the first landfills in our country to carry out a change that helps achieve the objectives acquired by Mexico in terms of reducing emissions to the atmosphere and in the same way to meet the objectives of sustainable development. As an initial stage, the landfill was managed by the city council of Cuautla in the period from 1999 to 2010, later the company Operadora de Ferrocarril y Manejo de Rellenos SA de CV carried out the rehabilitation of the final disposal site, to begin the reception of waste. Here a partnership between the municipality and the company took place and it continues. Before this it was necessary to carry out talks between the city of Cuautla and the private company to create a cooperative link for the final disposal of the solid waste generated in the city. In the same way, permits and municipal and state certificates were established for the legal operation of the"La Perseverancia"waste landfill. The innovation of the project has also

created two other partnerships that did not happened before. Local universities have gotten interested in what the waste landfill is doing and have already started a partnership in order to have students making professional practices there and to even reflect upon how to improve the processes of recollection and final disposal of all the solids waste in the city. These partnerships have also developed with international partners in Colombia for instance. The innovative part of this project has caught the attention of the region of Tolima in Colombia and a South-South cooperation project has taken place with the support of both Cooperation Agencies of Mexico and Colombia supporting the exchange happening between the two local governments in the field of solid waste management and the best practices. The resource for the implementation of the technology of the electric power generation plant and the generators was financed by the owner of the Operadora de Ferrocarril y Manejo de Rellenos S.A de C.V. The fee that all municipalities cover to make the disposal of the solid waste of their territories in La Perseverancia, helps also to cover the running costs of the site. Additionally, the reduction of greenhouse gas emissions has allowed the landfill to be a creditor of Carbon Bonds, which may be offered in the Carbon market and subsequently the economic benefit that will be obtained will be available for the improvement of the site.

Outcomes and Impacts

The first result that has been achieved is the generation of electricity through biogas generated by organic waste. Linked to this is the obtaining of carbon credits, which places the City of Cuautla as the first municipality in Mexico to have a landfill that has Carbon Bonds in the country through the California Protocol, which contributes to the compliance with the Agenda 2030 and the Sustainable Development Goals. On the other hand, the company's short-term objectives are to install a second motor generator to produce an additional 1 MW of electricity. Currently this second motogenerator has already been acquired and is being installed. The project of the final disposal of the waste, also contemplates the construction and operation of an industrial plant for the separation of recoverable waste, this will allow the waste landfill to extend its useful life since only the organic waste will be buried in the cells of final disposal with the objective of continuing to produce biogas and generating electrical energy. We reaffirm that the project covers the change in its four scales: local, regional, national and global First, the local and regional level is covered by being a site for the disposal of waste from 13 municipalities in the state of Morelos and a fraction of the capital of the country. At the national level, we are the city with the first waste landfill in Mexico registered in the California protocol that seeks the reduction of greenhouse gases generated in landfills. At a global level, we are preventing the gases generated by the degradation of organic waste from being released into the atmosphere, thus reducing the environmental impact and global warming. The indicators that are used to evaluate the change are directly related to dependencies of different orders, which verify compliance with the parameters that are necessary for the proper management of the landfill. To carry out the transport of electricity, we are interconnected with the network of the Federal Electricity Commission. And in turn with the National Center for Energy Control (CENACE) which is the Mexican agency that verifies the operational control and energy supplied from the electric power plant of the sanitary landfill in Cuautla. In addition to other verifying bodies such as the Federal Environmental Protection Agency (PROFEPA) that keep the landfill under surveillance to ensure that its activities and procedures are always in compliance with Mexican environmental regulations. To achieve the generation of electrical energy it was necessary to carry out a modification in the infrastructure of the project, first the extraction system was modified and the well system was redesigned carrying out a modification of vertical wells, and an implementation of horizontal wells. On the other hand, there was a policy to foster guided visits in the waste landfill La Perseverancia with the objective of the society to verify that the final destination of their waste is carried out in the best possible way, following the security measures that avoid creating a contamination to the soil and aquifers and, above all, to mitigate the environmental impact generated by this activity. All the activities carried out between the city council of Cuautla and the waste landfill are published by local media and on social networks. Due to the fact that the sanitary landfill is located in the municipality of Cuautla, there is guaranteed a place for the disposal of the waste, avoiding foci of contamination and having a clean vision of zero waste in the city, this is not only reflected in Cuautla, but that also in the surrounding municipalities. Having a waste landfill in the municipality of Cuautla that generates so many benefits, facilitates good communication with other countries that seek learning and cooperation in order to support the development of their cities. Placing the city of Cuautla as an example to the integral management of solid urban waste in the country.

Innovative Initiative

The landfill project and the generation of electrical energy can be considered as both, evolutionary and revolutionary. First, it is a revolutionary project because it has Spanish technology, which was chosen over others due to the success in other countries. However, the characterization of the waste as well as the climatological conditions of the region were not considered, which in turn caused a risk to the viability of the project. The project had to go through a series of changes and adaptations around the lessons learned to achieve the generation of electric power. The main changes were based on the modification of the operation and the extraction of the biogas. Based on the knowledge acquired, the implementation of horizontal wells instead of vertical wells was carried out as they were initially, which allowed for the use of methane gas at a lower cost. Due to all these accumulated experiences it was decided to buy a second generator engine to increase the production of electric power from 1 megawatt to 2 megawatts. The project has as an objective a growth of up to 4 megawatts of electricity production through the gases generated from the degradation of garbage. Once the biogas destruction system was implemented, it was possible to register the landfill in the California Protocol, through the Climate Action Reserve, and after an audit by the company NSF International Strategic Registrations it was possible to obtain 12501 Bonds of Carbon, converting the company into the first waste landfill in the

country to obtain Carbon Bonds under the California Protocol. The project to generate electricity through garbage was developed using Spanish technology, however never before had this type of project been carried out in the region. The first obstacle to overcome with this type of technology was that the weather conditions and the characterization of the waste was not the same for Mexico and Spain, so the system of connection of extraction wells and equipment failed to meet the objective of the generation of electric power. Firstly, the Spanish technology contemplated the installation of vertical wells which would extract the biogas generated in the cells by forced extraction. The design of these wells was not adequate, which caused a plugging in the pipe. After this, it was necessary to reengineer the forced extraction system to increase the efficiency and the radius of influence of the installed wells for a greater use of methane gas. Within these proposed improvements the thickness of the pipeline was modified, and a trap system was designed that would help prevent the biogas condensate from causing alterations in the electric power generation equipment due to the humidity of this gas. As the garbage was degraded, it generated leachate inside the landfill, so it was necessary to readjust the extraction systems to horizontal wells which were beneficial for a better use in the extraction of biogas, which represented an increase in the production of energy electricity and therefore a decrease in greenhouse gas emissions into the atmosphere. In Mexico, according to the environmental regulations established for a sanitary landfill (NOM-083-SEMARNAT-2003), it mentions that the biogas generated by the degradation of garbage should be burned by torches, but applying innovation in improving the sustainability of the environment. At the same time, a 1MW motor generator was installed for the production of electric power, this way not only an environmental benefit is generated, but also social and economic benefits that have provided a tool to share and exchange knowledge with the entire population of Cuautla, Morelos. Definitely, this innovation project has inspired the local government to establish public policies regarding the management of solid waste and other municipalities to implement something similar to what La Perseverancia does. It has also motivated local groups, institutions to develop a more aggressive campaign to sensibiliser the local population to handle better their waste. With the advancement of the technology, the project has led the company to diversify the sources of generation of power through solar cells. Resistance by the population to the final disposal of waste was the firstobstacle to overcome, all due to the bad experiences experienced with differentgovernment administrations that have caused people to consider landfills aspollution sites and not as places to mitigate environmental impacts. However, thanks to the approach of the private company together with themunicipality of Cuautla, it has been possible to work together to makethe"La Perseverancia"landfill known as a place with technology andcapacity to receive more than 1000 tons of waste per day and to generateelectricity. The openness that this place has offered to society has allowed thepeople who visit the facilities to have a better vision and understanding ofthe processes and benefits that are generated in this site.

Conclusion

Given the current energy situation of the country, characterized by a significant decrease in reserves and production of hydrocarbons, it is more important to consider the energy potential of municipal waste. In this sense, the current situation of this"energy resource"must be considered, as well as the existing processes for its conversion to energy, and the technologies available and tested commercially at present. Within this context, the garbage of the municipality of Cuautla complies with these attributes, since on the one hand it is generated in sufficient quantities and with the energy content necessary for its conversion to energy, while protecting the environment. Despite the existence of a large number of biogas projects with electricity generation in developed countries, in the metropolitan area of Mexico there is only the"La Perseverancia"project that can be seen as a successful case since 2015, as well as being able to serve as an example for other similar projects around the world. In these terms it can be said that the garbage generated in the municipality of Cuautla has a great potential for energy use, which provides a benefit to the environment due to its reduction of greenhouse gases, which can be verified with the Bonds of Carbon through the Climate Action Reserve. RELEVANCE TO SUSTAINABLE DEVELOPMENT GOALS Goal 1: End poverty in all of its forms Goal 4: Ensure inclusive and equitable education and promote life-long learning opportunities for all Goal 5: Achieve gender equality and empower all women and girls Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable Target 3: Participatory, integrated and sustainable human settlement planning and management Target 6: Improve air quality and manage municipal and other wastes Target 8: Support positive economic, social and environmental links between urban, peri-urban and rural areas Target 9: Improving resource efficiency, mitigation and adaptation to climate change, resilience to disasters and implement holistic disaster risk management Goal 13: Take urgent action to combat climate change and its impacts Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss Goal 17: Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development