from waste to value

BDI BioGas

TINOS 2015

3RD INTERNATIONAL CONFERENCE
on Sustainable Solid Waste Management

2nd - 4th July 2015

MUSEUM OF MARBLE CRAFTS

From waste to value….

BDI BioGas – The solution for industrial and municipal waste!

BDI develops technologies for producing energy from waste and by-products while ensuring maximum preservation of resources at the same time.

from waste to value

- **compact in size**
- **the system uses a reliable, stable biotechnology process**
- **outstanding for its high level of profitability**

…Your requirement is our challenge because BDI is a leading spezialized plant manufacturer with more than 15 years of experience!

Pre Processing of Waste

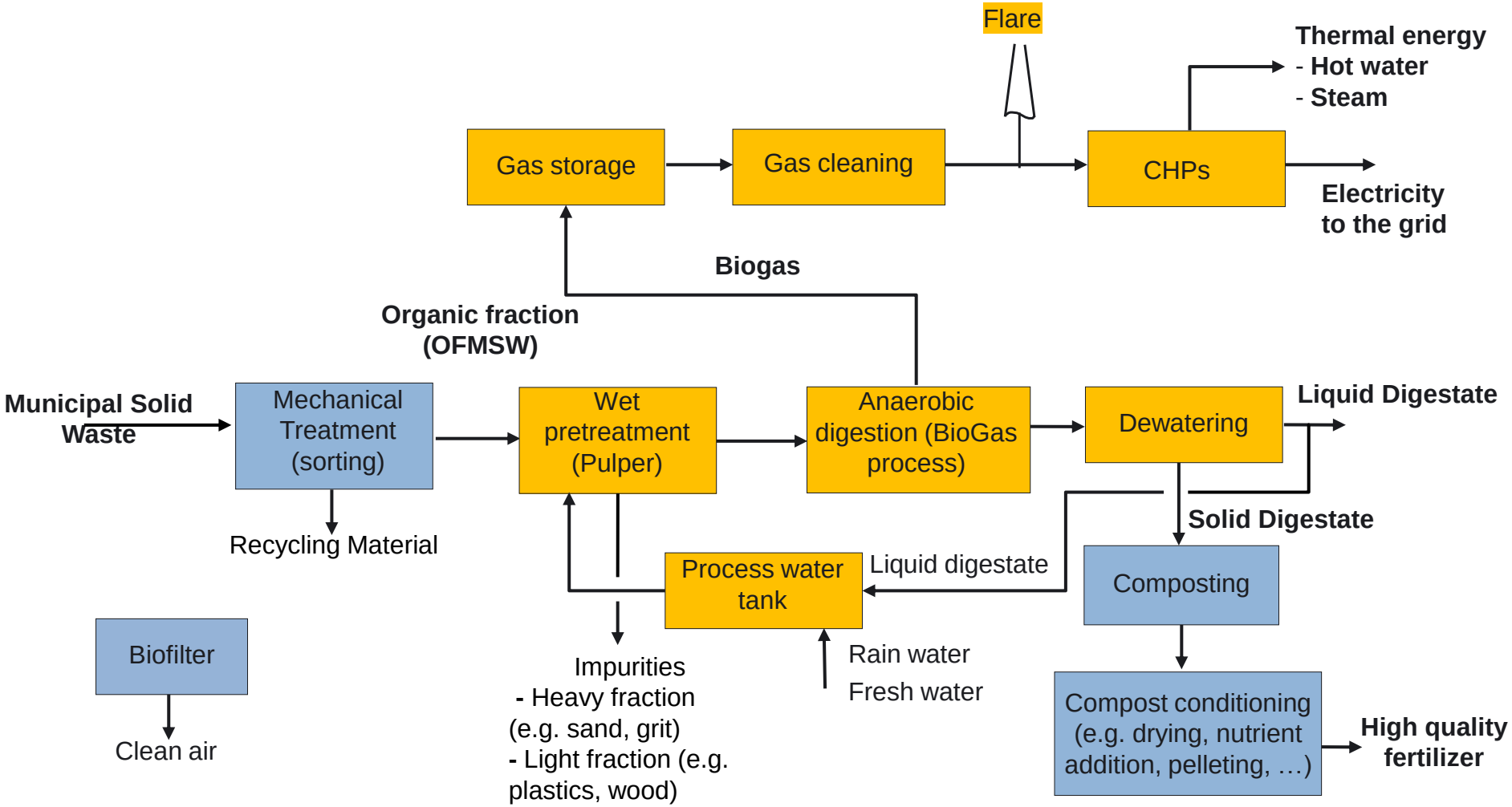
It's a bit like preparing food:

Depackaging…

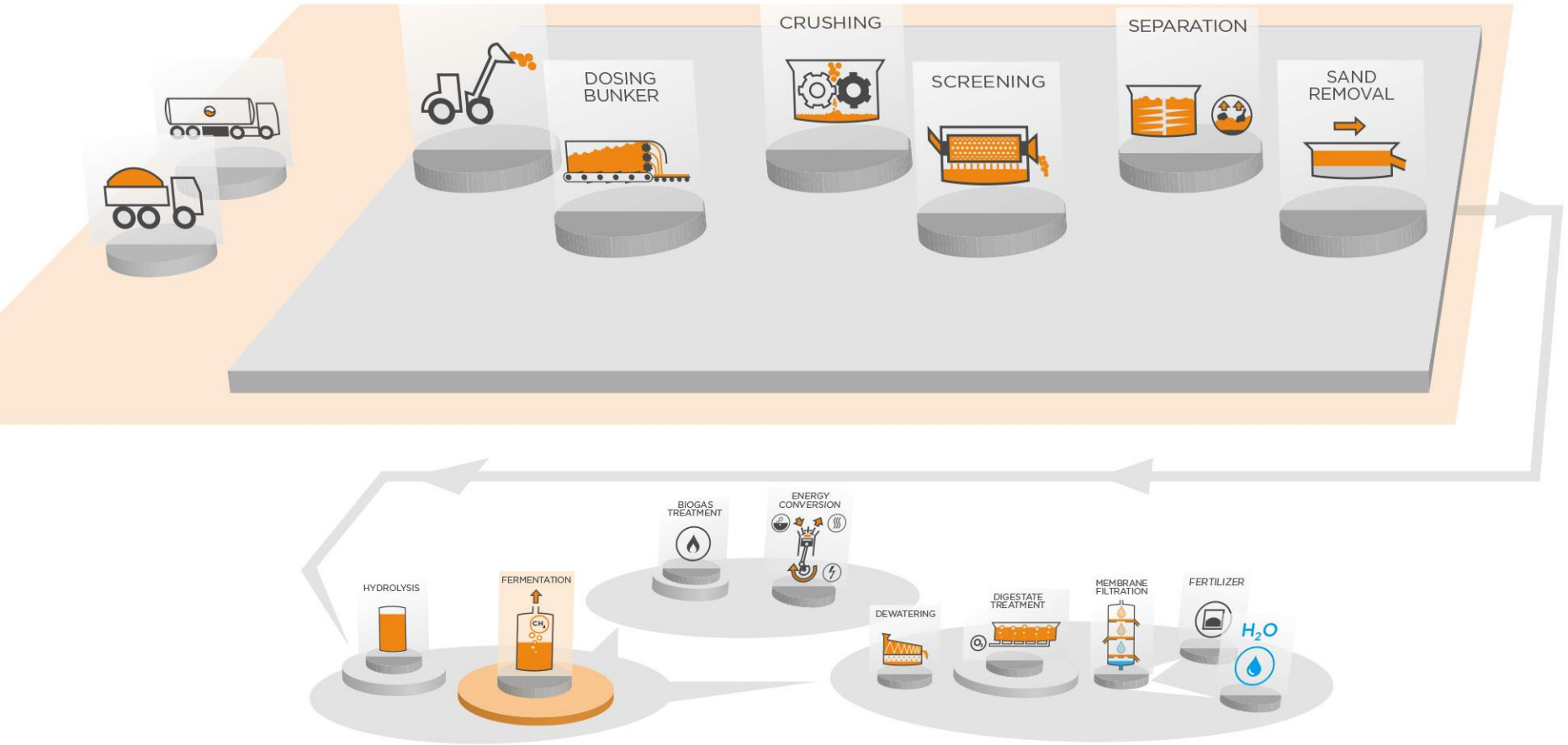
Removing Contaminants…

Mixing, stirring, cooking, …

Pre Processing of Waste & BDI Technology



Substrate Treatment



BDI Design criteria - summary

Organic loading rate **OLR:**

- **5-6 kg_{VS} / m^3 * d**
- **~8 kg_{COD} / m^3 * d**

Hydraulic retention time **HRT:**

- Hydrolysis reactor: **4 d**
- Fermenter: **25 d**
- Post digester: **15 d** (higher if energy crops are substrate)
- Digestate storage tank: **depending on local regulations and customer**

BDI Design criteria - summary

Process temperature:

- **38 – 43°C** (depending on TN and process conditions)

Nitrogen **TKN:**

- TKN Substrate: **max 6 g/kg**

Total Solids **TS:**

- TS Hydrolysis: max 13 %
- TS Fermenter: **max 10 %**

Substrates

Food industry waste

Expired food products

Industrial waste and by-products

Slaughterhouse waste

Food Waste and OFMSW



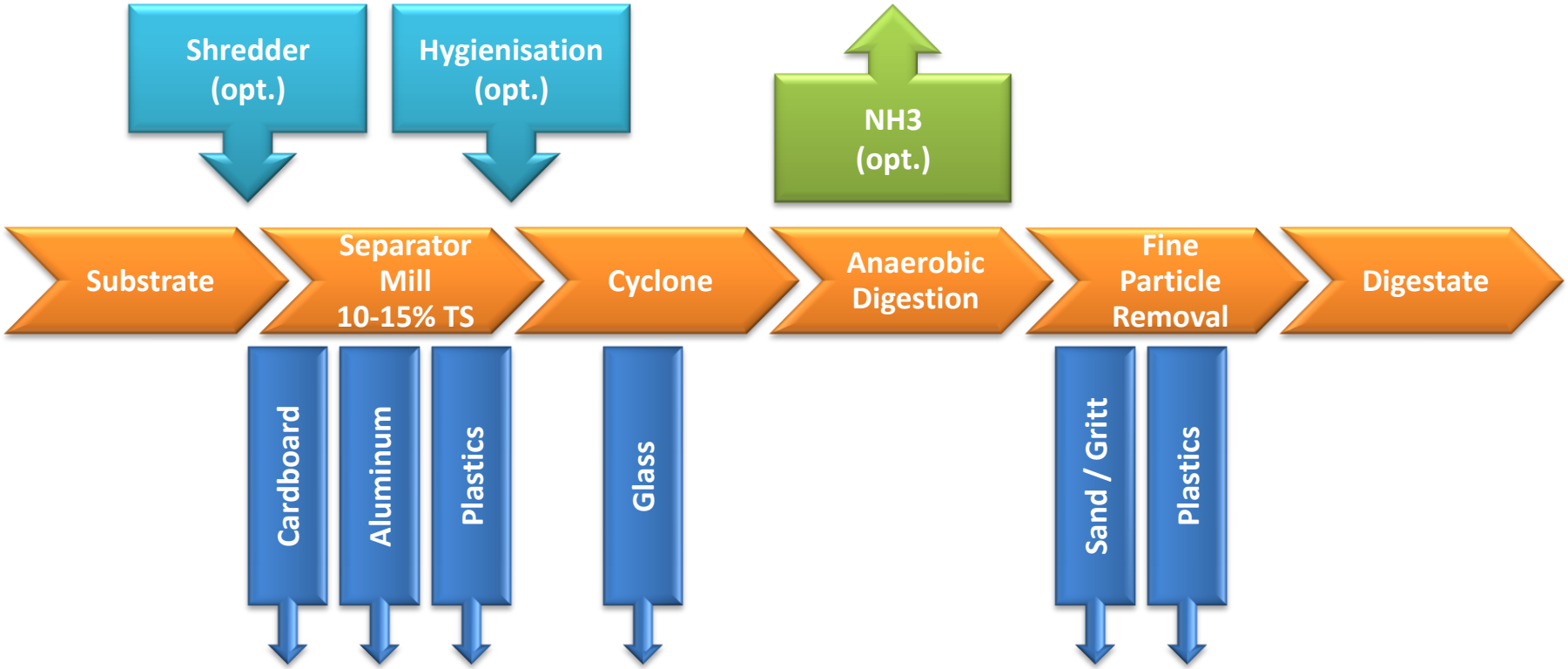




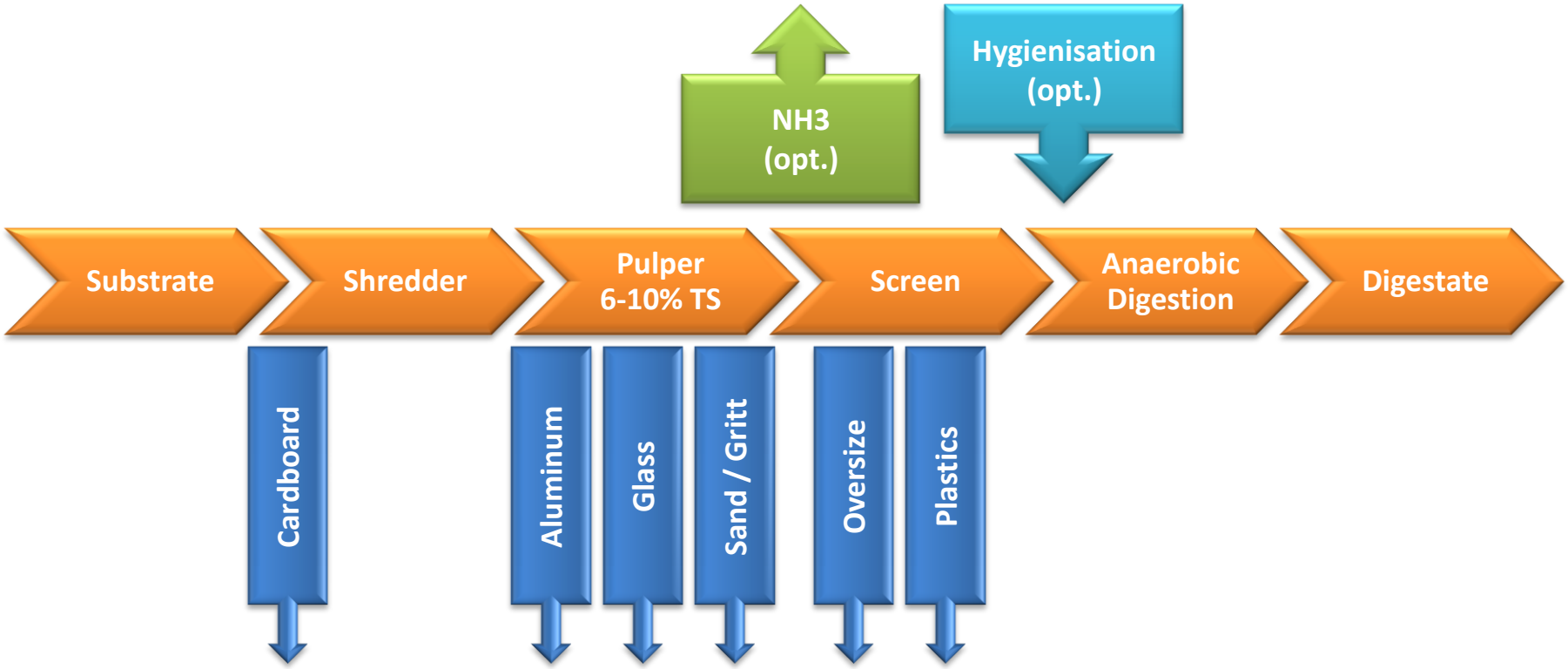




Substrate Treatment < 5% impurities



Substrate Treatment > 5% impurities



Crushing & Separation

Perfect solution for individual needs:

- Food waste with low amount of inerts
- Food waste with higher amount of inerts
- Biowaste and Organic Waste - OFMSW
- Slaughterhouse waste

Crushing & Separation

Treatment of packaged food waste

by means of

Centrifugal Separation

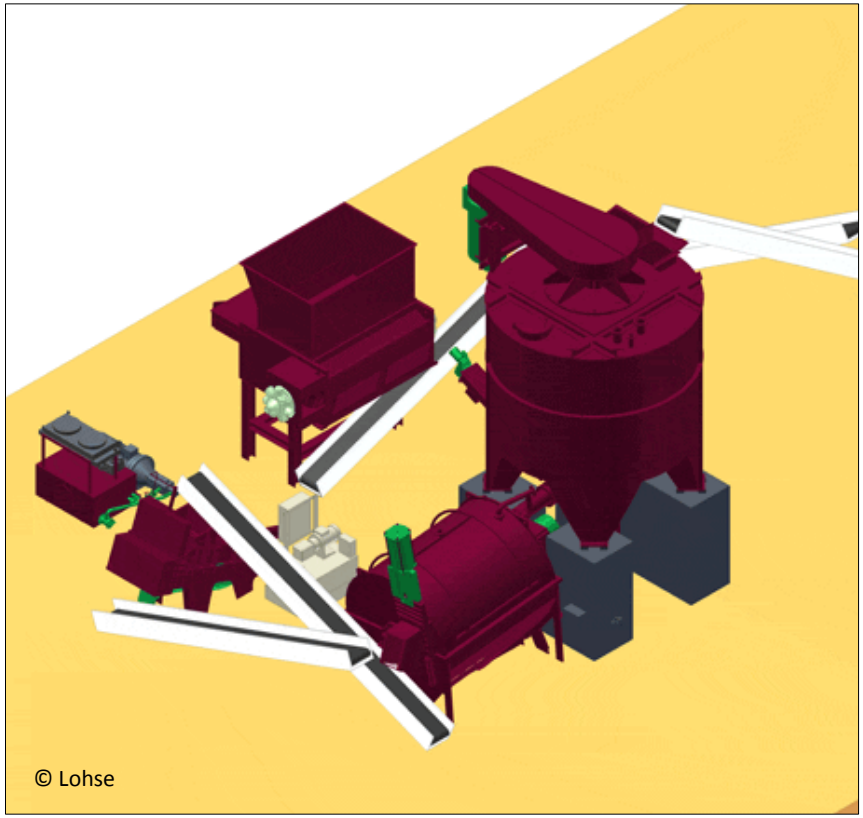
> 97% of the organics goes into the slurry.

< 3% organics in the fluffy inert stream.

Removal of inerts OFMSW

Removal of inerts
by means of
Pulper System

- Dissolving organic material into process liquid (liquid digestate)
- Separation of inert material (glass, sand, stones...) and washing
- Separation of light (non digestable) fraction like plastics and wood
- Storage of suspension in adjacent hydrolysis tank (first step of AD)



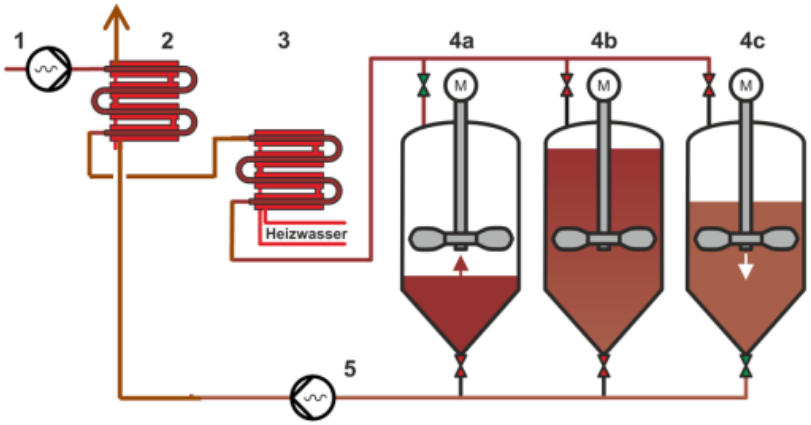
Substrate Treatment

- Impurities like glass, sand, metals, stones, e.g. cause problems in several sections of a BioGas plant
  - higher pump wear
  - sediments in heat exchangers
  - sediments in digesters

- Legal requirements to pre-treat organic substrates (EC 1069/2009) hygienization
  - Processed food waste
  - Slaughterhouse waste

- Tailor made solutions for any application
  - Screening
  - Sieving
  - Crushing

Hygienisation



Pasteurization:

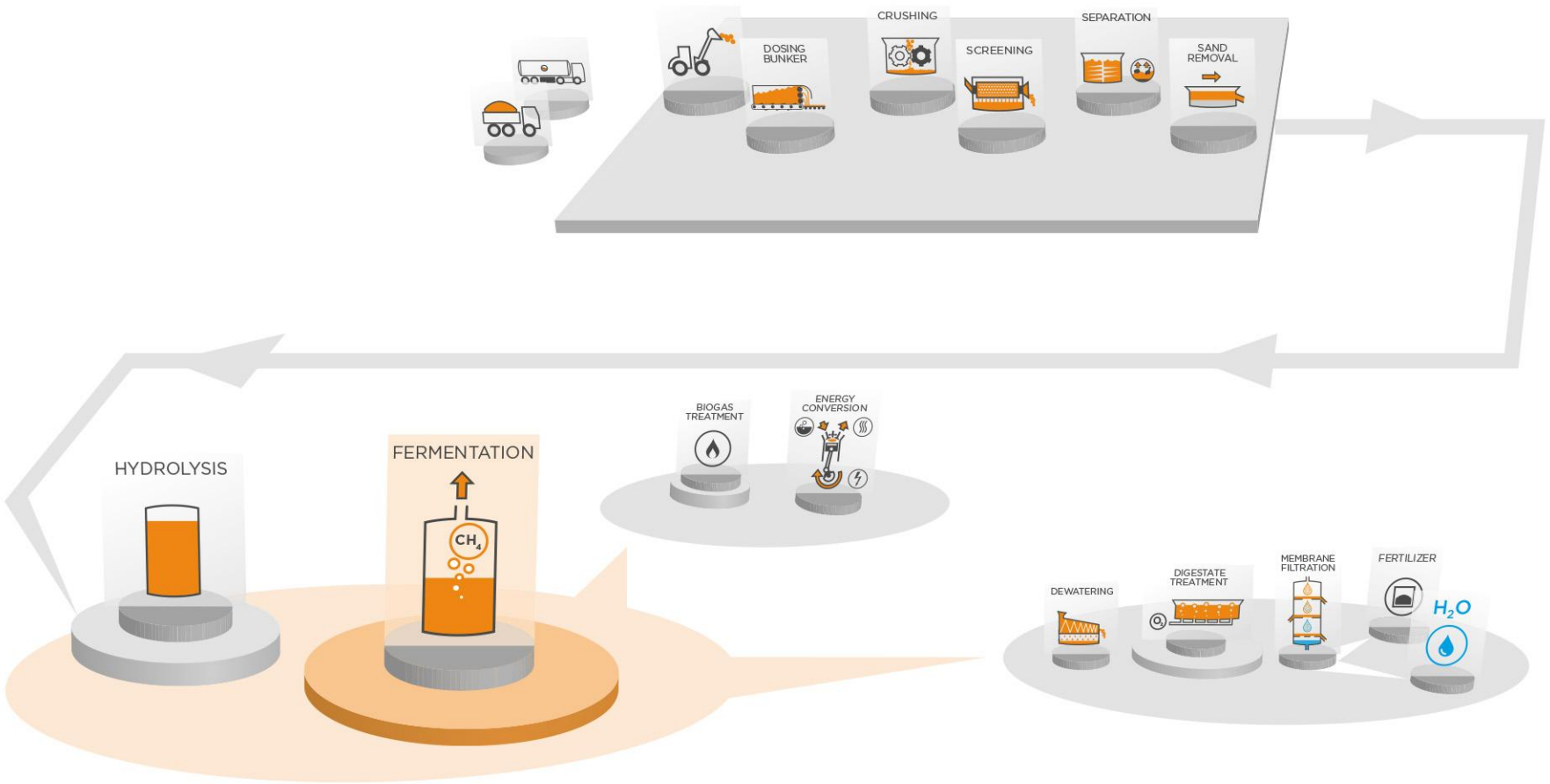
+ 1 hour at 70°C / 1 bar
+ Particle size < 12 mm

Sterilization:

+ 20 min at 133°C / 3 bar
+ Particle size < 50 mm

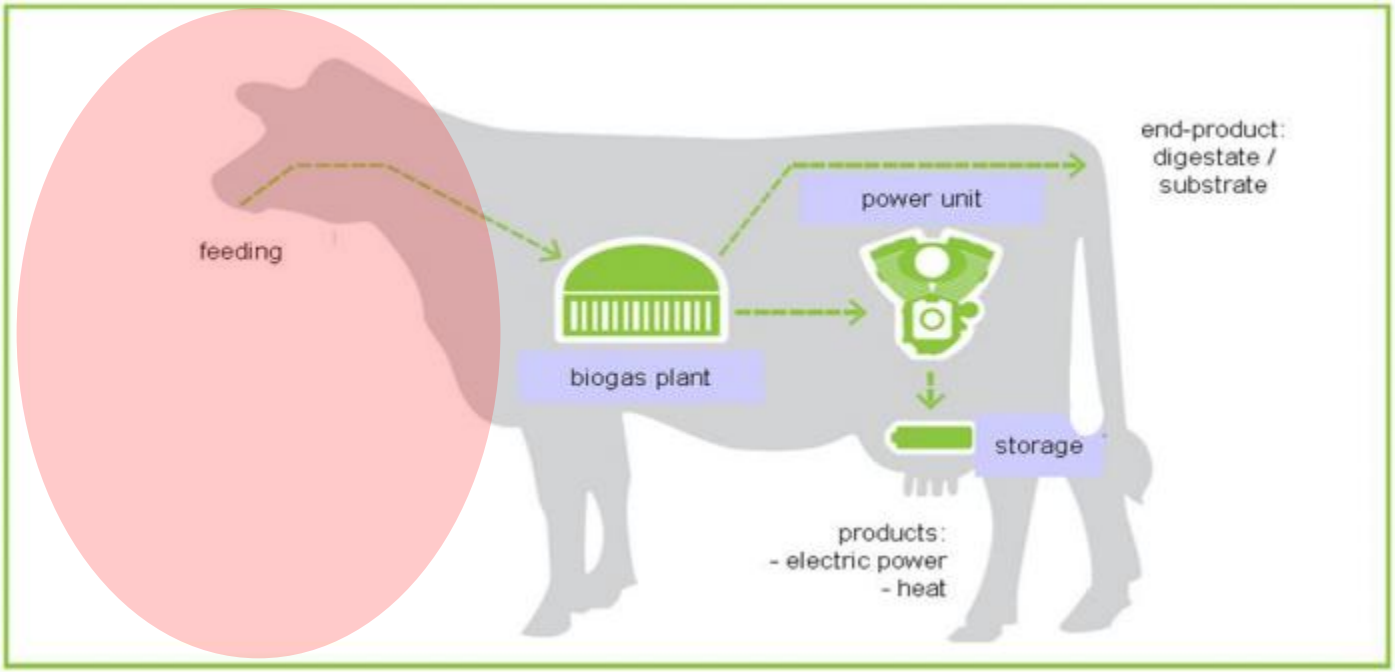
Required for meat based waste depending on local regulations (Europe: EU 1069/2009)

Anaerobic Digestion



Fundamentals Anaerobic Digestion (Biogas process)

The famous BioGas / Cow – Example:



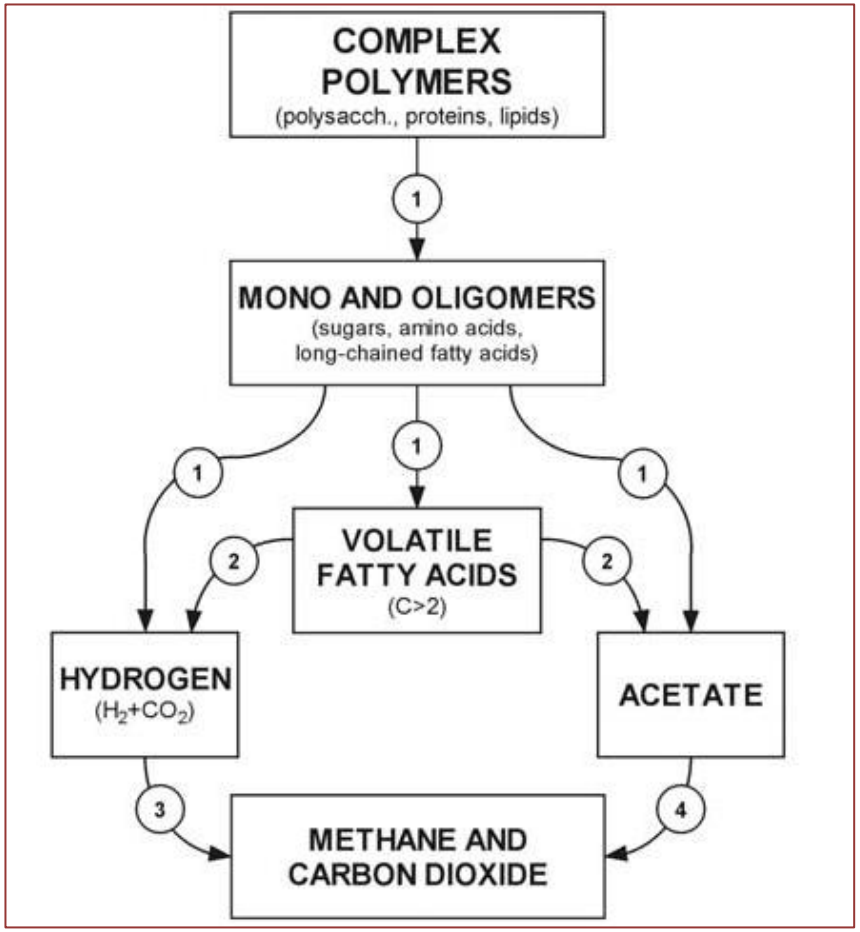
Focus on Pre-Processing

Microbiology

Inside an anaerobic digester there are specific consortia of microorganisms

4 major groups of microorganisms have been identified with different functions in the overall degradation process:

1. *The hydrolyzing and fermenting microorganisms*
2. *The obligate hydrogen-producing acetogenic bacteria*
3. & 4 *Two groups of methanogenic Archaea*



BDI BioGas-Technology

3 Stage System

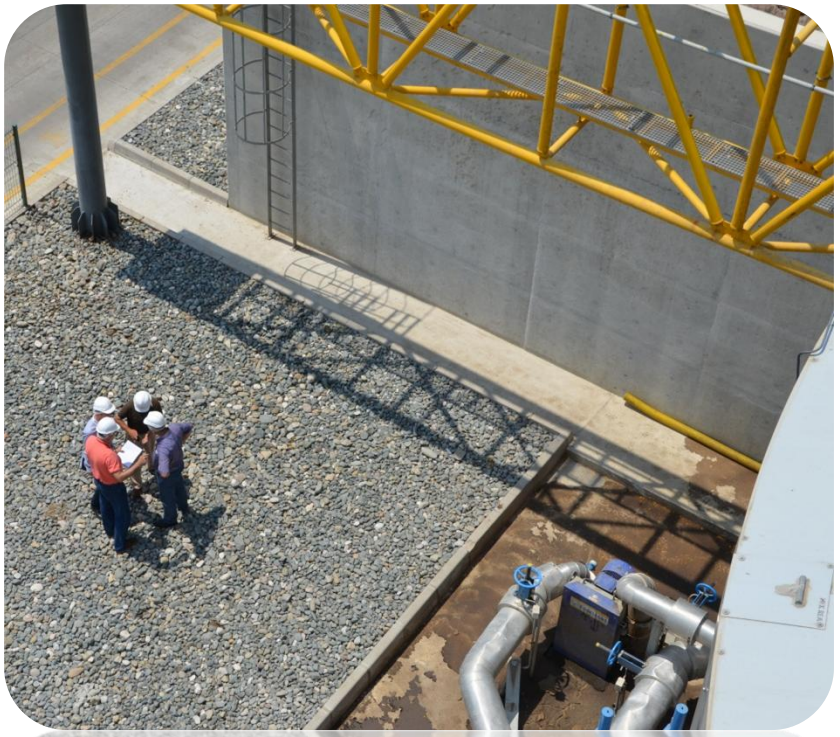
1. Hydrolysis / mixing tank
    - First degradation step of organic polymers
    - Homogenisation of fluctuating feedstock composition

2. Digestion tank
    - Main organic matter degradation
    - Main biogas production

3. Post digester
    - final degradation processes
    - Increasing digestate quality (better mineralisation, less odour potential)

Main characteristics of BDI technology

- CSTR technology (continuous stirred tank reactor)
- Digester Geometry: Height to diameter ratio ~ 1
- Central slow rotating paddle agitator
- External heat exchanger
- Tank material: bolted steel or reinforced concrete



Reactor mixing

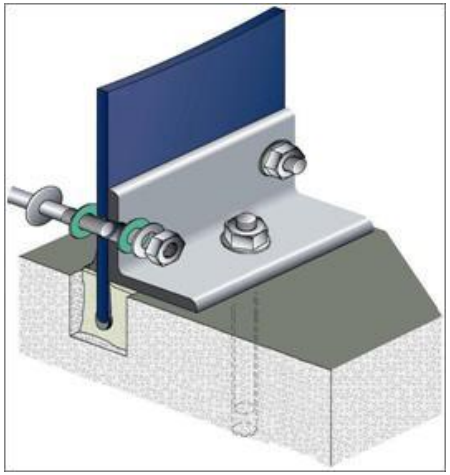
- Mixing of fresh substrate with digester sludge
- Even distribution of heat in the fermenter
- Distribution of nutrients
- Homogenisation; prevention of sedimentation and scum layer formation
- Good degassing of biogas from the fermentation sludge

This has to be fulfilled by a mixing technology with minimum energy demand !!!

Reactor Design

+ Diameter to height ratio of 1:1
+ Maximum volume of 4800 m³
+ Material resistant to corrosion

Steel

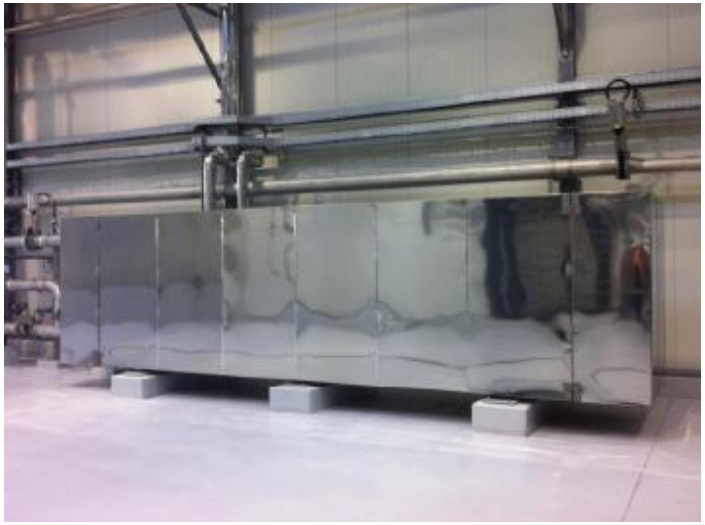


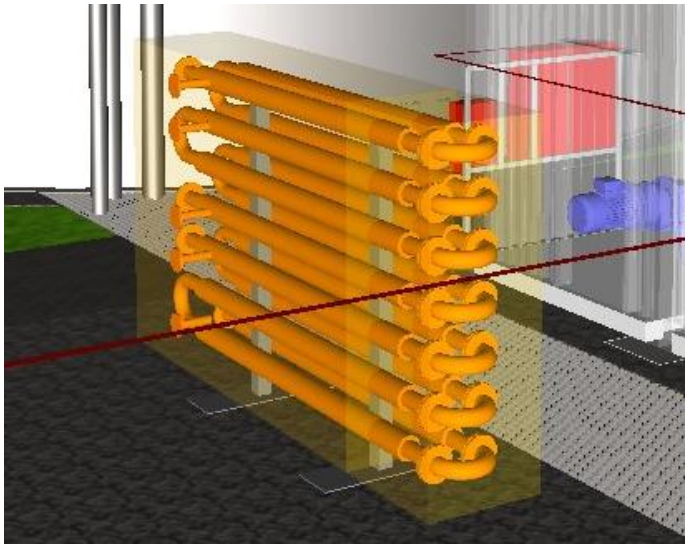
Concrete

Heating

External Heat Exchanger:

+ Optimum & equal heat transfer
+ Easy cleaning & maintenance
+ Good temperature control

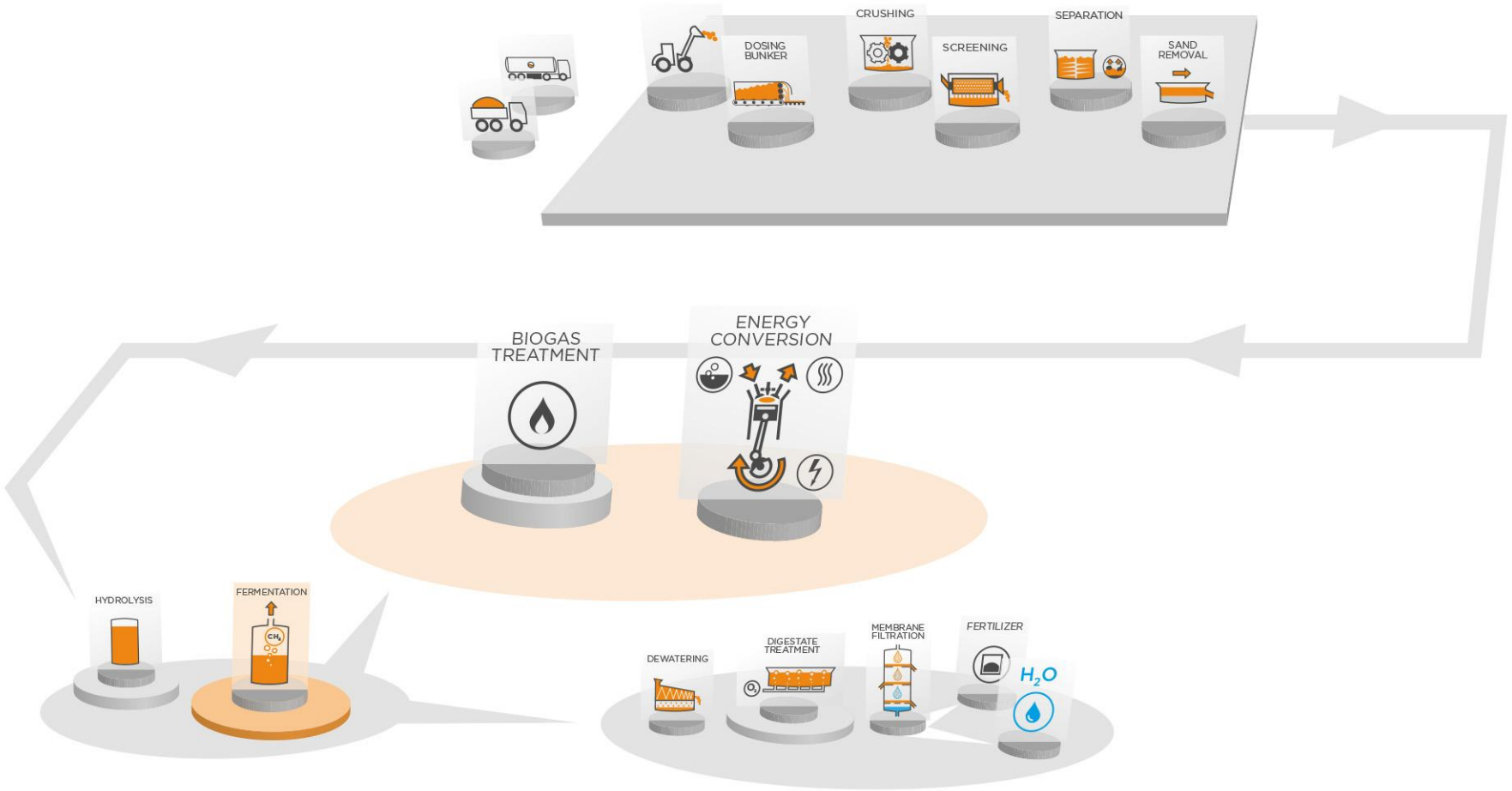




Advantages of the BDI technology

- Optimized digester mixing by customized central paddle agitator and digester geometry
- Reliable and easy to maintain digester heating system (external heat exchanger)
- Prevention of sediment and scum formation inside the digester
- Highest quality requirements for mechanical and electrical equipment
- High grade of plant automation
- Sophisticated security measures
  - Gas warning devices in critical areas (CH_4 and H_2S)
  - Security devices for Vessels (overpressure protection, busting disks, level indicators, overfill protection sensors
  - Automatic shut off measures

Energy Conversion



Energy Conversion

After the utilization of the BioGas (removal of sulfur and water) the BioGas can be used for:

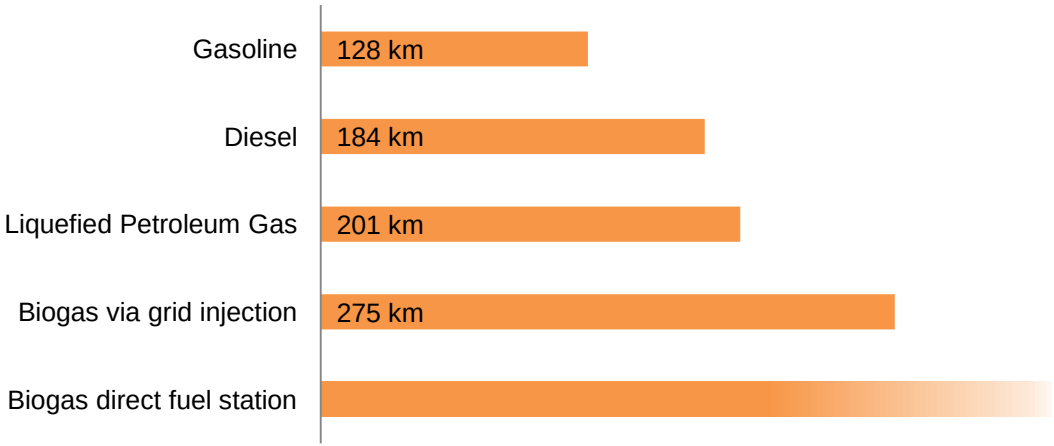
- Production of electricity and heat energy in a gas engine (CHP)
- Production of hot water or steam in a gas boiler
- Injection to the gas grid (purification units)
- Vehicle fuel (CBG)

Compressed Biogas (CBG) as vehicle fuel

Natural gas & Biogas as alternative vehicle fuel

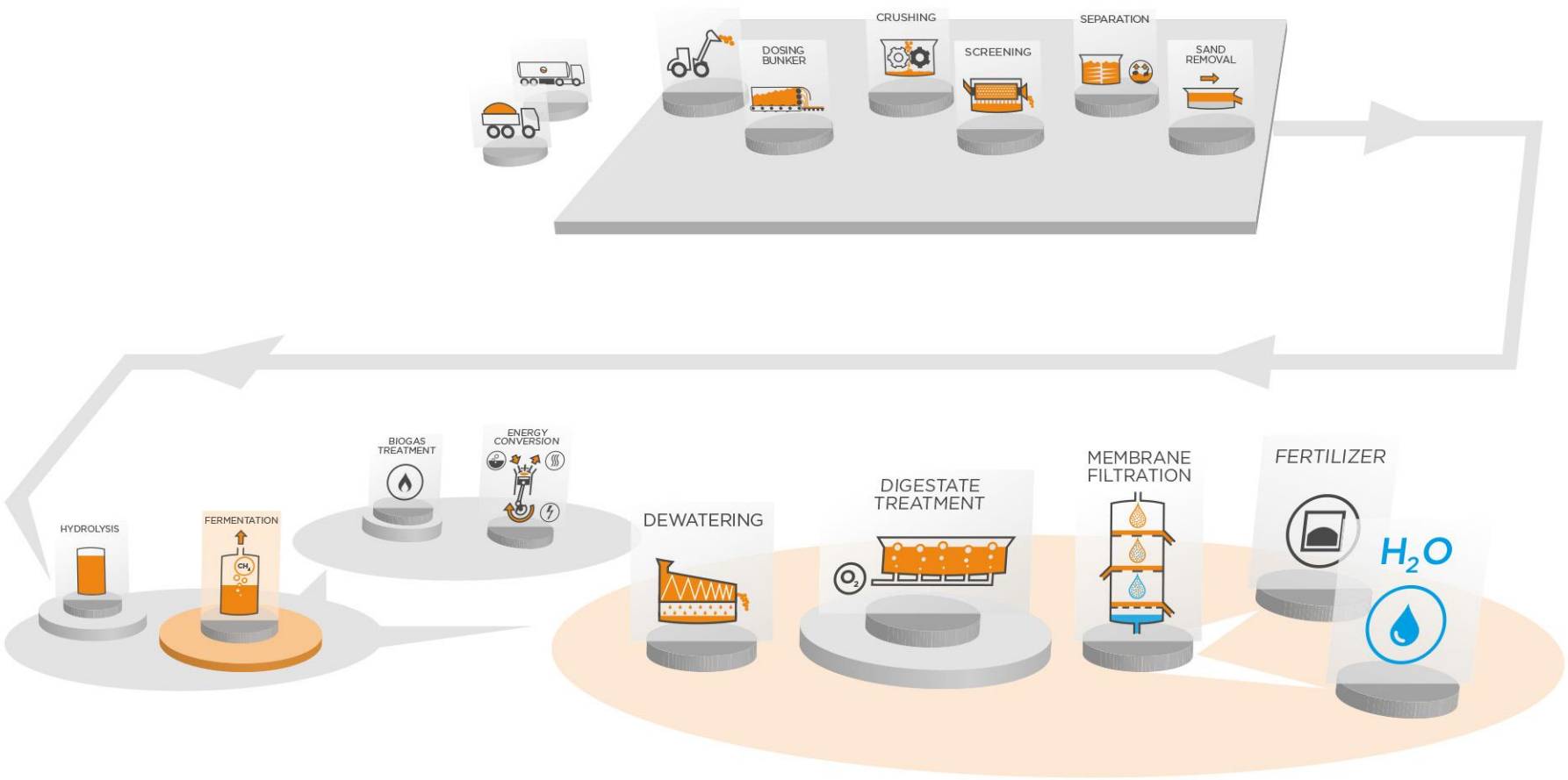
- Fleets are converting to CNG for cost savings and environmental sustainability.
- Compressed Biogas (Biomethane) can be used in vehicles operated with natural gas without any engine modification

Distance with fuel for 10€*



* depending on driving style. Information based on the Audi A3. Average prices of 2013. Publication of the Federal Ministry of Economics and Technology (Germany) from 30.6.2014.

Digestate Treatment



Digestate Treatment

- Most common utilization of digestate is land application as fertilizer
- As a result of large area demand due to maximum nutrient dosage the transport costs get significant.

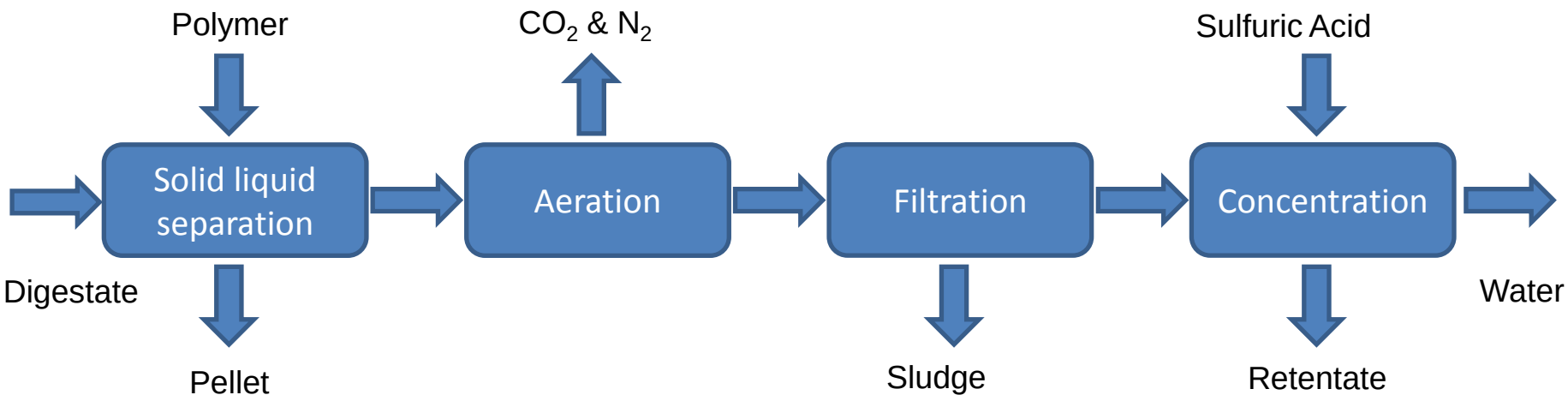
- Main goals of digestate treatment
  - Separating nutrients and providing a transportable, storable and marketable fertilizer
  - Reduction of the mass to be applied on agricultural land
  - Reducing costs for storing and land application
  - Reducing the impact on the environment

BDI solution → Membrane Bio Reactor (MBR-Process)

Membrane Bio Reactor

Process steps and main components

- Solid liquid separation (decanter and/or belt filter)
- Aeration basin
- Filtration(Ultrafiltration)
- Concentration (Reverseosmosis)

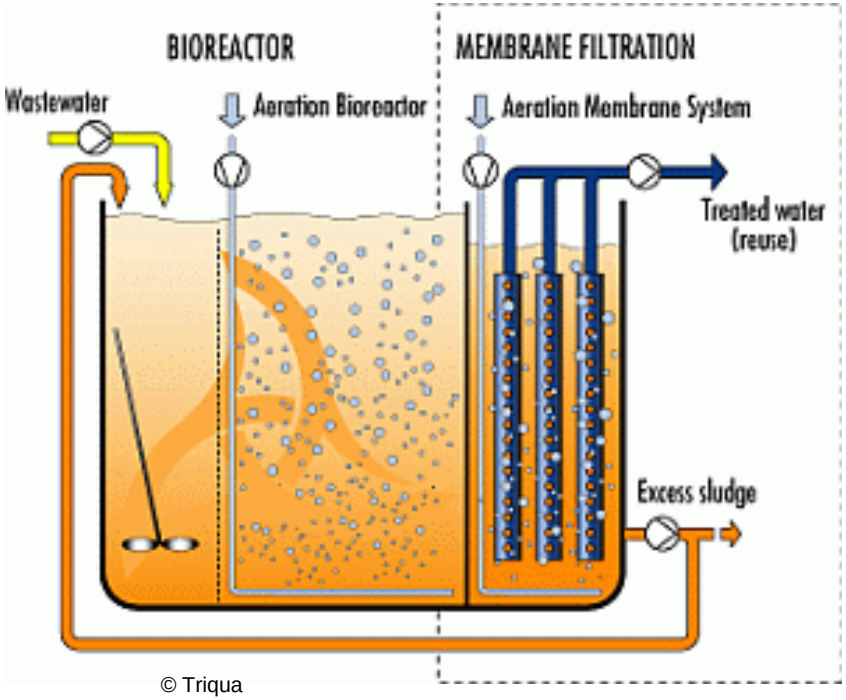


Membrane Bio Reactor

MBR Process:

- Goal
  - ➢ Reach direct discharge quality
  - ➢ Concentrated nutrient for fertilizer

- Advantages
  - ➢ simple modular setup
  - ➢closed system (odours)
  - ➢ physical separation method



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BDI BioGas

The solution for industrial and municipal waste

from waste to value

BioGas | Etampes North France

Capacity: 2,1 MW_{el} / **Substrate**: 65.000 tons/year

Scope of delivery: sanitation, fermentation, power generation, distribution of heat

Scope of services: planning, plant engineering, biological commissioning, assembling

Substrates: Food waste from households and restaurants, expired food products from super markets

Project start: December 2011

Construction start: February 2012

Handover: September 2013

BDI BioGas

The solution for industrial and municipal waste

from waste to value

BioGas | Pamukova Turkey

Capacity: 1,4 MW_{el} / **Substrate:** 56.000 tons/year

Scope of delivery: construction, planning of overall plant

Scope of services: planning, plant engineering, biological performance commissioning

Substrates: cleaned household organics, kitchen waste, manure, straw

Project start: March 2010

Construction start: September 2010

Handover: February 2012

BDI BioGas

The solution for industrial and municipal waste

from waste to value

BioGas | Marl Germany

Capacity: **3**,1 MW_{el} / **Substrate**: 60.000 tons/year

Scope of delivery: planning, delivery, installation commissioning and assembly

Scope of services: design & construction

Substrates: expired food waste, catering waste

Project start: May 2011

Construction start: September 2011

Handover: December 2011

Why BDI BioGas?

- BDI is a stock market listed company with many years of experience in international plant design

- BDI plants are suitable to handle various substrates

- BDI plants provides a continuous, stable and robust operation

- BDI plants ensure a high level of plant automation and the usage of high quality material and equipment

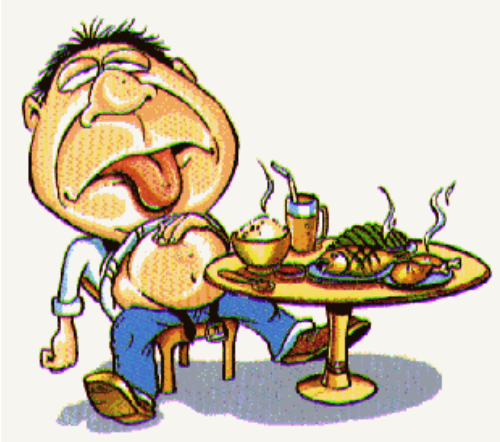
- BDI provides an extensive After Sale Service to ensure a maximum plant availability

After Sale Service

BASIC CONCEPT TO BE AWARE OF ……..

When biogas yields of the AD reactor are not so satisfactory

Take care of who is working together to produce it and try to understand what is the inhibition factor that make them



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