ANAEROBIC DIGESTION TO DECREASE THE CARBON FOOTPRINT

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ABSTRACT

Anaerobic digestion development has been marked by a constant evolution. Currently, due to the dramatic changes in climate with its consequences (natural disasters, food safety, glacier thawing, etc.) force us to use more sustainable, safe and efficient technologies in which GHG reduction is obviously taken into account. Therefore, Anaerobic Digestion is not only an efficient way to solve environmental problems or to provide energy and biosolids; it is an excellent opportunity to help in preventing the planet destruction. During the years in which the CO2 Emission Reduction Certificates had good prices, different Anaerobic Projects in developing countries were implemented due to economic factors. However, with the current prices without additional incentives, the decision is not only economic, it is a sustainability decision in which AD is a technological tool that can reduce GHG by CH_4 capture (10 % of the total GHG production) and by fossil fuels replacement.

In this work, a systemic approach for anaerobic digestion projects is shown. In this sense, GHGs reduction can help solving environmental and energy problems, given additional value to different processes and reducing the carbon footprint, a tool for the sustainability of industries, community, and countries. In this sense, NAMAs (National Appropriate Mitigation Actions) with the incorporation of Anaerobic Digestion strategies are shown as an efficient tool for developing countries in order to look for their environmental solution with GHGs reduction. Finally, different study cases are shown in order to validate this approach.

1. Biogas and its importance in GHGs reduction

The reduction of greenhouse effect gases is certified in equivalent tons of CO_2 through reduced emissions certificates (CERs) that are determined by means of the CO_2 equivalence that the different gases established in the Kyoto Protocol have. Another way is to add this reduction in order to reduce the carbon footprint for a product or for a whole corporation. The equivalences of each one of the gases is observed in Table 1.

Table 1: Equivalences among the different greenhouse effect gases established in the Kyoto Protocol at equivalent CO_2

Compound	**Formula**	**CO_2 equivalence**
Carbon Dioxide	CO_2	1
Methane	CH_4	21
Nitrous Oxide	N_2O	310
Hydrofluorocarbons	HFC	740
Perfluorocarbons	PFC	1300
Sulphur Hexafluoride	SF_6	23900

One thousand tons of CO_2e per year can be easily achievable by an anerobic digestion project, as it is enough to generate 48 tons of methane equivalent to 80 tons of biogas to achieve such an amount. This implies that a project that tries to solve an environmental problem in a company, if it is carried out correctly, could transform itself from a project that generates additional costs into a project with inconceivable benefits.

This is because medium-sized projects that use biodigesters would be generating approximately 5000 CERs that would become additional profits for the project developer directly (if CERs prices are higher) or indirectly by means of Carbon footprint reduction. It must be underlined that the GHG reductions are not enough to fully finance the project, however, they could partially cover part of the project or could provide the profitability that is missing to make the decision to go forward.

2. A systemic point of view for Anaerobic Digestion Projects

The benefits of anaerobic digestion are well known, which under adequate conditions not only can stabilize wastes, control odors and produce mineralized nutrients, but it also is a net energy producer and minimizes environmental impacts from waste emissions, especially avoiding the atmospheric emissions of CH_4, one of the most important GHGs.

From another perspective, Anaerobic Digestion has to be seen through a systemic point of view. If an industry needs to solve environmental problems with its effluents, the solution is not only a treatment plant, the solution is a comprehensive project in which the economic, energy and environmental sustainability are important, not only for the industry, but also for the region and the planet.

Figures 1a and 1b show the traditional and the proposed systemic and integrated approach. In the first case, the environmental problem is solved, but in Figure 1b, the energy and GHGs reduction are considered in the overall solution of the problem.

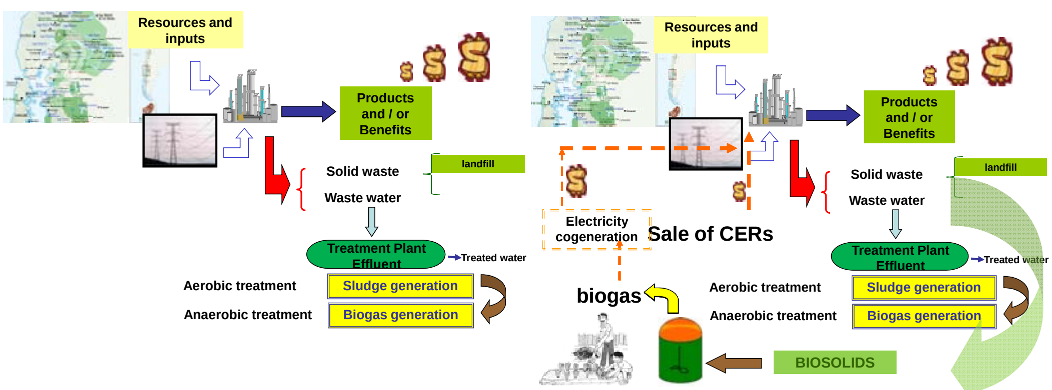

Figure 1: Different approaches for an environmental solution for the industry. (a) Traditional approach (b) Systemic approach

In industrialized countries, the solution is not easy, but it is possible. Subsidies, special fees, fixed and guaranteed prices for the energy are incentives for these types of projects. In the other hand, under developed countries didn’t have this kind of assistance for these projects. GHG Reduction or NAMAs policies is a way in which rich countries contribute to the environmental development of poor countries.

Currently, 18% of the projects registered as CDM at worldwide level corresponds to projects related to anaerobically digested biogas. As a whole, these projects decrease 1,307,785 tons of CO_2, and the main countries that have developed these projects are Mexico, Brazil, Philippines and Malaysia. The projects developed mainly correspond to liquid effluent treatment and livestock raising waste treatment. However, there are more possibilities than what the framework convention establishes because its methodological panel has established other possibilities that allow determining the GHGs produced under different circumstances. Table 2 presents a summary of the methodologies applicable to CDM projects, together with a description of the projects.

Table 2: Methodologies that can be applied to anaerobic digestion projects and their description

Meth. Number	**Methodology Title**
ACM0002	Consolidated methodology for grid-connected electricity generation from renewable sources
ACM0003	Emissions reduction through partial substitution of fossil fuels with alternative fuels or less carbon intensive fuels in cement manufacture
ACM0010	Consolidated methodology for GHG emission reductions from manure management systems
ACM0014	Mitigation of greenhouse gas emissions from treatment of industrial wastewater
AMS-III.H.	Methane recovery in wastewater treatment

These methodologies can be concretely applied to anaerobic digestion projects; however, biodigesters can be used in other types of projects through the use of biogas as fuel for electrical or thermal energy generation. Table 3 shows some of the methodologies that can be applied to biogas projects.

Table 3: Other methodologies that can be applied to biogas projects

Methodology	Description
AMS-I.D.	Grid-connected renewable energy connection
AMS-III.E	Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment
AMS- I.B	Mechanical energy for the user with or without electrical energy
AMS-III.D	Methane recovery in animal manure management systems
AMS-III.E	Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment
AMS-III.D	Methane recovery in animal manure management systems
AMS-III.G	Landfill methane recovery
AMS-III.A.O	Methane recovery through controlled anaerobic digestion
ACM 0010	Consolidated baseline methodology for GHG emission reductions from manure management systems

3. Final Remarks

Biogas production was proposed for the stabilization of waste products under different conditions, which is based on the transformation of organic matter via its degradation into a biogas, CH_4 and CO_2. This biogas may then be collected and used as fuel.

In developing countries there are some digestion processes for solid waste via anaerobic digestion; the majority of this energy is currently lost or it is produced at a very low proportion compared to the amount consumed. This approach gives incentives for the development of new technologies in which production of electrical energy from biogas generated from the stabilization of solids is seen as a valid alternative.

Biogas must be part of the Society's response to the challenge of reverting climate change problems. Anaerobic digestion reduces the GHGs in two ways. First, and the most important one, by capturing biogas, and second, when anaerobic digestion produces biogas to replace fossil fuels. So, Anaerobic Digestion is a flexible technology that is applicable at different scales and allows making society more resource-efficient, supporting economic grow for developing countries and improving quality of life for all.

The systemic approach shown in this work, allows developing more ambitious anaerobic projects in developing countries by considering the GHGs reduction as a fundamental variable. With this mechanism, industrialised countries help poor countries to develop and obtain their reduction goals.