Universidad Tecnológica de La Habana
"José Antonio Echeverría"

Solid Waste in Cuba: Actual situation and challenges

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Content

- ✓Who we are? Cuba, CUJAE, the Research Group
- ✓Cuban electro-energetic system and the renewable energy sources
- ✓Solid waste in Cuba. Biogas cases of study.
  - Agriculture. Rice residues
  - Food industry. Slaughterhouse Enterprise
  - Sugar cane industry.
  - Municipal Solid Waste in Havana
- ✓Challenges and conclusions

Basic figures on Cuba

- 109 884.1 km²
- 15 provinces, 1 special municipality
- 11 239 224 (2016) 70% urban, 30% rural
- 5 provinces (more than 700 000 inhabitants)

Universidad Tecnológica de La Habana “José Antonio Echeverría”, CUJAE

Unique Cuban University on Technical Sciences

- 13 Engineering careers and Architecture
- + 7000 undergraduate students
- + 3000 post-graduate students (masters and PhD)
- + 500 teaching staff (45% PhD)
- 13 research centres

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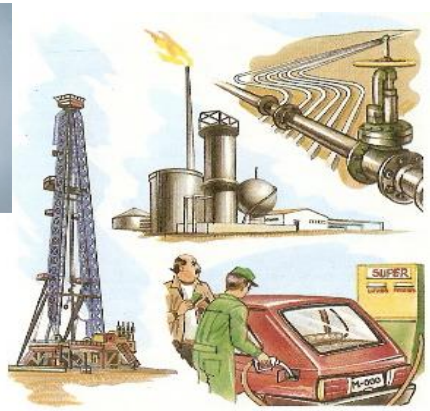
Environmental Eng. Research Group

Wide number of international collaboration

Main topic: Biogas

Cuban electro-energetic system

- Interconnected system on the main island and 5 isolated systems
- Electrification of the country: 99.9%
- Installed capacity: 5 620 MW
- Fossil fuel: 95.7%
- Renewable energy sources: 4.3%



Current moment of Renewable Energy Sources in Cuba

The Renewable Energy Sources and Energy Efficiency Policy is approved since 2014

MAIN GOAL

Electricity matrix 2030

Opportunity

24% from RES

9.5 years left!

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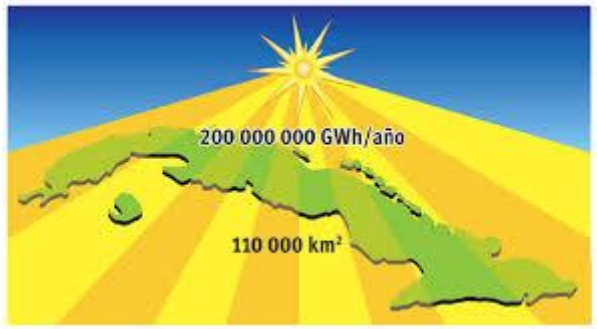
Main renewable energy sources in Cuba towards 2030



Biogas in Cuba towards 2030

Small scale for farmers
Pig manure-biogas reactors

Industrial scale…
Pig manure-covered lagoons for power generation

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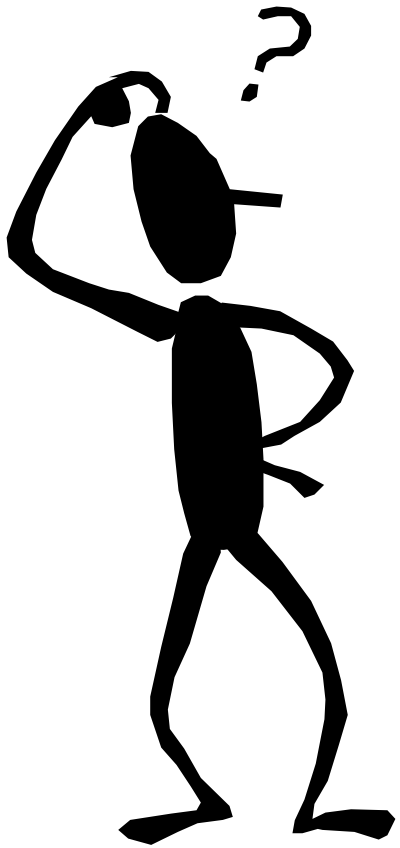
Previous experiences with other substrates



Solid wastes in Cuba ⟹ BIOGAS

- There is no a global evaluation but specific ones from different case of studies in areas as:
  - ✓Agriculture
  - ✓Food industry
  - ✓Sugar cane industry
  - ✓MSW

Rough estimation of wastes to energy: 7-12%

Case of study → Agriculture

Theoretically 50% of the total demand of Sancti Spiritus Province can be covered by the AD of rice residues and pig manure decentralized treatment

Rice industry Sur del Jíbaro Enterprise

10 MW power

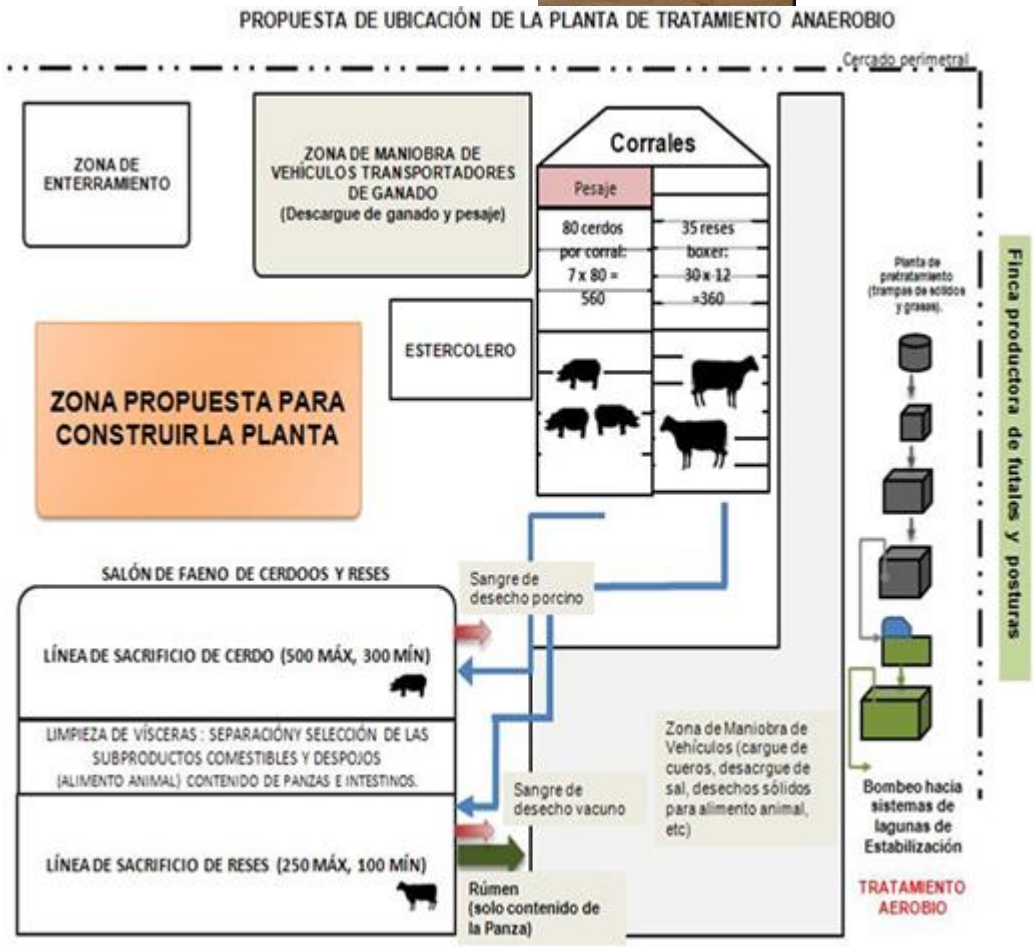
15 MW thermal energy

- Methane potential and biodegradability of rice straw, rice husk and rice residues from the drying process. Water Science and Technology 65 (6).
- Aprovechamiento energético de residuos arroceros por bioconversión. Revista Dyna: Energía y Sostenibilidad. Vol. 1, ISSN: 2254-2833.
- Tratamiento de la paja de arroz mediante fermentación anaerobio en estado seco. Revista Ingeniería Química de Uruguay, Nº 41, ISSN: 0797-4930.
- Energetic, environmental and economic potentialities of the anaerobic treatment of rice straw for the case of the Cuban enterprise 'Sur del Jíbaro'. International. Journal of Global Energy Issues, Vol.37, No. 5/6.

Case of study → Food industry

Slaughterhouse Enterprise

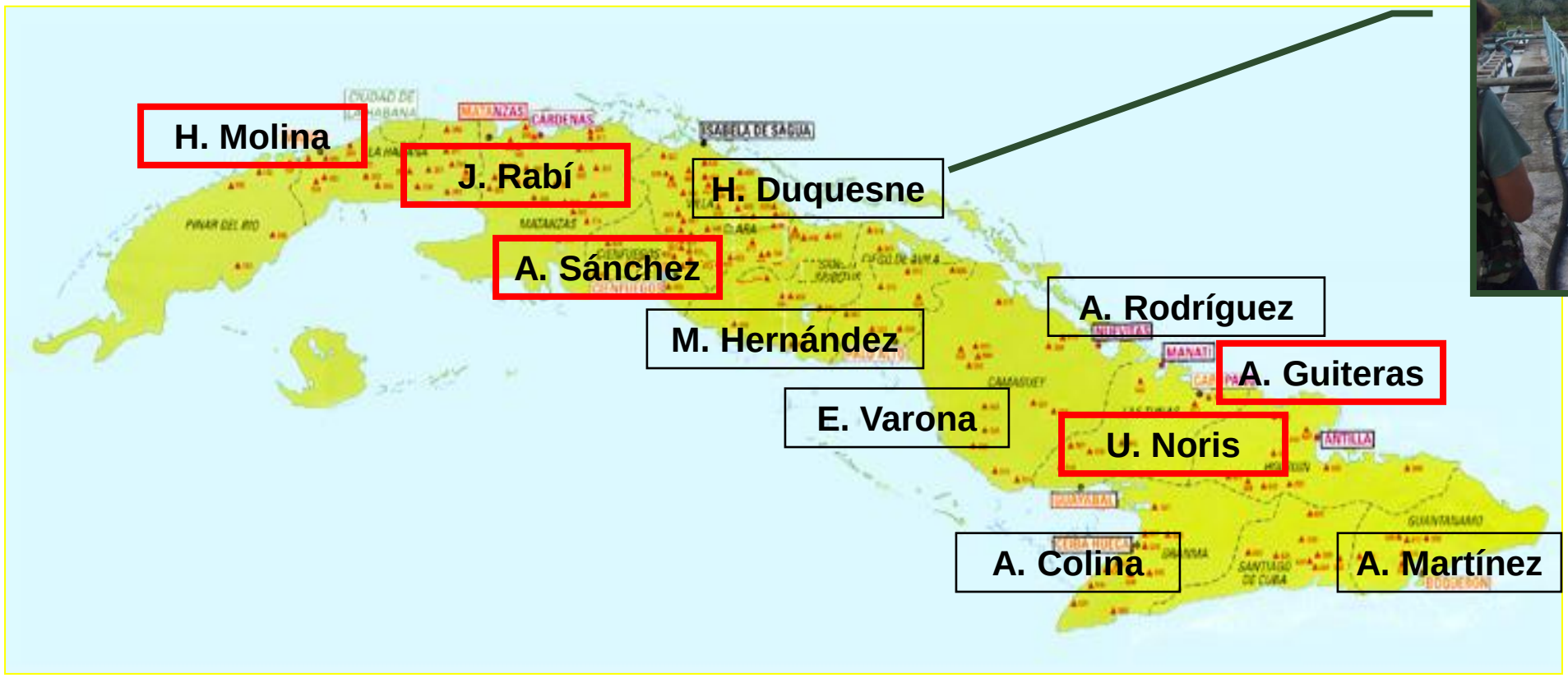
- The residues are sent to a lagoon system which is not working properly
- Inhabitants complains
- The AD could cover 10% of the total energy demanded by the Enterprise



- A comparison of process performance during the anaerobic mono and co-digestion of slaughterhouse waste through different operational modes. Journal of Environmental Science. Doi: 10.1016/j.jes.2017.06.004
- Co-digestion of different waste mixtures from agro-industrial activities: Kinetics evaluation and synergistic effects. *Bioresource Technology* 102 (23), 10 834-10 840.

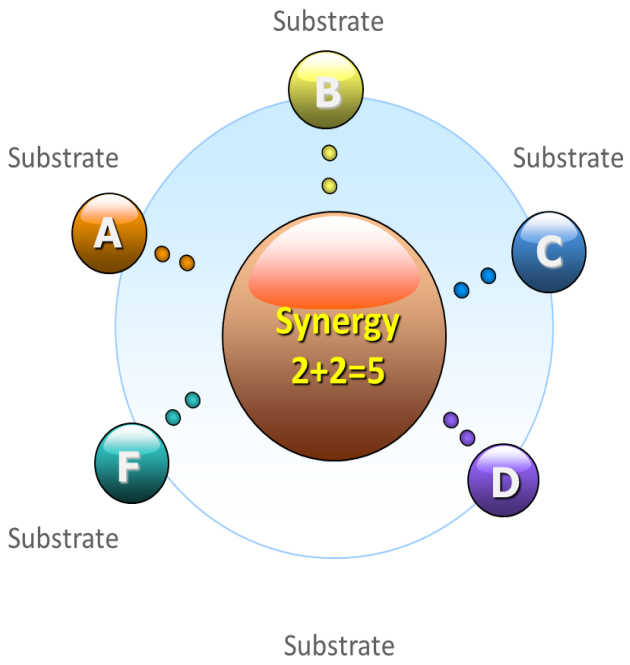
Case of study ➡ Sugar cane industry

Case of study → Sugar cane industry



- Anaerobic digestion of sugar cane vinasse through a methanogenic UASB reactor followed by a packed bed reactor. Applied Biochemical and Biotechnology. Doi: 10.1007/s12010-017-2488-2
- Anaerobic digestion of vinasses by combining an upflow anaerobic filter reactor and ozonation process. *Brazilian Journal of Chemical Engineering,* Vol 33, No. 4

Case of study → Sugar cane industry



Medium size Sugar Mill

- ✓**~ 30 MW**
- ✓**Stable operation 300 d/year**
- ✓**No extra biomass source**

- Anaerobic codigestion of sugarcane pressmud with vinasse on methane yield. Waste Management doi: 10.1016/j.wasman.2017.07.016
- Antagonistic effects on methane yield of liquid hot-water pretreated press mud fractions codigested with vinasse. *Energy & Fuels*, 29(11), 7284-7289.
- Effect of liquid hot water pre-treatment on sugarcane press mud methane yield. *Bioresource Technology*, 169, 284-290.
- Thermo-Chemical pre-Treatment to Solubilize and Improve Anaerobic Biodegradability of Press mud. *Bioresource Technology*, 131, 250–257.

Case of study ⟹ MSW

- ✓MSW in Cuba are generated by **a wide spectrum of sources**
- ✓**Cities** are **covered** by a MSW collection, transportation and disposal system
- ✓**No separation** of MSW at any point in the system
- ✓Final disposal is done in open dumps **without pre-treatment**
- ✓There are more than 900 **open dump sites** along the country

Case of study ➡ MSW

The recycling system is parallel to the MSW sanitation system

UNIÓN DE EMPRESAS DE RECUPERACIÓN DE MATERIAS PRIMAS

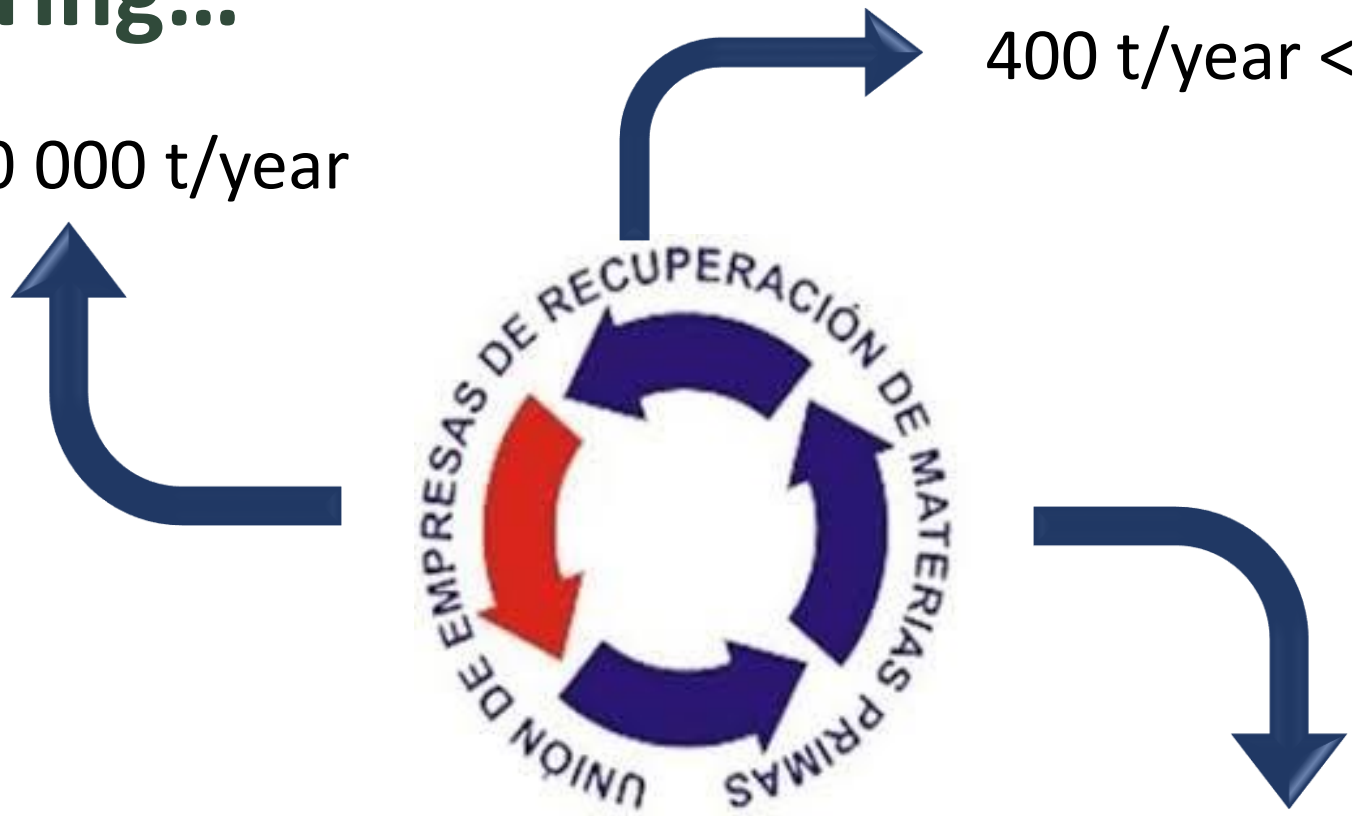
Privates and non-state associations has in the Recovering and recycling system, a business opportunity

Local companies are responsible of collection, recovery and processing of waste

Recovering…

400 t/year < **Glass** < 1 500 t/year

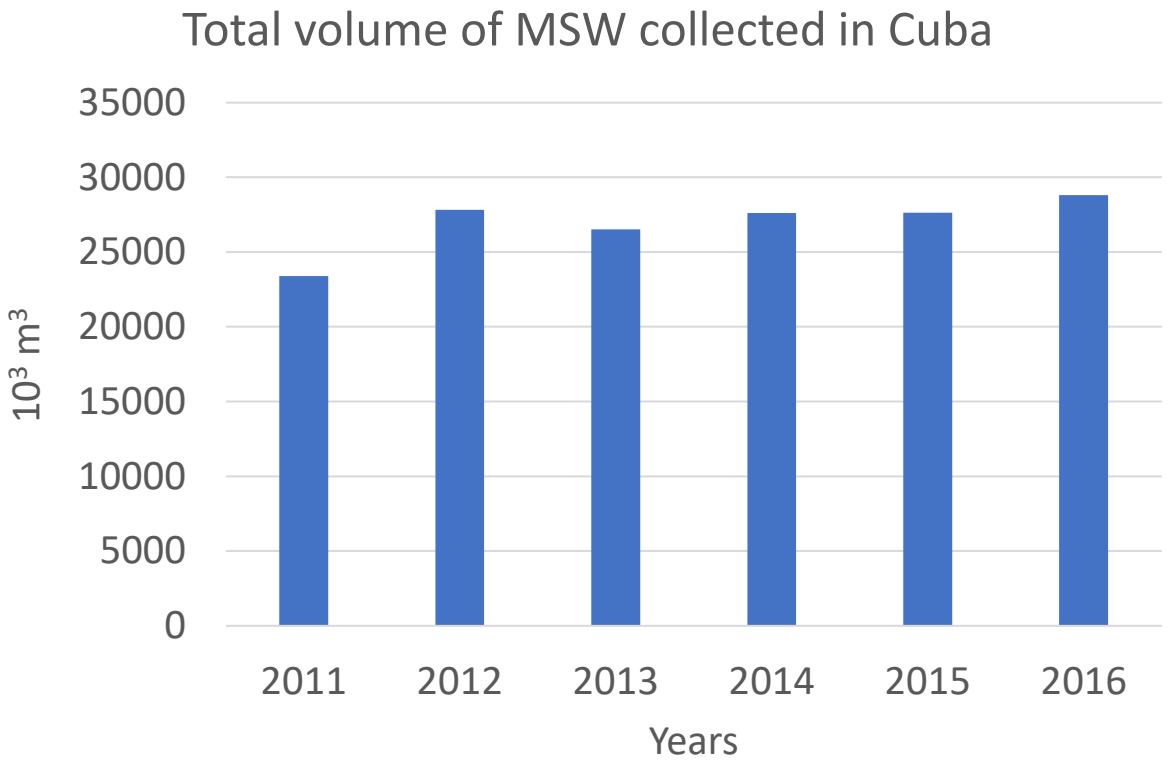
Steel > 200 000 t/year

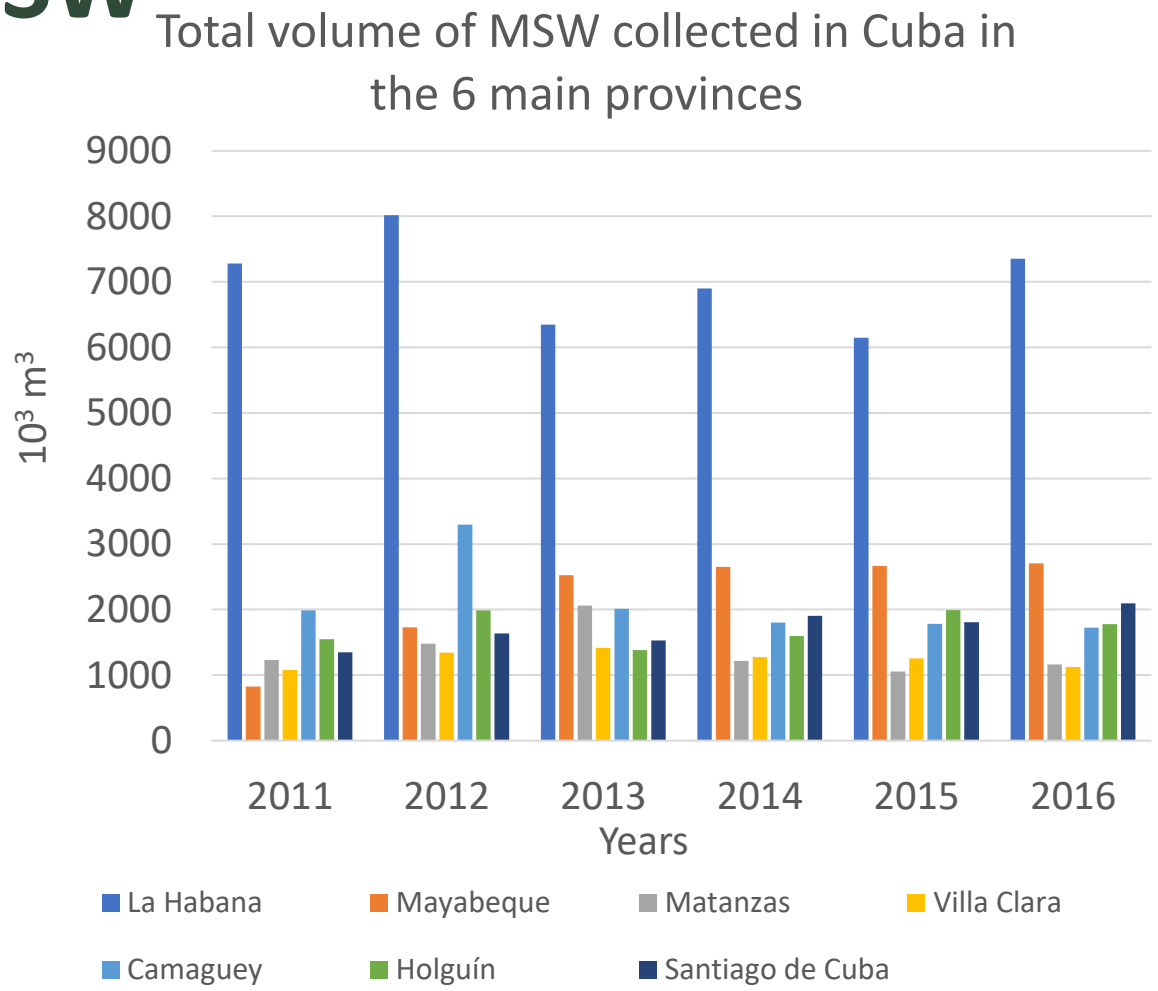


12 000 t/year < **Aluminium** < 16 000 t/year

Source: ONEI, 2017 (National Office of Statistics and Information of Cuba)

Case of study → MSW

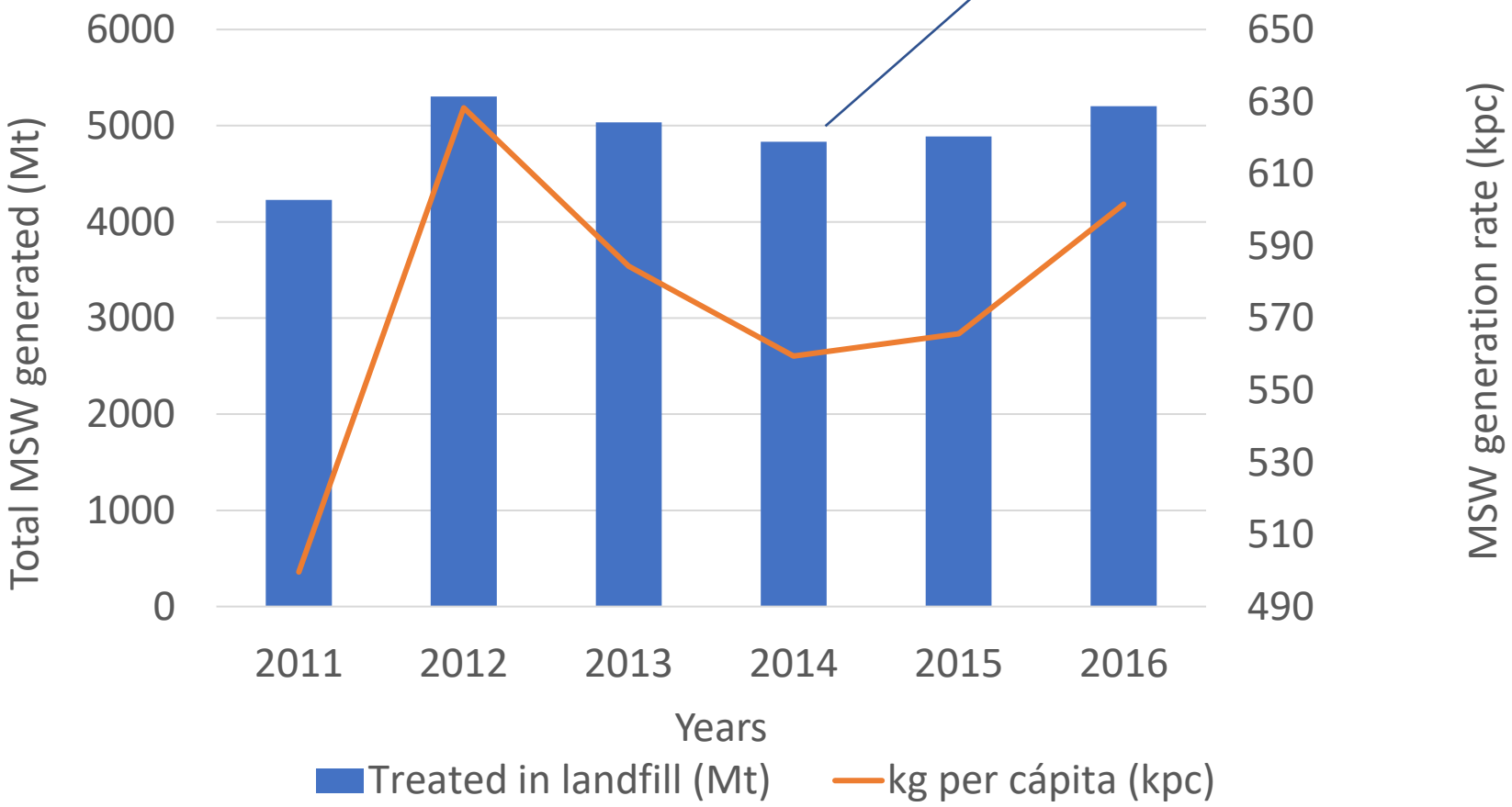




Source: ONEI, 2017 (National Office of Statistics and Information of Cuba)

Case of study → MSW

~ 1.5 kg/inhabitan/d



Espinosa et al (2019)
0.68-0.72 kg/inhabitan/d

Source: ONEI, 2017 (National Office of Statistics and Information of Cuba)

Case of study → MSW

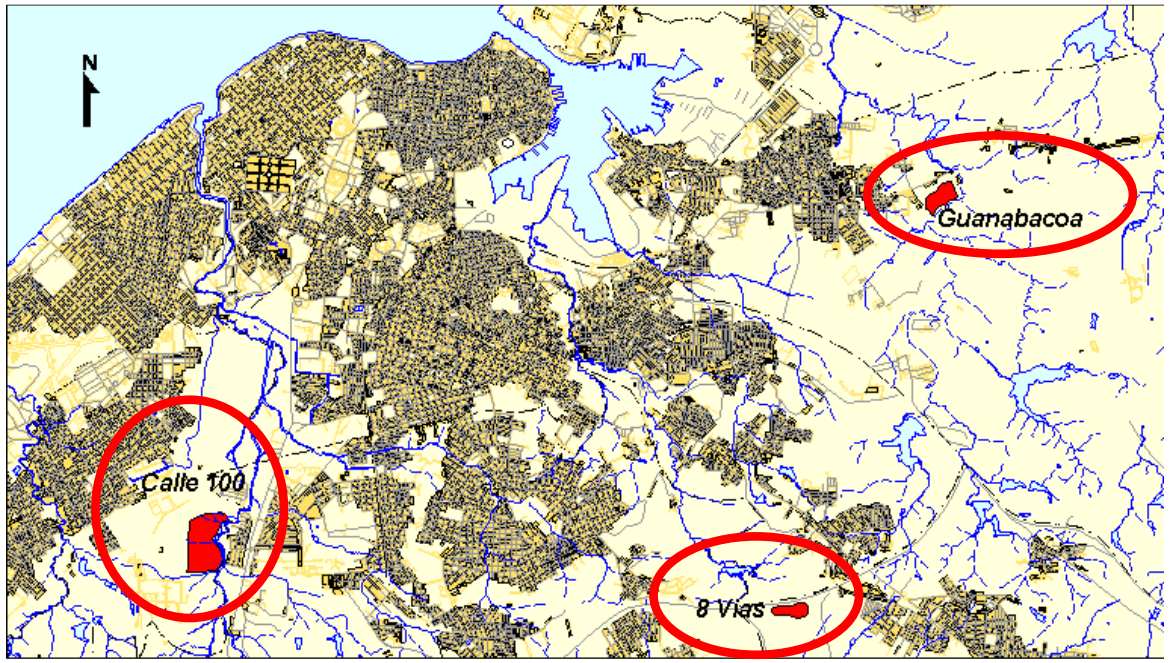
Landfills in Havana

Name of landfill	Calle 100	Guanabacoa	8 vías
Disposal area (ha)	104	28	30
Estimated closure date	2008	2006	2014
Build-up year	1976	1976	1976
Amount of waste received daily (t/d)	1510	349	353
Type of waste	Municipal	Municipal	Industrial and municipal

Potential

~ 45 MWe

~ 55 MWth



• Co-digestion of bovine slaughterhouse wastes, cow manure, various crops and municipal solid waste at thermophilic conditions: a comparison with specific case running at mesophilic conditions. Water Science and Technology 67, 989-995.

Then....

- Biogas production is still low….unfortunately
- Biogas use is local, mainly for cooking…..Expectations: power generation
- Transition in Cuba: The use of electric vehicles
- Cuba has a political framework approved, but little is done in terms of biogas

...we need

Transition toward a sustainable ecological dimension into economical development plans

Challenges? Opportunities?! Conclusions

- ✓Change the predominantly conventional waste management methods which do not effectively address local conditions
- ✓Cover the opportunities for innovative integrated approach for sustainable waste management such as the 3Rs, biological techs that involve all stakeholders including the community and the informal sector
- ✓Reach an integral waste management in Cuba, including a new model in the waste culture, financing issues, institutional framework and technical and human capacities
- ✓**Looking forward the development of resource-efficient biogas solutions**

Isaac Cordal. Politicians discussing Global Warming

Biogas can make the difference

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