Benefits of switching from incineration to sterilisation of health-care waste in Beira, Mozambique: sustainability, reuse of treated material, safety at work.

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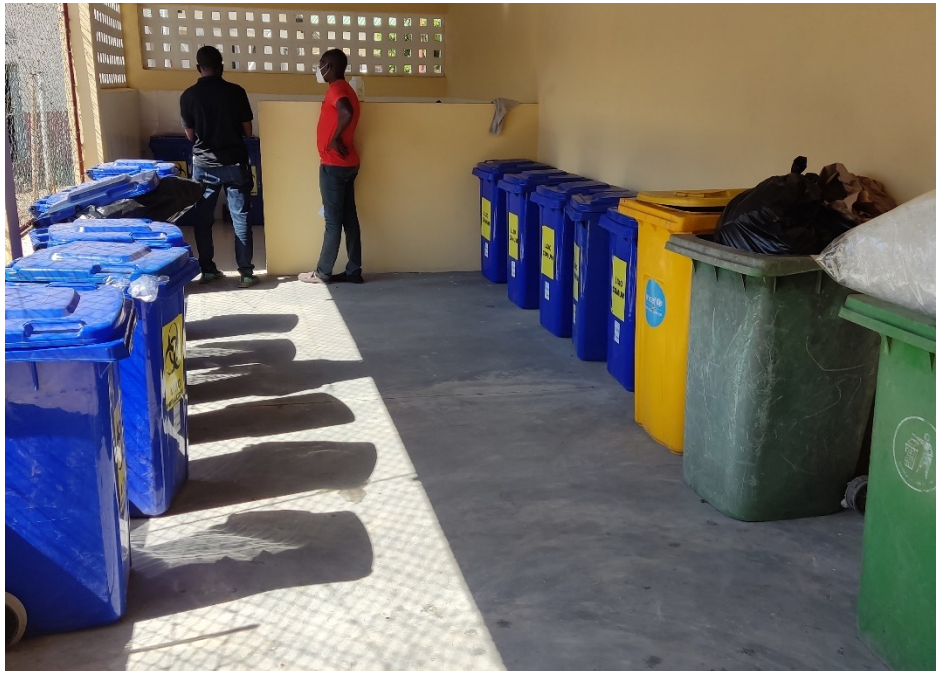
Introduction
Health-care waste, Biomedical Solid Waste, treatment alternatives

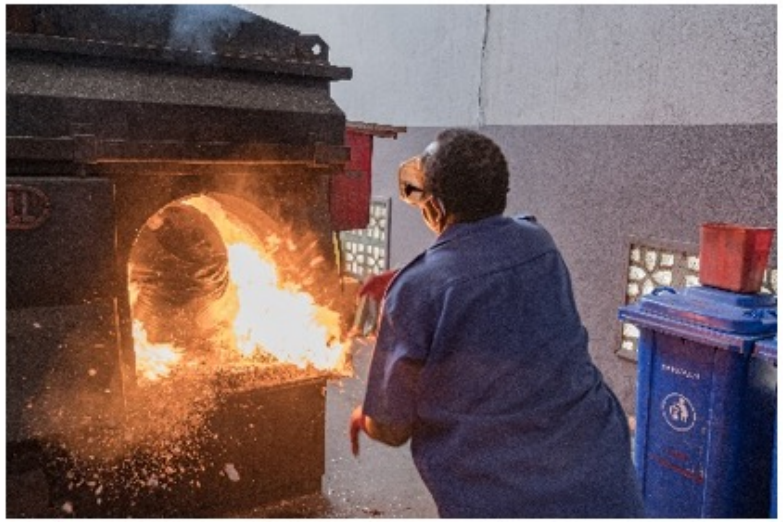
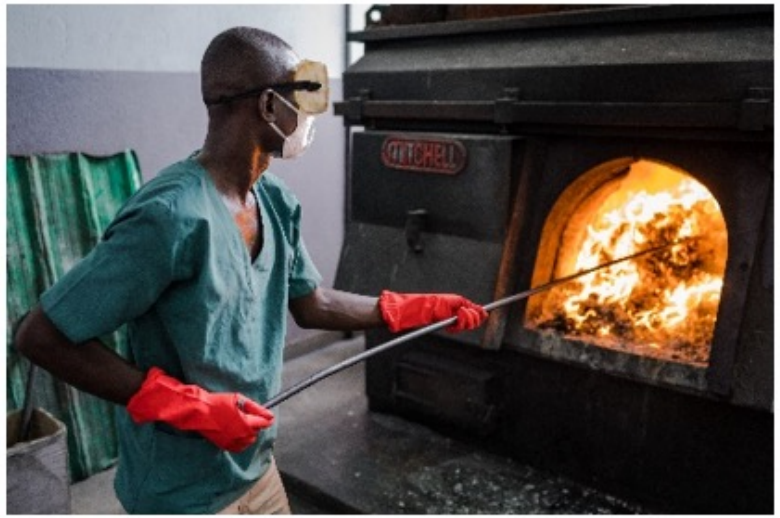
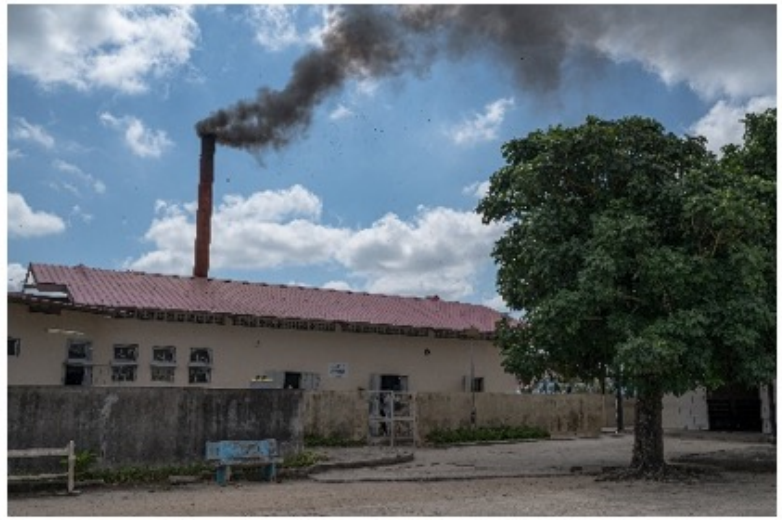
Health-care waste
- 85% common waste
- 15% hazardous waste (Biomedical Solid Waste)

“Today, there are virtually no environmentally friendly and cost-effective options for the safe disposal of BSW” (WHO)

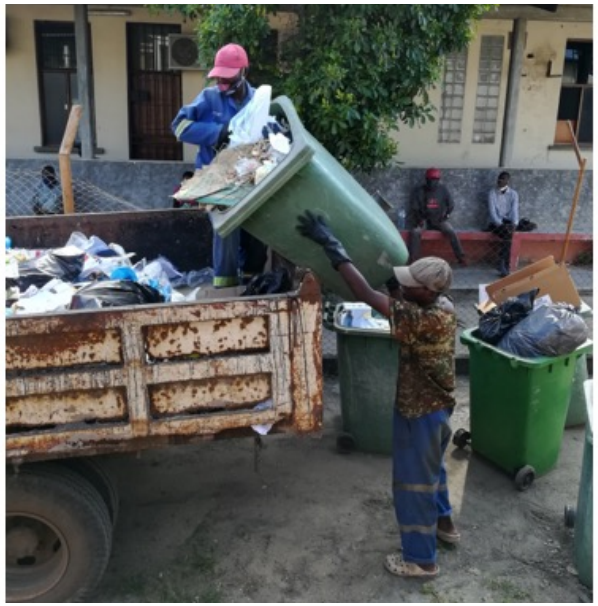
Incineration vs non-incineration techniques.

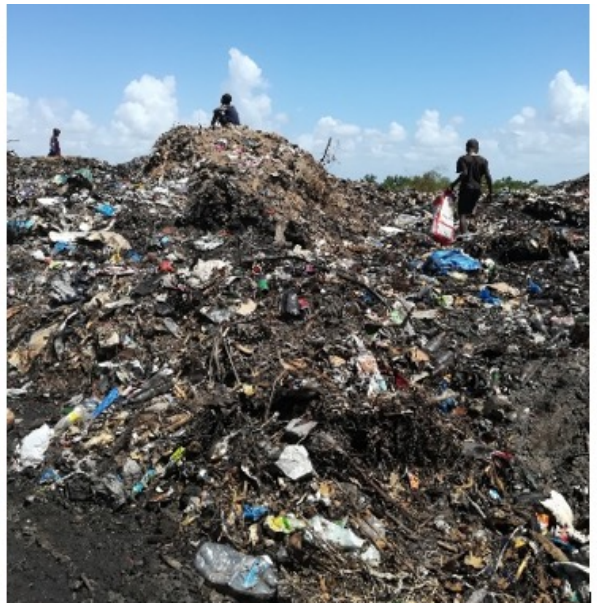


Why is it important to conduct this research and aims of the paper

Incineration of HSW in Beira Central Hospital. Credits to Paolo Ghisu.





Other “treatments” and final disposal alternatives for HSW in Beira.

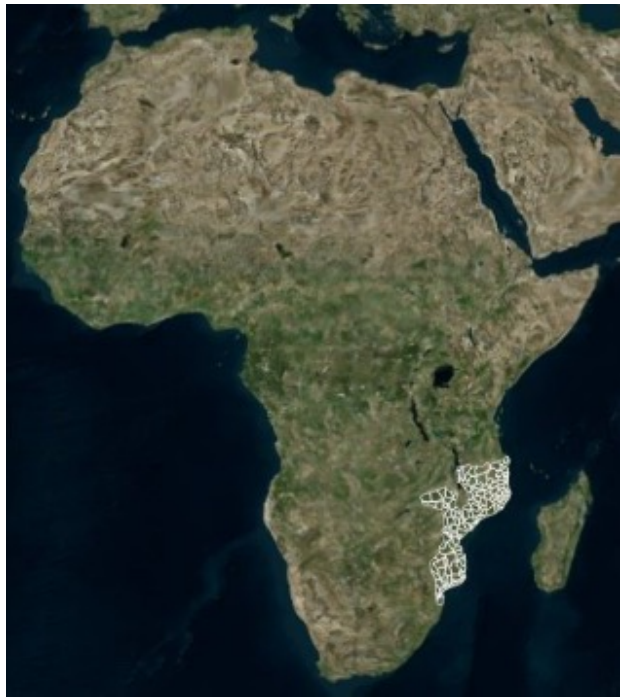
1- Sustainability: environmental, economic, social

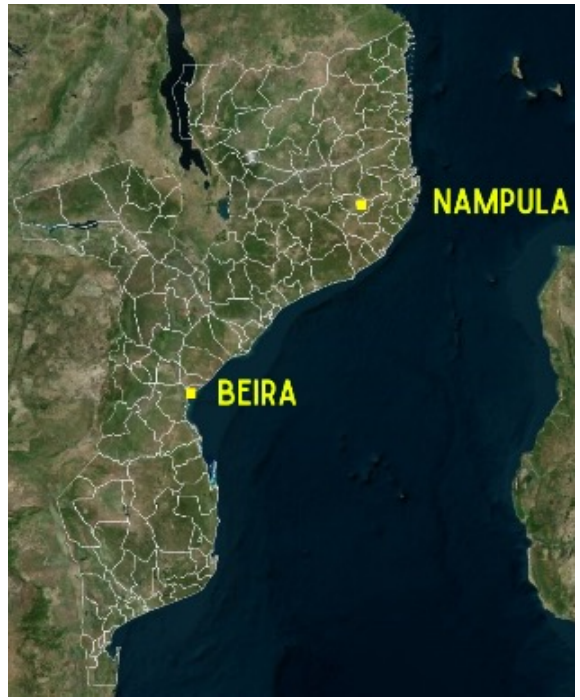
2- Final Disposal vs Circular Economy

3- Health and safety conditions for waste operators

Methodology

- Alternating academic research in Italy and fieldwork in Mozambique
- How to approach a completely different context than that which I am familiar with?
  - ✓ Intensive and frequent fieldwork
  - ✓ Do not focus just on technical aspects
  - ✓ Develop a clear state of art and continue to deepen it





Mozambique HDI: 0.446 → 185th/191 countries
Beira: capital of Sofála province, 673,685 inhabitants, 16 Health Units of National Health Service including a Central Hospital with the only incinerator in the city.

Since September 2022 → a new electric sterilizer

1. LimpaMOS MOÇambique project
2. SIRSU project

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LIMPAMOZ

LimpaMOS MOÇambique: Programa pelo fortalecimento da Gestão dos Resíduos Sólidos Urbanos nas Cidades de Beira e Nampula

PROGETTOMONDO

CAM Consorzio Associazioni con il Mozambico

UNIVERSITY OF TRENTO - Italy Department of Civil, Environmental and Mechanical Engineering

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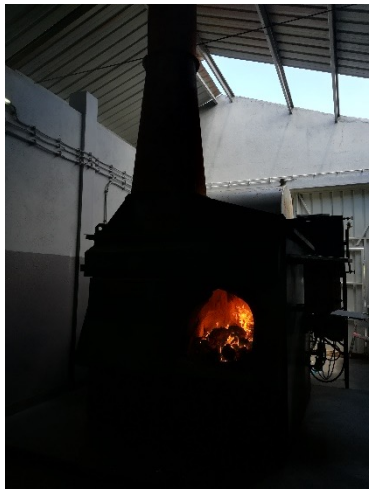
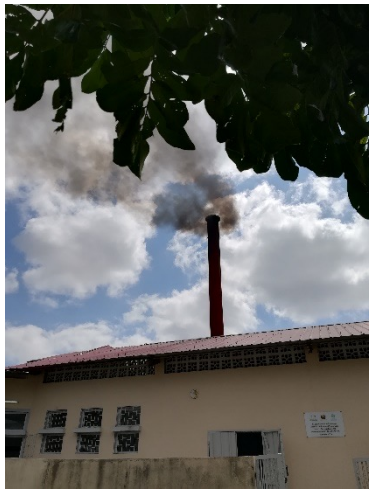
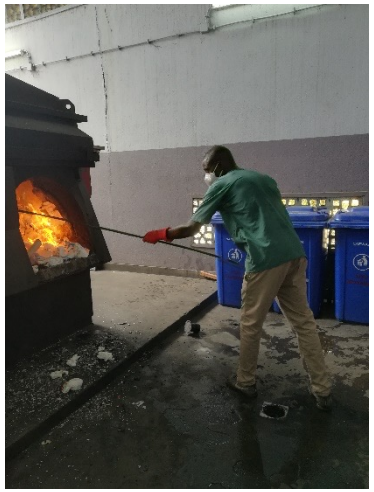
FONDAZIONE EDMUND MACH CENTRO TRASFERIMENTO TECNOLOGICO

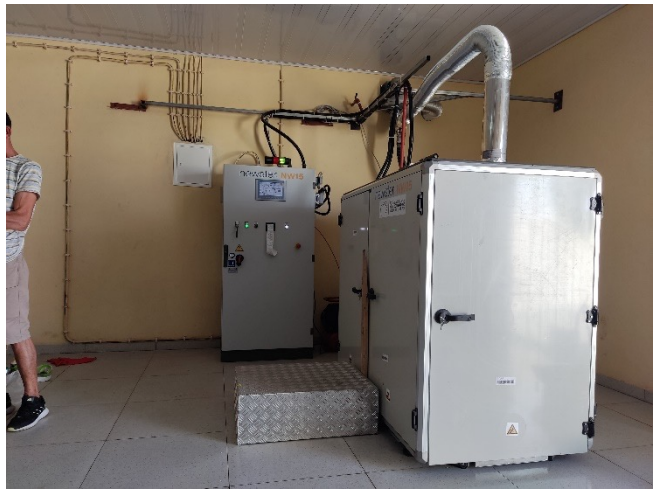
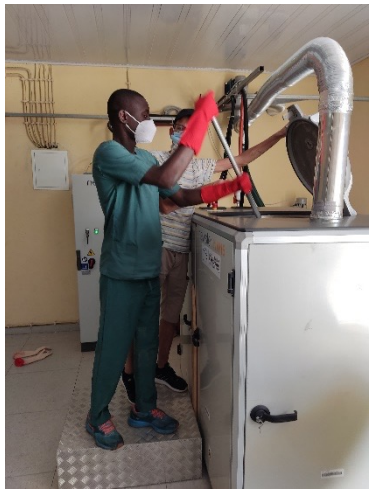
Aim 1 – Sustainability: environmental, economic and social aspects

Emissions: evidences. EIA, nor other studies ever conducted.

- Burning waste T<850°C, no fundamental prevention strategy against furans and dioxins
- No CO probe to check combustion quality
- No filtration system, stack often damaged

Emission factors can be 3-4 orders of magnitude higher than for EU-type incinerators for some parameters.

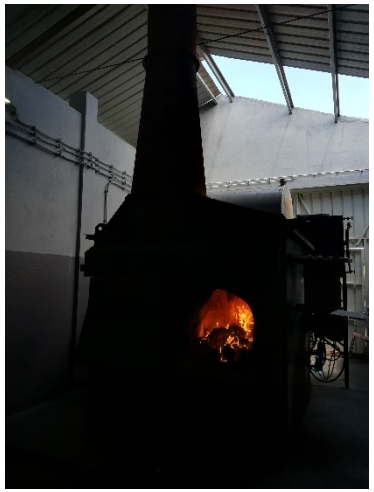
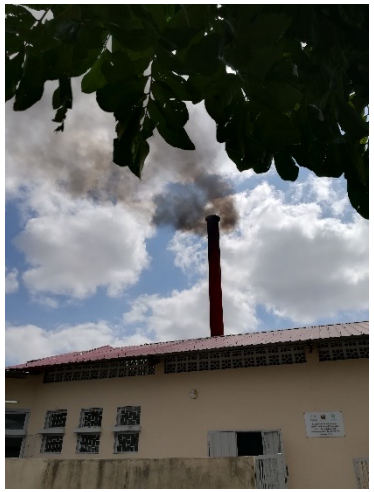
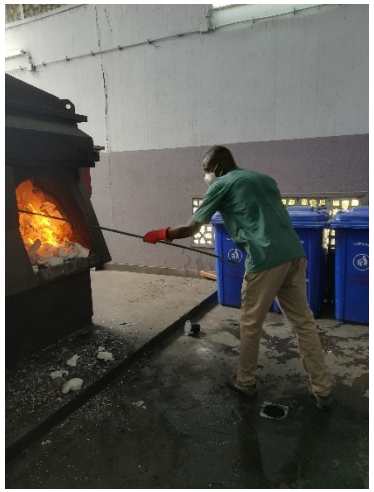



Very low emissions: Newster studies on impact
LCA and Environmental Authorisations for discharge into public sewer and emissions into atmosphere

- Occasional emission, with very low flow rate
- Activated carbon filter and absolute filter
- Listed among Best Available Technologies in the Stockholm Convention

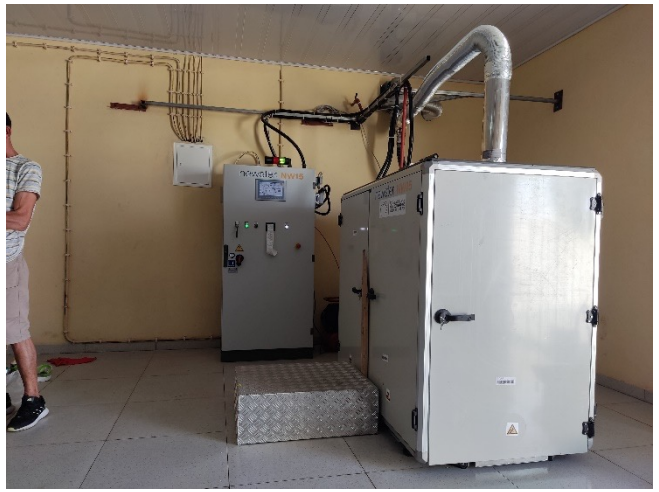
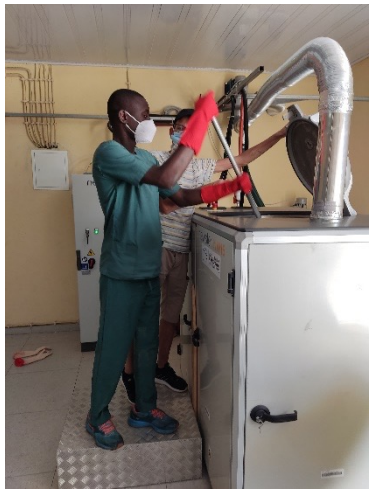
Emissions so low that even in Italy it is not mandatory to sample them, according to technical standards for sampling atmospheric emissions.

Aim 1 – Sustainability: environmental, economic and social aspects

Operating cost recovery? Yes, but sunk investment

Rather low operating and maintenance costs
- Fuel consumption
- Minimal maintenance
- 6 working hours per day

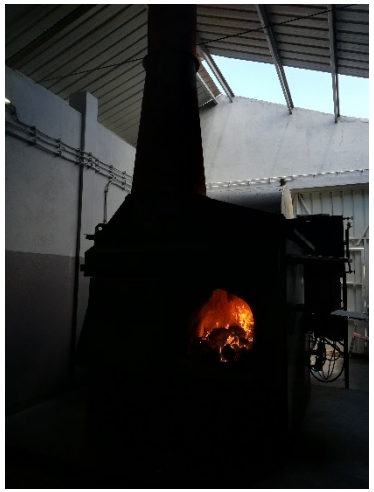
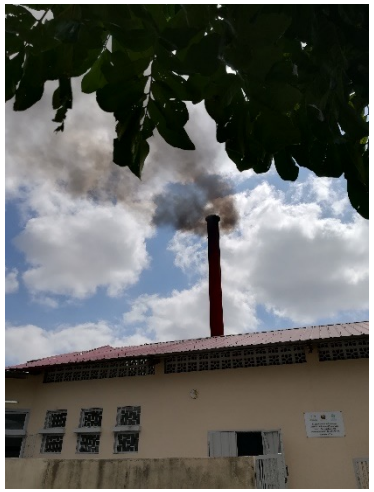
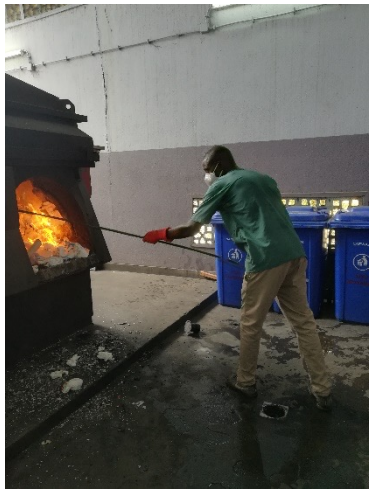
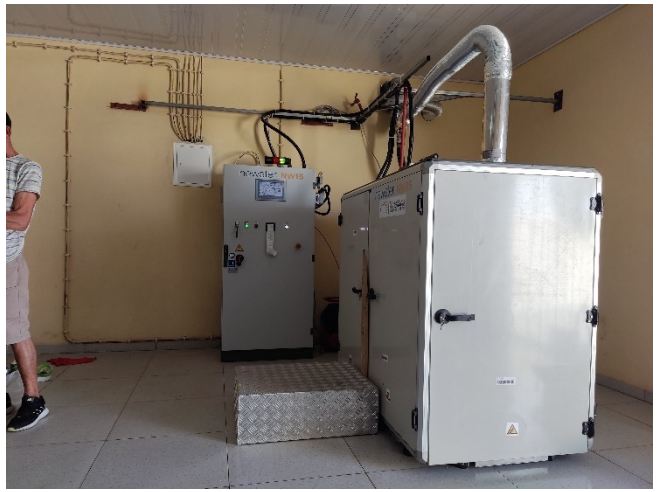
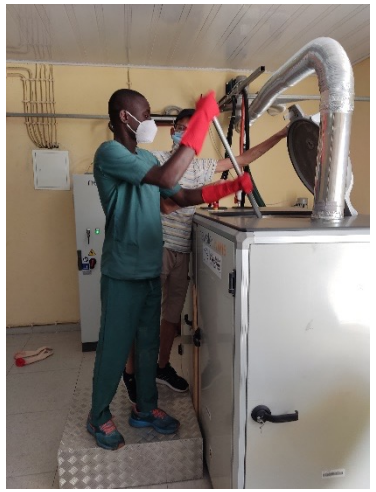



Operating cost recovery? SABE: local & CE

High operating and maintenance costs
- Water & electricity consumption
- Rather expensive maintenance (spare parts)
- More working hours per day
- Permits, taxes and SABE maintenance

SABE, LDA
Beira Environmental Services

Aim 1 – Sustainability: environmental, economic and social aspects

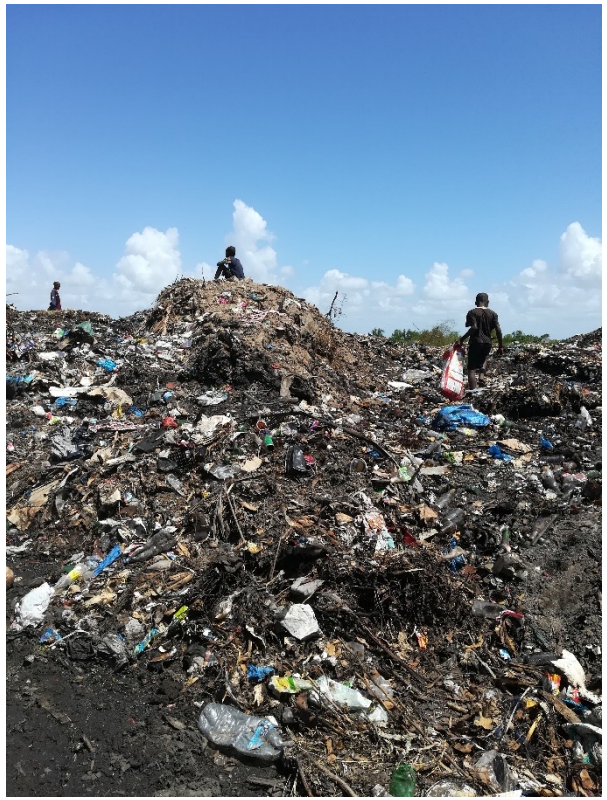






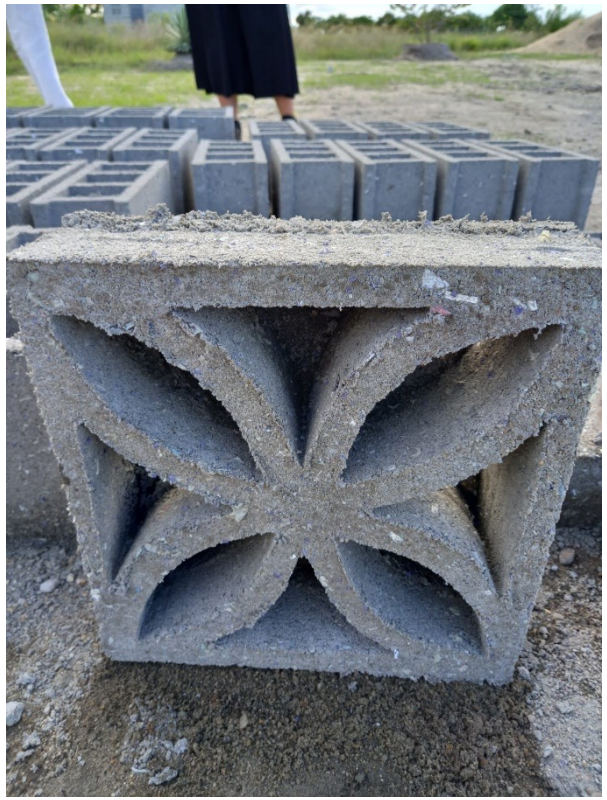
→ Aim 3 – Health & safety at work

Others:

Conflict resolution between Beira Central Hospital and local residents
Strengthening local entrepreneurship
Reducing emissions and the risk of related diseases
…

Aim 2 – CE for the BSW: reusing output sterilized material





- Bottom ash unsafe disposal in uncontrolled landfill, where many waste pickers work
- T<850°C → no complete destruction of sharps
- No ash management process provided by BCH

- Dry, safe and sterilised output material (landfill?)
- Derived fuel with high calorific value (e.g., in WtE plants or in cement factories)
- Secondary material in building aggregates (e.g., pavements, bricks, light mixture)
- Zimbabwe experience

Aim 3 – Ensure health and safety conditions for waste operators

	Incinerator	Steriliser
Before loading	• Wear the PPE (not always available) • Start the fire with fuel (gasoline)	• Wear the PPE • Weigh the correct waste amount in accordance with the capacity of the sterilising machine
Waste loading	• Order: combustion criteria/random • Very dangerous manual insertion by throwing waste bags and carton boxes for sharps • No lid closure because of his absence	• Order: a precise load order exists • Manual insertion of bags and carton boxes with the machine switched off and using a special stick (boat hook) to facilitate loading • The machine can't start until the lid is open.
During treatment cycle	• Very dangerous manual insertion of waste and fuel • Check that combustion takes place correctly and turning of the material • In case of any problem: no plans; personal evaluation	• Close the lid and operate the machine by pressing a button on the control panel • Just wait • In case of any problem: automatic stop of the machine; instruction manual; phone technical assistance provided by Newster
After the treatment	• Manual ash removal (very infrequent) with no safety procedures/PPE • No daily cleaning operations	• Automatic discharge of the output material • No daily cleaning operations

Conclusions & future developments

For decades, many criticalities and negative impacts of HCW incinerators in low-income contexts have been identified.

It is time to change the approach by restricting their use and switching to viable alternatives.

Further analysis: Improved impact measurements in Beira & economic estimates of the damage from environmental and social impacts caused by poor HCWM; continue studies on possible re-uses of output sterilised material in Beira

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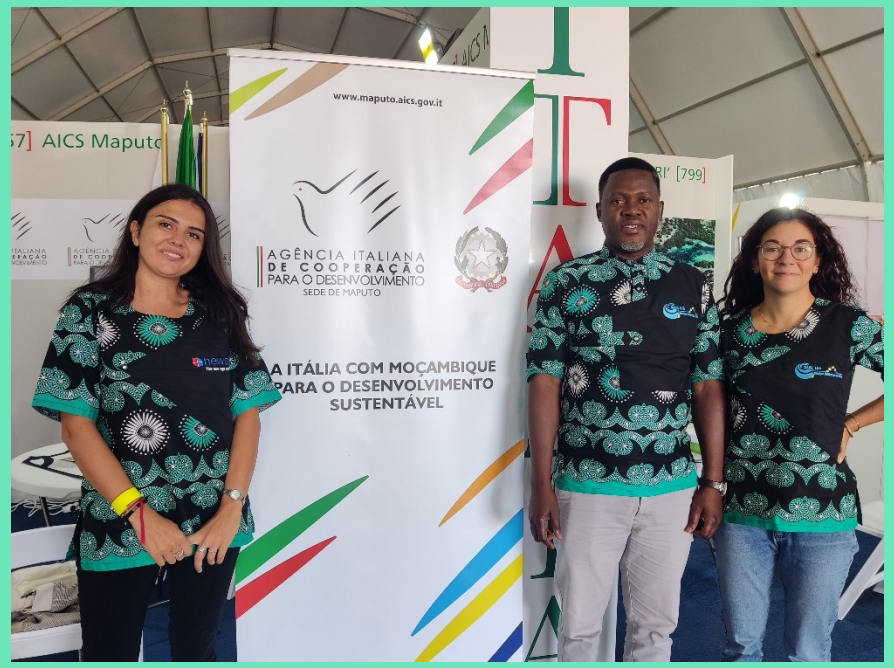
Thanks for your attention!



Mozambique is one of the world's lowest-income countries, where sustainable technological progress needs to be driven by developing strategies with - not for - local stakeholders.

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