Development of a Low Tech Carbonising Process for Management by Small Enterprises.

Oliver Ive – Amanz' abantu Services

P Kanise – Impilo Yabantu Services

Researchers: A McDonell, M Wilkinson & D Naidoo

African Water Facility
Facilité africaine de l'eau
Mobilising Resources for Water in Africa
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Background

- Started piloting social franchising of water services in Butterworth in 2009 under the brand of Impilo Yabantu Services.
- Impilo Yabantu means “Hygiene for People” in isi-Xhosa

Context: Social Franchising

Social franchising is: *"the application of commercial franchising concepts to achieve socially beneficial ends"* (Montagu 2002)

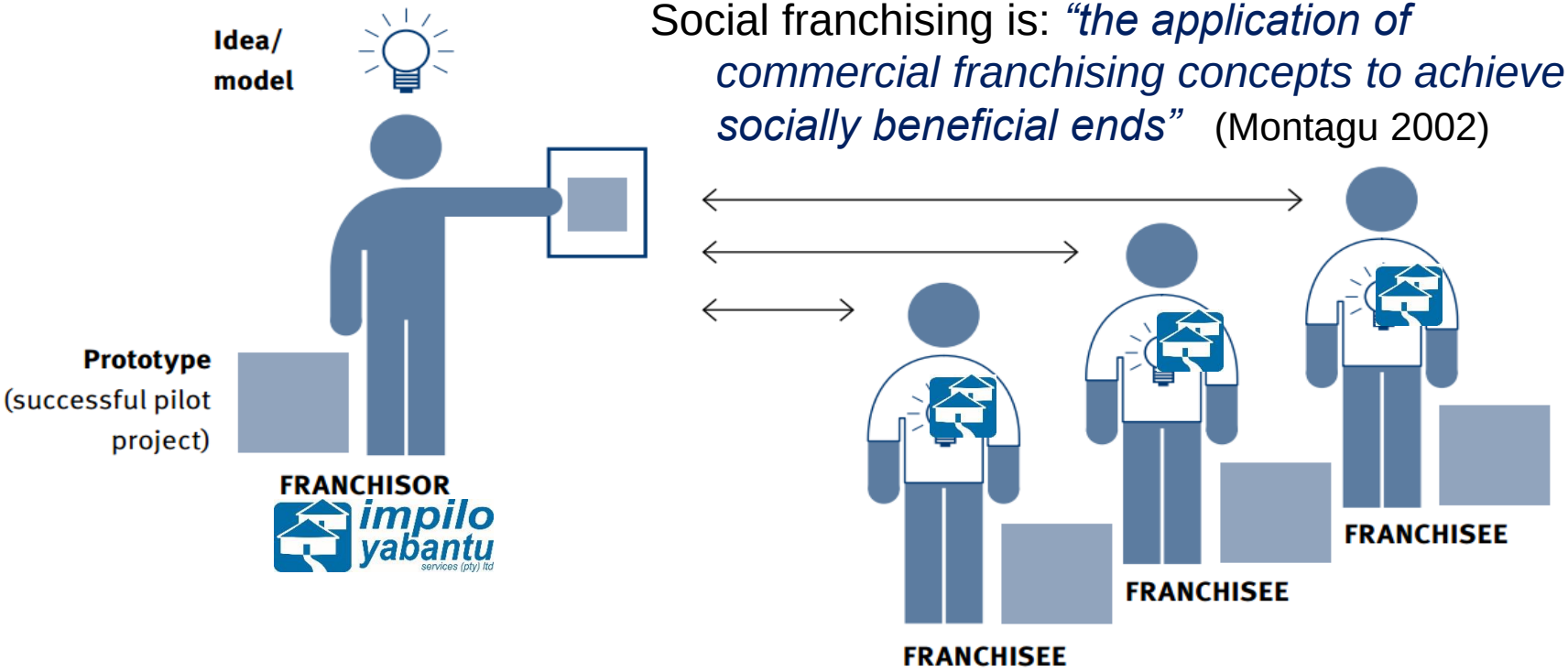


Image based on Ahlert et al (2008) *Social Franchising: A Way of Systematic Replication to Increase Social Impact* [Online] available from <http://www.stiftungen.org/fileadmin/bvds/de/Projekte/Projekttransfer/Social_Franchise_Manual_Englisch.pdf >

Regulatory Matters

- The Department of Water and Sanitation (DWS), Department of Environmental Affairs (DEA), Department of Health (DoH) and the Department of Agriculture (DoA) all have a regulatory role to play in the beneficial use of sludge
- Primarily three legislative instruments, namely Environmental Authorisation (NEMA), Air Emission Licence (NEM: AQA), and Waste Management Licence (NEM: Waste Act)

Legal & Regulatory Considerations

Transport and Storage

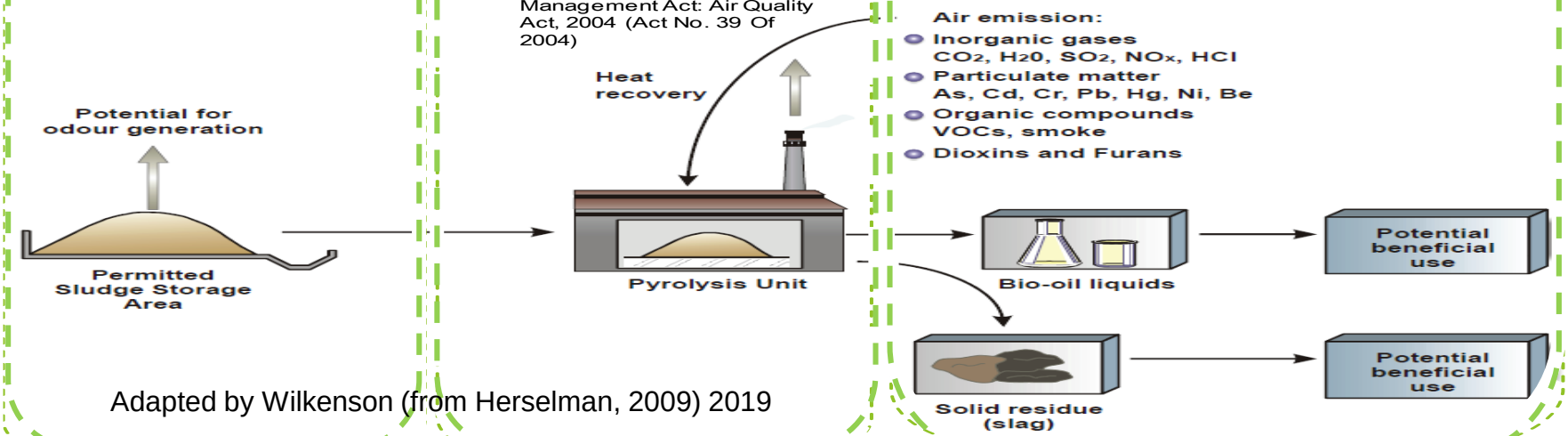
1. National Environmental Management: Waste Management Act
2. Hazardous Substances Act (Act No 15 of 1973)

Treatment & Process

1. National Environmental Management Act: EIA Regulations
2. National Environmental Management Act: Air Quality Act, 2004 (Act No. 39 Of 2004): Declaration Of A Small -Scale Char And Small -Scale Charcoal Plants As Controlled Emitters And Establishment Of Emission Standards
3. National Environmental Management Act: Air Quality Act, 2004 (Act No. 39 Of 2004)

Products

1. NEM:AQ Listed Activities
2. National Policy On Thermal Treatment Of General And Hazardous Waste
3. Fertilizer, Farm Feed, Agricultural Remedies and Stock Remedies Act
4. Hazardous Substances Act (Act No 15 of 1973)
5. National Health Act (Act 61 of 2003)



Adapted by Wilkenson (from Herselman, 2009) 2019

Options Considered

1: La De Pa Sludge Processing and Marketing
2: Wastewater Treatment Works Disposal
3: Lime Treatment and On-site Disposal
4: Biomass Portable Biogenic Refinery
5: Low Tech Biochar Production (Selected)

Project investigation report - McDonell 2018

Sludge Disposal

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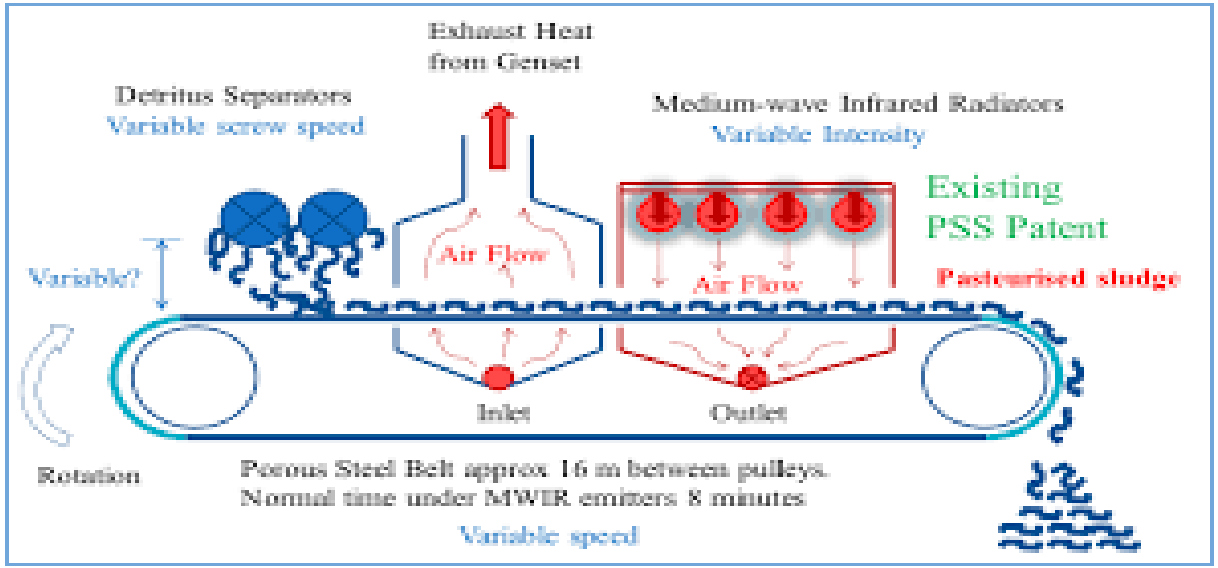
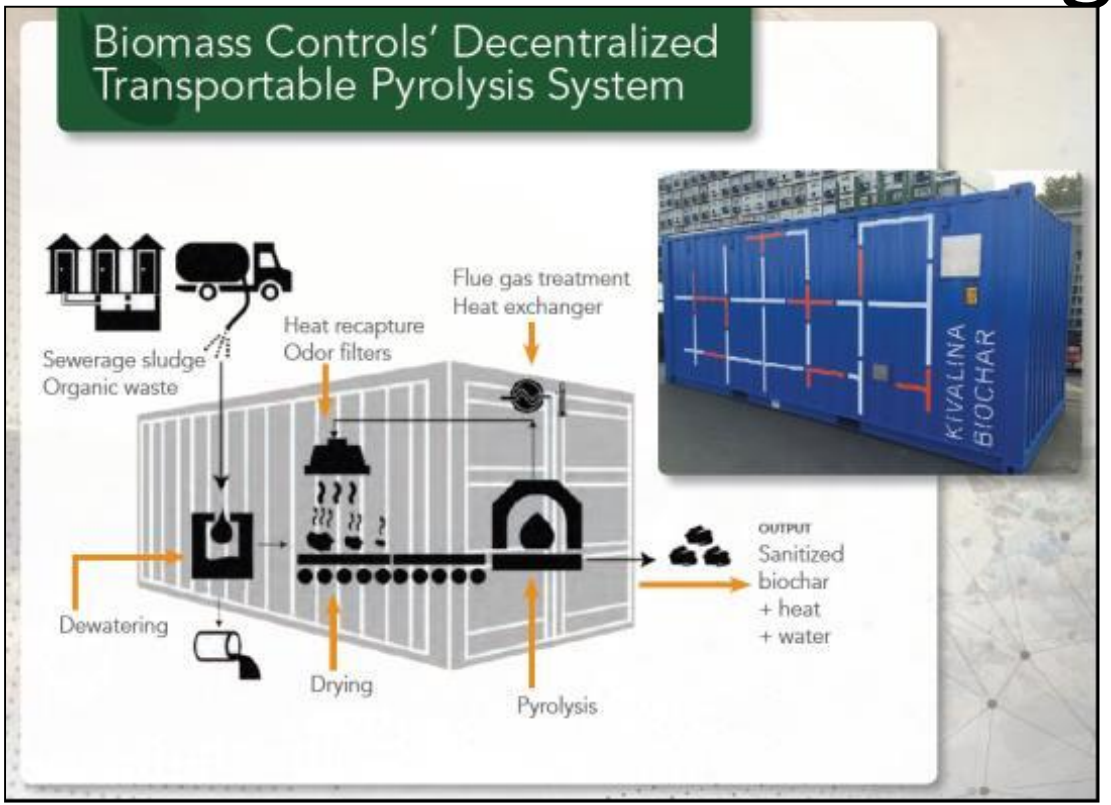
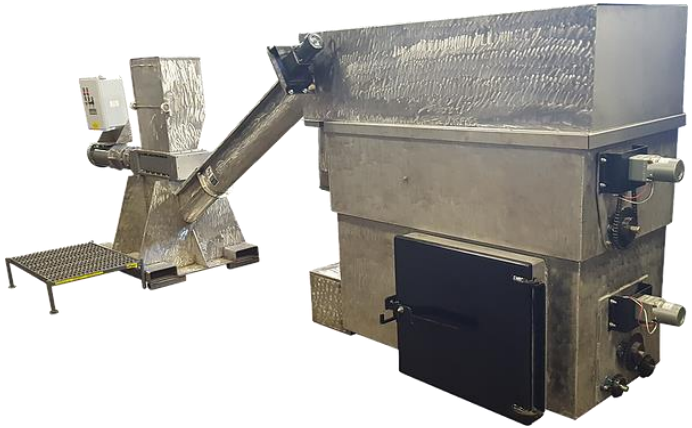

Exhaust Heat
from Genset
Detritus Separators
Variable screw speed
Medium-wave Infrared Radiators
Variable Intensity
Existing
PSS Patent
Air Flow
Air Flow
Pasteurised sludge
Variable?
Inlet
Outlet
Rotation
Porous Steel Belt approx 16 m between pulleys.
Normal time under MWIR emitters 8 minutes
Variable speed


SLUDGE TREATMENT JOINT VENTURE:
PATENT REGISTRATION NUMBER: 2010/23800
ETHEKWINI MUNICIPALITY
TREATMENT JOINT VENTURE:
PSS
PARTICLE SEPARATION TECHNOLOGIES (PTY) LTD
GEHL

Biomass Portable Biogenic Refinery



Biomass Portable Biogenic Refinery Processes



Biomass Portable Biogenic Refinery Unit

Why Low-tech carbonising

- Labour intensive
- Simple operating
- Easy maintenance for remote locations
- Low capital cost
- Low external energy requirement

Why Thermal Treatment?

- Destruction of pathagenic contamination including helminth eggs etc.
- Transformation of Faecal Sludge from a hazardous waste to a safe and beneficial product for use in the communities where it is sourced.

Faecal Sludge to “Biochar”.

- Biochar is the *char product that is created through the heating of organic biomass in a low or no-oxygen environment through a process called pyrolysis, and is then applied to* ***agricultural or forest soils***

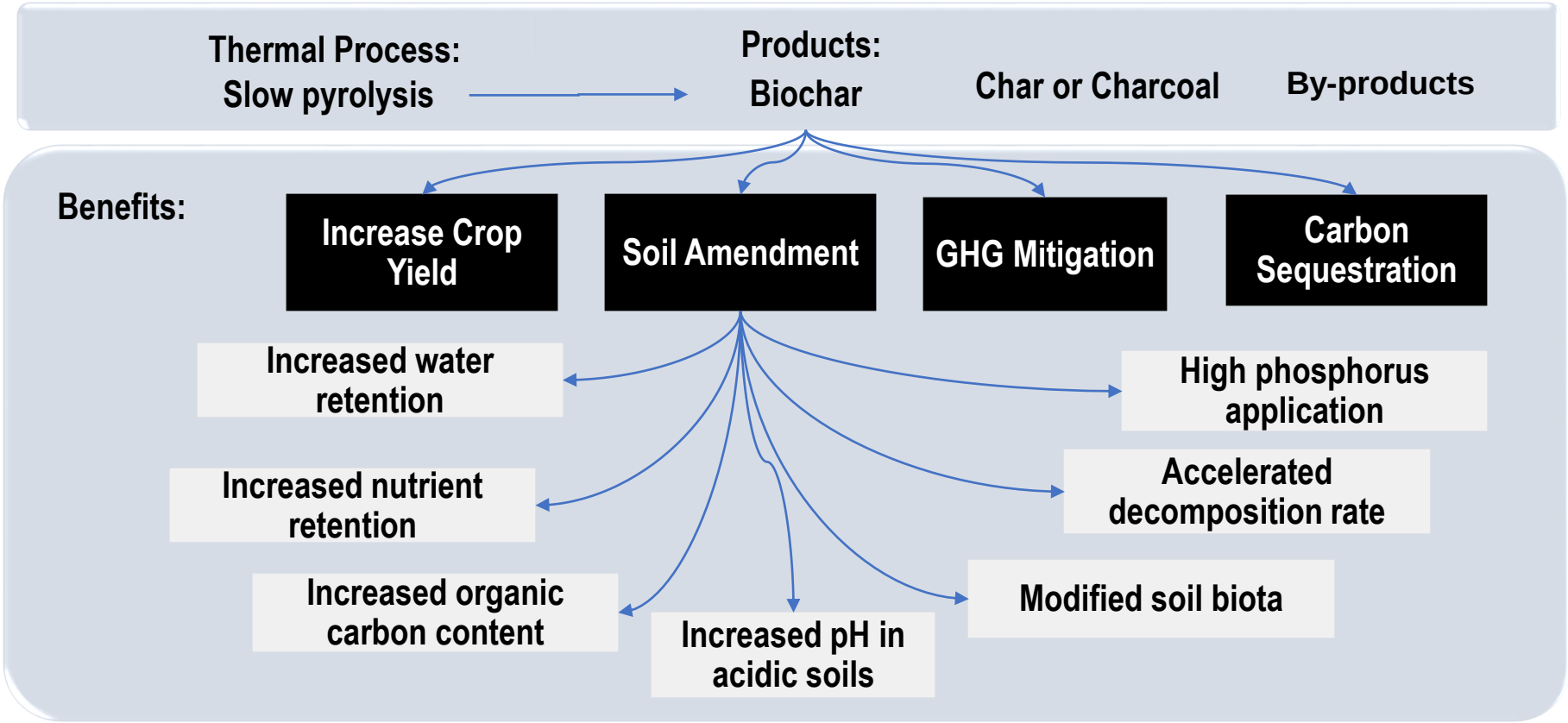
  (Department of Environmental Affairs 2015).

Why Biochar?

- Biochar supports agricultural sustainability, food security and livelihoods for resource-poor farmers in Africa and beyond
- Use of biochar is not only for soil enrichment but also for the contribution as a carbon sink and its value in carbon sequestration

(Leach et al. 2012).

Benefits of Biochar

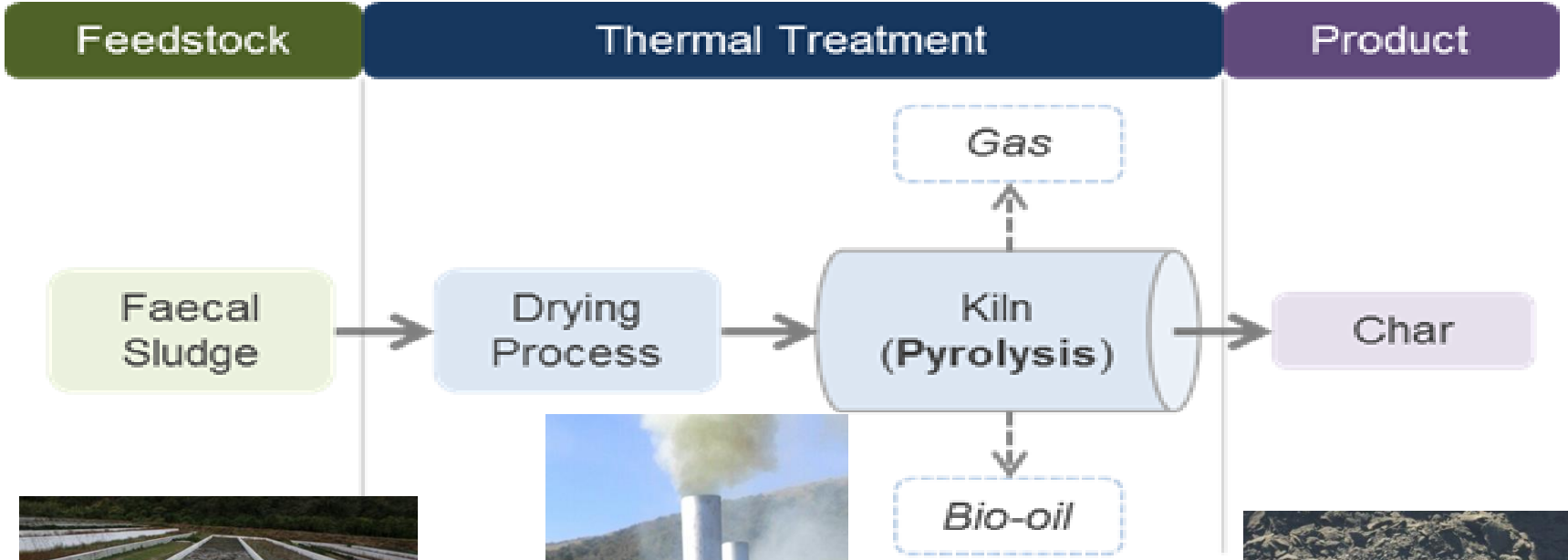


Faecal sludge beneficiation options for consideration by Social Franchises in the East London areas (Wilkenson, 2019)

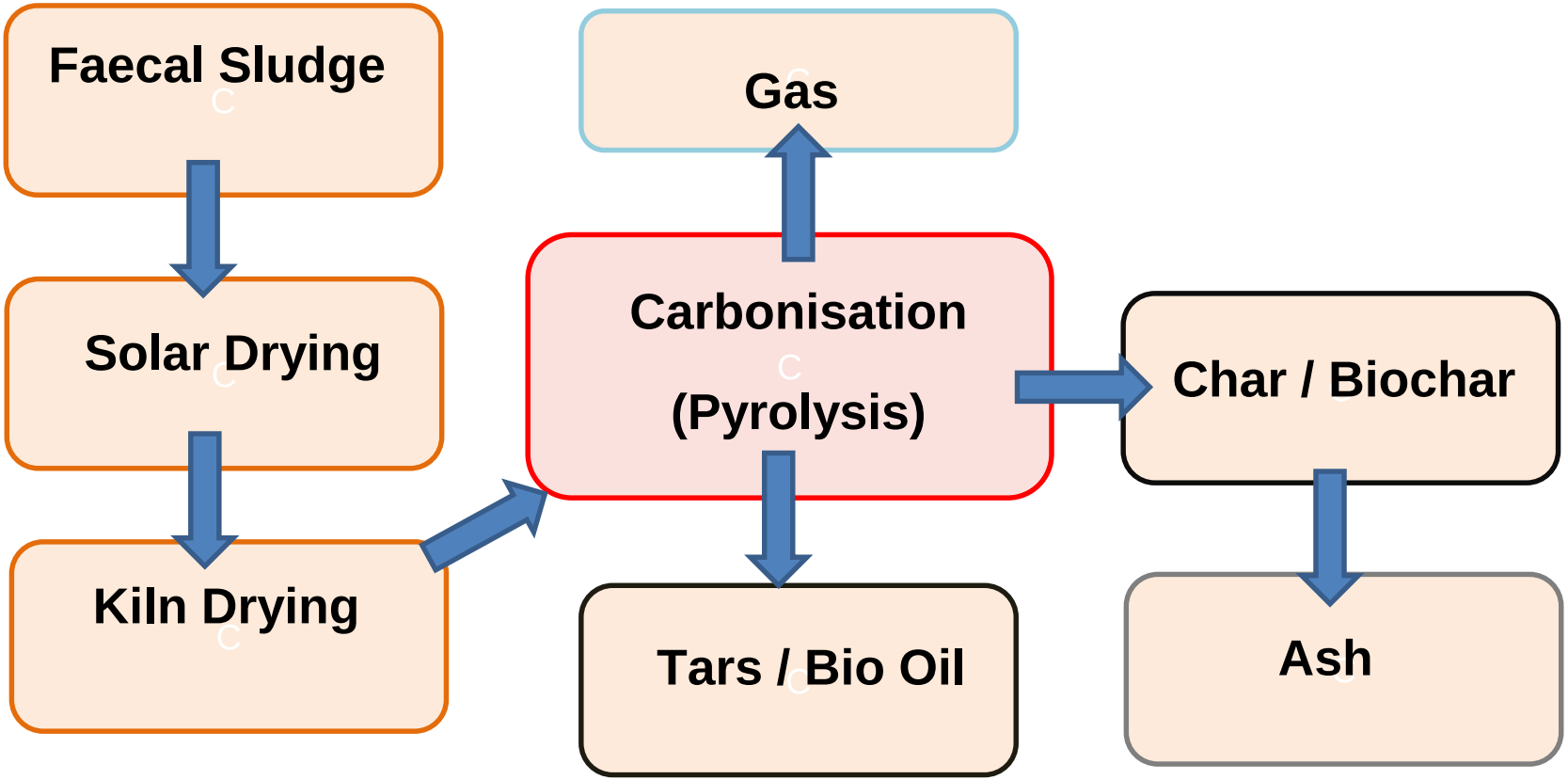
Chemistry and Physical Properties

- NPK capturing – particularly Phospherous and Nitrogen found in faecal biochar.
- Large surface area of char physical characteristic is conducive due to a “holding” of nutrient retention in the soil.
- High pH useful for soil conditioning reduce lime addition.

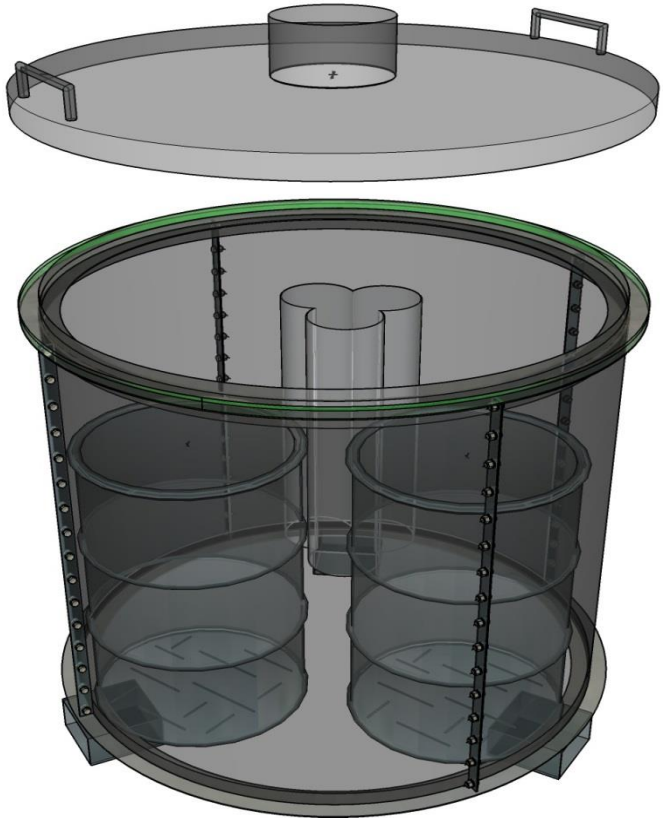
Process


Feedstock
Thermal Treatment
Product
Gas
Faecal Sludge
Drying Process
Kiln (Pyrolysis)
Char
Bio-oil

Process


Faecal Sludge
Solar Drying
Kiln Drying
Gas
Carbonisation
(Pyrolysis)
Tars / Bio Oil
Char / Biochar
Ash

Batch Carbonising Kiln / Retort



Single Batch Tests

- Initial tests used batch unlined steel kilns and 200ltr steel drums to carbonise the sludge
- Once proven, the carbonising continued for a period under management of franchisees

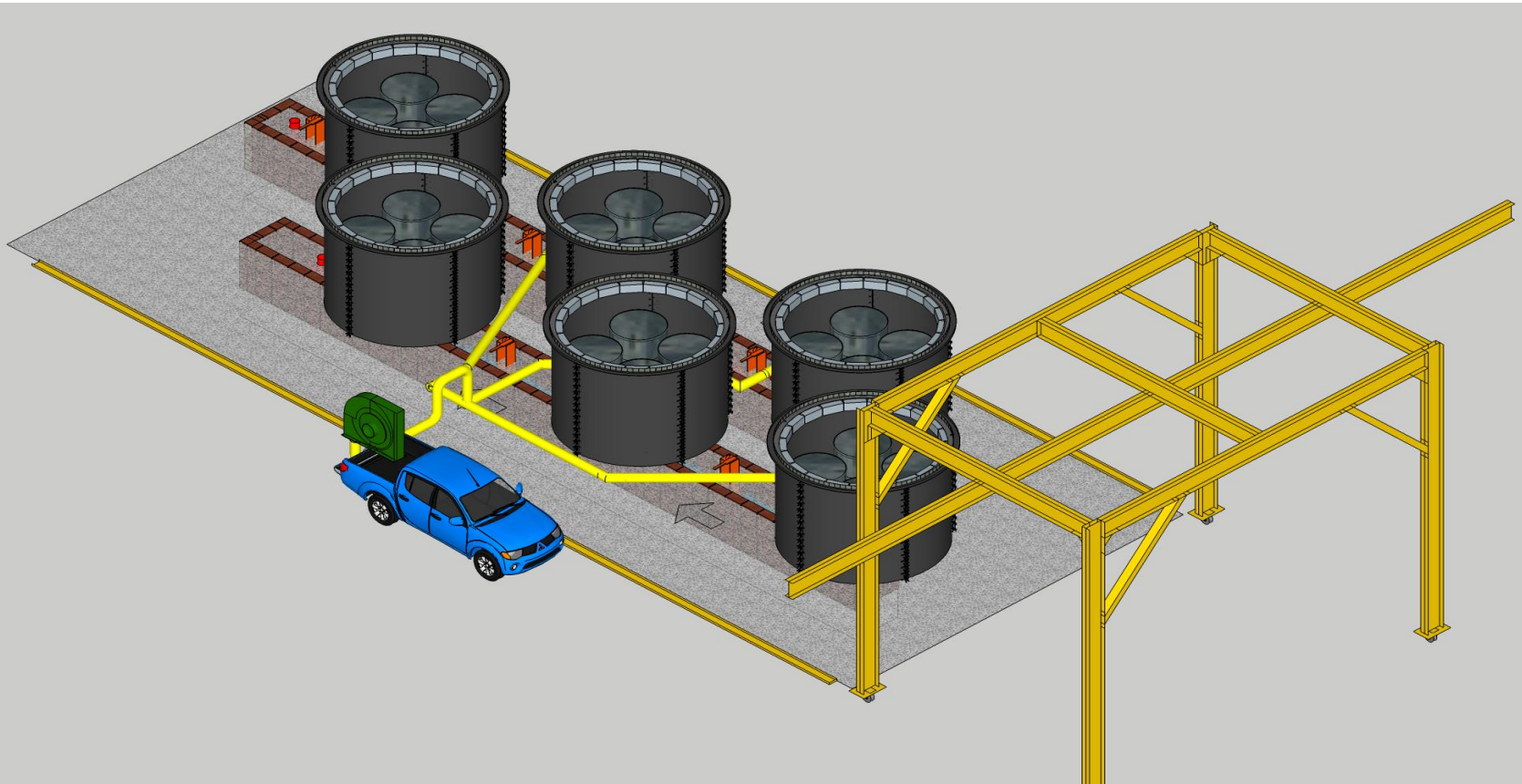
Next Steps

- Improvements in the conservation of the energy available from the pyrolysis of sludge together with the downstream use of heat in the flue gasses can provide additional benefit for drying

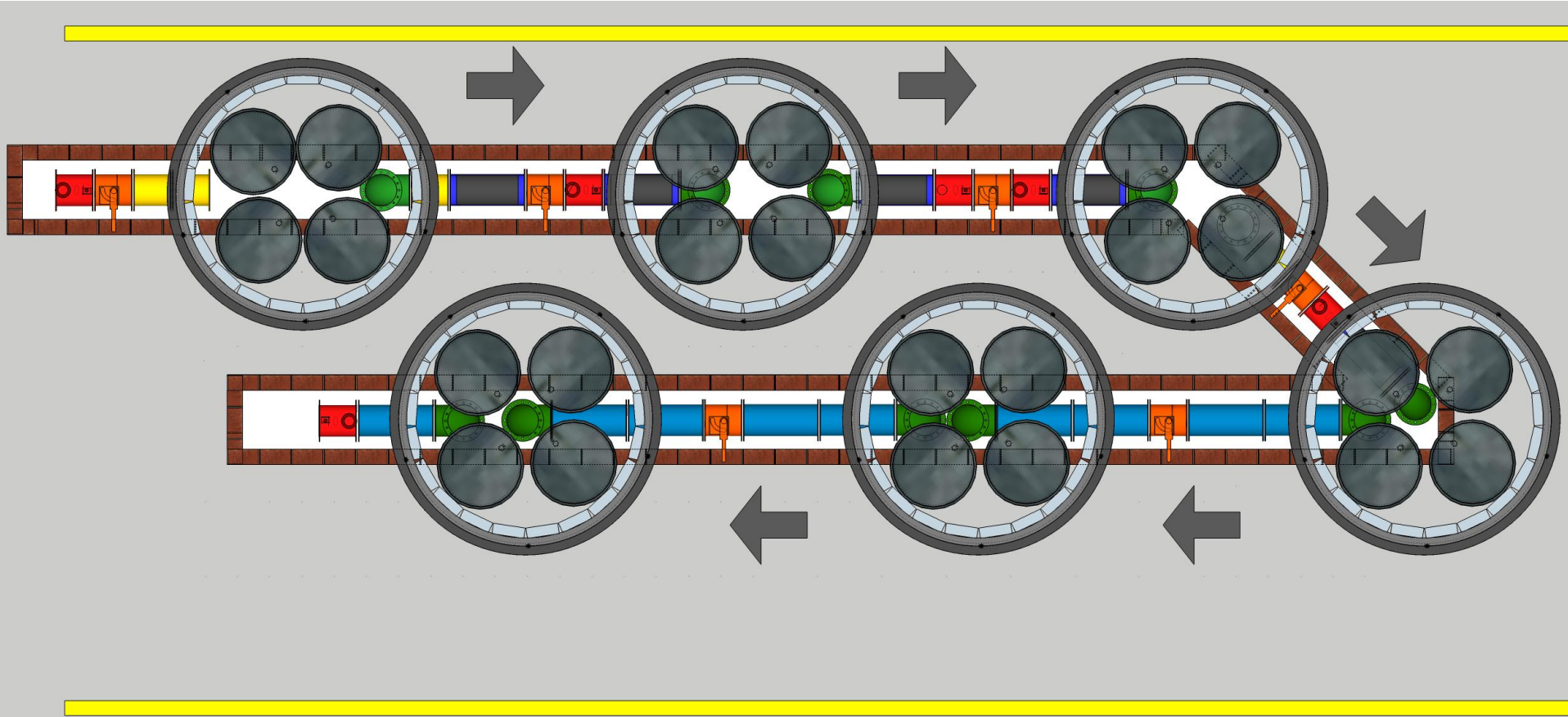
- Refining the kiln design to incorporate refractory bricks or and insulation for heat retention would allow for the reduction of wood fuel stock.

- Further refinements includes the addition of steel ducting and pressure controls required to transfer the heat from the pyrolysing kilns to be used in the drying kilns or special developed drying chambers.

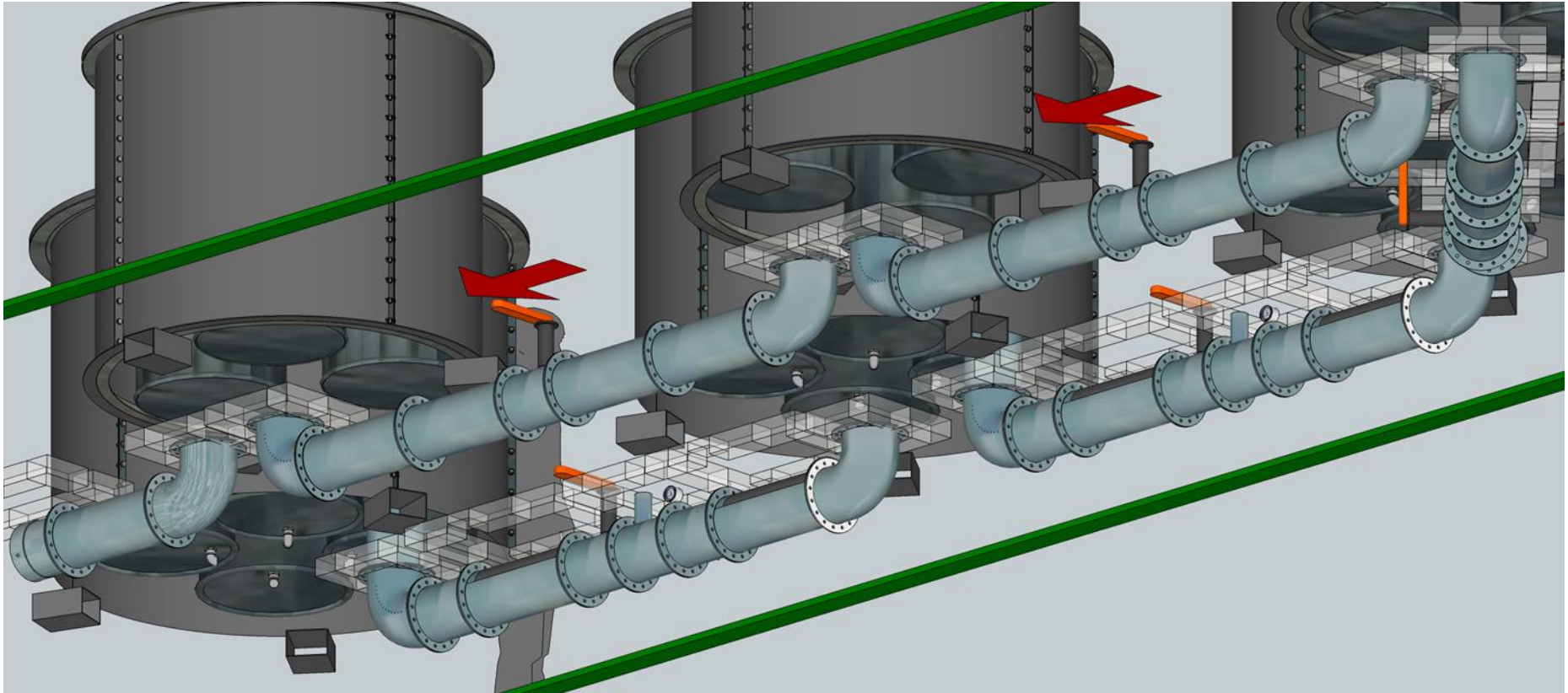
Carbonising Plant Schematic



Energy Conservation & Drying



Gas flows



Way forward

- Prove process efficiency and effectiveness
- Field test product range – soil amendment
- Deregister processed faecal sludge
- Verify Economic and Agronomic data
- Add sludge drying stages
- Product testing and production quality assurance

Conclusion

- This is a work in progress and we are very encouraged by results so far.
- Thermal treatment of faecal sludge treatment and beneficiation offers many advantages when coupled with the social franchising model,

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Thank You

For more information:

Oliver Ive
Amanz' abantu Services
oive@aserve.co.za

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