Technical Education and Analysis for Community Hauling and Anaerobic Digesters

(TEACH AD)

TEACH AD Webinar Series - June 29, 2023

Anaerobic Digestion: an overview of four technologies (CSTR, anMBBR, PFR, CLR) and their applications

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Technical Education and Analysis for Community Hauling and Anaerobic Digesters – TEACH AD

The goal of this program is to help communities and water resource recovery facilities in the Midwest region divert food waste from landfills by providing education and no-cost technical assistance to explore the increased adoption of anaerobic digestion and renewable energy biogas technologies.

- Educational Assistance
- Technical Assistance

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PROGRAM OFFERINGS

- Technical Assessments
- In-person Workshops
- On-line Webinars
- Project profiles

ELIGIBLE FACILITIES AND PROJECTS

- Water Resource Recovery Facilities
- Municipal Food Waste Digesters
- Community - Based Digesters
- Food Processing, On-Farm Digesters

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Webinar Speakers

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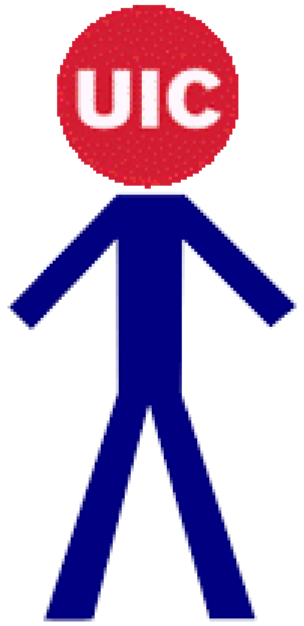

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Q&A

Submit your questions to the host using the Q&A box in the upper right-hand corner

Presentations

A recording of today's webinar will be posted on the TEACH AD webpage and you will be emailed a link by early next week

Survey

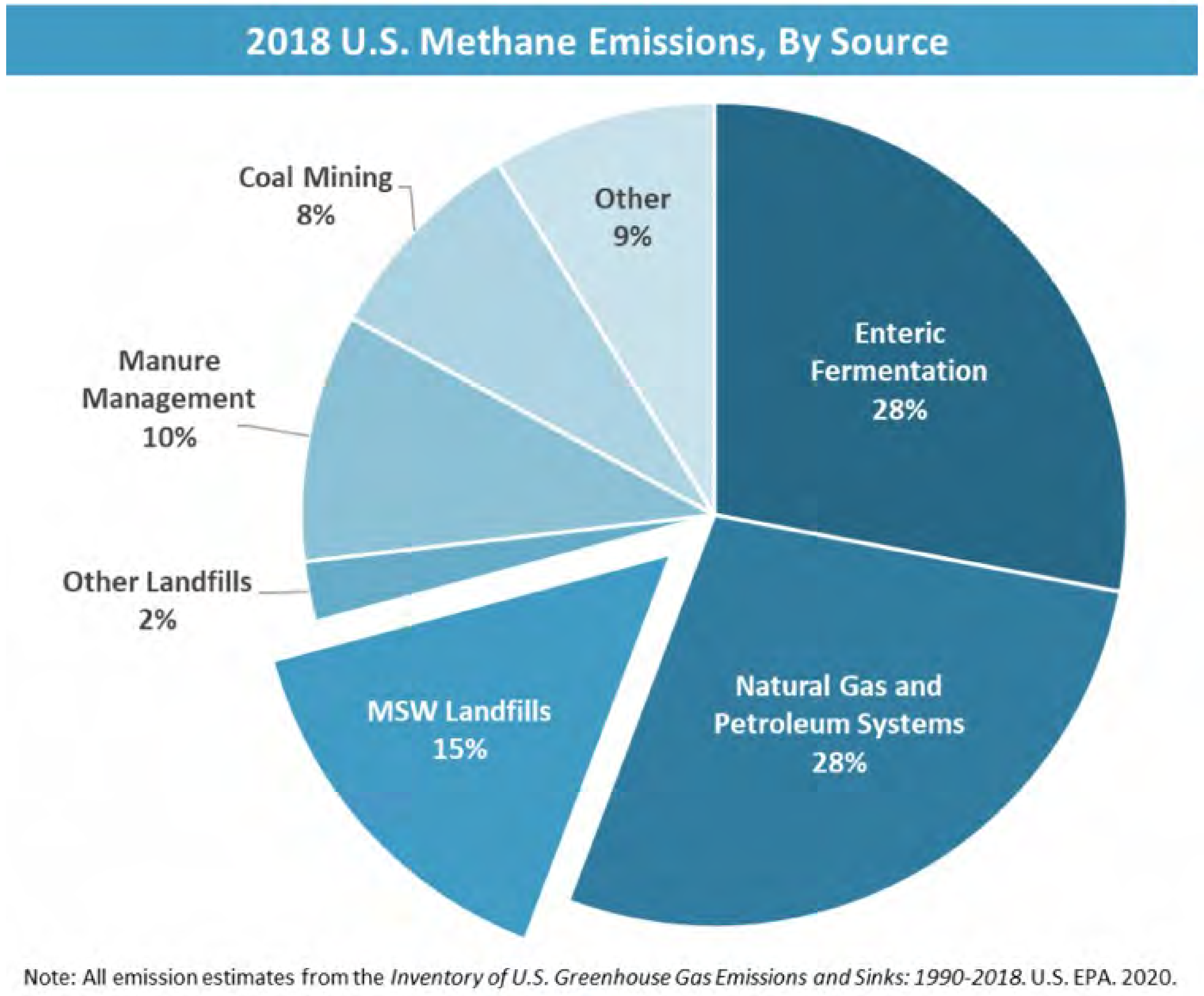
After the presentation you will receive a brief survey. We appreciate your feedback

Technical Issues

Contact Sam Rinaldi at: samr@uic.edu or 312-996-2554 for assistance

Importance of diverting food waste from landfills

- Municipal solid waste (MSW) landfills are the third-largest source of human-related methane emissions in the United States
- By reducing the amount of food waste landfilled, we reduce methane emissions



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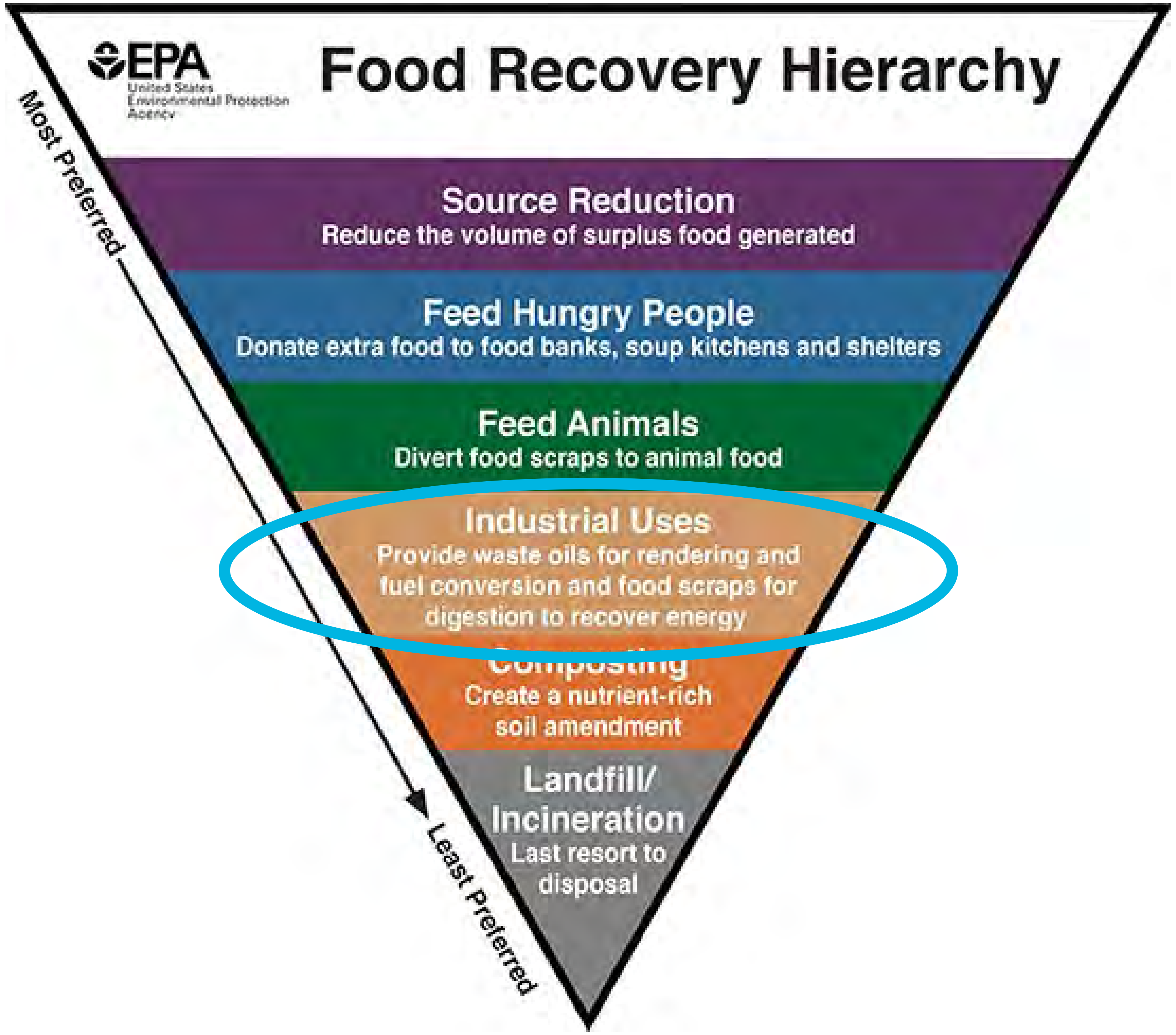
Importance of diverting food waste from landfills

- One-third of all food produced for human consumption worldwide is lost or wasted
- Source Reduction
- Feed People, Not Landfills
- Industrial Uses
    - **Anaerobic digestion**



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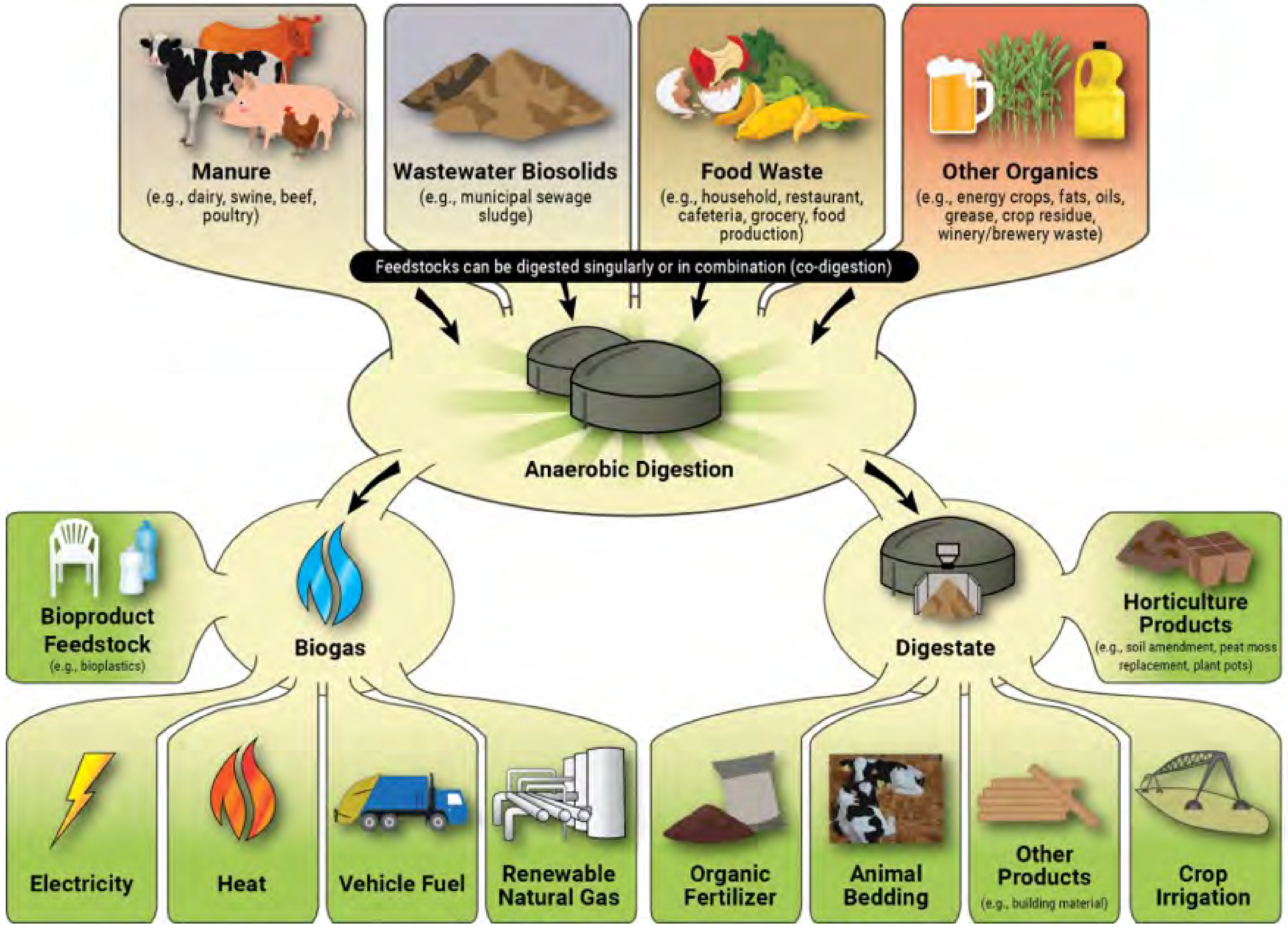
Overview of anaerobic digesters

- Anaerobic digestion is the natural process in which microorganisms break down organic materials in the absence of oxygen.
- Two valuable outputs
  - Biogas
  - Digestate

Sources: U.S. Environmental Protection Agency



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Technical Education and Analysis for Community Hauling and Anaerobic Digesters
TEACH AD

ANAEROBIC DIGESTION TECHNOLOGIES AND THEIR APPLICATIONS: SEBIGAS SOLUTIONS

Presentation Outline

SEBIGAS

- Forewords
- Anaerobic digestion advantages
- Continuous Flow Stirred Tank Reactors CSTR in agriculture RNG & in organic waste projects
- anaerobic Moving Bed Bio Film Reactors anMBBR technology in industrial plants
- Plug Flow Reactors (PFR),
- Covered Lagoon Reactors (CLR)
- Co-digestion
- Conclusion

Anaerobic digestion, not a new idea, but aligned with the challenges of our time

SEBIGAS

Theses days the energy business is mostly lead by Tax Credits, Financing, Public Opinion, and more recently by Carbon Accounting than by technologies. Examples are many in hydrogen, carbon capture, energy storage, syngas, biocoal , ….

Biogas production from waste through anaerobic digestion was originally –in Europe over 20 years ago – use to dry digestate or to produce electricity. In the US the industry started by going the rNG way with injection in natural gas pipeline. Now with potential changes in tax credits, electricity generation for EV might be in play?

If one add the numerous claims of companies whose sole purpose is "to save the world" in almost every field from water electrolysis to energy storage, to concentrated solar, … it is no wonder that industrial companies have trouble establishing a decarbonation plan for the coming 30 years.

The solution is to get started on sound projects, which make both economical and technological sense on their own.

➔ Biogas production from waste streams with enough organic content fits this approach.

Example of XXI century anaerobic digestor plant

INDUSTRIAL PLANT

CLIENT

Xalastra is an anaerobic digestion plant located in Salonicco (Greece) built in 2017. It consists of two digestors and structured in order to process heterogeneous and **complex biomasses**. The plant has a pre-treatment phase of by-products consisting of a **sanitization** and **pasteurization** system. At the end, digestate undergoes on a specific **water treatment**.

THE PLANT

The plant processes **148 tons of by-products daily**, divided into cattle manure, slaughter waste, expired food, beer residues and whey. The plant has an installation power of **1 MWe** and produces **450-500 Nm3/h of biogas**.

THE RESULT

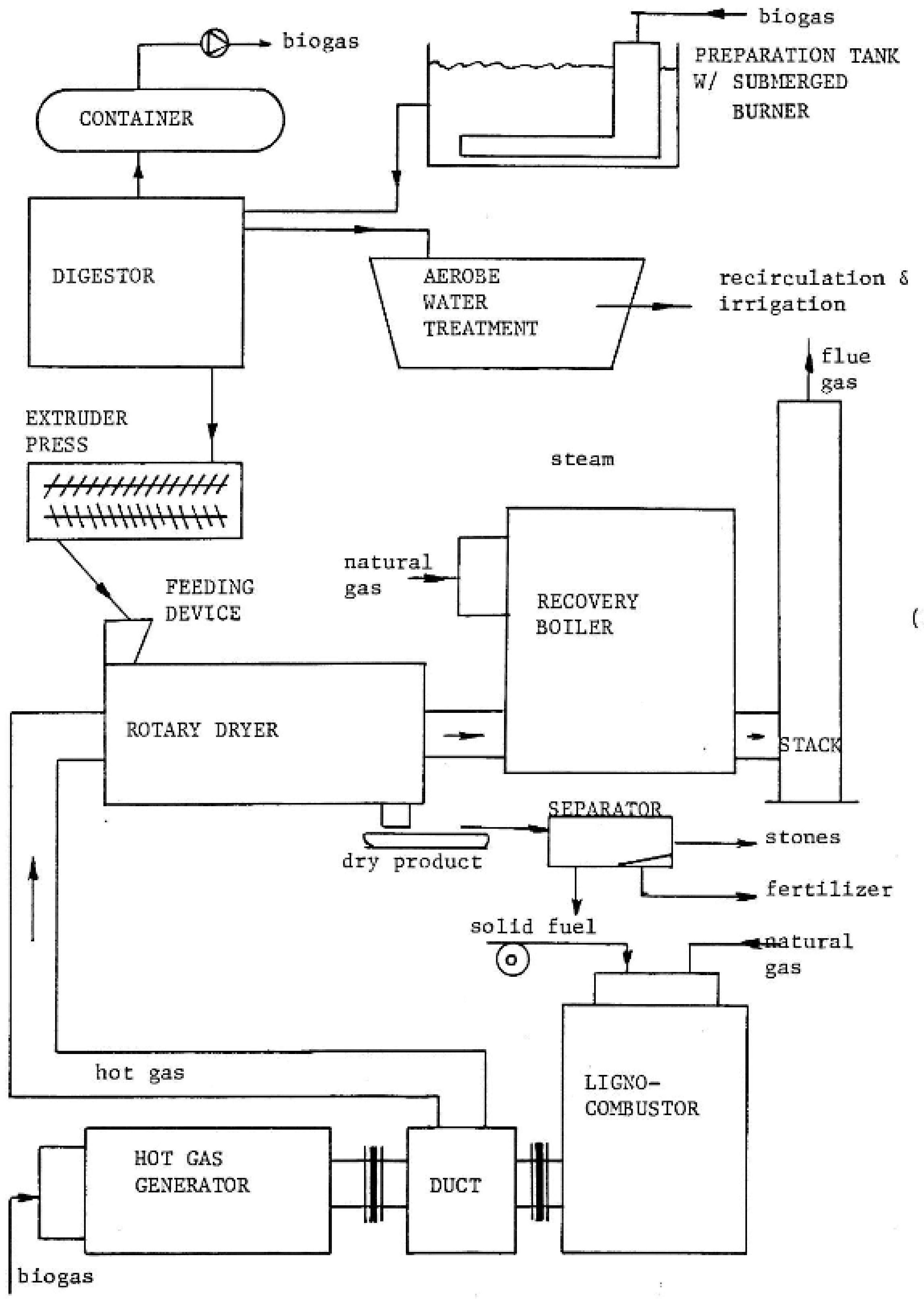
Thus Xalastra, **valorizes** waste by producing electricity, that is reused in their production cycle.
At the same time, it **reduces costs** in the waste the disposal..
Furthermore, for circular economy, they **reuse of digestate** as a fertilizer and soil improver in the surrounding areas.

CLIENT NAME:	Xalastra
LOCATION:	Salonicco (Greece)
FEEDING:	Cattle manure, slaughter waste, expired food, beer residues, whey
INSTALLED POWER:	1 MWe

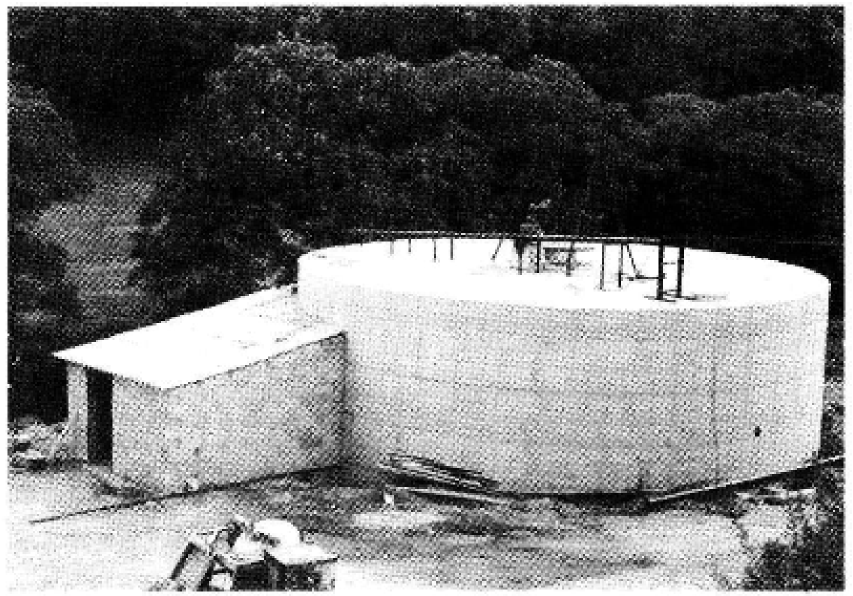
NOTE: 1 MWe, the maximum limit to receive subsidies!

Example of XX century anaerobic digestor

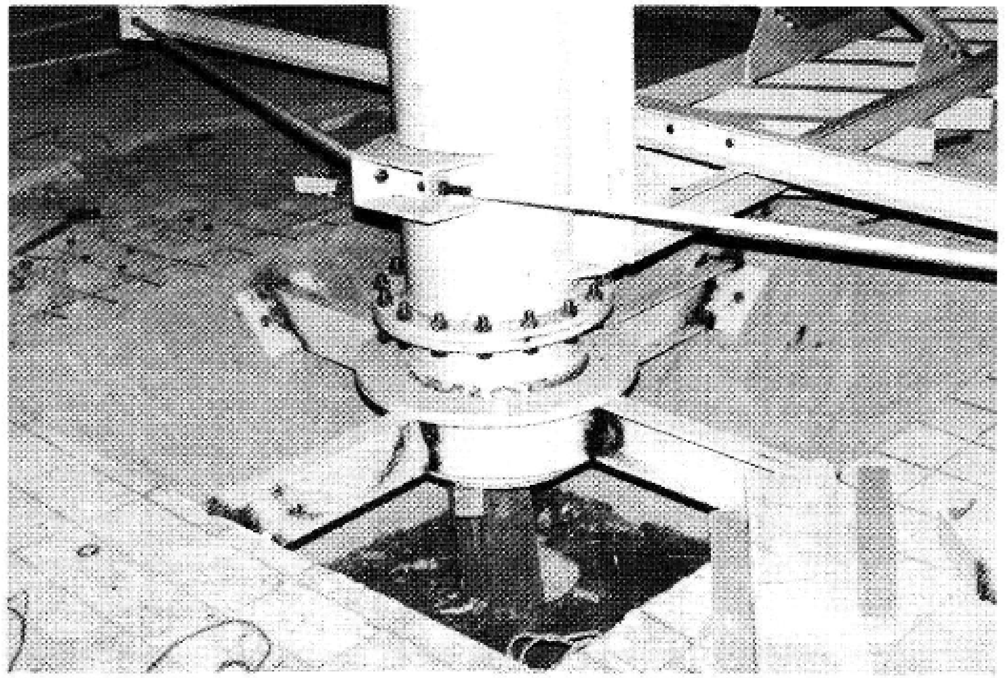
Project of a Modern Drying Unit with a Combination of Methanization and Combustion of Solid Waste



The technology is proven. On a personal note, that was my first project after my engineering school in 1983.



(Figure No.3) VIEW OF THE DIGESTOR AND THE TECHNICAL ROOM FOLLOWING INSTALLATION



(Figure No.5) INSIDE OF THE DIGESTOR MIXER AND SCRAPER DEVICE

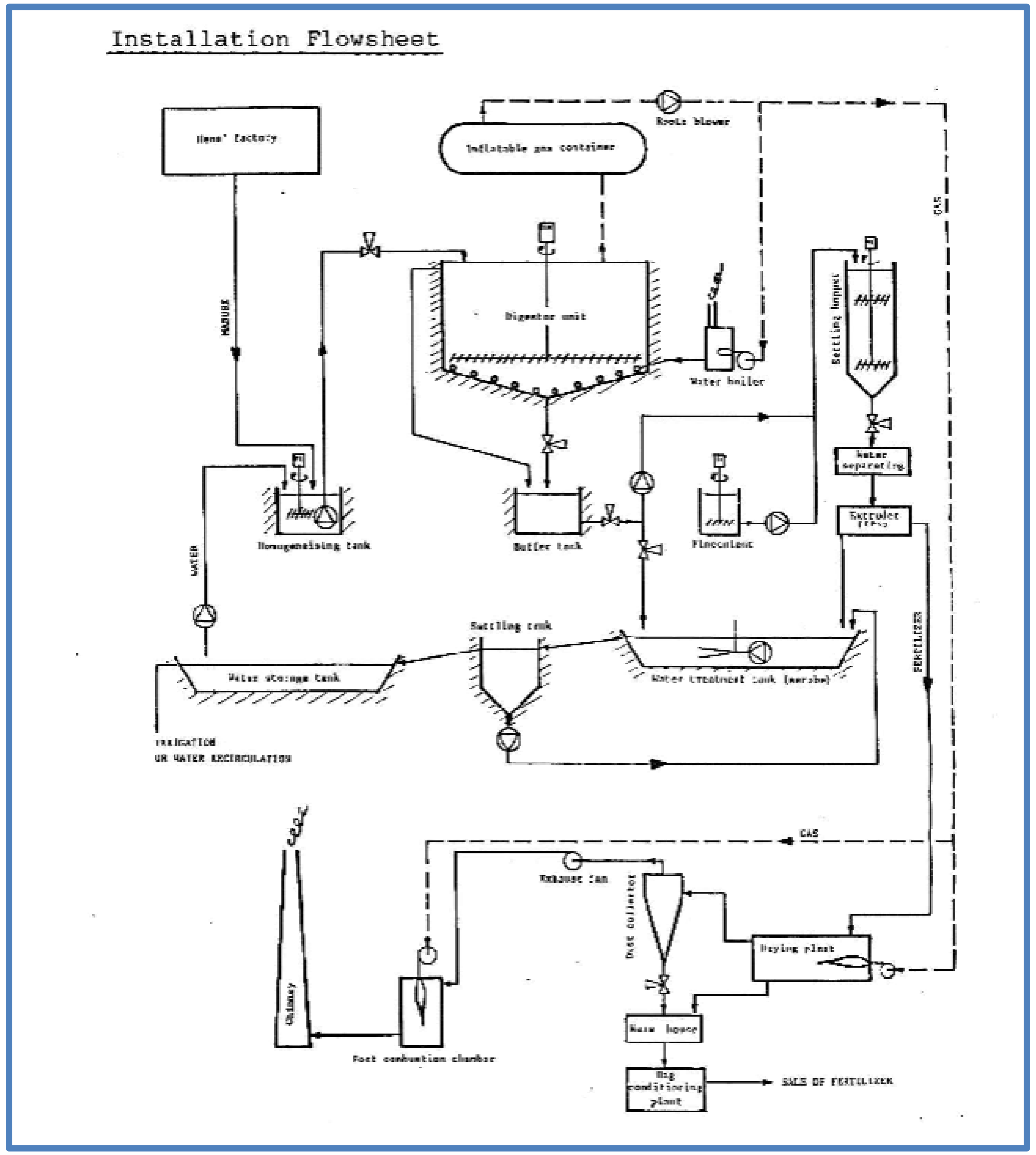


Image: private collection

Anaerobic digestion Technologies

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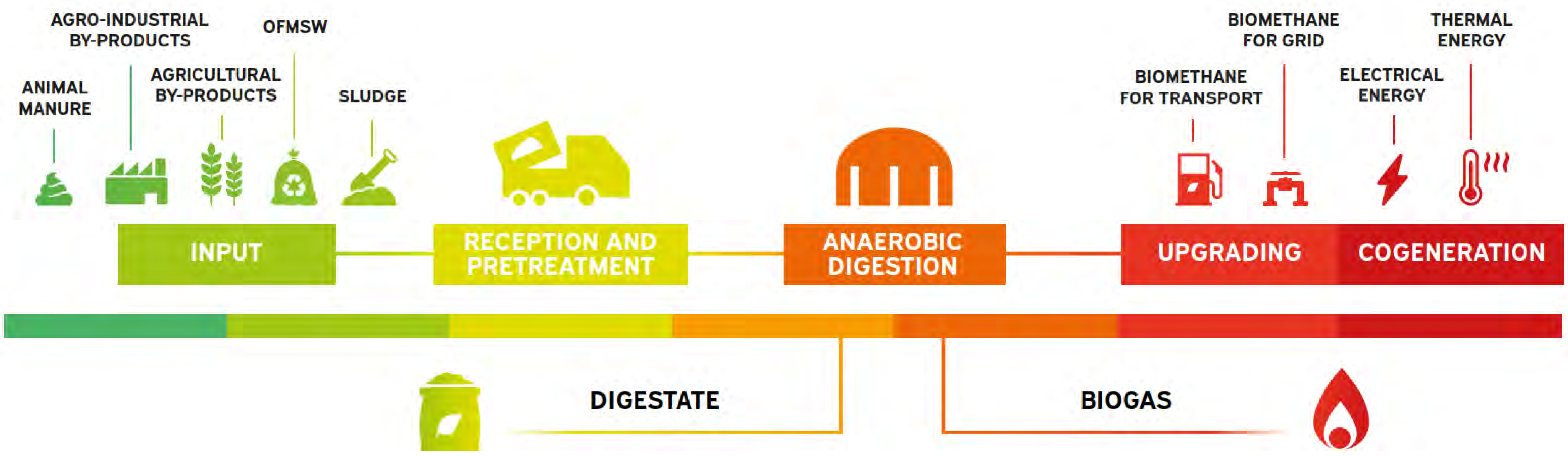
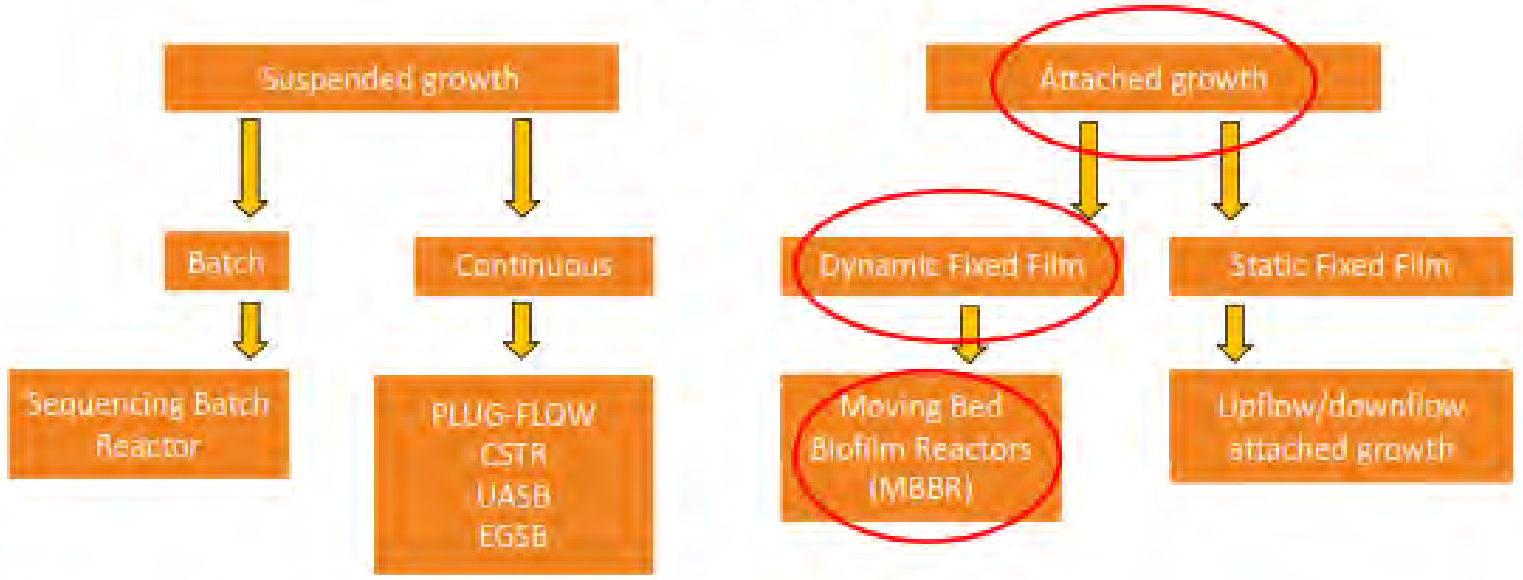


REACTORS/BIOMASSES

	WASTE		AGRI	INDUSTRIAL				
	DIRTY MSW	SORTED MSW	ANIMAL MANURE	SLAUGHTER WASTE	CIVIL WWTP SLUDGE	CIVIL WWTP LIQUID	F&B EFFLUENT	PAPER WW
BATCH	X							
PLUG-FLOW	X	X	X					
CSTR		X ✅	X ✅	X ✅	X ✅			
anMBBR						X ✅	X ✅	X ✅
EGSB						X	X	X
UASB						X	X	X

ANAEROBIC DIGESTION REACTORS



ANAEROBIC DIGESTION TECHNOLOGY ADVANTAGES

Brings sustainability and circularity in the production cycle

Our 84 plants in operation since 2010 led us achieve these goals:

76 MWe INSTALLED

23.000.000 TONS CO_2 EQ. AVOIDED

Produces good quality fertilizers, soil improvers and energy from renewable resources

TECHNOLOGY

Anaerobic digestion is a BIOLOGICAL PROCESS that takes place in the ABSENCE OF OXYGEN and thought which the organic content of biomass is transformed into biogas.

PROCESS

The biomasses used as inputs are diverse and come from the agricultural, industrial, waste or sludge management sectors.

ENERGY

After appropriate treatments, biogas can be used to produce electricity and thermal energy from cogeneration, or separated to obtain biomethane and carbon dioxide for industrial used.

DIGESTATE

The digestate leaving the process serves a dual purpose in agronomic terms, as it makes mineral elements available to plant and contributes to carbon storage in our soils. The digestate output can be separated and, if necessary, undergoes specific post -treatments.

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Acronyms, Parameters, and Definitions,

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Acronyms

- ATA anaerobic toxicity assays, a variety of chemical compounds that can inhibit digestion and especially CH4 formation, such as chlorinated compounds,
- BMP biochemical methane potential, The potential to produce biogas from an organic waste
- BOD biochemical oxygen demand; COD chemical oxygen demand
- HRT hydraulic retention time, the average length of time the dissolved portion of the waste spends in the digester.
- SRT solids retention time, the average length of time the feedstock remain in the digester's reactor and remain in contact with the bacteria. SRT & HRT are not always equal.
- Psychrophilic, ambient temperature; Thermophilic Digestion at 50–60 ℃.. Mesophilic Digestion at 25–40 ℃.
- OLR organic loading rate indicates the amount of VS that can be fed into the digester per day in g VS/L/day
- TS total solids, weight of the substrate after drying as percentage of wet weight. Also called dry matter (DM)
- VFA volatile fatty acid
- VFA/Alkalinity Ratio, Indicates the progress & stability of the digestion, and is used for process control. A ratio of 0.1 -0.25 is ideal and 0.5 indicates a sour digester
- VS volatile solids, the fraction of TS that are combustible and are used as an estimate of organic matter content.
- Loading rate Amount of substrate added to the digester. Expressed as kg VS per m3 digester and day.
- C/N -quota Relation between carbon and nitrogen content in the substrate.
- Methane yield Amount of produced methane expressed e.g. Nm3 per ton TS.

Key Anaerobic Digestor Features:

- Agitation or not, type of natural, hydraulic, digestate recirculation, mechanical (several types)
- Heated or not, type of heating from the wall, external recirculation,
- Hybrid options,
- Pre-digestion

Parameters that determine the efficiency of converting organic materials to biogas :

- Retention time
- Organic loading rate (OLR)
- Temperature
- Characteristics of volatile solids (VS)
- Inhibitors

Some parameters measured to evaluate a reactor performances & stability

- pH,
- total gas volume and gas composition, methane, hydrogen, carbon dioxide and hydrogen sulfide.
- FOS/TAC (volatile organic/(fatty) acids/total inorganic carbon)
- Ammonium -nitrogen concentration,
- solid and volatile solid of digestate,

The four main Anaerobic Digestion technologies

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CSTR

DRY SUBSTANCE	5% < DS < 10%
THERMAL REGIME	Mesophilic or thermophilic
RETENTION TIME	20 < days < 60
MIXING SYSTEM	Mechanical (slow and fast mixers), inside the reactor

anMBBR

DRY SUBSTANCE	DS < 1%
THERMAL REGIME	Psychrophilic or mesophilic
RETENTION TIME	< 10 days
MIXING SYSTEM	Mechanical (slow mixers) inside the reactor - gasmixing

CLR

DRY SUBSTANCE	DS < 5% and low fibre content
THERMAL REGIME	Psychrophilic or mesophilic
RETENTION TIME	15 < days < 25
MIXING SYSTEM	Hydraulic mixing (recirculation pumps)-gasmixing

PFR

DRY SUBSTANCE	15% < DS < 35%
THERMAL REGIME	Mesophilic or thermophilic
RETENTION TIME	20 < days < 60
MIXING SYSTEM	Mechanical (slow mixers) inside the reactor

Covered Lagoon Reactors (CLR)

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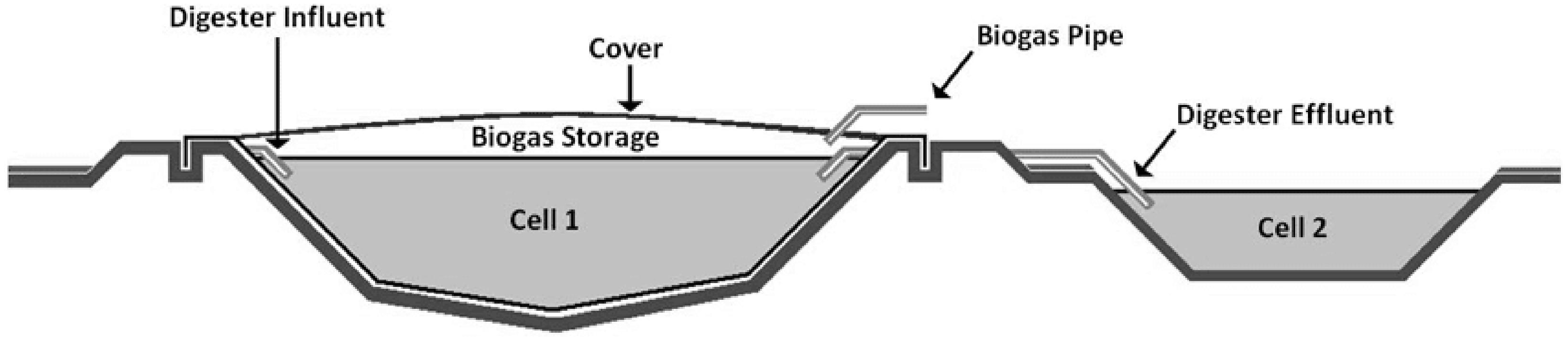
It is the simplest of the digestors' designs, however, still require experiences to be properly designed and built .

The anaerobic digestion of the organic content occurs through the biomass recirculation in an active sludge layer, with controlled quantities and velocities.

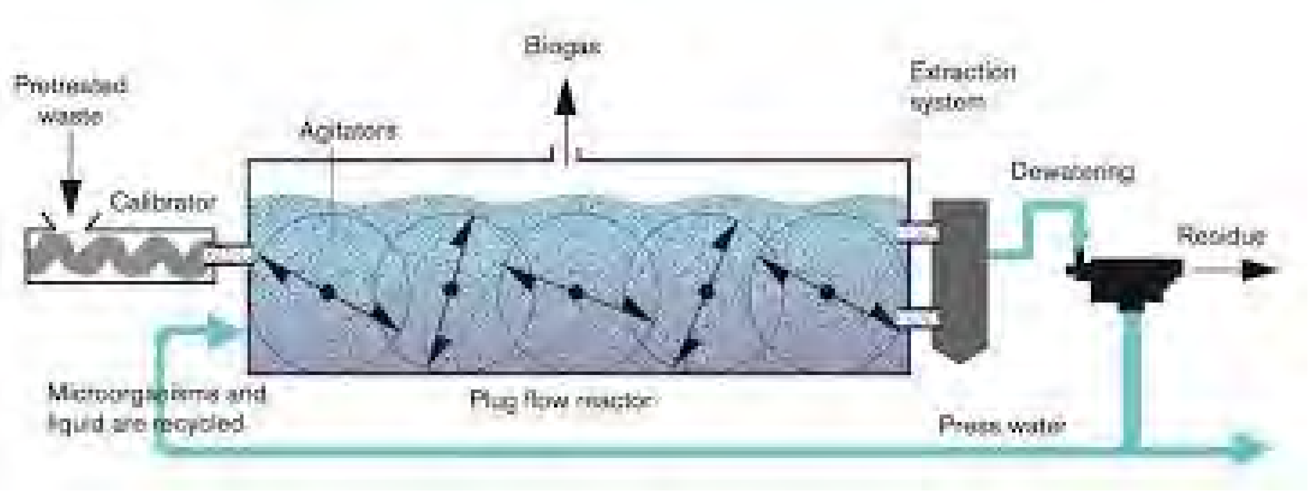
ADVANTAGES:
- Perfect internal mixing and optimized contact between the fresh biomass and the active sludge
- large internal buffer capacity and high process stability
- Very flexible automated feed distribution inside the anaerobic reactor , avoiding local biological disturbances
- Effluent clarification and flexible sludge recycle/discharge
- Flexible extraction of surplus biosolids from the lagoon reactor

Image: private collection



Plug Flow Reactors (PFR)

- It is a versatile technology that present a few variants, not continuously mixed, but either mechanically (paddles), or with the biogas re -circulation some forced movement of the material is possible,
- Due to the shape (elongated rectangle) and the feeding to one side and the outflow from the other side, it is a first in/first out type. The 4 stages of anaerobic digestion are somewhat sequential and separated
- The biogas is collected in inflatable
- It is often found at large dairy farms and It can accommodate some mixed waste input



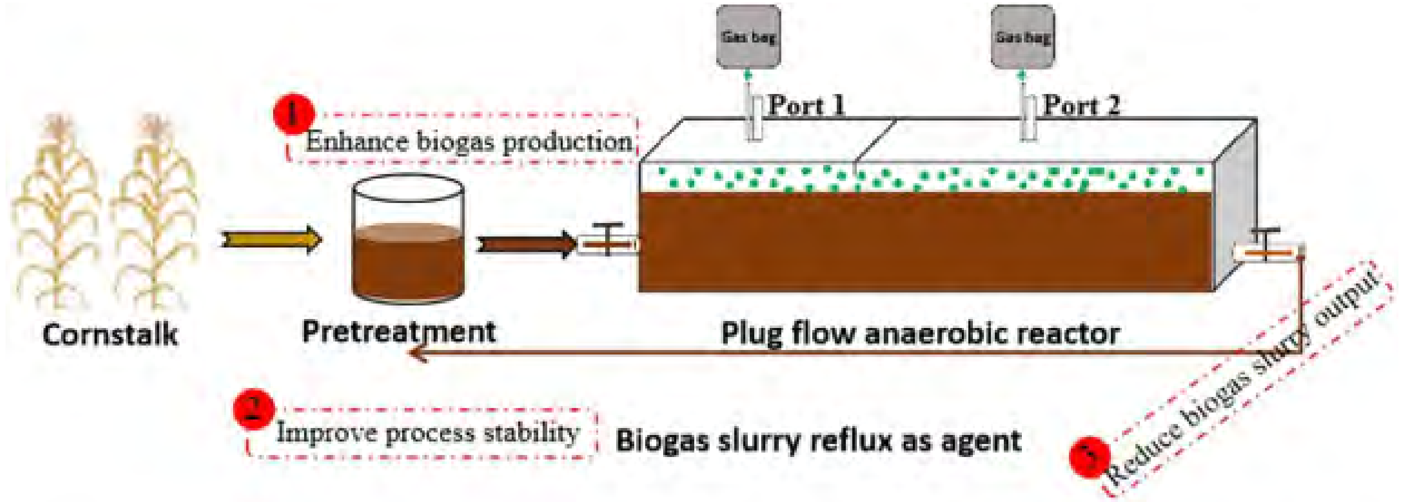


Image: Web – Science Direct & Research Gate

Image: private collection

CSTR TECHNOLOGY IN AGRICULTURE RNG PROJECTS

CSTR = Continuous Flow Stirred Tank Reactor

AGRICULTURE RNG

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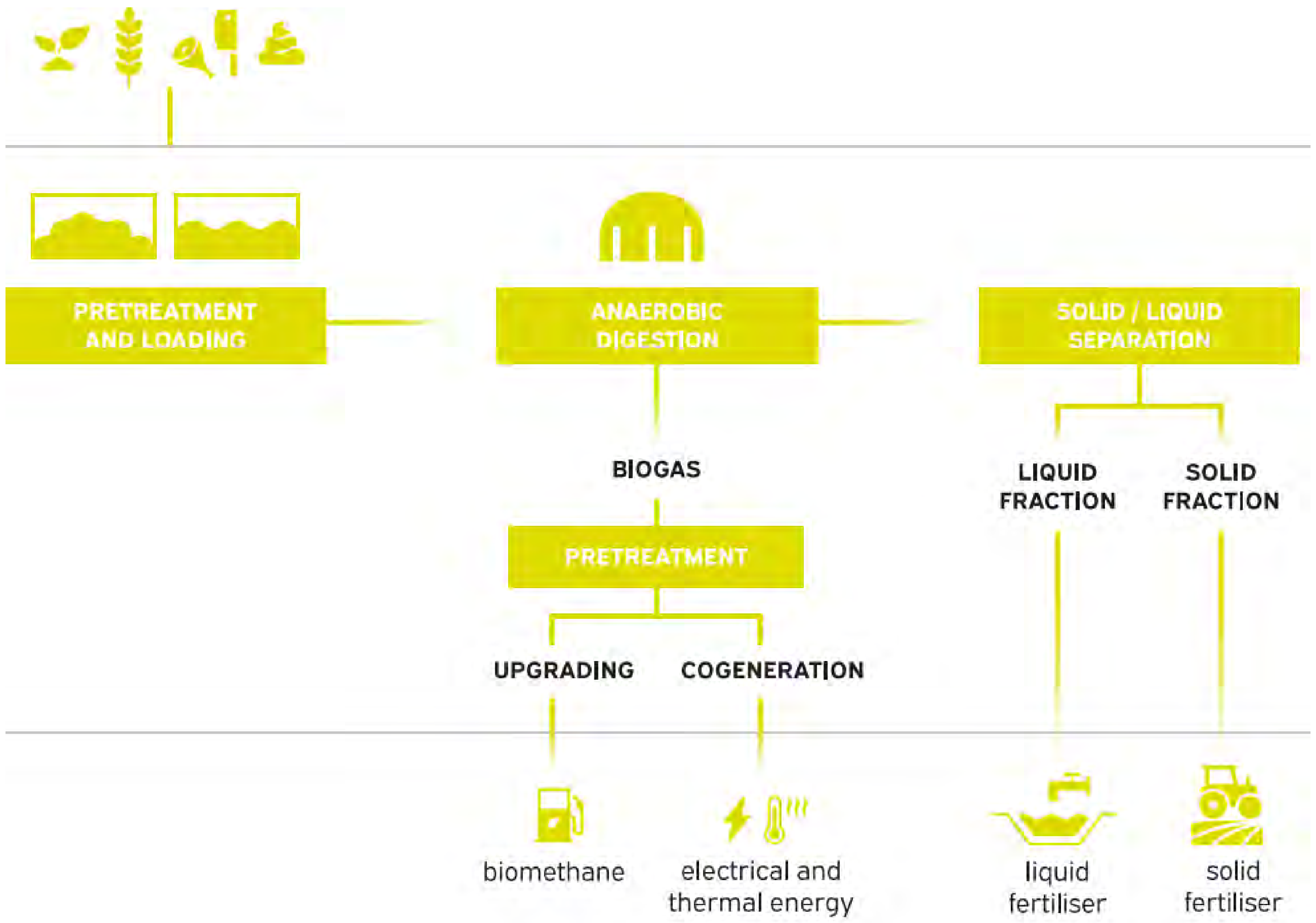
- Specific pretreatments solutions are implemented to digest complex matrices (sanitization, pasteurization, sand removal)
- Pasteurization or flotation technologies may be implemented in case of complex matrices (ex. slaughterhouse waste)
- Post-treatments step for digestate valorization and nitrogen recovery can be considered



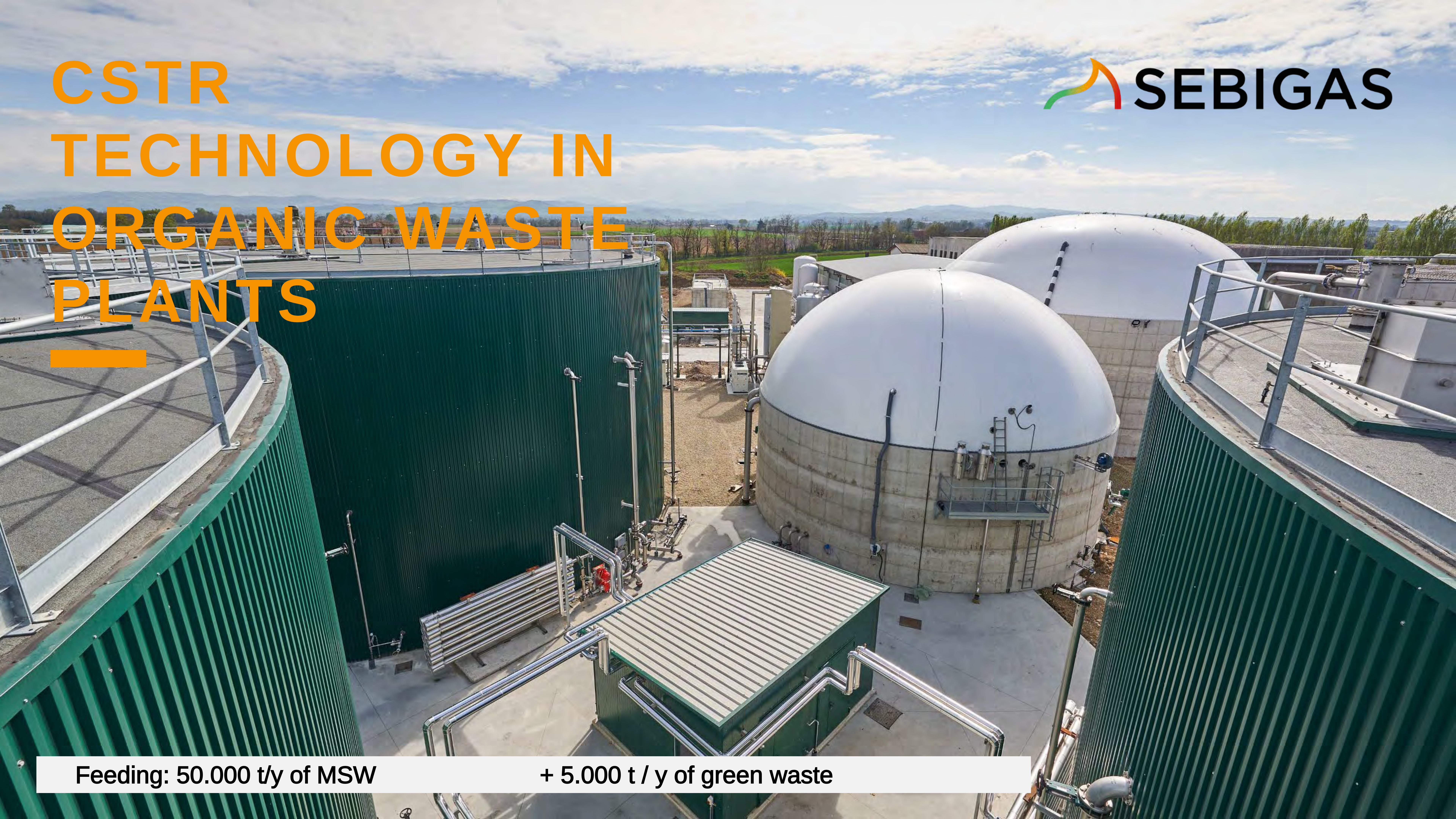
AGRICULTURE RNG ADVANTAGES

An agricultural plant with an installed power of 2 MW and fed with around 66.000 t/y of various biomasses

(maize silage, triticale silage, cow and pig manure, poultry litter)

In operation for 12 years, can avoid around **890.000 tons CO_2 equivalent**

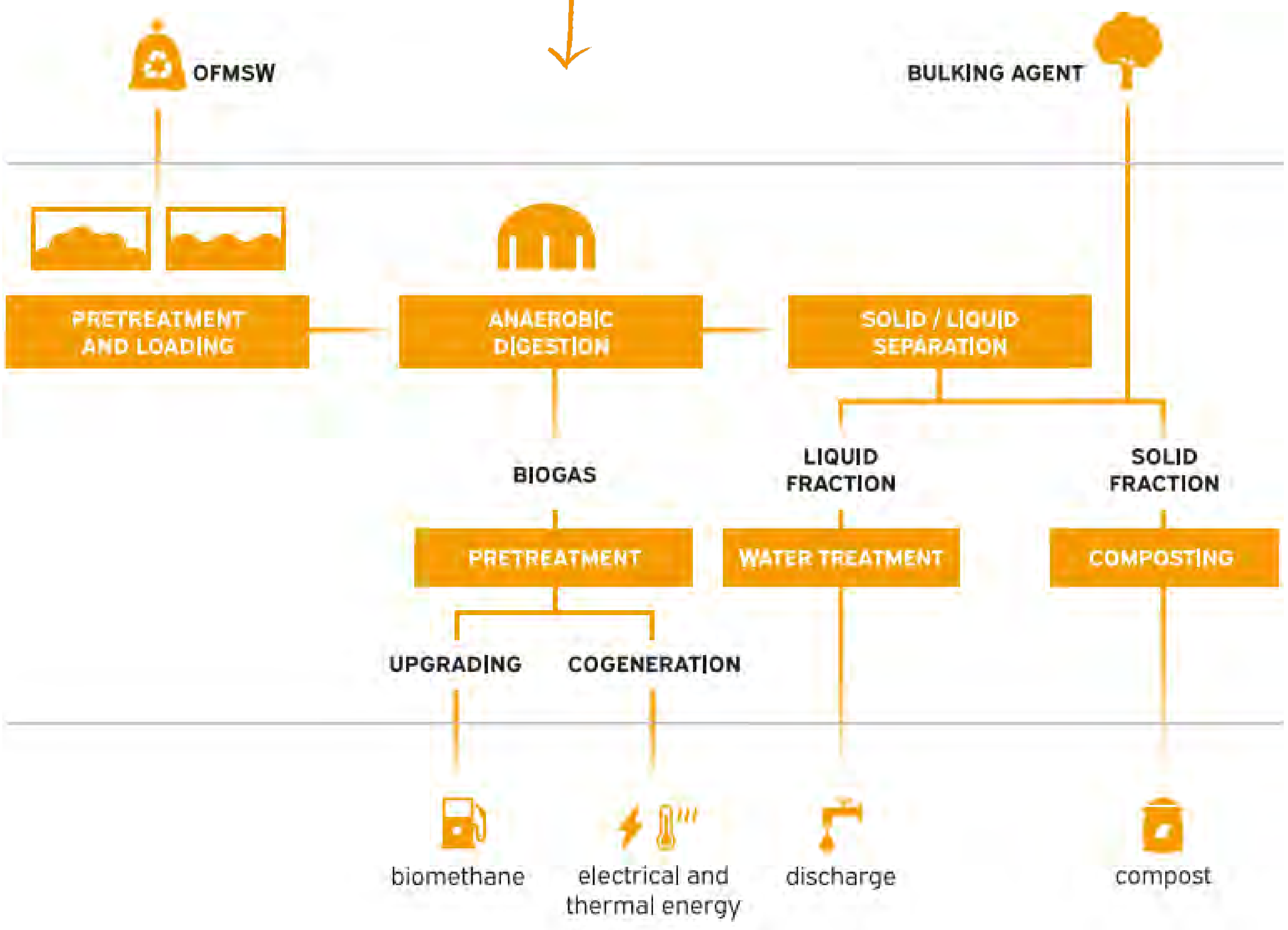
Produces good quality fertilizers, soil improvers and energy from renewable resources


CSTR
TECHNOLOGY IN
ORGANIC WASTE
PLANTS
SEBIGAS
Feeding: 50.000 t/y of MSW
+ 5.000 t / y of green waste

ORGANIC WASTE PLANTS

The plant ensures high performance while digesting high volumes and heterogeneous biomasses

Pretreatments to remove any unwanted contents that could affect the anaerobic digestion process (opening of bags, sieving and sand removal, removal of metals, etc.)



Post-treatments to separate the digestate and discharge the liquid fraction into the surface water bodies and use the solid fraction as a composted soil improver

ORGANIC WASTE TECHNOLOGY ADVANTAGES

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It recovers 50.000 tons of organic waste to produce **650 Nm3/h** of biomethane

1.700 TOE (Tons of Oil Equivalent) are saved every year

10.000 t/y of quality compost, used as a fertilizer + 30.000 m3/ y of clean effluent, suitable for river discharge

Biomethane produced (> 5,000, 000 Nm3/ year) for transportation is equal to 180.000 car fill up, to travel more than **54.000.000 km**

Typical large plant with CSTR digester, for the organic fractions of MSW

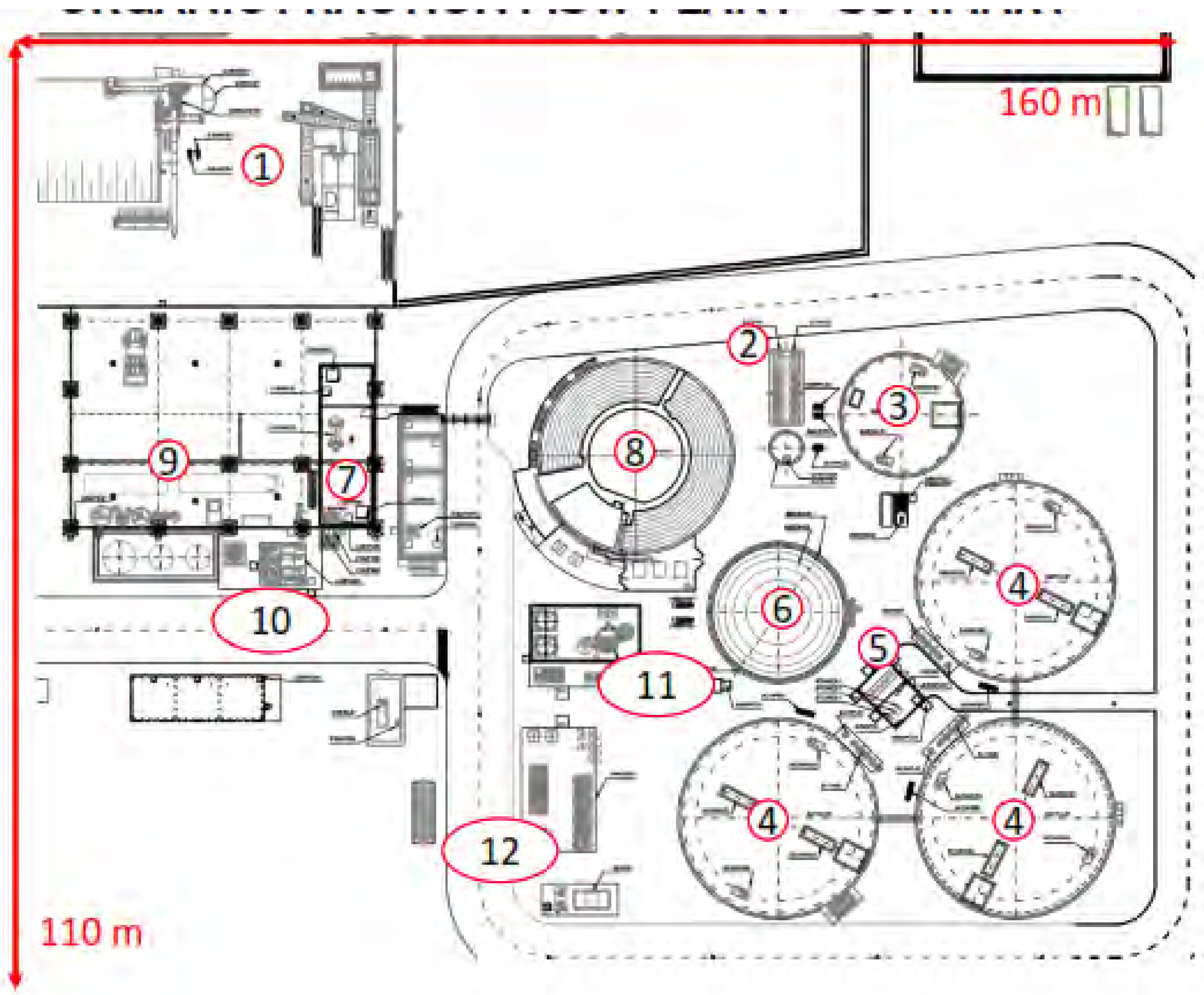

TABLE OF CONTENT

1. RECEIVING HALL – PRETREATMENT EQPM
2. GRIT REMOVAL SYSTEM
3. BUFFER TANK
4. DIGESTER (CONCRETE - 23X11)
5. PUMPING STATION
6. POST-DIGESTER
7. CENTRIFUGAL DECANTER
8. BIOLOGICAL AEROBIC REACTOR
9. UF AND RO AREA
10. EVAPORATOR
11. BIOGAS DESOx AND DEHUMIDIFICATION
12. BIOGAS UPGRADING AND HP COMPRESSOR

REMARK: COMPOSTING AND AIR TREATMENT IS MISSING!!!!

ultrafiltration (UF) and reverse osmosis (RO)

Site optimization and consideration to foot -print constrains is important.

Especially in the case of more complex plants where the digesters themselves are only a portion of the overall process, with pre -digesters and post -digesters requirement.

Presented here is a 1200 Nm3/h of biogas From 140 ton/d of domestic waste.

Typical Key Values

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Digester (CSTR) can be
up to 32 m in dia. 10 m height
for a volume of 7400 m3

CSTR digester retention time
is usually 30 days (varies from 15 to 30)

Such digester could produce different flow of biogas of biogas (depending on the feedstock): for example:

1 ton of liquid cow manure
could produce
between 15 and 25 Nm3 of gas

1 ton of waste
from slaughterhouse
could produce
200 and 225 Nm3 of gas

NOTES: Use 10 kWh/Nm3 of CH_4 for LCV as a rounded number
1,000 cows produce 1 ton manure per hour

anMBBR TECHNOLOGY INDUSTRIAL PLANTS

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anMBBR = anaerobic Moving Bed Biofilm Reactor

anMBBR REACTOR

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Which biomasses can be digested in the anMBBR Reactor?

It's a technological solution for the treatment of industrial wastewater in anaerobic digestion. Allows an on-site management of high streams, with low digestion volumes.

DRY SUBSTANCE	DS<1%
THERMAL REGIME	psychrophilic (or mesophilic (38-43°)
RETENTION TIME	<10 days
MIXING SYSTEM	Mechanical (slow mixers) inside the reactor - gasmixing

anMBBR REACTOR

Virgin plastic elements called "Carriers" are inserted into the reactor. Their shape ensures a high surface support for the proliferation of bacteria, allowing the creation of biofilm and enabling the digestion process

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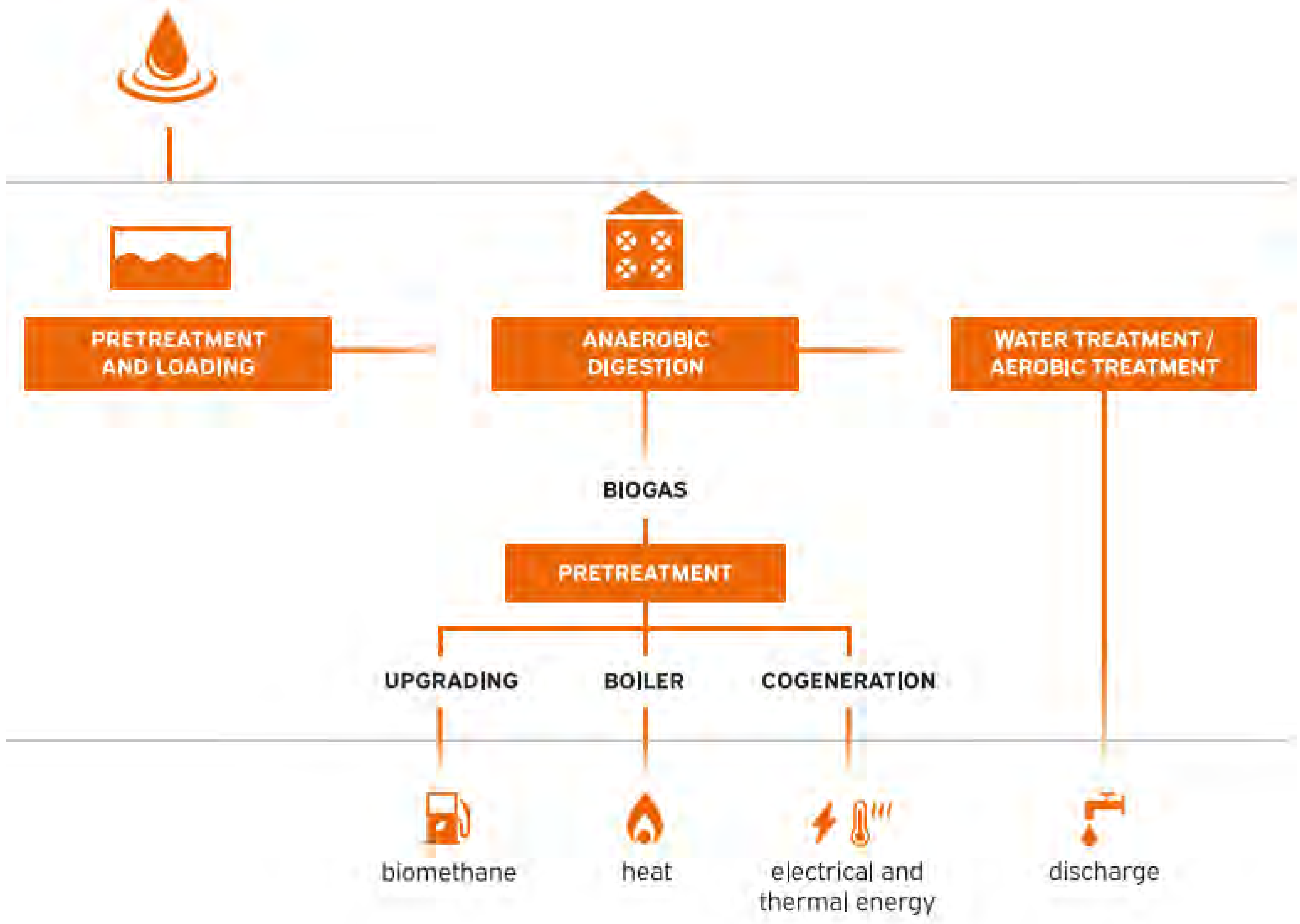
anMBBR industrial plants

- The plant ensures high performance while digesting high volumes and heterogeneous biomasses
- The technology can be applied on new or existing production lines, mitigating plant operating costs
- It is an alternative solution for energy -intensive sectors.



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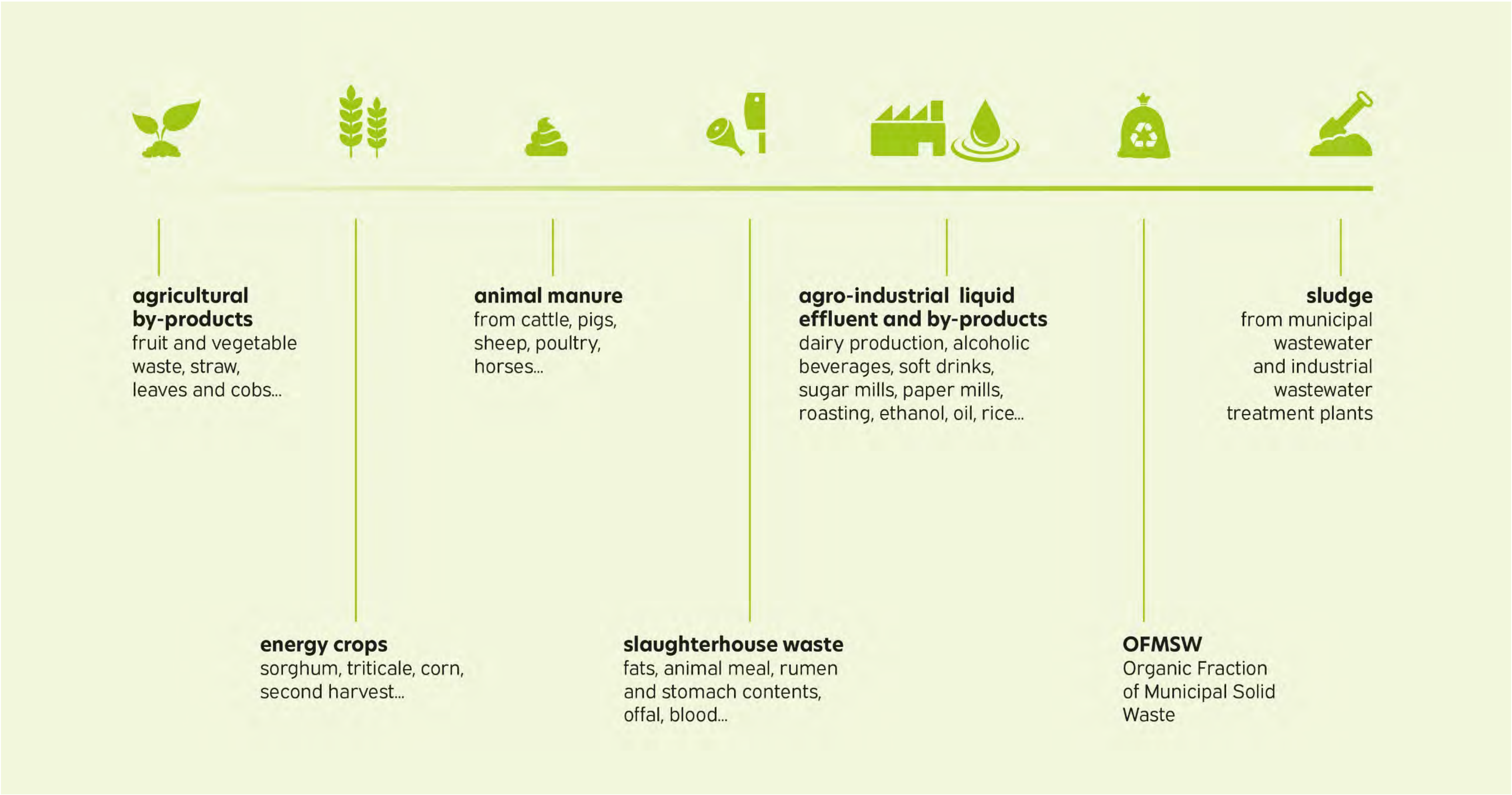
ANMBBR INDUSTRIAL PLANTS

- It contributes to the production of energy to be directly used in the production cycle
- Reduces the volume and sludge disposal costs
- The plant valorises high volumes of effluents, alternatively sent to disposal
- The plant is a source of saving, considering the energy demand of these industrial sectors

Co-Digestion

SEBIGASuses a combination of **expertise, research and flexibility** to create a tailor-made mass balance and treat in anaerobic digestion heterogeneous and complex biomasses.

With a portfolio of more than **70 types of biomass** analyzed, SEBIGAS guarantees the full exploitation of every biomass used as a feeding.



Containerization

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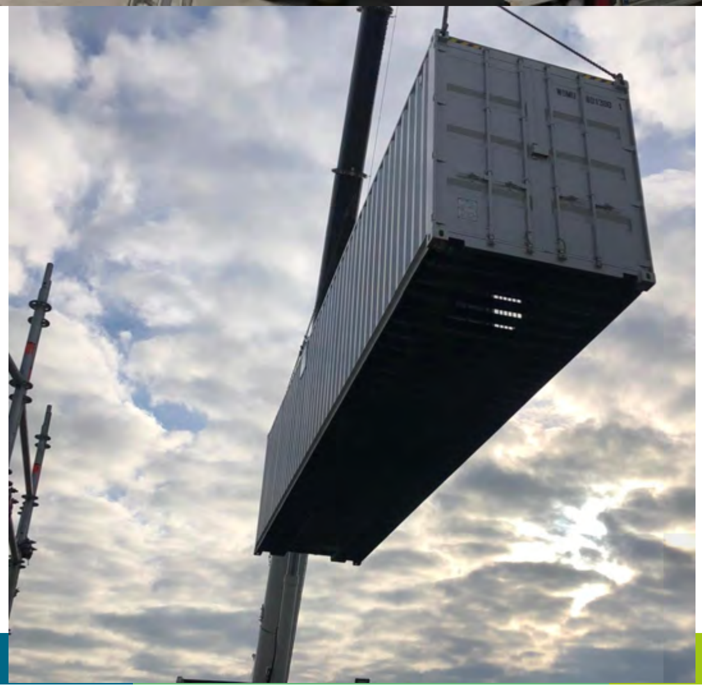
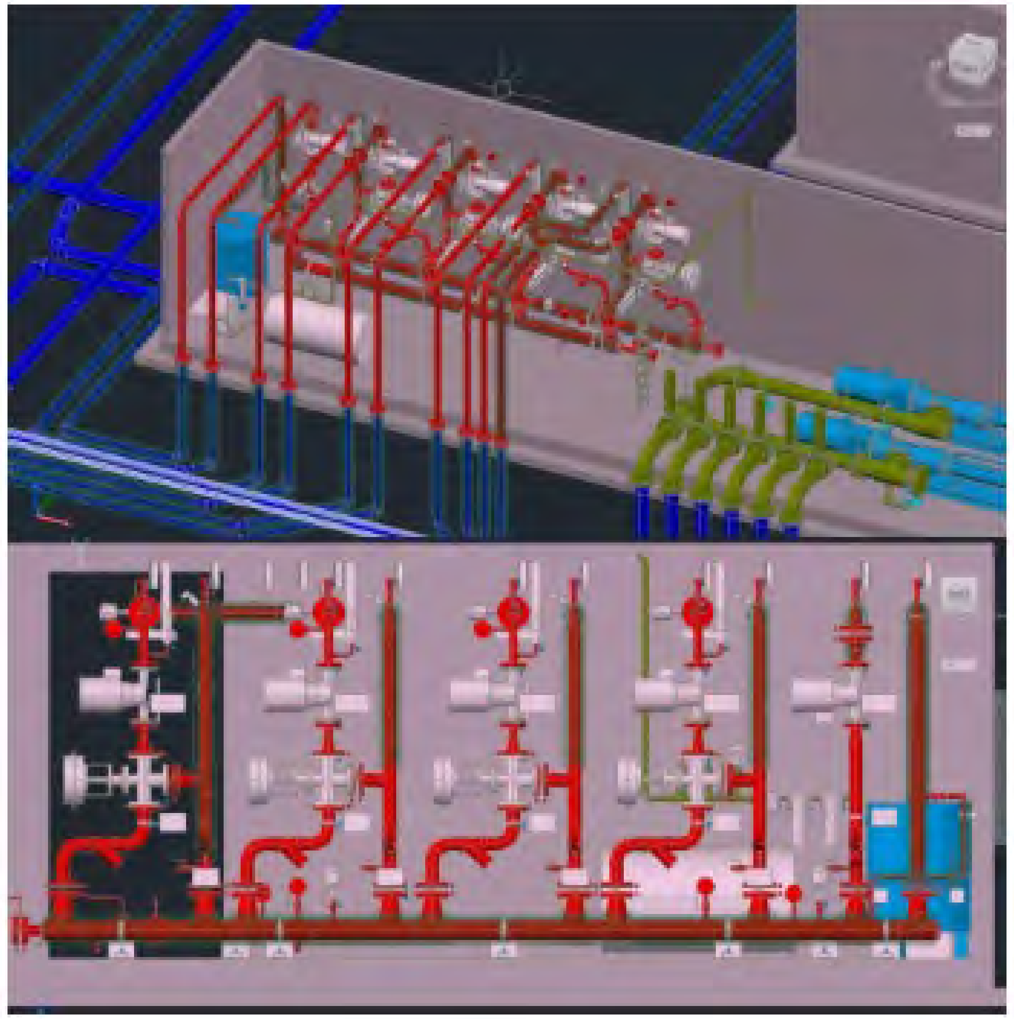
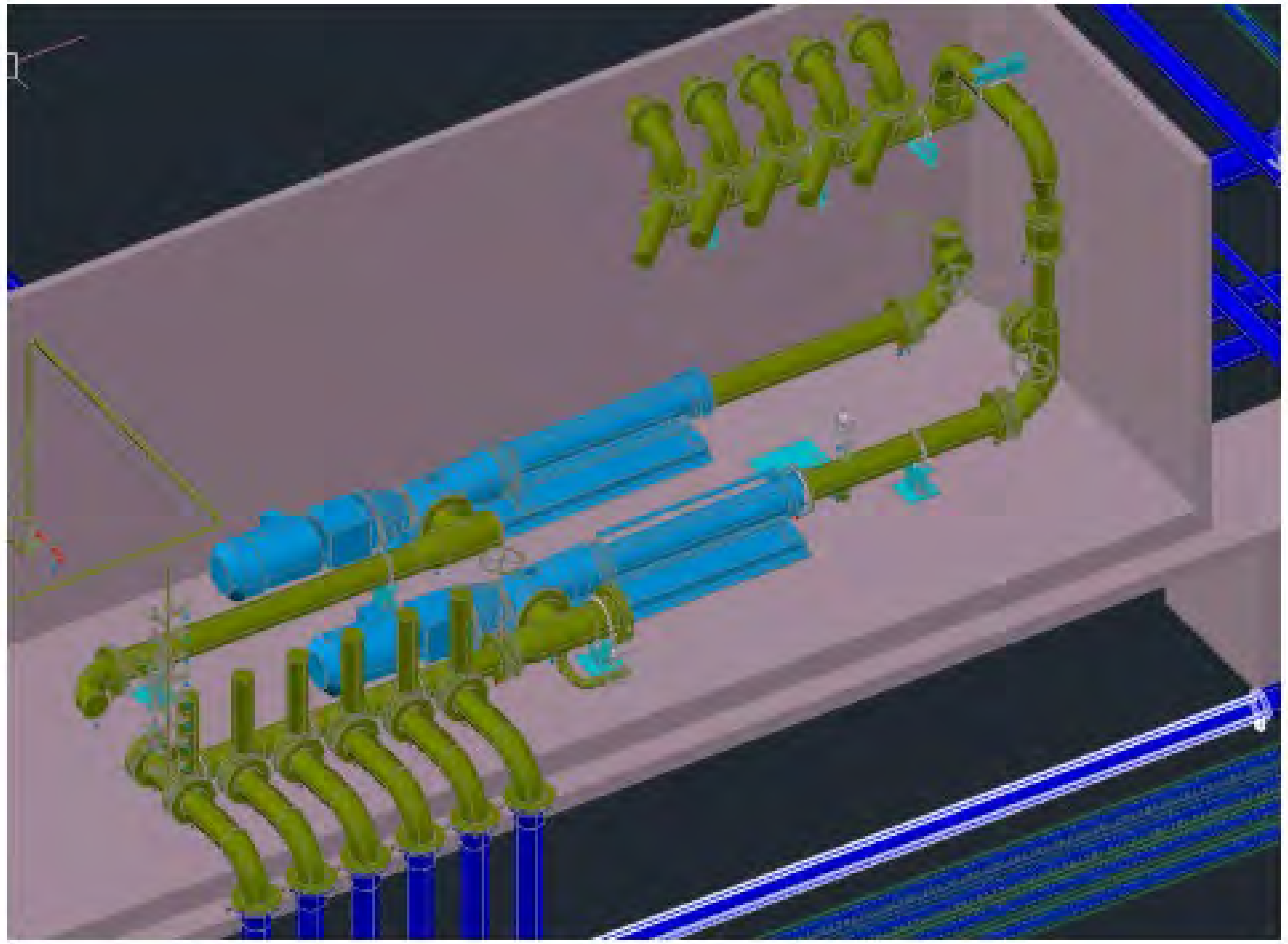
The important point of cost is to be considered. Especially in the US with supply chain disruptions, and labor force shortage and generally high cost, projects should focus on standardization and modularity.



BIOMASS FEEDING

PUMPING STATION





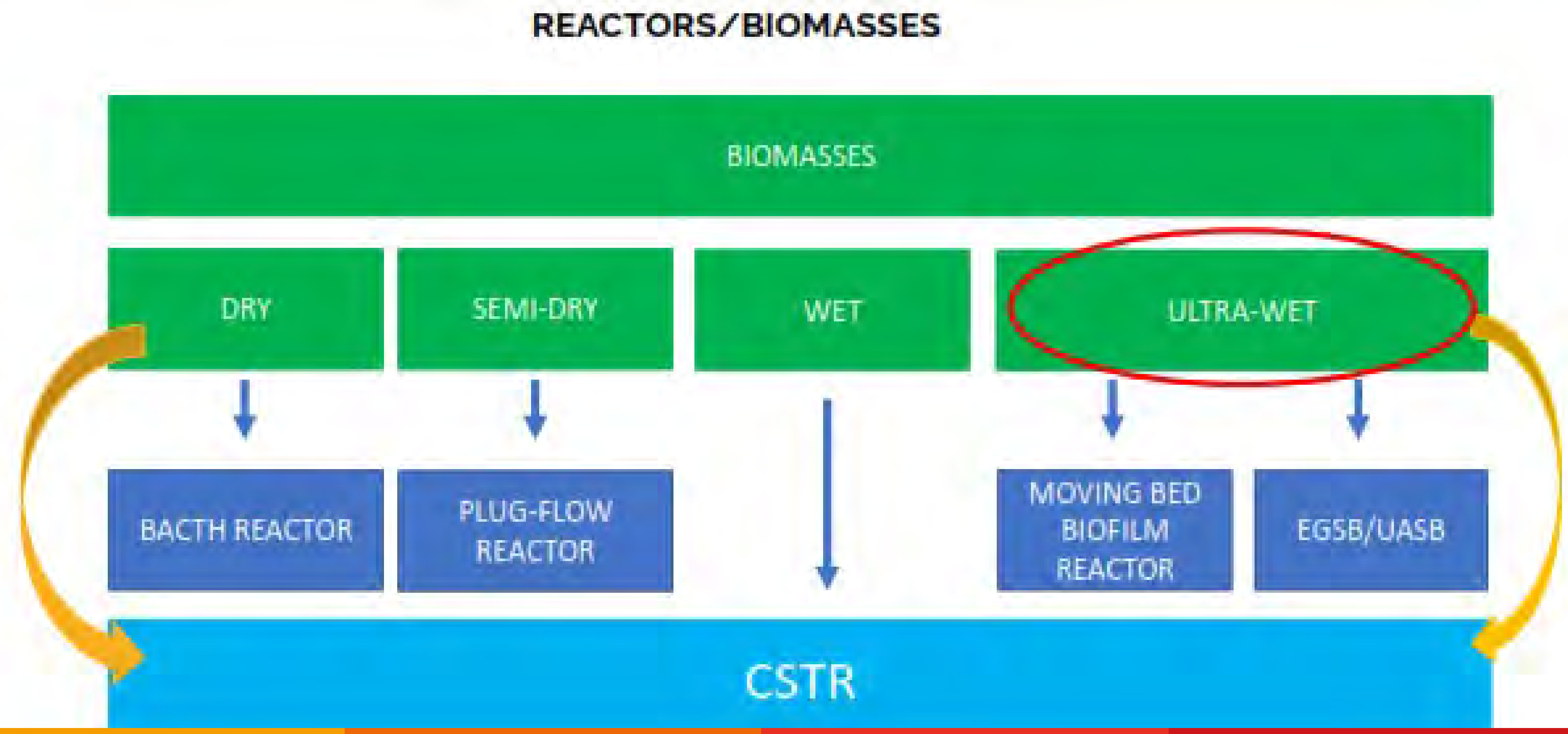
To cut 50% time and site work, Sebigas offers the entire pumping system (feedstock feed, digestate extraction, recirculation, transfer, ..).all installed in containers for "plug and produce" installation. Container arrives already tested and ready for commissioning.

Conclusions

In general, the strength and weakness of the American approaches to industrial project is the search for standardization, "cookie cutter" projects to eliminate technical risks, better access to finance, shorter project time from permitting to erection & commissioning. Thus, the specialization of companies and the mono-feedstock approach, mainly dairy farms and in addition, the search for the largest possible projects.
Universal is the search and need for subsidies, the RINs in the US, the fixed rNG or r-electricity in Europe. However, when all the large farms are equipped with a biogas plant, remaining projects will have to be smaller and more diversified. Thus, the European experience with co-digestion of various feedstocks.

In general, animal manures digest (or bio -degrade) more slowly than other organic matter. The addition of co-digestion feedstocks can increase the biodegradability and the VS in the digester. Volatile solids are the digestible organic matter that can be converted into methane gas. An increase in VS means an increase in biogas and methane production. Some crop residue feedstocks that contain a significant amount of lignin (which is not digestible) may be difficult to break down in the digester.

That approach often requires pre-treatment such as sorting, shredding, and dilution, ..also mixing would be important to feed the digester as homogeneous product as possible, which might require a holding tank upstream of the digesters. There is more frequent requirement for pH adjustment. Laboratory testing Tecomes a pre-requisite to any serious project. tests might include a biochemical methane potential (BMP) test, anaerobic toxicity assays (ATA), total solids, volatile solids, alkalinity (or pH), and chemical oxygen demand (COD



Conclusions

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Either co-digested or not, the broader types of feedstocks require to consider different types of digestor, each one better suited for a given project. Sebigas focuses on:

- Continuous Flow Stirred Tank Reactors (CSTR), The most versatile, easily arranged in multiple digesters. TS between 5% & 10% (feedstock can be diluted
- Anaerobic Moving Bed Bio Film Reactors (anMBBR), Perfect for any feedstock with TS below 1%, thus more waste-water treatment applications.

Some more recent developments are:

- The shifting - or not – depending on tax credits, regulations, and incentives, from rNG (biogas upgrading to produce natural gas quality fuel) production to electricity production through RICEs (Reciprocating Internal Combustion Engines) or CHP (Combined Heat & Power),
- The CCUS Carbon Capture Utilization & Storage. Biogas is mainly methane (50–75%) and carbon dioxide (25–50%). Up to recently CO2 would be vented. Although relatively small quantity when compared to a steel or cement plant (0.5 to 1 Mon ton CO2 emitted / year) as the technologies and infrastructure continue to grow, another benefit of the anaerobic digestion will be added

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Technical Education and Analysis for Community Hauling and Anaerobic Digesters
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THANK YOU!

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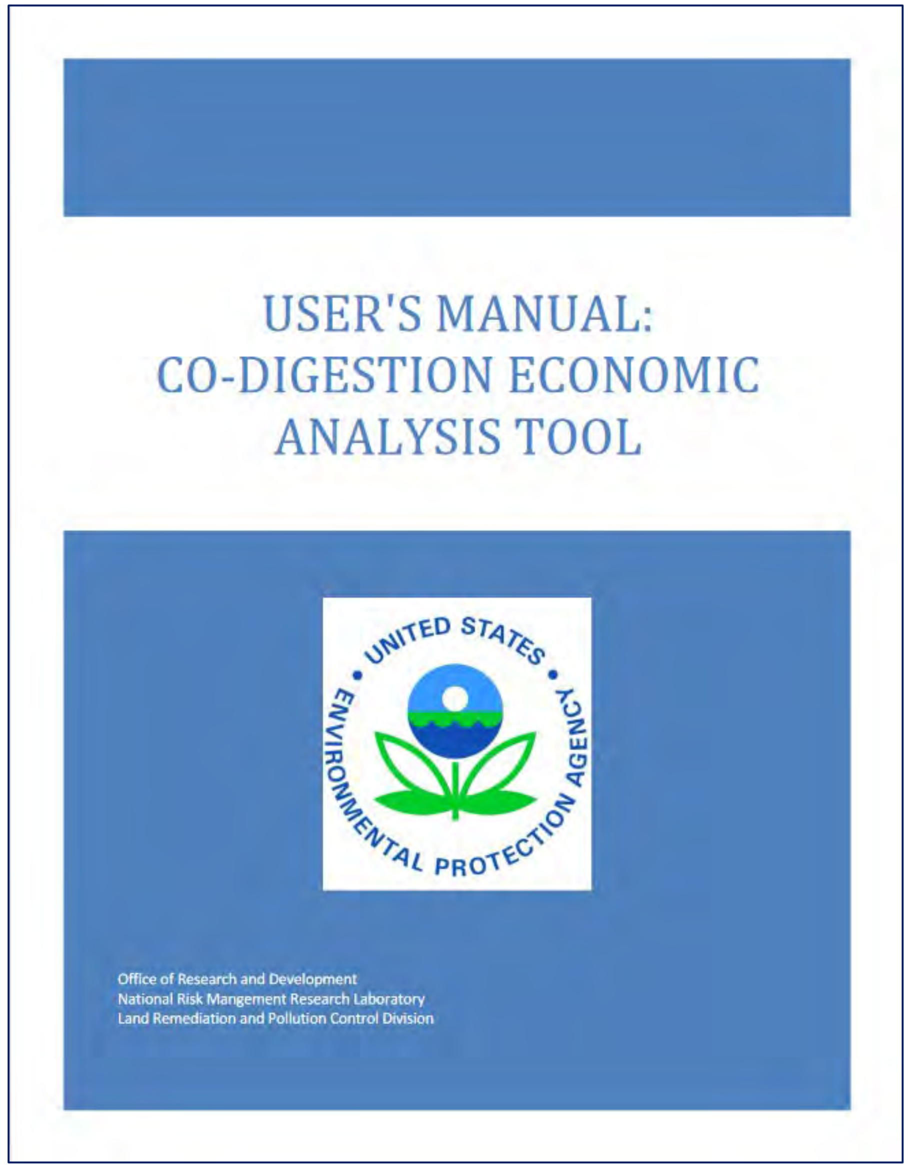
TEACH AD – Educational Assistance

- In person workshops (2)
  - Onsite events
  - Tour of the site
  - **April 2022: Kishwaukee Water Reclamation District**
  - **May 2023: Green Era Campus**
  - **Visit erc.uic.edu/bioenergy/teachad/in-person-workshops/**
- Webinars (10)
  - Cover different aspects of an anaerobic digestion project
  - **Visit erc.uic.edu/bioenergy/teachad/teach-ad-webinars/**
- Project profiles (8)
  - **UW Oshkosh, Urbana Champaign Sanitary District, Kishwaukee WRD, St. Cloud Nutrient, Energy and Water (NEW) Recovery Facility, Barstows Longview Farm, Des Moines Metropolitan Wastewater Reclamation Authority, Green Era**
  - **Visit https://erc.uic.edu/bioenergy/teachad/project-profiles/**

TEACH AD – Technical Assistance

- Anaerobic Digestion Technical Assessments
  - Tailored technical assistance to each client
  - Initial economic and physical feasibility assessment for (co)digestion of organic wastes
  - Assess opportunity for using U.S. EPA's Co-Digestion Economic Analysis Tool (CoEAT)
  - Report presentation and follow up with next steps

INITIAL DATA REQUEST → MEETING WITH THE SITE → REPORT PRESENTATION → FOLLOW UP



TEACH AD – CoEat Analysis

	Current	Future A	Future B	Future C	Future D	
Biogas Produced (cf/yr)	13,862,185	26,169,378	26,169,378	26,169,378	26,169,378	37,978.59 cfd
Total Biogas Heating Energy (MBTU/yr)	6,307	11,906	7,620	11,906	0	71,696.92 cfd
Total Energy Needed for Heating (MBTU/yr)	3,853	4,421	4,421	4,421	4,421	49.7895311 cfm
Max Capacity of Digester (gal)	1,115,000	1,115,000	1,115,000	1,115,000	1,115,000	
Feedstock Feed Rate (gal/day)	13,215	16,907	16,907	16,907	16,907	
% Solids of Feedstock Fed to Digester (%)	3.8%	5.2%	5.2%	5.2%	5.2%	
Percent Volatile Solids Reduction (%)	57%	57%	57%	57%	57%	
Actual Hyraulic Retention Time (days)	67.8	53.0	53.0	53.0	53.0	
Target Hydraulic Retention Time (days)	15.0	15.0	15.0	15.0	15.0	
Available Capacity (Gal/day)	46,519	42,827	42,827	42,827	42,827	
Additional Volume Needed to Treat Feedstock (gal)	0	0	0	0	0	
Mass of Biosolids (Tons/yr)	450	704	704	704	704	
Biosolids Cost ($/yr)	($58,608.55)	($88,792.80)	($88,792.80)	($88,792.80)	($88,792.80)	
Biosolids Revenue ($/yr)	$0.00	$0.00	$0.00	$0.00	$0.00	
Tipping Fees ($/yr)	$0.00	$127,622.25	$127,622.25	$127,622.25	$127,622.25	
Avoided Natural Gas Costs ($/yr)	$33,995	$66,038	$28,222	$0	($39,006)	
Avoided Electricity Costs ($/yr)	$0	$0	$129,613	$0	$0	
Avoided Vehicle Fuel ($/yr)	$0	$0	$0	$305,983	$486,629	
Annualized Cost of Plant Upgrades ($/yr)	$0	($36,833)	($113,230)	($134,973)	($149,467)	
Annual Operations and Maintenance ($/yr)	($5,000)	($5,000)	($67,566)	($87,632)	($121,673)	
Net Annualized Value ($/yr)	($29,614)	$63,035	$15,869	$122,208	$215,312	
Simple Payback (yr)	NA	NA	7.7	5.8	4.9	

Return to Inputs/ GUI

Restore Default Formulas

Print Input Values

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TEACH AD – CoEat Analysis

Current: Use biogas to heat digester and incomming feedstock. Value is given to excess heat. If digester heating demand is not met, expense for natural gas will incur.

Future A: Use biogas to heat digester and incomming feedstock. Value is given to excess heat. If digester heating demand is not met, expense for natural gas will incur. This scenario is not achievable as the plant does not have enough heat demand.

Future B: Use biogas in CHP to heat digester and incomming feedstock and generate electricity. Value is given to the electricity generated and excess heat. If digester heating demand is not met, expense for natural gas will incur.

Future C: Use biogas to heat the digester and convert the rest to vehicle fuel. If digester heating demand is not met, no biogas will be available for CNG and an expense for natural gas will incur.

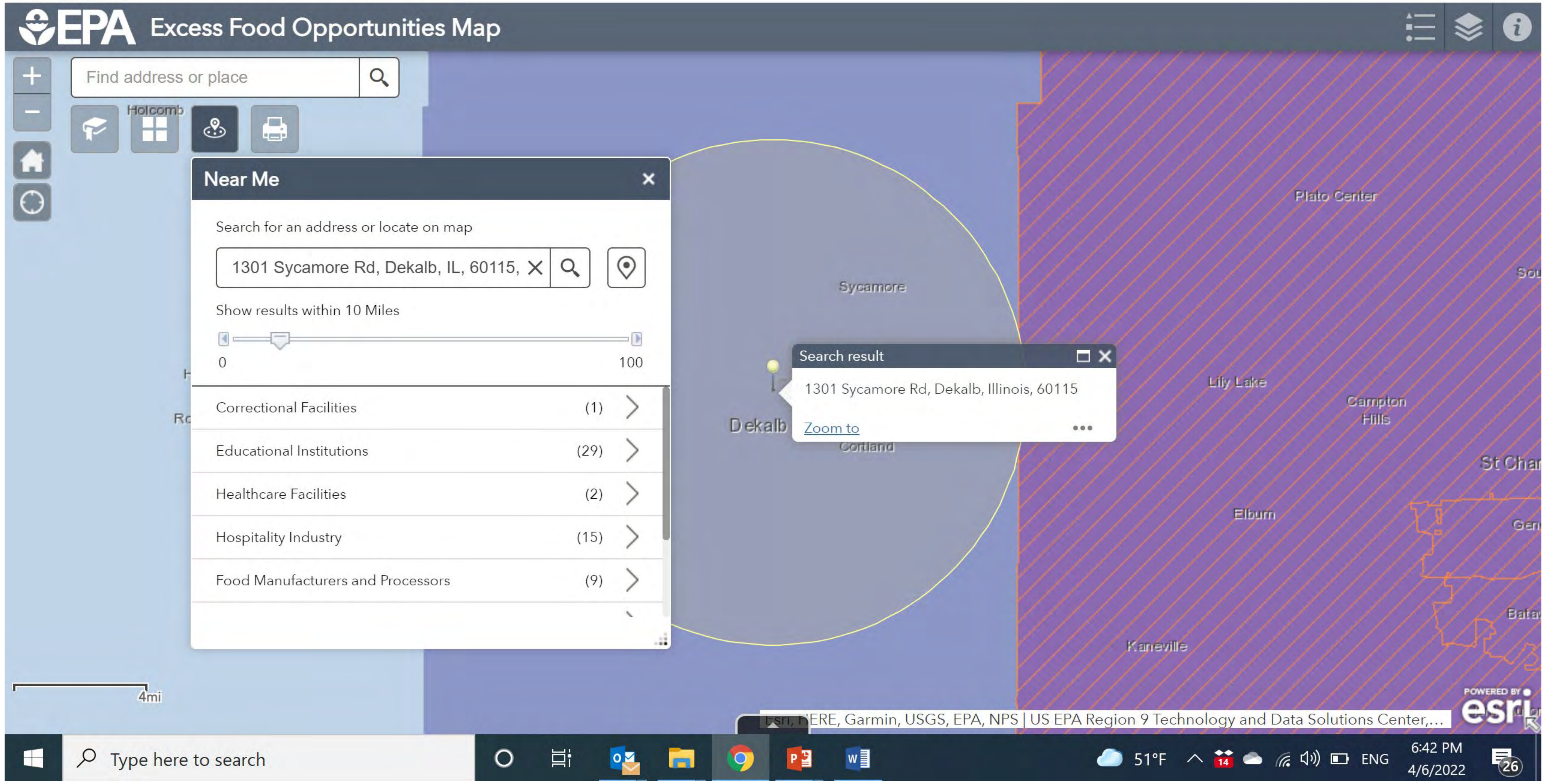
Future D: All biogas is converted into vehicle fuel. Cost of natural gas to meet the heating demand of the digester and incomming feedstock will incur.

For a detailed review of the calculations and assumptions, please observe the "4. Biogas Use" worksheet.

Analysis

Percent increase in heating demand =	**14.7%**	
Percent increase in biogas production =	**88.8%**	
Percent increase in biosolids =	**56.3%**	
Additional volume needed to treat feedstock =	**None**	[gal]
Size of CHP =	**149**	kW

TEACH AD – EPA Food Waste Map



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PROGRAM OFFERINGS

- Technical Assessments
- In-person Workshops
- On-line Webinars
- Project profiles

ELIGIBLE FACILITIES AND PROJECTS

- Water Resource Recovery Facilities
- Municipal Food Waste Digesters
- Community - Based Digesters
- Food Processing, On-Farm Digesters

Questions

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