

Expert mission on integrated solid waste management in Bolivia



Market survey for RVO

Confidential

May 22th, 2015

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1. Summary - Resumen



This report describes the results of a market survey to Bolivia in March 2015. The objective was to scout opportunities for Dutch suppliers of products and services in waste management and biomass. The survey was financed by the Dutch government through RVO, the Netherlands Enterprise Agency. Results may lead to a trade mission on waste management and biomass to Bolivia later this year.

The market survey was performed by preparative works on existing literature and data followed by two weeks of field visits and interviews in Bolivia. Most activities focused on municipal waste in Bolivia's backbone formed by the four biggest cities: Santa Cruz, La Paz, El Alto and Cochabamba. Additional interest was on mining waste and agricultural waste/biomass.

The most important results are:

- If a development can be described as an S (sigmoid) curve, Bolivia's waste market is most likely to be at the start of a period of exponential growth.
- Awareness, attitude, policies and programs are (almost) ready. Financing and organization are lagging behind but in preparation.
- Bolivia could very much benefit from Dutch know-how to accelerate and improve the development of its soft infrastructure of legal systems, public cooperation, governance and multi-annual programming.
- Investments are prepared for upscaling and improving the fleet of collection and transport vehicles and for large scale implementation of a public infrastructure of proper landfill sites and recycling facilities for separation, composting etc.
- Suppliers of containers, collection equipment and vehicles, liners, landfill-gas and leachate collection systems, water and gas treatment systems, separation and sorting equipment etc. will find a vivid market with eager players and a fairly good information infrastructure. Drawbacks include low energy prices, low waste tariffs and the risk of corruption.
- Additional opportunities are present in relation to household electronics, spent tires and hospital waste treatment.
- Challenging but uncertain opportunities can be found in the fields of biomass, industrial waste, construction and demolition waste and mining waste.

Alongside with the market survey, a LinkedIn group was set up as an exchange platform for Dutch and Bolivian enterprises, institutions and individuals interested in business and cooperation. The response to this initiative has been most encouraging. All in all, the mission and the interaction with stakeholders on both sides of the ocean results in a positive recommendation with regard to organizing a trade mission in October-November of this year.



Este informe presenta los resultados de un estudio de mercado en Bolivia en 2015. El objetivo fue explorar oportunidades para proveedores Holandeses de productos y servicios en gestión de residuos y biomasa residual. El estudio fue financiado por la Agencia Holandesa para el Empresarialismo RVO. Como seguimiento, posiblemente en el segundo semestre de 2015 se organizará una misión de negocios a Bolivia.

El proyecto inició con el estudio de literatura e información existente, seguido por dos semanas de entrevistas y visitas de campo en Bolivia. La mayoría de las actividades enfocó en el eje troncal de

Bolivia compuesto de las ciudades La Paz / El Alto, Cochabamba y Santa Cruz. Había un enfoque adicional en los residuos mineros y los residuos agrícolas / la biomasa residual. Los resultados más importantes son:

- Si se describe el proceso de desarrollo en una curva "S" (sigmoideal), es más probable que el mercado de residuos de Bolivia se encuentra al inicio de un crecimiento exponencial.
- La consciencia, la actitud, las políticas y los programas (casi) están listos. Faltan todavía la organización y el financiamiento pero existen avances en estos campos también.
- Bolivia podría aprovechar de los conocimientos Holandeses para mejorar su infraestructura de sistemas legales, cooperación pública, gobernabilidad y programación a mediano plazo.
- Se está trabajando en el mejoramiento y la ampliación de la flota de vehículos de recolección y transporte así como en el desarrollo de rellenos sanitarios e instalaciones de aprovechamiento de residuos (incluso separación y compostaje) a una escala más grande.
- Los proveedores de contenedores, equipos y vehículos de recolección, sellos, sistemas de biogás y de tratamiento de lixiviados, sistemas de tratamiento de agua y gas, equipos de separación y de sorteo etc. encontrarán un mercado vívido con actores interesados y una infraestructura de información relativamente bien establecida. Barreras incluyen los costos reducidos de energía, bajas tarifas de aseo y el riesgo de corrupción.
- Existen oportunidades adicionales en equipos electrónicos domiciliarios, neumáticos usados y el tratamiento de residuos hospitalarios.
- Existen oportunidades prometedoras pero inseguras en biomasa, residuos industriales, RCD y residuos mineros.

Paralelamente al estudio de mercado se creó un Grupo LinkedIn como plataforma de intercambio entre actores Bolivianos y Holandeses en residuos y biomasa. El interés en los dos lados del océano en participar en este grupo ha sido muy alentador. Los resultados del estudio de mercado junto con la respuesta de los grupos de interés llevan a la recomendación de organizar una misión de negocios a Bolivia en octubre o noviembre de este año.

BreAd BV

BreAd BV provides international consultancy on waste management, water treatment and site remediation. Services comprise development and implementation of waste collection and treatment, market research, business development, project management and connecting companies to markets, projects and partners. BreAd supports governments, cities, institutions and companies worldwide.

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MetaSus

MetaSus acts as a broker between European clean technology providers and their clients anywhere in the world. Typical services include company and sector profiling, the development of integrated sustainability concepts, market surveys, support to business missions and matchmaking activities. MetaSus works both for private companies and public sector institutions, focusing on English and Spanish speaking markets.

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2. Introduction

This market survey on waste management and residual biomass in Bolivia was compiled by MétaSus and BreAd B.V. at the request of the Netherlands Enterprise Agency (RVO). The strategy and approach were coordinated with Mr. Herman Huisman of Rijkswaterstaat Leefomgeving. The report is based on an exploratory mission to La Paz/El Alto, Cochabamba and Santa Cruz in the period 9-20 March 2015, plus additional research ahead and after the mission. The project was carried out in close cooperation with the Bolivian Ministry of Environment and Water, the Dutch Embassy in Peru and the Dutch network of representatives in Bolivia.

The market survey is meant for Dutch and Bolivian private and public sector suppliers of products, services and expertise in waste management and residual biomass. It will be circulated only within this audience.

For up to date information on business opportunities and direct Dutch-Bolivian contact on waste management and residual biomass, users of this report are invited to join the LinkedIn group on this subject by using <http://tiny.cc/bolivia>.

The authors of this report wish to express their sincere gratitude to all the people who were willing to share their knowledge and experience with us during our mission to Bolivia.

3. Brief profile of Bolivia

3.1 Overview

The Republic Bolivia is a land locked country in the center of South America, bordered by Peru, Brazil, Paraguay, Argentina and Chili. It has a surface area of almost 1,1 million km², 10% bigger than Western Europe. With a population of a mere 11 million, the country is sparsely inhabited. The main ethnic groups are 62% indigenous people, 27% mestizo and 8% of European origin. Spanish is the official

language, same as the main indigenous languages Aymara and Quechua (plus 34 additional languages).



Geographically Bolivia is very diverse. The west of the country is part of the Andes mountain range. The highest peak is the Nevado Sajama measuring 6.542 meters. The main cities La Paz and neighboring El Alto are part of the so called “altiplano” at an altitude of approximately 4.000 meters. In contrast, the east of Bolivia is low lying country, bordering the Amazon rainforest in Brazil.

Bolivia is subdivided into nine “departments” and 338 municipalities. The departments are depicted in the table below.

Picture 1. Political map of Bolivia

Department	# of inhabitants	Capital City
Beni	421.196	Trinidad
Chuquisaca	576.153	Sucre
Cochabamba	1.758.143	Cochabamba
La Paz	2.706.351	La Paz
Oruro	494.178	Oruro
Pando	110.436	Cobija
Potosí	823.517	Potosí
Santa Cruz	2.655.084	Santa Cruz de la Sierra
Tarija	482.196	Tarija
Total	10.027.254	

This market survey focuses on the so called “*eje troncal*”; the demographic and economic backbone of Bolivia made up of La Paz/El Alto (twin cities, both with close to 1 million inhabitants), Cochabamba (about 600.000) and Santa Cruz (1,5 million). For waste management in Bolivia, these cities are the ones to focus on because of their size, presence of key organizations, ease of access and stage of development. In the case of mining waste, the focus should be on the Andean Departments of Chuquisaca, Oruro, Potosí, Tarija and La Paz.

Table 1. Bolivian departments, inhabitants (2012) and capital cities

Projects in residual biomass so far have mainly focused on energy generation in remote locations, so the focus in this respect is on rural areas.

3.2 Bolivia in a global perspective

Bolivia is a developing country with all the challenges and opportunities one can expect. Bolivia's big plus is of course its language, which makes it accessible for foreigners, and its central position in a 300 million inhabitants market. But what else needs to be mentioned?

The world's countries can be ranked in relation to many factors. A selection of some relevant aspects, when considering trade with or investments in Bolivia, are discussed below.

Per capita income

Maybe the most relevant indicator is the Gross National Income per Capita which is estimated by the Worldbank to be \$2.250 per year. This income places Bolivia on position 136, which represents the average of the group of lower-middle-income countries close to countries like Morocco, India and Nigeria. (World Bank, april 2014)

GDP growth

Growth in gross domestic product has been strong in Bolivia showing an average annual rise of 5,3% over the period 2010-2013. This places the country amongst the 30 fastest growing countries in the world. (World Bank, 2014)

Trade freedom

Bolivia's freedom in regard to international trade is regarded to be on an average level with a score of 76. (Heritage Foundation, 2014)

Corruption

The corruption perception index places Bolivia on rank 103 with a score of 35, not far from China, Mexico and Panama. The total number of countries that are ranked are 175. (Transparency International, 2014)

Education

Bolivia ranks 78 at the UNDP Education index, just above the United Arab Emirates, Malaysia and Andorra. (UNDP Human Development report, 2014)

Stability

The Fragile States Index lists almost all countries in the world in regard to aspects like the strength and effectiveness of its central government, the provision of public services and refugee-topics. It places Bolivia on position 70 of a total assessed group of 178. Bolivia scores better than, for example, China and Colombia and is in the same range as most Latin-American countries. (Fund for Peace, 2014)

In general it can be stated that Bolivia's earnings are as yet low but growing at good speed. All other indicators show an average position when compared to other countries in the world.

4. Laws and regulations on waste management

Currently, there are no specific laws on waste management in Bolivia. The legal context comes from a number of laws and regulations which only partly deal with this subject. A concise overview of this framework:

- The *National Constitution* from 2009 hands (in general) the responsibility for environmental policies and regulations to the national government and the 9 regional departments. The 338 municipalities are to implement these policies, to operate all city cleaning and collection services and to perform the collection of necessary fees and taxes.
- In 2010 the “*Law Andrés Bóñez*” implemented a system of decentralization and of autonomy for the departments and municipalities. It confirmed the strong role of the departments and municipalities in many fields, including waste management, and reduced the role of the national government to only initiate and promote waste policies at the regional and local levels.
- Another law of 2010, called the “*Law of Mother Earth*”, assigned rights to the earth itself; one of them is being safeguarded from contaminations inflicted by human activities. It is not clear whether or not this law has only symbolic value.
- The *Law of the municipalities* is maybe more practical in a sense that it assigns the role of urban planning to the municipalities and obliges them to designate specific areas to specific functions, one of them being to house landfill sites.
- One of the older laws is the *Environmental Law 1333* of 1992 comprising a wide range of regulations. The regulations are on handling/treatment of hazardous waste and hospital waste s well as the operation of industrial, mining and oil/gas installations. In addition it contains several directives on terms, definitions, threshold concentrations, design guidelines for waste facilities and quality systems. The law also establishes a list of waste categories as presented in annex 4.

A milestone event was the creation in 2009 of the General Directorate of Integrated Solid Waste Management (DGGIRS) as part of the Ministry of Environment and Water. Since its creation, DGGIRS has played a central role in waste management in Bolivia, starting out with a national and departmental diagnosis of the waste situation in the country. In 2011 and 2012 a set of 6 guías (manuals) was issued dealing with designing and operation of landfills and composting facilities, closure of old dumpsites, environmental education, setting up of municipal waste management programs and performing impact analysis.

Environmental licensing is well regulated in Bolivia. According to Article 25 of the Environmental Law 1333, all public and private projects have to determine whether they need to carry out an Environmental Impact Assessment. There are four categories:

1. A full EIA is required
2. A specific EIA is required (this takes less time)
3. Instead of an EIA, the project is reviewed conceptually
4. No EIA is required

For example: a non-metallic waste recycling project with an installed capacity of over 400 KVA needs a full or a specific EIA; a 200-399 KVA project will be reviewed conceptually and a project below 200 KVA will not need an EIA. The Municipal Environmental Authority confirms the category and the final approval of the EIA is the responsibility of the Departmental Environmental Authority. After the license has been issued, the follow-up monitoring is the responsibility of the Municipality.

Some remarks on this legal situation:

- The integration of the “scattered” situation, described above, calls for integration. Already in 2007 preparations started for a new Law on solid waste including all regulations concerning waste handling and treatment and tariffs and taxes related to these services. Now, 8 years later, this law is still “under construction” due to discussions on assignment of competencies. The new Law on Solid Waste will serve as a framework for specific rules on hazardous and special wastes, recycling, planning, information etc. Producers of waste and regulating agencies will have to make investments in improved waste processing and authorities at all three levels of government (national, departmental and municipal) have to contract qualified staff. The last version is now awaiting definitive approbation later this year.
- There is no formal set of waste policy principles for example dealing with the waste hierarchy or the polluter-pays-concept.
- There is no attention for industrial waste (not being similar to household waste). This type of waste does not fit in the legal categories mentioned above and landfill sites are not allowed to accept it. It results in a “policy blind spot” leaving industrial companies without (legal) options to deal, with their waste.

5. The present waste profile of Bolivia

Bolivia's interest on waste management is primarily focused on municipal waste including household waste, waste from city cleaning and similar commercial waste. A few special types like hospital waste, spent car tires and batteries, draw some attention as well because of their infectious, voluminous or public character. Most other waste categories draw only marginal interest.

The next chapters will deal with all of these categories, summarizing their present productions, treatment and fate as much as possible. The information is mostly derived from diagnostic reports (nationwide and per department) produced in 2010-2012 and listed in annex 1, and from the interviews held in march 2015 as summarized in annexes 2, 3 and 4.

5.1 Municipal waste

Production

In 2010 the 9 departments of Bolivia produced an annual 1,75 mln tons of municipal waste, corresponding with a per capita production of 0,46 kgs/day. From 2010 to 2015 the population has grown to almost 11,5 mln inhabitants with an estimated production of 0,48 kgs/capita.day resulting in 2 mln tons of municipal waste per year at this moment.

Some 85% of this production actually comes from households. The rest is coming from city cleaning, schools, offices, markets and the commercial sector.

85% of Bolivia's waste is produced by 66% of its population living in urban area's.

2010	# inhabitants	production per day (tons)	production per year (tons)
Santa Cruz	1.624.885	1.044	381.000
La Paz/El Alto	1.790.016	1.049	382.000
Cochabamba	617.976	370	135.000
% of country	39%	52%	52%



The “Eje Troncal”, formed by the cities of La Paz/El Alto, Santa Cruz and Cochabamba, are the main providers with production volumes as described alongside.

Table 2. Waste productions in Bolivia's “big four”

The concentration of waste production, within a small area of the country, makes this backbone of Bolivia a promising market for companies considering entering the country. The region provides critical mass, purchasing power, adequate service-levels and a good city infrastructure.

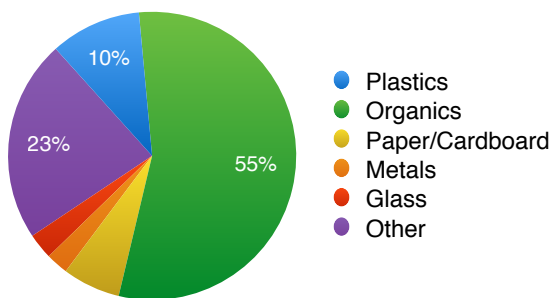


Figure 1. Contents of Bolivia's municipal waste

The average composition of Bolivia's municipal waste is presented below. The pie chart of figure 1 shows a large content of organic material, providing good potential for treatment by composting or digestion.

Looking at individual cities, this composition shows some variations depending on the climatic region, level of urbanization and per capita income.

Collection

Waste collection in Bolivia shows coverages of around 80% in the major cities and around 50% in minor cities. Most of the waste is collected from households. Some 20% is collected at public areas, markets etc. as presented in figure 2.

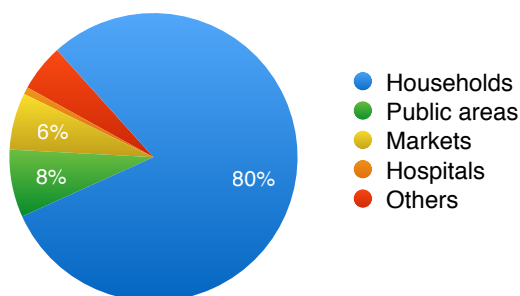


Figure 2. Source of Bolivia's municipal waste

The waste services are the responsibility of the municipalities. The services are deployed in several ways. Most of the smaller municipalities tend to do the work themselves with their own employees and vehicles. Sometimes this work is sourced out to private companies.

The larger municipalities have set up their own, decentralized and autonomous, municipal enterprises who, in turn, can do the work themselves or source it out to private providers. The situation in the most important cities is described in chapter 6.

The vehicle fleet of Bolivia shows quantitative and qualitative shortcomings. A diagnostic survey of 2010 showed a number of only 514 vehicles in 183 municipalities, with most of them being in urgent need of replacement. Since then, the situation seems to have improved somewhat due to tendering of new collection contracts on the market. Companies acquiring for municipal contracts in this field, are obliged to mobilize new vehicles to support of their services. Second hand equipment is not allowed to play a role in municipal contracting.

Collection is performed in many ways. Most prominent are door-to-door and corner-to-corner collection by compaction trucks. Important alternative modalities consist of collection by open trucks and tractors and collection through a network of containers. Source separated collection is starting up in several cities, for example in

Cochabamba where Emsa trucks separately collect organics, some recyclables and residual waste.

Although this expert mission did not aim at reaching in-depth insight in the market of collection vehicles, the following observations may be relevant to the Dutch sector:

- All global suppliers of trucks and spare-parts appear to be present in Bolivia and predominantly in Santa Cruz.
- Collection trucks spotted in the cities, visited on this mission, were: Volkswagen, Mercedes, Iveco, Sinotruck, Volvo, Toyosa/Hino, Nissan en Hyundai
- The mounted collection systems, that were spotted, came from Randon (Brazil), OMB (Italy), Planalto (Brazil) and from many Asian manufacturers.
- European brands in general, are in high esteem in Bolivia. The higher price level may be an obstacle.
- Purchasing of collection vehicles is mostly done by private companies after being awarded collection contracts.

In general the waste market in Bolivia seems to be at the threshold of a period with new investments. New initiatives and good intentions are all around but there's a lot to be optimized. Some examples in relation to the collection sector:

- Although the cities are large and densely populated and the landfill sites are at some distance outside the urban areas, there is no network of transfer stations. All collection vehicles have to drive long distances through heavy traffic.
- Cities are autonomous and, in general, do not work together in matters such as joint tender procedures, maintenance etc.
- In general, collection frequency is high (2 to 4 times a week) leading to high costs.
- Alternating collection routes for organics and residual waste are not present. Combined collection of source separated waste in a single truck seems to be suboptimal.

Treatment

The prevailing method of waste treatment in Bolivia is dumping or landfilling. The country distinguishes three levels of landfilling:

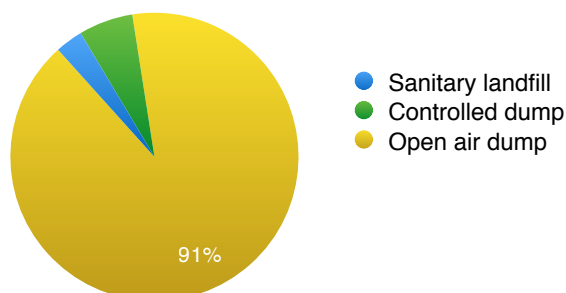


Figure 3. Dump- and landfill-sites in Bolivia

- Open air dumping without any form of control, fencing, leachate drainage, gas control etc.
- Controlled dumping with some control of incoming waste, minor facilities for catchment of leachate and gas. No compaction of waste.
- Sanitary landfill with a modern and adequate set of facilities.



IVECO truck at Alpacoma landfill, La Paz



Howo Sinotruk at Alpacoma Landfill, La Paz



IVECO compactor truck in Cochabamba



Volkswagen truck in Cochabamba



Source separated collection vehicle, Cochabamba



Same vehicle, backside (Hino)



Sinotruk, Santa Cruz



Foton compactor truck, Santa Cruz

Picture 2. Examples of garbage trucks in Bolivia

In 2010, 183 Bolivian municipalities were assessed in order to obtain an overview on how their sites should be qualified. It turned out that 97% of these municipalities operated dumpsites with no or only a few facilities to protect the environment.

When extrapolating to a national scale this percentage may even be higher because of a bias in the assessment towards larger cities. On the other hand, these percentages only represent the number of landfill sites involved. When related to volume of waste on these sites it turns out that at least 50% of Bolivia's municipal waste is treated at sanitary landfills.

The total number of operated dumpsites in Bolivia is not available but it must be well above 500 taking into account that there are 338 municipalities and that most of these municipalities may be expected to have several places to get rid of their waste. The dumpsites form a serious threat to human health as they are open for direct contact with people living around them and water and leachate is running off to rivers and groundwater. In 2010 only 10-15 sites could be classified as sanitary landfills. The last 5 years have shown a growth of 13 new landfills. During visits to the most important ones in La Paz (Alpacoma), Cochabamba (K'ara k'ara) and Santa Cruz (Normandia), some relevant observations could be made:

- Landfills are predominantly constructed as a collection of separate compartments. Combining these separate cells into one joint and interconnected landfill-body, with much more capacity and stability, is not common.
- The landfills are provided with HDPE bottom liners applied, if locally available, on a prepared clay layer.
- Leachate drainage systems are placed directly above these liners and are covered with locally available sand and gravel.
- Vertical landfill-gas chimneys are constructed with coarse gravel and/or PE-tubes, following the building-up of the landfill-body. Gas is flared and burned at all individual chimneys.
- Compacting and covering is performed by compactors and/or bulldozers.
- Top covering is performed by HDPE liners and/or locally available clay.
- Leachate is stored and treated in HDPE-lined ponds. Treatment is carried out off-site (Normandia, see box 1) or on-site by combinations of anaerobic, aerobic and physicochemical methods. Resulting effluents are used in local irrigation.
- Recirculation and infiltration of leachate in the landfill-body is not widely used despite favorable climatic conditions (little rain, high temperature and often low humidity). Landfill operators are afraid of instability of the landfill-body although the waste contains a high percentage of "reinforcing" materials like plastics.
- Separate cells are operated to accommodate the reception, quick lime treatment and covering of hospital waste.
- Most landfills also accommodate the reception, storage and/or treatment of spent tires and batteries and have facilities for composting organic waste and separation of plastics.
- Most landfills have extended opening hours or even (expensive) 24 hours services to accommodate nocturnal collection routes due to the absence of transfer stations with adequate storage capacities.



Reception building at Alpacom, La Paz



Overview of tipping zone at Alpacom



Medical waste handling at Alpacom



Aeration of leachate, Alpacom



Flaring of biogas, K'ara K'ara, Cochabamba



Construction of new cell, Cochabamba



Plastics separation, K'ara K'ara, Cochabamba



Road block, Normandía, Santa Cruz

Picture 3. Impressions of landfill sites in Bolivia

A general problem in Bolivia is the lacking ability (or reluctance) of authorities to enforce laws on urban planning and environmental protection at the public level. In the case of landfills the municipalities fail to prevent or remove illegal housing within the 1 km zone around the sites. After some time these new neighbors start protesting against the operation of the landfill site. Road blocking is widely used as a method of protest and it is also frequently used in the case of landfill sites. The downside of these protest is disruption of the waste collection system. The upside may be an accelerated awareness of the importance of professional operations and reduced landfill use.

EMACRUZ Santa Cruz is looking for a leachate treatment plant

The Normandía landfill site in the outskirts of Santa Cruz receives 1.500 tons of municipal waste a day. The Brazilian company VEGA/SOLVI operates the landfill whereas the municipal agency EMACRUZ is in charge of the landfill's infrastructure. EMACRUZ currently transports over 40.000 m³ of leachate a year to a municipal water treatment plant 23 kms away at US\$ 9,50/m³ (transport and treatment), adding up to a total cost of US\$ 380.000 a year. The company plans to install an on-site treatment plant capable of removing heavy metals, organics and salts from the leachate, so the water can be used for on-site irrigation. Leachate yields vary between 300 and 1.000 m³/day, depending on the season. EMACRUZ eagerly awaits technology offers from the Netherlands to solve the leachate situation. Contact person at EMACRUZ is Mr. José Alberto Rendón Crespo, Tel. +591 76662425, email: jrendon@emacruz.com.bo.

Box 1. Santa Cruz is looking for a leachate treatment plant

Bolivia is indeed trying to get away from dumping and landfilling of municipal waste. Numerous small initiatives and pilots are filling a pipeline of future investments. Most of these initiatives focus on small scale open air composting of organic waste from households and municipal services. Volumes at this stage are still negligible and stay well below the normal capacities we see in Europe. The same holds for separation and sorting of mixed, or source separated, household waste and mixed plastics. This small scale and “scattered” approach may seriously inhibit the development of Bolivia’s waste management towards a normal and accepted industrial activity. It seems to be caused by a general reluctance towards cooperation between municipalities as a result of their cherished autonomy. The figure alongside clearly illustrates the problem. In general it can be stated that there is no viable or sustainable way to own and operate a sanitary landfill at less than 100.000 tons/year

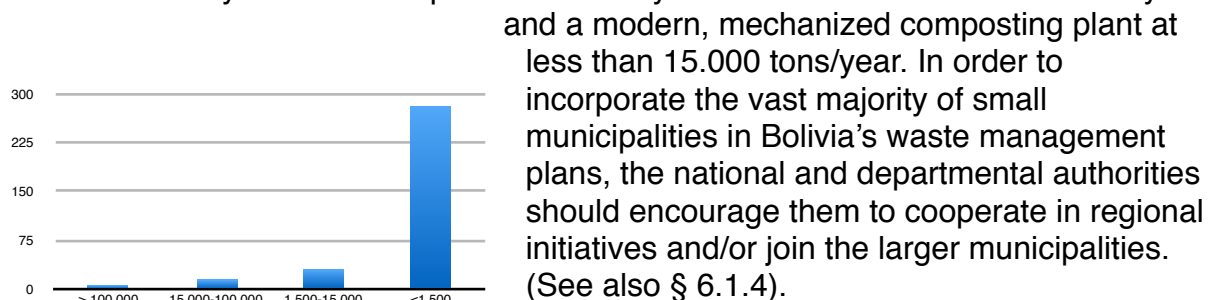


Figure 4. Distribution of municipalities in relation to their waste

In general the visited sites showed to be well equipped, showcasing Bolivia is ready for large investments in this field. On the other hand it can be concluded that the country is still lacking solid experience. Most operations seem to build on knowledge provided by the national handbooks [Annex 1] and by foreign service-providers.

5.2 Special waste types

Spent tires

Most larger cities of Bolivia have implemented collection systems for spent car tires. Collected tires are mostly put in storage on the landfill sites. The Santa Cruz landfill site houses a treatment facility in which the tires are shredded and iron is recuperated. Exact numbers about the volume of this waste stream, its collection efficiency and recycling percentage are not available. Fact is that most landfill sites show volumes of stored tires of 5-10.000 tons.

Plastics, paper, glass and cans

Bolivia has a sizable, largely informal, sector of waste pickers collecting and separating recyclables originating from municipal waste. 2010 estimates show a workforce of around 10.000 people having permanent and fulltime activities in this field. Their recycled volumes add up to about 10% of the total municipal waste stream and about 25% of the total amount of recyclables in municipal waste. Measured in weight, 65% is paper/cardboard, 30% is plastics and 5% is glass and cans.

Separately collected products	€/kg
PET mixture	0,23
PET selected	0,43
LDPE mixture	0,09
LDPE selected	0,53
paper/cardboard	0,1-0,5
glass	0,03
PVC	0,53
PP	0,17
oil	-,04

There's an active, fine-meshed network of gathering centers (*centros de acopio*) and transporters. Santa Cruz, for example, has some 200 gathering centers receiving 1500 tons of recyclables per month. The prices payed to the collectors at the *centers de acopio* are presented in the table alongside.

Table 3. Prices of separately collected products

The network of companies recycling these gathered products is very diverse. Fundare, a recycling network established by the chambers of commerce, keeps records of almost all companies involved. A selection of them is shown in annex 5. Good examples are Kimberly for recycling of paper/cardboard and Empacar for recycling of PET. Both these companies are located in Santa Cruz. Empacar operates state of the art machinery for selection, washing, grinding, pelletizing and blow-molding of new bottles. The company was the first in South-America in this field that was certified to Coca Cola standards which allow to add 10% recycled PET to virgin material in bottle production and they aspire to increase this portion to 30%.

Their processing capacity of recycled PET is 1.000 tons per month. However, due to the current low prices they are producing at 30% capacity.

Most of the recycling industries seem to have an overcapacity in regard to the volumes that are collected. Some of them import their raw materials from other countries. Metal fractions are all exported, but this will change once the company Acería Guadix starts processing scrap metal in Santa Cruz.

Batteries

Estimates of dangerous materials in Bolivia's household waste range up to almost 10 tons per day. Batteries are supposed to be half of this volume. They are generally collected in most larger cities but in these cases collection efficiencies are still very low (5-10%). Collected batteries are taken to the landfill sites and put in storage awaiting future treatment and recuperation.

At this moment, Bolivia has no sustainable option to process spent batteries. As an example, at the Jarka Loma landfill site in the city of Sacaba (near Cochabamba) a 2,4 m3 concrete container is constructed to dispose off spent batteries, at an investment of € 3.400. At this moment, it might be more sustainable (and probably also cheaper) to collect the batteries nationwide and ship them overseas for proper treatment. In the Netherlands, for instance, the batteries could be received at a cost of approximately € 750/ton. If properly presorted in Bolivia, this cost is likely to drop. Such arrangements would alleviate many landfills in Bolivia of a pressing problem and could pave the way for more widespread spent battery collection programs in Bolivia.

Electronics waste (WEEE)

A study performed in 2008 showed an average production of household E-waste of 2,2 kg/inh.year. Extrapolated with the growth of electronics imports in Bolivia this figure would now be 3,3 kg/inh.year (around half of the Dutch production).

Potential for RAEE (residuos de aparatos eléctricos y electrónicos)

This year some 30 tons of RAEE will be exported to treatment facilities outside Latin America. This volume is expected to grow rapidly towards 100 tons next year. On the horizon lies a yearly 20.000 tons of electronic devices which are discarded at this moment, growing to well above 30.000 within a few years.

The Centro Ambiental RAEE Fundare tries to act as a coordinating centre for setting up a network of collection, aggregation and transport. One of the collection firms is REEcicla in La Paz.

This market is "fresh and fertile" offering lots of opportunities to new players, especially when interested in adding value to the Bolivian context by performing selection, dismantling and recuperation activities inside the country.

Potential partners are:

Fundare, Moira Gálvez

Bolrec, Carlos Borja Alarcón

RAEE Recicla, Jhonnatan Butrón

Box 2. Potential for RAEE

Collection of E-waste in Bolivia is in its infancy. Fundare is initiating a number of activities in this field, accompanied by a professional public communication campaign called “*En su lugar*”. Fundare is cooperating with Bolrec, a company established in 2014 focusing on recycling of household electronics. They work together in collection and export of this waste. This year will show an export of around 30 tons to China, the US, Denmark and Belgium.

Hospital waste

The production of hospital waste is estimated to be around 5.000 tons/year, mainly in the major cities. Half of this waste is either infectious, holds sharp artifacts or has a specific character; the other half is more or less normal waste. Most bigger cities operate some kind of dedicated collection system.

The waste is not autoclaved prior to transport and disposal. It is packaged in special bins or bags, transported and tipped. Some 20 landfill sites operate special compartments where the waste is treated with quick lime and then covered with soil. The occupational risks for directly involved workers, to acquire infections and injuries appears to be considerable.

Construction and demolition waste

This waste stream does not draw any attention in Bolivia at this moment. The volume of this type of waste will be equal to or a multiple of the production of municipal waste. For Bolivia this would show a production of at least a few million tons per year.

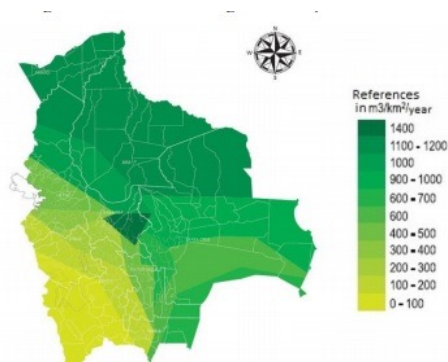
C&D waste contains bricks, concrete, soil, wood, iron and plastics but also considerable quantities of paint/solvent residues and asbestos. Bolivian C&D waste regularly seems to end up in illegal dumping and in use for embankments. Especially the fate of asbestos is a matter of concern. It may be present in higher percentages in Bolivian C&D waste because blue asbestos was mined and processed in Potosí and may have played an important role in the regional production of construction materials.

5.3 Agricultural and forestry waste and biomass

Biomass resources are huge in Bolivia. According to the United Nations (2012), in some places annual biomass production reaches values of up to 1400 m³/km² per year (see also fig. 5). The areas with the highest biomass output tend to be those where many small communities have no access to the power grid (this holds true for over 20% of the population).

Through its Vice Ministry of Electricity and Alternative Energy, the Ministry of Hydrocarbons and Energy is responsible for the development of biomass as an energy source. In the late ‘90s, the Netherlands has supported Bolivia to formulate a

National Biomass Program (NBP). This activity was executed by the World Bank in the framework of its Energy Sector Management Assistance Program (ESMAP).



According to the ESMAP report, around the year 2000 biomass (firewood, dung, charcoal and forestry and vegetal residues) accounted for approximately 90 percent of total household energy consumption in Bolivia. This consumption occurred mostly in rural areas in the form of firewood (about 965,000 tons per year) and dung (about 263,000 tons per year). The approximately 4.000 rural industries consumed the equivalent of about half a million tons of firewood.

Picture 3. Biomass production in Bolivia

Supply problems, concerning the use of biomass, are related to the low availability of forestry resources in the highlands plus unsustainable forestry practices. On the

Sugar mill	Department	Power plant?
Aguai	Santa Cruz	Unknown
Don Guillermo	Santa Cruz	Unknown
Guabirá	Santa Cruz	21 MW (grid)
IABSA	Tarija	Unknown
San Aurelio	Santa Cruz	Yes
San Buenaventura	La Paz	30 MW (grid)
Unagro	Santa Cruz	5MW
La Bélgica	Santa Cruz	Unknown

Table 4. Sugar mills in Bolivia.

demand side, the efficiency of the use of biomass is very low, both in households and in industry, thus increasing the demand. In Bolivia, bagasse from sugar cane and almond shells (castañas) is already being applied for electricity production. Other promising types of biomass for electricity generation are sunflower seeds, sawdust, rice husks and also biogas from waste water treatment plants, sanitary landfills and farms. Whether or not these latter applications will be feasible depends on the price of electricity, the concentrated and uniform availability of biomass and the proximity of the electricity grid.

Sugar cane cultivation is especially big in the Santa Cruz Department. Annually, Bolivia produces over 500.000 tons of sugar based on 6 million tons of cane. Until 2005, the cane was only used for sugar production, but the country has started to produce ethanol as well. There are seven sugar mills in the country, six of them in Santa Cruz and one in Tarija (see Table above). Another mill is under construction in La Paz. Several sugar mills burn bagasse to generate electricity and heat for on-site use and for feeding into the power grid (in the case of the Guabirá mill and the San Buenaventura mill in La Paz). In August 2014 the Bolivian Government announced that it would raise the price to be paid per MWh of electricity delivered to the grid by sugar mills. This could justify investments in power lines, enabling the mills to sell their surplus energy to the power grid. Thus an additional 80 MW of power could be created.

Almond shells are generated primarily in the Beni and Pando Departments in the north of Bolivia. In 1993, a study by DHV revealed a potential of close to 100.000 tons of almonds in shells per harvest, of which 30 tons could be converted into marketable almonds. The approximately 20 almond mills in the Bolivian Amazon region have a total installed capacity of 43.400 tons/year.

There have been attempts to use the almond shells for electricity generation. In the city of Riberalta a 1 MW power plant provided electricity to a community of 43.400 plus the local almond factory. It ran on a mixture of 90% almond shells and 10% sawdust. It was a simple process of burning the shells, generating steam and then electricity. For unknown reasons currently the plant is no longer operating. Another US\$ 3 million plant was developed with Dutch Private Sector Investment (PSI) support in Tahuamanu in the Pando Department near Brazil. In this case, syngas is generated through a controlled burning process of the shells. After purification of the syngas it is burnt in a gas engine to produce electricity. Unfortunately the managers of the project have not been able to come to an agreement with the local electricity provider Empresa Nacional de Electricidad (ENDE) so the power plant, although ready by 2012, has not yet been connected to the grid.

5.4 Mining and metallurgical waste

For Bolivia, mining activities generate the third largest exports revenue, after hydrocarbons and agriculture. In 2013, exports of silver, lead, zinc, tin and other minerals yielded a little over US\$ 3 billion. At the same time, one of the largest waste problems in Bolivia (and probably the largest environmental problem as such) is related to the mining industry. After centuries of mining history the country is left with a heritage of “pasivos” and “activos”. Pasivos are the legacy of many hundreds of old,

closed and abandoned mines comprising many million tons of highly polluted mining- and processing-residues (tailings), dangerous lagoons filled with poisonous sludges, contaminated, often acidic, leachate water running off to Bolivia's rivers and fine tailings dust diffusively spread by wind erosion. The activos are active concessions, legal and illegal, producing their daily contribution to this heritage.

Company	Ranking	Comment
Minera San Cristobal	29%	Japanese until 2014, then nationalized
Sinchi Wayra	8%	Part of Glencore, Switzerland.
Pan American Silver Bolivia	5%	Canadian owned.
Empresa Minera Manquiri	5%	Part of Coeur Mining, USA
Empresa Metalúrgica Vinto	5%	State owned
Empresa Minera Paititi	4%	Part of Canadian owned Orvana
Empresa Minera Inti Raymi	3%	Part of Guatemala's Promisa
Others	41%	Amongst them: Comibol

Table 5. Principal mining companies active today in Bolivia

The Table above shows the most important mining companies active in Bolivia today, ranked according to the payments they make to the Bolivian Government (% of total). Foreign involvement in Bolivian mining is obviously still significant. Amongst the

others are the national mining company and some 1600(!) so called “cooperativos”; small, mostly informal, mining companies.

The ministry of mining and metallurgy (MMyM), the national enterprise on mining concessions (Comibol) and the national mining agency (Sergeomin) have been working on an inventory of pasivos and activos since many years. According to Sergeomin in 2014, 40% of the pasivos were mapped with all geographical, physical, chemical and environmental characteristics. This information is however not publicly available at this moment.

Mining waste

There's a lot to be done concerning mining waste in Bolivia. We talked with the environmental department of the Ministry of Mining and Metallurgy (MMyM) in La Paz on their program to map all pasivos in the country. It turns out that the State of Bolivia is the owner of all mining “left-overs” because mining activities usually were put on the market as fixed term concessions. After expiration of these concessions the companies left the sites and were not held liable for the remains.

The results of the pasivos-inventory confronts the Ministry with the question what to do. There seems to be a clear need to design a national strategy to cope with this poisonous heritage. A strategy which will:

- rank the pasivos in order of priority,
- produce an environmental and financial cost-benefit analyses of all possible measures and technologies to mitigate and remediate,
- produce cost scenarios when applying these measures and technologies,
- explore all possible ways of funding and
- define the necessary organizational set-up.

Dutch consultancy firms could be of interest to the Bolivian government. Most of the bigger firms have experience in dealing with rehabilitation of mining areas. But what's maybe more important; The Netherlands has performed similar longterm planning tasks before, for example when setting up flood prevention programs and contaminated soil remediation programs on a national scale.

There's interest on the Bolivian side but it's not yet substantiated in an actual request. Interested companies should present themselves to the ministry MMyM (Sra. Giovanna Gonzales Saracho - giovanna.gonzales@mineria.gob.bo- and Primo Mamani Morales - deprimoes@yahoo.es) or get in contact with Comibol (www.comibol.gob.bo) or Sergeomin (www.sergeomin.gob.bo).

Box 3. Mining waste

The problem of this historical and actual mining waste is urgent because it can be held responsible for probably the most important source of contamination of Bolivian rivers and groundwater and for substantial exposure of civilians and workers living in the mining areas. On the other hand, the dimensions are too large to fit this problem into a general policy on waste management. It needs its own policy, comprising, in addition to the inventory studies mentioned above, measures and actions on priority planning, mitigation and remediation schedules, financing and funding etc.

5.5 Industrial waste

The Bolivian register of industrial and commercial companies Fundempresa (www.fundempresa.org.bo) holds more than 140.000 companies. More than 100.000 of them are located in the departments of La Paz, Cochabamba and Santa

Cruz. 14.000 companies are registered as being manufacturing industries of which more than 50% is related to the food industry.

Industrial waste

Industrial waste draws no attention in Bolivia so far. Policy makers seem to have forgotten or neglected the importance of having a sound infrastructure in order to facilitate their manufacturing companies. But interest is growing and authorities seem to realize they can't just leave it up to individual companies.

There's no problem in assisting companies by granting them access to public waste treatment sites. In fact it may benefit both authorities and industry:

- Many industrial waste streams can be beneficial in the operation of landfill sites. For example: foundry sands can be used for drainage of leachate or for daily covering, sludges can be used for prevention of dust emissions and wet organic waste streams will enhance landfill gas production.
- The same holds for the use of organic waste streams in co-composting or co-digestion.
- Extra volumes of waste on transfer sites, landfill sites etc. will promote economies of scale.
- Centralizing end-treatment facilities like landfills in the hands of the authorities can provide insight in waste streams and provide opportunities to impose incentives for prevention and recycling.

Dutch waste management companies coming from the public domain, know how to integrate the interests of producers of industrial waste into a public infrastructure. And that's exactly the know how that is needed in Bolivia at this moment. It would need some initial investment from the Bolivian side (industry and authorities) but in the end it will be very beneficial to all.

And it's not a one-way game. Parts of the Bolivian industry can also play an important role towards municipal waste. One of the most important chances lies in the cement industry located around La Paz (SOBOCE) and Cochabamba (COBOCE). These klinker production sites could use substantial volumes of industrial mono-wastes and municipal waste derived secondary fuels to fire their rotary kilns.

Players in this field:

The Ministry of water and environment MMAyA, Mr. Vladimir Gutierrez Ledezma

The Chambers of Commerce (www.bolivia-industry.com, www.cainco.org.bo and www.cnc.bo)

Fundare Santa Cruz, Mrs. Moira Alejandra Gálvez López

The cement industry (www.soboce.com, www.coboce.com)

Box 4. Industrial waste

The legal context in Bolivia states that industrial companies are responsible for managing their waste in a proper way and to use prevention and recycling as much as possible. "So far, so good" one could say, but what happens with the waste that can not be prevented or recycled. As far as this waste is similar to household waste, there is no real problem. The public infrastructure of landfills is allowed to accept this waste, and will do so as it is more profitable than household waste. The problem is that specific waste, arising from industrial processes, is not accepted on public landfill sites. This situation is caused by the fact that the legal responsibilities, already written down in the Regulation on the manufacturing industrial sector (RASIM), are still not implemented due to lack of coordination between the different administrative levels in Bolivia.

The production volumes and characteristics of this specific industrial waste are not known at this moment. The same holds for the fate of this waste, in the past and nowadays. Industrial companies have no place to go and are forced to find their own "solutions". This is, without a doubt, leading to uncontrolled contaminated sites with all adverse effects one can imagine. There is a need to improve insight in this situation and formulate strategies.

6. Roles of the different actors

6.1. Public sector

6.1.1 National level

In Bolivia, the Ministry of Environment and Water (MMAyA) is responsible for the definition of general policies and rules in solid waste management through its Vice Ministry of Potable Water and Basic Sanitation (VAPSB). The Vice Minister Mr. Rubén Méndez Estrada is well aware of the challenges in solid waste management because of his former position as chief of the Municipal Waste Agency of El Elto. In 2009 the General Directorate for Integrated Solid Waste Management (DGGIRS) was created. This approximately 10 staff unit within VAPSB has produced a big step forward towards sustainable solid waste management in the country. In 2011, it published a diagnostic study into solid waste management in Bolivia, together with a five year action plan for the period 2011-2015. It has issued technical guidelines on the design, operation and closure of landfills and composting facilities, environmental education, setting up of municipal waste management programs and performing impact analysis. The DGGIRS director Mr. Vladimir Gutierrez Ledezma, his colleague Mr. Luis Fernando Peñaranda and their staff have been most effective counterparts in the present market survey.

The most important project DGGIRS is working on is a new law on waste management in Bolivia, which is expected to strengthen the legal framework for integrated waste management. Besides that the directorate is to develop a new “Plurinational Program on ISWM 2016-2020”.

6.1.2. Department level

In 2009, Bolivia was rebaptized as a “Plurinational State”. Among other changes, this new status provided a high degree of autonomy to departments and municipalities in subjects such as waste management. As a result, Bolivia’s nine Departments are now supposed to develop strategies and action plans to improve waste management in their jurisdiction.

The level of involvement in solid waste management varies between departments. La Paz has its separate “Secretaría de Medio Ambiente y Recursos Naturales” (Secretariat of Environment and Natural Resources) and also Potosí has been quite active in waste management. Some Departments are playing a leading role in the regionalization of waste management systems (see next section).

6.1.3. Regional level: Metropolitan areas and “mancomunidades”

There are encouraging signs of regionalization of waste management. The driving forces are the scarcity of suitable locations for landfills and the need for cost

effectiveness in waste management through economy of scale. Two tendencies worth mentioning are Metropolitan Regions and the so called “*mancomunidades*”.

Metropolitan regions

In all three major cities La Paz, Cochabamba and Santa Cruz, so called Metropolitan Regions have been created or

Metropolitan Region	Municipalities	Status March 15
Area Metropolitana de La Paz	La Paz, El Alto and Viacha (2,3 million inhabitants, 1.100 tons/day MSW)	Under development
“Kanata” Cochabamba	Cercado, Quillacollo, Sipe Sipe, Tiquipaya, Vinto, Colcapirhua and Sacaba (1,2 million inhabitants, 680 tons/day MSW)	Created May 2014
Santa Cruz	Santa Cruz de la Sierra, Cotoca, Warnes, La Guardia, Porongo and El Torno (1,75 million inhabitants, 1.200 tons/day MSW)	Under development

are in the making. These cooperative institutions between municipalities are official administrative entities with common goals of a supra-municipal nature and often in the area of sustainability. Table 6 shows the (projected) composition of the Metropolitan Regions.

Table 6. Composition of Metropolitan regions in Bolivia and status March ‘15

Waste treatment tends to be among the focus areas of the Metropolitan Regions. The case of Cochabamba is presented in Box 5.

Opportunity: US\$ 60 million investment in waste treatment in the “Kanata” Metro Region

End of May 2014 the Metropolitan Region “Kanata” was created, the first in Bolivia. It unites seven municipalities around Cochabamba with a total of approximately 1,2 million inhabitants: Cercado, Quillacollo, Sipe Sipe, Tiquipaya, Vinto, Colcapirhua and Sacaba. The Kanata region aims to promote integral urban and rural development in its jurisdiction, focusing on issues that can best be dealt with on a supra-municipal level such as the management of the Rocha river, road construction and waste treatment.

The main municipality Cercado (with the city of Cochabamba) generates around 500 tons of MSW a day. The total output of the seven municipalities is approximately 680 tons a day: 75% of the waste of the entire Department. The current Cochabamba waste disposal site K'ara K'ara will have to be closed in two years. This is why the Kanata region is planning a joint waste treatment site including the following approaches:

- 1/ Post consumer waste separation and selection
- 2/ Biological waste digestion
- 3/ Composting
- 4/ Car tire recycling
- 5/ Leachate treatment plant
- 6/ New waste disposal site

Waste collection and transport will still be organized separately by the participating municipalities. The tricky part is to find a suitable location for the site, which is to last for at least 15 years. The Spanish consultancy firm ATJ Consultores (www.atjconsultores.com) has pinpointed a location in a military zone but this proved unacceptable for the surrounding community. A new location will be proposed in the coming weeks. Once the location is determined the project will be set in motion with a US\$ 60 million loan by the Interamerican Development Bank. For Dutch suppliers of waste treatment technologies this is certainly a project to keep an eye on. Contact person at the Department of Cochabamba: Mr. Alejandro Fabrizio Böhr, +591 71765077, faboco@gmail.com.

Box 5. Opportunity: \$ 60 mln investment in Kanata Metro Region

“Mancomunidades” (municipal cooperation)

Another type of municipal cooperation is the so called “*Mancomunidades*”. These cooperative arrangements between municipalities are often temporary in nature and do not have a formal administrative status. The market survey yielded a well-developed example: the Mancomunidad de Municipios del Valle Alto. This is a group of 14 municipalities at about half an hour distance from Cochabamba. The population of 140.000 generates 63 tons of MSW a day. Currently, these municipalities have nine open air dumps and four “micro-dumps”. The plan is to close the dumps and create a joint integrated waste management company EVAGIRS, featuring one common sanitary landfill, adequate waste service equipment and different types of recycling facilities. Tentative locations for the landfill have been identified. The overall project cost is almost EUR 10 million. The impression of the market survey team was that instead of developing a sanitary landfill for 63 tons of waste a day, it must be more cost effective to participate in the Metropolitan Region landfill to be developed. In case of a mismatch in terms of timing, a low tech temporary arrangement could be developed. This will cut investment and operational costs significantly. Contact person for the Mancomunidad Valle Alto is Mr. Hugo Llano Rueda, +591 71490131, mmvallealto@live.com.

6.1.4. Municipal level

Municipalities are ultimately responsible for waste management in Bolivia. There are several ways in which the waste management is organized (percentages 2010):

1. The municipality itself takes care of waste management (39% of the municipalities). This is mostly the case in intermediate or small municipalities (often in rural areas) with waste quantities that do not justify private sector involvement. In some cases certain waste services (such as final disposal) can be outsourced.
2. Public decentralized municipal waste companies (3%). This model is usually applied in the capital cities of the Departments plus major other cities. Cochabamba is an example with the company EMSA.
3. Outsourcing or “tercerización” (5,5%). Waste services are outsourced to private companies.
4. Waste concessions (1%). This type of contracting is applied in some of the major cities, see Table below.
5. No service at all (51%). This tends to be the case in rural communities with less than 2.000 inhabitants.

Table 7 shows the companies currently executing the waste management in La Paz, El Alto, Cochabamba and Santa Cruz. These are important players to keep in contact with as a Dutch supplier of goods and services in waste management. SABENPE is a Venezuelan company and Vega Solvi is Brazilian. Tersa, Colina and Trébol are Bolivian. The first concession to expire is the SABENPE contract in La Paz. When a new concession is being issued, usually the purchase of new mobile equipment is required. The fixed infrastructure (e.g. landfill construction, leachate treatment,

recycling equipment) is purchased by the municipality or its waste agency. Contact details of the waste companies are in Annex 3.

Source separation and recycling activities are still rare. The most well developed separate collection system was observed in Cochabamba. This is perhaps due to the

City (responsible)	City cleaning	Waste collection and transport	Waste disposal
La Paz (SIREMU, a separate municipal agency)	Sabenpe and Tersa 2006 - 2016	Sabenpe and Tersa 2006 - 2016	Tersa Closure of Mallaza Alpacoma 'til 2029
El Alto (EMALT)	Trébol 2013 - 2023	Trébol 2013 - 2023	Colina SRL
Cochabamba (EMSA)	EMSA (public company)	EMSA (public company)	Colina SRL Operation until '16 Closure '14-'24
Santa Cruz (EMACRUZ)	Vega Solvi 10 yr concession	Vega Solvi 10 yr concession	Colina SRL

fact that the municipal waste agency EMSA is in charge of waste collection and transport there. In the other major cities private companies are in charge of waste collection and transport and they get paid per ton of waste they deliver to the landfill site (e.g. SABENPE gets EUR 20 per ton).

Table 7. Companies in charge of waste services in four major cities in Bolivia

Around 2010 there has been an attempt to create the Bolivian Association of Public Enterprises in Urban Waste Management ABEMAU. Unfortunately this has not been a success. Hopefully another attempt will be made as such an organization would be a very useful crystallization point of cooperation, knowledge exchange, business and innovation in waste management.

6.2. The private sector

Private companies active in recycling are emerging in Bolivia. Quite a few companies in plastics recycling were identified, as well as other materials such as WEEE, spent oils, paper and metals. They source their materials directly from industry and/or from the network of storage centres for recyclables ("*centros de acopio*") which receive their materials from informal waste pickers. In Annex 5 a list is provided of Bolivian companies working in the waste sector. The actual list is way longer; only the ones currently having a website are listed in the Annex.

As part of the market survey representatives of Jake Oil, Acería Guadix (scrap recycling) and EMPACAR were interviewed. The level of professionalism of the recycling activities was good. The bottle-to-bottle recycling plant of EMPACAR near Santa Cruz is considered an outstanding example.

As yet there are few companies in Bolivia providing equipment for waste separation, source separation and industrial waste management. The market for such products and services appears to be wide open. On the other hand, first the proper legislation and enforcement has to be in place in order to create a fertile ground for such companies to flourish. Advisory services in waste management are provided by companies such as Abono SRL, Ecología y Empresa, Servicios Ambientales and

Simbiosis. They can serve as a port of entry with the necessary contacts to initiate business in Bolivia.

Recycling companies are supported by the FUNDARE Foundation, founded by the Bolivian Chambers of Commerce in 2005. FUNDARE has several offices in the big cities, each with its own characteristics but with a clear focus on recycling. Each year in fall FUNDARE Santa Cruz organizes the Ecoferia, a trade fair on waste management and recycling. See for more information www.cainco.org.bo. For more general information on CoC registered companies in Bolivia it is recommended to consult www.fundempresa.org.bo.

6.1.5. Technical and financial supporting organizations

Thus far, bilateral involvement in waste management in Bolivia has been provided mainly as Overseas Development Assistance (ODA). Some examples:

- The Catalan Agency of Cooperation for Development (ACCD) together with the Catalan Waste Agency (ARC) manage an ongoing financial and technical assistance program in waste management. Elements include capacity building, the development of planning and technical instruments, preparations for the upcoming waste law, pilot recycling projects and technical norms for waste management. ACCD/ARC have supported DGGIRS and the Departments in carrying out the diagnosis of waste management in Bolivia and designing the five year program 2011-2015. ARC also helped design the collaborative waste management program of the Valle Alto municipalities.
- Swisscontact has implemented the project "Ecovecindarios", meant to promote environmental awareness at the community level and empower local people to collect recyclables and create a small scale recycling business
- Through JICA, the Japanese Government has also implemented programs such as a waste project in the city of Uyuni. At some point Japan has also provided garbage trucks.

Multilateral Development Banks are starting to get involved in waste management in Bolivia:

- The Andean Development Corporation (CAF) is funding waste projects in the Departments of Santa Cruz, Potosí, Cochabamba and Oruro. Furthermore, CAF has financed a Pre-Investment Multi-Sector Program (PROMULPRE) for studies meant to create a portfolio of investment opportunities in economic and social infrastructure development projects, basic services and environmental resources. As an example, FUNDARE Santa Cruz is considering to propose a US\$ 0,5 million study into the sustainable collection and treatment of special waste to be co-financed by PROMULPRE.
- Through a US\$ 20 million/5 year InterAmerican Development Bank loan, the Ministry of Environment and Water is supporting the municipalities of El Alto, Riberalta and Potosí in upgrading their waste management (e.g. development of environmentally sustainable sanitary landfills, see box 6). The debt financing structure is being negotiated with the Ministry of Environment and Water, the

Departments and the Municipalities. Once this is finalized, the so called TESA studies will be carried out (technical, economic, social and environmental).

- The IADB is also planning to fund the US\$ 60 million Cochabamba Metropolitan Region waste treatment facility.
- In 2015, IADB will fund a US\$ 250.000 pre-investment study into a regional waste management system in six cities of the Santa Cruz Department.

20 mln USD for 3 Bolivian cities.

The Inter American Development Bank BID sees good perspectives for investments in the Bolivian waste infrastructure. Recently BID granted a \$ 20 mln loan to the national government for financing investments in landfills, separation and composting facilities in Potosí, Riberalta and El Alto. The projects are in preparation and waiting for financial commitment of the local authorities. Works will be tendered on the international market through MMAyA.

Contacts are:

- At BID Mr. Vladimir Seborga, vladimirs@iadb.org
- At MMAyA Mr. Luis Fernando Peñaranda, lufeper@yahoo.com

Box 6. Opportunities in El Alto, Riberalta and Potosí.

6.1.6. The Bolivian population and NGO's

Bolivia's indigenous concept of "*pachamama*" (Mother Earth as the highest divinity) appears to be an ideal foundation for a sustainable attitude among the population. However, as yet there are few signs that this is the case. The strongest public emotion related to the environment encountered during the exploratory mission was a "Not In My Back Yard" (NIMBY) attitude towards existing and future landfills. Such attitude could become a driver for change towards better landfills as well as alternative treatments such as (small scale) composting, recycling etc. There are systems of source separation in place (for example, the system managed by EMAS in Cochabamba). Some earlier attempts elsewhere have failed because by the time the system was introduced there were no vehicles for separate collection. In general, the impression is that inadequate waste management systems and the unwillingness of the population to pay for the waste tariffs hold each other hostage for the moment.

A number of NGO's are working on turning around this situation. The Fundación Gaiapacha in Cochabamba and Santa Cruz (www.gaiapacha.org), for instance, is a group of young environmental professionals working on subjects such as climate change and urban gardening. One of their projects is to discourage the use of plastic bags in stores. Another initiative is Sustainable Bolivia (www.sustainablebolivia.org). This is a Cochabamba based network supporting its 36 partner organizations active in social (most) and environmental (some) sustainability.

6.2. Mining waste

In Bolivia, little occurs in mining without the involvement of the state mining organization Comibol. This is not a mine operator but it manages the government's interests in mining concessions (and metallurgical and industrial plants) through joint

ventures, lease and/or service agreements with private companies. For more information: Tel. +591 2 2682100, <http://www.comibol.gob.bo/>.

The environmental section of the Ministry of Mining and Metallurgy is responsible for monitoring and alleviating the environmental impact of past and present mining activities. The Director is Mrs. Giovanna Gonzáles Saracho, +591 72571003, giovanna.gonzales@mineria.gob.bo.

Sergeomin (www.sergeomin.gob.bo) offers geological services to the mining sector. One of its important tasks is to monitor the quality of water aquifers in Bolivia.

6.3. Residual biomass

Some organizations active in residual biomass include:

- Energética (www.energetica.org.bo) is a private NGO working on energy issues in rural areas in Bolivia.
- The EnDev project (www.endev-bolivia.org) is a joint program on rural access to energy in Bolivia managed by GIZ Germany and co-financed by the Netherlands, Norway, Australia, England and Switzerland. The EnDev website has a lot of links to other players in the field.

7. Opportunities for Dutch companies and institutions

This chapter sums up a longlist of subjects in which The Netherlands could add value to waste management in Bolivia. An overview is presented in the figure below. The figure shows in green the fields of interest and in grey/black the fields with little to no opportunities.

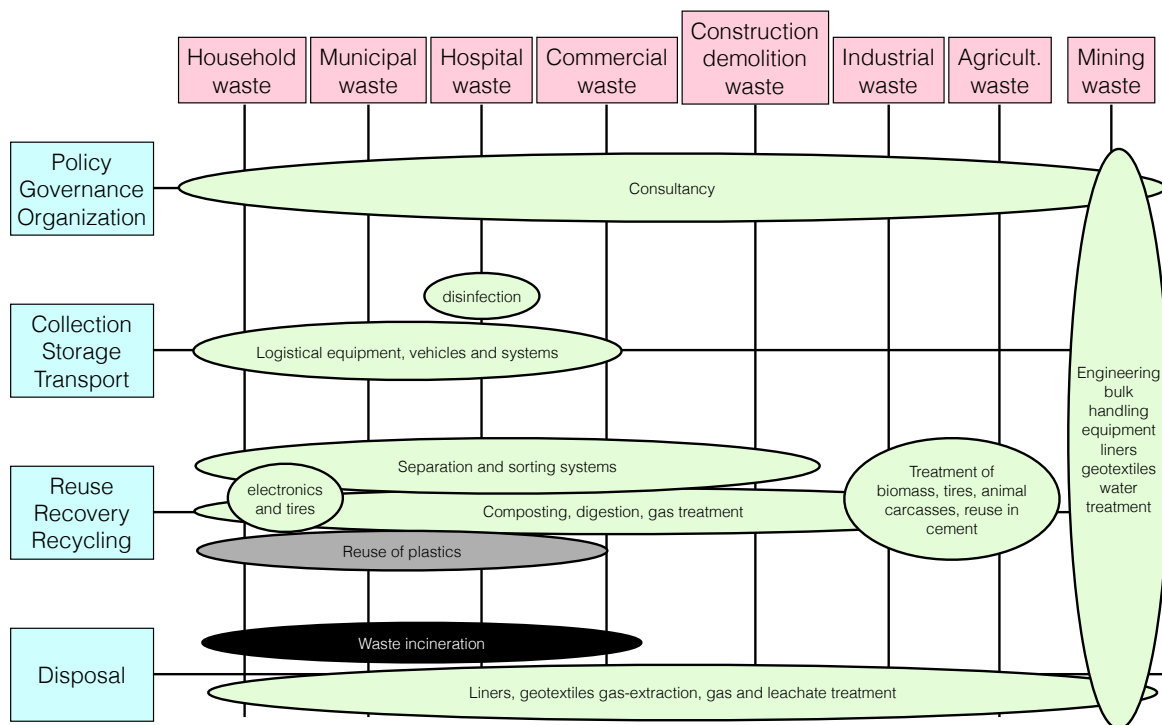


Figure 5. Overview of opportunities

The chapter will finish with a paragraph on some general background figures which may be important when considering commercial opportunities in the country.

7.1 Research and Policies

Holland has a long history in research and policy on waste management. Bolivia could benefit from this condensed experience. Some fields of interest:

- *The scale of the treatment facilities is too limited for proper investments and operations.* Bolivia's departments and municipalities should be encouraged to cooperate and establish a larger scale for treating municipal waste. Dutch partners could provide research on optimizing scale with respect to logistics, investments and environment.

- *Cost coverage by household fees is too low, leading to an unhealthy influence of the political agenda on waste-operations.* It may be necessary to develop national rules for governance in relation to municipal waste management in order to establish a transparent organization with well assigned and separated responsibilities. Dutch partners could provide assistance in developing a sound governance structure.
- *Industrial production waste and construction and demolition waste are “orphans” in Bolivian waste policy. This leads to substantial environmental risks.* The Bolivian government should consider additional legislation and policies in order to safeguard sound treatment for non-recyclable wastes of this kind. Dutch partners could provide assistance on setting up a diagnostics and a policy for these types of waste.
- *Mining waste is Bolivia’s biggest waste problem. The vastness of the problem is in sharp contrast with the attention it gets.* The country needs a national plan to mitigate and remediate the “pasivos” and “activos”. A national plan preferably would comprise technology assessments, prioritizing, funding and financing. Dutch partners could assist in setting up a plan like this.
- *The potential of organic waste is not used.* Organic waste holds an array of opportunities to lower the Bolivia’s CO₂-footprint. Dutch companies and institutions could help to realize the potential.

7.2 Collection, logistics and equipment

Bolivia is preparing to make a leap in its waste management systems. This leap will start with a substantial improvement of collection services and equipment. At this moment some 60-70% of all households are serviced with waste collection. The growth in demand will partly come from improving this coverage, which is programmed to be 1% per year. The largest demand however will come from replacement of existing equipment, predominantly in collection. This replacement will be encouraged by tender procedures (procuring either equipment or collection services) prescribing the purchase of new equipment.

When going through the public Bolivian tendersite using the keyword “residuos” for 2014, some 200 tenders are displayed of which 60% deal with providing consultancy and communication services. 35 tenders deal with collection, 20 tenders with landfills, 10 with composting and 10 with waste-separation. Most of these tenders are about supplying equipment for collection, containers and container-transport. A good number are on supplying heavy compactors for landfill sites and some are on supplying compost-handling machinery. The tender site also shows a considerable interest in renting used equipment and machinery. This seems to be contrary to the legal obligation for municipalities to buy only new equipment (and contract collection companies prescribing the use of new equipment).

The tender site can be found on www.sicoes.gob.bo

Box 7. Bolivian public tenders

The public market, dominated by laws on public procurement, is by a private market dominated by Bolivian and other Latin-American companies providing services for collection, recycling and landfill operations. Their procurement volume seems to be

significant as most of Bolivia's collection and operation services are sourced out to private companies.

A tangible interest is developing in specific equipment, supplies and knowledge like:

- dedicated containers for separate collection of household components,
- dedicated container-systems for stationary container collection of municipal waste,
- small scale baling systems for formal and informal collectors of plastics,
- packaging solutions and disinfection equipment for specific hospital waste,
- design and implementation of Household Waste Recycling centers (HWRC's).

Transfer stations can play an important role in reducing the costs of collection and transport. Besides that, they will reduce transport intensities, they will enable nocturnal collection schemes and they can be used for short term waste storage and vehicle maintenance. The scale of Bolivia's cities necessitates the use of transfer stations. Typically (depending on population density, city-morphology and traffic characteristics), 1 station servicing 2-300.000 inhabitants would be optimal. Except for Cochabamba, Bolivia does not have these transfer facilities. Dutch consulting partners could supply technical assistance in setting up logistical studies, transfer station designs and good practices.

7.3 Recovery and recycling

Bolivia's recycling initiatives are still small-scale, scattered and usually designed as pilots. Dutch knowhow and hardware are expected to draw public and private interest.

The country's ambitions are high. With a growth in recycling over the last 5 years going from 5 to 8% of the total waste production, the new 5 years programs shows an accelerated increase towards 40%. This will mean that an extra recycling capacity (for municipal waste alone) of more than 700.000 tons/year has to be installed.

Government's policies for the treatment of municipal waste will produce an interest towards a combination of separation, sorting and composting/digestion. This combination provides interesting opportunities for Dutch companies. Some remarks in this regard:

- The present tendency is still mostly towards labor-intensive sorting due to low cost of labor. The government is, however, interested in a fast development towards larger scales, including more mechanization.
- Composting technology is wanted throughout the country. Technology levels are still relatively low. The major system is small scale, open air row-composting for combinations of garden and household wastes. The tendency towards higher capacities, mainly connected to an increase in separate collection, will lead to higher levels of mechanization and possibly also towards indoor composting.
- Digestion of the organic fraction, produced in post-separation, could be of special interest because it can be used for all kinds of combinations with agricultural biomass. Gas prices are low in Bolivia due to governmental subsidies. This may

inhibit digestion initiatives. On the other hand the country has a very well developed gas distribution system which may be fit for biogas feeding and the government is promoting sustainable energy projects.

Incineration of mixed municipal waste is not considered an option in the current Bolivian context because of its high capital cost.

Recycling of plastics waste is already a big topic in Bolivia. Bottles, bags and foils are collected and recycled at a large scale and most recycling technologies seem to be present. This “mature” market is already serviced by providers but may still leave room for interested companies from the Netherlands with dedicated separation equipment.

Some additional remarks and opportunities:

- Recycling of spent tires is expected to become a good market. Collection initiatives are all around but a professional treatment infrastructure is still lacking.
- There could be a good potential in setting up collection and treatment of household electronics
- Batteries are collected in small volumes with a national total of no more than 0,5 ton/yr. Nevertheless the cost of storage for this quantity is high. It is worthwhile to explore the possibility of transporting the batteries to the Netherlands for proper treatment.
- There is a good potential for the use of waste derived fuels in the cement industry.
- There's no proper infrastructure yet for collection and processing of animal cadavers and slaughterhouse waste.

7.4 Disposal

At this stage of Bolivia's development in waste management, most interest is drawn towards improvement of its disposal infrastructure, consisting mainly of dump- and landfill sites. The national waste program of the last five years contained an ambition of implementing 45 sanitary landfills. The actual result of the program was an extra number of 13. For the next five years investments in an additional number of 55 landfill sites is foreseen.

The requested technology level of new landfill-sites is already at a good level, providing interesting opportunities for suppliers from the Netherlands.

Dutch companies can provide polymer- and bentonite-polymer-liners (like German companies already do), geosynthetic fabrics, compactors, gas extraction systems, gas upgrading technologies and leachate treatment systems. Besides that, consultancy firms can provide knowledge on optimizing landfill operations (geo-hydrology, leachate recirculation, reduction of odor-nuisance, combination of landfill-cells).

7.5 Other opportunities

Opportunities related to *residual biomass* include:

- Efficient wood stoves for households to reduce the demand for firewood.
- Biomass based electricity, gas and/or heat generation for remote communities
- Industrial applications of biomass, such as additional use of bagasse for energy generation at sugar mills, power generation on almond shells, and co-generation with residual biomass in cement kilns.

Lignocellulosics from the Bolivian Altiplano

(by Christian Carrasco Villanueva, lecturer San Andres University, La Paz)

Quinoa is a good crop in arid and semi-arid areas, such as the Bolivian Altiplano. It has a high nutritional value and the interest has increased in the last few years. Peru and Bolivia are the main producers. As for other crops, quinoa gives rise to waste biomass. Seed coats, leaves and stalks are left in the field when quinoa grains are harvested.

In general, endemic Bolivian biomass is found at altitudes of between 3800 and 4800 metres above sea level in the western mountain range of the Bolivian Altiplano. The dry high-Andean forest provides lignocellulosic biomass from native plants like paja brava, thola, kishuara, achacana and kañilli.

The paja brava (the brave straw) is the most common specie on the Bolivian Altiplano. These plants form large communities of vegetation (known as "matas") and help to prevent soil erosion. The paja brava is commonly used as fodder in the roofing of the houses and in the packaging of fruit and foods (such as cheese). An old report also mentions the use of the material for paper-making. Thola is the second most dominant plant in the Altiplano, and used commonly as firewood. Previous studies of this plant have shown a chemical composition rich in resins (essential oils) and gums. Achacana was used like potatoes by ancient Andean civilizations in the region surrounding the Bolivian Altiplano. However, most of these materials are used as firewood in the region, and sometimes as construction materials. The chemical composition of these materials, especially their extractive contents, is highly variable, which may be due to the extreme environmental stress in this region.

Lignocellulosics from Bolivian Altiplano as quinoa stalks have a great potential as biofuel feedstock and other biorefinery applications. Recent studies identified the bioconversion of these materials to biopolymers (i.e. EPS and PHB). Paja brava is also interesting because it could produce almost 250 litres of ethanol per ton of dry matter.

Box 8. Biobased potential in the Bolivian highlands

Mining waste holds an unprecedented but also uncertain reservoir of opportunities. There's a lot of work to be done on ground- and surface-water management, tailings dewatering, lagoon stabilization, dam constructions, water treatment, dust prevention and so on. Most of this work seems to fit really well with the activities of many Dutch companies. It could provide opportunities related to:

- Consultancy on management of tailing dumps and lagoons and their emissions,
- Engineering on improvement of containment of sludges and contaminated water in lagoons in order to prevent dam breaches.
- Advisory services on water management in mining areas.
- Knowledge and services on constructions with geotextiles and -tubes.
- Knowledge and services on stabilization/immobilization and forced dewatering of unstable depots
- Supply of geotextiles and HDPE and bentonite-based liners.
- Technology on remediation of contaminated sites.

- Technology on treatment of water with low pH and contaminated with heavy metals, cyanides etc.

As most pasivos are state-owned and all active concessions are national, the “market” is clear. The question is: will the Bolivian government recognize its urgency and ensure necessary financing and regulation for this market to develop?

By volume less important than mining waste, but most probably larger than municipal waste, is the situation relating to *construction and demolition waste*. It’s a waste stream with a high potential for recycling at relatively low cost. Investments in this area will only be considered when the Bolivian government implements and enforces regulations on obligatory recycling for construction firms. Dutch companies supplying separation and sorting technology may then acquire an excellent position in this market.

General information

Some general information that may be useful in decisions on whether or not embarking on trade with or investments in Bolivia, is listed below.

Aspect	Amount	Unity
Household electricity pricing	0,08	€/kWh
Industry electricity pricing	0,05	€/kWh
Household gas pricing	1,07	€/m3
Industry gas pricing	1,64	€/m3
Household water pricing	0,30	€/m3
Industry water pricing	1,63	€/m3
Minimum salary april 2015	189	€/month
Import taxation	0-5	%
Value added tax	13	%
Transaction tax	3	%
Revenue tax	25	%

Box 9. General information on Bolivian cost factors

8. SWOT analysis of doing business in waste / biomass in Bolivia

The strengths and weaknesses of Bolivia's waste market, and the opportunities and threats when considering to do business in this field, can be summarized schematically as shown in the table below.

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> • Bolivia's healthy GDP growth • Central location in Latin America • Access to 350 million Spanish speaking market • Relatively free market for import and export • Basic waste management infrastructure to build on • Enormous resources in residual biomass • Youth well educated and enthusiastic for sustainability • Bolivian and Dutch culture have a lot in common 	<ul style="list-style-type: none"> • Waste legislation still weak and incomplete • Enforcement of rules needs strengthening • Energy prices are low • Waste tariffs insufficient and bad payment discipline
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> • Bolivian population fed up with landfills (NIMBY) • Bolivia on the edge of a tech leap in waste management • Multilateral orgs start to invest in waste management • Lots of low hanging fruit in waste and biomass • Opportunity for country branding in waste management • Holland enjoys a good image in Bolivia 	<ul style="list-style-type: none"> • Competition from other countries • Government interference with strategic businesses • Risk of corruption

Table 8. SWOT analysis

9. The next step: how to turn opportunities into business

9.1. Market approach

At this point, the Dutch Embassy in Perú (which also serves Bolivia) discourages Dutch companies and individuals to invest in Bolivia. This still leaves many options for waste and biomass business in the country, such as:

- Selling Dutch waste equipment or services through a Bolivian agent or distributor
- Establishing a partnership with a Bolivian company to jointly market waste related products or services (e.g. by bidding on Bolivian tenders)
- Establishing a partnership with a Bolivian company or organization to jointly propose R&D or development projects to be (co-)financed through development cooperation
- Import waste from Bolivia to be treated in the Netherlands

Many of the general recommendations for doing business in Latin America are valid for Bolivia:

- Visit the country yourself to get to know the waste management system from up close
- In most cases, a reliable local partner company or organization is essential for successfully doing business in the country. Take time to learn to know potential partners and clients
- English as a second language is not widely spoken among key staff, so make sure that you speak Spanish or hire an interpreter
- Make good use of the Dutch support network and Dutch nationals doing business in Bolivia (see 9.2.). You're not the first Dutch to explore business opportunities in Bolivia; there's a lot of experiences to build upon
- If possible, hook up to a joint business mission to quickly build your network and cut costs (see 9.4.).

There is a low threshold option to establish the first contacts in Bolivia through the LinkedIn group "Opportunities for Dutch companies on the Bolivian waste market": <http://tiny.cc/bolivia>. You are most welcome to post your inquiries and suggestions there. The Bolivia country page on the website of the Netherlands Enterprise Agency (RVO, www.rvo.nl) contains a lot of information on doing business with Bolivia.

A next port of call may be the Bolivian Embassy in The Hague. The contact details are: Mrs. Katerin Brieger Valencia
First Secretary Bolivian Embassy in the Hague
Tel. 070 3616707
Email: embolned@embassyofbolivia.nl



Once in Bolivia, the following organizations are recommended to get a first impression of the business environment:

Bolivian Institute for International Trade (IBCE) (based in Santa Cruz)
 Mrs. María Esther Peña Cuéllar
 Tel. +591 3 3362230 ext 107
 Email: gtecnica@ibce.org.bo

And: Chamber of Industries, Commerce, Services and Tourism (CAINCO)
 Santa Cruz Office
 Mrs. Cristina Wille Engelmann
 Tel. +591 3 3342353
 Email: cristina.wille@cainco.org.bo

Apart from the public network, a number of Dutch nationals doing business in Bolivia can be valuable sources of information. Some of them can be traced through the website <http://www.internations.org/bolivia-expats/dutch> (you have to sign up as a member). One of these Dutch nationals is Has Willet, who works with the Bolivian Ministry of Environment and Water on a regular basis and who was one of the organizers of the September 2013 incoming mission from Bolivia (together with Mr. Jan van Dijk of Giraf Results). They can be reached at haswillet@hotmail.com and jan.vandijk@girafresults.com. A fellow Dutchman keen on exploring and developing business opportunities is Wolt Bodewes of Terwel Consultancy. He is based in Santa Cruz and can be reached at +591 60502281 or wolt@terwel.net.

9.2. Dutch support network in Bolivia

City	Dutch representative	
La Paz	Mr. Ricardo Galindo Representative for Dutch-Bolivian development projects Tel. +591 777 83000 Email: agregadocomerciallapaz@hotmail.com	
La Paz	Mr. Paul Kuijper Honorary Consul General in La Paz Tel. +591 72500360 Email: pk@enbolivia.com	
Santa Cruz	Mr. Hans van Mourik Business liaison in Santa Cruz Email: agregado-santacruz@nlconsulate.com	
Santa Cruz	Mr. Ludo Ham Honorary Consul General in Santa Cruz, Beni and Tarija Tel. +591 72144442 Email: santacruz@nlconsulate.com	

At the beginning of 2014 the Netherlands closed its Embassy in Bolivia (and also the ones in Ecuador, Uruguay, Nicaragua and Guatemala). One objective was to save money, but the Embassy's closure also reflected a change in ambition away from development cooperation and towards a trade relationship. Nowadays there is still a sizable Dutch support network in Bolivia, mainly geared towards business promotion and with a minor focus on development cooperation. The Table below shows the contacts.

Table 9. Dutch representatives in Bolivia

The Dutch Embassy in Perú is considering the possibility of establishing a Holland House in Santa Cruz, similar to the one in Bogotá, Colombia. Whether or not this Holland House will materialize will depend on the question whether the private sectors in the Netherlands and Bolivia are willing to invest in it. The choice of Santa Cruz as the projected venue of the Bolivian Holland House reflects its importance as the main business center in Bolivia.

9.3. Dutch support programs

The Table below depicts a list of relevant Dutch support programs which are applicable in Bolivia. Additional and up to date information can be obtained at www.rvo.nl.

Acronym	Name	Relevant elements for waste and biomass trade with Bolivia
DGGF	Dutch Good Growth Fund	Export credit insurance up to EUR 15 million and export finance of up to EUR 2 million
DHK	Demonstration, feasibility and market research	Support for market surveys, feasibility studies and demonstration projects
DRIVE	Developmentally Relevant Infrastructure Investment Vehicle	Successor of the ORIO programme with an objective of Dutch private sector involvement. This program is expected to be announced in the spring of 2015.
G2G/K2K	Government-to-Govt Knowledge-to-knowledge	Dutch-Bolivian public and academic sector cooperation programs supporting exports promotion
MMF	Matchmaking facility	Support for Bolivian SME's looking for a Dutch business partner

Table 10. Dutch support programs

9.4. Events

Three annual business events in Santa Cruz stand out as opportunities to showcase the Dutch expertise in waste management and residual biomass;

- **Expocruz** (18-28 September) is a very large trade fair in Santa Cruz. In ten days the 2.000+ exhibitors attract over 500.000 visitors. Some sectors represented include automobile, telecommunications, construction, agriculture, art and culture. This year the Dutch Embassy will have a pavilion to present the Netherlands.
- **Matchmaking event on Recycling** (Wednesday 22 July 2015) to be organized by FUNDARE Santa Cruz
- **Ecoferia** (Oct-Nov 2015, exact date to be announced). This is a Trade Fair on waste management and environmental technology, also to be organized by FUNDARE in Santa Cruz.

For the moment, it is felt that at Expocruz it will be hard to stand out with Dutch technology in waste and biomass. The matchmaking event on recycling is planned in

the Dutch summer vacation period but could serve as an opportunity for additional online matchmaking through the existing LinkedIn group. The Ecoferia Trade Fair in November appears an ideal occasion for Dutch involvement.

9.4. Proposed short term follow-up: Business mission to Ecoferia Santa Cruz

Through the visit of Bolivian officials in 2013 to the Netherlands, the March 7-20 2015 exploratory mission to Bolivia and the LinkedIn group, a solid basis has been created for business between the Netherlands and Bolivia in waste and biomass. The next step is to organize a business mission of Dutch entrepreneurs to Bolivia. The following is proposed:

- To organize a one week trade mission with at least eight Dutch private sector participants (approximately six in waste, two in biomass)
- To spend two days in La Paz / Cochabamba and three in Santa Cruz
- To time the business mission in a way that it coincides with Ecoferia Santa Cruz (October or November 2015)
- On the Dutch side, to cooperate with ENVAQUA and possibly the Dutch Waste Coalition in the organization of the event
- In Bolivia, to cooperate with MMAyA/DGGIRS and FUNDARE (Santa Cruz)
- To consider the possibility of cooperating with a Flemish counterpart to attract some Flemish private sector participation (e.g. three waste companies and one in biomass). Apart from broadening the trade delegation, this way the mission could serve an additional purpose in contributing to Dutch-Flemish cooperation in waste and biomass.

9.5. Follow-up beyond the trade mission

Among other purposes, the proposed trade mission will serve as a test for the level of interest in Bolivian-Dutch business on waste and biomass on both sides of the ocean. This level of interest will be decisive for possible longer term cooperative action. There are some positive signs. Companies and other stakeholders in the Netherlands and Bolivia have responded very positively to the opportunity to join the LinkedIn group. The potential for more participants is considered significant and will continue to be explored (more Bolivians would probably sign up if LinkedIn were used more widely in the country). Another positive sign is that the Bolivian Minister of Environment and Water has already solicited input from the Dutch team of experts regarding options for sustainable waste management in Bolivia. A lot of low hanging fruit was identified in the two weeks the team stayed in Bolivia. Environmental improvements go hand in hand with money saving. This is an attractive combination which may spark additional Dutch involvement in the waste sector in Bolivia.

In order to position Dutch suppliers of products and services in waste management and biomass on the Bolivian market, it is considered beneficial to support trade promotion activities with a Holland-Bolivia public sector cooperation program. After all, the environmental market is very much driven by regulations and enforcement. And maybe more important: a sizable part of the waste market is in the hands of public entities at the national, departmental and municipal levels.

The goal of such a public support program is threefold: (1) to upgrade the Bolivian public sector in waste management and biomass; (2) to create a fertile ground for Dutch private sector involvement; and (3) Holland Branding in waste management and biomass.

In search of a clear focus of such a public cooperation program, the following factors have to be taken into account:

- There has to be an urgent problem in Bolivia and a willingness to take action
- ... matched with strong expertise and experience in the Netherlands
- ... and a good pool of Dutch suppliers of products and services in the field of focus

In section 7.1 "Research and policies" a number of fields of interest have been listed. It is tentatively proposed to choose industrial waste and construction/demolition (C&D) waste as a focus of a future public cooperation program because:

- The Expert Mission has identified a clear gap in legislation in these fields
- Industrial companies in Bolivia have an urgent problem in getting rid of their waste
- There is a lot of "low hanging fruit" with regard to industrial and C&D waste, which generally are uniform waste streams with a relatively high recycling potential
- Dutch product and service companies have a lot of expertise and equipment to deal with these types of waste.

Low hanging fruit - practical improvements with high pay-offs

1. Optimize systems and routes for waste collection and transport
2. Have at least one waste transfer station per 300.000 inhabitants in urban areas
3. Investigate which additional types of industrial waste can be allowed on sanitary landfills
4. Have bigger compartments (cells) at sanitary landfills
5. Recirculate leachate on landfills where possible
6. Regionalize waste management so landfills process at least 100.000 tons/yr
7. Collect and process used batteries on a national scale
8. Collectively procure waste collection and transport equipment, e.g. garbage trucks
9. Have mining concessionaires contribute to funds for cleaning up after the concession

Box 10. Low hanging fruit

Some elements of a Holland-Bolivia cooperation program on industrial and C&D waste could be:

- Inventory of types and quantities of industrial and C&D waste
- Support in the formulation of legislation on these waste types
- Analysis of the types of industrial waste that could be deposited/used in sanitary landfills.

Annex 1. Sources

- ESMAP Technical Paper 115/07 (2007), “Bolivia: National Biomass Program - Report on operational activities”
- Gobierno Municipal de Cochabamba, “Procedimientos y requisitos para obtención de licencias ambientales” (Procedures and rules for obtaining environmental licenses), 32 pp.
- MMAyA/VAPSB/DGGIRS (2010), Diagnóstico de la Gestión de Residuos Sólidos en Bolivia (Diagnosis of Solid Waste Management in Bolivia), 266 pp.
- MMAyA/VAPSB/DGGIRS (2012), Programa Plurinacional de Gestión Integral de Residuos Sólidos (Plurinational Program for Integrated Waste Management in Bolivia), 191 pp.
- MMAyA/VAPSB/DGGIRS (2012), Guía para el Diseño Construcción, Operación, Mantenimiento y Cierre de Rellenos Sanitarios (Guide for the design, construction, operation, maintenance and closure of landfills), 198 pp.
- MMAyA/VAPSB/DGGIRS (2012), Guía para el Cierre Técnico de Botaderos (Technical guide to closure of landfills), 96 pp.
- MMAyA/VAPSB/DGGIRS (2012), Guía para la Presentación de Proyectos de Preinversión de Residuos Sólidos (Guide to the presentation of pre-investment projects on solid waste), 122 pp.

Annex 2. Public organizations and companies in waste management in Bolivia

Organization	V	Activities	Web site / Facebook
DMAT		Waste service Tarija	www.tarija.bo
Dept of Santa Cruz	✓	Departement of Santa Cruz	www.santacruz.gob.bo/
EMACRUZ	✓	Waste service Santa Cruz	www.emacruz.com.bo
EMALT	✓	Waste service El Alto	https://aseoelalto.wordpress.com/
EMAO		Waste service Oruro	http://emao-oruro.blogspot.nl/
EMAP		Waste service Potosí	On facebook
EMAQ Quillacollo	✓	Waste service Quillacollo	On facebook
EMAS Sucre	✓	Waste service Sucre	On facebook
EMAUR		Waste service Riberalta	On facebook
EMAUT		Waste service Trinidad	On facebook
EMSA Cochabamba	✓	Waste service Cochabamba	www.emsa.gob.bo
GERES	✓	Waste service Sacaba	
Mother Earth Secr. Cochabamba	✓	Environmental Agency Dept Cochabamba	www.gobernaciondecochabamba.bo
Municipality of Cochabamba	✓	Municipality of Cochabamba	www.cochabamba.gob.bo/
Valle Alto Community	✓	Regional cooperation Valle Alto	On facebook
MMAyA	✓	Ministry of Environment and Water	www.mmaya.gob.bo
MMyM	✓	Ministry of Mining and Metallurgy	www.mineria.gob.bo/
SIREMU	✓	Supervision waste management in La Paz	

V = Visited during expert mission 9-20 March?

Annex 3. Private companies in waste management

Organization	V	Activities	Web site / Facebook
Abono S.R.L.		Environmental consultancy; hazardous waste treatment	http://abonosrl.com/
Acería Guadix	✓	Setting up a scrap metal recycling plant near Santa Cruz	http://aceriaguadix.com/
Bolrec SRL		WEEE recycling	www.bolrec.com
CGM Consultores	✓	Project biosubstrate out of prunings and organic waste	www.cgm-consultores.com
Cobra-met		Non-ferrous metals recycling	www.cobrametales.com
Colina		Operates sanitary landfills El Alto, Cochabamba, Sta Cruz	
Commetal		Car batteries recycling together with BATEBOL	www.commetal.com.bo www.batebol.com
COPELME/RECME		Paper recycling	www.copelme.com
Crisil S.R.L.		Glass recycling	http://en.crisil.com.bo/
Ecohardware		WEEE recycling and other materials	www.ecohardware.com.bo
Ecología y Empresa		Environmental consultancy; a.o. mining / other industries	http://ecologiayempresa.com
Ecoplastic S.R.L.		Industrial plastics recycling	http://ecoplasticsrl.com/
EMPACAR	✓	Plastics recycling (bottle to bottle)	www.empacar.com.bo
Ferrostaal Bolivia		Recycling of aluminum, copper, tires, techn. waste	www.ferrostaalbolivia.com
Gaar Ingeniería		Metal mechanics firm, a.o. separation equipment	www.gaaringenieria.com
HGC Consultores	✓	Biomass project development	On facebook
Jake Oil	✓	Oil recycling	http://jakeoilubric.com/
Kimberly Clark Bolivia		Paper recycling	www.kimberly-clark.com.bo
M&A Importaciones y Representaciones		Imports of a.o. waste containers	http://myaimport.com/
Madepa		Plastics and paper recycling	www.madepa.com.bo
Marecbol		PET recycling for markets in USA and Europe	www.marecbol.com
Metalci S.A.		Metals recycling	http://metalci-sa.com/
Pantanal		Plastics recycling	www.pantanalrecicla.com
Plaxburg SRL		Plastic products a.o. waste (separation) containers	www.plaxburg.com
RAEE Recicla		WEEE Recycling	On facebook
Recumet Bolivia		Metals recycling	www.recumetbolivia.com
SABENPE		Waste collection and transport in part of La Paz	
Servicios Ambientales S.A.		Environmental consultancy; especially re climate change	www.sasa-bolivia.com
Simbiosis		Environmental consultancy; a.o. pollution prevention and industrial waste management	www.simbiosis.com.bo
Tarija Eco Gestión		Treatment of solid and liquid wastes	http://www.tarijaecogestion.com/
TERSA La Paz	✓	Waste collection and transport in part of La Paz	
Terwel Business Development	✓	Business development in Bolivia	www.terwel.net
Trébol		City cleaning, waste collection and transport in El Alto	On facebook
VEGA/SOLVI		City cleaning, collection and transport of waste in Sta Cruz	www.vega.com.bo
Vidrio Lux S.A.		Glass recycling	On facebook

V?= Visited during expert mission 9-20 March

Annex 4. Other relevant organizations in Bolivia

Organization	V	Activities	Web site / Facebook
Cainco Santa Cruz	✓	Chamber of Industries and host to Fundare	www.cainco.org.bo
Fundare La Paz	✓	Promotion of recycling in la Paz	www.cainco.org.bo
Fundare Santa Cruz	✓	Promotion of recycling in Santa Cruz	www.cainco.org.bo
German Consulate in Santa Cruz	✓	Expert on mining sector	
Bolivian Institute for Internatl Commerce	✓	Promotion of international trade	http://ibce.org.bo/
Inter American Development Bank	✓	Supports some waste related projects	www.iadb.org
San Andrés University	✓	Research on biobased applications	http://quimica.umsa.edu.bo
SGAB Env'tal Management Society		Environmental Management Group in Cochabamba	www.sgab-bolivia.org

V = Visited during expert mission 9-20 March

Annex 5. Classification of solid waste in Bolivia

Classification of solid waste in Bolivia	
A.	Household waste
B.	Bulky waste
C.	Commercial waste
D.	Waste from city cleaning
E.1	Special waste: car wrecks and household electrics waste
E.2	Special waste: car tires
E.3	Special waste: non-hazardous sanitary waste
E.4	Special waste: dead animals
E.5	Special waste: construction and demolition waste
E.6	Special waste: garden waste
F.	Industrial waste, similar to household waste
G.	Slaughterhouse waste
H.	Sludges
I.	Agricultural, cattle-breeding and forestry waste
J.	Mining and metallurgical waste
K.	Hazardous waste

Annex 6. Examples of Bolivian industrial companies looking for waste solutions

These companies have participated in the latest Ecoferia event in Santa Cruz.

Company	Type of product/service	Looking for
Alianza Vida Seguros y Reaseguros S.A.	Insurance company	Options for WEEE recycling; paper recycling options
Batebol S.A.	Production of car batteries	Improvement of the waste recycling system
Bolland	Equipment and services for the petrochemical sector	Treatment of plastic and metal drums, lab waste, pallets, hazardous waste
Brightstar	Technology solutions	Batteries, accessories, WEEE (mobile phones etc)
Con4t	Real estate development	Waste management for 80 unit apartment building; food waste recycling
Equipetrol	Oil engineering, trade and service company	Treatment of oily sludge, alkaline and lithium batteries, waste with paraffin
Fagal Bolivia	Food processing company (cookies etc)	Treatment of food waste, carton, plastics, metals, paper, CFL's, WEEE
Industrias de Alimentos Santander S.A.	Food processing company	Treatment of egg shells, egg white, tomato waste, pallets
Pinturas Coral de Bolivia (Akzo Nobel)	Paint production	Treatment of wood pallets, plastic and metallic drums, PE bags, etc
Servipetrol S.A.	Project and service company for the oil industry	Treatment of oily waste, tires, lead sheets, chemicals, scrap
Tecnopor	Production of Expanded Polystyrene (EPS) products	Treatment of metal scrap, pallets, plastic bags and EPS waste
YPFB Transporte	Transport of hydrocarbons	Treatment of spent oils, oil contaminated water and soil, etc.

Source: Fundare Santa Cruz