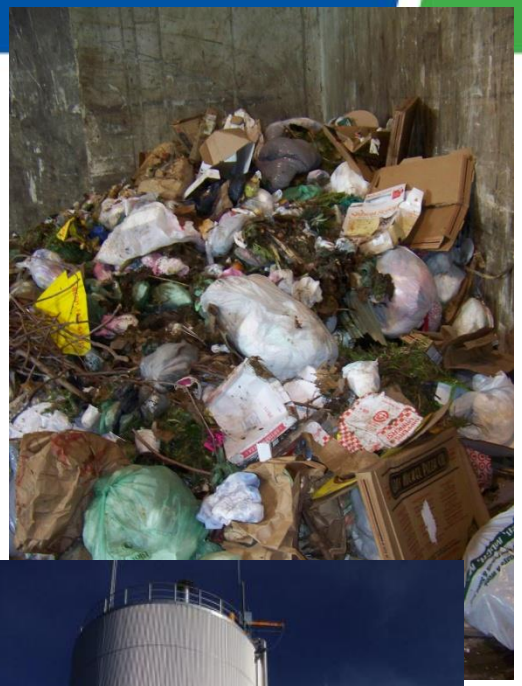
RECOVERING ORGANICS AND ENERGY FROM MSW

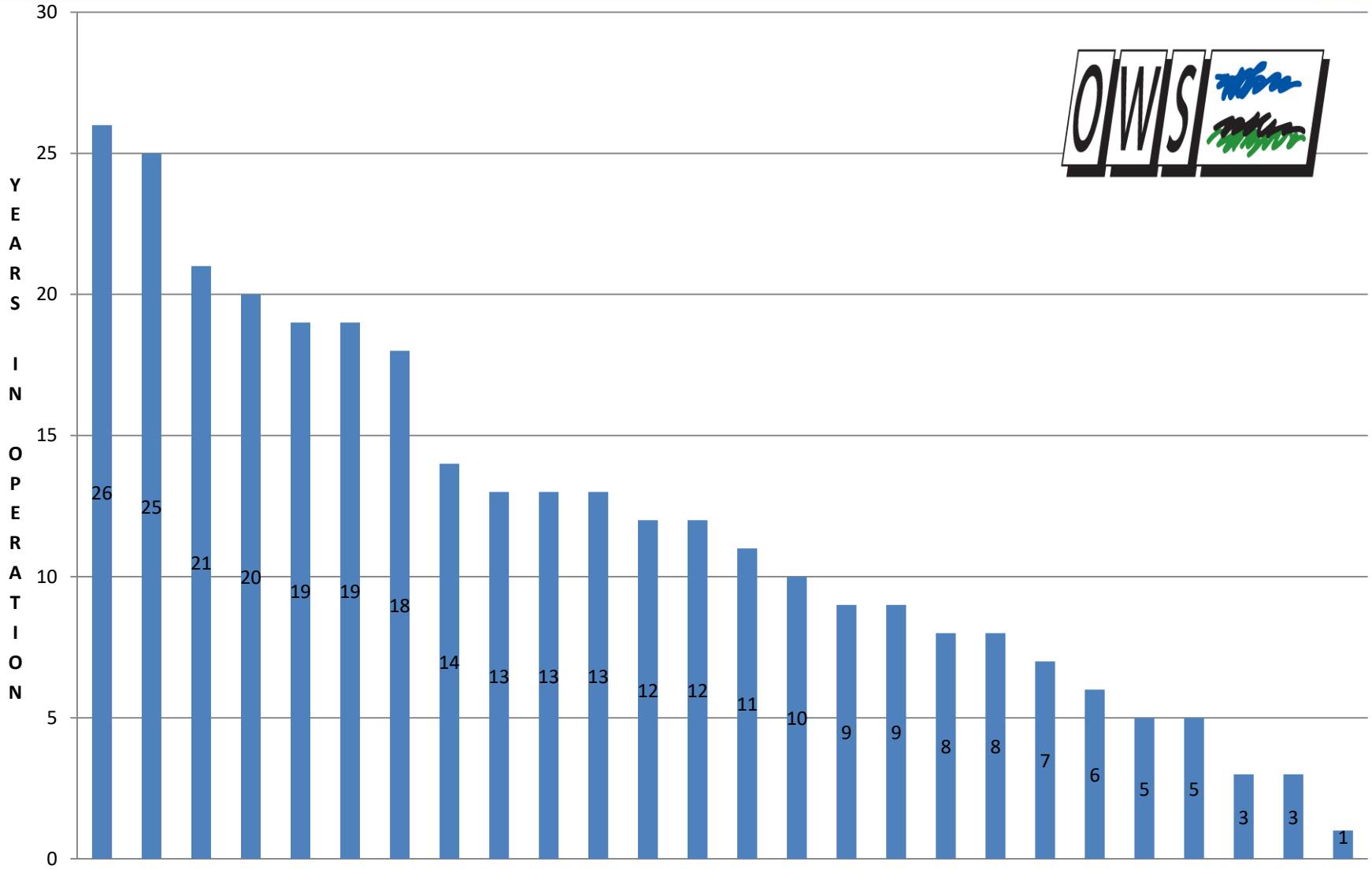
RAM/SWANA CONFERENCE – MINNEAPOLIS, OCTOBER 1018

Brief CV of OWS



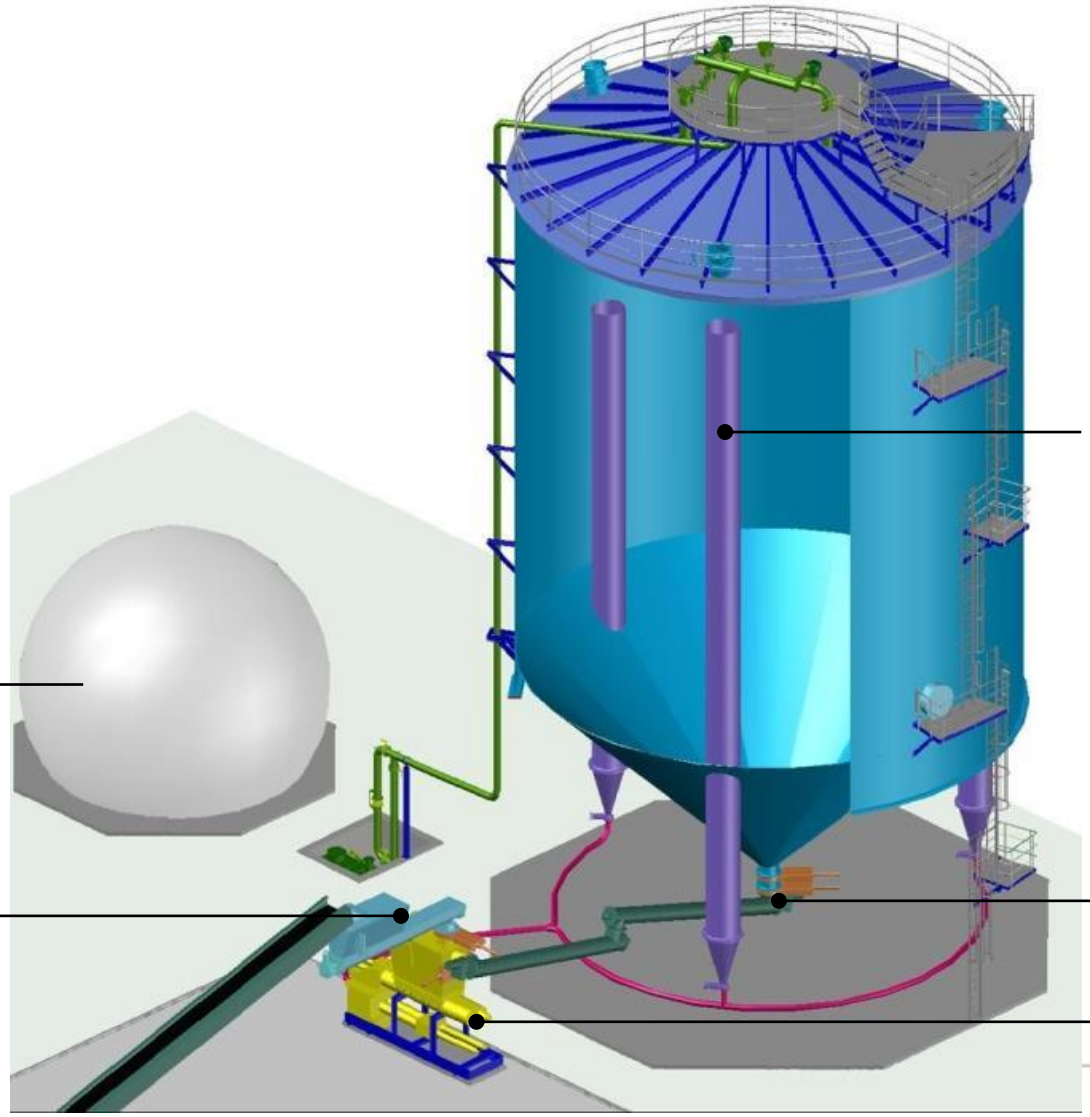
- Developer and owner of DRANCO technology: dry continuous digestion technology developed in early 80's
- OWS founded in 1988: >30 years experience in anaerobic digestion of <u>household/municipal organic waste (SSO – OFMSW – Food Waste)</u>
- 85 people
- 30 projects in 15 countries, >9 million tons processed to date
- HQ in Belgium; in Ohio since 1990

COMMERCIALLY PROVEN TECHNOLOGY for OVER 25 YEARS



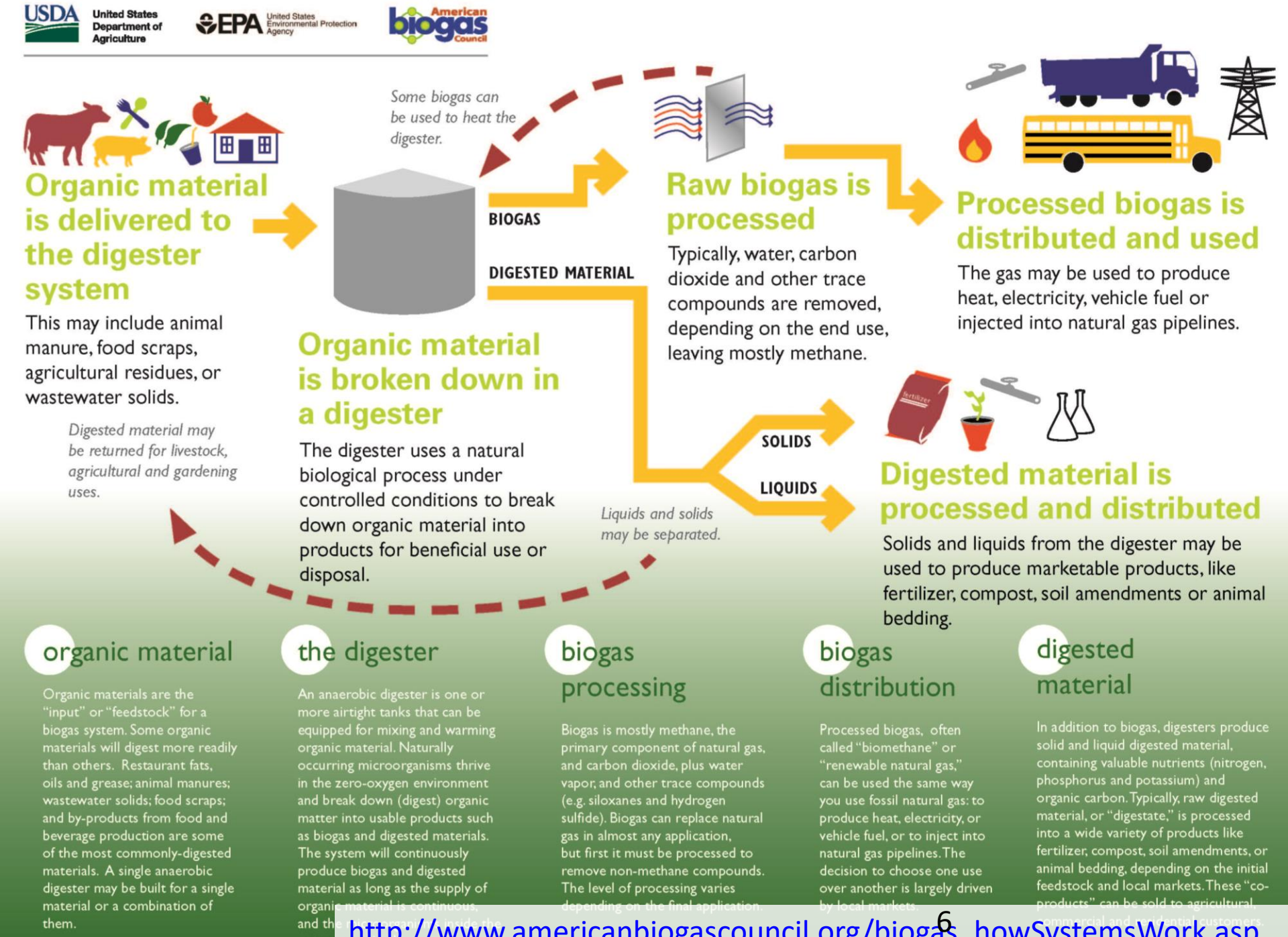
THE DRANCO TECHNOLOGY

DRANCO DIGESTER



TRIFECTA: ENERGY, RECYCLABLES AND COMPOST FROM MSW

- Organics in MSW represent the largest potential for increasing diversion and recycling – but how to separate them for reliable AD and clean compost? At the curb or at a facility?
- Inorganics/plastics in MSW represent thermal conversion opportunity – but how to eliminate the wet organics?
- Remaining recyclables in MSW represent potential added recovery – but how to separate a saleable fraction?



http://www.americanbiogascouncil.org/biogas_howSystemsWork.asp

BIOGAS – Uniquely flexible in feedstocks, process, products and revenue streams

AGRICULTURAL
- MANURE
- STOVER
- STUBBLE
- SPOILAGE
- COMPOSTED MORTALITY
- ENERGY CROP

AG PROCESSING BYPRODUCTS
- GLYCERIN
- SYRUP STILLAGE
- BLEACHING CLAY
- COBS AND HUSKLAGE
- SPOILAGE

FOOD PRCESSING RESIDUALS
- BAKERY
- FATS, OILS AND GREASES
- VEGATABLES
- WHEY
- OTHER DAIRY WASTE
- RUMEN CONTENTS
- ANIMAL RENDERING FATS

PAPER WASTE
- SHREDDED OFFICE PAPER
- SHREDDED CARDBOARD

COMMUNITY
- LEAVES
- GRASS CLIPPINGS
- RESTAURANT WASTE
- CAFETERIA WASTE

Need to know what is available where and at what cost

WET DIGESTION
5-13% TOTAL SOLIDS
1-10 SCF/GALLON BIOGAS
Minimum Economical Size:
25 million gpy

DRY DIGESTION
20-45% TOTAL SOLIDS
40-100 SCF/GALLON BIOGAS
Minimum Economical Size:
50,000 ton/yr

Choice of process dictated by feedstocks
Both processes require carbon:nitrogen balancing
Either process could be local or central

BIOGAS
~600 btu/scf

- MEDIUM BTU GAS SOLD TO LARGE USER
- HIGH BTU GAS SOLD TO LARGE USER OR UTILITY
- ELECTRICITY SOLD TO LARGE USER OR UTILITY
- USE AS VEHICLE FUEL REPLACEMENT

Value of energy depends on market conditions and type of energy produced

LIQUID NUTRIENTS
Composition depends on inputs
Quantity depends on process

- DIRECT LAND APPLICATION
- CONCENTRATION AND BULK SALES
- ALGAE CULTIVATION
- GREENHOUSE AQUACULTURE

Use of effluents depends on local market conditions
Opportunities for new business development

SEPARATED SOLIDS
Composition depends on inputs
Quantity depends on process

CELLULOSIC ETHANOL PRODCUTION

Biogas production is determined by feedstocks and process
Quantity and composition of effluents depends on inputs and process

HOW DOES AD COMPARE?

140°F+

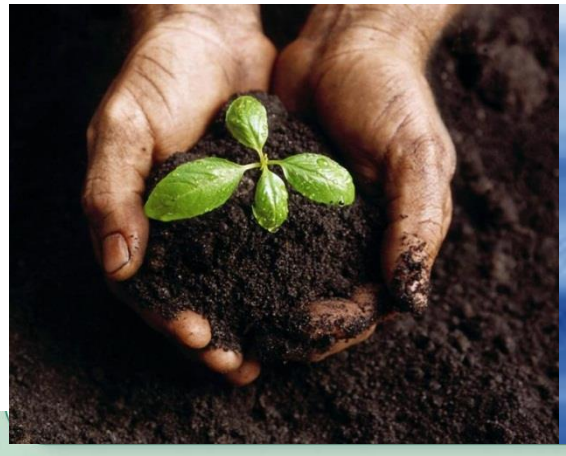
35°F - 85°F

Variable

COMPOST > SOIL > FRESH WATER > MARINE WATER > LANDFILL

ANAEROBIC DIGESTION

95°F or 135°F



HOW DOES AD COMPARE?

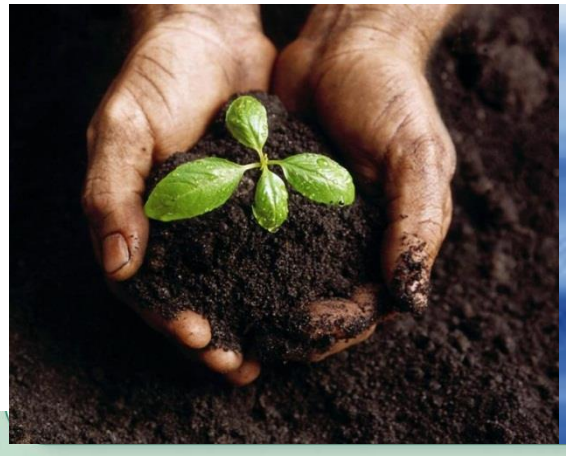
Fungi + Bacteria
+ Actinomycetes

Bacteria only (almost)

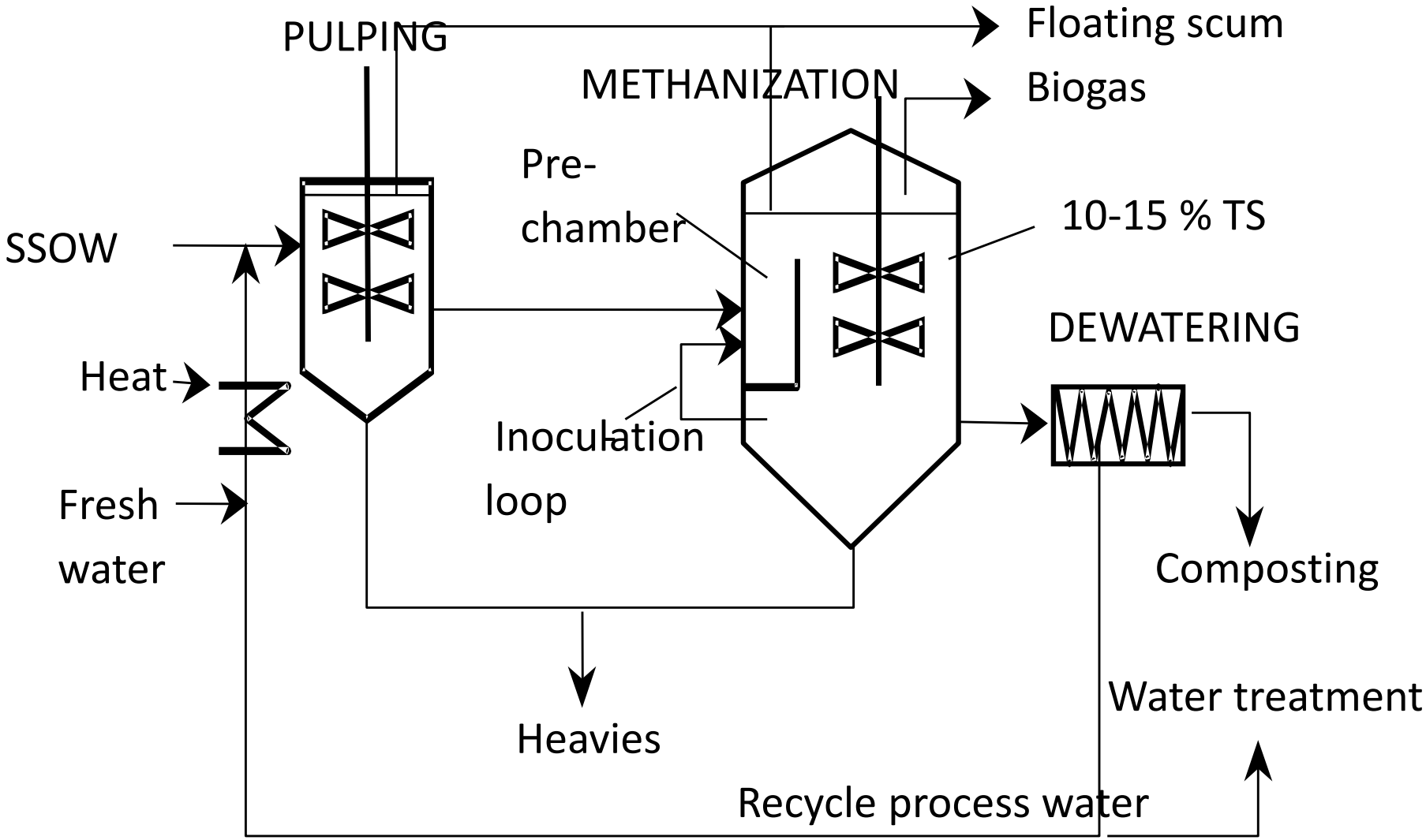
COMPOST > SOIL > FRESH WATER > MARINE WATER > LANDFILL

ANAEROBIC DIGESTION

Multiple Bacteria



WET SYSTEMS

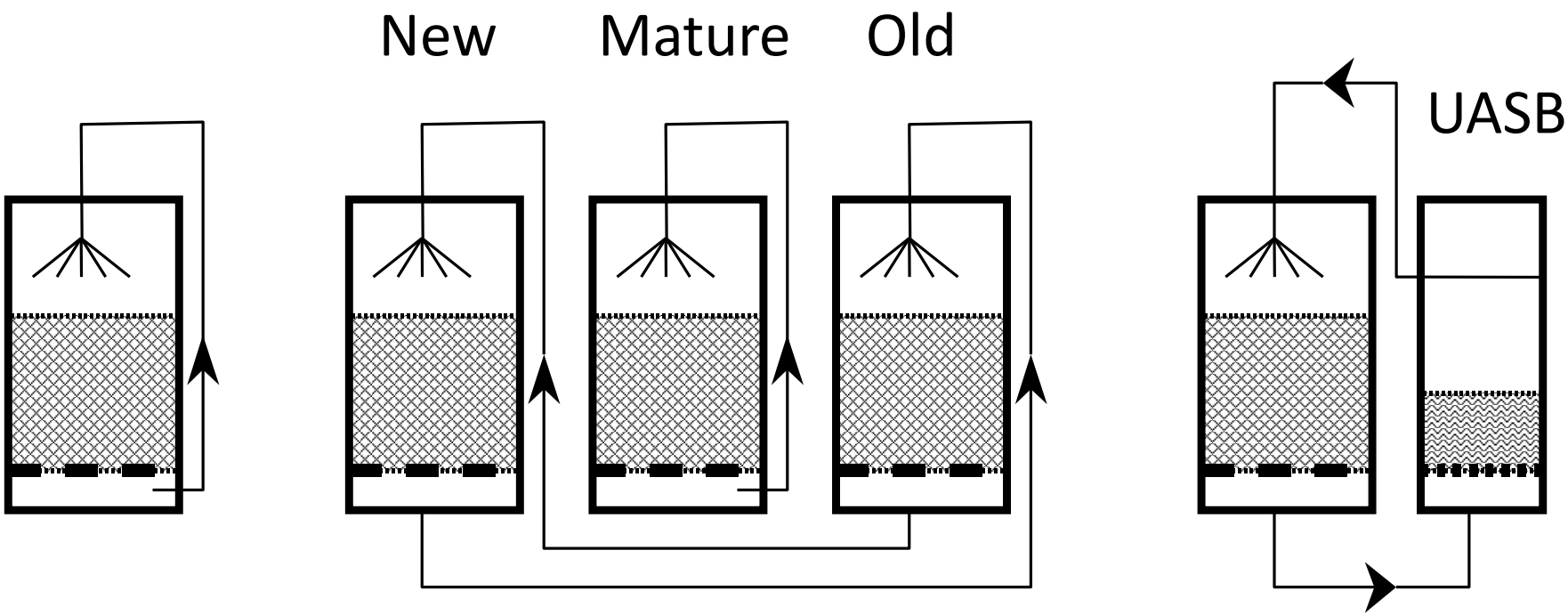

PULPING
Floating scum
METHANIZATION
Biogas
Pre-
chamber
10-15 % TS
SSOW
DEWATERING
Heat
Inoculation
loop
Fresh
water
Composting
Heavies
Water treatment
Recycle process water

BATCH SYSTEMS

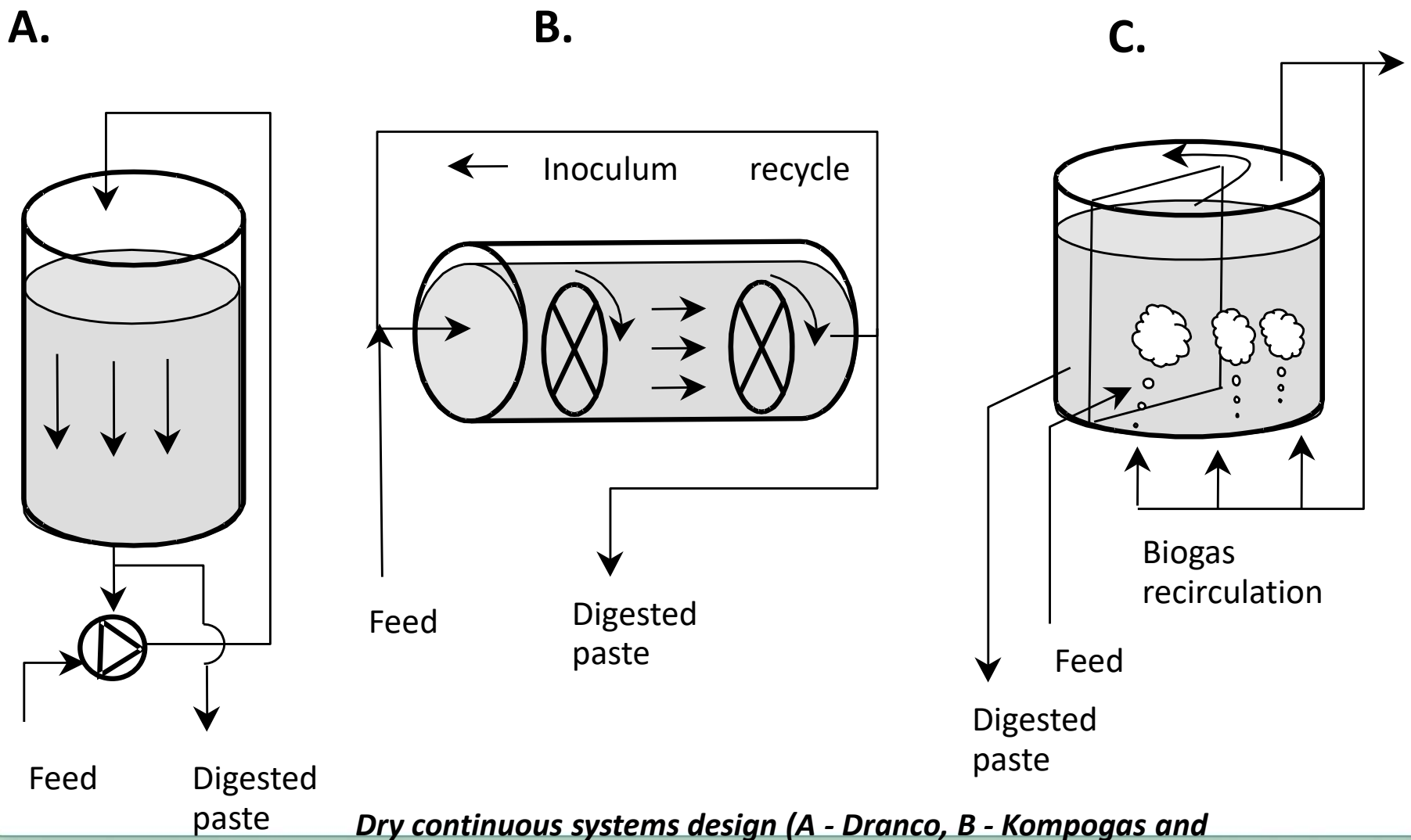
A. Single-stage

B. Sequential batch

C. Hybrid batch-UASB



DRY CONTINUOUS SYSTEMS

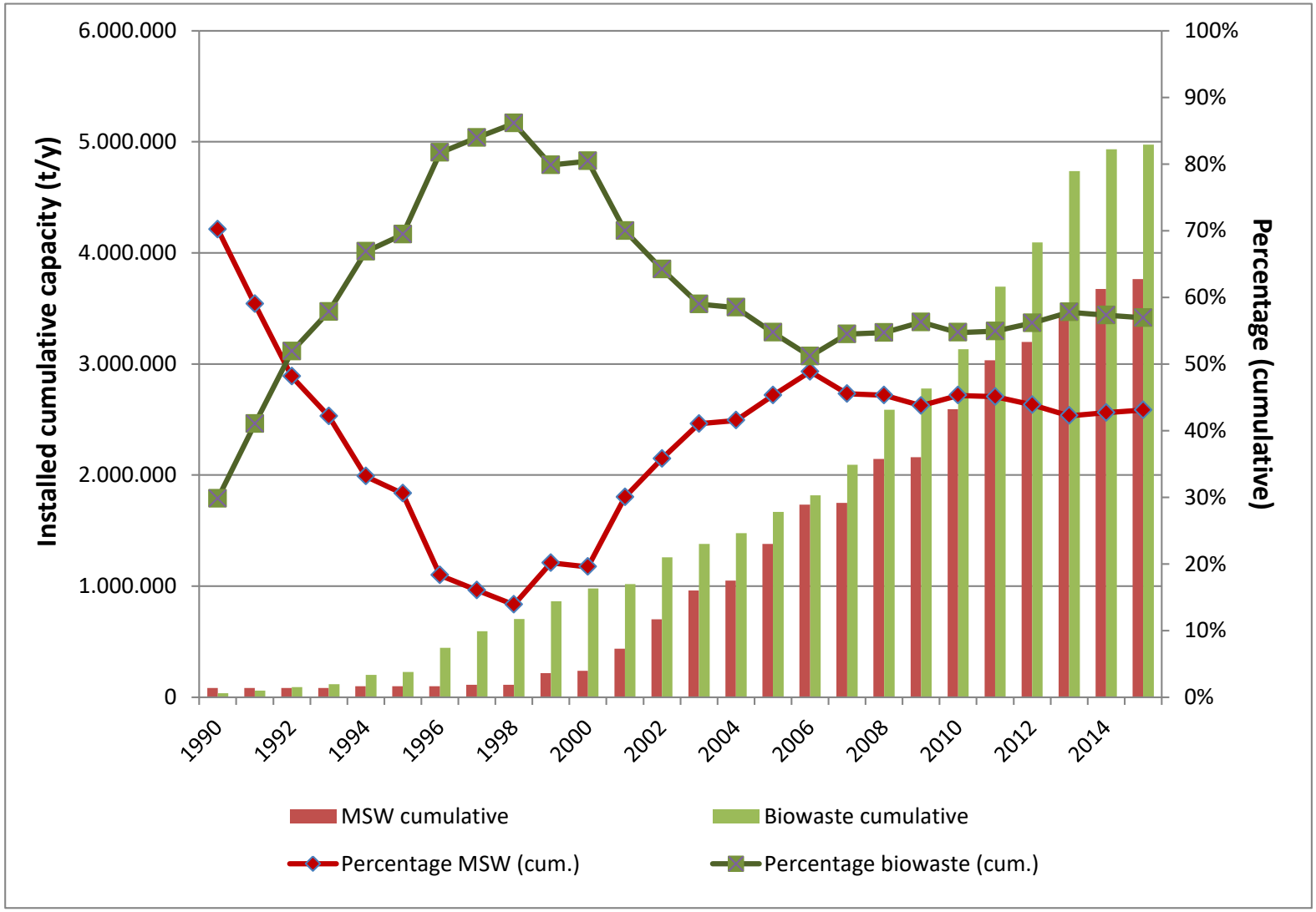


Dry continuous systems design (A - Dranco, B - Kompogas and BRV , and C - Valorga)

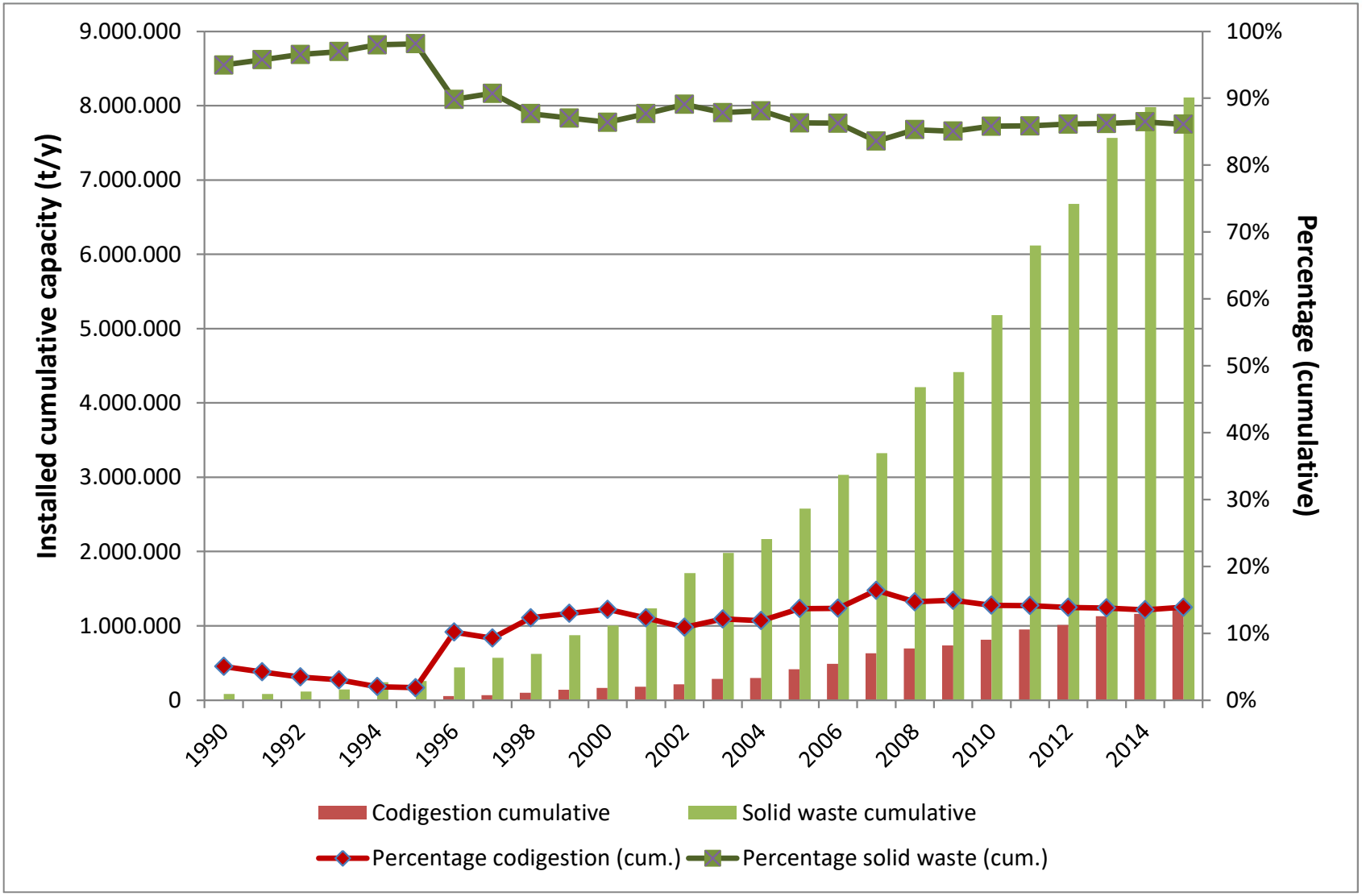
Benefits of Anaerobic Digestion

Waste Management	Energy	Environmental	Economic
•Biological process •Mature technology •Small footprint •Reduces waste volume •Very efficient and complete decomposition •Nutrient recovery **•It's <u>recycling</u>, not disposal**	•Net-energy producing •Multiple end-uses for biogas: •Heat/electricity/both •Pipeline quality, renewable natural gas •Vehicle fuel •Very reliable •Baseload renewable energy (not intermittent)	•Complete biogas/methane capture **•Odor reduction** •Reduced pathogens •Reduced greenhouse gases •Addresses nutrient run-off •Increased crop yield	•Reduced waste volume **•Reduces costs** •Jobs (temporary and permanent) •Balance sheet: changes an expense to revenue •Works well with composting (biogas first) **•Marketing: A Greener Choice**

AD is Equally relevant to SSO and OFMSW



Co-digestion of Solid Organics at WWTPs has limits



Develop both SSO and OFMSW pathways

SSO

- Economics, logistics vary by community – do it where it makes sense
- Separate collection will get ~50%, composition will vary greatly between residential/ICI
- Tailor pretreatment for AD system requirements

OFMSW

- Achieve >85% diversion
- Shift collection savings to pretreatment costs
- Can be sole route, or in addition to SSO
- Depending on primary goal (SLCP reduction or organics recovery), spend proportionately on compost or ADC production

Integrate AD+Compost

- Achieve higher overall diversion by converting food/green waste, soiled, non-recyclable paper
- Maintain waste treatment fee paradigm, *but combine with organics recovery and recycling*
- Expedite permitting (?)
- Being “neighborly” by reducing open time, emissions, odors
- “Marry into” market expertise for compost production and sales
- Eliminate redundant capital expenses for pretreatment
- Manage seasonal volume/composition fluctuations

CASE STUDY:

Hengelo (The Netherlands)

HENGELO: DIGESTION OF BIOWASTE

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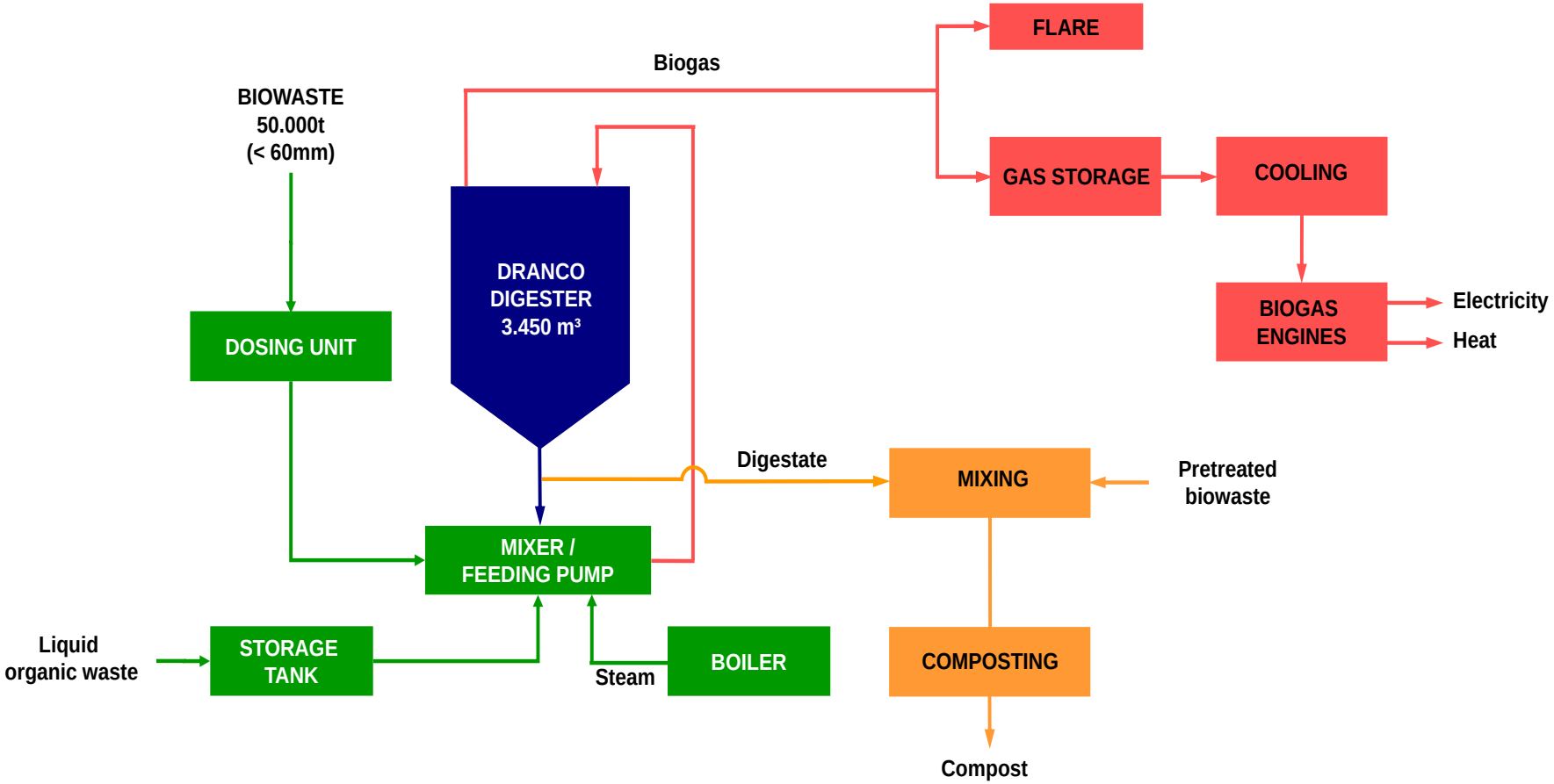
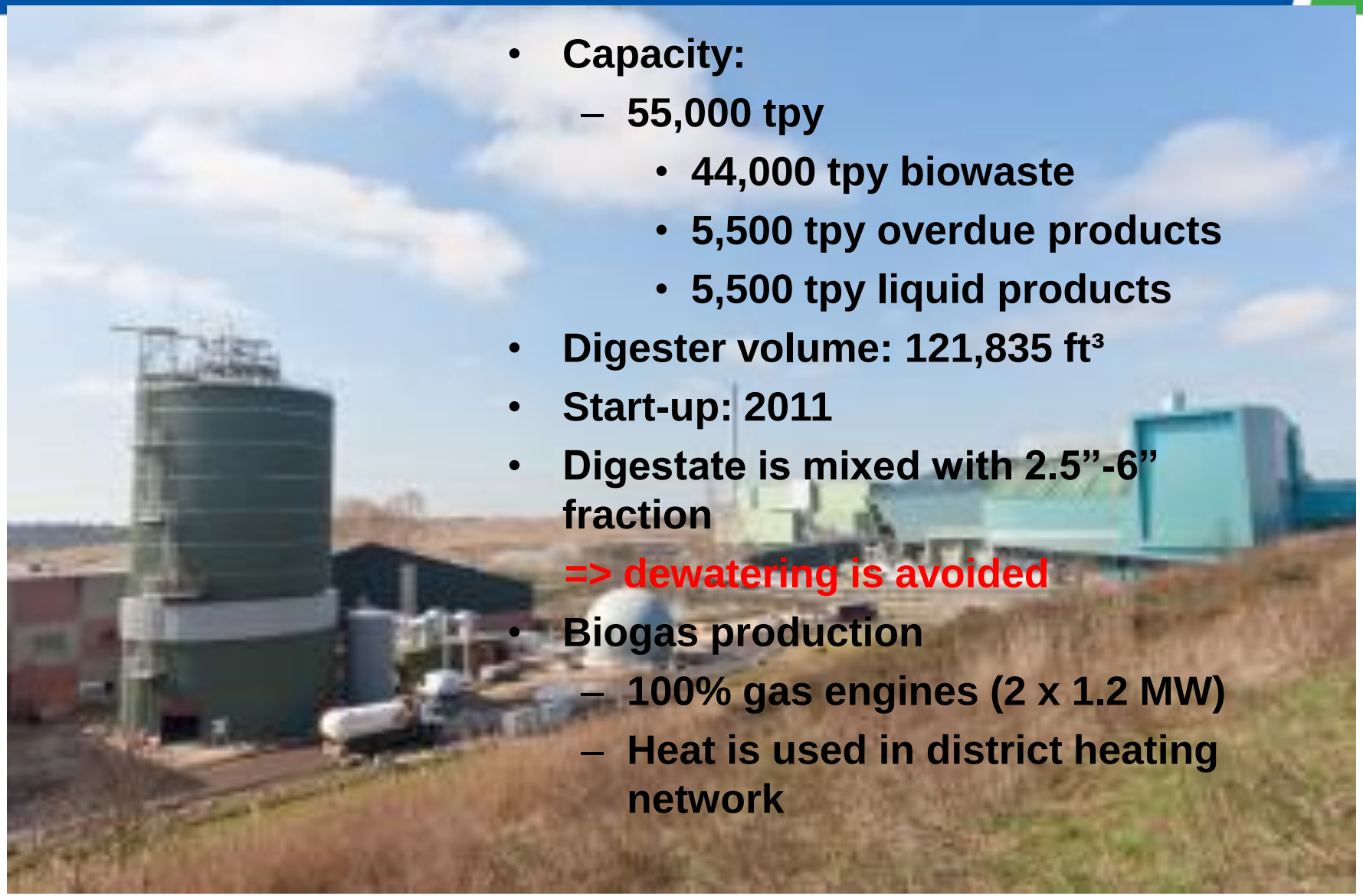
HENGELO: DIGESTION OF BIOWASTE



HENGELO: DIGESTION OF BIOWASTE



- **Capacity:**
  - **55,000 tpy**
    - **44,000 tpy biowaste**
    - **5,500 tpy overdue products**
    - **5,500 tpy liquid products**
- **Digester volume: 121,835 ft³**
- **Start-up: 2011**
- **Digestate is mixed with 2.5”-6” fraction**

  => dewatering is avoided
- **Biogas production**
  - **100% gas engines (2 x 1.2 MW)**
  - **Heat is used in district heating network**

HENGELO: DIGESTION OF BIOWASTE

Existing aerobic composting: 3.7 acres

Anaerobic digestion: 0.4 acres

WHY LOOK AT MIXED WASTE?

- Some communities find separate collection unaffordable
- Even with SSO collection, remaining organics in mixed MSW represent the largest potential for increasing diversion and recycling
- If we can produce a clean compost and recyclable fractions from mixed waste, then a significant increase in diversion: ZERO WASTE (>90% diversion) becomes attainable
- But so far mixed waste compost has been of low quality

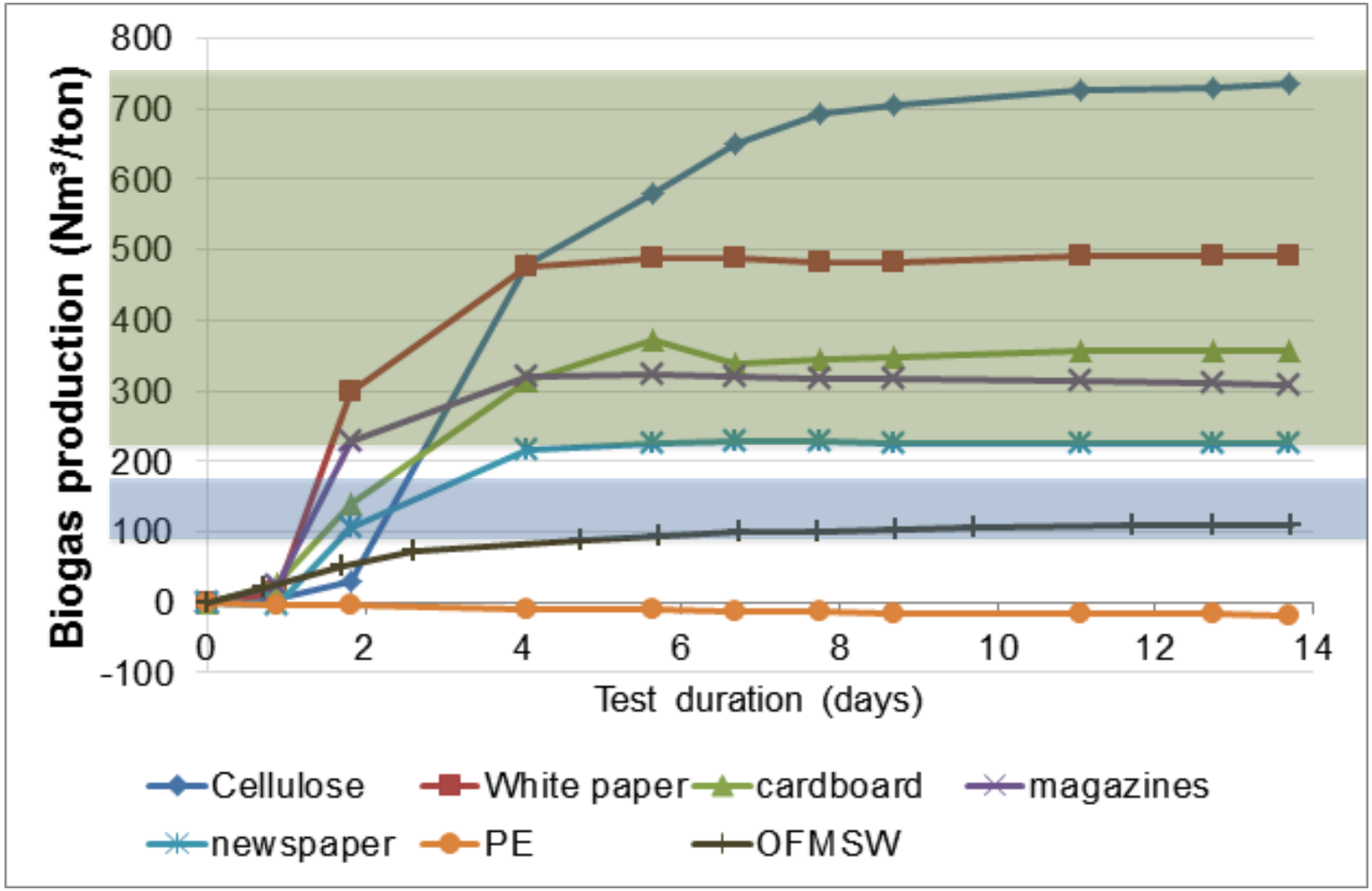
HOW DO WE GO ABOUT IT?

ADVANTAGES DRANCO DIGESTION for OFMSW

- Less intensive pre-treatment
  - Sized to <2” diam. (e.g. corn cob) rather than <3/4” (e.g. thumbnail) as for wet digestion
  - No need to remove all grit and plastics
    - No floating layers
    - No settling/accumulation in the tank or percolate system
  - No need to remove paper
    - Soiled paper beneficial to C:N ratio and energy production
    - No mixing equipment inside the digester; increased viscosity OK

- Higher flexibility, more energy production
  - Total solids content in digester 15 – 40%
  - Intensive and reliable digestion
  - Nearly 100% of organics in MSW converted to biogas and compost

MAXIMIZES VALUE OF SOILED PAPER



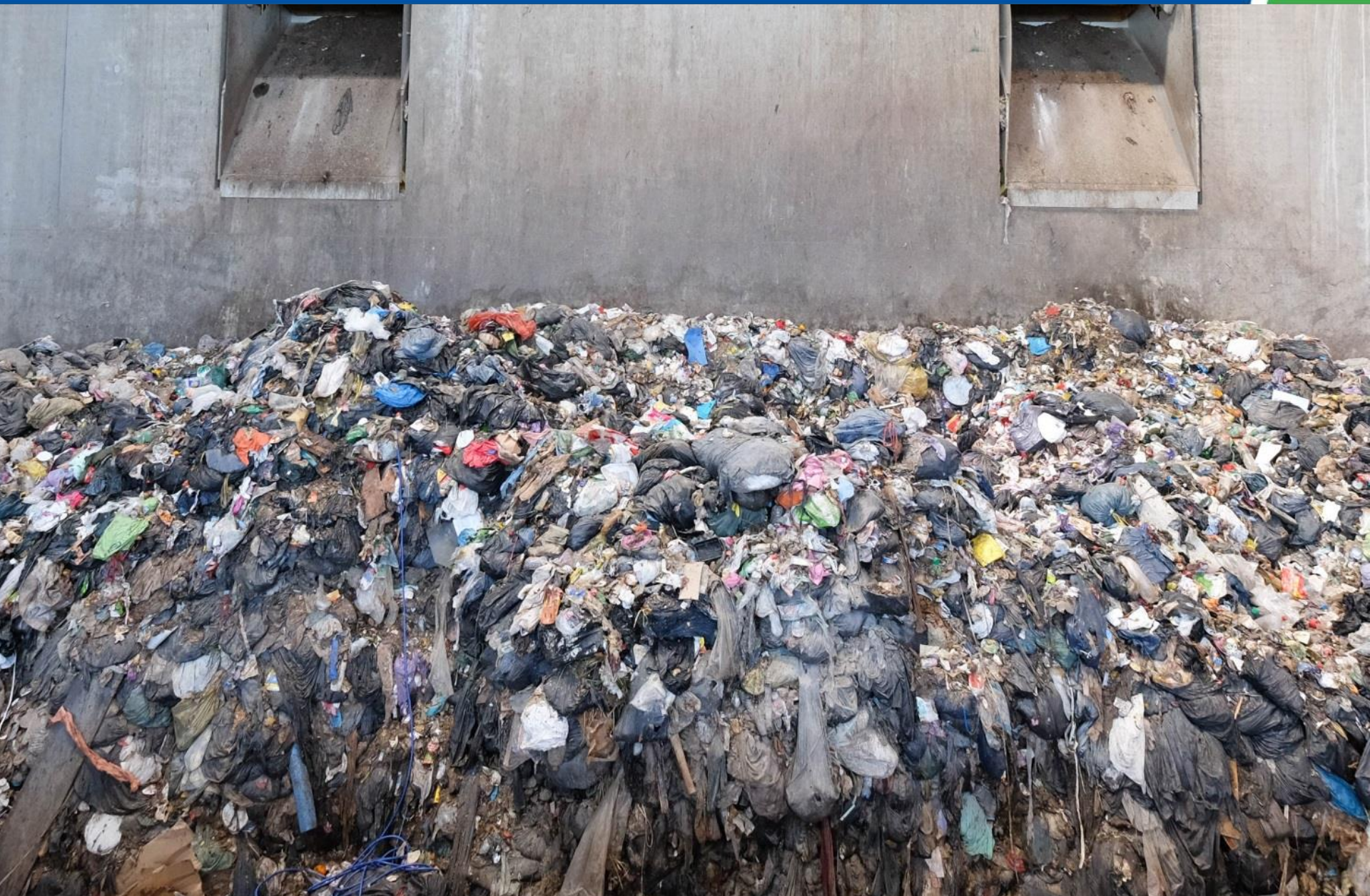
PAPER RANGE

ORGANIC WASTE RANGE

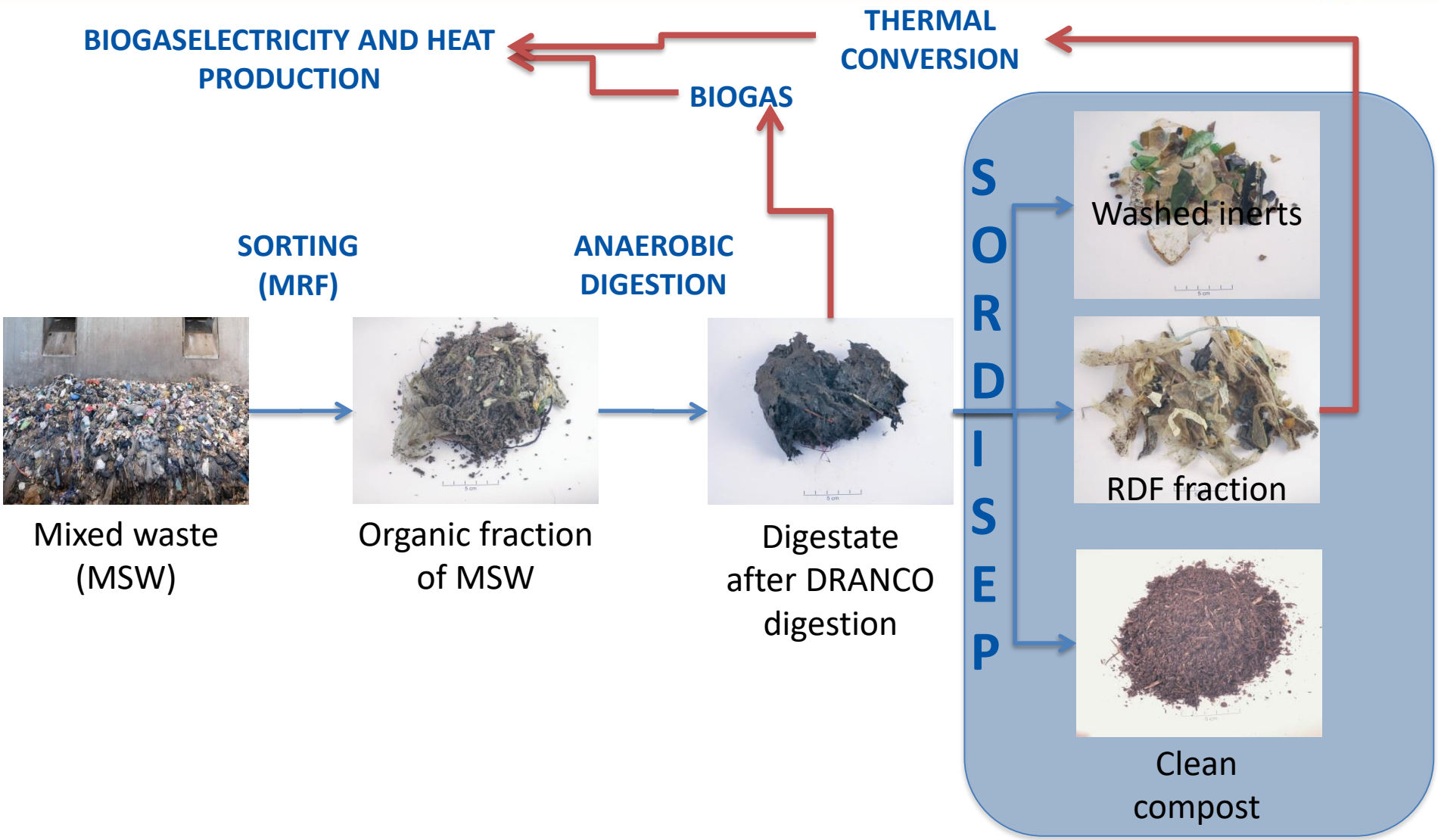
RCNG+LCFS+D3 RIN VALUE
EQUIVALENT OF >$150/TON SOILED PAPER

BOURG-EN-BRESSE PLANT (FRANCE)

FEEDSTOCK: BLACK BIN MIXED WASTE



PROCESS FLOW AT BOURG EN BRESSE



BOURG-EN-BRESSE: INTEGRATION DRANCO-SORDISEP

- Capacity:
  - 72,700 sh t/y mixed waste
  - 8,200 t/y green waste
  - Capacity AD: 44,000 t/y
- Volume digester: 115,000 ft^3
- Start-up: end of 2015
- 'Industrial operation' since May 1st, 2016
- Production of:
  - Compost: 23,000 sh t compost/y
  - Biogas: 4,800 scf/ton
  - Electricity from biogas: > 10,000,000 kWh/y

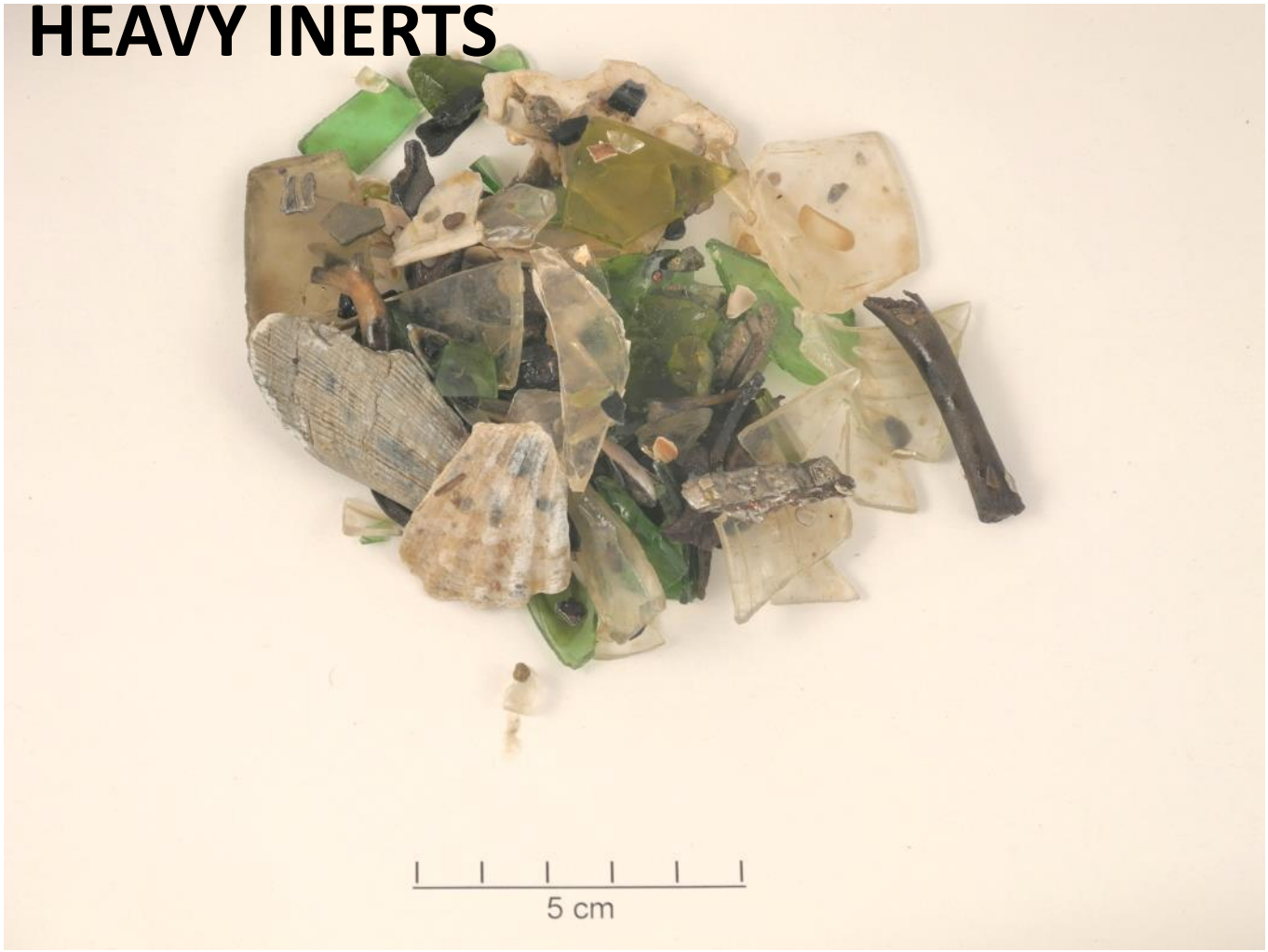
SORDISEP – INITIAL MIXED WASTE DIGESTATE

DIGESTATE

SORDISEP – END PRODUCTS

LIGHT FRACTION

SORDISEP – END PRODUCTS



SORDISEP – END PRODUCTS

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SORDISEP – END PRODUCTS

OUTPUT: LIGHT FRACTION (FIBERS, PLASTICS,…)

- Particle size: <50 mm in 2 dimensions

  (after pretreatment and DRANCO AD)

- Composition
  - light plastics: 25-35%
  - hard plastics: 5-20%
  - textiles/fibers: 25-45%
  - Other (fraction <5 mm incl.): 15-25%

- Calorific value:
  - Lower combustion value: 5,100 BTU/lb
  - Higher combustion value: 6,000 BTU/lb (**brown coal** 8,000 BTU/lb)

SORDISEP – END PRODUCTS

OUTPUT: HEAVY FRACTION (INERTS,…)

- Particle size: <50 mm (after pretreatment and DRANCO AD)

- Composition (on TS)
  - Glass: 70-85%
  - Stones: 5-20%
  - Others: 5-15%

- Quality meets the clients' demands (leachate test to determine soluble matter and TOC)

ANALYSIS: HEAVY METALS IN SORDISEP COMPOST (1)

Results of press cake & compost in comparison to standards:

Metals *mg/kg TS*	Norm US EPA mg/kg TS	Norm France mg/kg TS	Compost BeB mg/kg TS	Norm Ontario CLASS AA	Norm Canada CLASS A	Norm Canada CLASS B
Arsenic	75	18	*2.4*	*13*	*13*	*75*
Cadmium	85	3	*0.8*	*3*	*3*	*20*
Chromium	3,000	120	*67*	*210*	*210*	*1060*
Copper	4,300	300	*126*	*100*	*400*	*760*
Lead	840	180	*66*	*150*	*150*	*500*
Mercury	57	2	*0.2*	*0.8*	*0.8*	*5*
Nickel	420	60	*57*	*62*	*62*	*180*
Zinc	7,500	600	*402*	*500*	*700*	*1850*

ANALYSIS: HEAVY METALS IN SORDISEP COMPOST (2)

Results of SORDISEP compost in comparison to SSO & green waste compost

Metals *mg/kg TS*	Norm US EPA mg/kg TS	Norm France mg/kg TS	Compost Mixed waste mg/kg TS	Compost SSO Brecht mg/kg TS	Green waste compost Brecht mg/kg TS
Arsenic	75	18	*1,6*	*3,4*	*1,7*
Cadmium	85	3	*1,4*	*0,9*	*1,3*
Chromium	3,000	120	*39*	*21,0*	*35,1*
Copper	4,300	300	*151,2*	*64,4*	*143,9*
Lead	840	180	*64,6*	*73,7*	*65,4*
Mercury	57	2	*0.2*	*0,0*	*0,1*
Nickel	420	60	*36,7*	*13,8*	*46,3*
Zinc	7,500	600	*534,2*	*215,3*	*531,9*

ANALYSIS: IMPURITIES

Results of press cake & compost in comparison to standards

=> Digested organics for compost production are screened over ***3mm***

California norm Jan 1, 2018:

Physical contaminants ***> 4 mm***: <=0,5% on TS → <5 g/kg TS
and <20% of these contaminants are film plastics → <1 g/kg TS

=> SO STANDARD WILL CERTAINLY BE MET!

CLEAN COMPOST PRODUCED

COMPOST CHARACTERISTICS BOURG-EN-BRESSE

- *Digestate has been wetted to 5% solids (95% water) and is subsequently screened over a sieve of 3mm. The organics are recovered by centrifugation of the liquid containing the fine organics and composted*
- *Compost meets the future CA regulation of less than 0.5% contamination of which less than 20% can be film plastics*
- *Low heavy metals (similar to SSO) and other contamination way below standards (herbicides, PCB's, PAH'S,petroleum based mineral oils)*

Thank you!

For more information and videos, please visit our website, www.ows.be

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