

# FOOD WASTE / MANURE

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# Manure and Food Waste Digestion

- Types of food waste
  - ▶ (preconsumer, postconsumer, industrial, liquid, solid)
- Types of manure
  - ▶ (farm yard slurry, farm yard manure)
- How much of what goes in to a manure or food waste digester comes out the other end and what can you do with that leftover stuff?
- How much food waste and manure is available to digest?



Meet cow...cow eats food...



Cow makes milk...



Cow gets milked...



Milk is pasteurized onsite and sold locally



Cow makes poop...super cool poop scraper collects poop in tank below

# Clover Hill Dairy, Wisconsin | 1,250 Cows | 300kW Power



# Albany NY | Small Farm Digester



# Western NY | Patterson Farms



# Auburn, NY Community Digester



# Various Digester Designs





# Mini Digester | 1 Ton /day





**Grinder**

People waste food...the waste water is collected in tank and the food is ground up...

Ground food, waste water and poop mix in tank then moves to digester



Digester is 60 feet deep and covered to collect gases release from the breakdown of foods

**Mixing tank**

# Substrate Management

- Substrate takeover facility
    - ▶ Closed building w/ truck take-over & washing
    - ▶ Negative pressure & bio-filters (NO odors)
    - ▶ Substrate stream management (blending, mixing, storage, etc.)
    - ▶ Trained personnel
  - Separation Equipment
    - ▶ Automated organics / packaging separation
    - ▶ High throughput
  - Substrate Processing Equipment
- Key requirements:
    - ▶ Ability to deal with Multiple Feedstock
    - ▶ Removal of impurities
    - ▶ Particle size reduction
    - ▶ Ability to deal with changing feedstock
    - ▶ Substrate preparation for Anaerobic Digestion



## Multi-Feedstocks

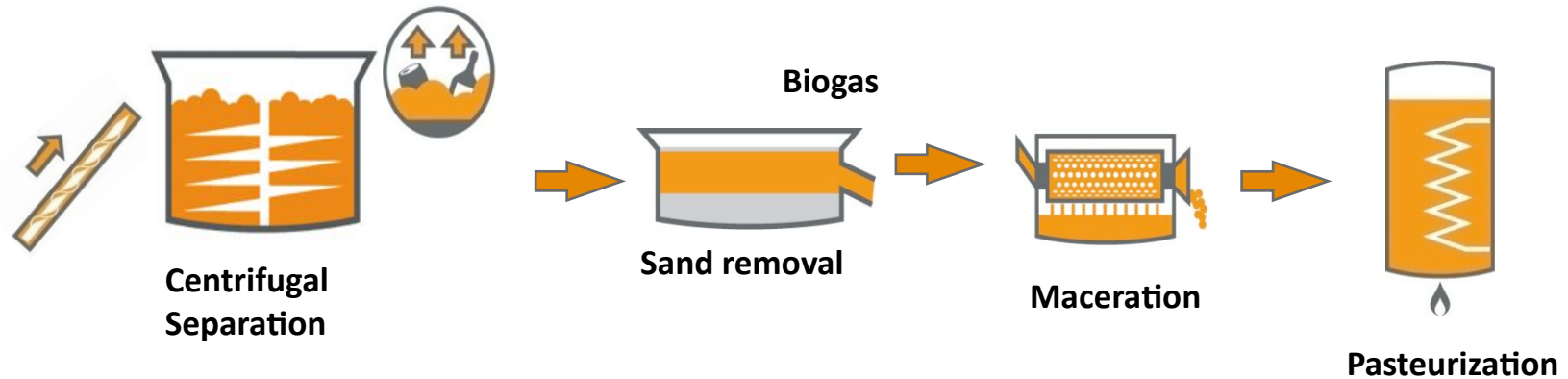
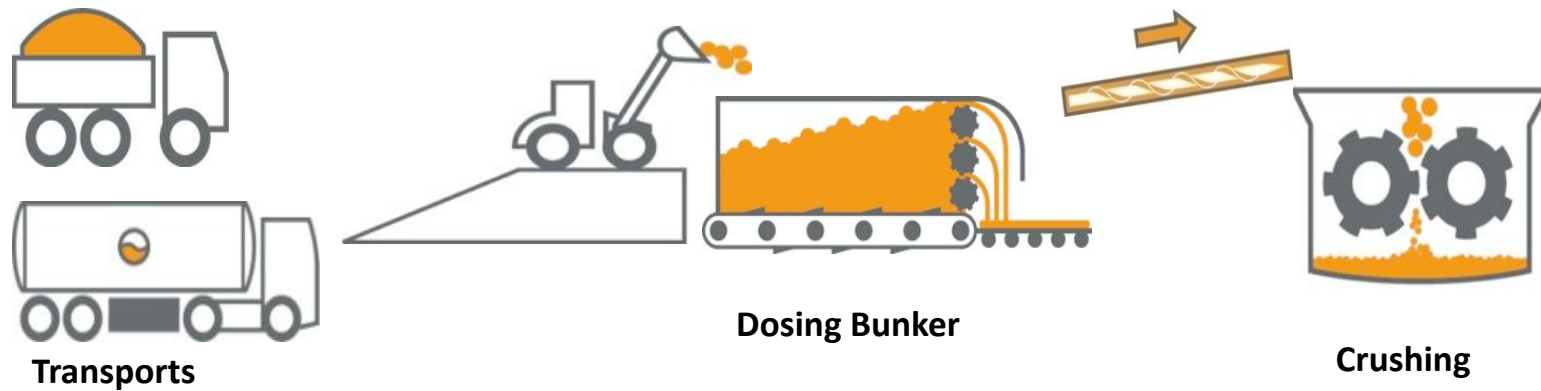
- Food Industry Residues (from breweries, dairies, slaughterhouses)
- Organic Waste (e.g. kitchen waste, packaged food waste, OFMSW)
- Biofuel Industry Residues (e.g. ethanol stillage, distillation residues)
- Agricultural Residues and Products (e.g. chicken litter, cow manure)



- Suitable for various, complex and challenging industrial residues
- Conversion into BioGas separately **OR** as a mixture
- Maximum possible efficiency and energy output from any feedstock

# Substrate Management

## Example



# Waste Separation Equipment



# FEEDSTOCK DRIVERS

- Will there will be significantly more anaerobic digesters developed (both urban & agricultural) in the next 10-20 years?
  - **YES!**
- Will there be more competition for clean, high energy potential feedstocks over the next 10-20 years?
  - **YES!**
- What will be the impact on the economics of AD plants only able to handle clean feedstocks?
  - Potential shortages of feedstocks.... Lower energy production....Lower energy revenue
  - Lower tip fees – 50-60% of revenue

# FEEDSTOCK PROCUREMENT SUCCESS

- **Price**
  - Lower than local alternatives
- **Location**
  - Lower transportation costs
- **Flexibility**
  - Accept contaminated feedstock



# FEEDSTOCK CHARACTERIZATION

	CLEAN SOLID	LIQUID	CONTAMINATED SOLID
AGRICULTURAL	<p>Manure (10-12%TS)</p> <p>Energy crops e.g. corn silage</p>	<p>Liquid Manure (6-10% TS)</p>	<p>Feedlot Manure</p> <p>Greenhouse</p>
URBAN	<p>Fruit &amp; Vegetables</p> <p>Distillery/brewery grains</p> <p>Residential Yard &amp; Garden</p>	<p>Fats, Oils, Greases</p> <p>DAF (Dissolved Air Floatation)</p> <p>Juice, softdrink</p>	<p>Residential Food Waste</p> <p>Packaged Food</p> <p>Product Destruction e.g. off spec, expired</p>

# FEEDSTOCK SEGMENTATION

## Clean Solids



**Breaded Chicken**



**Fruit Peels**

## Contaminated Solids



**“Separated” Grocery**



**Non-separated  
Restaurant**



**Packaged Food**

## Liquids



**Milk & Yogurt**



**Fats Oils Greases**

# BIOGAS POTENTIAL

	CLEAN SOLID	LIQUID	CONTAMINATED SOLID*
AGRICULTURAL	Manure - <b>LOW</b> Energy crops - <b>MED</b>	Liquid Manure - <b>LOW</b>	Feedlot Manure - <b>LOW</b> Greenhouse - <b>LOW</b>
URBAN	Fruit & Veg - <b>LOW</b> Distillery/brewery - <b>HIGH</b> Residential Yard & Garden - <b>LOW</b>	Fats, Oils, Greases - <b>HIGH</b> DAF (Dissolved Air Floatation) - <b>MED</b> Juice, softdrink - <b>HIGH</b>	Packaged Food - <b>HIGH</b> Product Destruction - <b>HIGH</b>

**LEGEND:**

**LOW** = 10 – 30 m<sup>3</sup> / ton

**MED** = 30 – 100 m<sup>3</sup> / ton

**HIGH** = 100 + m<sup>3</sup> / ton

\* Varies with % Contaminants

# TIPPING FEE REVENUE

	CLEAN SOLID	LIQUID	CONTAMINATED SOLID
AGRICULTURAL	LOW	LOW	LOW
URBAN	MED	HIGH	HIGH

**LEGEND:**  
**LOW = \$0-\$20/ ton**  
**MED = \$20-\$50/ ton**  
**HIGH = \$50-\$150/ ton**

# FEEDSTOCK SPECTRUM

Contaminated Solid

**Non-Separated**  
e.g. grocery,  
restaurant, residential

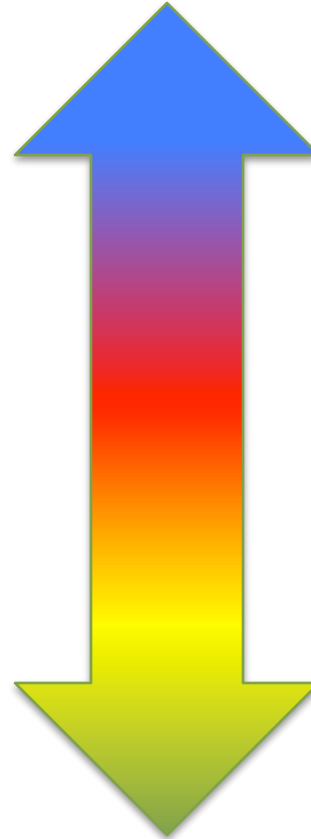
**Packaged**  
e.g. off-spec, expired

**Liquid**  
e.g. FOGs

Clean Solid

**Clean ICI**  
e.g. food processors

**Separated**  
e.g. grocery produce



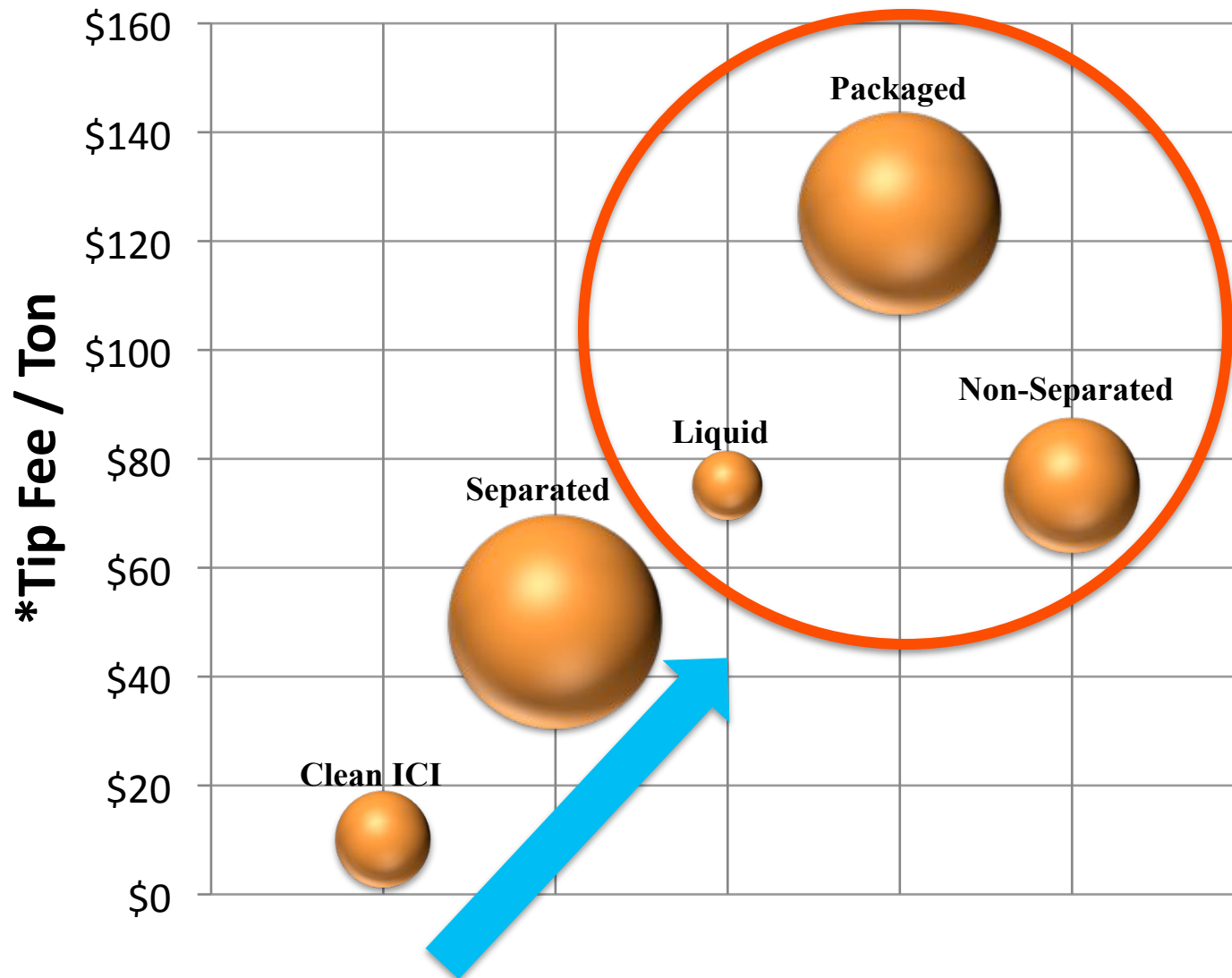
**Few Disposal Options**  
e.g. Landfill

**= Higher Tip Fees**

**Many Disposal Options**  
e.g. compost, animal feed, farm AD

**= Lower Tip Fees**

# FEEDSTOCK SWEET SPOT



# THE PROBLEM WITH CONTAMINANTS



**Contaminants  
like bones,  
packaging,  
dishes, cutlery,  
light & hard  
plastic etc.**

# THE PROBLEM WITH CONTAMINANTS





# CONTAMINANTS END UP IN YOUR DIGESTATE OR THE BOTTOM OF YOUR TANK



**Sinking Contaminants: bones, metal, glass, shells, rocks, sand**



**Floating Contaminants: soft & hard plastic, rubber, styrofoam**

# CONTAMINANT REMOVAL OPTIONS



*Chain Shredder & Pump Press*



*Hammermill*



*BTAB Hydropulper*



*Internal Agitator*



# MULTI-STEP CONTAMINANT REMOVAL

## SYSTEMS...WHY?

- No conditioning or pre-treatment equipment will be 100% EFFECTIVE... some contaminants always get into the tanks
- 1: Break up organics & contaminants
  - Achieve better particle size reductions
- 2: Screen out organics & heat... 1-2 times
  - Achieve better solid separation
- 3: Remove those contaminants that sink and those that stay in suspension or float
  - Light plastics will float
  - Heavy solids like bones, metals & eggshells will sink

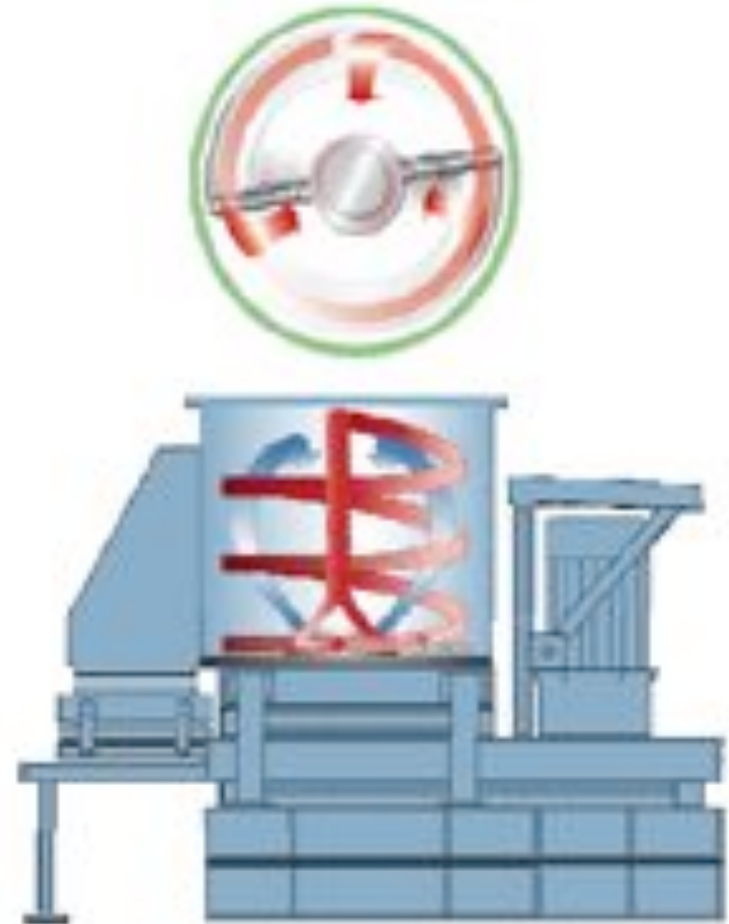
# YIELD/FITEC

## 3 STAGE CONTAMINANT REMOVAL SYSTEM

- 1<sup>st</sup> : Shredding and pressing removes 95% of contaminants
- 2<sup>nd</sup> : Heating and pressing removes 50% of remaining contaminants
- 3<sup>rd</sup> : In-tank floor scraper and skimmer removes balance of contaminants



# CHAIN SHREDDER



# Separation Equipment

## Example

<b>Feedstock</b>	$\leq 10$ t/hr Packaged Food Waste; SSO
<b>Location</b>	<b>Benet, France</b>
<b>Customer</b>	<b>SIFDDA / SARIA</b>
<b>In operation since</b>	<b>2010</b>



# Covington NY | Food Waste Codigester



## Success Stories

- Pamukova, Turkey – Biosun / Hexagon

<b>Feedstock</b>	<b>50 000 t/yr</b> SSO; OFMSW; Agricultural Residues
<b>Energy production</b>	<b>~ 1.4 MW<sub>el</sub></b>
<b>Start-up</b>	<b>2011</b>

- Co-Located with composting facility
- Integrated with MRF and RDF facility
- Heat used for local heating applications
- Favorable environment for renewable electricity
- Owner/Operator has large waste collection business





# Success Strategies

## Example Este (Italy) – Largest Plant in Europe



<b>Feedstock</b>	OFMSW, food industry waste, slaughter house waste, biofuel residues
<b>Input</b>	105,000 tons/year
<b>Fermenter</b>	2 x 2900m <sup>3</sup> , loading rate > 10 kg COD/m <sup>3</sup>
<b>Output</b>	Biogas: 1,450 Nm <sup>3</sup> /h (59% CH <sub>4</sub> ) Electricity: 3.4 MW <sub>el</sub> (27 GWh/y) Purified Water & Fertilizer
<b>Start-up</b>	2006 (original plant), 2011 (expansion)

- Co-Located with composting facility
- Located next to former landfill
- Heat is fed into district heating network, concentrated fertilizer for land appl.
- Owner / operator is major player in waste industry (experience)
- Favorable environment for renewable electricity

### SARIA ReFood, Marl, Germany



**Multi-Feedstock BioGas plant**  
**Customer: SARIA ReFood**

<b>Substrate</b>	Expired food from food retailers, catering waste (87,000 tonnes per year)
<b>Capacity</b>	6.3 mio Nm <sup>3</sup> of BioGas (approx. 3 MW <sub>el</sub> )
<b>Side Products</b>	Heat, Fertilizer

- Located within industrial food waste processing complex
- Next to rendering processing company (user of thermal energy)
- Owner / Operator is major player in food residue industry (experience)
- Favorable environment for renewable electricity

[www.americanbiogasCouncil.org](http://www.americanbiogasCouncil.org)

# THANK YOU

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