



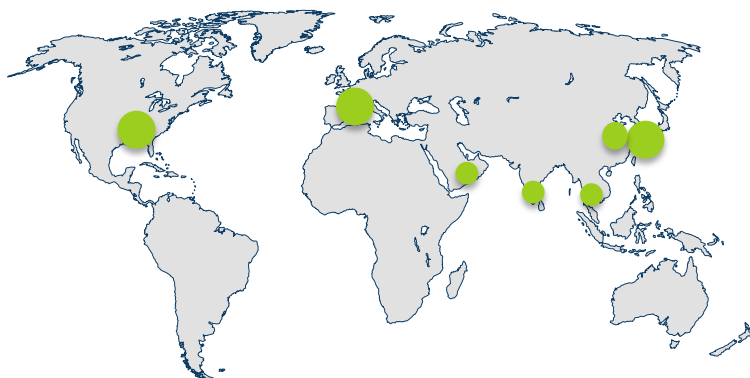
Hitachi Zosen
INOVA

Organic waste to biogas – The Kompogas system

More than 500 years of operational experience

Hitachi Zosen Inova

Waste is our Energy



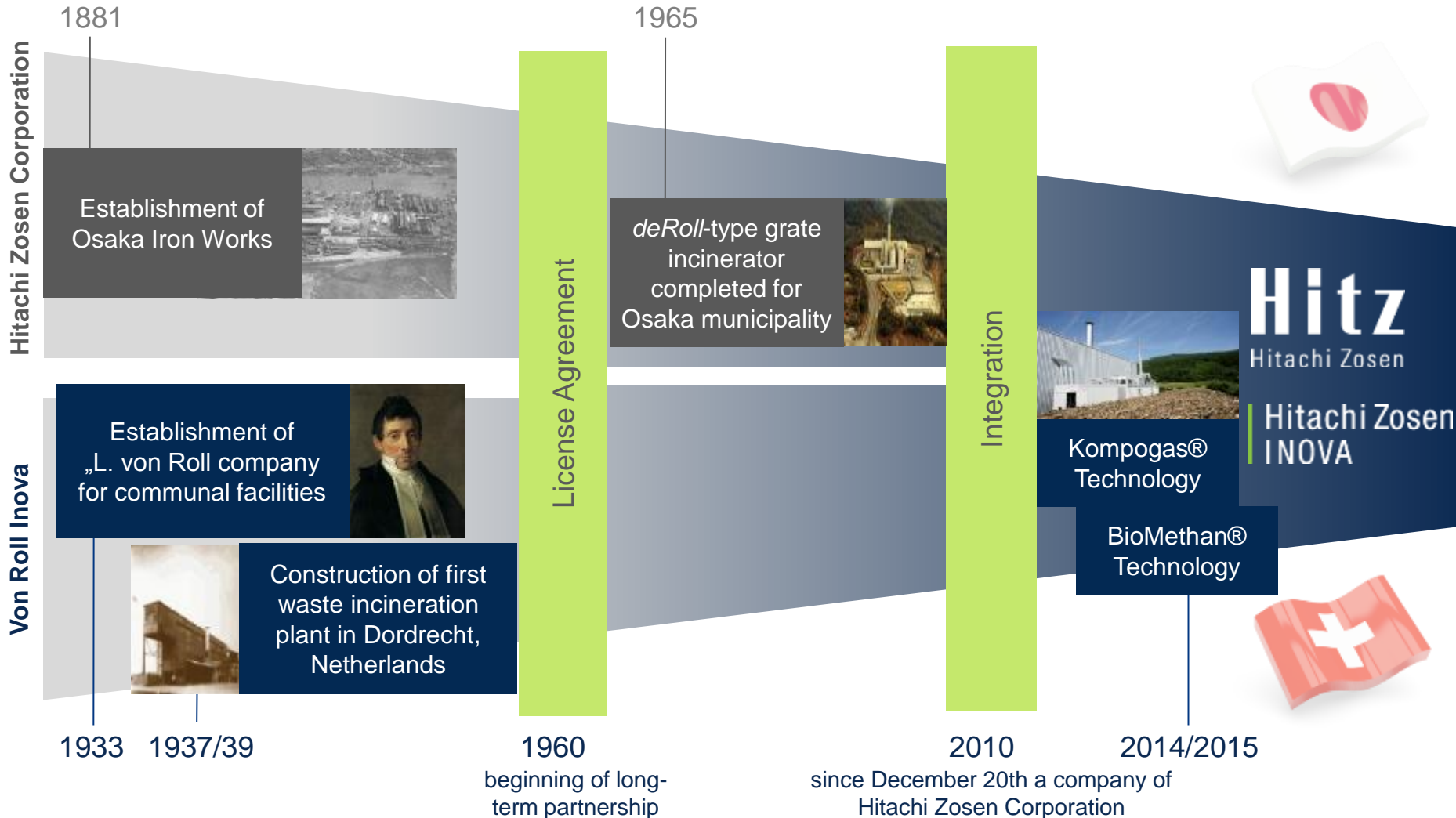
- | Proprietary EfW, AD & biogas upgrading technologies
- | Complete turnkey plants and system solutions
- | Operation, maintenance & service business
- | 600+ employees in Switzerland, Germany, UK & USA
- | More than 600 reference projects worldwide
 - | > 500 thermal Energy from Waste plants
 - | > 75 biological Energy from Waste plants
 - | > 50 biogas-to-methane upgrading plants
- | A Hitachi Zosen Corporation subsidiary

 Hitachi Zosen Locations



More than 80 years experience in Energy from Waste plants

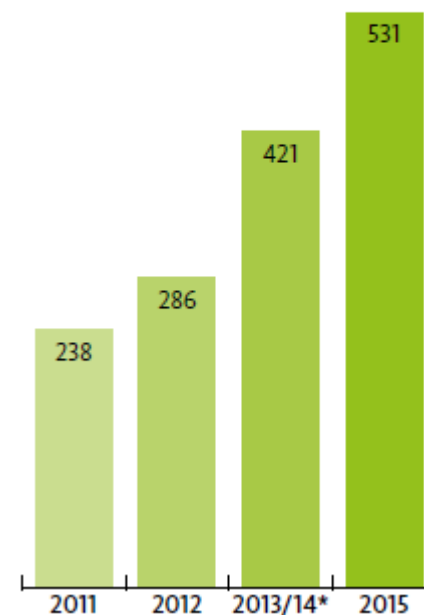
More than 600 projects delivered



Legal structure and revenues Hitachi Zosen Inova AG



Revenues (CHF million)



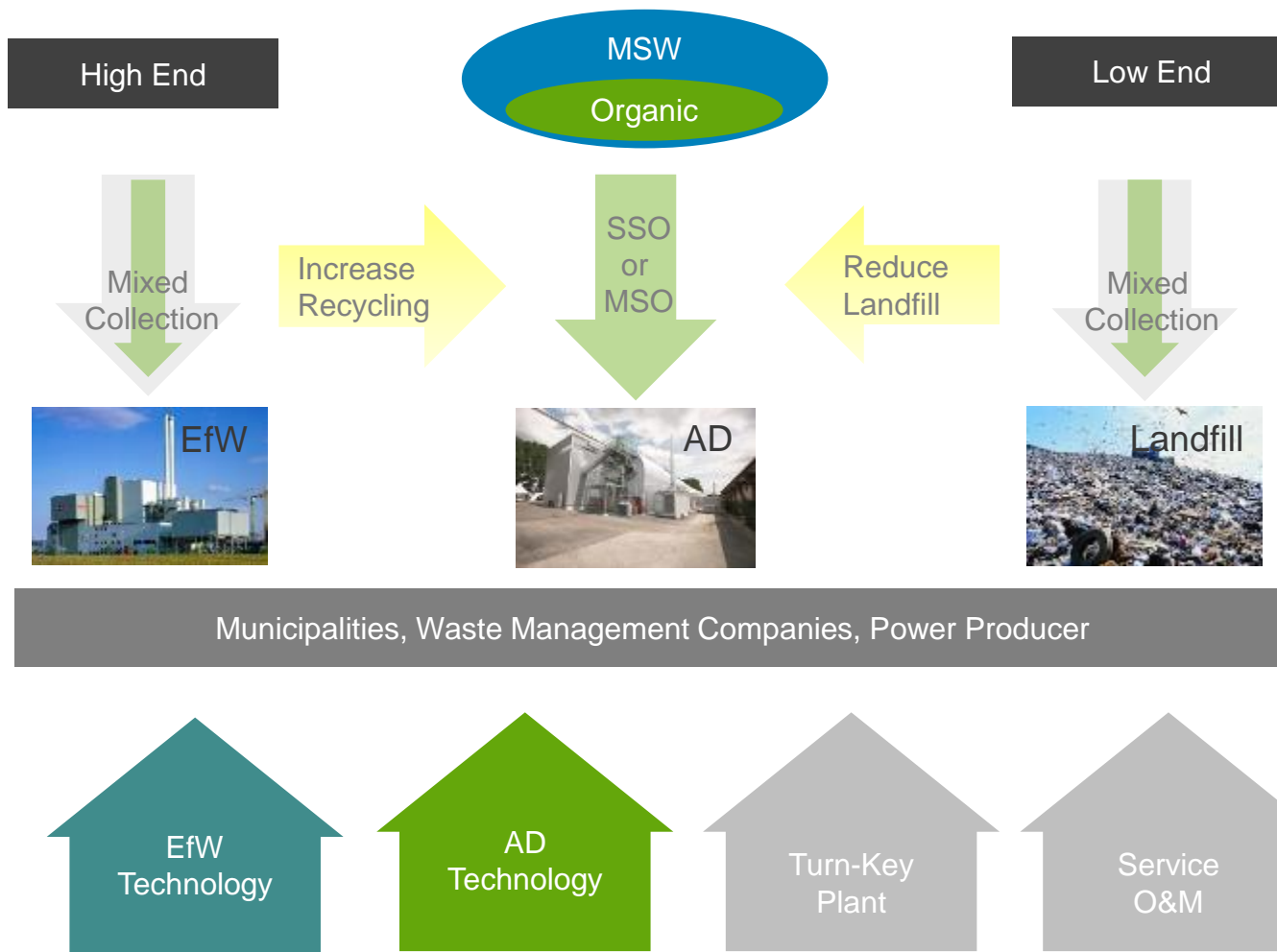
AD and thermal EfW integrated in a sustainable waste management

Markets and drivers for AD

Technology and Outcome

Clients

Value Proposition



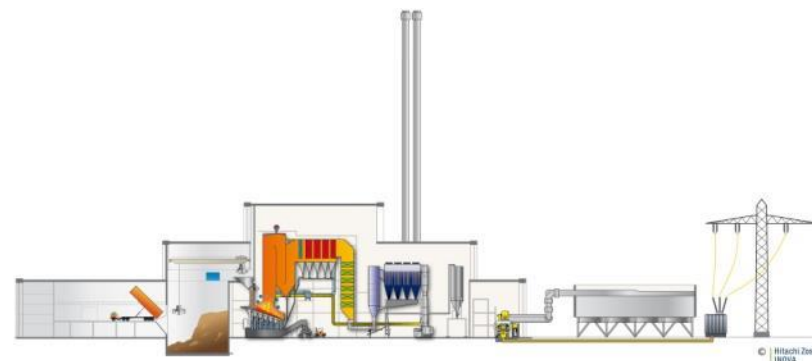
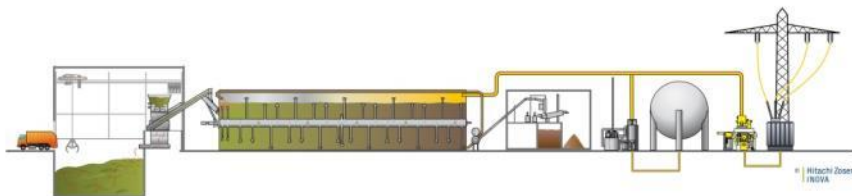
SSO: Source separated organics, MSO: Mechanically separated organics

Energy from Waste – HZI’s contribution to a circular economy

Energy & Compost
from bio-waste with
anaerobic digestion



Energy & Material
from non recyclable waste
with thermal treatment



Recycling

Compost & fertilizer

Direct Recycling

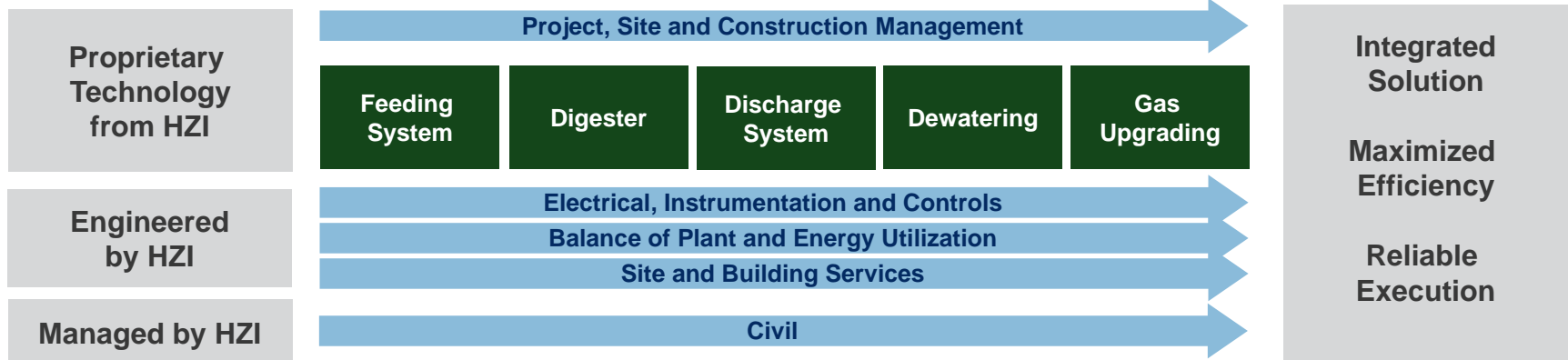
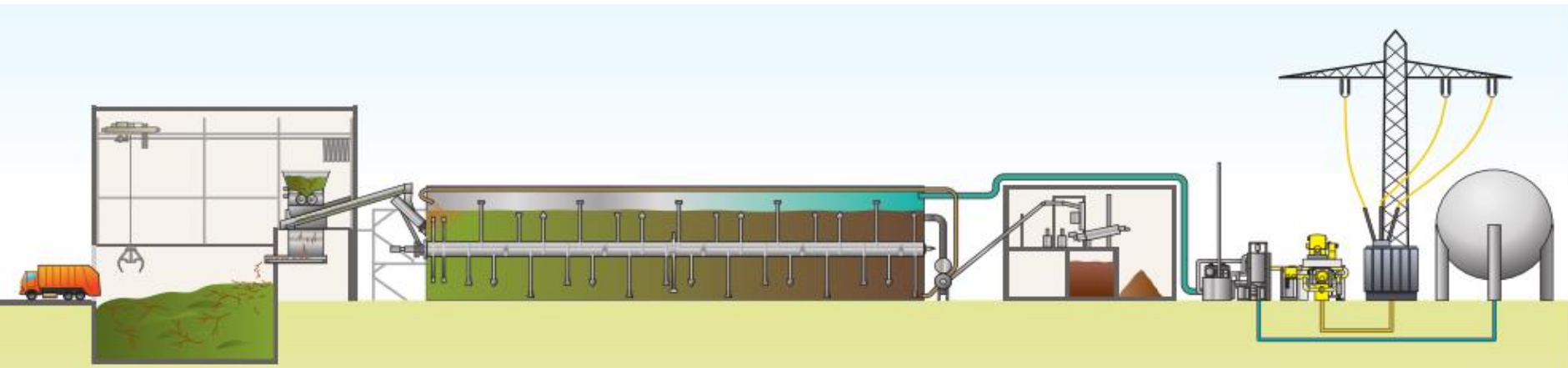
Glass, paper, metals

Recycling

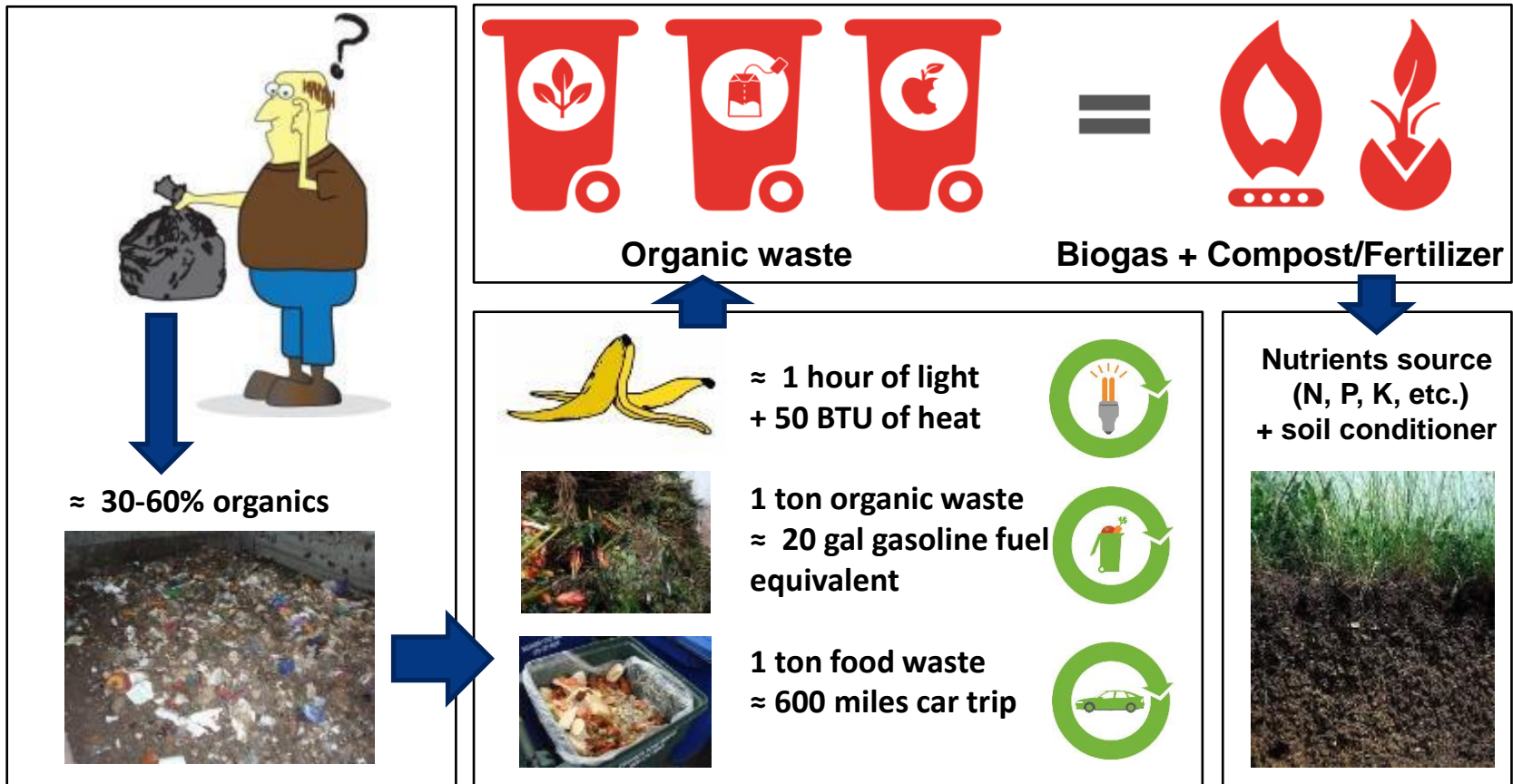
Metals & minerals

Kompogas AD and BioMethan gas upgrading

First class technologies combined with HZI turn-key capability



Why organics recycling with AD? Closing the nutrient cycle while generating energy

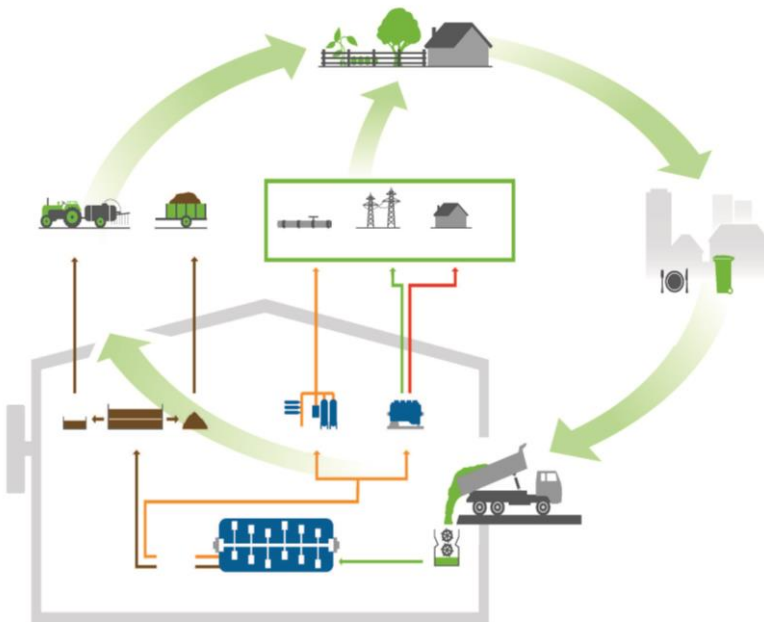


Avenues for organics recycling

Source segregated collection vs. mechanical separation of MSW

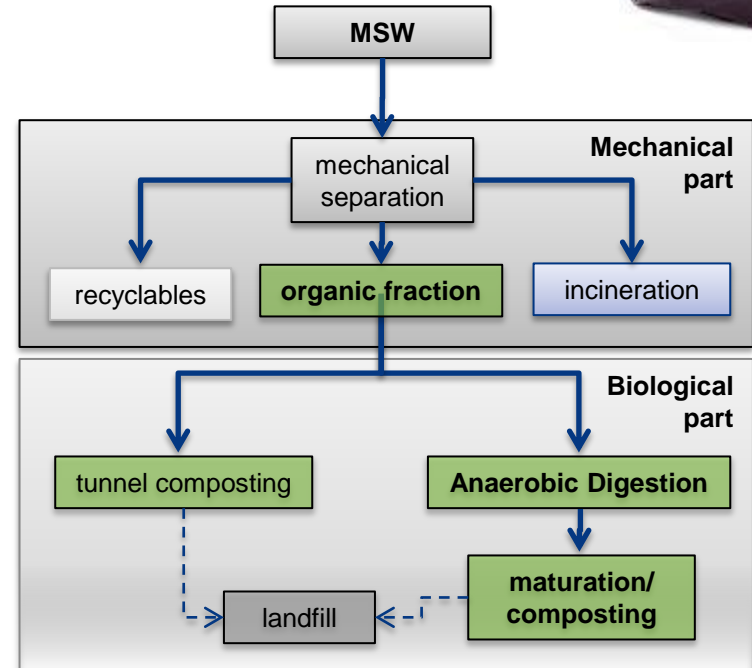
Avenue 1: SSO

Collection of source segregated organic waste and processing in a bio-waste Anaerobic Digestion plant



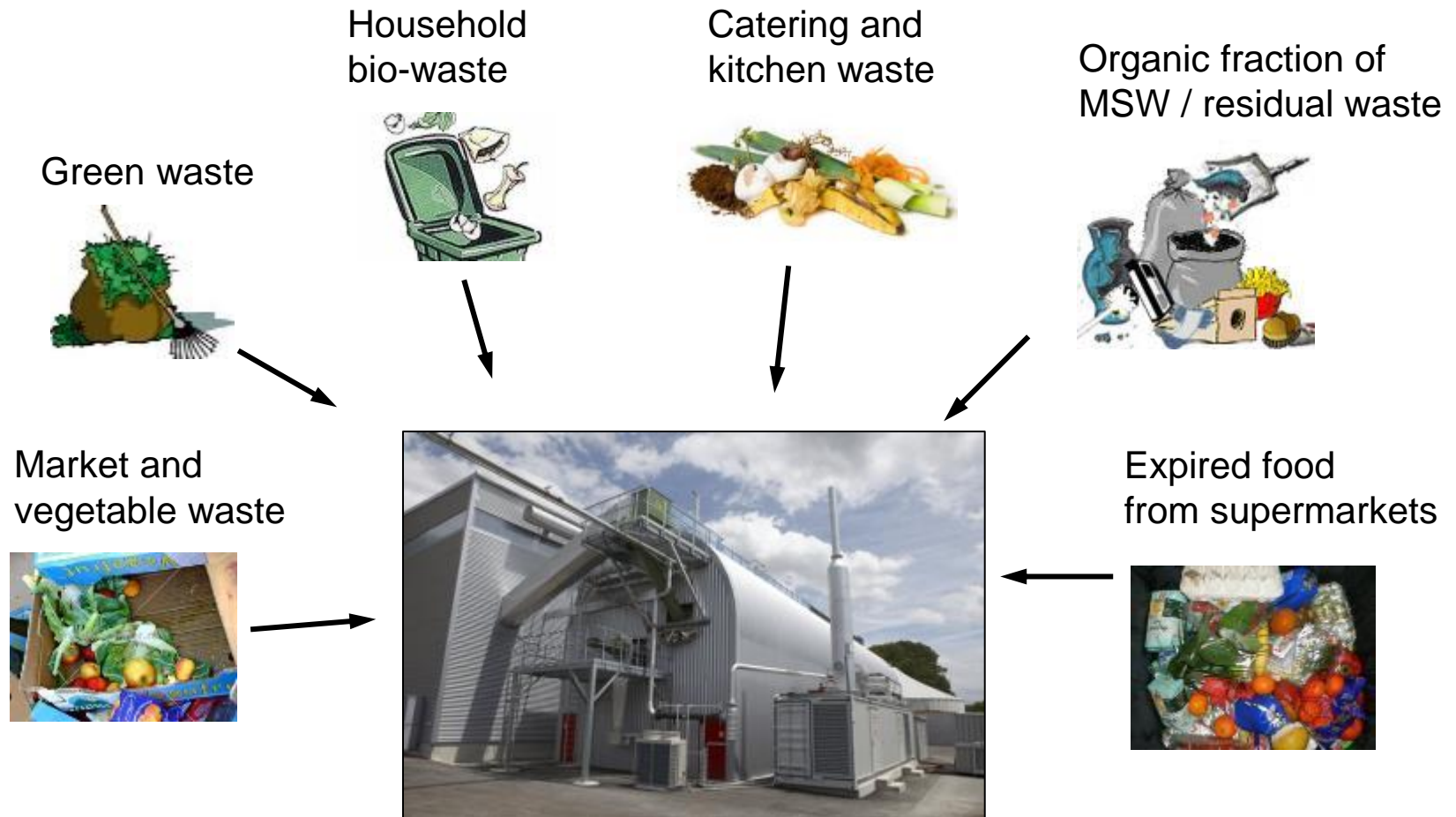
Avenue 2: OF MSW

Collection of MSW and separation of organics in a Mechanical-Biological Treatment (MBT) plant, incl. AD system



Kompogas dry AD

Designed for a large variety of input materials



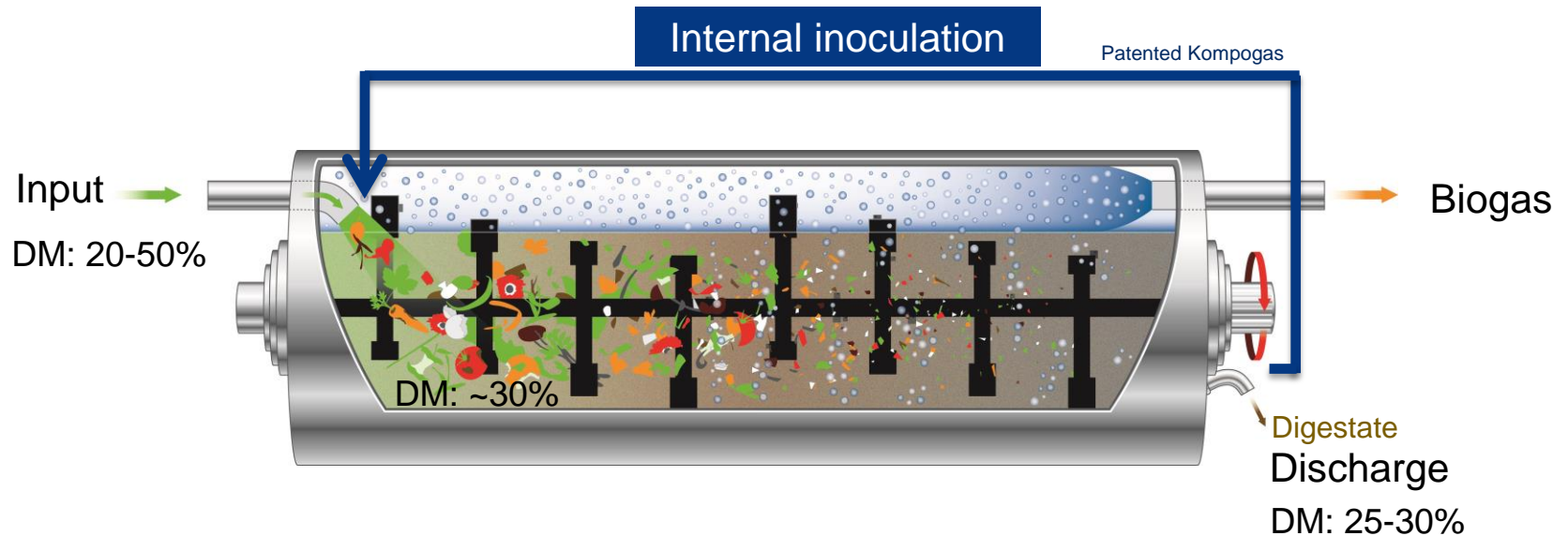
Kompogas dry AD

Designed for a large variety of input materials



Kompogas dry AD

The plug-flow advantage



**Horizontal
plug flow**
- Optimal digestion -

**Thermophile
temperature 131° F**
- Biological activity -

**Longitudinal
agitator**
- Energy saving & tight -

Internal inoculation
- Stable & quick process -

- Retention time 14 days @ 131° F → sanitized fertilizer products
- Inoculation allows fastest process start, defined & specialized process conditions allow highest conversion efficiency → highest biogas production and quality

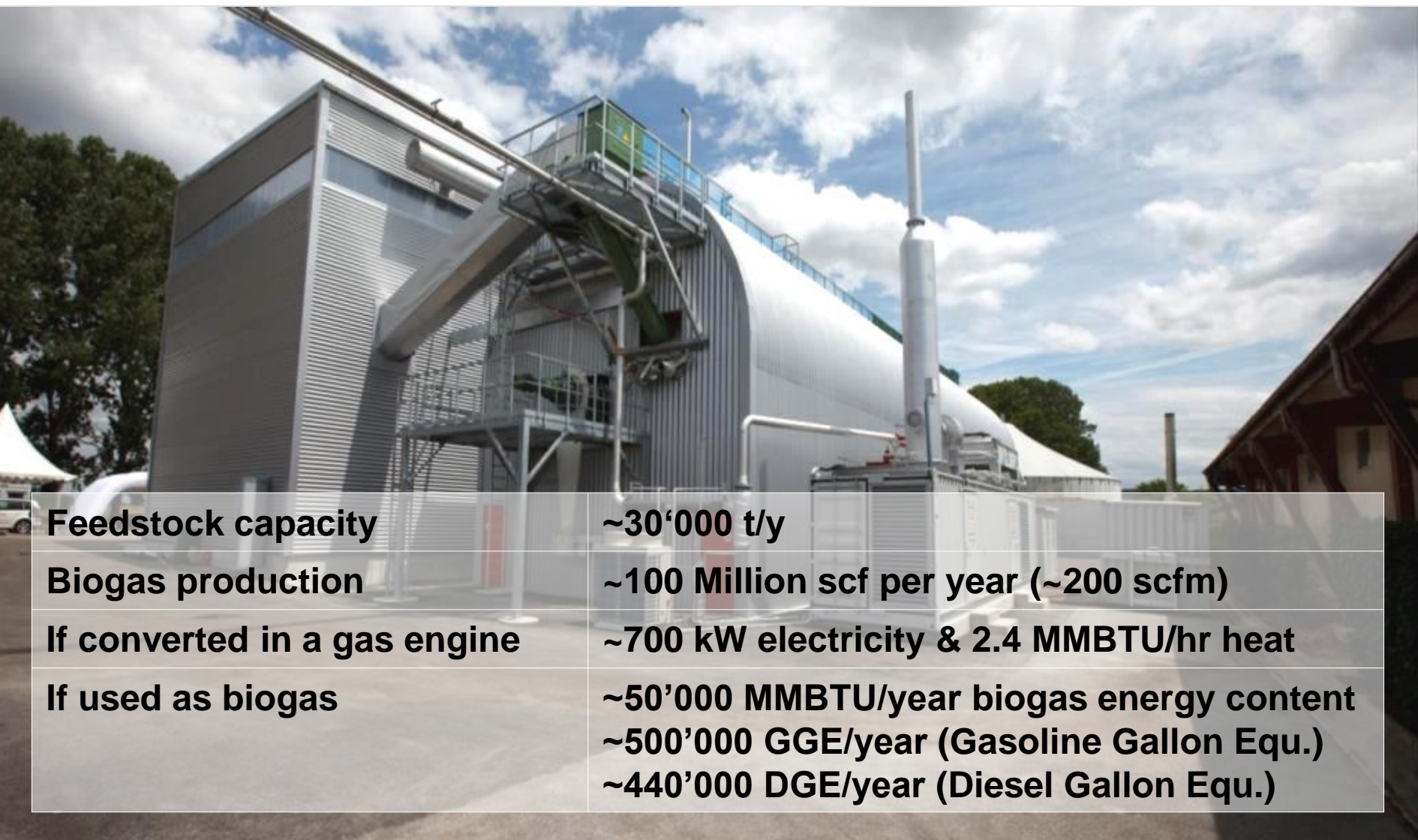
Kompogas steel digester

Robust and reliable, available in various sizes



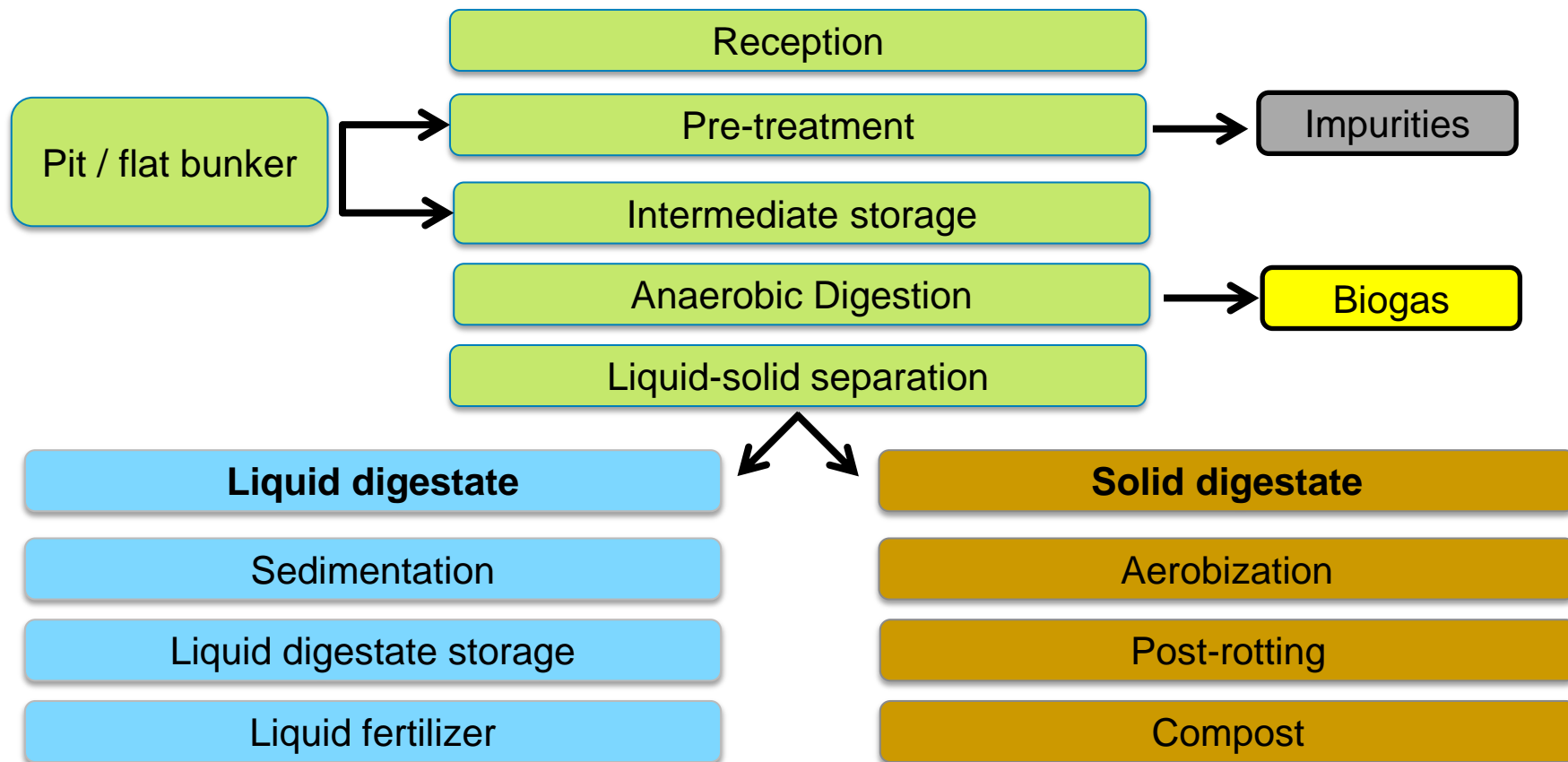
- Digester sizes: PF1200, PF1500, PF1800, further sizes on request
- Modular design for fast installation
- High and constant biogas yield from anaerobic degradable inputs
- Continuous process and stable biology
- Safe and emissions-free

Steel digester PF1500

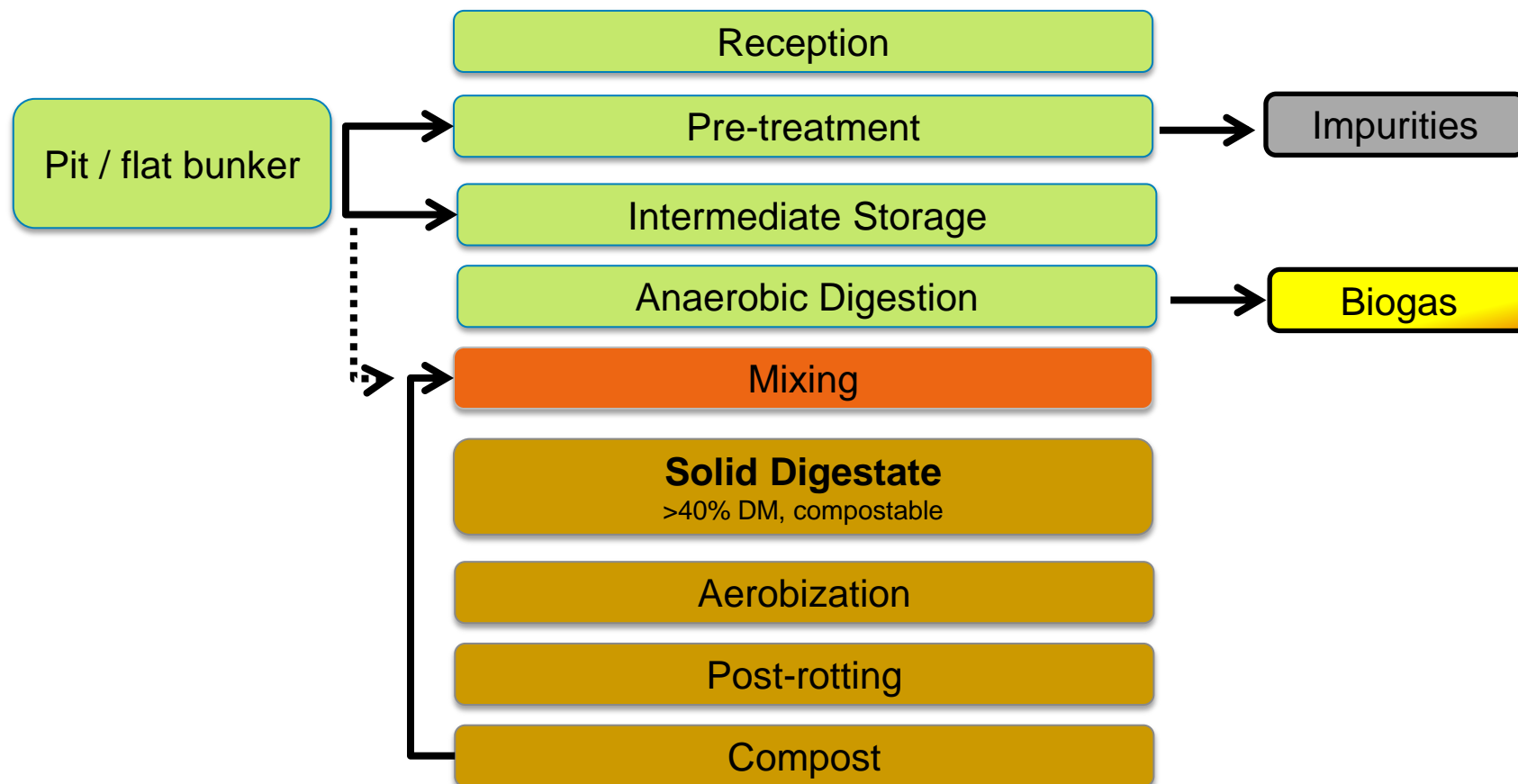


Feedstock capacity	~30'000 t/y
Biogas production	~100 Million scf per year (~200 scfm)
If converted in a gas engine	~700 kW electricity & 2.4 MMBTU/hr heat
If used as biogas	~50'000 MMBTU/year biogas energy content ~500'000 GGE/year (Gasoline Gallon Equ.) ~440'000 DGE/year (Diesel Gallon Equ.)

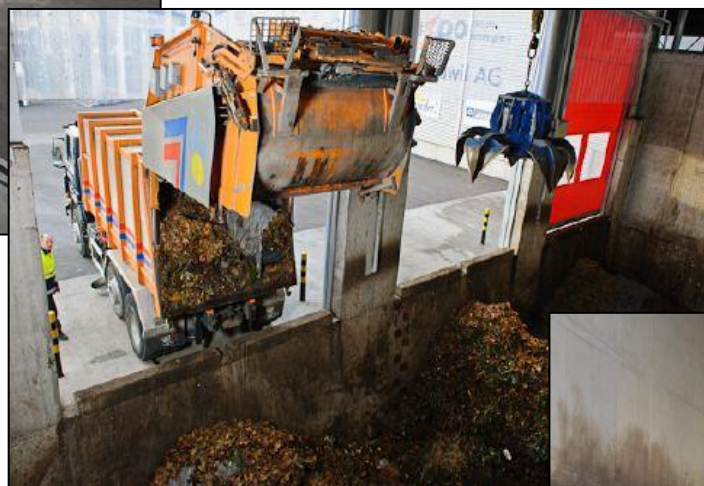
Kompogas Process – Full stream



Kompogas Process – Partial stream



Technology – Reception



Technology – Pre-treatment



Technology – Intermediate storage & Digester feeding



Technology – Kompogas digester



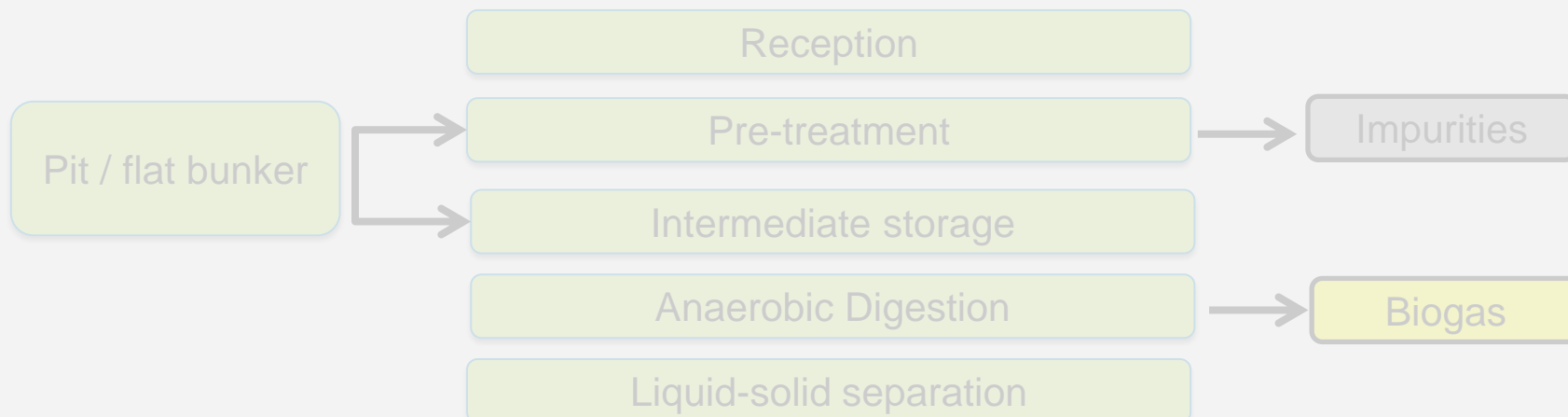
Length	33.8 m
Diameter	8.5 m
Nominal volume	1500 m³



Technology – Extraction & liquid-solid separation



Kompogas Process – Full stream



Liquid digestate

Sedimentation

Liquid digestate storage

Liquid fertilizer

Solid digestate

Aerobization

Post-rotting

Compost

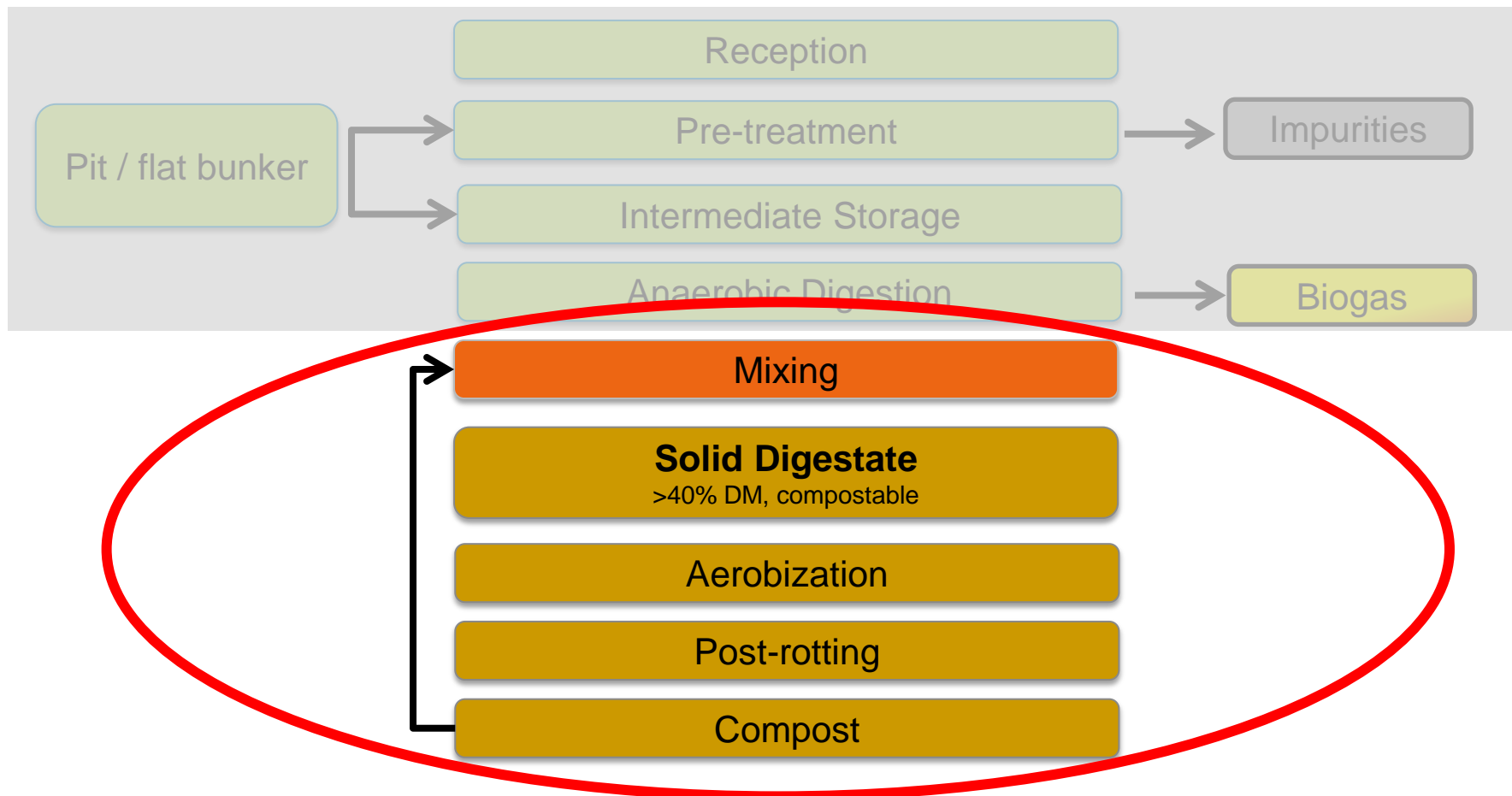
Technology – Liquid-solid separation & liquid storage



Technology – Liquid-solid separation & Aerobization



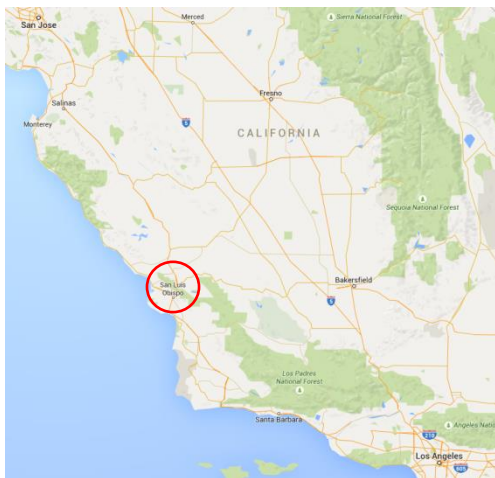
Kompogas Process – Partial stream



Technology – Mixing & Aerobization



San Luis Obispo Anaerobic Digester Project



Project Background

- SLO county needs to achieve 75% diversion goal (state mandate by 2020)
- IWMA manager knows and prefers Kompogas
- Alternative is composting in neighboring counties (with rising compliance requirements in California for open composting)
- HZI is selected by WC to develop a FDBOO project

Project Set-up

- SLO has 24'000 t/a of yard waste (currently composted/ disposed) and want to include 3'500 t/a food waste in the future
- Waste Connections (WC) provides disposal services for SLO
- WC owns a site with office, workshops and truck parking which is foreseen and permitted for composting/ digestion operation
- SLO waste disposal agreement with WC is extended (min. 15 years) based on AD investment (Plant) required to fulfill new CA 75% diversion rate requirements by 2020 (actual 68%)
- WC not interested in 'technology projects' – look for third party to finance-design-build-operate the Plant
→ waste supply and land lease contract with WC

Project Key Data

	Remarks
Technology	• Dry AD – Kompogas with CHP for power production
Project Type	• FDBOO (Finance, Design, Build, Own, Operate) • First Reference Plant in US
Subsidy	• Grants: CalRecycle, CEC EPIC, CAEATFA) • ITC program (Investment Tax Credit)
EPC	• HZIU (expected project duration 15 months)
O&M	• HZIUH SPV (duration 20 years)
Customer	• Waste Connection with its Subsidiaries
Feedstock	• 33'000 t/a (~30'000 t/a metric) – WC is focusing to increase feedstock from 27'500 to 33'000
Property	• Owned by WC Subsidiary – can be leased @ 1 \$/a • Building available that will be modified • End-of-Lease-Terms to be defined
Water	• Available at site
Power	• Available at site • Usage @ 16 ct/kWh
Compost & Liquid Digestate Sales	• 10 \$/t for compost sale • Usage for liquid digestate – pick up at no cost

San Luis Obispo Anaerobic Digester Project

- | Design, Build, Own, Operate
 - In house financing
 - Full EPC
 - In house operations for 20 years
- | Full Permitting
 - CUP
 - CEQA
 - Building permits
- | 33,000 tpy organics inc. yardwaste, commercial and residential foodwaste
- | 20 year community commitment, including rate increases and 20 year franchise extension agreements

Selected references of >75 Kompogas plants in operation worldwide

The first



Rümlang (CH)
built 1991

The most ecological



Rijsenhout (NL)
Recovering CH₄
and CO₂ for
greenhouses

The largest



Doha (Qatar)
15 digesters
for 301'400 t/y
(OFMSW & SSO)

The compact



Winterthur (CH)
PF1500 steel
digester & biogas
upgrading

Zurich, Switzerland



Client
Start-up

Biogas Zürich AG
2014

Technology

Plant type
Input material
Digester type
Biogas usage

Biowaste plant
Comingled green and food waste
PF1500 steel digester
Biomethane & grid injection

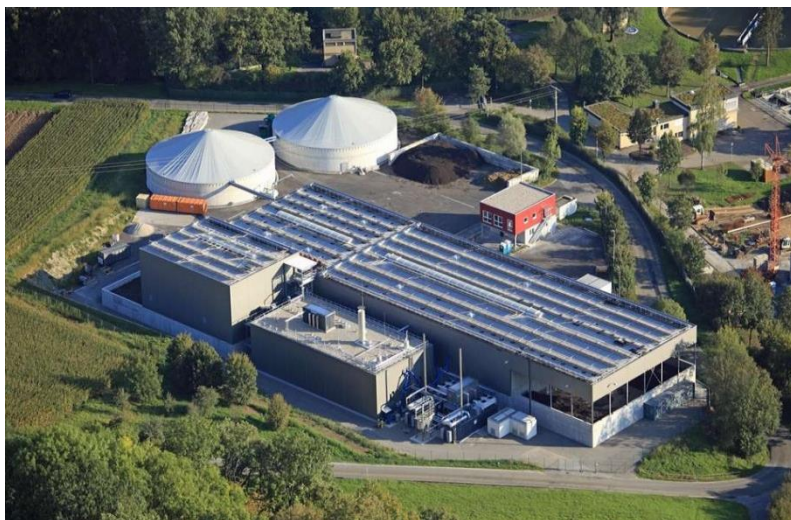
Technical Data

Plant Capacity
Biogas production
Biomethane production
Energy content
Solid digestate
Liquid digestate

25`000 Mg/a
2`100`000 Nm³/a
1`200`000 Nm³/a
12`000`000 kWh
10`000 Mg/a
12`000 Mg/a

- | Typical Swiss Kompogas dry AD plant, with pit bunker reception and high automation level
- | EPC turnkey contract for complete plant incl. civil works
- | Located close to living areas (requiring sound odour control) and a river
- | Biogas is upgraded and injected into the gas grid, enough to heat 3`000 homes
- | Full use of liquid and solid fertilizer, thereby closing nutrient cycle 100%
- | First Kompogas steel digester PF1500 delivered to private client

Backnang, Germany



Client
Start-up

AWG Rems-Murr-Kreis mbH
2012

Technology

Plant type
Input material
Digester type
Biogas usage

Biowaste plant
Comingled green and food waste
PF1300-2 concrete/steel digester
CHP

Technical Data

Plant Capacity
Biogas production
Electricity production
CHP installed:
Solid digestate
Liquid digestate

36`000 Mg/a
4`300`000 Nm³/a
10`200`000 kWh/a
2 x 800kW_{el}
10`000 Mg/a
15`000 Mg/a

- | Typical German Kompogas dry AD plant, with flat bunker reception and high level of automation
- | EPC turnkey contract for complete plant incl. civil works
- | Use of excess heat capacity for waste water treatment sludge drying
- | Full use of liquid and solid fertilizer, thereby closing nutrient cycle 100%

Rijeseenhout, Netherlands



Client
Start-up

Meerlanden Holding eV
2010

Technology

Plant type
Input material
Digester type
Biogas usage

Biowaste plant
GFT (green & kitchen waste), grease
PF1300-2 concrete/steel digester
Biomethane & grid injection

Technical Data

Plant Capacity
Biogas production
Biomethane production
Energy content
Solid digestate
Liquid digestate

48`000 Mg/a
2`600`000 Nm³/a
12`200`000 Nm³/a
12`200`000 kWh
40`000 Mg/a
5`000 Mg/a

- | Partial stream Kompogas process (patented), hence no liquid digestate
- | Biogas upgrading to 99,5%CH₄ content and grid injection
- | CO₂ capturing while biogas upgrading and reuse in neighbouring greenhouses
- | Use of condensate water from composting tunnels for street cleaning and surplus heat for neighbouring greenhouses
- | On site CNG fuelling station for Meerlanden's own garbage trucks

Botarell, Spain



Client

Baix Camp Serveis Comarsals
Mediambientals SA
2010

Start-up

Technology

Plant type
Input material
Digester type
Biogas usage

MBT plant
MSW / Organic Fraction of MSW
PF1300-3 concrete digester
CHP

Technical Data

Plant Capacity

100'000 Mg/a (AD: 54'000 Mg/a)
110,230 ton/y (AD: 59,525 ton/y)

Biogas production

4'300'000 Nm³/a (160.5 MMSCF/y)

Electricity production

9'900'000 kWh/a

Solid digestate

40'000 Mg/a (44,092 ton/y)

Liquid digestate

none

- | EPC delivery of AD plant incl. intermediate storage, automatic feeding and dewatering system
- | High impurity content in organic fraction sorted from MSW
- | High energy yield: in average 160 Nm³ (5,418 SCF) of biogas per metric ton (short ton) input material
- | Dewatering system with centrifuge and subsequent water treatment plant
- | Full-fledged composting plant, using composting tunnels

Montpellier, France



Client
Start-up

Montpellier Agglomération
2008

Technology

Plant type
Input material
Digester type
Biogas usage

MBT plant
MSW / Organic Fraction of MSW
4 x PF1300-2 concrete digester
CHP

Technical Data

Plant Capacity

Biogas production
Electricity production
Solid digestate
Liquid digestate

203'000 Mg/a (AD: 105'000 Mg/a)
223,770 ton/y (AD: 115,743 ton/y)
14'400'000 Nm³/a (537 MMSCF/y)
30'000'000 kWh/a
28'000 Mg/a (30,865 ton/y)
none

- | Largest AD plant in Europe, being integral part of an MBT
- | High impurity content in organic fraction sorted from MSW
- | High energy yield: in average 140 Nm³ (4,740 SCF) of biogas per metric ton (short ton) input material
- | Dewatering system with centrifuge and subsequent water treatment plant
- | Full-fledged composting plant, using tunnels and covered windrows
- | Odor treatment with water/acid scrubbing system, fully enclosed biofilter and activated carbon

Doha, Qatar



Client	Ministry of Municipality & Urban Planning
Start-up	2011
Technology	
Plant type	Integrated MSW Management Centre
Input material	MSW / Organic Fraction of MSW, green waste
Digester type	5xPF1300-3 concrete digester
Biogas usage	CHP
Technical Data	
Plant Capacity	840'000 Mg/a (AD: 274'000 Mg/a) 925,942 ton/y (AD: 302,033 ton/y)
Biogas production	24'200'000 Nm ³ /a (903 MMSCF/y)
Electricity production	56'900'000 kWh/a

- | Large integral waste processing plant combining mechanical sorting, Kompogas dry AD and thermal treatment systems
- | Largest Kompogas dry AD plant in the world with 15 x PF1300 concrete digesters operating in parallel, i.e. 12 x OFMSW + 3 x SSO (Source Segregated Organics)
- | Main driver for dry AD: production of compost
- | Biogas usage in Combined Heat and Power (CHP) plant

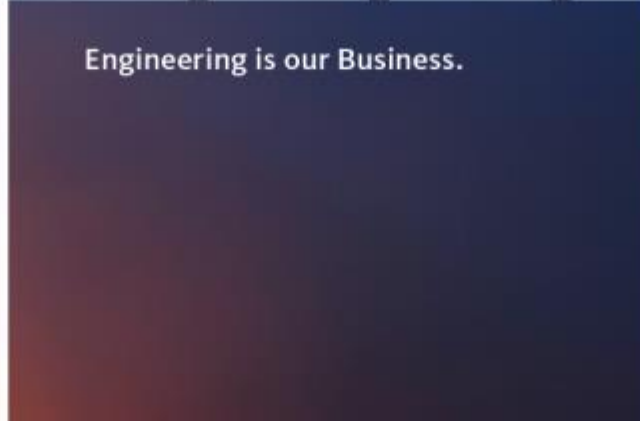
Waste is our Energy



Waste is our Energy.



Engineering is our Business.



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Sustainable Solutions are our Mission.

