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# UNDERSTANDING THE PARADIGM SHIFT: FROM WASTEWATER TREATMENT PLANTS TO WATER RESOURCE RECOVERY FACILITIES

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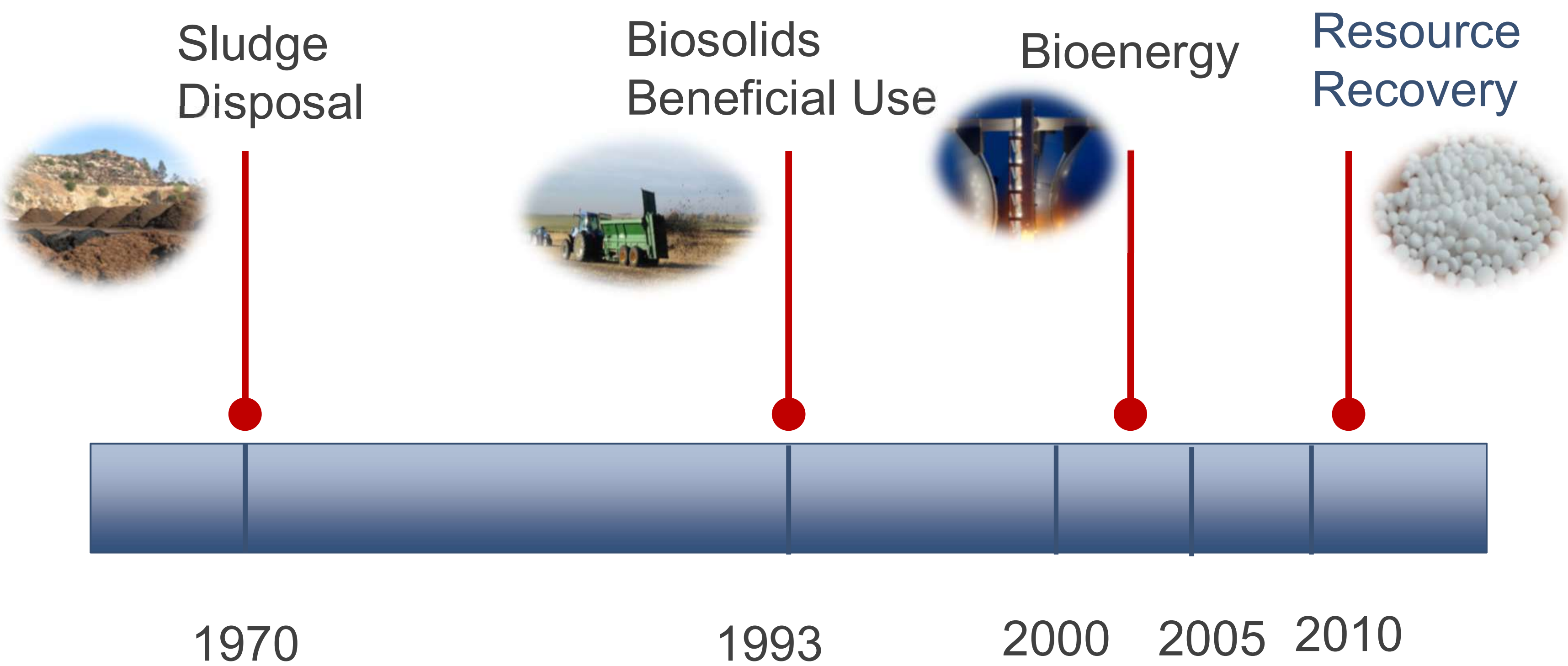
**01/29/19**

AZ Water Association
*Professionals Dedicated To Arizona's Water*

American Water Works Association Arizona Section

Water Environment Federation

# From Sludge Disposal to Resource Recovery




Aim: Maximizing the utilization of resources in biosolids and minimizing landfill disposal & combustion without energy recovery.

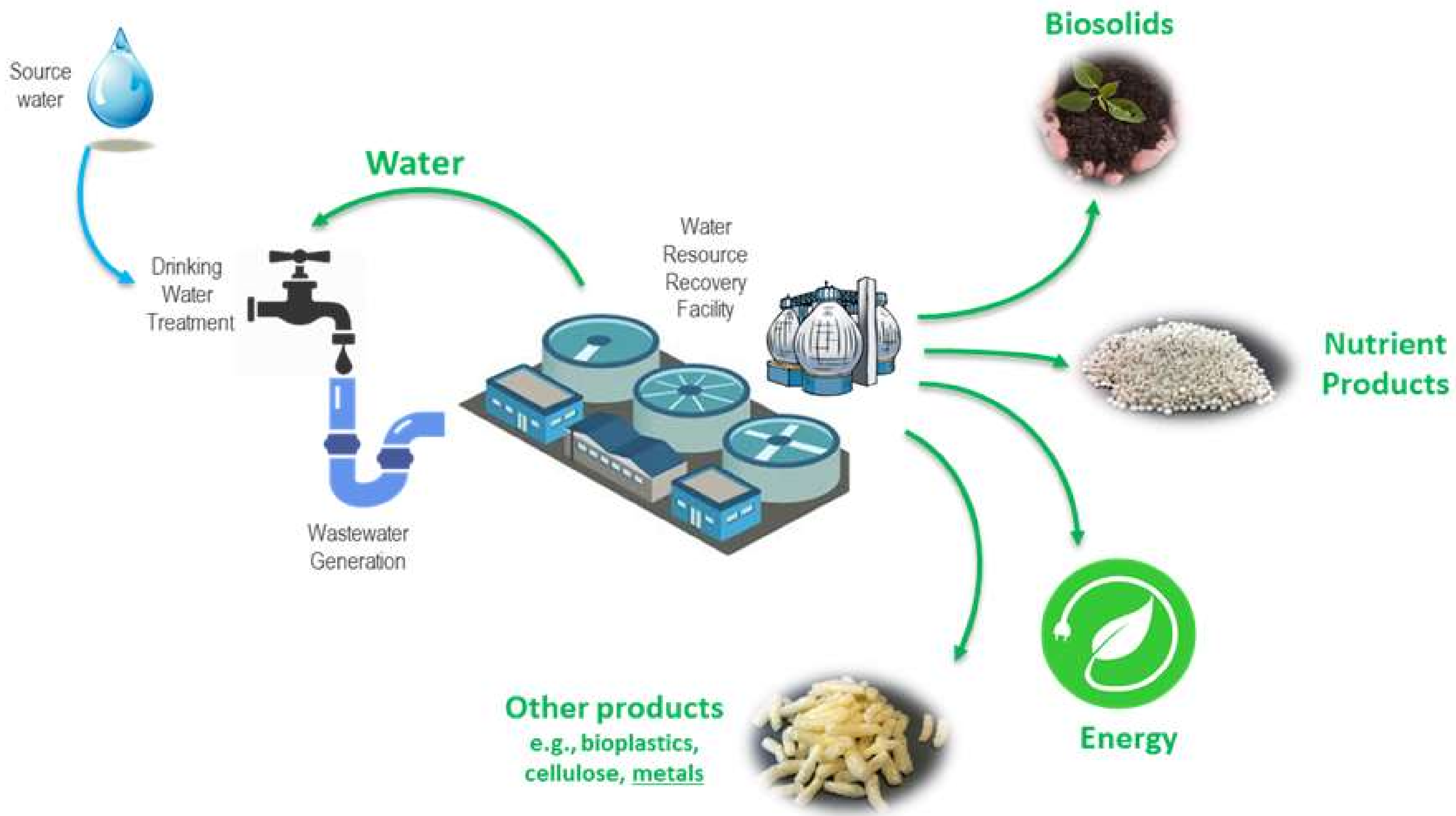
# WATER RESOURCE RECOVERY FACILITIES NOT WASTEWATER TREATMENT PLANTS

WWTP's are not polluters. The name has changed

GOLETA SANITARY
Water Resource Recovery District

Water resource recovery facilities produce:
clean water, recover nutrients, and have the potential to reduce the nation's dependence upon fossil fuel through the production and use of renewable energy.

# Looking at Big Picture – Holistic Approach



# Resources in Biosolids

Biosolids are now recognized as a source of multiple recoverable assets

Water

Nutrients

Energy

Organics

# Maximize RESOURCE RECOVERY of Constituents

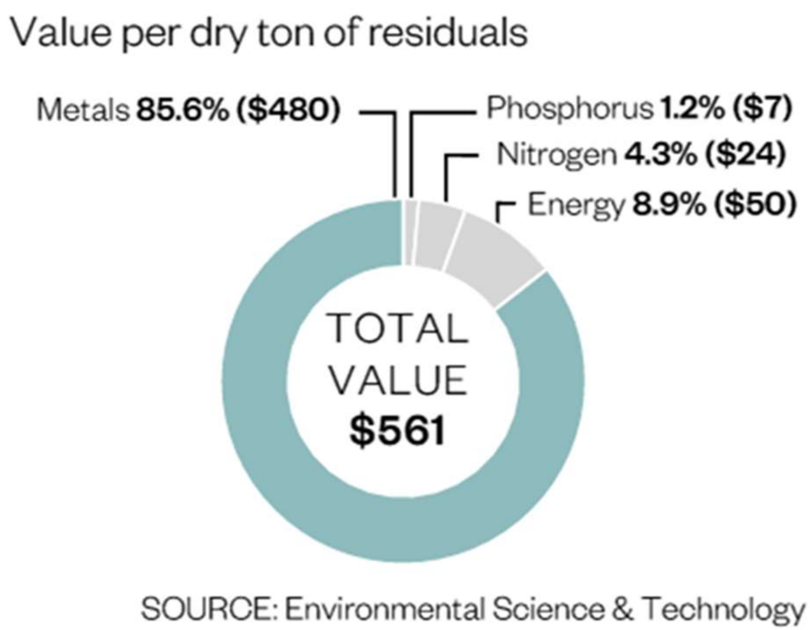
| Resources | Use | Possible Issues |
|---|---|---|
| Water | valuable in agriculture in arid climate | cost of transport |
| Organic matter | vital to soils | putrescible, odors |
| Nutrients | food for soil, plants & animals | impacts to water |
| Energy | renewable, displaces oil/gas air emissions | maybe<br>no use of nutrients & organic matter |

## MINIMIZE POTENTIAL RISKS OF CONSTITUENTS

Reduce/control/mitigate trace elements (e.g. metals), pathogens,synthetic and natural organic chemical compounds

# Are We Recovering the Proper Resources?

- Energy:
  - Net zero energy facilities
  - Integrated waste management approach
- Nutrients:
  - Marketable biosolids end-products
  - Increased value of soil amendments and fertilizers
  - Struvite recovery
- Metals (Rare Earth Elements) recovery



# Energy Recovery/ Co-digestion

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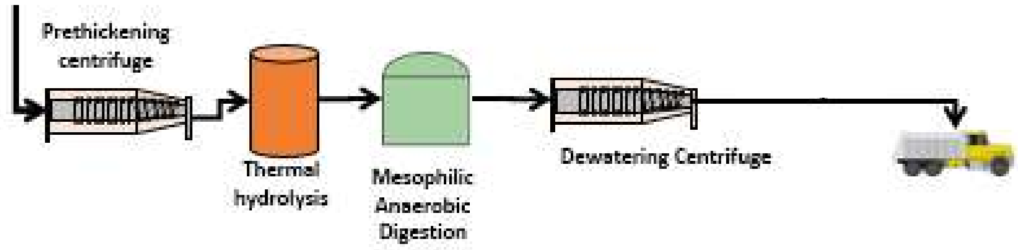
# Biosolids and Energy Neutrality

## Advanced Biosolids Treatment

- Reduced Mass
- Greater Energy Recovery Potential
- Higher quality Biosolids



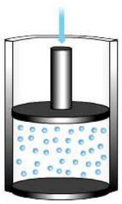

## Codigestion

- Impacts to Overall Mass
- Greater Energy Recovery Potential
- Needs assessment to determine impacts to biosolids quality

# Advanced Biosolids Treatment

Technologies use combinations of pressure, temperature and chemical inputs

- Heat
  - ~330°F



- Pressure
  - 90 to 130 psi

- Time
  - 20 to 30 minutes

Cell lysis

COD solubilization

Class A (maybe) via time/ temperature

Preheated material for digestion (maybe)

# Thermal Hydrolysis Pretreatment (THP)

### Process

- Treats dewatered sludge (from 14 to 17%) prior to anaerobic digestion, under the following conditions:
  - High temperature of 150 - 170° C (300 – 340° F)
  - Under pressure of 6 to 9 bars (90 – 130 psi)
  - Reaction time 22 to 30 min
- Dewatered sludge Input to digestion 8 to 11%

### Result

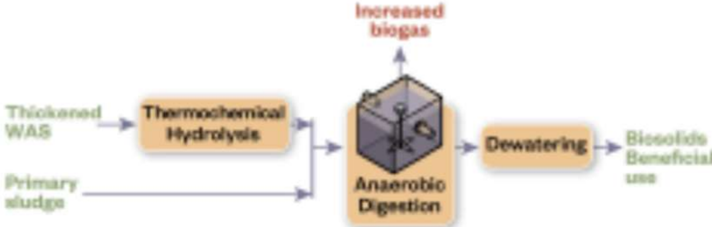
- Decrease viscosity
  - Allows sludge mixing at higher concentration
  - Decrease digestion volume
- Sterilized sludge (Class A)
- Improves anaerobic digestion
  - Increase VS reduction
  - Improve biogas production
  - Reduce mass for further processing
- Improve final dewatering

**Before TH**

**After TH**

# Thermochemical Hydrolysis Pretreatment, PONDUS

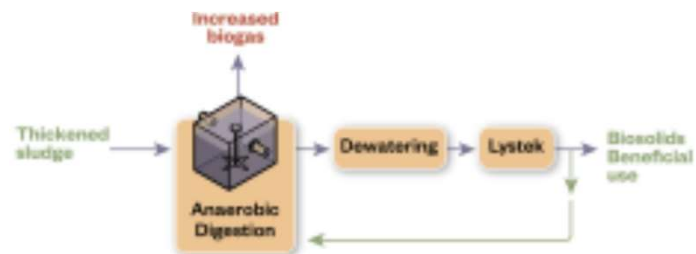
- Applicable to TWAS
- The process uses increased pH and heat to hydrolyze the TWAS




- Enhanced Biogas Production (up to 30%)
- Improved VSR (up to 6% increase)
- Improved digestibility of feed solids thus less energy required to heat, pump, and mix
- The hydrolyzed sludge could generate dryer cake thus lowering polymer consumption (3-6%)

# Thermo-Chemical Hydrolysis Post-treatment Lystek

- Exposes dewatered biosolids to heat, high pH conditions (9.5-10) and high sheering to create a high-solids flowable biosolids product (13% to 15% TS)
- Hydrolyzed biosolids is re-fed to digesters for additional VS destruction (10-50%)
- 10 facilities in North America



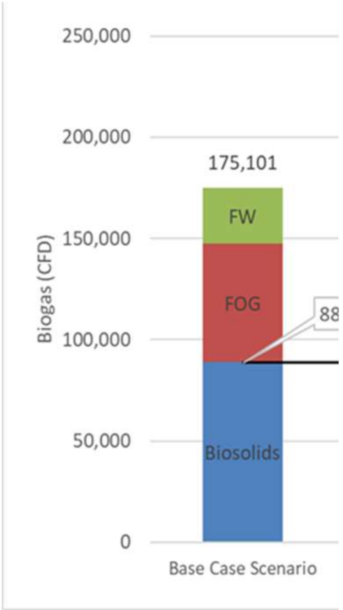

Lystek Re-feed Process for increased digestion capacity and biogas production

- Enhanced Biogas Production
- The solids concentration after Lystek process is 15%.
- Generates liquid Class A product

# Codigestion

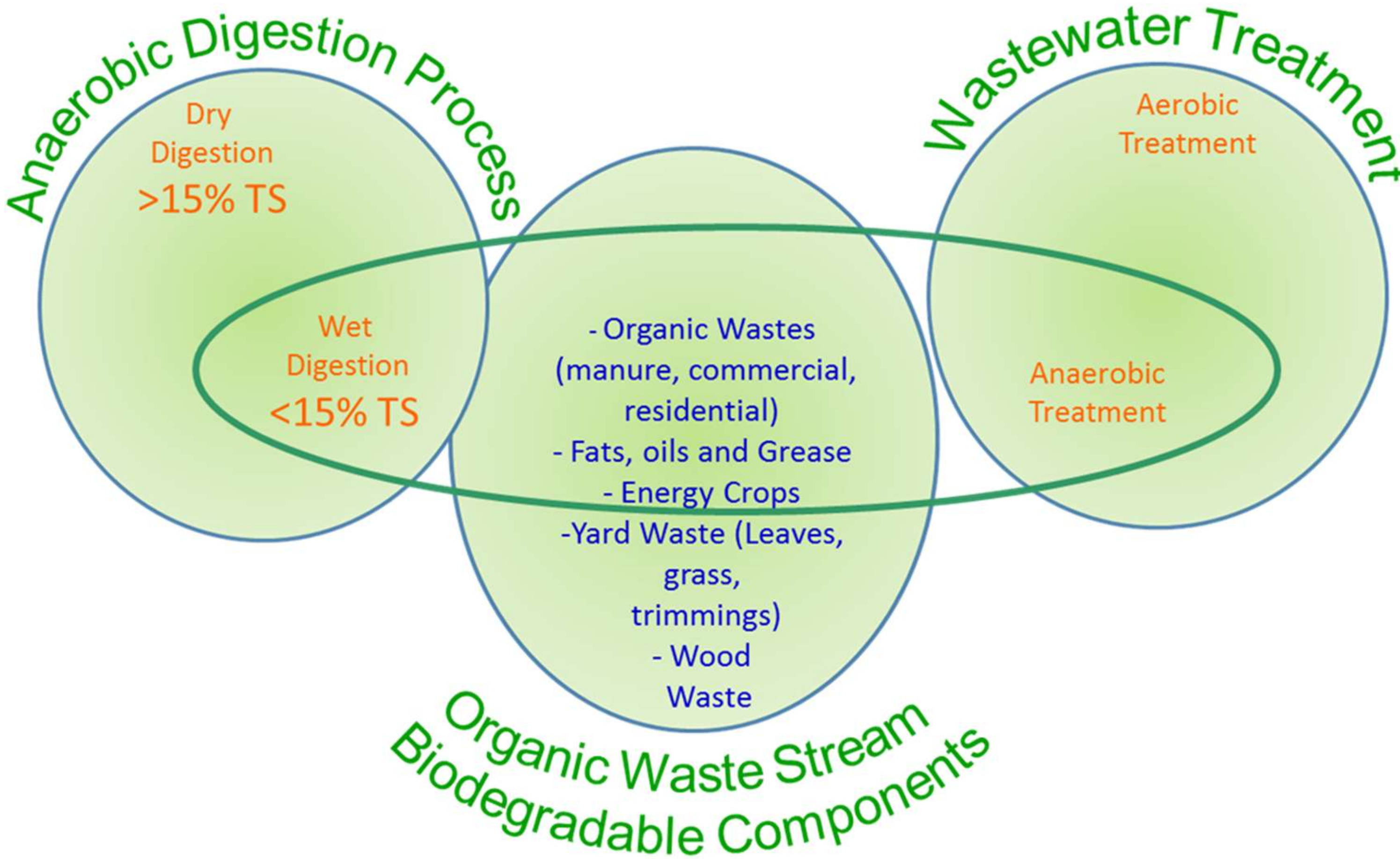
Different sources can be added in Anaerobic Digester to boost energy generation

- Fats, Oils & Grease
- Food Waste
- Source Separated Organics
- Brewery waste
- Whey
- Woody Biomass etc


It is possible to double your biogas generation with small amount of HSW addition

# Combine with Water Resource Recovery Facilities

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## Slide 15

**KD5** just be aware there are not that many anaerobic digestion plants in AZ
Kobrick, Doug, 1/28/2019

# Why Water Resource Recovery Facilities

- Infrastructure already in place
- ~15-30% excess digestion capacity nationwide
- Energy demand on the rise
- Located in populated areas: proximity to waste streams
- Still, need to be economically viable!

# Biogas to Energy

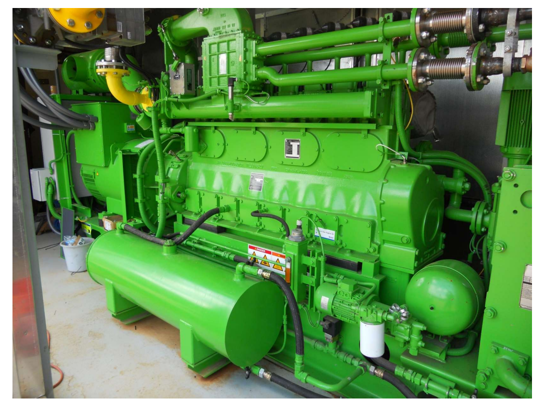
**"Energy Balance Considerations"**

*Sludge Drying*

*RNG Pipeline Injection*


*Vehicle Fuel (CNG)*

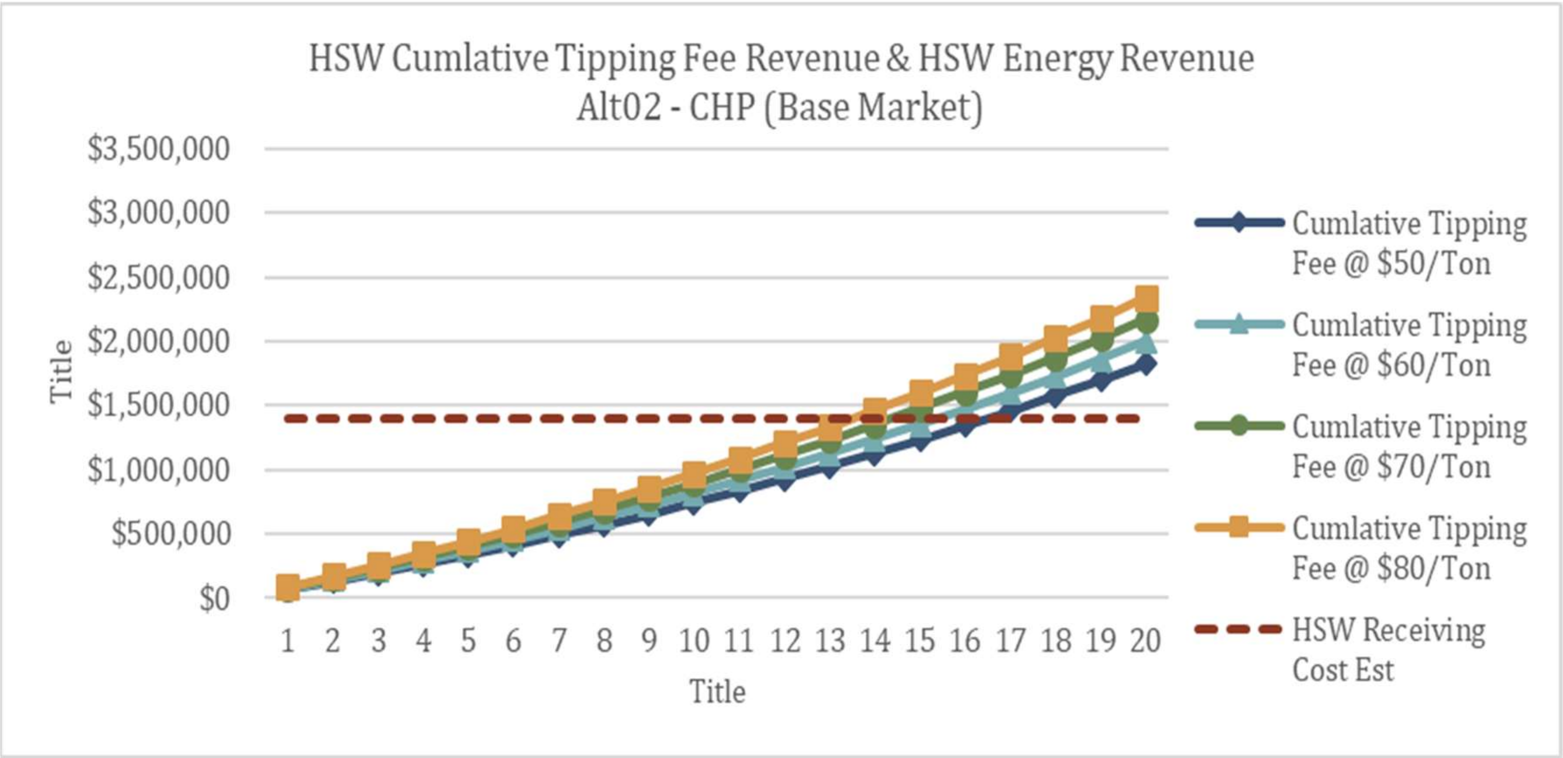
*Thermal Energy*



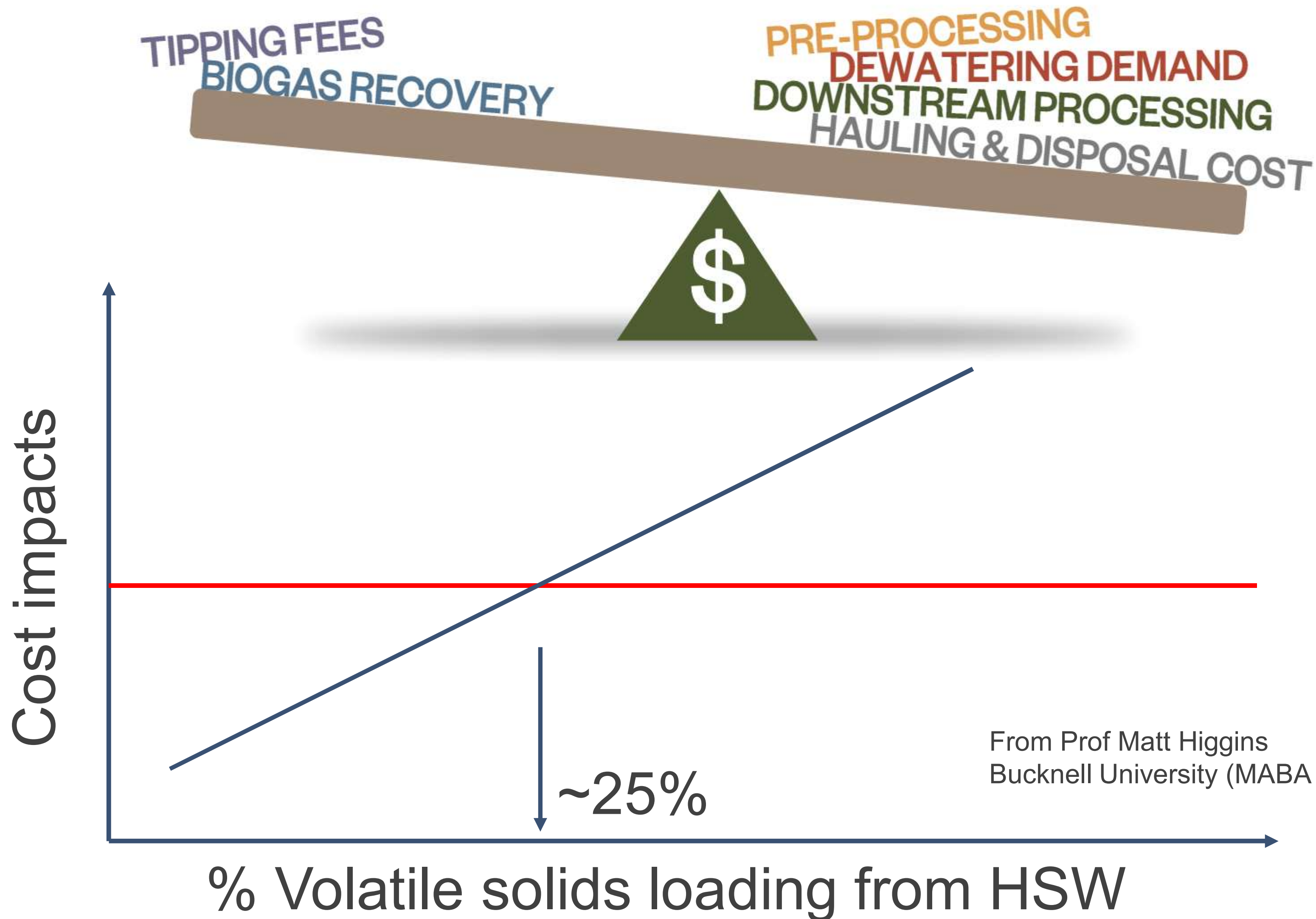
*Electricity Production*

The value of biogas varies for each utilization method

# Cost/Benefit Analysis



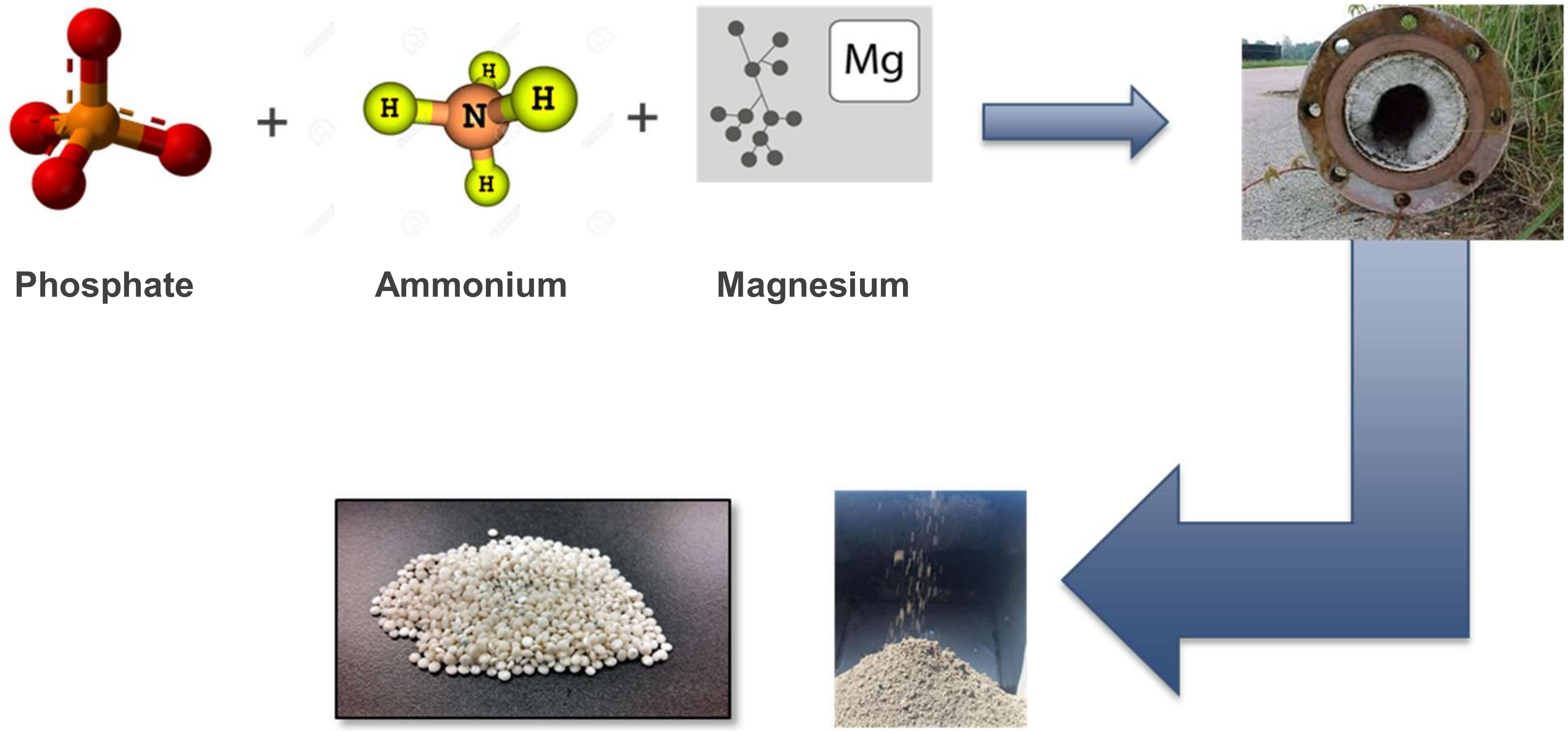
# Economic balance is important to the practice




From Prof Matt Higgins
Bucknell University (MABA 2016)

# Nutrient Recovery

# Struvite: From Nuisance to Resource Recovery




$NH_4$ & $PO_4$ released in digestion, typically Mg limited

Mg addition for odor control (i.e. $Mg(OH)_2$) can promote struvite formation

# Struvite Removal can be costly

NYC Newtown creek –
$270,000 to clean digester transfer lines

NYC Newtown Creek WPCP

Miami Dade SDWRF


# Example Technologies to Recover Struvite

Recovery can be practiced from:

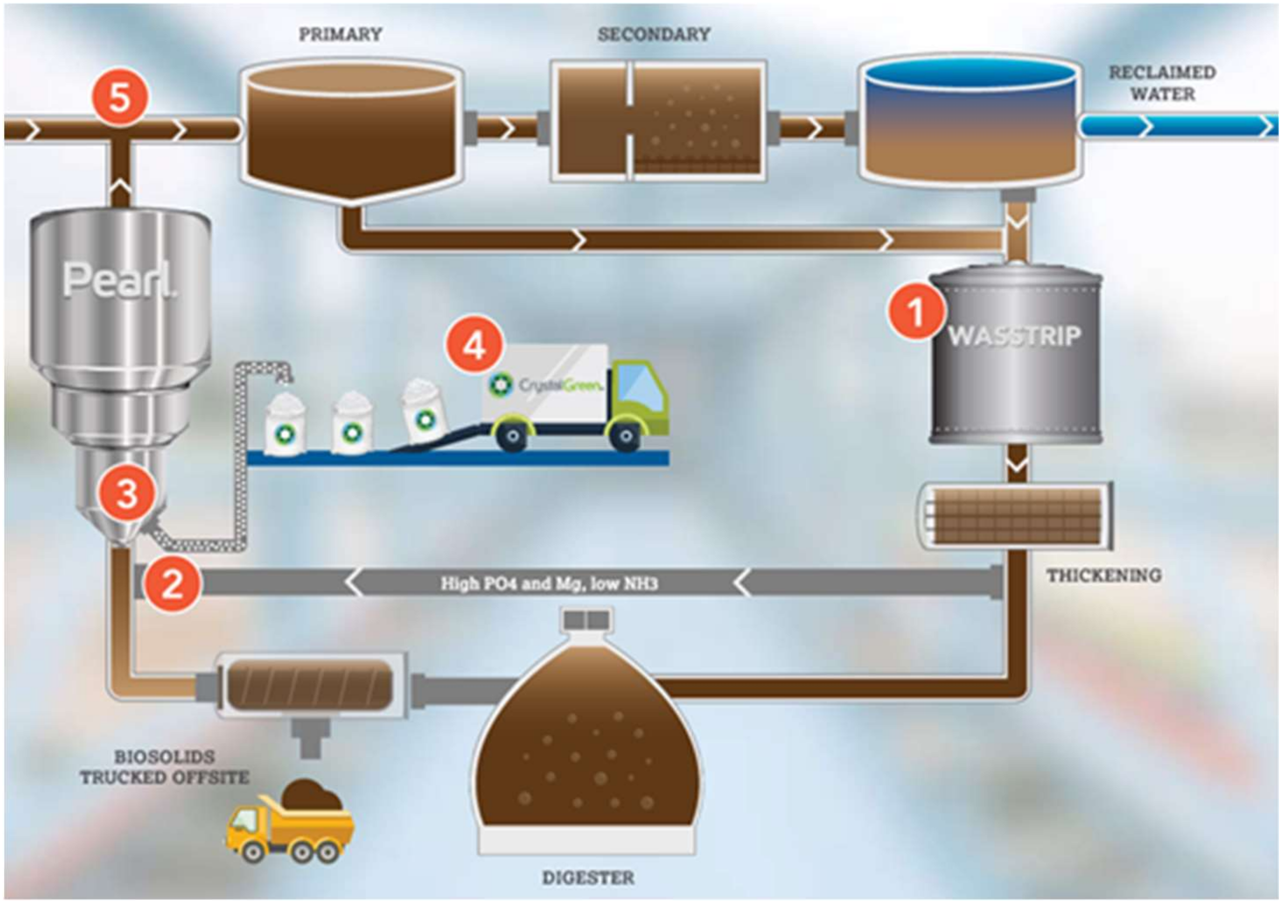
- Digested biosolids: positive impact on dewatering
- Centrate/filtrate


Pearl®

AirPrex®

Multiform™

# Recovering Phosphorus and Nitrogen as high value fertilizer



# Organics Recovery

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# Biosolids Recovery driven by Regulations

Biosolids offset need for fertilizers

Fate and value dictated by suitability for land application

- Value as land amendment

Federal and state regulations regarding biosolids characteristics

| **Regulated Parameters** | **Non-regulated Parameters** |
|---|---|
| Pathogen reduction | Moisture |
| Vector attraction reduction | Odor |
| Trace elements | Trace organic compounds |
| | Nutrients |

# Biosolids Market

Land application is STILL the most common market

Triggers

- Revenue potential
- Ease of operation
- Movement towards energy neutrality
- Land application regulations

Nutrient limits associated with land application will impact decision to implement nutrient recovery

# Increasing the Value of Biosolids Products

Increasing value as land application amendment

Unclassified | Class B | Class A | EQ

Classification dependent on quality and ability to meet regulations

Shift to Class A/EQ biosolids will create additional possibilities for biosolids management

Higher quality biosolids potentially have higher demand and value

- Land application
- Third party soil blending
- Thermal fuel

# Revenue Potential and Ease of Operation

Biosolids market value

- Product characteristics
- Public perception/ acceptance in the specific region

WRRF

WRRF pays contractor for disposal

Third party contractor

**Class B**

- Contractor provides biosolids to farmers for little to no cost

**Class A/EQ**

- Contractor provides biosolids to farmers for fee

**Class A/EQ**

- Contractor contracts with blender for fee

# Specialty Products

*Courtesy of Materials Matters*

Soil amendment products with demand

Targeted characteristics

- Stable
- No odors
- Accommodates handling
- Consistent appearance
- Nutrients content

# QUESTIONS

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# *Water, Nutrient, Energy Recovery Case Study*

# F. Wayne Hill WRC, Gwinnett County, Georgia – Resource Recovery

Gwinnett County, GA

60 mgd advanced WWTP

0.08 mg/L TP effluent limit

- ✓ IPR,
- ✓ Nutrient Recovery,
- ✓ Energy Recovery (CHP/FOG/HSW)

# Treated Effluent Discharged to Lake Lanier - Indirect Potable Reuse

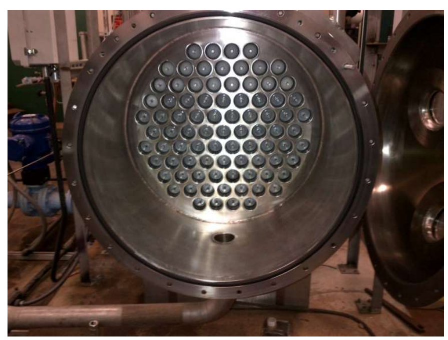
BNR Activated Sludge

Tertiary Clarification

Tertiary UF membrane filtration

$O_3$/BAC/$O_3$

Lake Lanier

# Digester Gas-to-Energy System
# 2.1 MW Engine FOG/HSW Receiving Station

Average Power Cost:

| Facility | Cost |
|---|---|
| F.Wayne Hill | $0.036/kWh |
| Yellow River | $0.071/kWh |
| Crooked Creek | $0.069/kWh |

60,881,169 kWhr : Total Power Consumed

9,165,440 kWhr : Self Generated Produced

**$2,300,000** Savings in in Purchased Power with Real Time Power Structure and Engine Generator

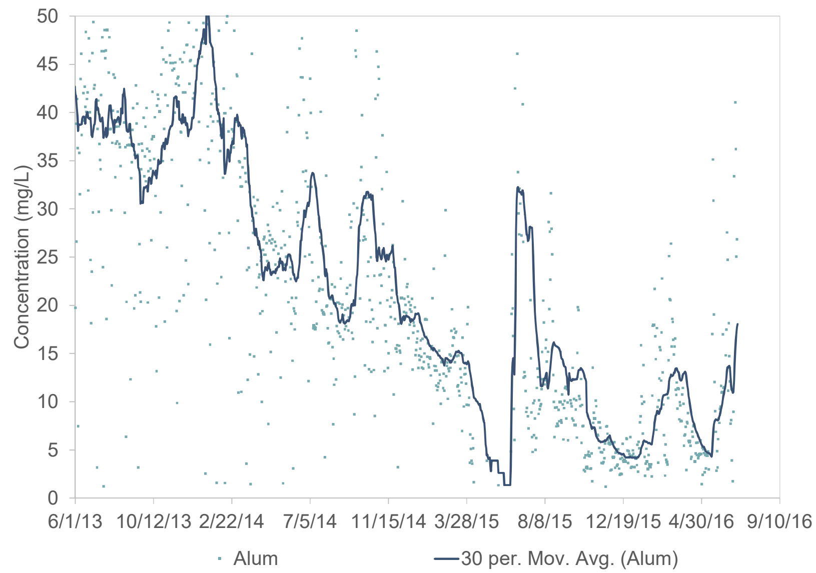
# Nutrient Recovery Facility – WASSTRIP + Recovery


*52,000 lbs/month recovered*

# Nutrient Recovery Equipment and Product


# FWH Nutrient Recovery

- ✓ Eliminated nuisance struvite issues
- ✓ Significant reduction in alum use for P limit
- ✓ Benefit to dewatering




| Year | Avg Dewatering Polymer Dose Rate (lb/DT) |
|---|---|
| **2013** | 51 |
| **2014** | 44 |
| **2015** | **32** |
| **2016** | **28** |

| Year | Avg Dewatering Cake Solids %TS Concentration (%TS) |
|---|---|
| **2013** | 21.8 |
| **2014** | 22.2 |
| **2015** | **23.4** |
| **2016** | **23.9** |

KD4

# Codigestion – Driven by Regulations
# California Regulations

- AB341 (2011): Increase solid waste diversion to 75% by 2020
- AB1594 (2014): Removes incentive for green waste to be used as ADC
- SB1383 (2016): Regulation to be developed by 2018 targeting short-lived climate pollutants by 2030:
  - Divert 50% of organic waste from landfills by 2020
  - Divert 75% of organic waste from landfills by 2025
  - Achieve 40% reduction of methane emissions by 2020

CalRecycle

**Slide 39**

**KD4** cut this slide, not interested in Calif regs
Kobrick, Doug, 1/28/2019