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Proposal for the Generation of Alternative Sustainable Energy Using Methane Gas from the City's Landfill

MAURA CELI MARTINS[1], JANDECY CABRAL LEITE[2], JOSÉ ANTONIO SOUZA SILVA[3]

Abstract

In the last two decades, various studies on the concentration and greenhouse effects gas flow (especially CO2 and CH4) have been performed on lakes and natural rivers and dams worldwide, showing that these environments may significantly contribute to the greenhouse effect. Aquatic environments produce these biogenic gases in the process of decomposition of organic matter produced within the environment (autochthonous) or which is imported from the watershed (allochthonous). It is estimated that these environments contribute with about 40% of the total methane gas emission into the atmosphere. Several cities in the world in order to reduce this problem, are taking advantage of landfills to generate electricity and also marketing this renewable energy, arising from that thought, it would be of essential importance to Manaus, as being the largest capital of the Amazon forest and which has not seek further to minimize this impact yet. The proof is that the recycling of control in terms of statistics only began in the year 2012. This article's goal is to propose a sustainable alternative energy generation through methane gas in the city's landfill, based on data from the city bodies. The methodology applied was through research in loco in the sectors of local, state and federal governments to find out whether Manaus is within the minimum parameters and data analysis of solid waste, the research universe and detailed description of the data analysis. The results showed that today Manaus generates around 2632.156 t/day of solid waste, from home and hospital collections, mechanical removal, manual removal, pruning collect, separate collection and others'.

Key words: Sustainability, Power generation, Selective collect, Process management

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INTRODUCTION

By analyzing the urban space in the Brazilian cities it is clear that they are all covered by materials that could be recycled and reused or why not say reused in a consciously and appropriately way. In terms of development and cooperation between federal, state and local governments this article presents the generation of energy from renewable sources for forest consistently and consciously preservation, otherwise, within a few years the whole environment, rivers and effluents, growth disordered population's lack of preparation, installation and disposal of industrial objects that could be recycled in inappropriate places will destroy the future of generations of the greatest capital of the forest and will still pollute the longest river in water volume in the world, the Amazon river. According to LOVELOCK (2006), a sustainable development policy will lead the planet to a probability of disastrous change having already exceeded the limit of what would be possible to go back and prevent disasters caused by global warming. Even environmental measures as the search for renewable energy sources are innocuous, if not, further aggravate the process of global warming.

MEIRELES FILHO (2007) says that the Brazilian Amazon is the home to one third of all living species on the planet. Biodiversity is so intense that, in some regions, in one hectare of forest 300 different types of trees have been cataloged. The subsoil is also rich: its stock of ore was estimated by experts at 7.2 trillion dollars. There are large deposits of gold, copper, tin, titanium, tin, lead, tantalum, zinc, columbite,

* *Post graduate program in process engineering (PPGEP-ITEC-UFPA) of the institute of technology of the Para federal university (PPGEP-ITEC-UFPA).*
[1]*E-mail: mauraceli@hotmail.com*
[2] *Galileo Amazon institute of technology and education (ITEGAM)*
E-mail: jandecy.cabral@itegam.org.br
[3] *E-mail: jass@ufpa.br*

uranium and niobium. The current practice of large mining policy is to obtain the maximum profit possible and it contributes very little to the communities, and worse, it causes serious social and environmental problems.
Due the above, this research focuses on the capital of the Amazon State, Manaus, which has been growing throughout the concern with the environment and environmental responsibility to the region and throughout its surroundings, especially the cities far from the capital.

The priorities should be addressed so that future generations are not penalized by the ambition of the now and today, only for profit and financial return:

1 - Environmentally friendly;
2 - Socially fair;
3 - Finally, economically viable.

Investments in all sectors, should rather be made to improve the economy and the development of cities, however there are mitigating and compensatory measures that can be viable and bring back profit, many times in the long term, certainly prioritizing man and the environment, as a group whose future and coexistence should be far above commercial interests, as stated in the Urban Manaus Master Plan.
The article presents an analysis conducted by the Manaus Urban Master Plan which is organized in the Unidades de Estruturação Urbana (UES) – The Urban Structuring Units (USU) - of the city neighborhoods where the selective collection and feeds the city's electric utility - Eletrobrás Amazonas Energia - where points of selective collection could be installed and the rest could be taken to the landfill for processing methane gas as a source of generation.
Consumption habits of modern society, the definition of specific regulations for the mining and metallurgy industries, the implementation of research and development of appropriate technology centers, constitute the agenda for specific actions of government and business sectors in the recycling of industrial waste, that is why the suggestion to install another landfill in the District II area to allocate all the garbage collected from industries.
This paper aims to present a proposal for *energy generation from waste (biogas)*, among the main problems appears the gas which is now released into the atmosphere, causing damage to the ozone layer and increasing the heat. The use of methane that is released into the atmosphere to generate electricity allow us to increase our power generation, which is small, while emphasizing that the energy produced by the thermal power is very expensive and economically unviable and environmentally damaging.

LITERATURE REVIEW

Manaus Characteristics

The characteristic of the city in not to present recycling points draw attention, because the news are always the same: "preserve the environment". But how to do it if the population does not find ways to contribute. And the most common collection points would be in places that are viable and easily accessible to the population, such as neighborhood, children's school, industries, among others, or at least collection points zoned by neighborhood or group of neighborhoods.
In 2008, the city of Manaus conducted a socioeconomic survey to verify the income situation that each of the collectors developed with selective collection task. A socioeconomic registration of members of the nucleus was conducted. The nuclei were organized into groups called I, II, III and IV as follows: Nucleus I is established at Travessa nove, Lagoa Azul no Bairro Santa Etelvina; Nucleus II is located at AM 010, Km 18, Ramal do Janjão, Beco Nossa Senhora de Fátima, no Bairro Santa Etelvina; Nucleus III is located at Beco Curimatã, nº. 06 Santa Etelvina and nucleus IV is located at Rua Jasmim, 359 - Santa Etelvina. All members of the four nuclei come from the landfill area, following its restructuring. The characteristics of these nuclei are not very different, basically summarized in the following features: 1) Formed by families - maximum of eight; 2) Most members of the nucleus is female; 3) The materials are sold in large

quantities and the profit is split between the members equally; 4) The land they occupy are mostly belong to the collectors without basic structures for the activity (RODRIGUES, 2010).
Modernity brought by the industrialization process quickly affected the everyday way of life of the Amazonians. The landmark of these changes occurred in 1967, it was implemented the economic model "Manaus Free Trade Zone" within the framework of regional policy of national integration of the military governments (RODRIGUES, 2010).
According SCHERER and SON MENDES (2006), like other Brazilian cities, Manaus is made up of numerous suburbs without infrastructure of collective goods and environmentally degraded areas. Only in 2002 and 2003, there has been recorded more and new land occupation in the urban area of Manaus, according to the Amazon Bureau of Land and Housing (SETHAB). In 2004 they were accounted for around 3.5 occupations (SETHAB, 2004). The poorest segments of the subaltern classes were pushed to the margins of streams and environmentally precarious peripheries. Reason to agree with (ACSELRADI, 2001), that environmental inequality is undoubtedly one of the expressions of social inequality that marks the history of Brazil, where the poor are more exposed to risks arising from the location of their homes, the vulnerability of these villas floods, landslides and the action of open sewers.
The dimensions of solid waste in Manaus are dormant and the slums process in every area of the city aggravates the problems related to lack of adequate sanitation. Garbage is a major challenge for issues that relate to integrated planning that prioritizes health, environmental preservation and sustainability of the service (RODRIGUES, 2010).

Energy Efficiency
By increasing energy offer the most effective way is to find ways that the energy prices can decreased and this way making life easier for the Manauenses citizens, mainly because it is one of the hottest cities in Brazil, and so it is virtually impossible to live without the air conditioner.
Carbon credit trading is a form of transactions accepted by the CDM (UNFCCC, 2007a). This initiative induces investments in sustainable projects where there may be reduction of emissions and / or carbon sequestration, ensuring a clean development model for emerging countries, where implementation costs of such projects are ores (CEBDS, 2001). Brazil, as a country member of the Kyoto Treaty is entitled to develop GHG reduction projects and issue carbon credits to industrialized countries that must reduce their emissions (DA SILVA, 2015).
The biogas produced in landfills is composed mainly of methane (CH4 - from 55 to 65%), carbon dioxide (CO2 - 35 to 45%), nitrogen (N 2 - 0 to 1%), 2hidrogênio (H2 - of 0 to 1%) and hydrogen sulfide (H2S - 0 to 1%) (POLPRASERT, 1996). In a 100 year period, 1 gram of methane contributes 21 times more for the formation of the greenhouse effect than 1 gram of carbon dioxide than (UNFCCC, 2007). The complete combustion of methane produces carbon dioxide and water vapor. To produce energy through the garbage coming from landfill biogas according to information from the US Environmental Protection Agency (USEPA, 2005), the World Bank and the Intergovernmental Panel on Climate Change (IPCC) (DA SILVA, 2015).

Legislation and Solid Waste
By the accumulation of waste that Manaus produces today, around 2632.156 t / day, home collection, hospital collection, mechanical removal, manual removal, pruning collect, separate collection and third parts' a more detailed study is necessary to improve quality of life and meet the needs that claims the environment.
Landfills around the world produce about 20 to 60 million tons of methane per year as a direct result of the decomposition of organic waste components (MUYLAERT et al., 2000).
The excess of disposable packaging is another cause to increased waste (FORLIM and Faria, 2002) adding to this, waste of energy and natural resources. Yet as the authors GRIMBERG & Blauth (1998) emphasize, "among the most notorious waste are non-use of solid waste and the almost complete absence of reduction initiatives and waste reduction at the source, the industries". This fact shows the need to change the production model of enterprises, seeking to reduce damage to the environment and

promoting a socially responsible development. There are management tools for this purpose as the Cleaner Production (KIPERSTOK;. Coelho et al, 2003), Evaluation of Product Life Cycle (FORLIM and FARIA, 2002) and Environmental Management Systems (BARBIERI, 2007) that when well implemented, promote the reduction of these impacts.

Oak and Viana (1998) emphasize that talking about sustainable development means talking about balancing the economic, social and environmental dimensions. Law No. 12,305 / 10, establishes the National Policy on Solid Waste (PNRS). It is quite current and it creates means for the present confrontation in the country towards the environment by establishing a shared responsibility of the waste generators: manufacturers, importers, distributors , merchants, citizens and management services to owners of municipal solid waste in the reverse logistics of waste and post-consumer packaging, creating important goals that will contribute to the elimination of the dumps and will institute planning instruments at national, state, regional micro intercity and metropolitan and municipal; Besides requiring that individuals develop their Solid Waste Management Plans.

The main regulations at the municipal level of Manaus citizens are: Organic Law of the Municipality of Manaus, Title II, Article 8 The municipal jurisdiction.. VII, f) publishes cleaning, collection, treatment and disposal of waste. Law n. 605 of July 24, 2001, establishing the Environmental city of Manaus code and give other providences. The state of Amazonas has several other laws that aim to cover the whole environment, along with the State of Amazonas Constitution. The state of Amazonas was the first Brazilian state to enact a law establishing a State Policy on Climate Change, Environmental Conservation and Sustainable Development (Law 3135 of June 5, 2007).

MATERIALS AND METHODS

The survey was conducted by parameters provided by the Manaus Department of Environment and Public Cleaning (SEMULSP) with basic statistical data and survey parameters. Information and interviews with "scavengers" of the city together with cooperatives to which they are linked or not (stand-aloners).

Collection of information from eletrobrás Amazon energy to check the substations to districts and energy supply capacity.

The method used to carry out the research is that for being a great capital of the Amazon forest Manaus still does not have a proper waste sorting system for a population of 1,802,014 inhabitants (IBGE, 2010) and the proper disposal of solid waste is still considered very small for the current over production of "garbage" levels.

Aiming to improve quality of life of the Manaus citizens as well as for its environmental surroundings, it was observed that there is much to do, because the development of the city took place in a lawless and reckless manner, because the destination of the citizens waste go to the water tables, contaminating rivers and springs. Information is sought-from public bodies to catalog information and data for percentage and statistical analysis of waste, along with SEMULSP to check whether it would be feasible to generate energy from methane gas from garbage and if Manaus produced enough gas to generate energy, considering that cities which have promising prospect for large landfills (≥500t / day), then Manaus is within expectations. Subsequent to this, the collection of data by the electric utility in Manaus (Eletrobras Amazonas Energia), to discover their transformers (substations), they were placed in strategic locations to capture and distribution in the neighborhoods that is sectored. It came up that that the dealership does not have sectoral division of the city, and the Manaus Municipal Institute of City Planning (IMPLURB) separates the city by UES (Urban Structuring Units), in each specific neighborhood characteristics housing, environment, road traffic, verticalization, among others.

Today Manaus can generate around 900kW to 1,2MW through the thermoelectric are interconnected electrical substations and distributed to the entire city, however, it is not separated by areas or neighborhoods. So the suggestion of the research is that neighborhoods are separated by substations and generation can be aimed at specific areas, each increase in gas production meets certain neighborhood and thus growing every year. Although the generation is suggested that the city can be divided into 2

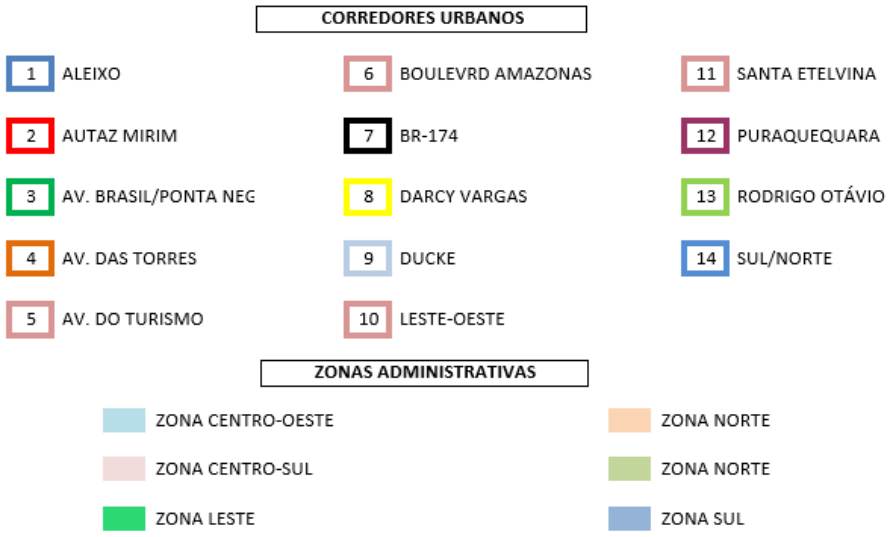
generation sources, ie plants to be installed in the main embankment of the city, km18 AM010, where it used to be the dump of Manaus. It has an area of 750 hectares and so far has expiry date by 2021, the methane gas release is what motivated the generation of study, since the release of the gas has a greater impact on global warming.

All the gas produced in the landfill is monitored by means of suitable pipes that lead to a treatment plant. At the station, the gas is burned at a temperature of 850 degrees Celsius. The same process is done with the manure, which is only water after treatment, which returns to the river beds and from the that period (2021) will no longer be able to receive the waste of the city. Another proposed site was a landfill in the District II area to meet the industries that receive electricity at 69KV. The city seeks to enable an embankment at km 13 of the BR-174 to replace the current one. Of course, that of the new landfill would be a long-term installation, because the main aim is to target the neighborhoods served by smaller substations in the city, with a view to early implementation of the project by the lower capacity the SE tip of Ishmael that has capacity transformation 26,6MVA since Manaus produces 1,303kg / inhabitant.

RESULTS AND DISCUSSIONS

The results are of relevance to the city of Manaus, which seeks sustainability and technological and energy development, can be met by waste that currently generates and what would be this generation installed capacity. According to the cadastral map of the city of Manaus, there is already the main Urban Structuring Units (UES), which can be installed in each corridor, selective collection points which are intended waste for recycling and others can be used for the waste (landfill). Figure 1 shows the UES.

Figure 1 - Urban Corridors



Source: IMPLURB, 2015.

In order to the cooperative and its affiliates do not loose their jobs they would have to be allocated in settled points

Waste recycling cooperatives in Manaus that act specifically in the area of collection of recyclable materials have increased due to the large influx of organic and inorganic materials that have been wasted in an uncontrolled manner causing pollution and harming the environment. Thus these people who make

themselves available for the act of recycling has been working hard with a view to ensuring their income source.

Considered "scavengers", this class of people who make up a small part of society involved in the interest of keeping the importance of recycling every day, is fortifying, and they come every day helping with the city to keep it clean, and get remuneration with this practice. There is still much to work with the intention of making all this demand for waste extracted from the streets and streams before they can be reusable, putting them back on the market in other formats.

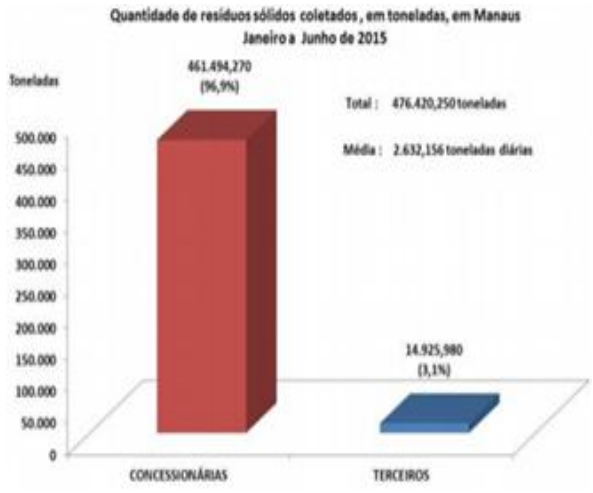
The Cooperativa de Catadores Aliança (CCA) - "Alliance of Waste Pickers Cooperative" today is a major incentive for recycling, as they work directly with the reuse of which is wasted by the population, making it able income and employing many people.

Nowadays Manaus has gained other allies when addressing the issue of sustainability and the environment, therefore to address the recycling still to the state is not something completely normal. The Cooperativa Associação de Reciclagem e Preservação Ambiental (ARPA) - Recycling Association and Environmental Protection Cooperative - recently created with the support of people working in the area of recycling and which are growing with the correct handling and distribution of recyclable materials to the proper order. The importance of these cooperatives has been successful because it has generated opportunities and income for many families.

The field research helped this study statistically foster people's opinions when discussing the theme of sustainability in line with recycling and how it has helped to ensure that their participation contributes to a cleaner city. According to the Environment Ministry's website discerns as selective collection the following meaning: selective collection of waste it is a treatment of waste, which begins at the source segregation or separation of materials is both organic and inorganic, and then with at its disposal and destination.

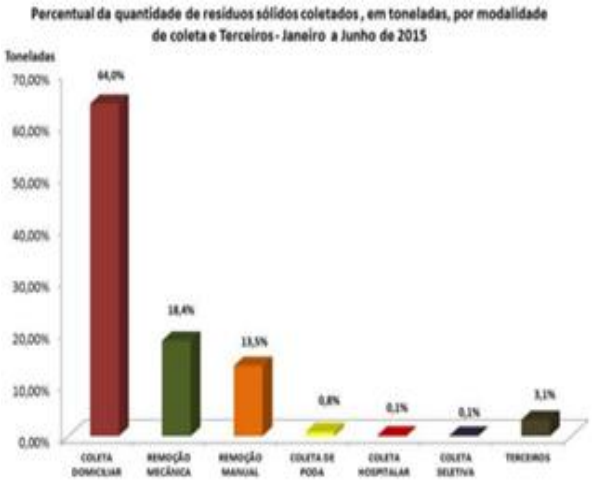
The city of Manaus has the support of the Secretaria Municipal de Limpeza Urbana (SEMULSP) – Municipal Urban Cleaning – and according to the website of SEMULSP it has been operating in Manaus with the concern to maintain the public urban cleaning of Manaus. Among the procedures are home collection, hospital collection, mechanical removal, manual removal, pruning collect, separate collection and thirds' which has a differential because it is the collection of waste from service providers. In addition to these arrangements there are lectures for the people whose concern relay the importance of the environment as well as self education to the collection of refuse and solid waste and how they can be reused.

Figure 2 - Collected waste quantity in tonnes in Manaus.



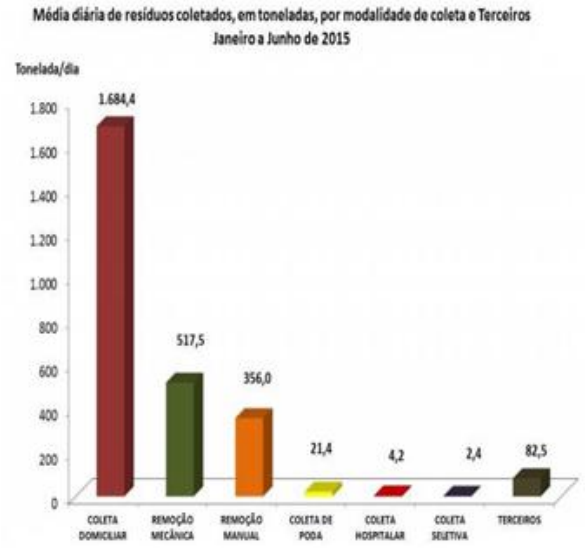
Source: SEMULSP 2015

Figure 3 - Percentage of collected waste in tonnes by type of collection and others'



Source: SEMULSP 2015.

Figure 4 - Average daily solid waste in tonnes by type of collection and others'.



Source: SEMULSP 2015.

After visiting the workplaces of the "pickers" it has benn found an inhuman situation, because the sites are unhealthy and dangerous and do not provide any comfort even for them to have meals.
It can be confirmed by checking the pictures below which polls are not wrong when they say that living the margins of society with many even without documents, but which play a key role for future generations.

Figure 5 - places where solid waste is stored.

Source: Author

After the extraction and collection to be held by people of the cooperatives, the waste will be destinated to the landfill, where there will be the processing and the power generation by combustion, as explained in Figure 7 bellow.

Table 1. Amount of waste in tonnes by garbage collection service in Manaus from Jan to Jun 2015

Modalities	Collected (Tons)	Daily Average (tons/day)	Relative share
Coleta Domiciliar	304.876,750	1.684,402	64,0%
Remoção Mecânica	87.461,500	517,524	18,4%
Remoção Manual	64.431,140	355,973	13,5%
Coleta de Poda	3.738,690	21,364	0,8%
Coleta Hospitalar	628,190	4,245	0,1%
Coleta Seletiva	358,000	2,387	0,1%
Terceiros	14.925,980	82,464	3,1%
Total	476.420,250	2.632,156	100,0%

Source: SEMULSP 2015

Statistics of Garbage Collection

Table 1 presents the data collection of solid waste in Manaus in the first half of 2015 highlighting: During this period, 476,420 tons of solid waste of the city of Manaus has been collected, down 0.5% compared to the 1st. Half of 2014; The daily average in 2015 was 2632 tons, with each citizen producing, on average, 1,303 kg / day of waste; The Household Collection participated with 64.00% of the total garbage collected in the city, an average of 1,684 ton./day with a per capita rate of 834 grams per day of waste collected from households, small industries, trade, banks, schools;

Clean-ups

The city's cleaning-up staff has more than 300 servers divided into teams covering all urban areas of the city. From January to June 2015 the clean-ups treated more than 200 locations in Manaus with a gathering of 87 462 tons of solid waste, with an average rate of 31 tonnes per km and 9,625 tons per hectare.
Table 2 - Cleaning Task Forces held in Manaus with the amount of waste collected over 1000 tonnes from January to June 2015.

Table 2 - Waste collected by districts over a thousand tons.

#	Districts	Tons
1	Alvorada	4.065,9
2	Colônia Antônio Aleixo	3.815,4
3	Compensa	3.633,8
4	Redenção	2.748,8
5	Monte das Oliveiras	2.358,5
6	Santa Etelvina	2.279,3
7	Nova Cidade	2.172,6
8	Japiim	1.869,5
9	Cidade de Deus	1.844,8
10	Rio Piorini	1.418,6
11	Grande Vitoria	1.367,2
12	Jorge Teixeira	1.356,2
13	Zumbi	1.333,3
14	Nova Esperança	1.318,1
15	Novo Reino	1.253,0
16	Joao Paulo	1.220,2
17	Parque das Laranjeiras	1.207,9
18	Tarumã	1.183,5
19	Terra Nova	1.165,5
20	Nossa Senhora de	1.137,8
21	Cidade do Leste	1.090,3
22	São José	1.061,9
23	Conjunto Nova República	1.024,5

Source: SEMULSP 2015.

Streams Cleaning and Streams

This service consists in the collection of solid waste in surface water and the banks of streams and brooks of Manaus.

From January to June 2015, 4,204 tons of solid waste streams and brooks of Manaus have been collected, an average of 23 tons / day, in a run length of 70 km, which corresponds to a rate of approximately 59 tons of waste collected by kilometer. The average cost in this service and R$ 945,532 per month, with the average cost per tonne equal to R$ 1,349.

Environmental Education / Selective Collection

From January to June 2015, the selective collection organized by the Manaus System of Public Cleaning was responsible for the collection of 5,589 tons of recyclable materials. The recyclable material recovery rate reached 1.2%.

Table 3 - Recyclable Materials in the public sanitation system

Source	Amount collected in 2014 (tons)	%
Door to door	**358,0**	**6,4**
Cooperativa aliança	**5.179,1**	**92,66**
Specific Collecting points (schools, etc.)	**52,4**	**0,94**
Total	**5.589,5**	**100**

Source: Author

Assuming that the solution to the garbage problem is very related the population's education, SEMULSP, through the Comissão Especial de Divulgação da Política de Limpeza Pública (CEDOLP) – Public Cleaning Disclosure Special Committee – prioritizes the integration of awareness activities on the Selective Collection as vector to keep environmental and social inclusion. These actions lead information about disposal of solid waste, prioritizing community involvement through schools and guidance teams. The shares have been developed with activities at the Center, under the guidance of the mayor.

An agreement with shop tenants was carried out so that they are responsible for the separation of recyclable waste and subsequent delivery, at strategic points, allowing collectors associations make the collection of the material.

The separate collection at the commercial center in the first six months of 2015 indicated a monthly average of 60 tons of recyclable waste. Two trash points addicted to the city center were extinguished by CEDOLP. One between Guilherme Moreira and Quintino Bocaiuva streets and another at the Getulio Vargas Avenue. Cardboard, paper, plastic, glass and other recyclable waste is separated and taken for recycling cooperatives. The non-recyclable material is collected by appropriate vehicle and taken to the city's landfill.

The outreach team also developed informative work in relation to time and correct disposal of their waste in hard to reach areas such as Rip-Rap's and invasion areas. These are places where the results will be achieved in the medium and long term. From January to June 2015, 966 environmental education actions have been conducted, being sensitized 61,815 people.

Table 4 - Environmental Education Actions and People sensitized in 2015

Month	Actions	Sensitized People
January	176	8.422
February	104	3.300
March	173	3.874
April	30	5.135
May	271	31.970
June	212	9.114
Total	**966**	**61.815**

Source: SEMULSP 2015.

SEMULSP currently supports about 200 waste collectors, distributed in 17 entities (between cores and associations). In accordance with the National Policy on Solid Waste, Manaus City Hall, through SEMULSP has already enabled the rent of 7 sheds to accommodate associations and improve working and living conditions of these professionals.

Evolution of Semulsp Indicators 2013 2015

A special collection system in the commercial center and a partnership with the waste pickers has been implemented. These activities reflect directly in the recycling rate in 2013 it was 0.21% and jumped up to 1.2% in 2014. Recycling in Manaus in the first half of 2015 shows a significant increase of 700% compared to the 2012 rate.

Table 5 - Recycling rate in Manaus - from 2012 to 2015

Year	% Indicator
2012	0,15%
2013	0,21%
2014	1,2%
First semester of 2015	1,2%

Source: SEMULSP 2015.

H*ousehold per capita collection generation*

The household per capita generation in 2015 shows a decrease of 3.9% compared to the rate of 2012, and the increase of the recycling rate in Manaus occurred from 2014, one of the major causes for the explanation of the desirable behavior in production household waste per inhabitant in Manaus.

Table 6 - home collection per capita, in kg / inhabitant / day in Manaus - from 2012 to 2015

YEAR	Inhabitant KG/Day rate
2012	0,868
2013	0,838
2014	0,860
1° semestre de 2015	0,834

Source: SEMULSP 2015.

Per capita general collection generation

The general waste collection of Manaus when compared to the population of Manaus in 2015 shows a decrease of 7.0% compared to the per capita rate of 2012, and this decline was motivated primarily by the increase of the recycling rate in Manaus which occurred from 2014.

Table 7 - General collection per capita solid waste in kg / inhabitant /day in Manaus - from 2012 to 2015

Year	Inhabitant KG/Day rate
2012	1,401
2013	1,310
2014	1.315
First semester of 2015	1,303

Source: SEMULSP 2015.

KM collection in manaus streams

Tons of waste collected in streams per kilometer in 2015 shows a decrease of 7.9% compared to 2013, with the decline driven by increased recycling rate in Manaus and concurrently by the growth of activity and audience reached by training and sensitization of environmental education.

Table 8 - Waste Density collected in t / km, the cleaning of streams of Manaus – 2012-2015

Year	Waste density tons/Km
2012	-
2013	68,1
2014	63,3
1°semestre de 2015	62,7

Source: SEMULSP 2015.

Environmental education

Data for daily amounts of activity and audience reached by training and sensitization for the promotion of environmental education showed that in the first half of 2015 it increased by 35% in the average monthly number of environmental education in relation to the prior year. When compared to 2013, the advancement of this average was 137%. There has also been the growth in the average number per month sensitized people rising from 4540 in 2013 to an audience of 10,303 in 2015, which equals an increase of 127%.

Costs

The budget of SEMULSP for the year 2015 was of R$ 245,301,000.00, representing 5.5% of the budget of the city of Manaus (R$ 4,485,516,000.00).

The budgetary actions Maintenance of the collection and disposal of waste represent 61% of the total budget of SEMULSP in 2015.

The cost of collection and final disposal of waste in the period from January to June 2015 reached the mark of R$ 91,067,297.94.

Table 9 - Statistics on activities of Environmental Education in Manaus -from 2012 to 2015

Year	Monthly activities average	Monthly sensitized people average
2012	-	-
2013	68	4.540
2014	112	12,242
First semester of 2015	161	10.303

Source: SEMULSP 2015.

Table 10 - % incidence of the budget of SEMULSP and per capita expenditure on collection and Final Waste disposal

Year	Initial budget allocation		Relative share	Spendings on collection and final waste disposal	Manaus polpulation IBGE (inhab.)	Per capita monthly expendidure(R$/inhab.)
	SEMULSP	City Hall				
2013	217.388.000,00	3.473.000.000,00	6,26%	160.370.046,05	1.982.179	6,74
2014	234.812.000,00	4.058.639.000,00	5,79%	177.537.556,32	2.020.301	7,32
Jan to Jul 2015	245.301.000,00	4.485.516.000,00	5,47%	91.067.297,94	2.020.301	7,51

Source: SEMULSP 2015

Technical Fundamentals and Energy Relevance

Atmospheric concentrations of greenhouse gases considered in the Kyoto Protocol (especially CO2) are increasing continuously due to increasing use of fossil fuels (oil, coal, natural gas) and changes in the pattern of land use (agriculture, urbanization, deforestation). Energy use is responsible for more than two-thirds of greenhouse gas emissions.

According to studies of the Departamento Técnico e Econômico da Associação Brasileira de Importadores de Produtos de Iluminação (ABILUMI) - Technical and Economic Department of the Brazilian Lighting Products Importers Association - at least 90% of the energy used by incandescent light bulbs is lost as heat, ie incandescents have low energy efficiency because they convert less electrical energy into visible light. A calculation of potential savings made in the USA with the replacement of incandescent bulbs with CFLs would reduce the country's costs with electricity at $ 18 billion per year, considering an installed base of 4 billion incandescent in use.

This amount would make it unnecessary about 80 thermoelectric power plants fueled by coal and thus would reduce emissions of gases that cause the greenhouse effect of about 158 million tons per year.

Subdivision of Distribution

Manaus has the capacity to generate around 1.5 million megawatts of power / hour. Upon the completion of the third plant in the Mauá Power Plant, it will generate 600 megawatts of power / hour for three turbines in all its installed thermoelectric and will still receive the transmission line that is connected to Brazil. This ability to generate energy without harming the environment is because its fuel is derived from natural gas from Urucu.

The restructuring of the Brazilian electric sector began in 1995 with the enactment of Law no. 9,074 of 7 July 1995, which established standards for granting and extension of concessions and permissions of public services and in particular the creation of a new agent into the national energy matrix, the Produtor Independente de Energia Elétrica (PIE) - Independent Producer of Electric Energy - being the object of this research in Manaus.

This is a variable that can help reduce the environmental damages, mainly related to the emission of air pollutants. Examples are the thermal natural gas utilities which significantly reduced the release of pollutants into the atmosphere. With the data provided, we would consider types of landfills: non-hazardous industrial, residential and commercial, with a capacity that Manaus has to produce 2,632 t / day x 360 = 947.520t / year.

For example: 3 motor generators with a nominal capacity of 1 MW each = 3MW.
Biogas consumption: 550 m3 / hour for generating (50% CH4).
Considering power installed per household: 5MW 10,000 = 500 W / residence.
Compliance with electricity: 6000 residences.

Outlook

A power plant will consist basically of a capture system, purification and use of biogas in stationary engines and gas turbines that generate electricity.

The landfill of São Paulo receives 12,000 t / day of waste and generates 48 MW of electricity. Manaus with a daily production of 2632t / day may generate 10,5MW. Considering the loads in homes could meet 18 thousand homes.

Considering a stationary engine example stationary motor for use of biogas and electricity generation (*) Source: Waukesha Supplier - Dresser. Obs .: Birmingham Landfill (England).

(*) Engine consumes 60.6 m3 / h of biogas and generates 1MW of electricity.

Table 11 - Substations in the city of Manaus

SUBSTATIONS		
Name	**Neighborhood**	**Pot. (MVA)**
Aparecida	Aparecida - Centro - Gloria - Santo Antônio - São Raimundo	106,4
Cachoeira Grande	Aleixo - Amazonino Mendes - Cidade Nova - Coroado - Flores - Novo Aleixo - Parque Dez - Parque das Laranjeiras - São Jose	120
Cachoeirinha	Betânia - Cachoeirinha - Centro - Col. Oliveira Machado - Educandos - Morro Da Liberdade - Petrópolis - Praça 14 - Raiz - Santa Luzia - São Francisco	79,8
Cidade Nova	Amazonino Mendes - Cidade Nova - Col. Santo Antônio - Col. Terra Nova - Flores - Monte Sinai - Nova Cidade - Novo Israel - N.S. Fatima - Riacho Doce	106,4
Compensa	Compensa - Presidente Vargas - Santo Agostinho - Santo Antônio - São Jorge - São Raimundo - Vila da Prata	80
Distrito Dois	Armando Mendes - Coroado - Distrito Industrial - Puraquequara - São Jose - Zumbi	106,4

SE Distrito Industrial	Distrito Industrial - Japiim - Mauazinho - Petrópolis - Raiz - Vila Buriti	106,4
Presidente Figueiredo	Presidente Figueiredo	15
Flores	Adrianópolis - Alvorada - Alvorada I - Bairro da Paz - Chapada - Cidade Nova - Cj. Kissia - D. Pedro I - Flores - N.S. Das Graças - Parque Dez - Parque das Laranjeiras - São Jorge – União	106,4
Iranduba	Iranduba	39,9
SE Jaraqui	Lago Azul - Novo Israel - Rural - Santa Etelvina – Tarumã	53,2
Marapatá	Betânia - Cachoeirinha - Col. Oliveira Machado - Crespo - Distrito Industrial - Japiim - Morro da Liberdade - Petrópolis - Raiz - São Lazaro	53,2
Mauá	Col. Antônio Aleixo - Distrito Industrial - Mauazinho - São Jose	53,2
Mutirão	Amazonino Mendes - Brasileirinho - Cidade de Deus - Cidade Nova - Joao Paulo II - Jorge Teixeira - Novo Aleixo - N.S. de Fatima - N.S. Fatima - Rural	120
SE Ponta do Ismael	Compensa - Santo Agostinho	26,6
Ponta Negra	Alvorada I - Alvorada II - Alvorada III - Compensa - D. Pedro I - D. Pedro II - Distrito Industrial - Lírio do Vale - Nova Esperança - Planalto - Ponta Negra - Santo Agostinho - São Jorge – Tarumã	106,4
Redenção	Alvorada - Alvorada I - Alvorada II - Alvorada III - Bairro da Paz - Cj. Ajuricaba - Cj. Juruá - Col. Santo Antônio - Flores - Planalto - Redenção - Santa Etelvina - Tarumã	79,8
Santa Etelvina I e II	Cidade Nova - Col. Terra Nova - Monte das Oliveiras - Nova Cidade - Novo Israel - Santa Etelvina – Rural	56,6
Santo Antônio	Cidade Nova - Col. Santo Antônio - Col. Terra Nova - Flores - Monte das Oliveiras - Novo Israel – Tarumã	106,4
São José	Amazonino Mendes - Cidade Nova - Jorge Teixeira - Nova Vitoria - Novo Aleixo - São Jose - Tancredo Neves – Zumbi	79,8
Seringal Mirim	Adrianópolis - Aleixo - Cachoeirinha - Centro - Chapada - N.S. das Graças - Praça 14 - Presidente Vargas - São Francisco - São Geraldo - São Jorge	106,4
V-Oito	Adrianópolis - Aleixo - Coroado - Japiim - Parque Dez - Petrópolis	79,8
	TOTAL	**1788,1**

Source: Eletrobrás, 2015.

The city of Manaus has a total energy processing capacity for use in UC's (Consumer Units) home and small ones a total of 1788,10MVA. (Eletrobrás).

CONCLUSION

The investments of public bodies for orderly improvement and growth of the city of Manaus should follow in line with the Urban Master Plan as the research all the agencies are doing what suits them rather than for the growth with structuring and development. The neighborhoods are not organized with recyclable capitation and its allocation in the immediate area as urban corridors are properly informed by the cadastral map. The collections are made randomly to the neighborhood that labeled as more "organized" and easily accessible. Above all, the power utility does not feed the neighborhoods in an orderly fashion by neighborhood but also by random sectors.

By implementing the suggested improvements the city of Manaus should have another vision for the future, aiming at quality of life and the environment in which it is established, organizing its generation and serving all users, whether consciously and usefully to the environment and all those who live and profit because of the forest.

Therefore, it is feasible from biogas which is removed from the waste through combustion, where it will be burned and will result in mechanical energy that activates the pistons and after this movement it is transformed into electrical energy.

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