

# Trends and Technologies for Energy Management for Industrial and Municipal Projects

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Geosyntec   
consultants



- Introduction
- Anaerobic Digestion Overview
- Technology Choices
- Project Drivers and Trends
- Case Studies
- Lessons Learned
- Summary



- WEF has the Energy Roadmap
- Industry has been doing Energy Recovery from WW for many years using AD
- Industry has Sustainability Goals on Energy, Water, Wastes etc.
- Land Bans are driving food waste to energy projects in CT, MA, CA and this will continue
- Municipal WWTPs are interested in co-digestion
- More P3's evolving with industry and POTWs working together

- COD in the wastewater creates energy
- 5.6 cubic meters methane per pound COD removed
- Methane has 960 BTU per cubic feet versus natural gas at 1030 and propane at 2516
- Sanitary wastewater COD around 500 mg/l
- Industrial wastewater COD can be 50,000 mg/l or 100 times
- 40,000 tons per year food waste can generate 1.2 MW of electricity and 1 Million BTUs heat

Industrial Sector	Number
Beverage	623
Food	310
Pulp and Paper	137
Chemical/Pharmaceutical	107
Dairy/Ice Cream/Cheese	67
Sewage	67
Meat/Poultry/Fish	23
Other	265
Total	1,599

**Reference:** Chemical Engineering, April 2003



## Pre/Post Consumer



## Packaged Waste



Fats/Oils/Greases



Dairy/Beverages

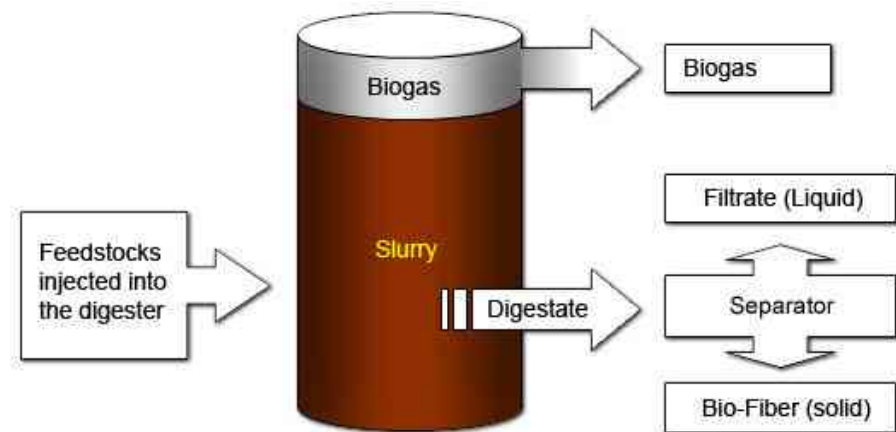


Food Processor Waste



# What is Anaerobic Digestion?

- Biological conversion process (oxygen free)
- **Organic feedstock** consumed by bacteria
- Feedstock material is stabilized
- Byproducts
  - Biogas: 50 – 75% methane, 25 – 50 % carbon dioxide, trace gases
  - Digestate
- **Commodities**
  - Power
  - Recoverable heat
  - Biomethane
  - Soil amendment



Basic Anaerobic Digestion Process

# Digesters in the United States

- Digestion is widely used across the world as a recycling technology.
- 2,000 digester installations in the United States and growing rapidly.
- 7,000 digester installations in Germany and growing.



*Orlando, FL*



*San Jose, CA*

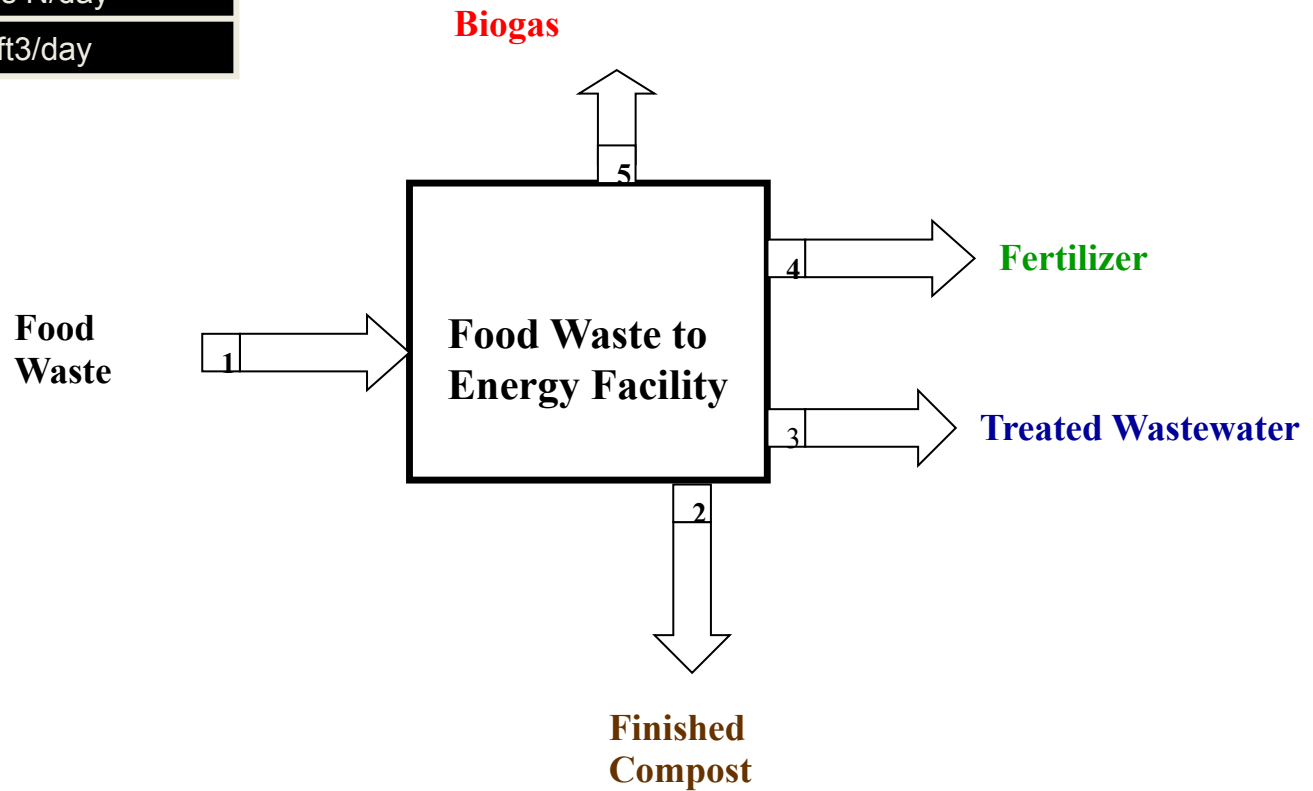


*Sacramento, CA*



# Case Study – Facility Input/Output

1	577 US tons FW/day
2	48 US tons/day
3	72,000 gal/day
4	2.25 US Tons N/day
5	1.95 million ft <sup>3</sup> /day



- Lower power and sludge production
- Renewable energy produced
- Can reduce greenhouse gas emissions
- Soil amendment produced
- Increased landfill diversion
- Proven technology

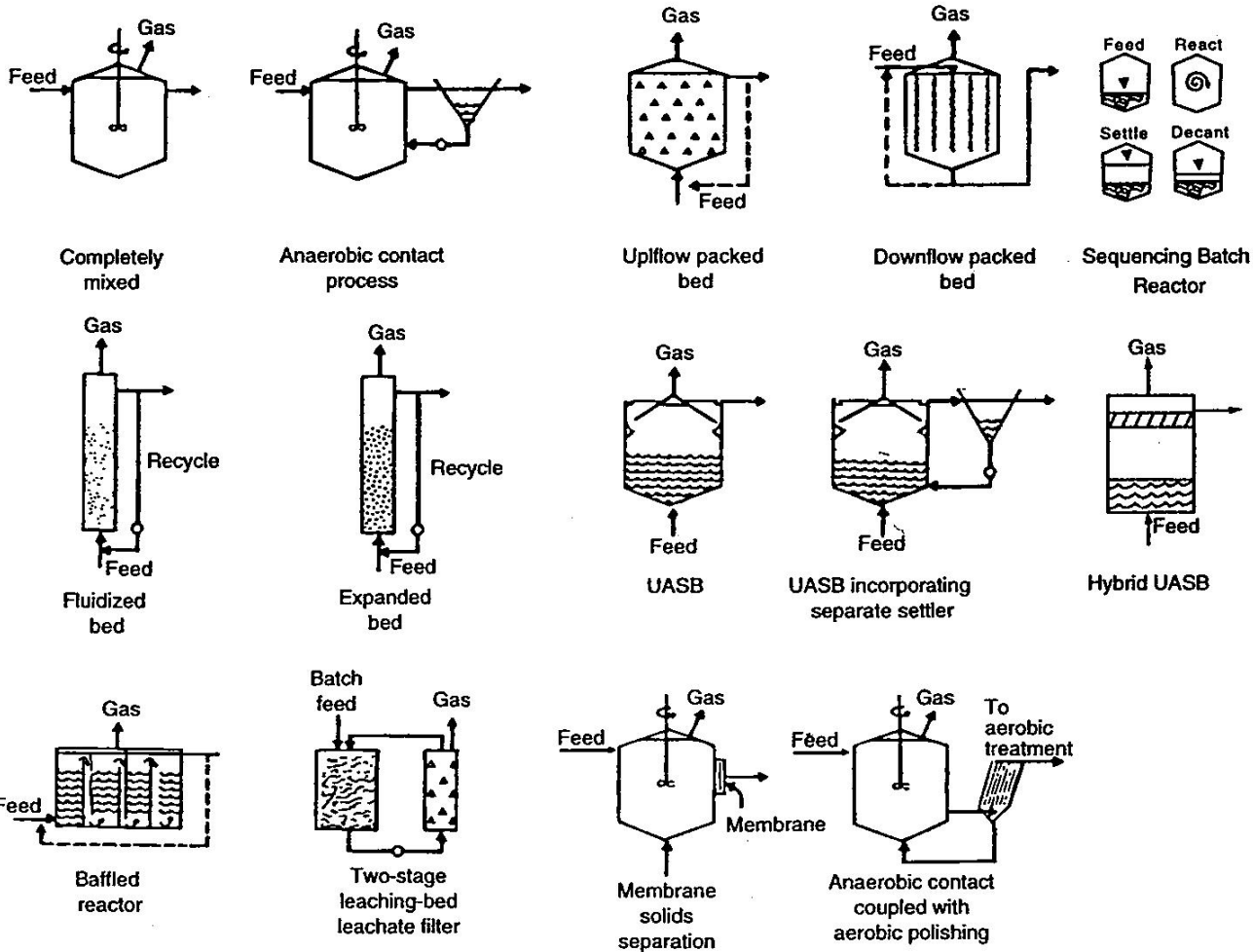
- **Municipal Wastewater Treatment Plants**
  - ~1,500 municipal WWTP using AD for solids stabilization
- **Industrial Wastewaters**
  - ~200 AD facilities primarily food & beverage production
- **Animal Manure Organics**
  - ~190 AD facilities for animal manure
- **Organics derived from MSW and other sources**
  - < 10 AD facilities

*Approximately 200 AD facilities in the US are used for digesting organics...*



# Anaerobic Digester Technologies

# Many Choice for Reactor Configurations – Wet AD

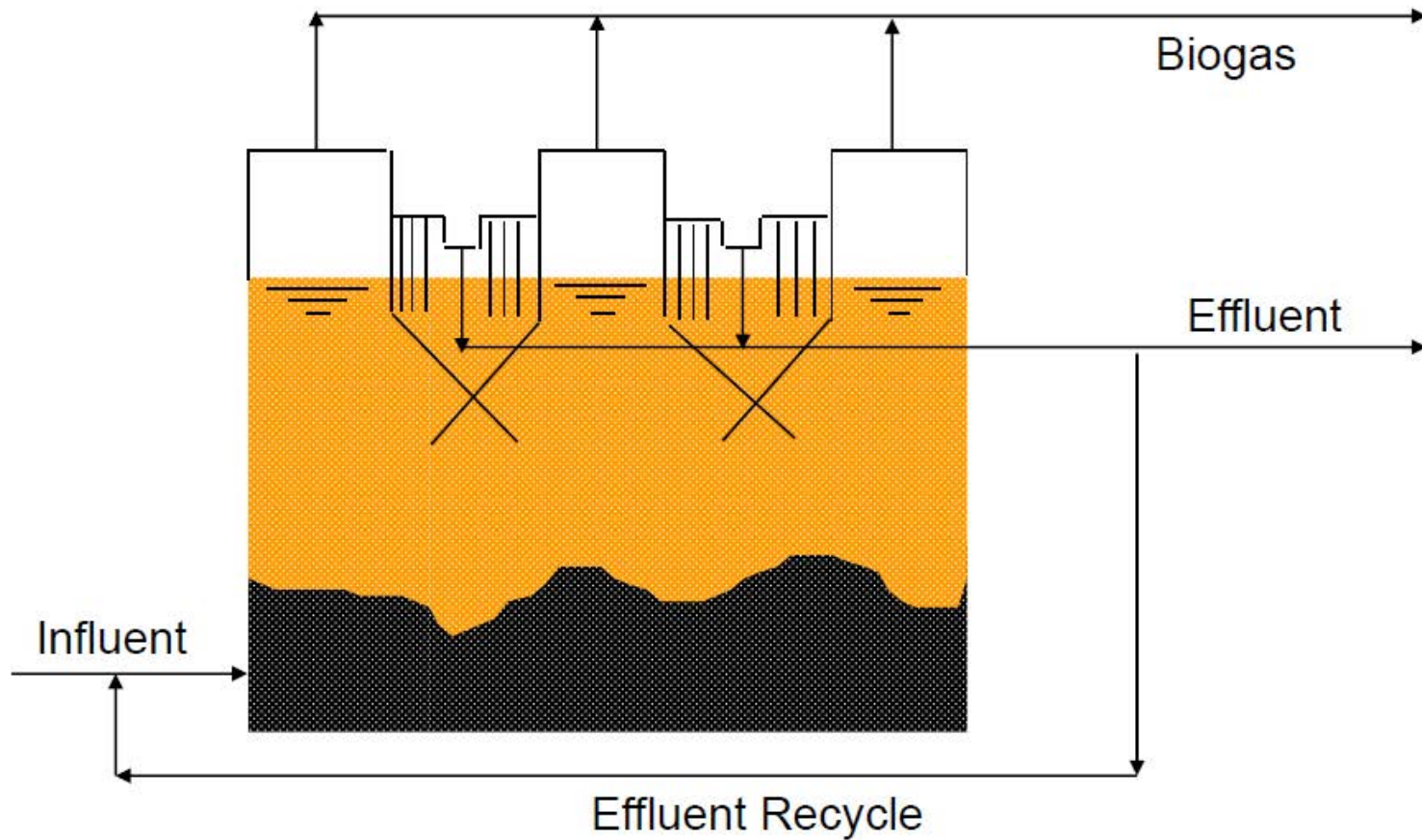


Reference: R.E. Speece, 1996





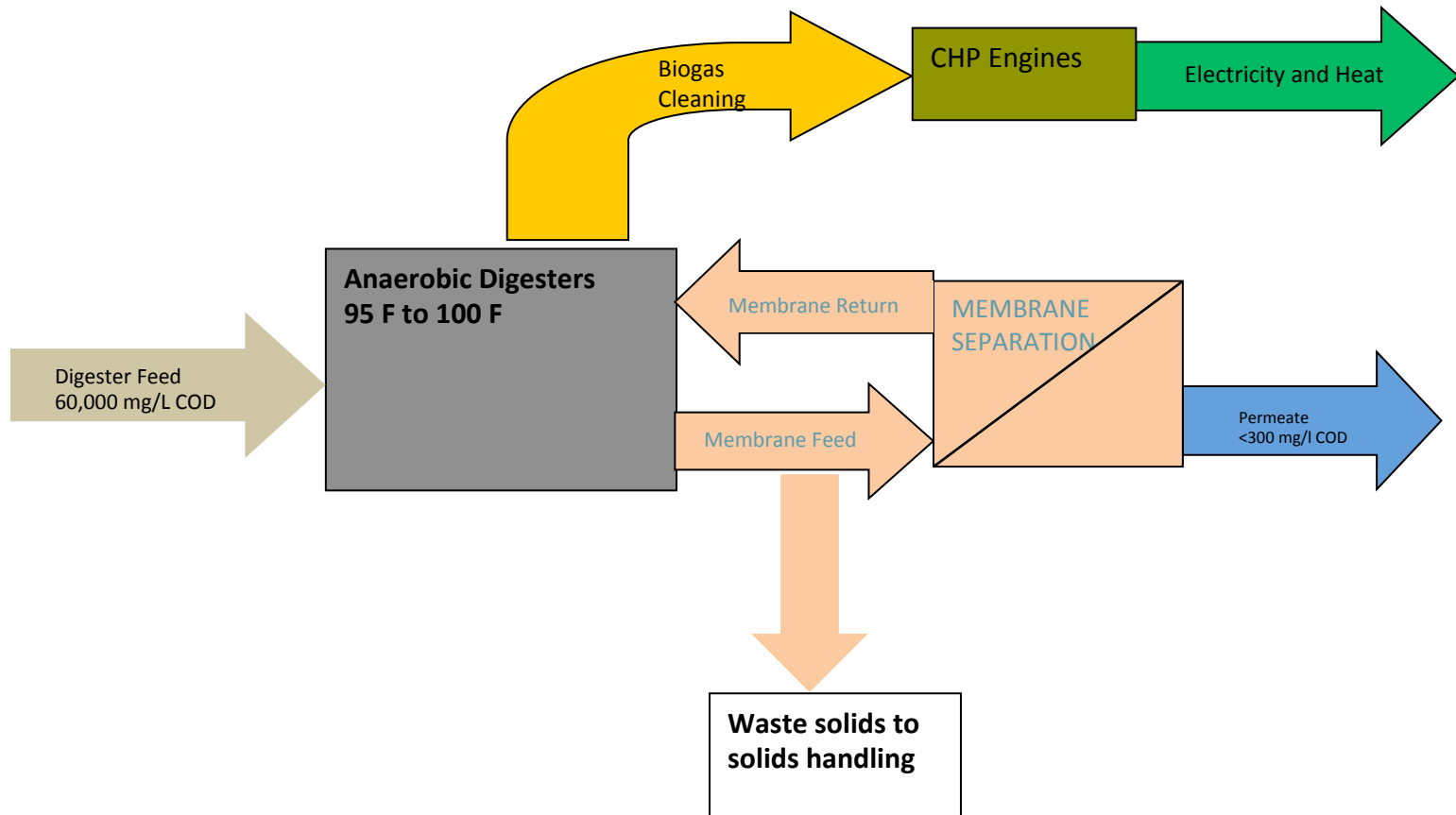
# Upflow Anaerobic Sludge Blanket (UASB)



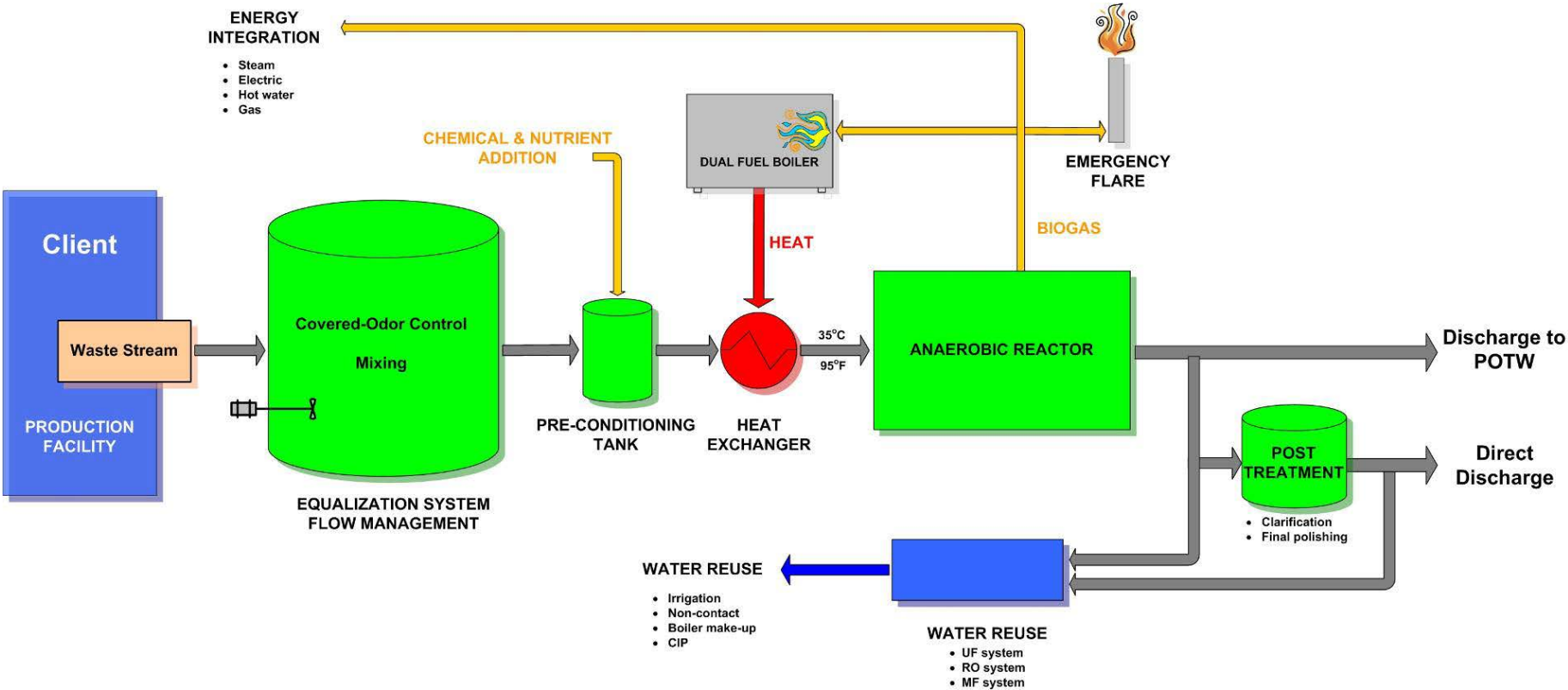
# Small Footprint



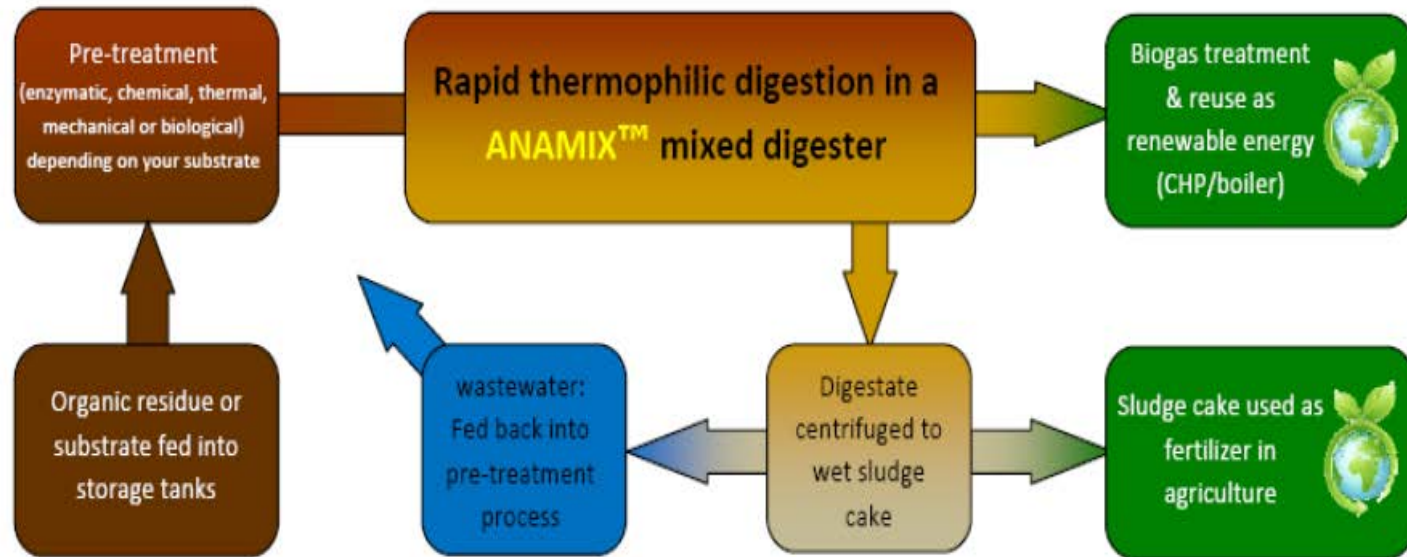
# Anaerobic MBR Simplified Flow Diagram



# Conceptual Total Solution PFD



## The Raptor<sup>®</sup> Process



GW&E/Ovivo



- Organic input remains stationary; solids concentration greater than 25%-35%
- No pretreatment of organic waste needed
- Material loaded into gastight building and saturated with percolate
- Batch operation and more labor intensive



- Ridgewood, NJ Co-Digestion of FOG and Biosolids
- Yogurt Whey, NY Co-Digestion and Industrial Pre-treatment
- Distillery Wastewater San Juan, Puerto Rico
- Food Waste to Energy, CT



- Co-Digestion of FOG and Biosolids
- 5 MGD Treatment Plant
- Two trucks per day average – 10,000 gallons FOG
- Increased gas production by two to three times
- 240 KV Engine plus solar panels
- Produces 100 % plant power with excess power to grid
- Reduced electrical costs to client over 20 years with no capital
- Financing at no cost to Ridgewood NJ client
- NSU lead DBOF project with HDR doing engineering





- Expand on current Co-Digestion of Whey at POTW
- Design-Build Anaerobic Pretreatment system for whey volumes in excess of the 25MM gallons per year
- Collect and utilize the produced biogas
- Selected Anaerobic MBR Technology



## Biogas Utilization Options

- Local uses in facility (heating, boiler)
- Transfer to food processor: Boilers
- Conversion to Electricity (CHP engines or other)

- 342 mm BTU/day biogas energy available
- GE Jenbacher engines(2) with a power output of 848 kW each
- More than 5 times the electric power required for the whey treatment plant
- Excess electric power will be exported to the grid
- Heat recovered used to maintain (37 C) digester temperature



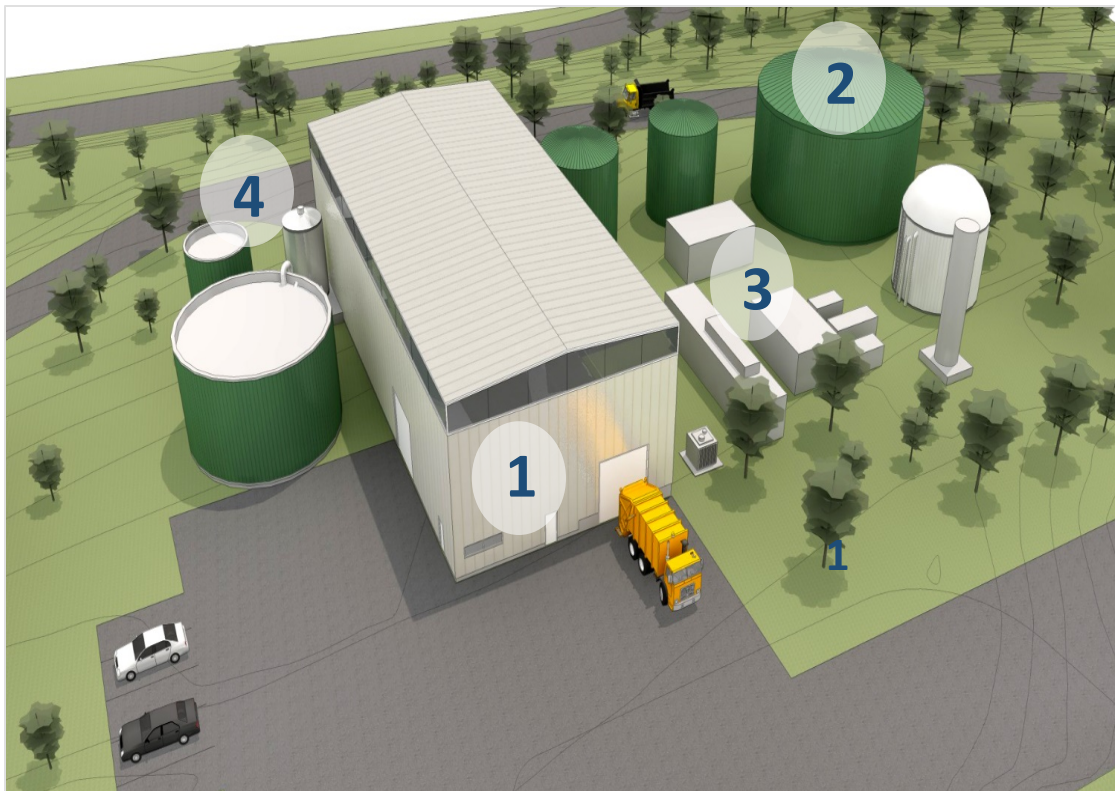


- CODs over 50,000 mg/l treated
- Anaerobic fixed film process
- Biogas has high sulfur( over 2-3 %) requiring treatment for use in boilers
- Plant gets 50% of energy to run the distillery from the wastewater





***Quantum Biopower* is completing construction of a 40,000 ton per year, 1.2 MW Digester – CoGen facility in Southington CT. Online NEXT MONTH Plans to initiate new 3-5 projects in 2016-2017**



## 1. Food Waste Processing

**40,000 Tons/Year**  
**Fats/Oils/Greases**  
**Meats**  
**Produce**  
**Packaged products**  
**Bakery Items**

## 2. Methane Production

**Natural process**  
**Heat and Mixing**  
**Methane created**

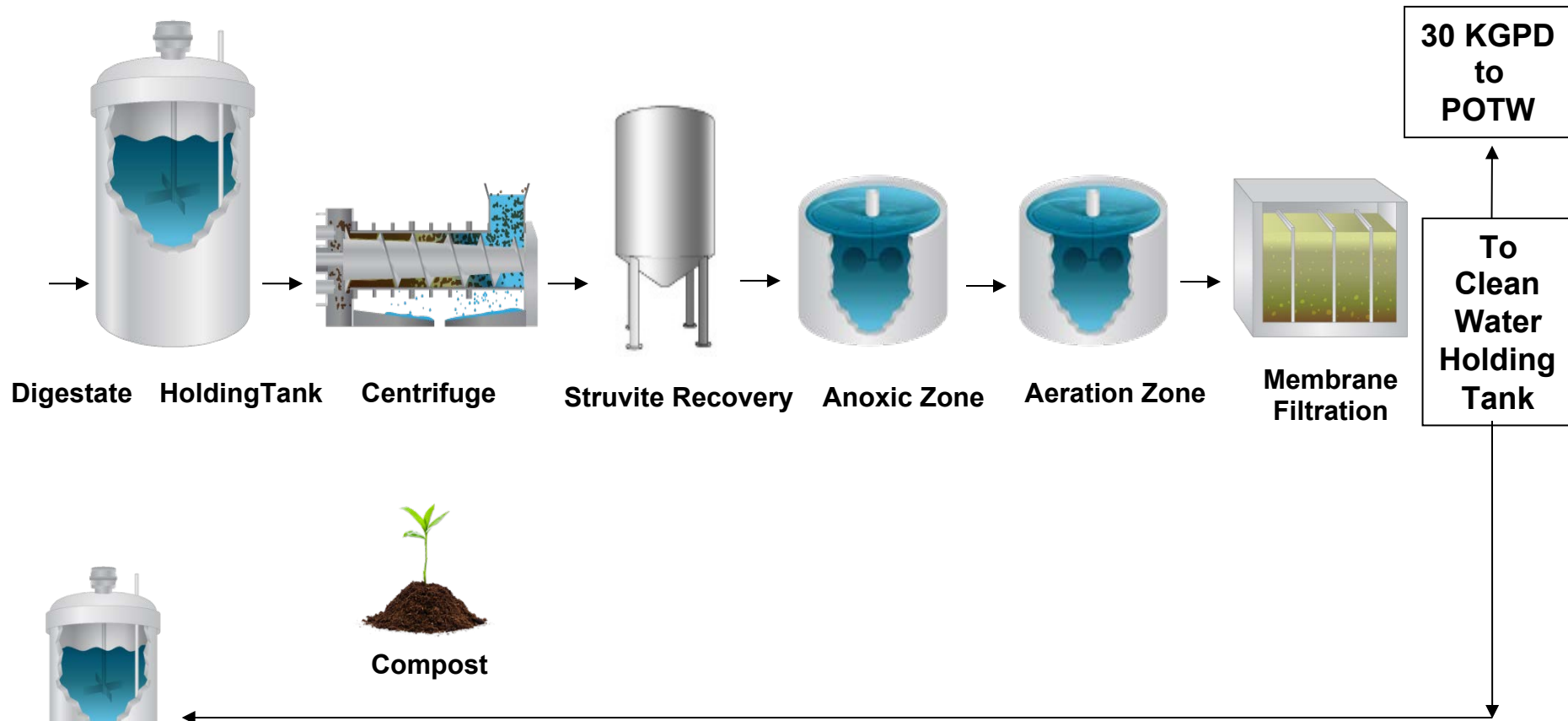
## 3. Sustainable Energy

**1.2 MW of electricity**  
**1 MM BTU's of heat**  
**Southington, CT**

## 4. Compost

**10,000 tons/year**  
**Organic compost**  
**Farms & Growers in CT**

# Wastewater Treatment – Nutrient Recovery



**Digester Facility Effluent Quality**

Parameter	Average Daily Limit	Maximum
BOD	185 mg/l	370 mg/l
TSS	185 mg/l	370 mg/l
Nitrogen	50 mg/l	50 mg/l
Phosphorus	5 mg/l	10 mg/l



Digester




Compost

- Get a good waste and wastewater characterization.
- Consider need and benefits for treatability testing.
- Develop a good design basis with variability in loadings.
- Evaluate and select best technical solution first.
- Evaluate technology providers who can deliver the solution as well as project delivery models.
- Build in flexibility in design for production shutdowns and expandability.

- Anaerobic Digestion( AD) has been used for years for biosolids and high strength industrial wastewaters for energy value.
- The trend now is using AD more for co-digestion of FOG, food wastes and organics with biosolids and manure for energy.
- Municipal digesters with excess capacity are being used for FOG and Organics for energy.
- Source separated organics and industrial wastes residuals are also going to new AD systems for energy.
- There are other project drivers including landfill bans in some states.

Thank you for the opportunity to present.

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