RECOVERING ORGANICS AND ENERGY FROM MSW
• 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 household/municipal organic waste (SSO – OFMSW – Food Waste)
• 85 people
• 30 projects in 15 countries, >9 million tons processed to date
• HQ in Belgium; in Ohio since 1990
COMMERCIAL PROVEN TECHNOLOGY for OVER 25 YEARS
• 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?
Organic material is delivered to the digester system

This may include animal manure, food scraps, agricultural residues, or wastewater solids.

Digested material may be returned for livestock, agricultural and gardening uses.

Organic material is broken down in a digester

The digester uses a natural biological process under controlled conditions to break down organic material into products for beneficial use or disposal.

Biogas processing

Biogas is mostly methane, the primary component of natural gas, and carbon dioxide, plus water vapor, and other trace compounds (e.g., siloxanes and hydrogen sulfide). Biogas can replace natural gas in almost any application, but first it must be processed to remove non-methane compounds. The level of processing varies depending on the end use.

Processed biogas is distributed and used

The gas may be used to produce heat, electricity, vehicle fuel or injected into natural gas pipelines.

Digested material is processed and distributed

Solids and liquids from the digester may be used to produce marketable products, like fertilizer, compost, soil amendments or animal bedding.

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 PROCESSING RESIDUALS**
- BAKERY
- FATS, OILS AND GREASES
- VEGETABLES
- WHEY
- OTHER DAIRY WASTE
- RUMEN CONTENTS
- ANIMAL RENDERING FATS

**PAPER WASTE**
- SHREDDED OFFICE PAPER
- SHREDDED CARDBOARD

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

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

**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

**LIQUID NUTRIENTS**
- Composition depends on inputs
- Quantity depends on process

**SEPARATED SOLIDS**
- Composition depends on inputs
- Quantity depends on process

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

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

METHANIZATION

DEWATERING

Floating scum

Biogas

Pre-chamber

Inoculation

loop

SSOW

Heat

Fresh water

Heavies

Recycle process water

10-15 % TS

Composting

Water treatment

10-15 % TS

Recycle process water

SSOW

Heat

Fresh water

Heavies

Recycle process water

10-15 % TS

Composting

Water treatment

10-15 % TS

Composting

Water treatment
BATCH SYSTEMS

A. Single-stage

B. Sequential batch

C. Hybrid batch-UASB

New  Mature  Old

UASB
Dry continuous systems design (A - Dranco, B - Kompogas and BRV, and C - Valorga)
# Benefits of Anaerobic Digestion

<table>
<thead>
<tr>
<th>Waste Management</th>
<th>Energy</th>
<th>Environmental</th>
<th>Economic</th>
</tr>
</thead>
</table>
| • Biological process  
• Mature technology  
• Small footprint  
• Reduces waste volume  
• Very efficient and complete decomposition  
• Nutrient recovery  
• It’s **recycling, 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

- **Biowaste**: 50,000t (< 60mm)
- **Dosing Unit**
- **Dranco Digester**: 3,450 m³
- **Mixer / Feeding Pump**
- **Storage Tank**
- **Boiler**
- **Mixing**
- **Composting**
- **Flare**
- **Gas Storage**
- **Cooling**
- **Bio Gas Engines**

**Outputs**:
- Biogas
- Digested
- Liquid organic waste
- Pretreated biowaste
- Compost
- Heat
- Electricity
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

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

Mixed waste (MSW) → Organic fraction of MSW → Digestate after DRANCO digestion

SORTING (MRF) → ANAEROBIC DIGESTION → BIOGAS

BIOGASELECTRICITY AND HEAT PRODUCTION

THERMAL CONVERSION

Washed inerts → RDF fraction → Clean compost
• Capacity:
  – 72,700 sh t/y mixed waste
  – 8,200 t/y green waste
  – Capacity AD: 44,000 t/y
• Volume digester: 115,000 ft³
• 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
LIGHT FRACTION
HEAVY INERTS
SORDISEP – END PRODUCTS

CENTRIFUGE CAKE
COMPOST
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)
## Results of press cake & compost in comparison to standards:

<table>
<thead>
<tr>
<th>Metals (mg/kg TS)</th>
<th>Norm US EPA (mg/kg TS)</th>
<th>Norm France (mg/kg TS)</th>
<th>Compost BeB (mg/kg TS)</th>
<th>Norm Ontario CLASS AA</th>
<th>Norm Canada CLASS A</th>
<th>Norm Canada CLASS B</th>
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Results of SORDISEP compost in comparison to SSO & green waste compost

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<th>Compost SSO Brecht mg/kg TS</th>
<th>Green waste compost Brecht mg/kg TS</th>
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<td>534,2</td>
<td>215,3</td>
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</table>
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!
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](http://www.ows.be)

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