

Consejo de Investigación y Tecnologías de Valoración Energética de Residuos en Colombia

WTERT Colombia Council

Supported from the Earth Engineering Center of Columbia University (EEC) in New York, United States and as a result of the efforts of the Colombian Association of Engineers (ACIEM) and its chapter of Antioquia, the WTERT Colombia Council has been created, made up of representatives from the University, the Society, the State and the Productive Sector.

It seeks to stimulate research, to contribute to identify and disseminate different methods and technologies for energy use and waste management, especially for urban solid waste. Actively seeking participation of industrial and governmental organizations interested in promoting waste management.



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MEETINGS, ACTIVITIES AND AIMS

The Council **meets every three weeks** to discuss different topics both in the progress of the work plan, possible contacts and projects to be executed, among others

The meetings are used to **discuss different technical** WTE topics, with the contribution of members, with members being in charge of exposing to the group in a subject matter of their knowledge.

The councils aims to establish and maintain **relationships** and request **technical visits** with other institutions, companies and waste treatment outfits

One of its aims is to develop **databases** of people and companies, experts and persons interested in the subject, in order to participate in projects, bids, review of works, or activities related to the subject and attract others to WTE activities. This includes **searching for financial resources** in association with ACIEM Antioquia



COURSES AND TRAINNING ON WTE

Courses on WTE will be offered in alliance with university institutions and with ACIEM

Wtert Colombia Council and ACIEM, Antioquia Chapter, together with the Remington University Institution, are organizing a first Diplomate in Energy Recovery of Solid Waste. This will be a 90 hour teaching class and shop effort, aimed at engineers, officials and managers of environmental authorities in the region and personnel of technological vocation with interest in the valuation and rational use of solid waste. This will be offered in the beginning of 2019







This event was held at Medellín with the attendance of some 110 people from different universities in Colombia as well from people from companies, government sectors and manufactures of specialized equipment for waste handling and WTE.

Through the key note talks and the oral presentations attendants could see how universities and other concerned scholars and experts are paying growing attention to study WTE technologies as they best apply to developing countries, doing work to assess the potential of MSW in several applications, including municipalities. Among the work presented there were studies to characterize and estimate the calorific and other properties of MSW and studies to determine the feasibility of WTE technologies for Latin American countries.



Companies in the industrial sector, cement, steel and agricultural, presented ongoing projects in which they are already applying WTE technologies to valorize and treat different types of waste.

For example, cement companies that use the tires of the vehicles and the African palm crops that use the waste to produce biogas.

It is necessary to put the industrialists and public officials in contact, so that they bring experiences and encourage the municipalities to undertake this type of projects



The experiences shared by public officials and the City of Mexico and the State of Mexico, as city and state, pioneers in Latin America in the management and approval of two WTE projects that apply the incineration of MSW, shows that if it is possible to convince to the environmental authorities and the community in general to accept this type of technology.

The work of WTE plant suppliers, such as Babcock and Wilcox, and Veolia, to financially structure WTE projects, together with municipal and departmental governments, to make the projects viable, is a lesson for project engineers and public officials who must promote this type of projects.







THE NEED FOR SUSTAINABLE WASTE MANAGEMENT IN COLOMBIA

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ABOUT COLOMBIA





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- Colombia is the third-most populous country in Latin America (50 million people) with and urban population estimated at 76%.
- The average national unemployment rate in 2017 was 9.4%, but informality is a big problem for the labor market.
- The Gross domestic product per capita, 2017, is 6.472 U.S. dollars.
- As in 2016, the National Administrative Department of Statistics (DANE) reported 28.0% of the population below the poverty line, of which 8.5% in extreme poverty.





- As it happens in other countries with high levels of poverty, indigence and unemployment, this comes associated with informal waste recycling practices, especially among the poor.
- Around 20 people per 10.000 habitants work in Colombia in these recycling task, 3,9 organized in collective groups; 5,7 as workers in separating plants; 14,5 associated to the recollection systems; and 9,7 in other places.





According to date from an OPS (Panamerican Health Office) study this figure compares the daily per capita urban solid waste generation in Colombia to the situation in Latin America, showing that Colombia generates waste at a rate a little lower than the average. With a medium generation of 0.54 kg/hab./day, the estimated daily generation will be around 26.000 tons.





- In Colombia, recycling has been in practice since many years ago, and employs about 100.000 people, with about 30% associated in 128 cooperatives, having even a National Association of Recyclers (ANR), and 70% working independently.
- Colombia is a model in the region in the recycling of paper and cardboard, with a recovery of 57%.
- The recycling rate of waste such as paper, cardboard, glass, metals and plastics is 17%, and by 2018 the goal will be to achieve a recycling target of 20%

ABOUT COLOMBIA



- The rest of the waste goes to waste dumps or sanitary landfills as there are not any thermal treatment facilities in the country.
- Following the OPS report, 81,8 % of this go to sanitary landfills (100 % for the case of the large cities); 4,1 % to controlled dumps; and 12,5 to open dumps.
- Out of these disposing facilities, very few have lixiviate treating plants or methane burning systems. Space is becoming an issue and there are growing concerns and limitations about the growth of the landfill system areas in the coming years. In other cases, environmental concerns are becoming more and more important.



LEGAL FRAMEWORK IN COLOMBIA FOR THE INTEGRAL AND SUSTAINABLE MANAGEMENT SYSTEM OF SOLID MUNICIPAL WASTE (MSW) AND THE USE OF WTE SYSTEMS

In Colombia, general planning is carried by the National Direction of Planning through directives generated by COMPES (*Consejo Nacional de Política Económica y Social*, National Council of Economic and Social Policy). There is currently a defined National Policy for the Management of Solid Waste, updated through the CONPES 3874 of 2016. The policy is based on:

- Reduce the generation of MSW (the same as USR, urban solid residue).
- Minimize MSW that are deposited in landfills or dumps as a final disposal.
- Promote the reuse, use and treatment of solid waste.
- Minimize and avoid the generation of greenhouse gases

Principles of Circular Economy defined in Colombia





Principle	Description			
Eco-conception	Considers environmental impacts throughout the life cycle of a product and integrates them from the very conception of the process			
Industrial and territorial ecology	Establishment of a mode of industrial organization in the territory, characterized by an optimized management of stocks and flows of materials, energy and services			
Economics of functionality	Privilege the use of goods in comparison with their possession. Privilege the sale of services against the sale of goods			
Second use	Reintroduce into the economic circuit products that no longer correspond to the initial needs of consumers.			
Re-use	Re-use certain waste or certain parts of it that can still be used, to manufacture new products.			
Repair	Find new life for damaged products.			
Using	Take advantage of the materials found in the waste.			
Valorization (treatment)	Energetically and functionally make good use of waste that cannot be recycled.			

The application of the Principles of Circular Economy defined in Colombia



The ways of proceeding described in the table imply, in many cases, new ideas and beliefs, as compared to the usual practices.

To establish those mindsets among people (consumers, producers, government, leaders, and citizens) it is necessary to work out ideas about change, points of view, creativity, testing, observing, imagining, proposing, normalizing, developing culture and education.

To attain changes there is the need of investing time, resources, developing tools and good communication and leadership.



Colombia has assumed international compromises that have to do with the management, use and valorization of the MSW. This is the case of COP21-2015 where the country has agreed to reduce 20 % its GHG emissions in 2030.

In the United Nations 2015 summit, Colombia subscribed to the 17 sustainable development objectives, which went into application in 2016. Specifically, objectives 11 and 12, refer to the integral and sustainable management of the MSW, where WTE projects, like a biogas plant and incineration systems, apply perfectly.



In the National Development Plan of Colombia for the period of 2014-2018, called "All for a New Country", it is proposed to issue a general law for the integral management of solid waste, to harmonize the existing regulations.

The National Development Plan refers to desirable efficiencies in the integrated management of solid waste for local entities, which will allow for incentives when the Plans for Integral Solid Waste Management (called PGIRS) include projects for using and taking advantage of waste.

Real legal possibilities for WTE in Colombia



- Decree 1077 of 2015 of the Ministry of the Environment regulates the provision of the waste handling services and requires that the municipalities incorporate their use in the PGIRS [10].
- In article 361 of the Political Constitution of Colombia, 1991, it is indicated that the state must ensure the provision of public services to all the inhabitants of the country, while Law 142 of 1994, allows the municipalities to delegate this work in authorized private entities. Therefore, the Municipalities of Colombia can be directly promoters and/or owners of WTE plants or assign to an existing entity that purpose.

It follows that, according to the legal framework described, the execution of WTE projects in Colombia is possible from the normative point of view.



EXISTING BARRIERS FOR WTE IN COLOMBIA AND SUGGESTIONS TO MANAGE THEM

Based in their experience as promoters of WTE projects; members of WTERT - Colombia council; as project engineers and interested subjects in the field and participants in several international and national forums, seminars, university courses and conferences, the authors have been able to perceive a list of barriers.

They make somewhat difficult the development of WTE projects in Colombia, at least in the short term. They are listed and analyzed. For each one, suggestions are proposed for their managing and mitigation, with the purpose of promoting the realization of sustainable and well- designed projects of WTE systems that become truly beneficial for the country.

Barrier	Proposed actions		
Lack of knowledge of WTE technologies	Encourage knowledge and public awareness among people, academy, designers, consulting firms, authorities, public officials, companies and entities responsible of managing waste.		
Lack of an appropriate technological base and lack of complete engineering when doing projects	 waste. Stimulate local technology and engineering in the project to develop technology, create jobs and prosperity. Promote application and knowledge of all the engineerin stages (conceptual, basic, detailed, execution) to each project. Planning and design based on the establishment of clear objectives. Execution under technical criteria. Control and monitoring of execution to be within the budgeted costs and with the required quality. Exercise feedback and recurrent work, based on discipling interdisciplinary group work, motivation and leadership, 		

Barrier	Proposed actions		
The interests and influence of existing waste managing concessionaires	 Stimulate the existing concessionaries to become part of the new WTE schemes, especially as investors, considering the large capital requirements for these projects. Introduce the WTE projects as a growing part of the total solution, as it would be quite difficult to change the existing systems at once. Allow WTE systems to generate new opportunities and 		
Political- technological relationships	 new areas of work for concessionaries. Stimulate strong connections between engineering (represented by professional societies and guilds) and politicians and policy makers. Professional societies and groups should reach maturity and develop capabilities to study and propose WTE projects and alternatives, to exercise good communications to be able to be listened to and convince 		

Barrier	Proposed actions		
Required initial investments	 Develop procedures to demonstrate from the technical, environmental and social points of view, the advantages and real operating benefits and costs and initial investments for a WTE project. Include critical analysis of the real costs, associated investments and life-cycle environmental impacts of sanitary landfills. This could help to better defining the MSWH projects. 		
Legal framework for WTE projects	 Stimulate the completing of the regulatory norms for the existing laws Try to stimulate simplifying the regulatory process following the already existing developments on WTE in several countries. 		

Barrier	Proposed actions				
	• The waste sector must consider a broader perspective and see electricity generation as one aspect of WTE and not the only goal.				
Interests and perspectives of WTE as seen from the electricity	• It is necessary to understand the WTE projects from the economic point of view and add to the economic considerations the corresponding social and environmental evident and hidden benefits, which should be monetized				
sector	 and included in the cash flow to evaluate a given project. To get some initial experience, it seems advisable, in Colombia, to work out WTE projects with low electricity production 				
Environmental permits	 WTE projects should be considered part of the waste sector and not part of the Colombian electricity sector for environmental permit considerations. Devise integral evaluating protocols that favor the development of these systems, consider the importance of the environmental benefits they have 				

Barrier	Proposed actions		
Availability of land	• Make use of the advantage that WTE projects		
	have in relation to land use, as compared to		
	sanitary landfills		
Tipping or gate fees	Some revisions of this should be proposed to help		
	financing a WTE project, understanding that gate		
	fees will not likely be the main source of financing		
	these projects, which require high investments and		
	requires public equity.		
Zero waste policies	There must be knowledge and practical wisdom, to		
	understand the ways of reaching minimum waste		
	generation and minimum waste disposed		
	improperly into the environment, as absolute Zero		
	waste is impossible. WTE is perhaps the best		
	practical advance in the right direction		



To help provide some perspective on this matter, the authors present here a model of application of WTE to solid waste in Colombia. It is based on simulating the impact on the economy of these projects, according to variations on the auxiliary fuel used (natural gas or coal) and in the water content of the treated waste (which varies according to the percentage of organic domestic biodegradable material separated before the WTE facility.

The model estimates required electricity sale prices and electric power generated for a unit capable of treating 500 ton/day of waste after recycling at current levels and organic waste separation at the simulated levels. It also estimates number of plants and total generated electricity for the treatment of all the separated waste in WTE.



Required electricity prices for an WTE cogenerating plant if a 20 year pay back is considered, based on yearly interest on debt of 6 and 10 %, applied to 50 and 100 % of investment (equity by owners) and gate fees of 0,01 and 0,02 US \$/kg, both for natural gas and coal as auxiliary fuels

The total number of 500 ton/day WTE plants for this would be between 29 and 45. The total installed generating capacities would be between 400 and 850 MW. The estimated annual generated energy will be between 3500 and 7400 GWh.

The estimated investment for total treatment of separated waste by cogeneration WTE plants would be between 1600 and 3400 million US\$.

To have a perspective for these numbers consider that the local utility company, EPM is currently investing between 5500 and 6500 million US\$ in the Hidroituango hydroelectric generating plant with an installed capacity of 2400 MW and 13930 GWh of annual generated energy.

Another perspective comes from comparing the projected uses of natural gas and coal to the current yearly uses in the country.

	Natural Gas	Coal
Fuels use in Colombia, ton/year	11.000.000	7.500.000
Average use for WTE for total separated		
cogeneration, ton/year	477.301	1.405.488
Average use for WTE for total separated		
cogeneration, ton/year	4,3	18,7

Putting into functioning these systems, in the average, will require important proportions of the cogeneration fuels usage in Colombia, especially in the case of the cogeneration with coal. However, in this case, Colombia is a large exporter y producer of coal for exports and there are enough reserves for this WTE application. Besides, some of the considered cases do not require auxiliary fuels.

After this simulation and analysis, it can be seen that it is necessary to add to the economic considerations the corresponding social and environmental evident and hidden benefits, which should be monetized and included in the cash flow to evaluate a given project. Among these, it is worth to mention the following ones:

• Job generation. This is especially important if a decision is taken to integrate, as much as possible, local engineering, installation and manufacturing into the project. This also applies to the jobs associated to the production of coal in the case of coal cogeneration.

• Contribution to eliminating greenhouse gases and to eliminating water and air pollution.

• Value and scarcity of the necessary land necessary for future landfills and expansion of existing ones and early recovery of valuable land of the existing landfills, for public use.

- Cost of lixiviate and biogas treatment for any required landfill expansions.
- Valued added by the necessary research and development associated with the WTE systems and their technology. Intellectual property can be generated and negotiated.
- Transportation cost to far away landfills.
- Available electric power to equilibrate the offer when hydroelectric plants suffer for lack of rains and availability of electric energy to develop industrial and high technology agriculture in the sites close to the WTE plants.
- Possibility of uses for the ashes coming from the WTE plants

Similar analysis should be done by waste managing concessionaires, responsible in great part for the final disposition of the MSW. In so far, apparently, they have no seen yet WTE as an option to be considered.

It is important to find schemes in Colombia that allow promoting WTE projects, for example, sharing the initial investment between institutional actors and private actors or actors in the electricity sector. This means that the municipalities, local states and national government contribute with equity and investment in the stage of thermal or biochemical treatment and that the others invest from the turbine or internal combustion engine forward, for example.

The public organizations could so provide steam, biogas or synthesis gas, which they deliver to the private stockholders to produce and commercialize the electricity.

To get some initial experience, it seems advisable, in Colombia, to work out WTE projects with low electricity production, for example with capacities between 500 kW and 20 MW, practically the same range of small hydroelectric plants, and still small compared with the capacities of coal-fired thermoelectric and natural gas plants that exists in the Colombian electricity sector. However, each time a WTE project is executed that contributes with some MW, it displaces the need for conventional large-capacity thermoelectric power plants over time, replacing existing ones or new projects, which in principle seem good from the macroeconomic point of view because coal and natural gas could be directed to sectors where their use is more efficient.



Energética de Residuos en Colombia

Thank you very much for your attention!

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