# Biogas from food processing wastes

## Examples in Sydney and New Zealand potential

**Jürgen H Thiele**



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# The Hidden Value of Waste

| | |
|---|---|
| • Energy/fuel | 5-10 $/GJ (biogas) |
| • Nutrients/fertilizer | N/P/K value, 100-200 $/ton |
| • Water | site specific |
| • Organic matter | soil builder, 30-50 $/ton |
| • Carbon credits | 15 - 25 $/ton CO2 (2008)<br>130 - 150 $/ton CO2 (2012) |

# Waste Solutions Ltd.

- 32 years practical experience in waste digestion
- Fundamental understanding of the process technology
- Cost effective plants that work better
- Process engineering, automation & control
- Heat and mass balance modelling
- Wide ranging knowledge of component technologies

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# BTA GmbH, Munich, Germany

- Source segregated organics and green waste
- Plants in operation since 1992
- Pre-treatment, pulping and contaminant removal


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# More than 22 Regional Facilities (BTA GmbH)

11,500 Tonnes/year

17,000 Tonnes/year

20,000 Tonnes/year

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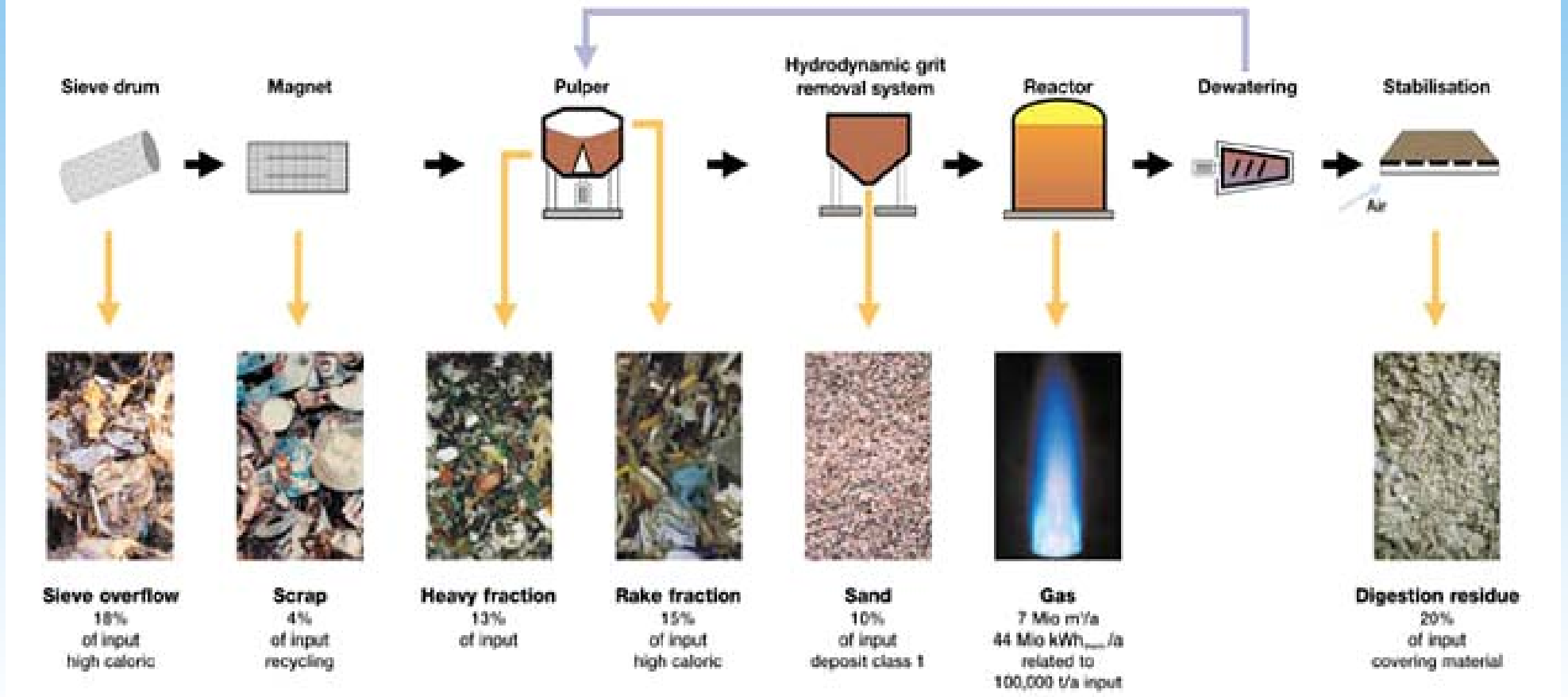
# BTA Process - intermediate stages

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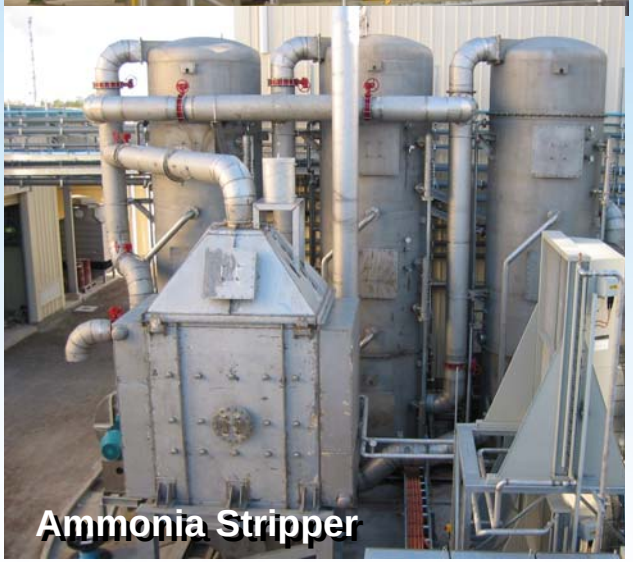
Waste reception & Digester 1

Thickening and dewatering

The BTA 32 $m^3$ pulper



Ammonia Stripper

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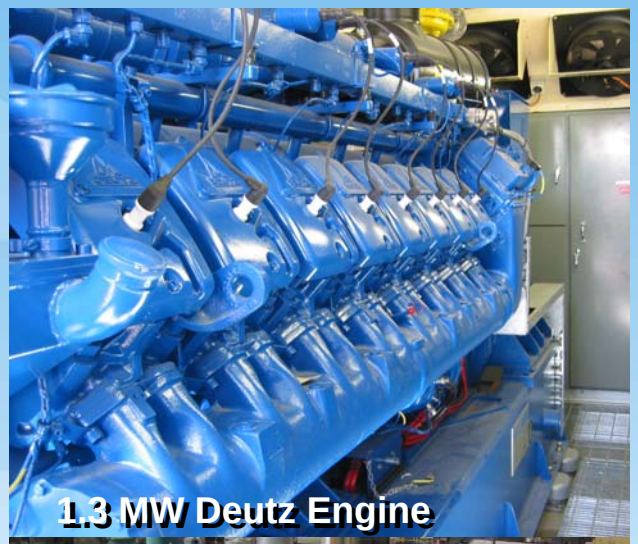
Co -Generation

Flo-Dry Dryer



1.3 MW Deutz Engine

Odour Control

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# Final Fertilizer Product

# “Can Waste Sources Change?”

- Project Developer - “What if we can only get hauler waste?”
- Waste Solutions stated:
  - “Post-consumer waste”
  - “High expectation of foreign objects”
  - “Likely plant damage or capacity reduction.”
  - “ Waste pre-treatment would have to re re-introduced
- Project Developer - “ Stay with the old waste specification ”
- Supermarket waste (< 4 % non food contamination)
- Dairy factory processing sludge (no foreign objects)
- Reject food material

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# Foreign Objects

- Computers
- Fridges
- Vending machines
- Rope and cable
- Car body parts
- Tires
- 44 gal drums
- Video cameras
- Televisions
- Wire coat hangers
- Paving stones
- Kitchen sinks

# Actual Waste Deliveries

- Raw waste delivery limit exceeded by 40%
- Digestible matter input 82% too low
- Average contamination 29 times too high
- Fat toxicity limit exceeded by 120%
- Digestibility too low
- Plastic content as high as 30 % of received waste

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# The Technology - 2002

- The plant had only 16 hours in ten months where wastes could not be accepted. (99.8% availability)
- Waste reception handled wastes well outside of the specification.
- Fully automated - 6 PLC integrated network
- Digestion exceeded expectations even with a lower digestibility waste.
- Dryer operation using co-gen exhaust worked well.
- Dryer operates well despite high paper fibre content.

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# Achievements of the Team's Design

- BTA pulper technology handles 35% contamination
- High specific gas yield achieved
- High gas productivity (4 Vbiogas/Vreactor.day)
- Resilience to process disturbance
- Dryer energy 85% from waste heat
- Dryer technology resilient to excessive paper
- Dryer technology resilient to excessive plastic

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# 2004

- **Installed all the component technologies**

  **in order to be able to process “contaminated feedstock” (initially not installed for cost reasons) .**

- **One 1.3 MW engine runs 5 days/week, despite waste input with low digestible content.**

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# 2007

- **Camellia Digester Facility, Sydney was sold to a European operating company with extensive previous experience in the waste management sector.**

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# Revenue/costs for waste types

**(For New Zealand Conditions)**

| Process Options | Tipping fees | Electricity sales | Fertiliser sales | Operating cost | "EBITDA" |
|---|---|---|---|---|---|
| 5% contam. | 11.1 | 4.5 | 2.3 | 9.4 | 8.5 |
| 0% contam. | 3.8 | 5 | 2.6 | 8.8 | 2.6 |
| 35% contam | 14.6 | 3.8 | 2 | 14.3 | 6.1 |
| Europe (2002) | 39.2 | 4.5 | 0 (Compost) | 9.4 | 34.3 |

Figures are percent of capital cost

"EBITDA" Earnings Before Interest, Tax, Depreciation, Amortisation.

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# Lessons from the Sydney Project

**For Developers:**

- **Control and know the waste.**
- **Don’t sacrifice flexibility for capital savings.**
- **Gate fees are critical for commercial success.**
- **Economic fundamentals must be right!**

**For Waste Solutions:**

- **Ensure client has control over the wastes.**

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# The Way Forward

- Single waste supplier projects
- Lower capital (US$ 1-5 million)
- Flexible waste capability
- Khorat Waste to Energy project
  - US$ 3.4 million capital
  - Energy sales US$ 2.2 million/year (60% of capital)
  - Carbon credits US$ 1.75 million/year (pending approval)

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# Anaerobic digestion advantage:

- Low residue volume
- Compost market price and size is uncertain
- AD reduces specific volume of waste
- AD reduces quantity of waste
- AD residue low in nuisance vector attractants
- Residue quality suitable for low cost composting



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# New Zealand Potential ?!

- 75 % reduction of the landfill volume for the digestible waste (if digestion residue not sold as fertilizer)
- Source segregation of digestible waste reduces capital costs
- Requires above approx. 20,000 t waste/annum for economy
- High level of garden waste increases digester capital costs, operating costs and reduces energy yield
- Collected tipping fees (avoided landfill charges) should be above about 100 NZ$/ton

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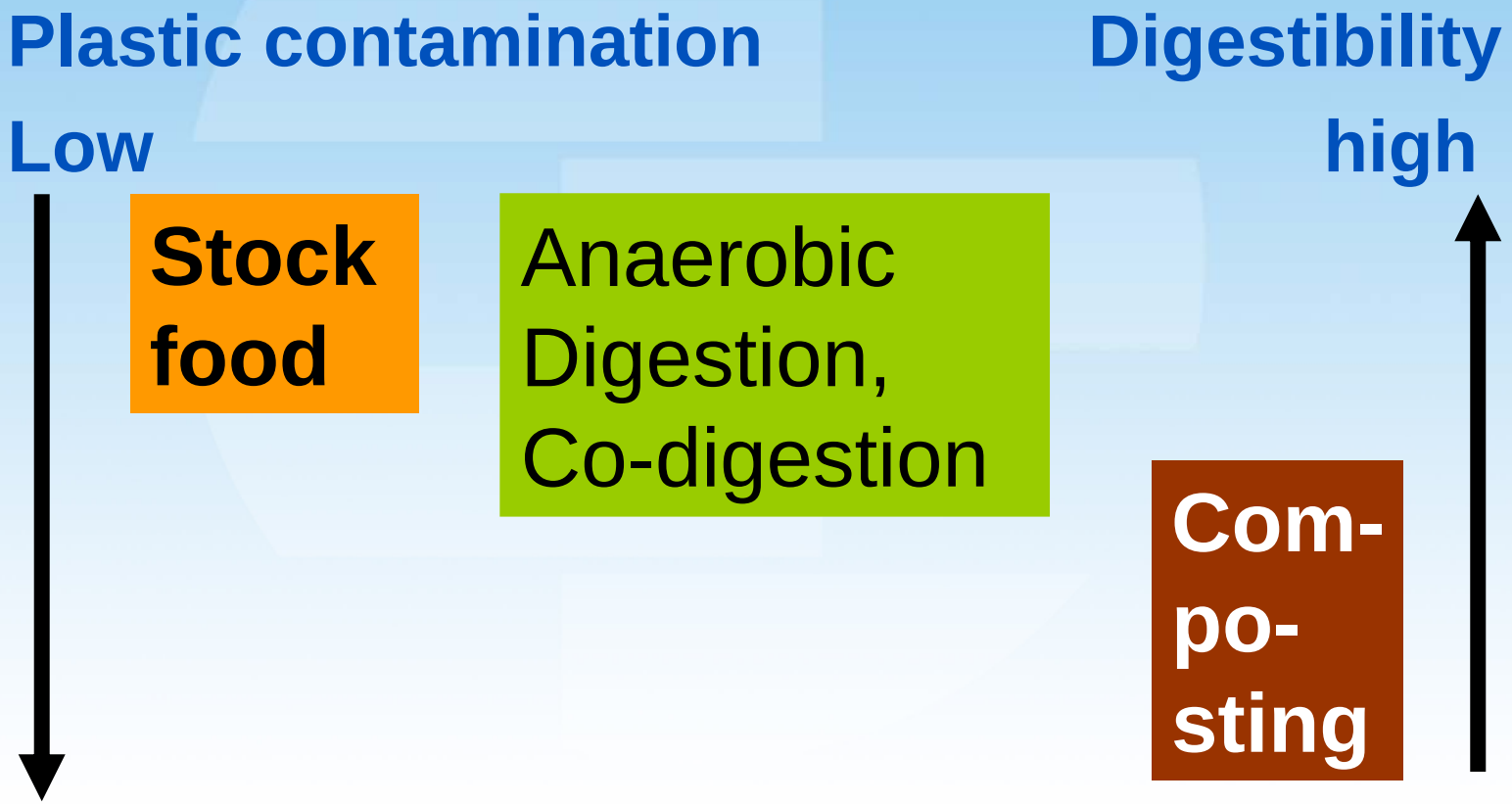
# Options for NZ – a flexible approach

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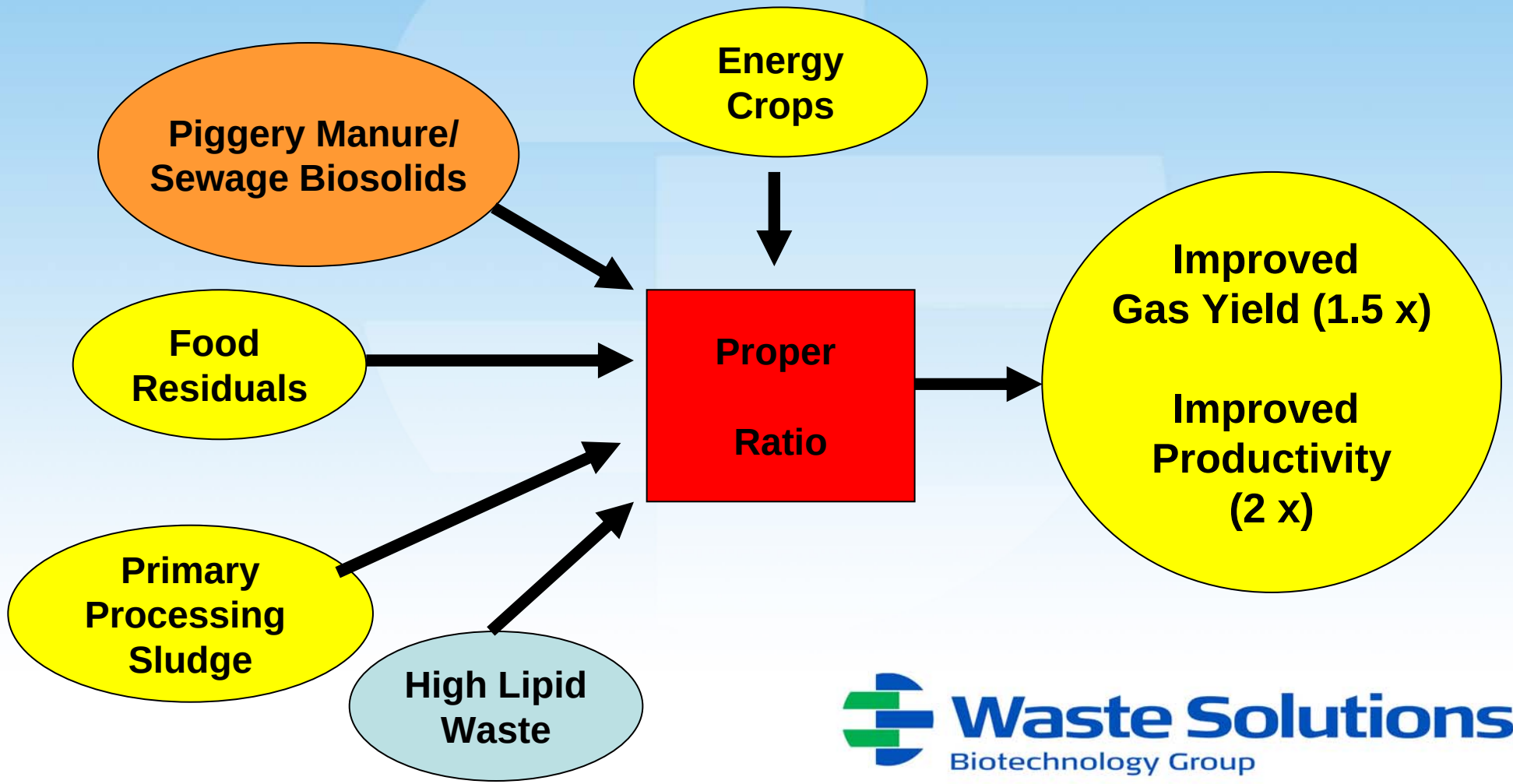
# Co-Digestion Systems

## Co-digestion : Food Waste + Industrial Feedstocks

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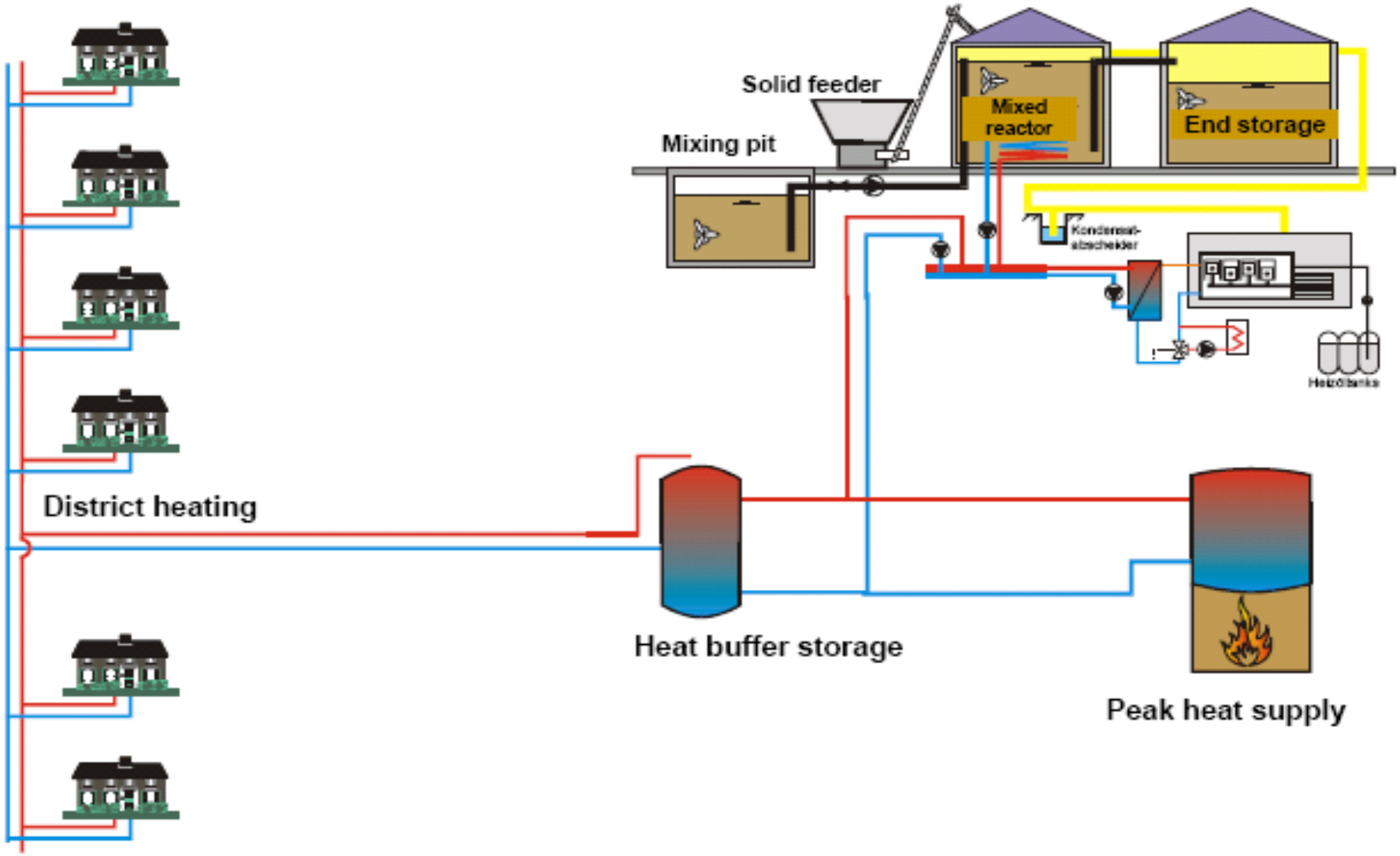
# Components of an Agricultural Biogas Heat and Power Station



# Schwanau Ottenheim, 500 bull feedlot, digester, maize + manure

## 2 x 1500 $m^3$ digester, 1 x 2500 $m^3$ digestate storage

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