# WASTEWATER IN-PLANT TRAINING

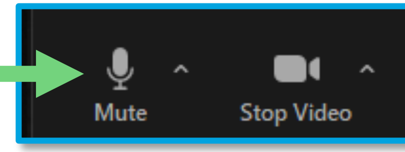
## SESSION 7 – SOLID STREAM

# Using Zoom!

**Mute yourself!**

Have a question?
Use the chat feature.

*Controls accessed at the bottom*



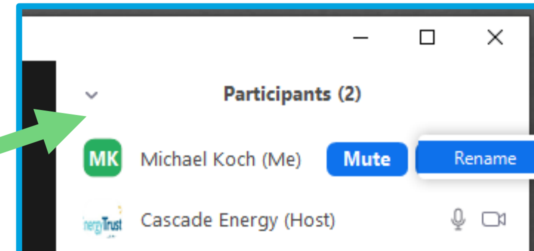

**Rename yourself**

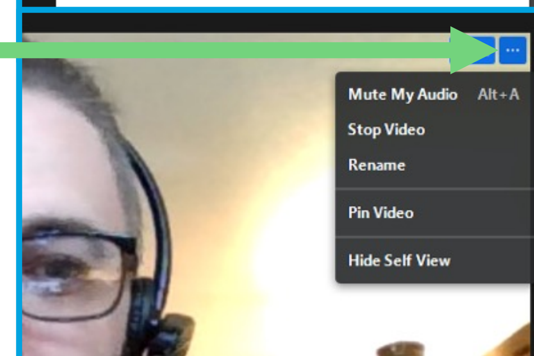
"Name (Company)"

*Right click on your picture or 3 dots*

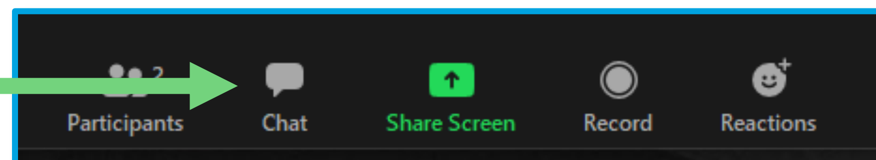
*OR*

*Controls accessed at the right after clicking 'Participants' at bottom.*




**Access Chat at the bottom**



# Recording

**This meeting is being recorded (both audio and video)**

*If you do not consent to being recorded, please let the meeting moderator know ASAP and we will facilitate your participation in another way or adjust our procedure.*

# Thank You!

## Sponsor

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# Today's Agenda

| | |
|---|---|
| Welcome and Introductions | Dissolved Air Flotation |
| Opportunity Register Check-in | Compressed Air |
| Solid Stream Opportunities | Closing Remarks |

## SLIDE 6

### Which of the following best describes your use of an anerobic digester for use as a co-generation fuel?

- **We already are!!**
- **We are planning to**
- **We are too small of a plant**
- **We are not**

### Do you have a Green House Gas (GHG) Policy at your plant

- **Yes**
- **No**

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# OPPORTUNITIES?

## Report Outs

## Energy Projects

| Energy Project | | Step 1 | Identify | | | | Step 2 | Prioritize | | | | | Step 3 | Implement | | | | | St |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Opportunity # | Opportunity Name | | Description | Location | System* | Submitted By | | Energy Impact | Energy Savings | Type of Energy Saved* | Cost/Effort Required | Decision | | Next Step | Assigned To | Target Due Date | Completed Date* | Status* | |
| 1 | Reduce Mixer Run time | | Mixers in the aeration basin operate 24 x 7 and this measure will reduce the operating time by 15% | AB | Aeration | RJG | | Quick wins | 20,000 kWh | Electric | Low | Do it now | | Adjust SCADA controls | Wei | 6/30/2022 | | | |
| 2 | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | |

# For Next Week's Session:

- Find 5 opportunities and fill out your Opportunity Register.

- Be prepared to report out on 1 or 2 of your opportunities.

- Use the PP template that is sent to you, to describe 1 of your opportunities.
    - **MAKE THIS SIMPLE. PROJECT DESCRIPTION & SAVINGS,**

# Opportunity Energy Calculation

- A plant is looking for ways to reduce energy consumption in their W3 plant water system. They currently operate their plant water at 90 psig and have estimated that the average flow is 625 gpm.

- If the plant water system consists of 3- 75 hp pumps with 93% efficient motors, has an average flow of 625 gpm, and the pump efficiency is 68%, what are some opportunities that can be entered into their Opportunity Register?

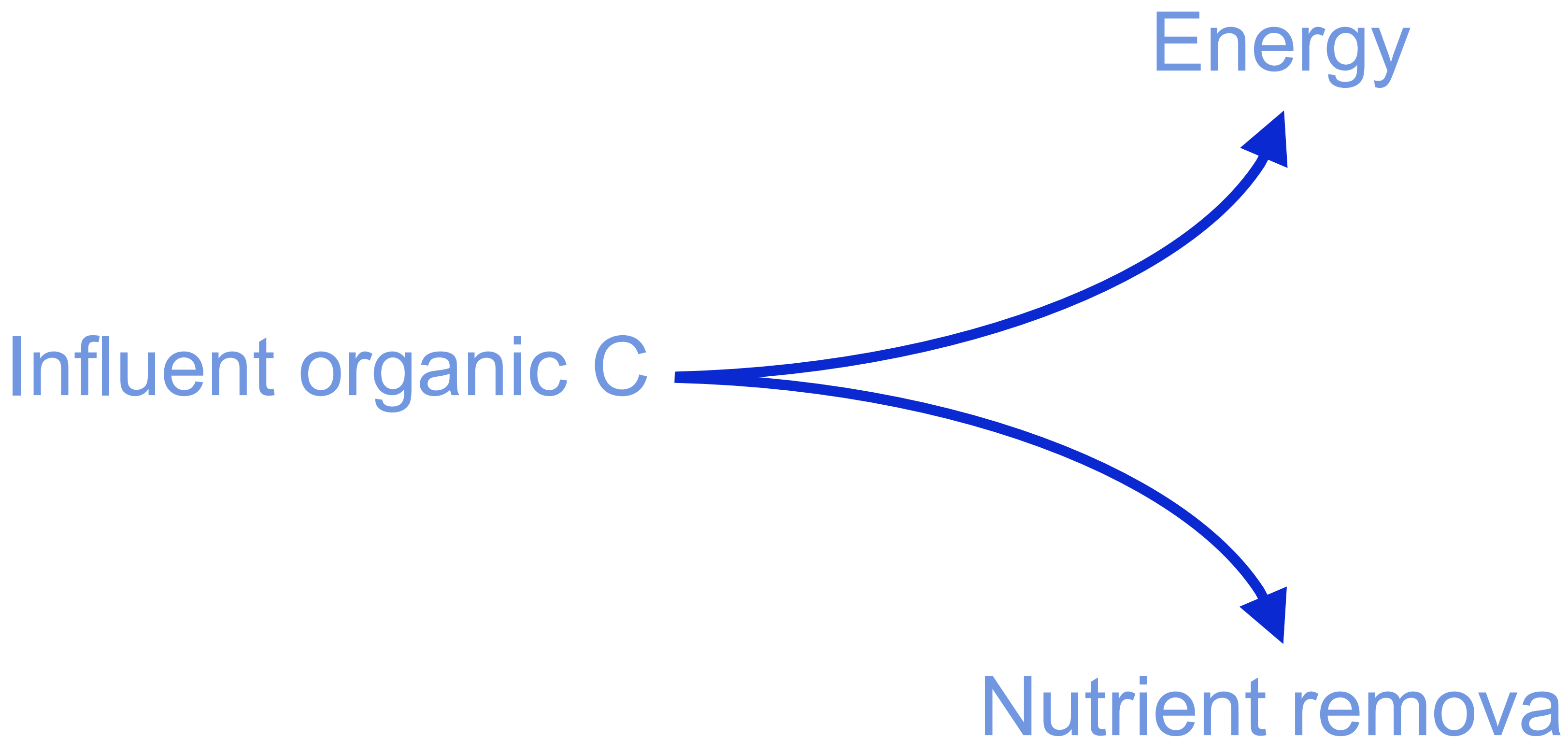
- Where to start?............Well, what do we know?

- Baseline

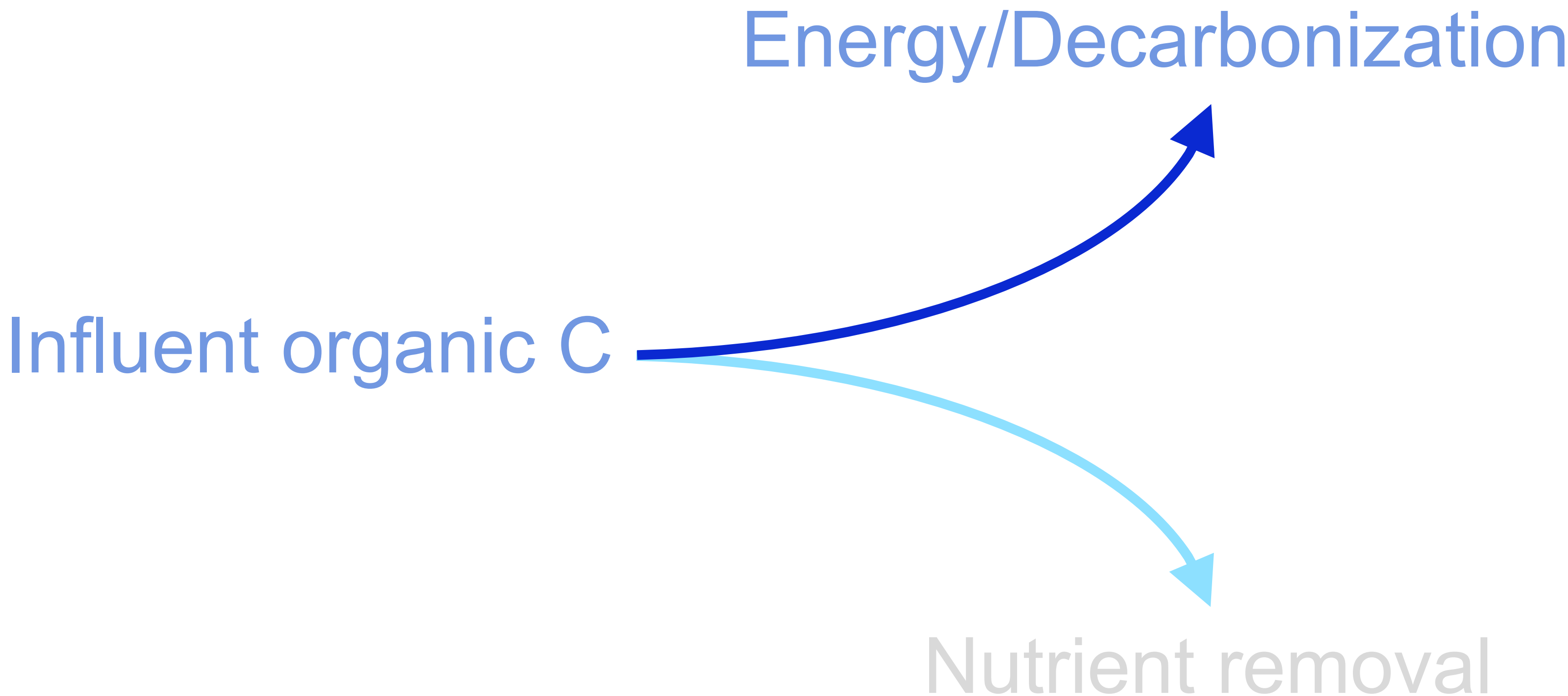
What else can be done?

# We Operate Multi-Billion, Multi-Million Dollar Facilities With Someone Else's Money

# The wastewater treatment industry is at a crossroads

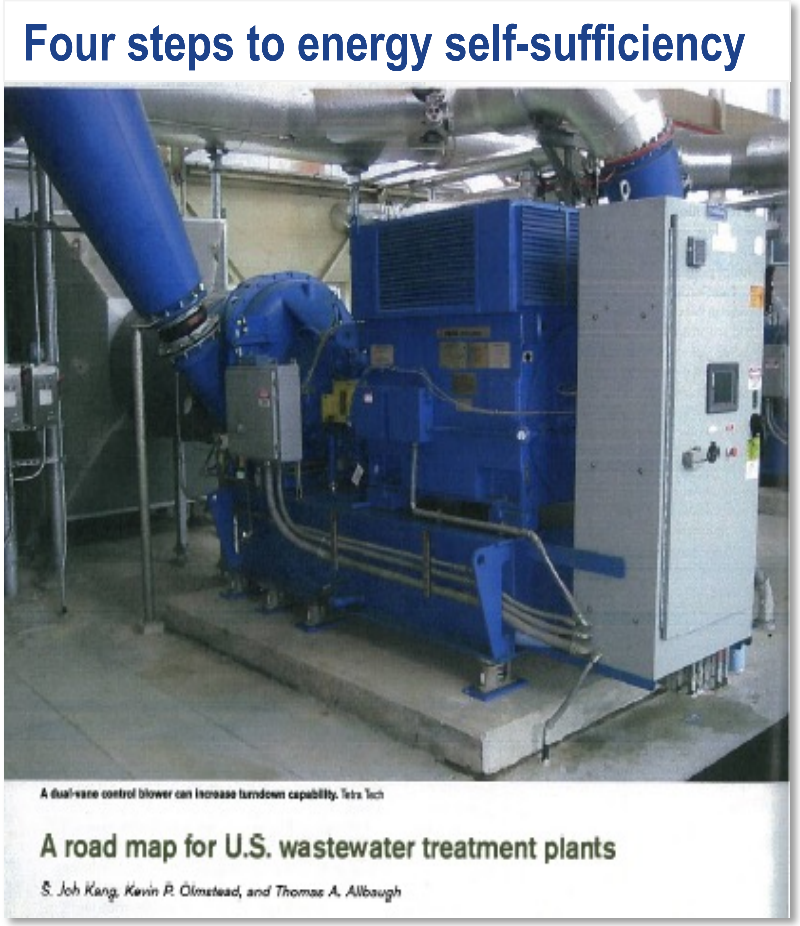


# Here we focus on using the influent $C_{org}$ for energy generation *via* methane production



# Four Steps to Energy Self-sufficiency

1. Commitment to saving energy throughout organization
2. Energy generation
3. Process energy conservation
4. Assess and refine


Four steps to energy self-sufficiency

A dual-vane control blower can increase turndown capability. Tetra Tech

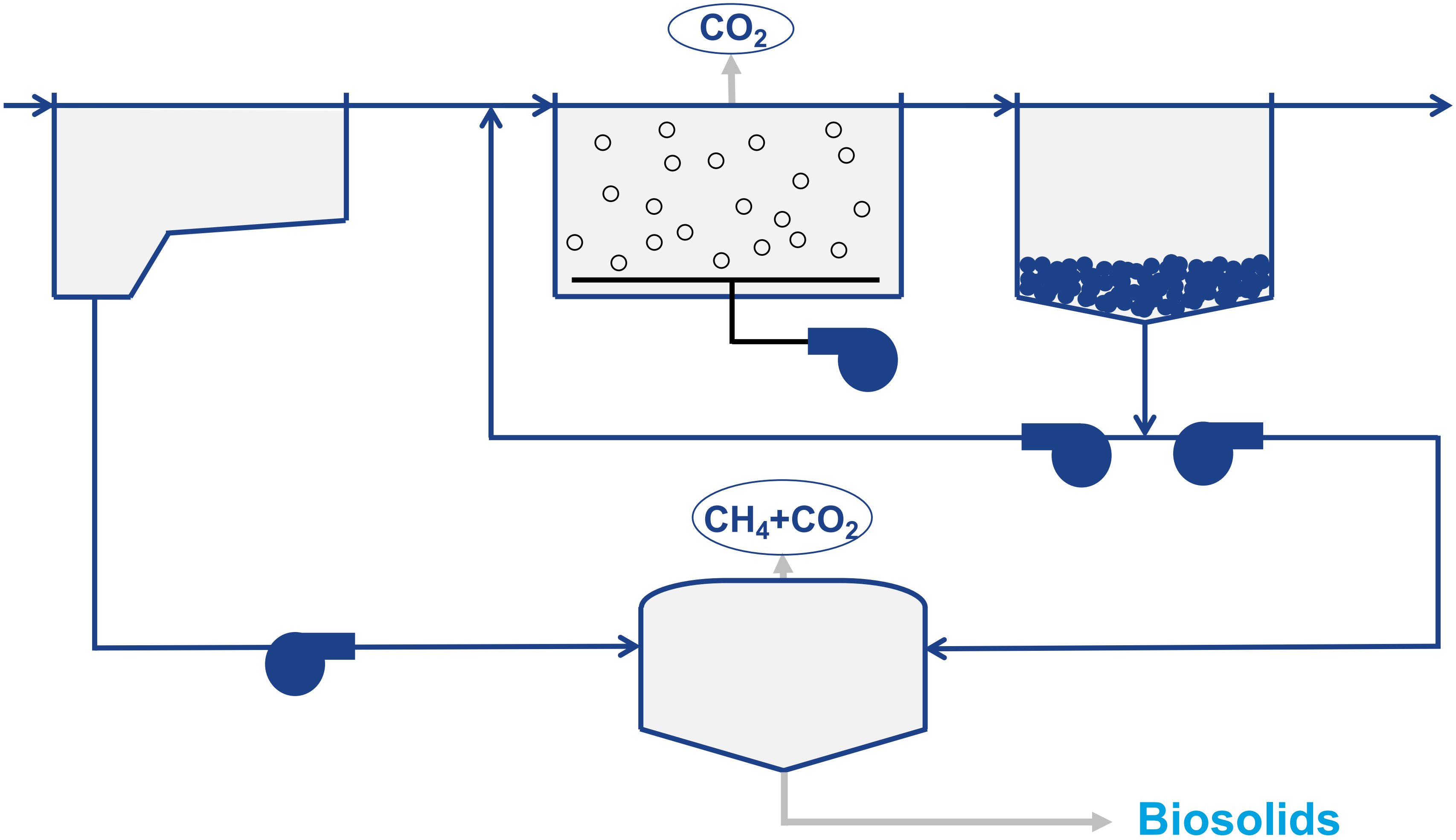
A road map for U.S. wastewater treatment plants

S. Joh Kang, Kevin P. Olmstead, and Thomas A. Allbaugh

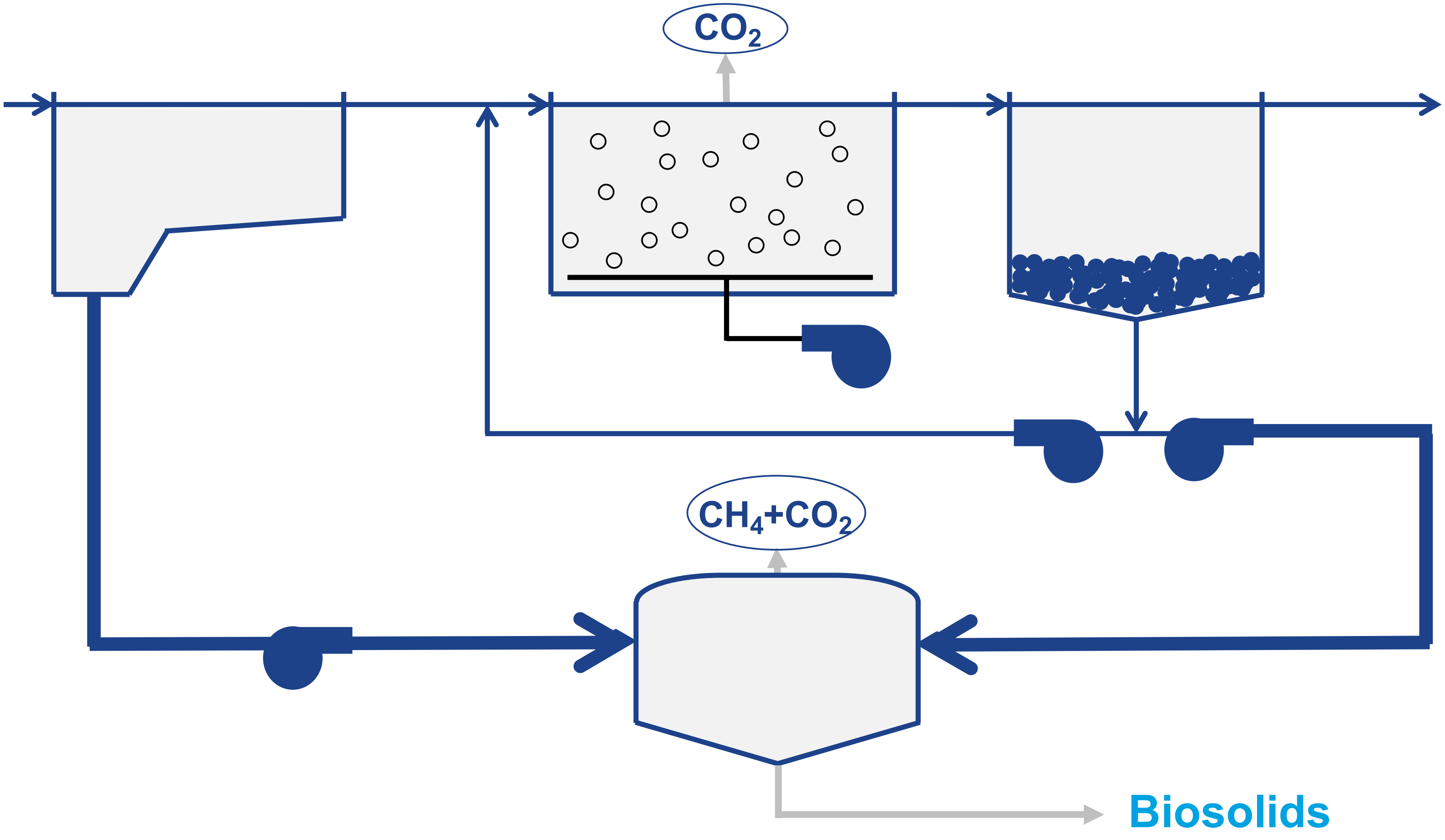
# Can't Generate Energy Without Using the Gas Produced by Anaerobic Digestion

1. Commitment to saving energy throughout organization
2. **Energy generation**
3. Process energy conservation
4. Assess and refine

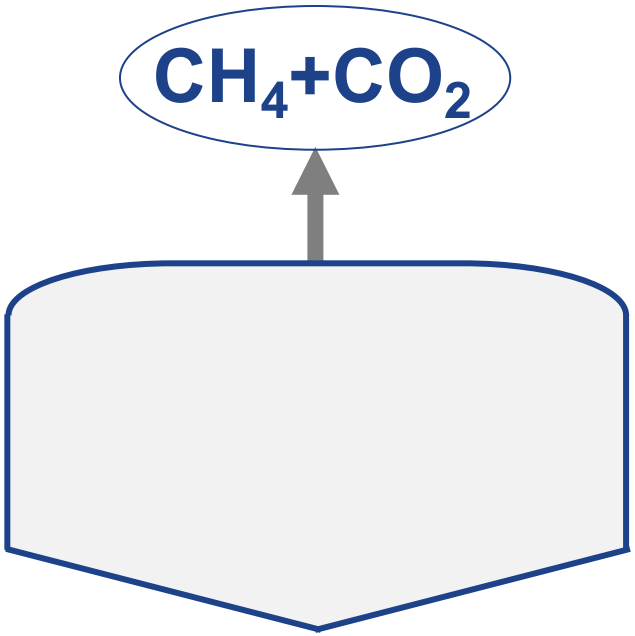
# To Increase Gas Production, There are Essentially Three Options



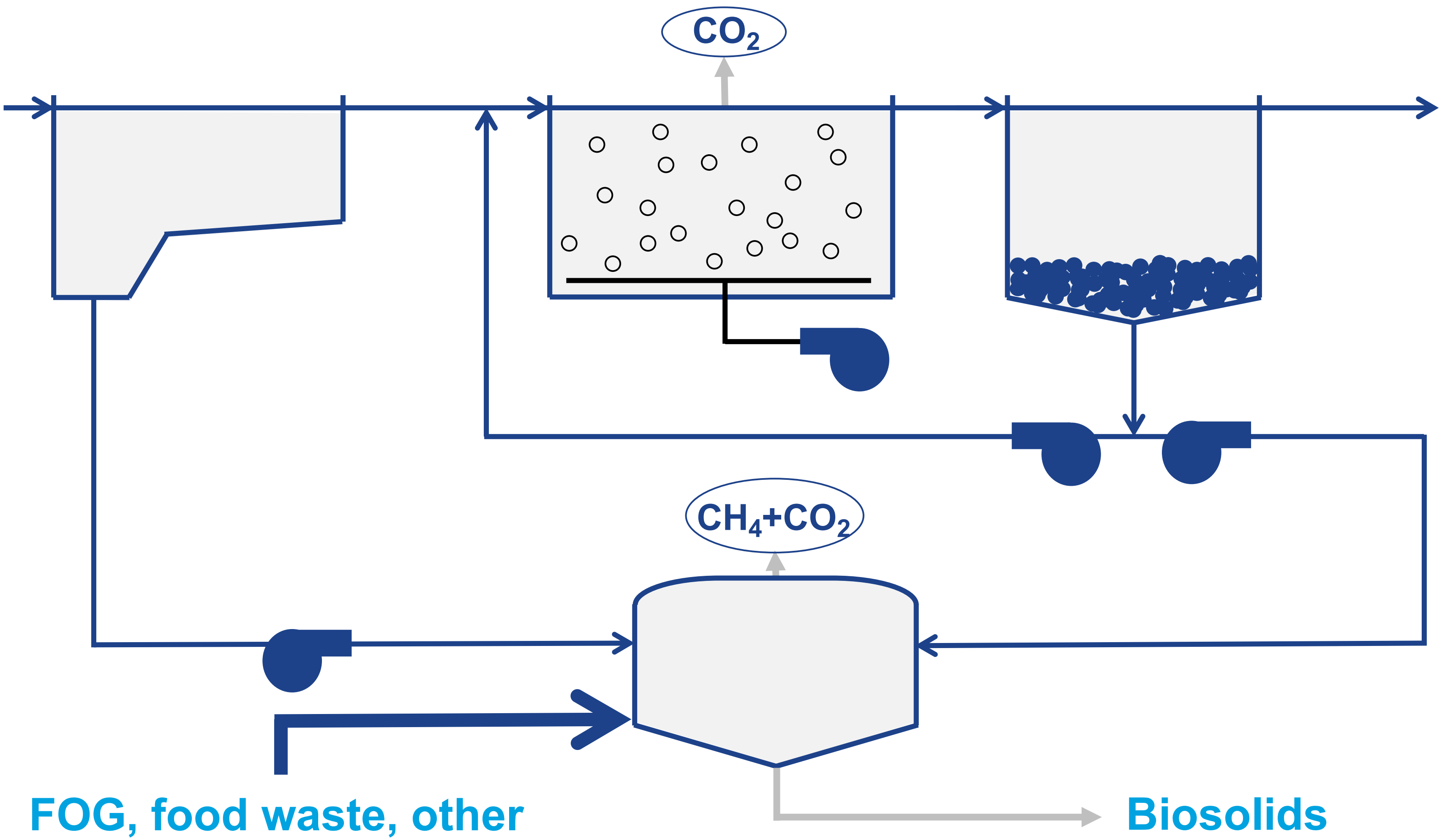
# 1. Increase VS Load From Within the Plant



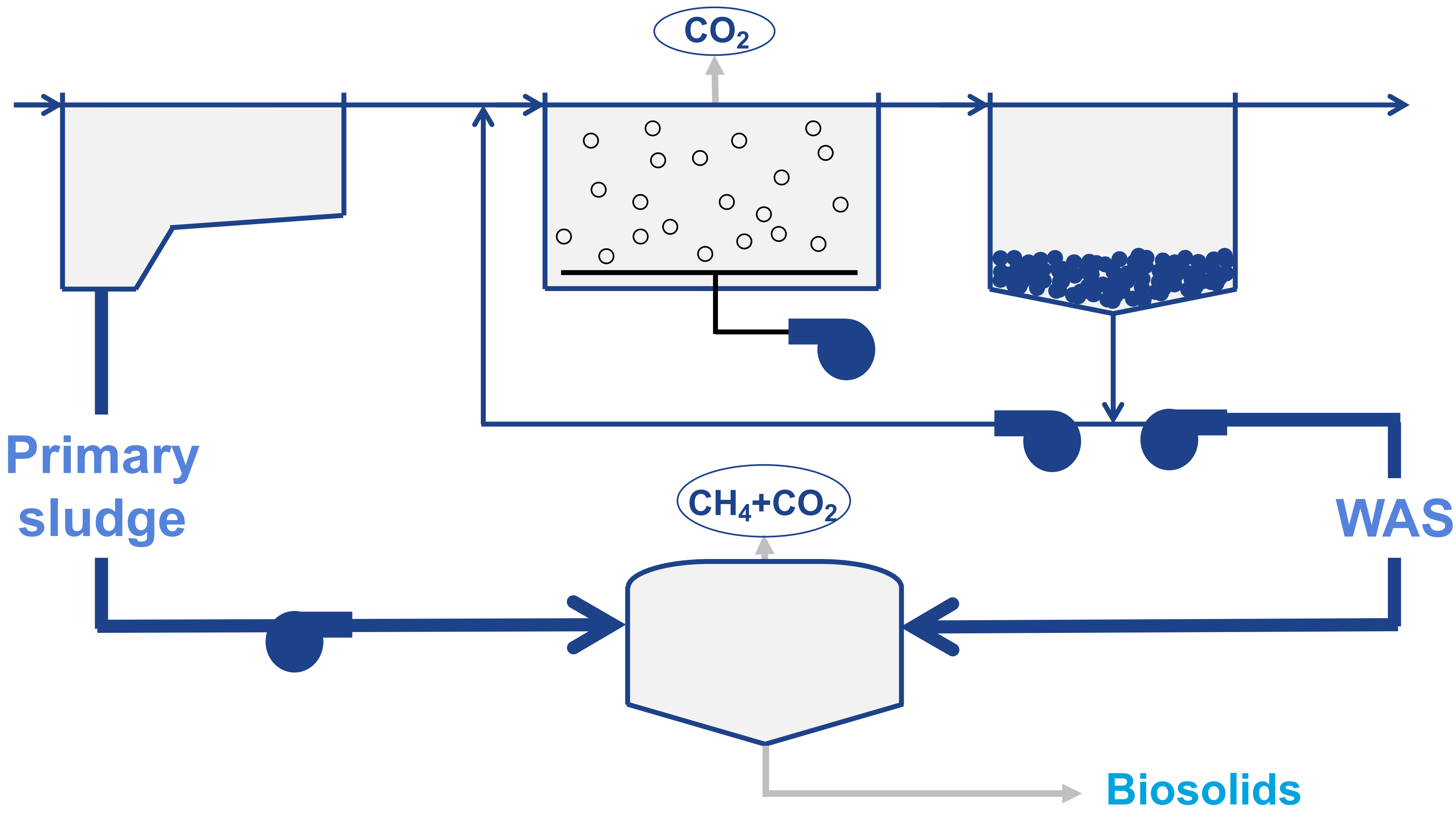
# 2. Optimize Digester Performance



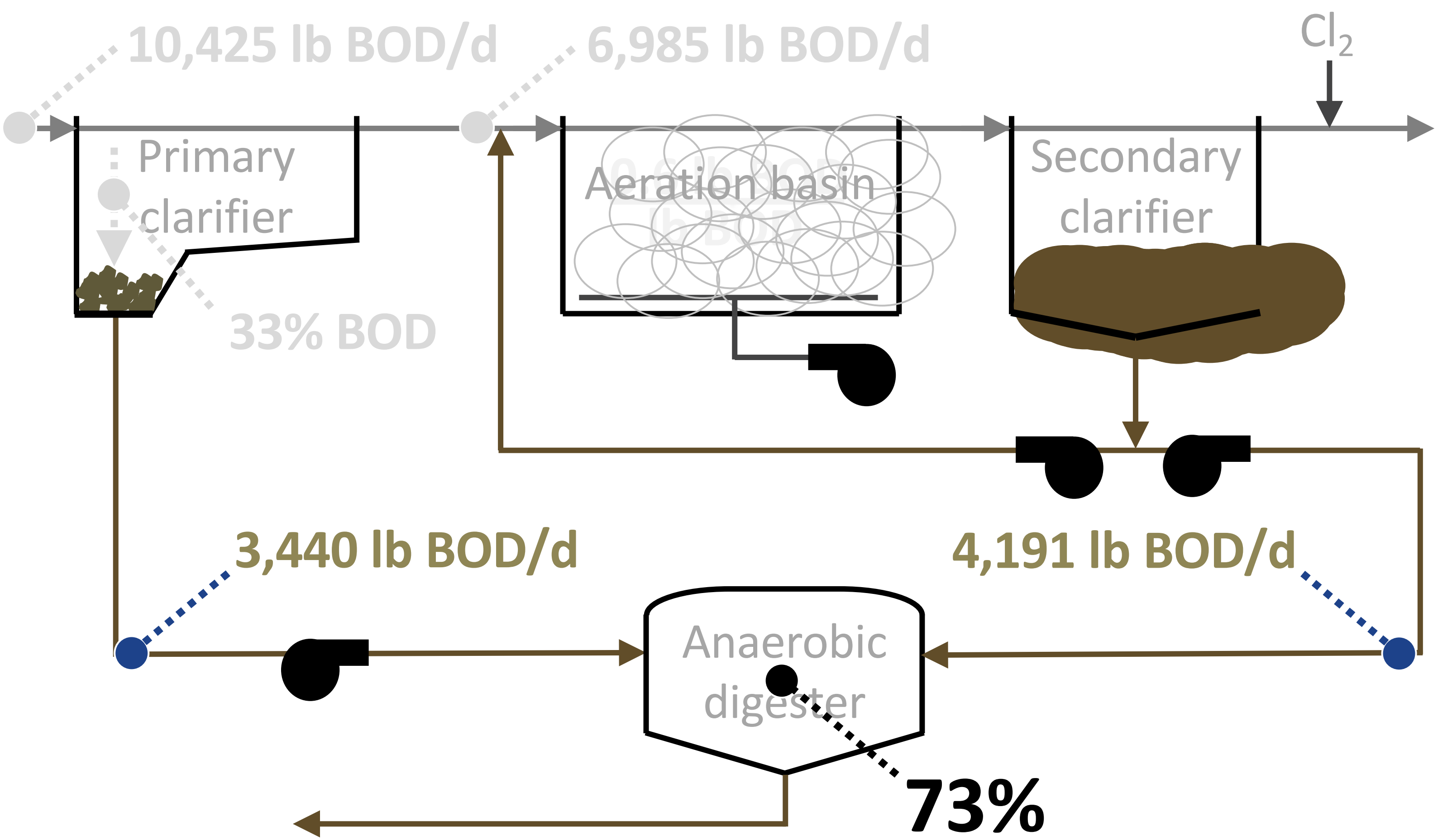
# 3. Add External Carbon Source



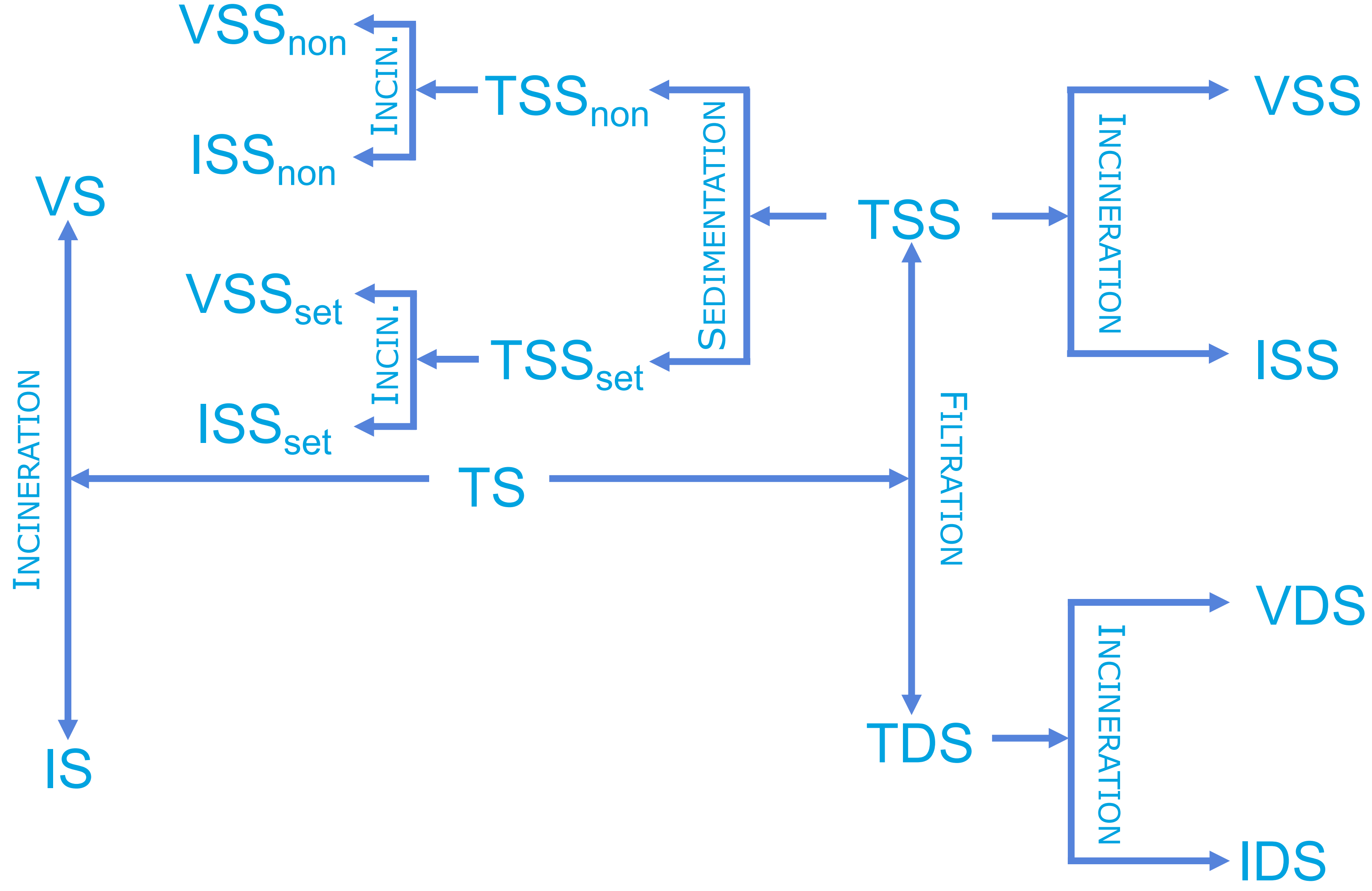
# Two VS Inputs to Anaerobic Digester

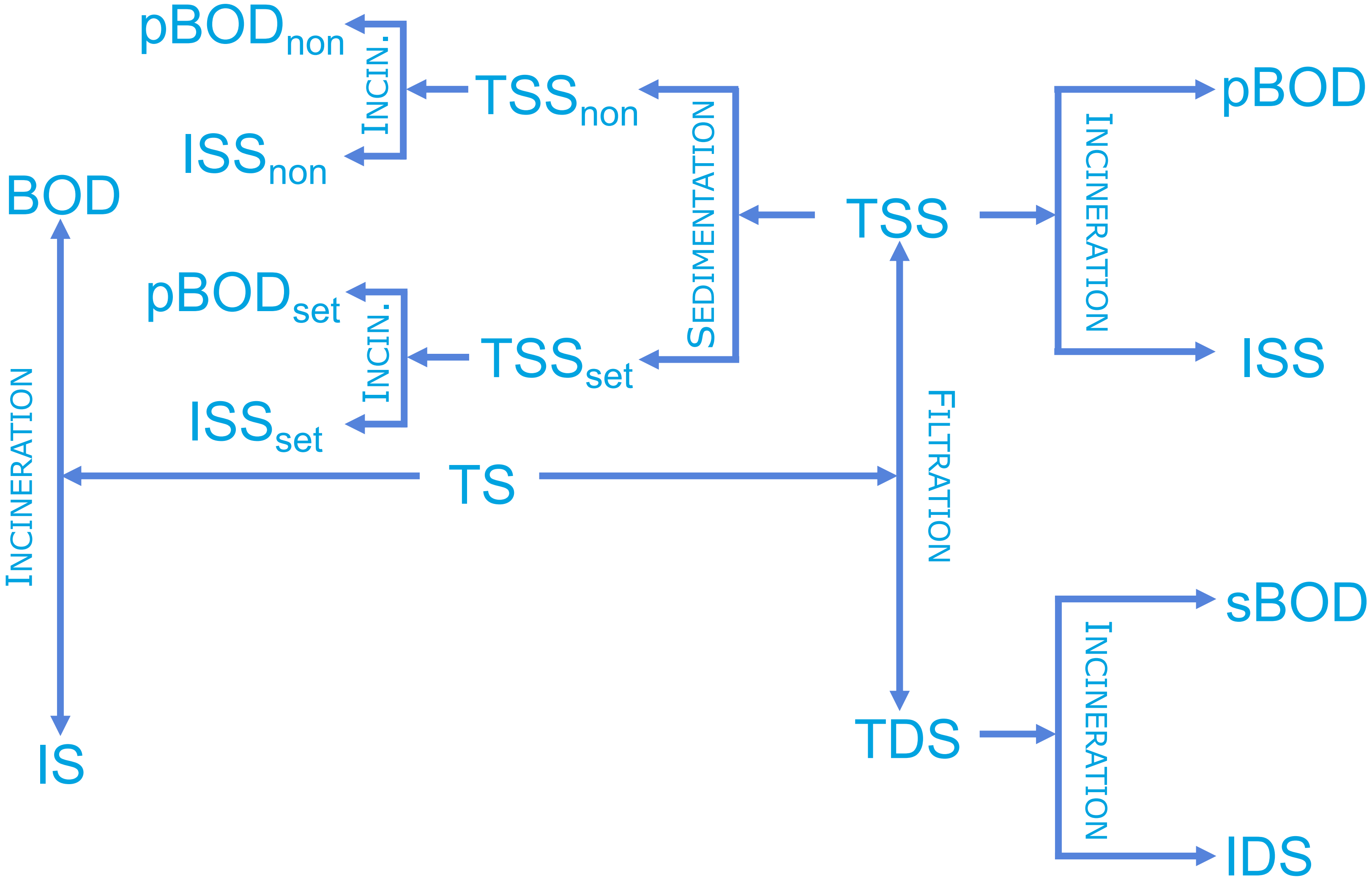


# All BOD is not Created Equal



# Where's the BOD?




$pBOD_{non}$
INCIN.
$ISS_{non}$
$TSS_{non}$
SEDIMENTATION
$pBOD_{set}$
INCIN.
$ISS_{set}$
$TSS_{set}$
TSS
INCINERATION
pBOD
ISS
BOD
INCINERATION
TS
IS
FILTRATION
TDS
INCINERATION
sBOD
IDS

# Two guiding principles (not all VS are created equally)

1. VS in primary sludge are **<u>significantly</u> <u>easier</u>** to digest than VS in WAS

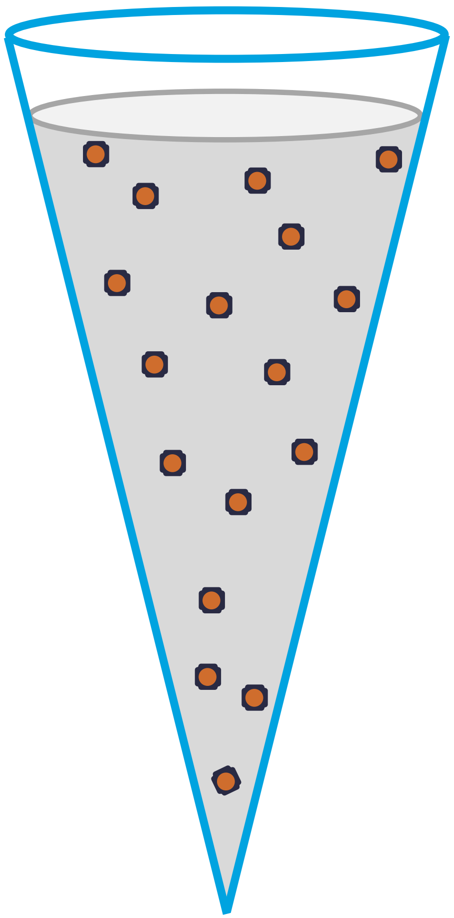
2. VS in WAS become **<u>more difficult</u>** to digest and there's **<u>less of them</u>** with increasing SRT

# Two guiding principles translated

1. Capture as much as possible in primary clarifiers

2. Operate activated sludge systems at lowest SRT possible

# A Very Simple KPI—Capture as Much as Possible in Primary Clarifiers, Maybe CEPT

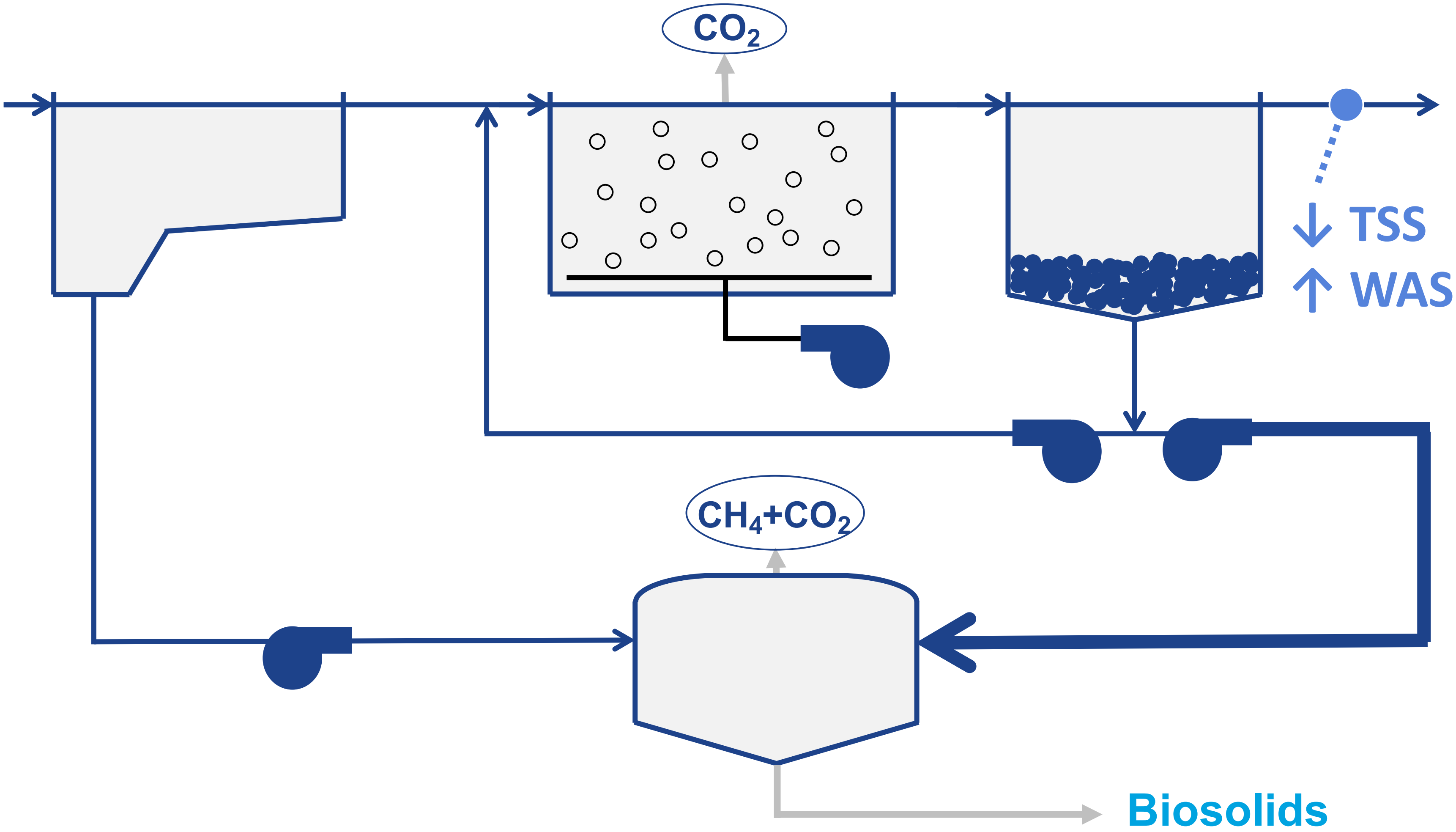


***NO** TSS$_{set}$ in primary clarifier effluents*

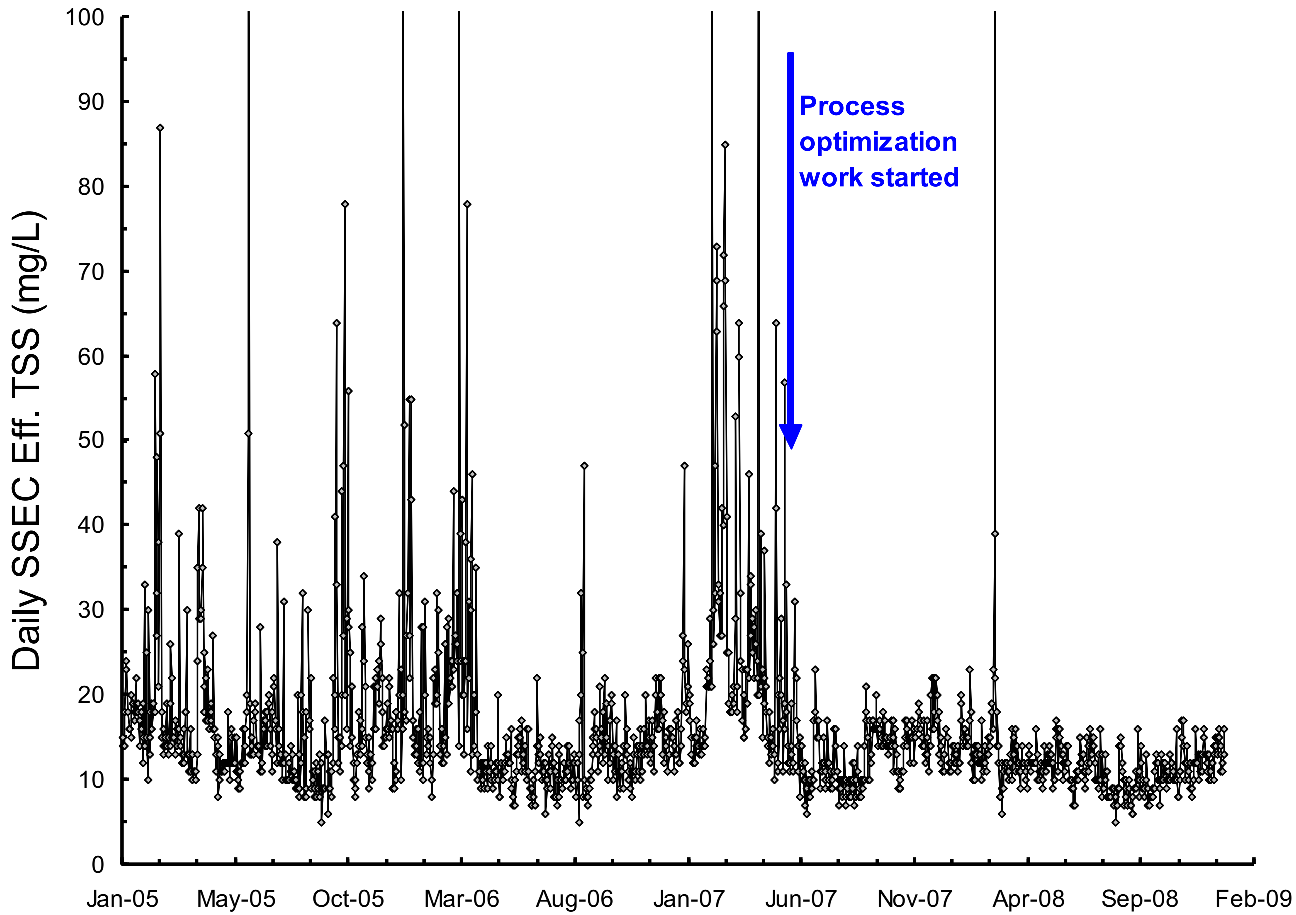
# Three Considerations Setting $SRT_{TARGET}$

1. **Effluent ammonia requirement**
2. **Best sludge quality**
3. **Minimum $SRT_{TARGET}$ that will satisfy 1 and 2**

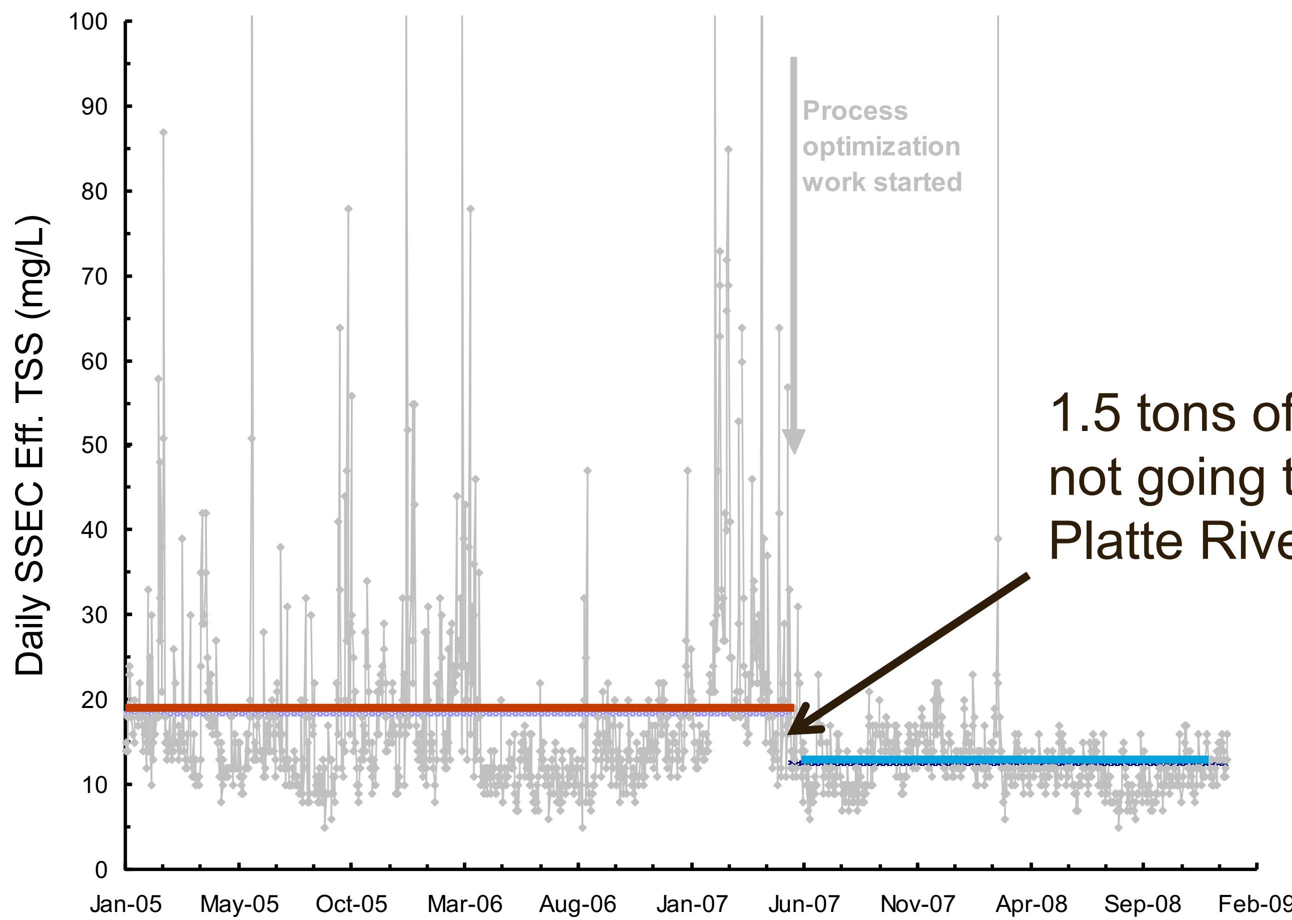
# Minimum TSS (and VSS) Loss to Effluent With Best Sludge Quality



# Optimize Secondary Treatment
# (SRT control, minimum $SRT_{TARGET}$, $Q_{RAS}$ control)

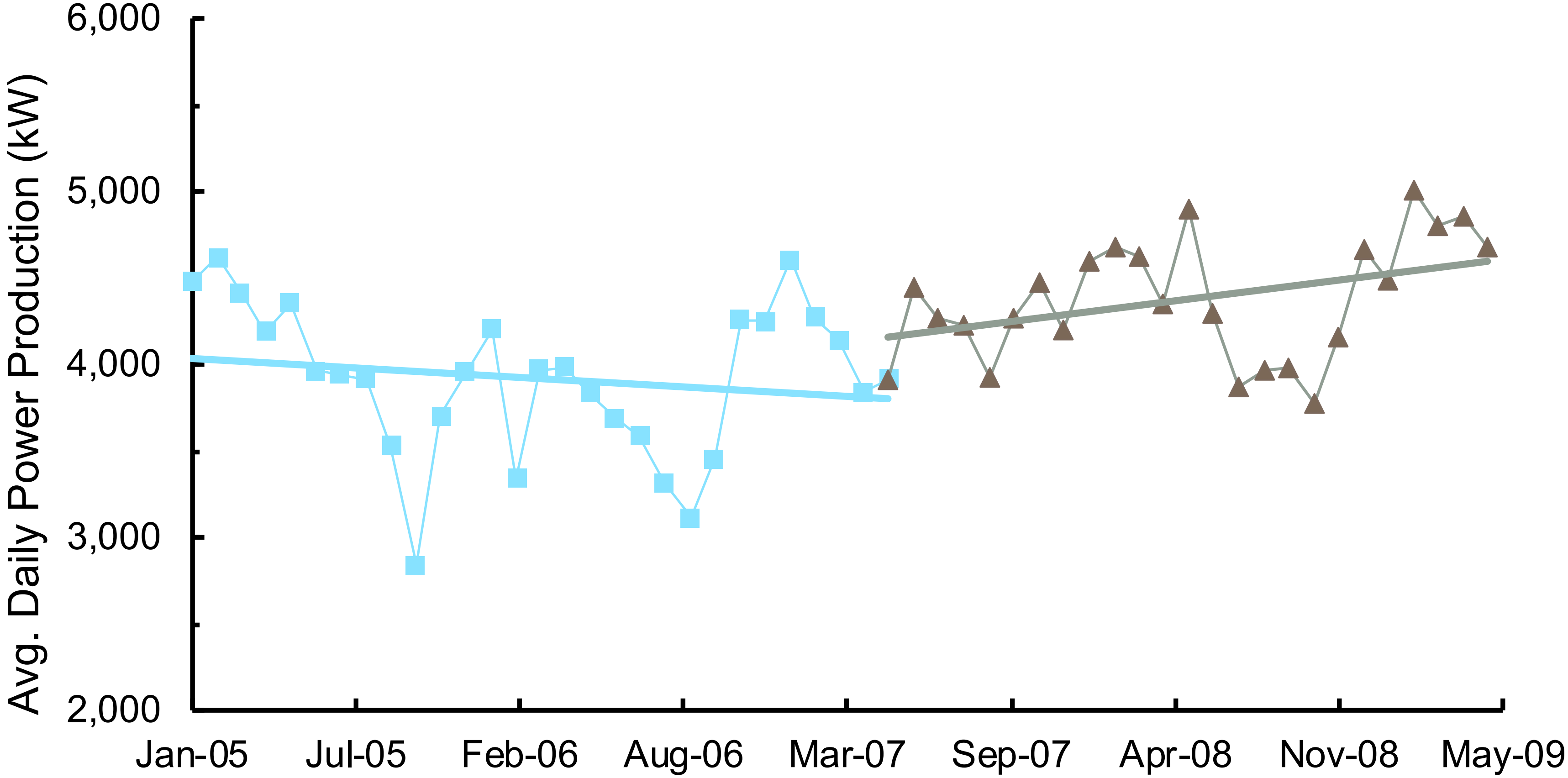


# If Not to the River, Where Are These Solids Going?

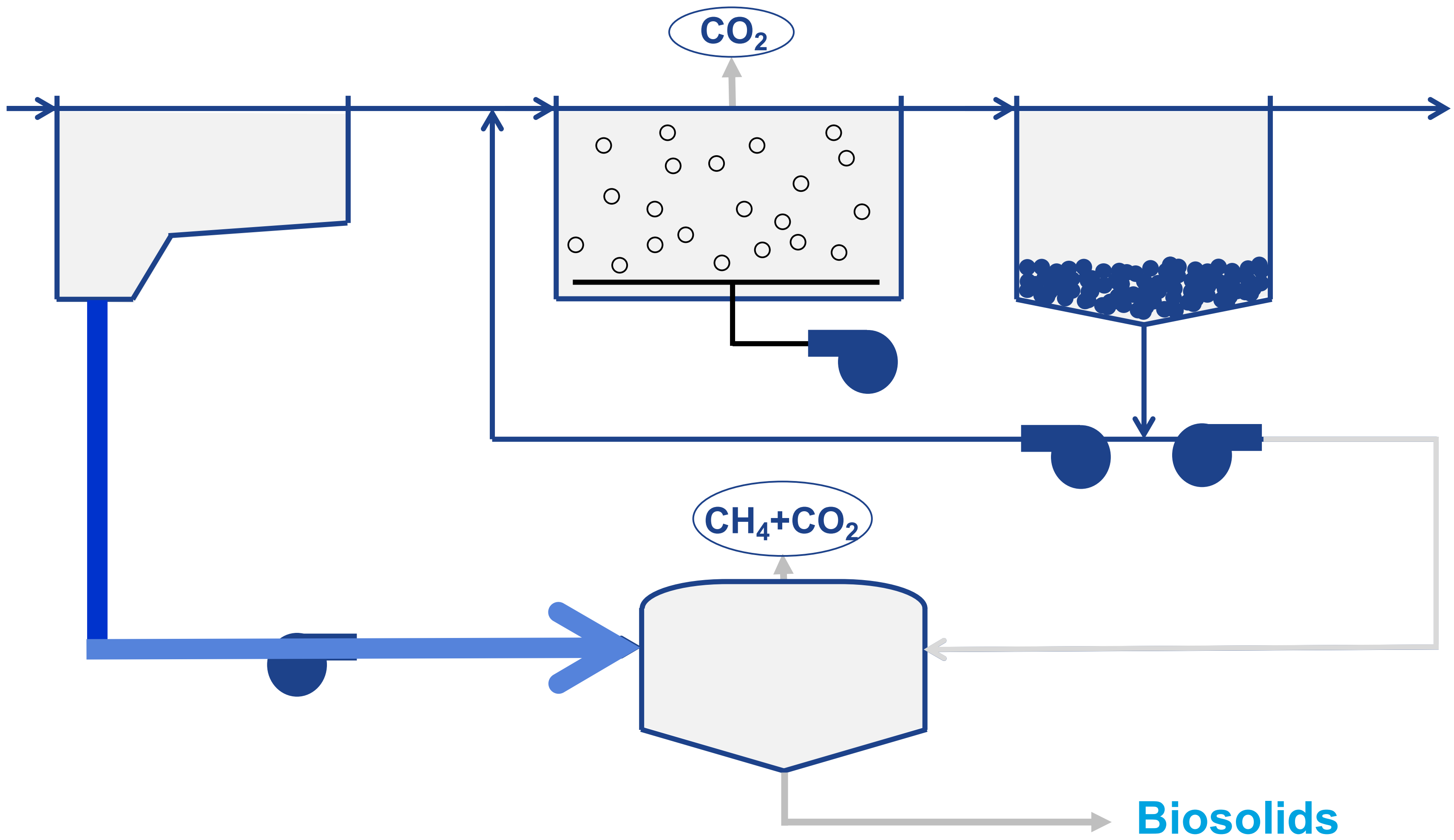



1.5 tons of solids/day not going to the South Platte River

# More VSS to Digesters, More Gas, More Heat and Power

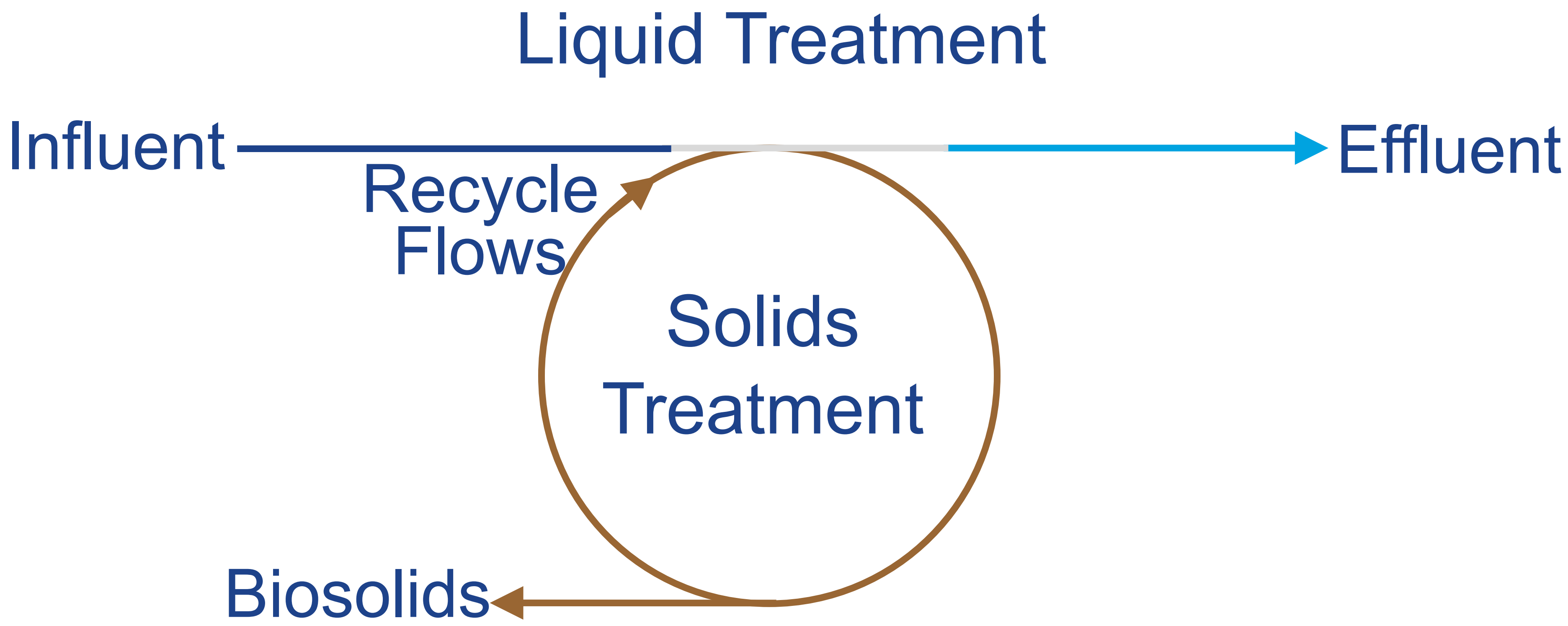


# Least Cost Operation: Maximize $VS_{PS}$, Minimize $VS_{WAS}$

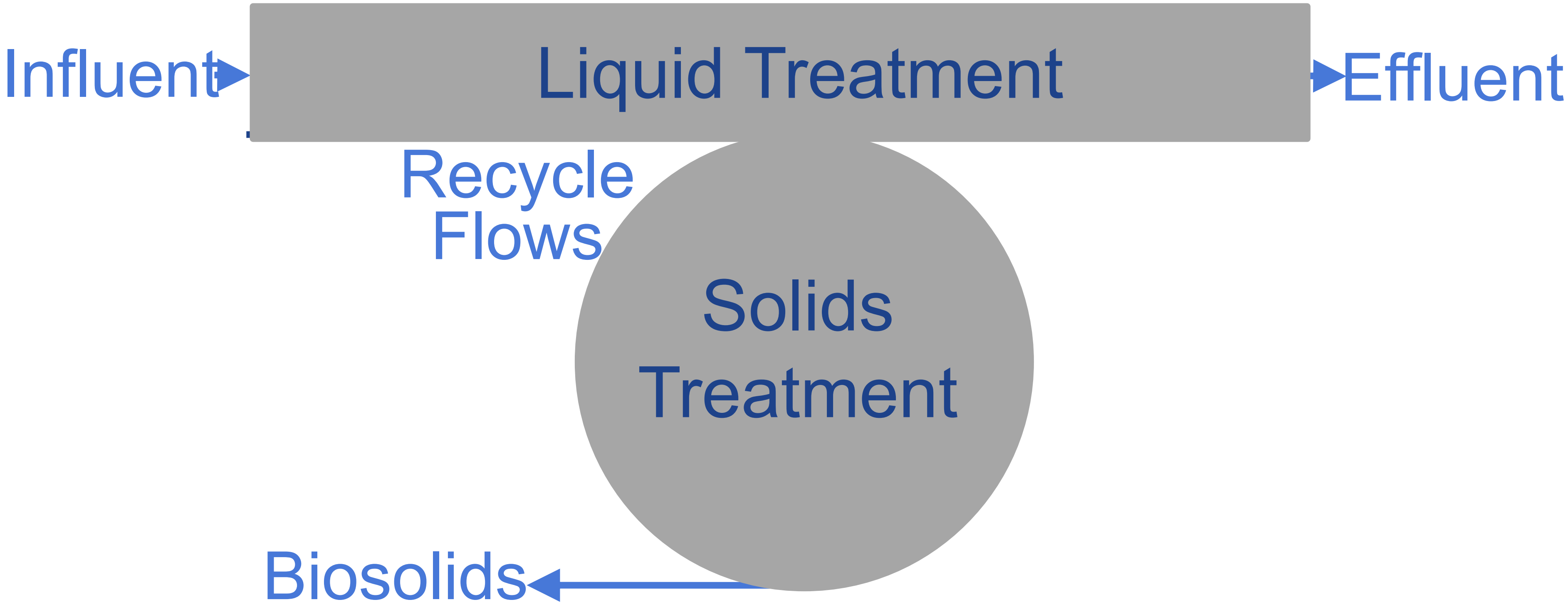


# Look Inside and Outside (Upstream) to Optimize Digester Performance

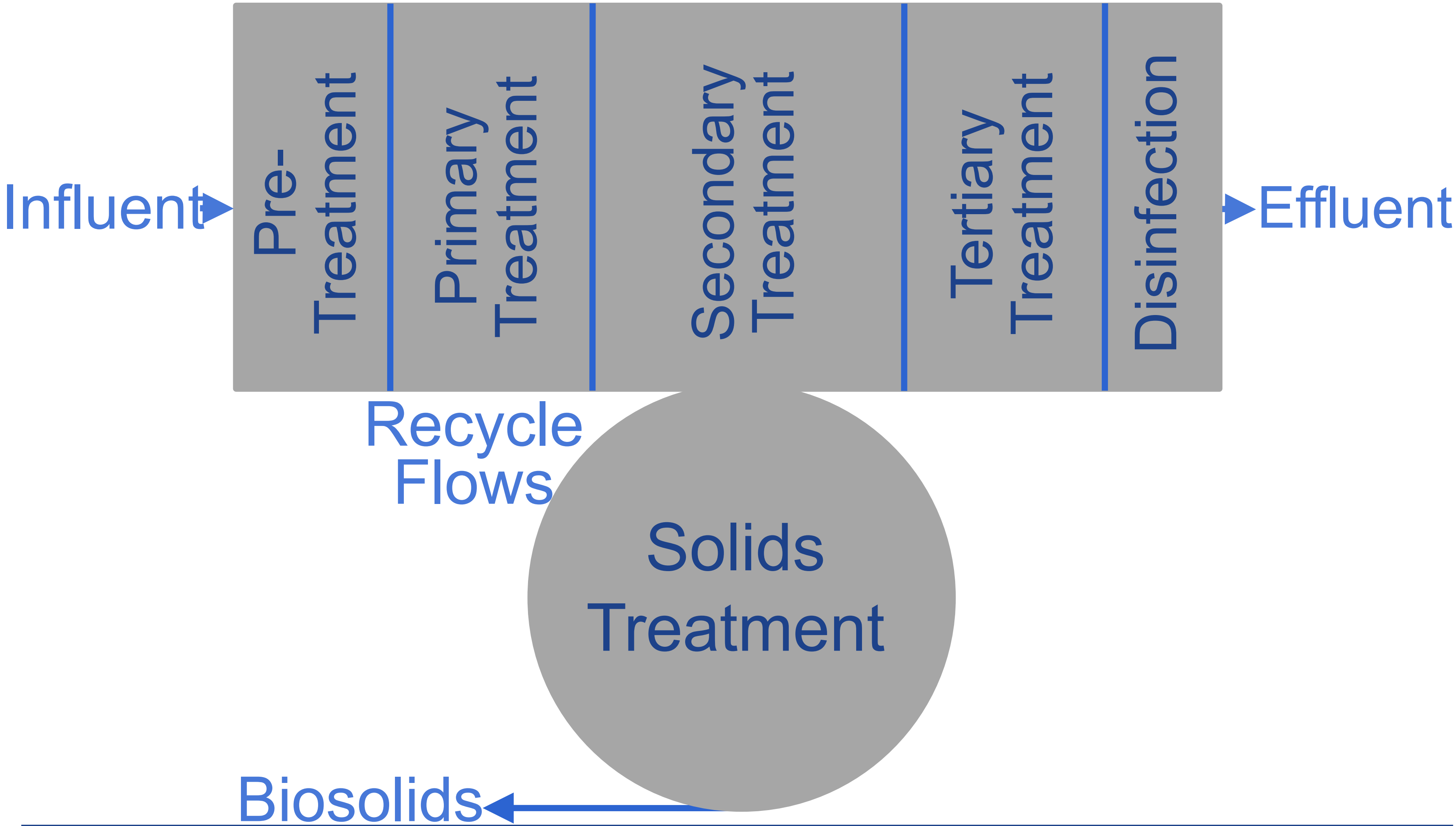
# A WWTP is like a manufacturing plant



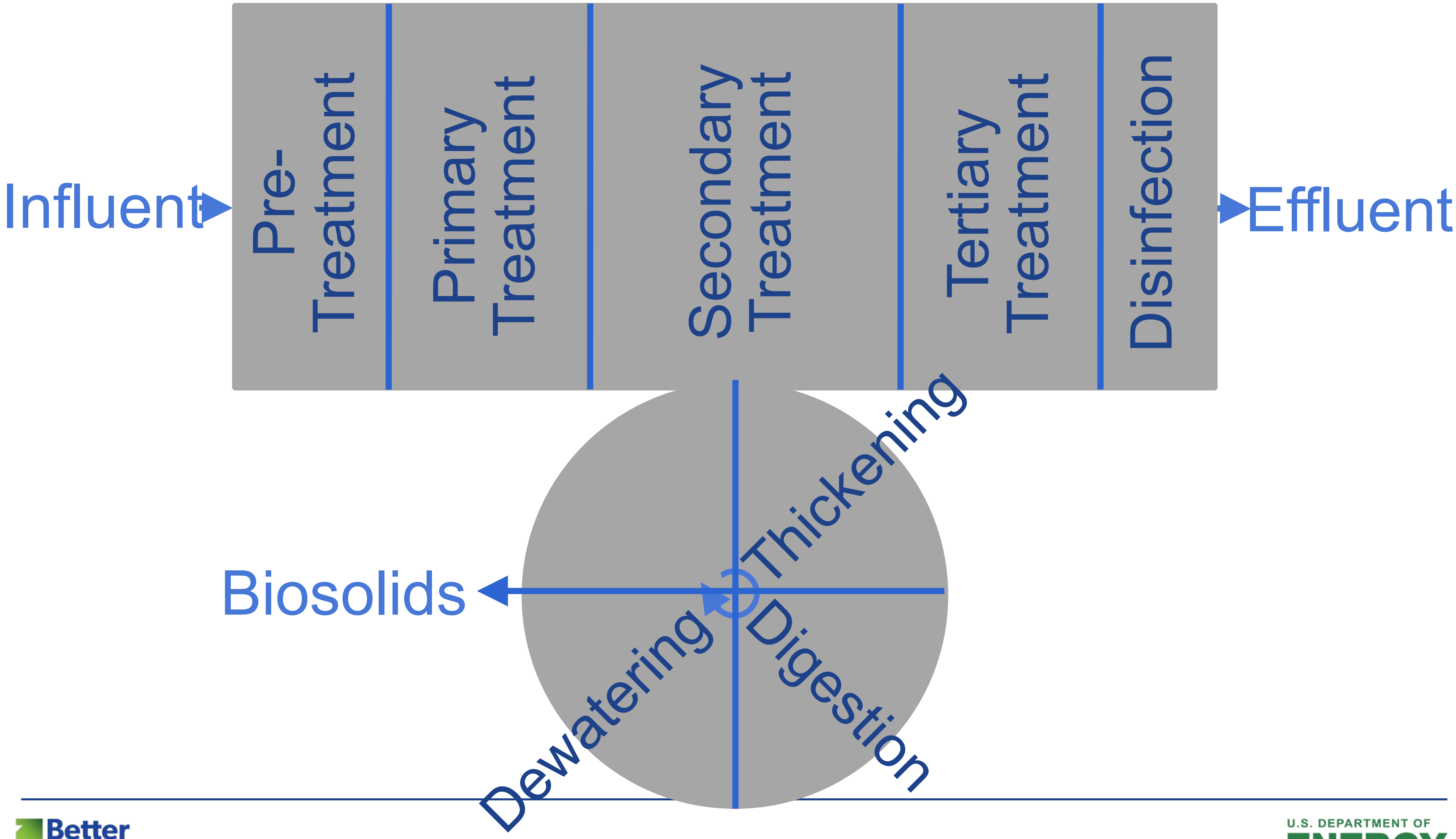
# Treatment occurs in process steps each dependent on performance of upstream steps



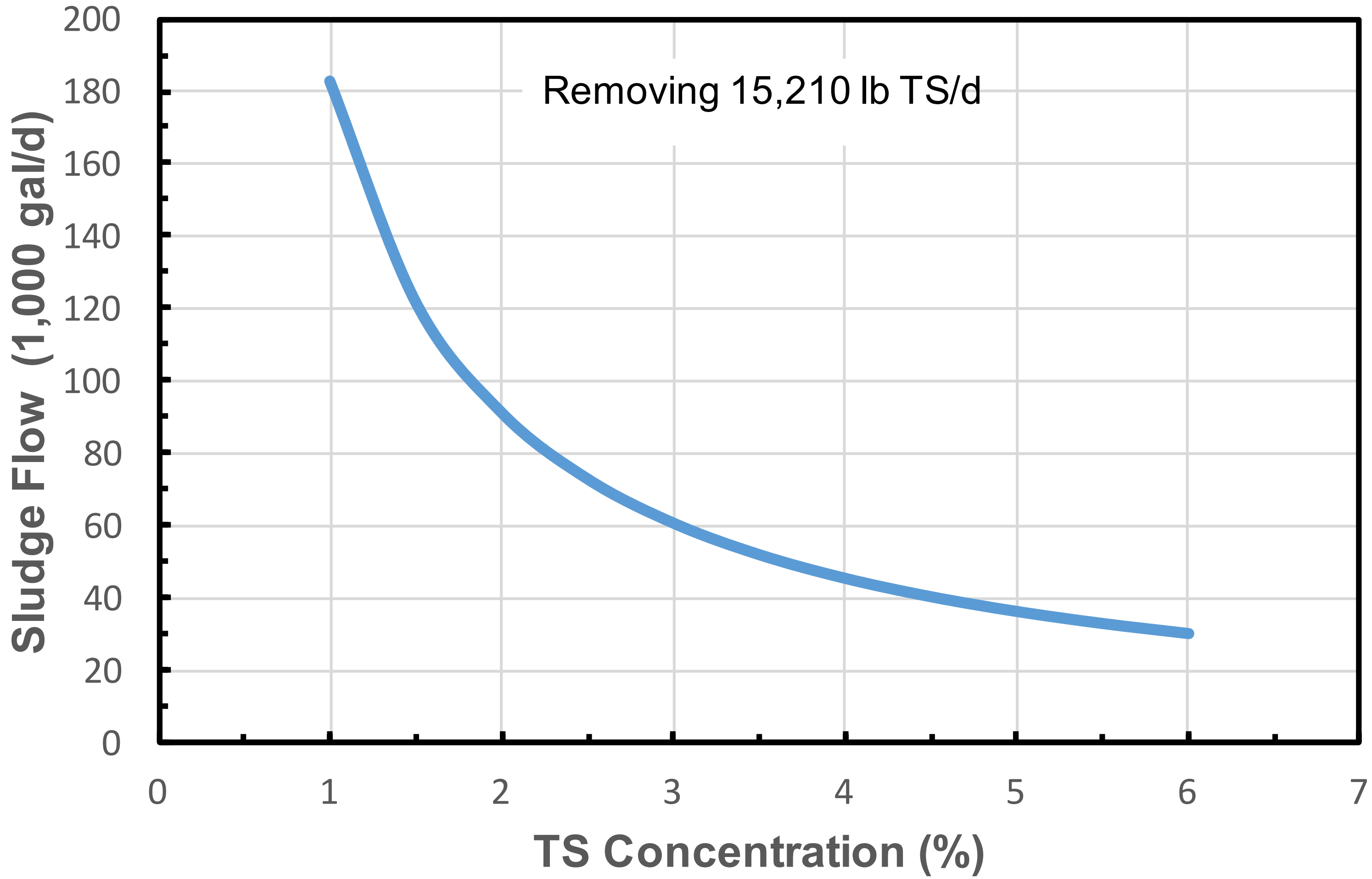
# Liquid treatment train broken down into treatment steps



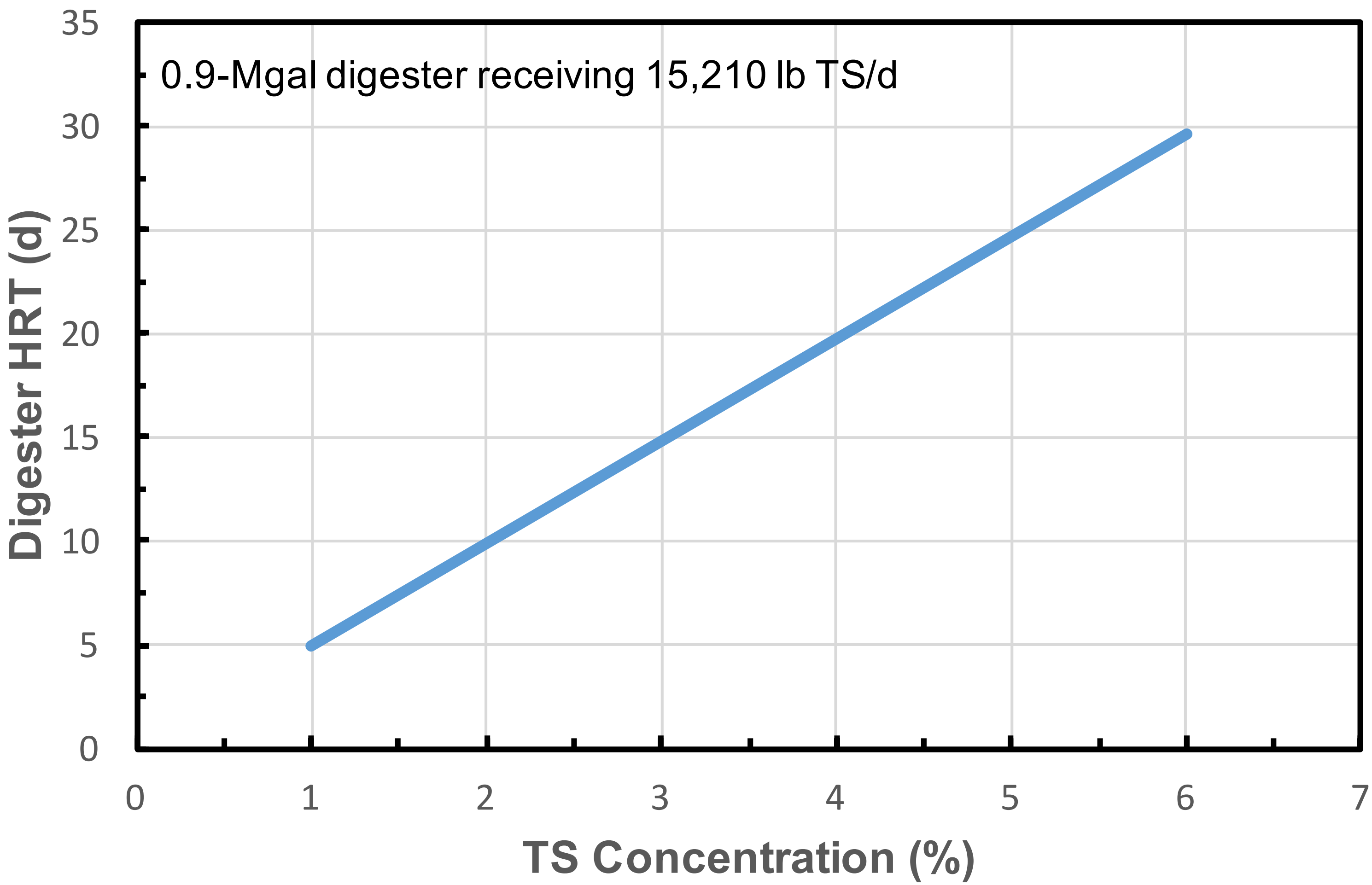
# Solids treatment train as well



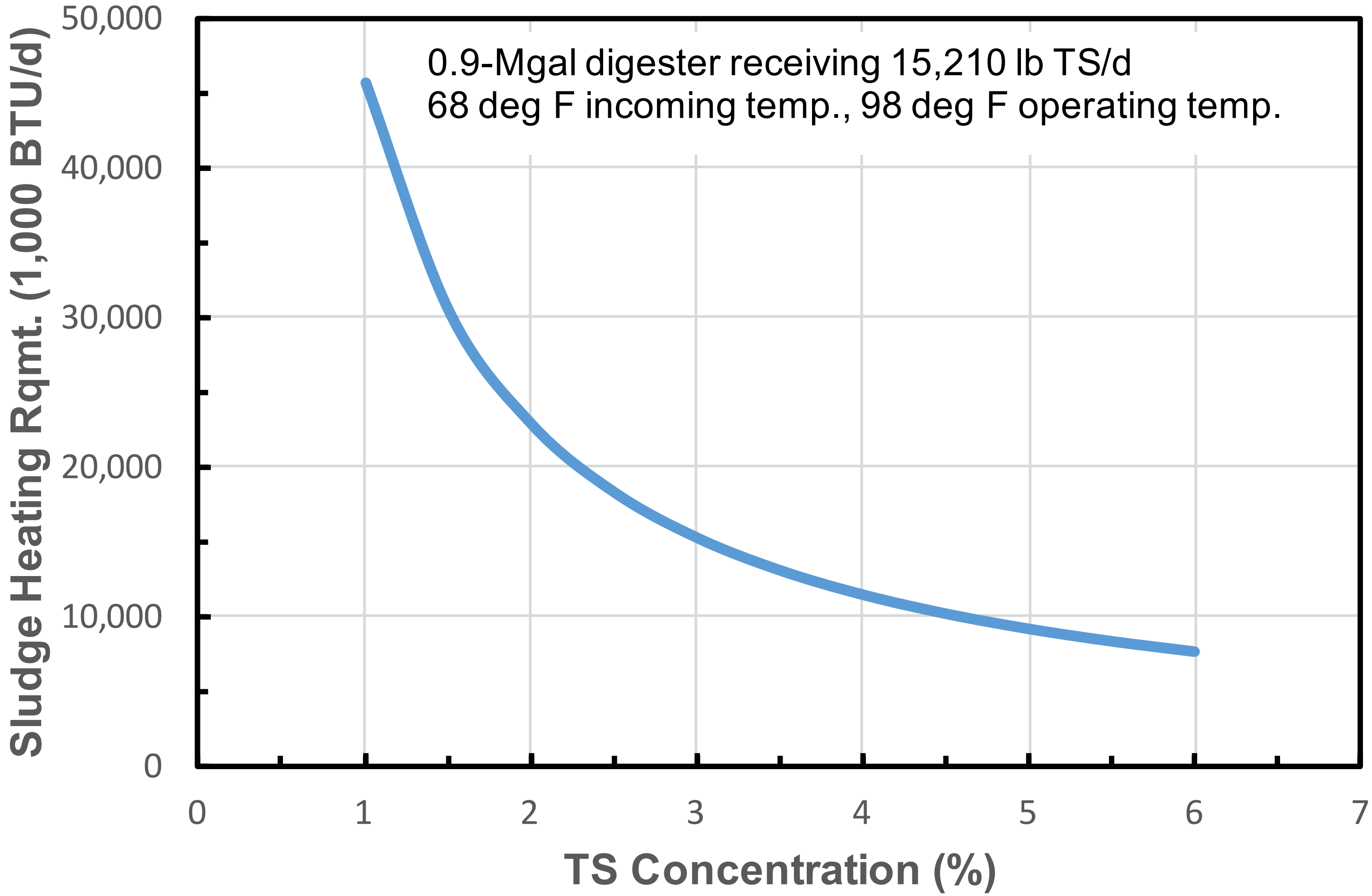
# Pumping: Thickening is ABSOLUTELY Critical



# Detention Time: Thickening is ABSOLUTELY Critical

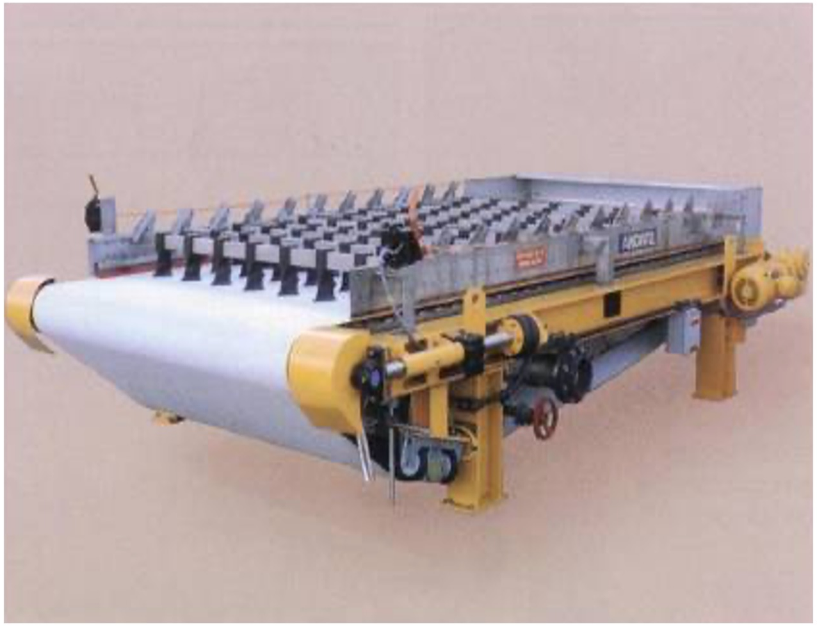


# Heating Requirements: Thickening is ABSOLUTELY Critical



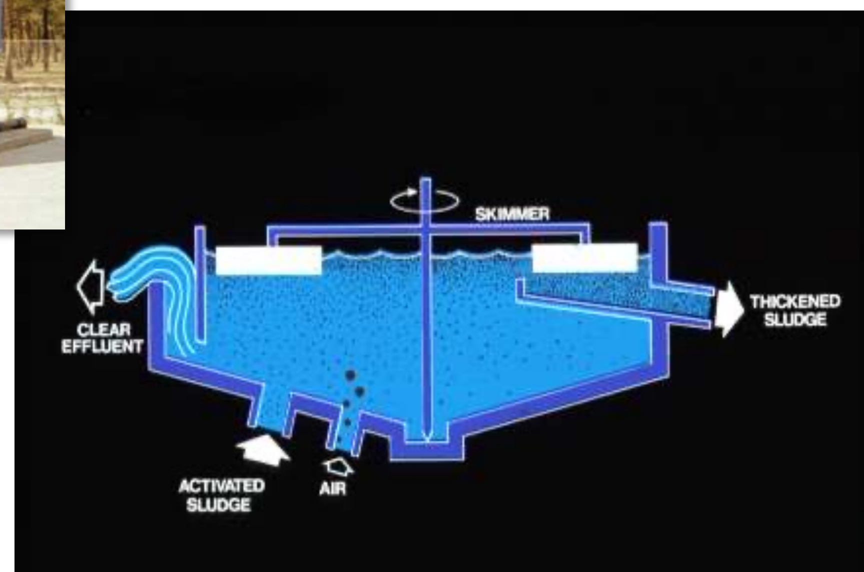
# Gravity Thickener

# Gravity Belt Thickeners

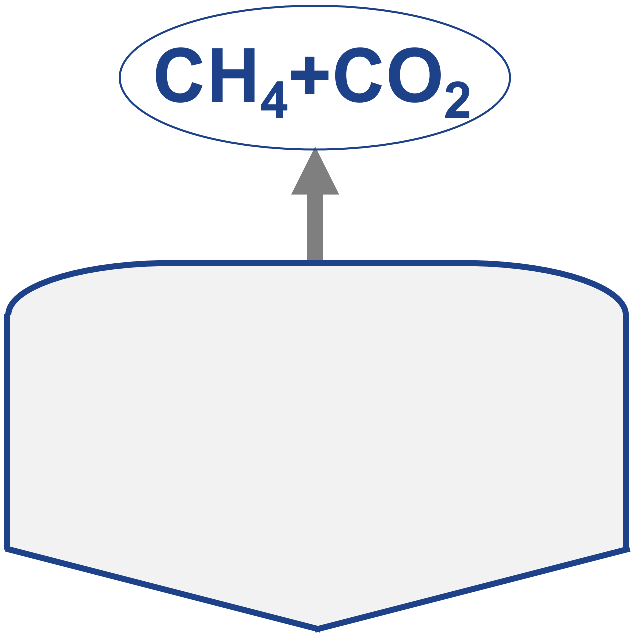


# Rotating Drum Thickener

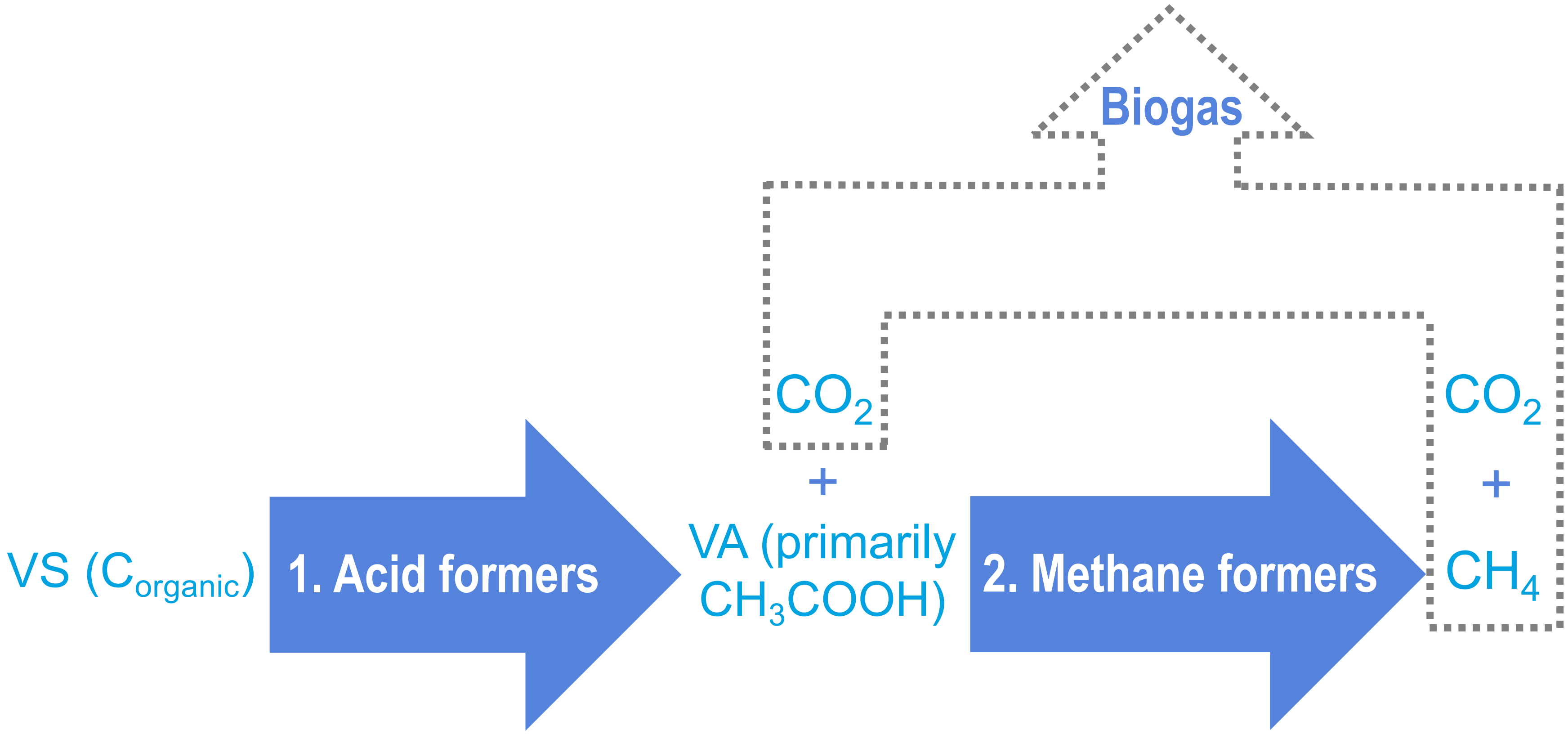
# Dissolved Air Floatation Thickener

# Past Performance is Not Indicative of Future Results



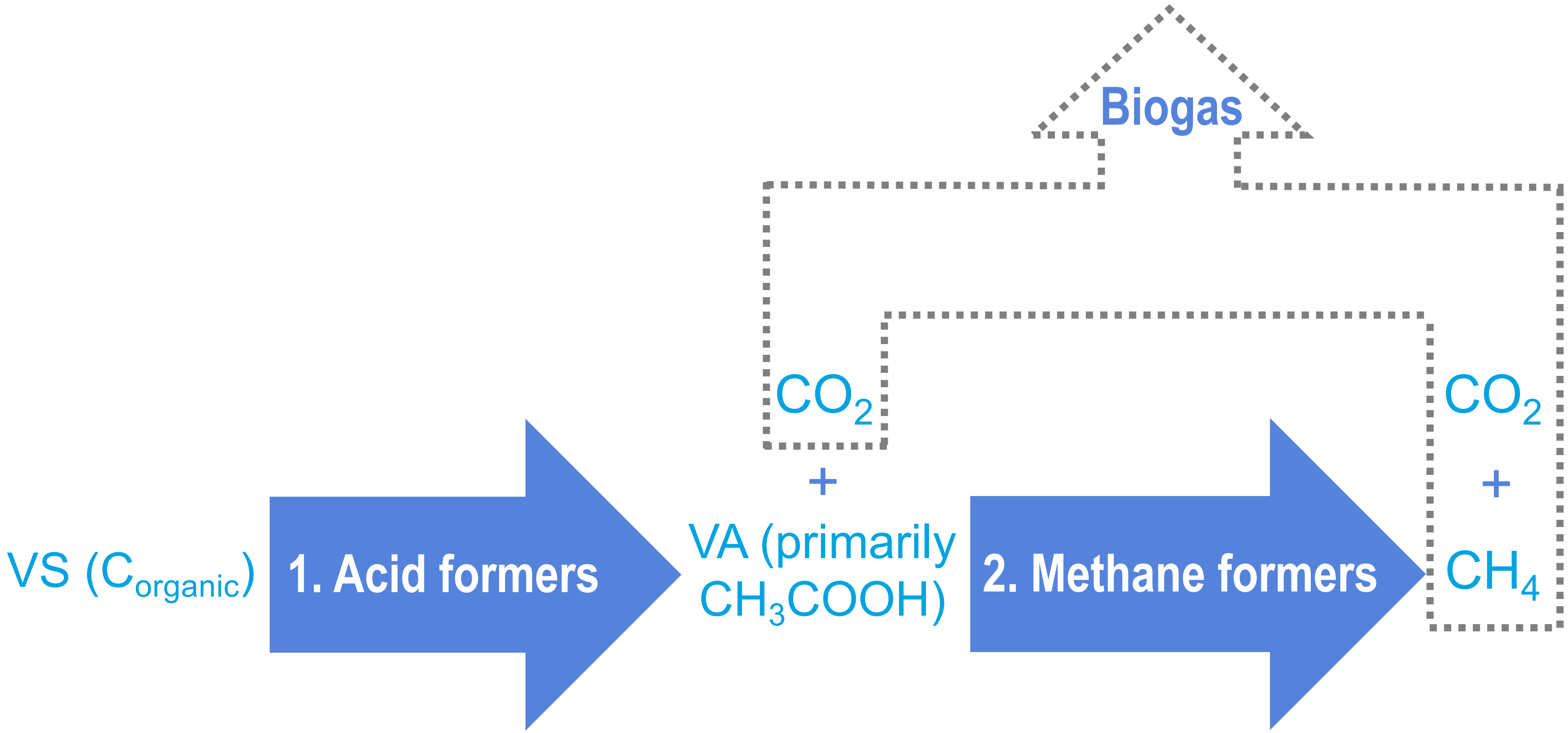
# Simplification Explains A Lot



# Three Words Capture Process Control Approach

1. **Stable**
2. **Consistent**
3. **Uniform**

# Objective of Process Control: Maintain Balance



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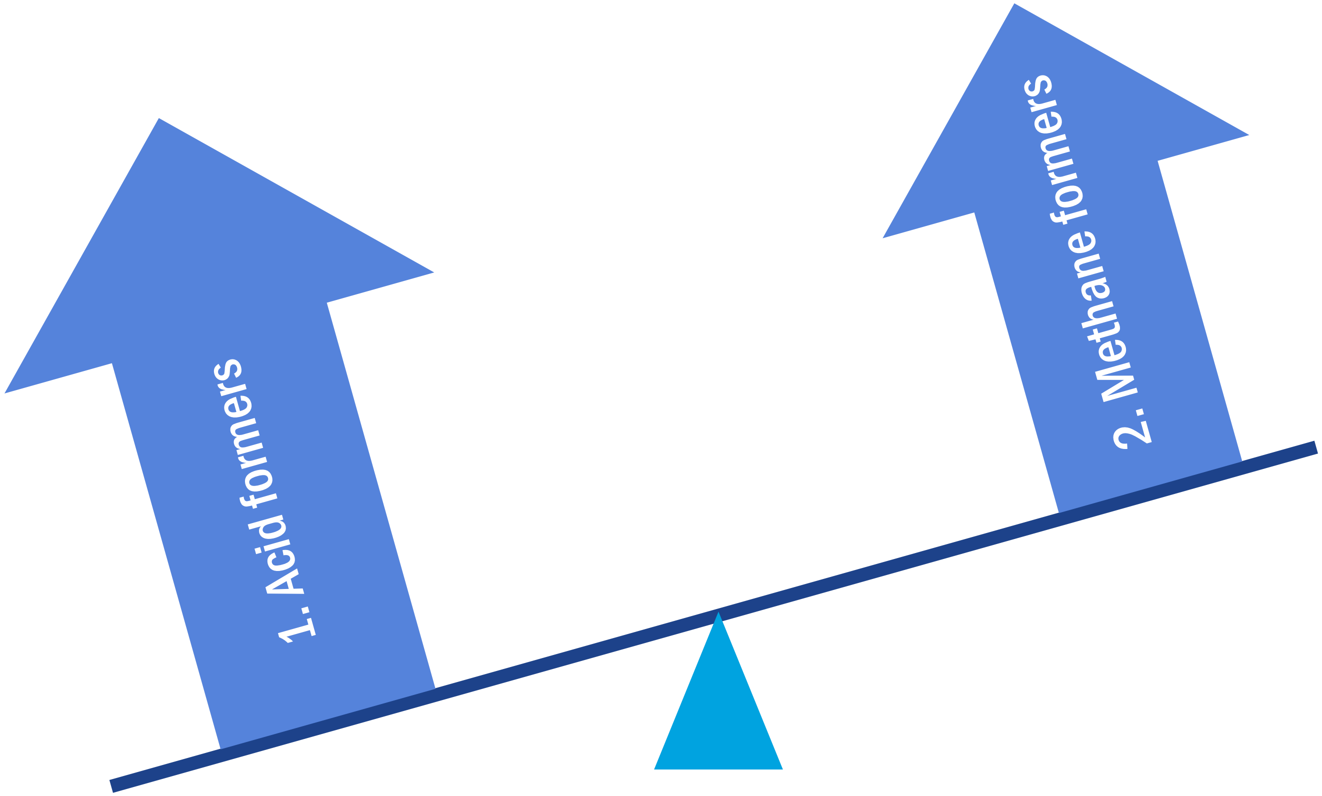

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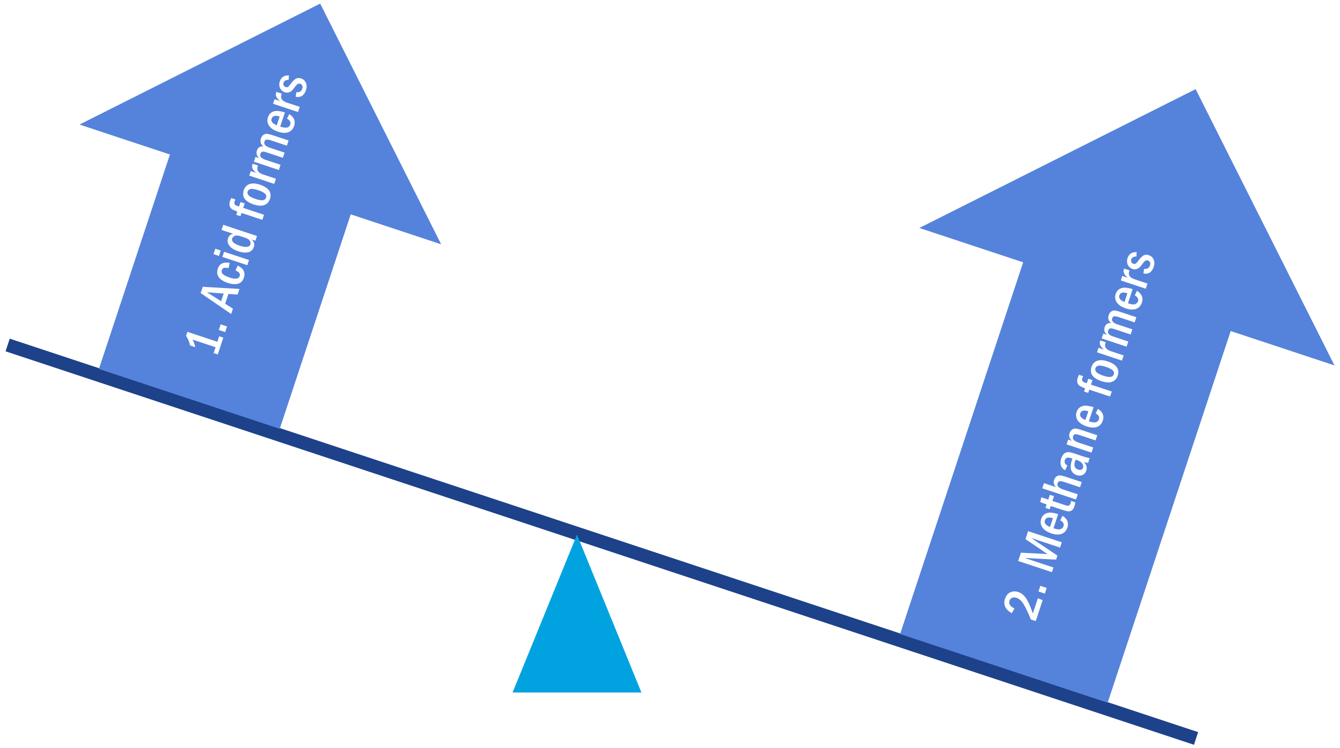

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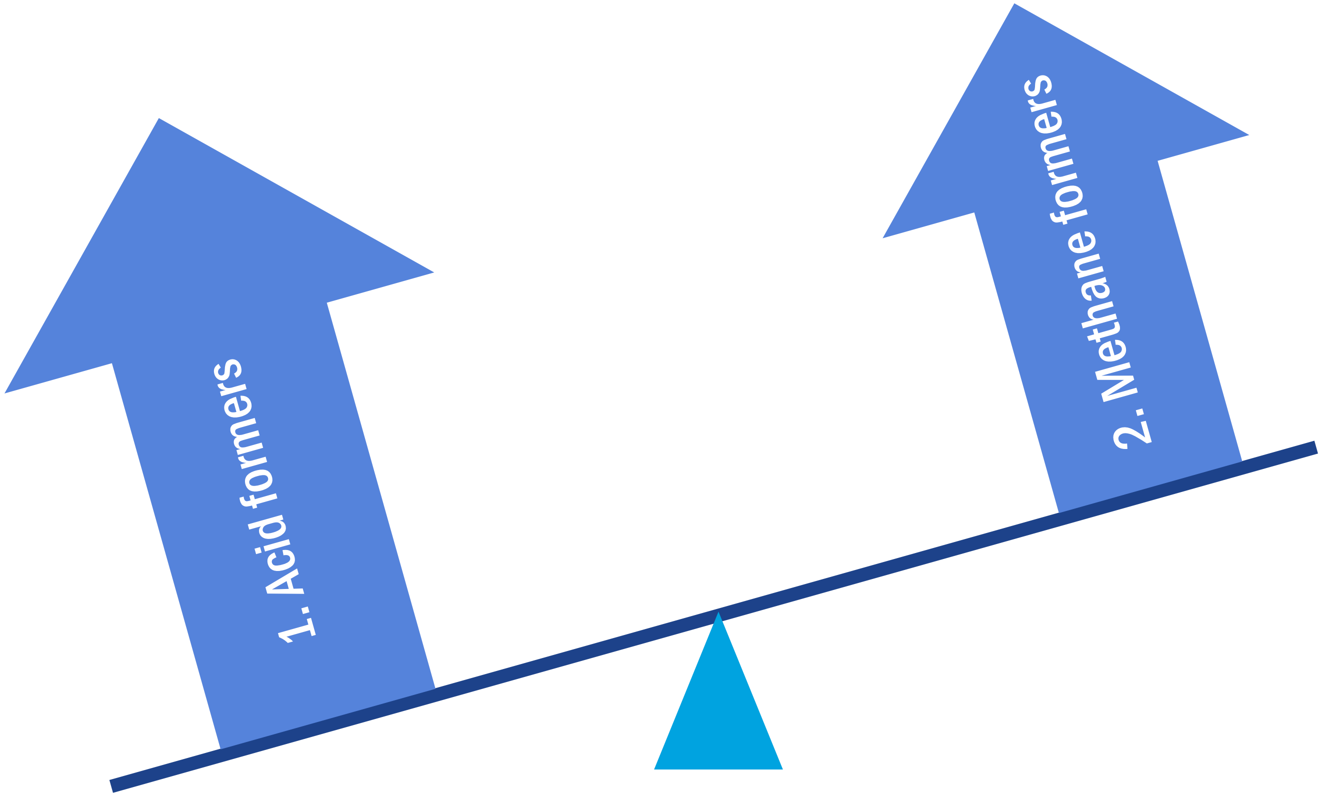
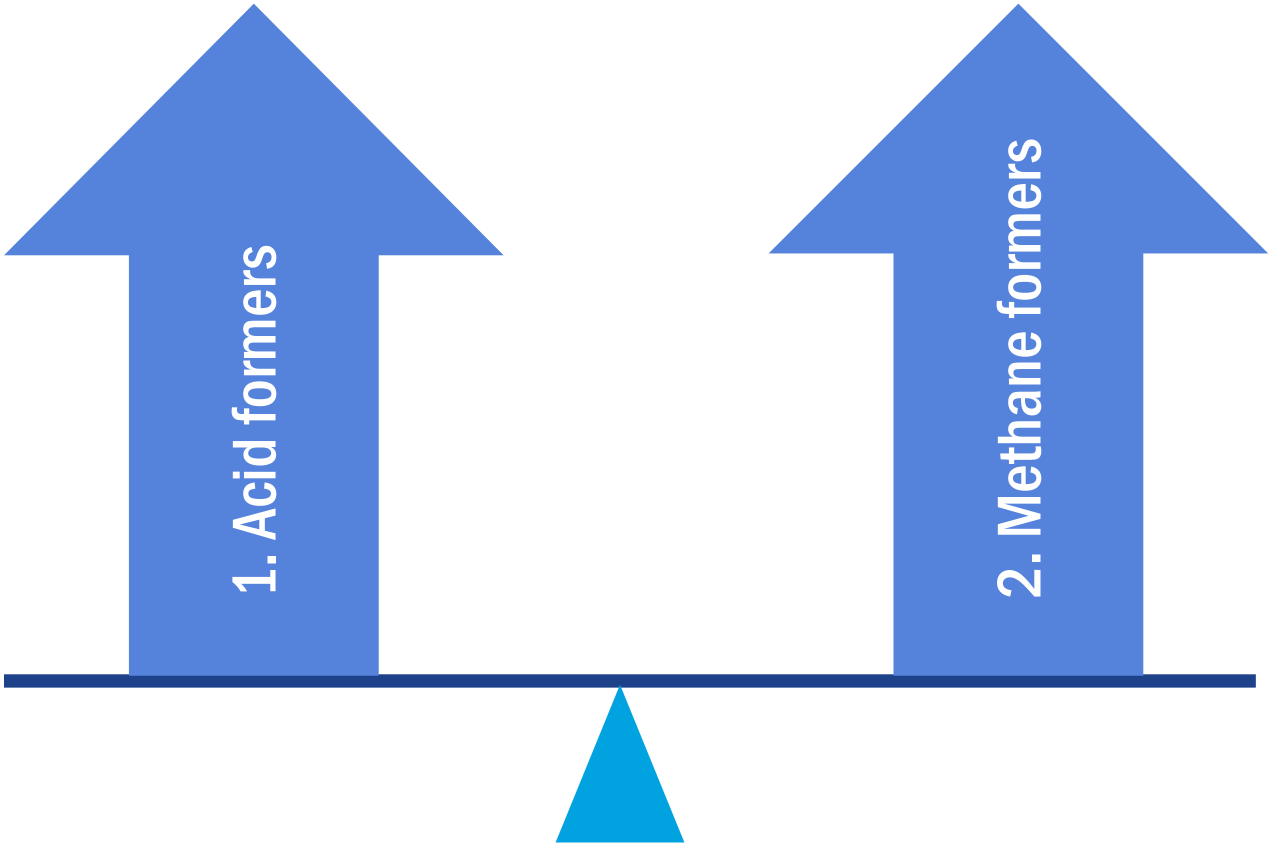


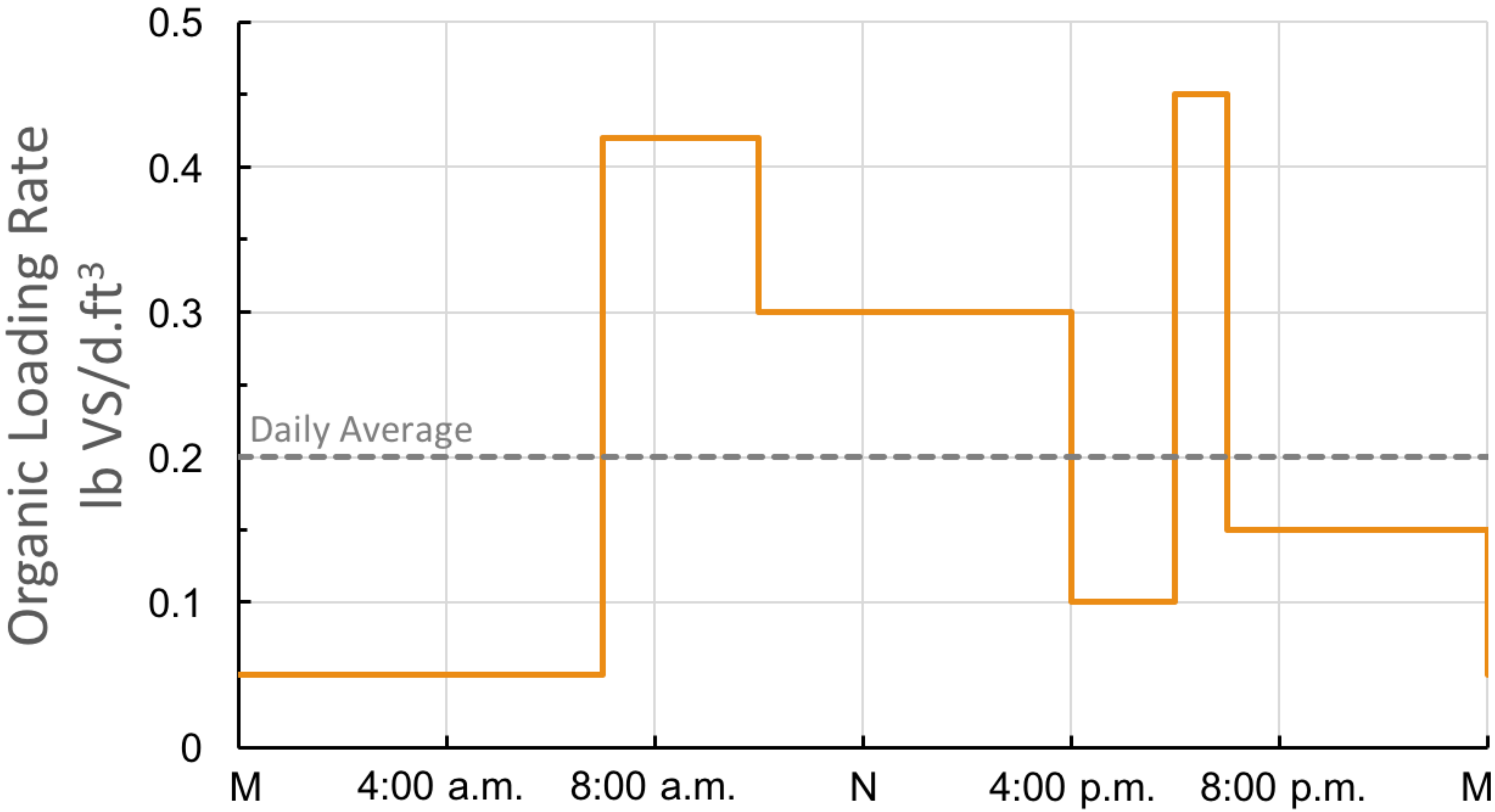
# Objective of Process Control: Maintain Balance



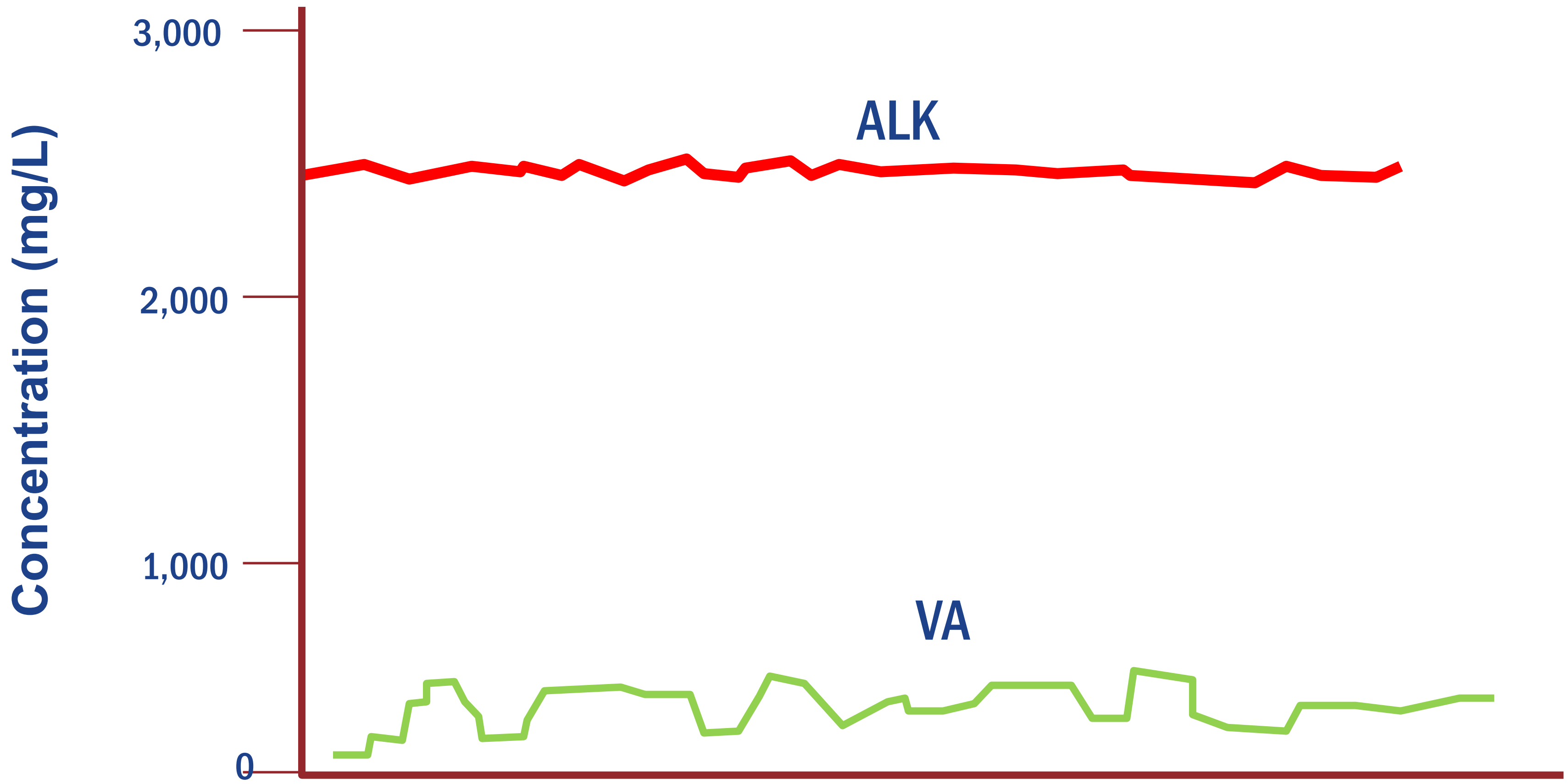
# Really Only Two Things in Operators' Control

1. **Organic loading**
2. **Temperature**

# Loading Pattern Hits Target for Daily Average, But Neither Consistent nor Stable

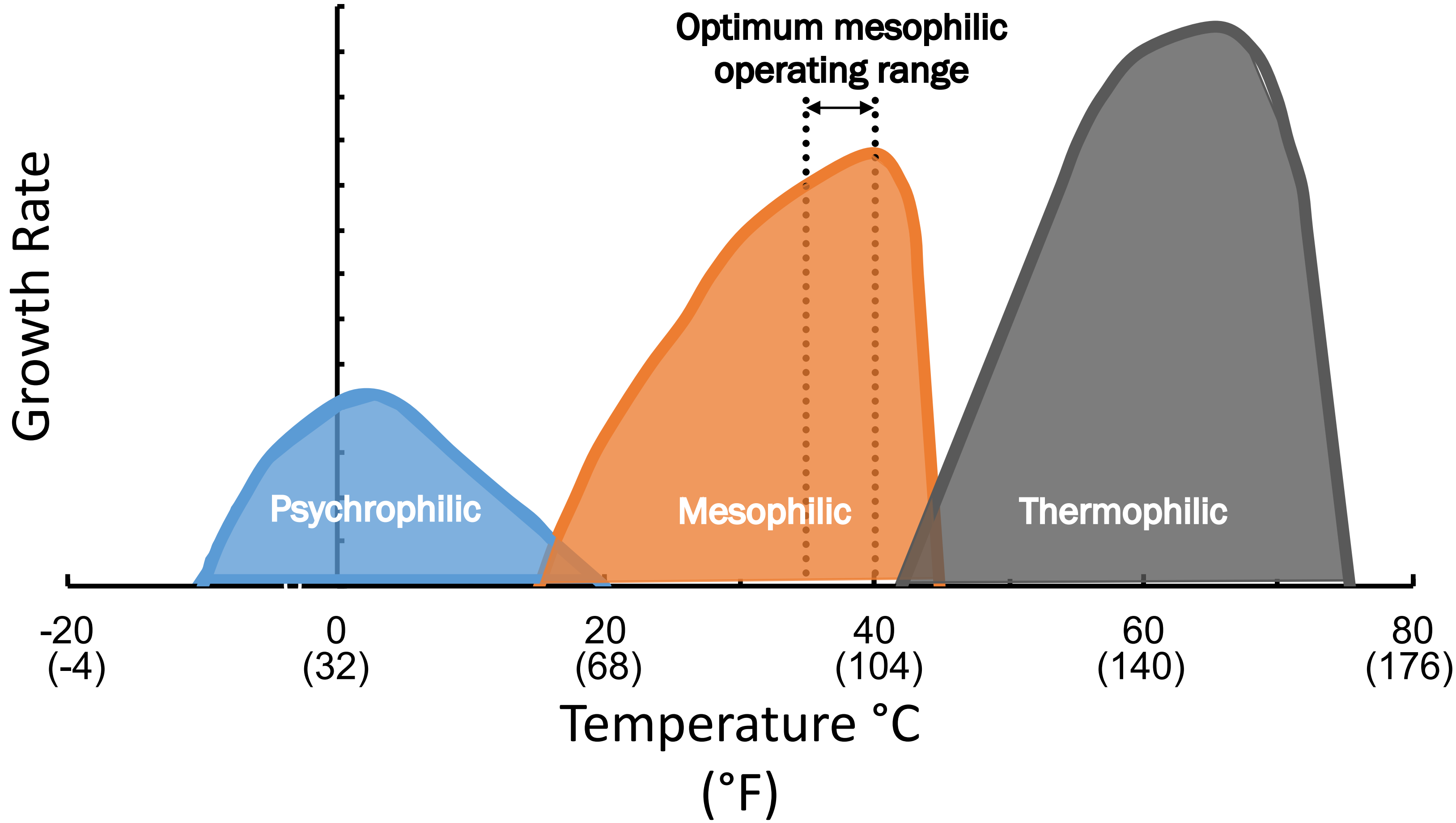


# VA Concentration Oscillates With Feeding



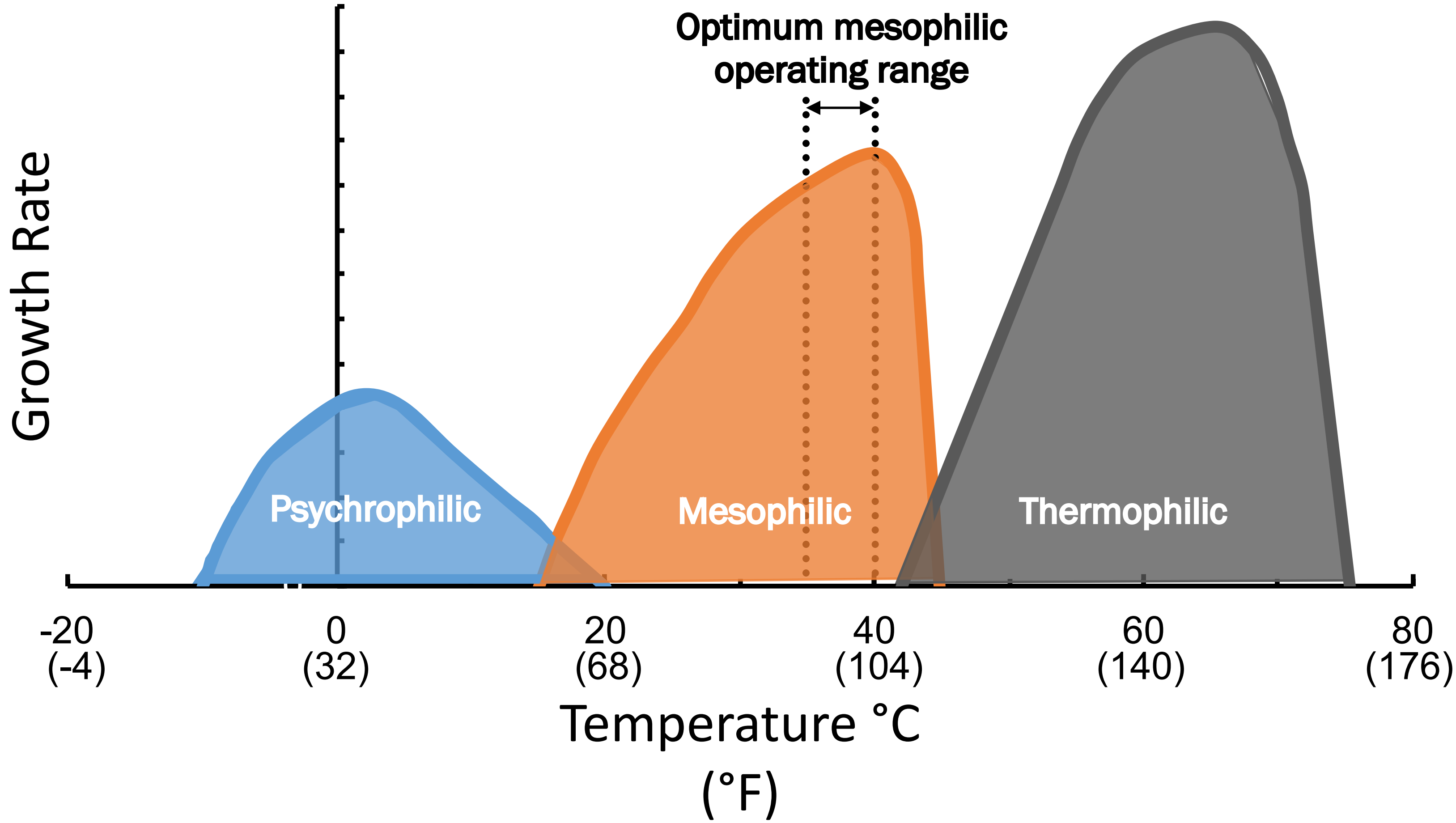

Source: Schafer *et al*., WEFTEC 2014

# Stable, Consistent, and Uniform Temperature Essential

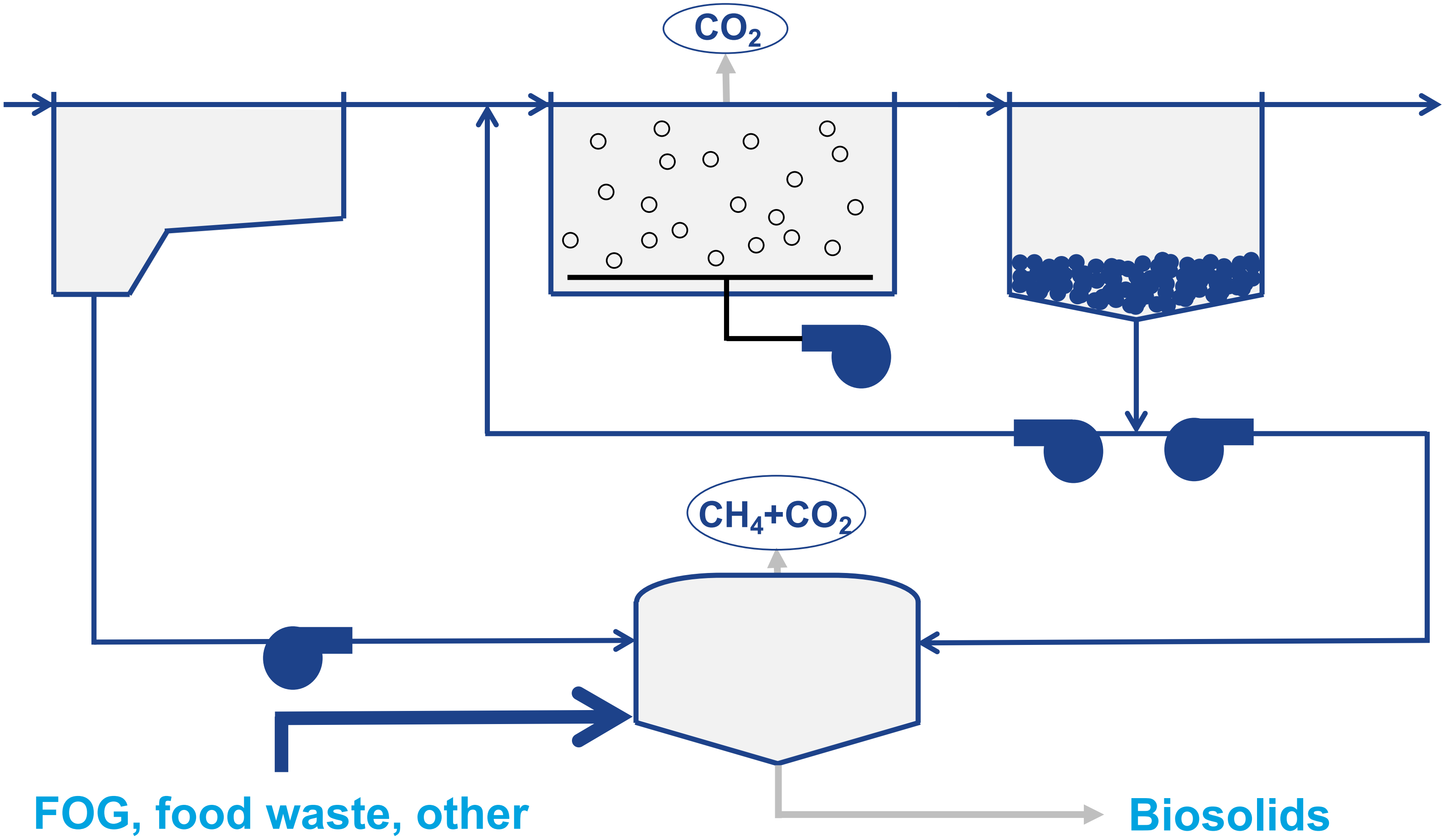



Source: Schafer et al., WEFTEC 2014

# Stable, Consistent, and Uniform Temperature Not Possible Without Good Mixing

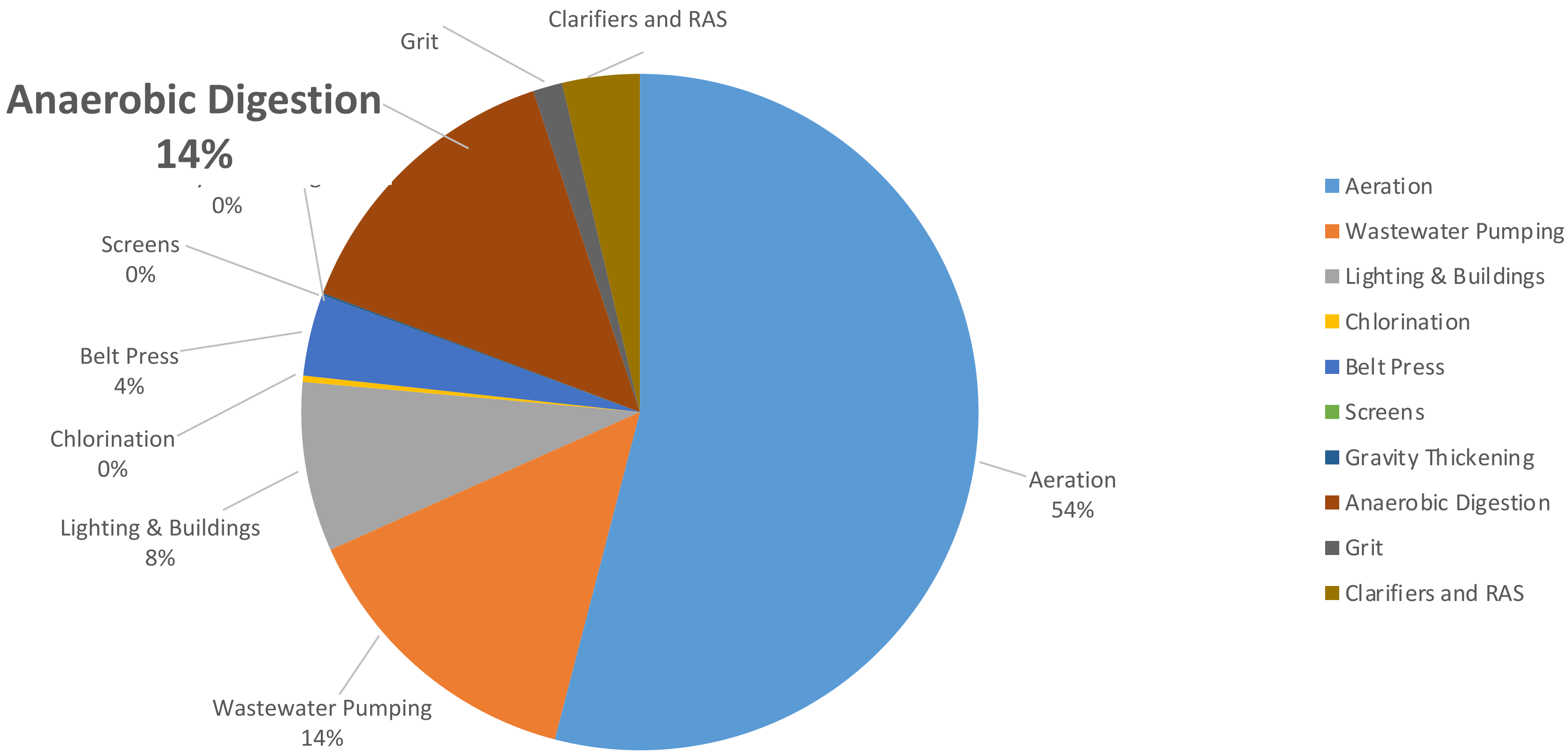


# If Co-Digesting Must Ensure **Mixture is as Uniform** as Possible



# Plant Process Electricity Use Overview

## Electricity Requirements for Activated Sludge Wastewater (Non-UV)




Derived from data from Focus On Energy WWOA 49th Annual Conference, October 7, 2015 presentation by Joseph Cantwell, PE

# Most Important Unit Process: Performance Monitoring is Paramount

1. **VA concentration**
2. **Volatile solids reduction**
3. **Gas production per VS destroyed**
4. **Gas composition**

# Heat Exchangers, Heat Loops & Spaghetti Bowls

# Aerobic Digestion

# Aerobic Digestion

**Basically an aeration tank with a LONG retention time.**

**Aerobic digestion is often only "slightly" aerobic – blowers are run by "nose" on small facilities.**

**Very coarse bubble diffusers are used – like ¼" holes drilled along the bottom of the air pipe.**

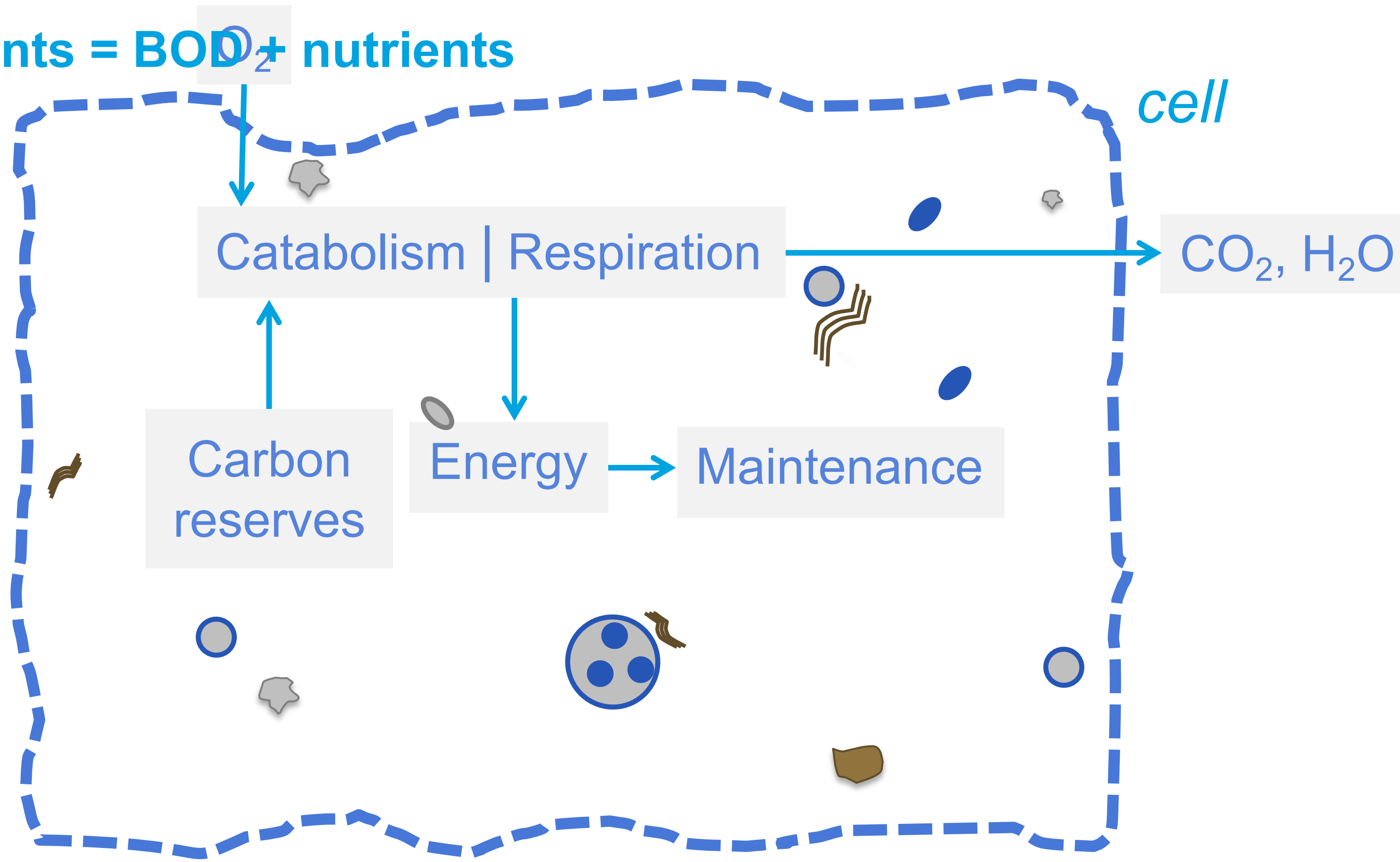
**Can be a good place to retrofit blowers.**

**If your permit requires 38% reduction, is there a benefit to getting 45% or 50% reduction? What is the energy cost of that benefit? Other cost?**

**Nitrification unavoidable, denitrify (*mixed not aerated*) to lower aeration requirement**

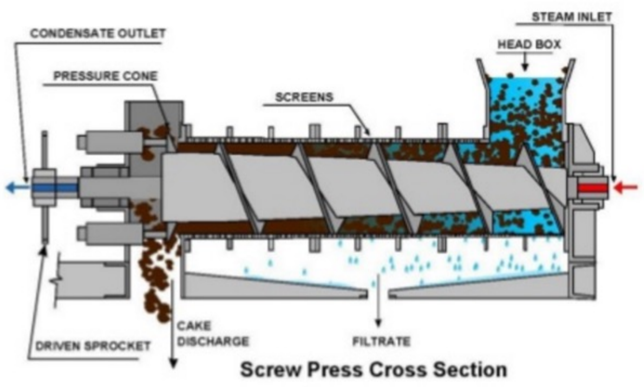
# Depleted Carbon Reserves Leads to Cell Death, Cell Contents Substrate to Survivors

**Cell contents = BOD + nutrients**

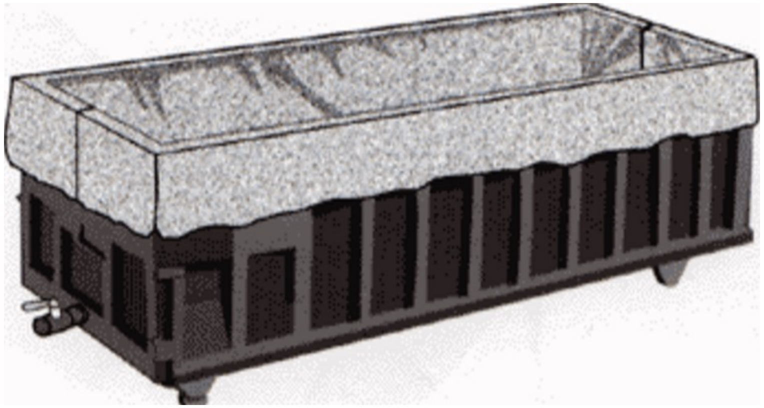


# Dewatering Equipment Considerations

# Lots of Ways to Skin This Cat




Courtesy: FKC



Degremont Heliantis solar drier

# Sludge Disposal
# is #3 or #4 Expense for Many Plants

**Power Costs** – dewatering, pumping, washing, odor control

**Recycle Costs** – return streams

**Disposal Costs** – hauling and ultimate disposal

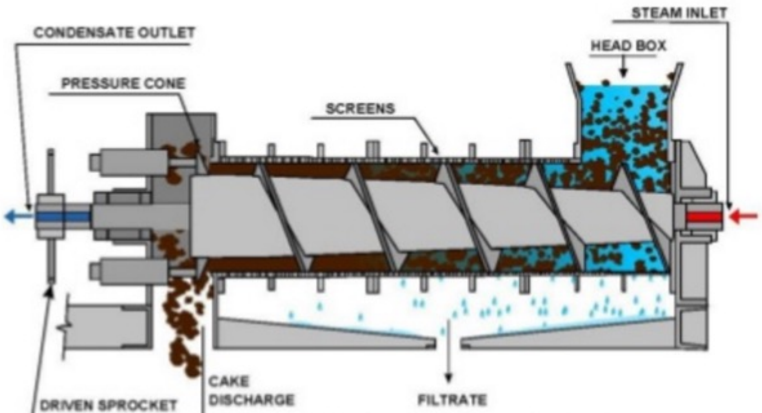
**Polymer & Chemical Costs**

**Labor Costs**

**Maintenance Costs**

# W3 and Thickening

# A story on dewatering......




Screw Press Cross Section

Courtesy: FKC

# Operational Considerations

## If dewatering is a batch process at your plant

**Does odor control run continuous?**

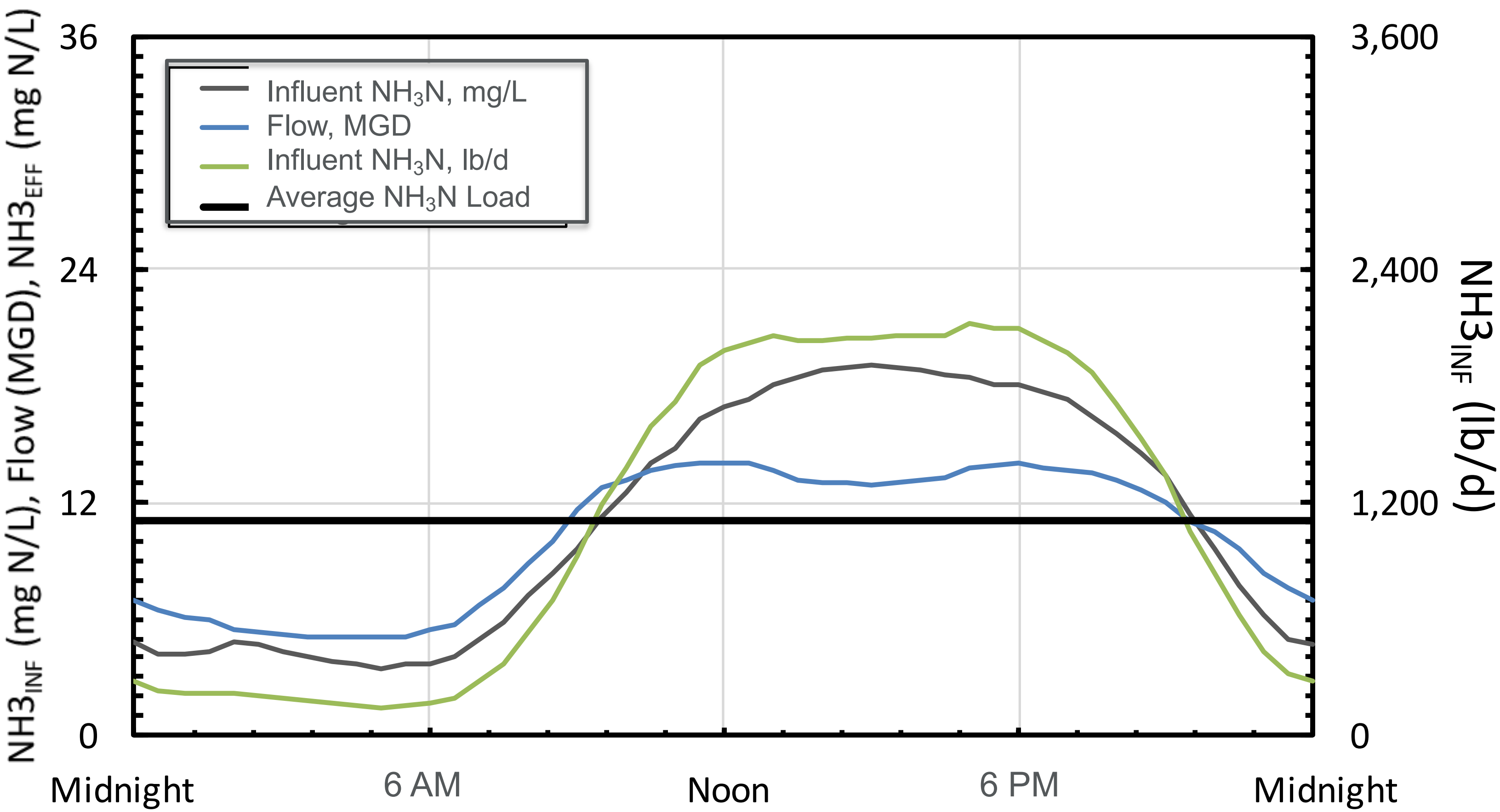
**Is building heating/cooling set to different temp at night than in day?**

**Can W3 water pressure be reduced because demand is reduced?**

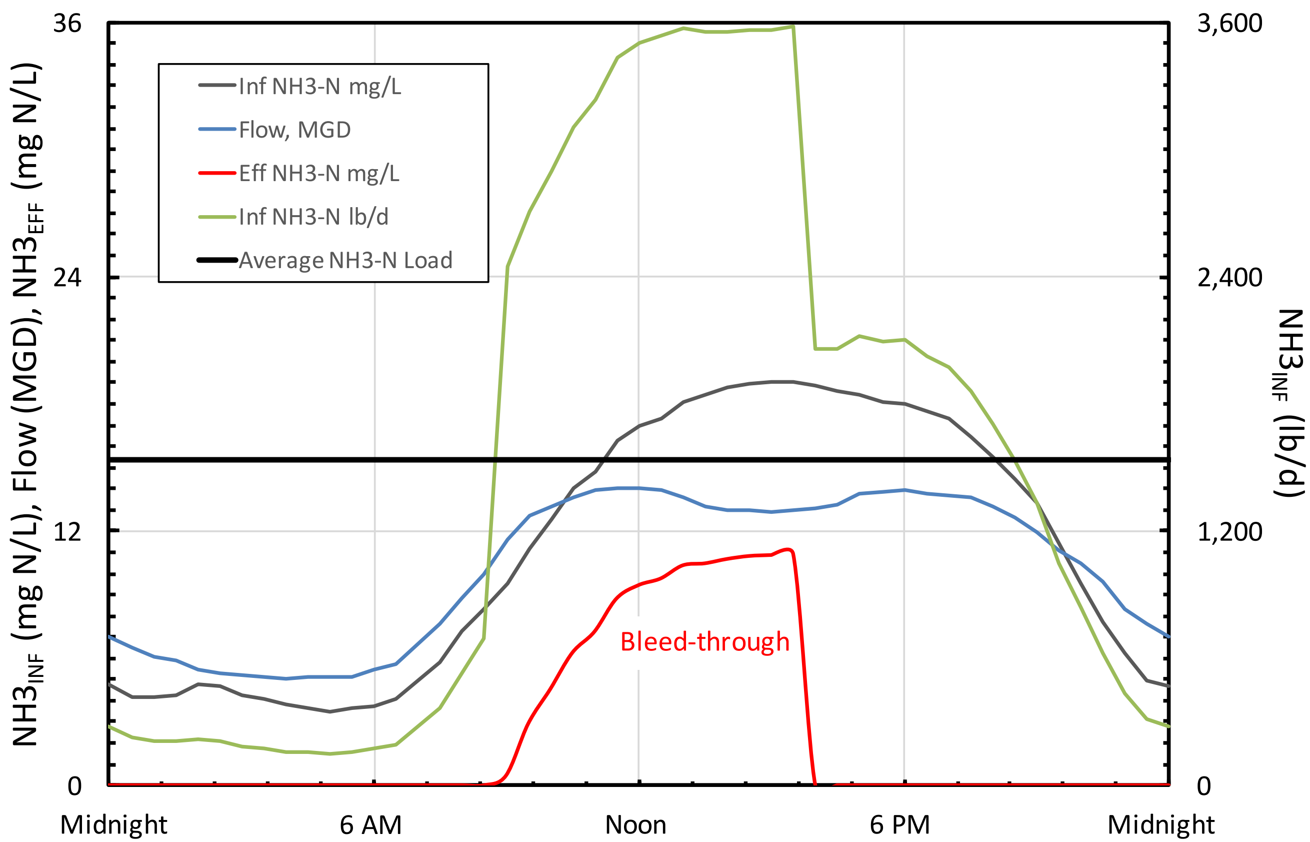
**Would moving to longer run times eliminate a batch (and associated start-up/shut-down energy)?**

**Would shifting batching time of day reduce total plant electrical demand? Improve plant performance?**

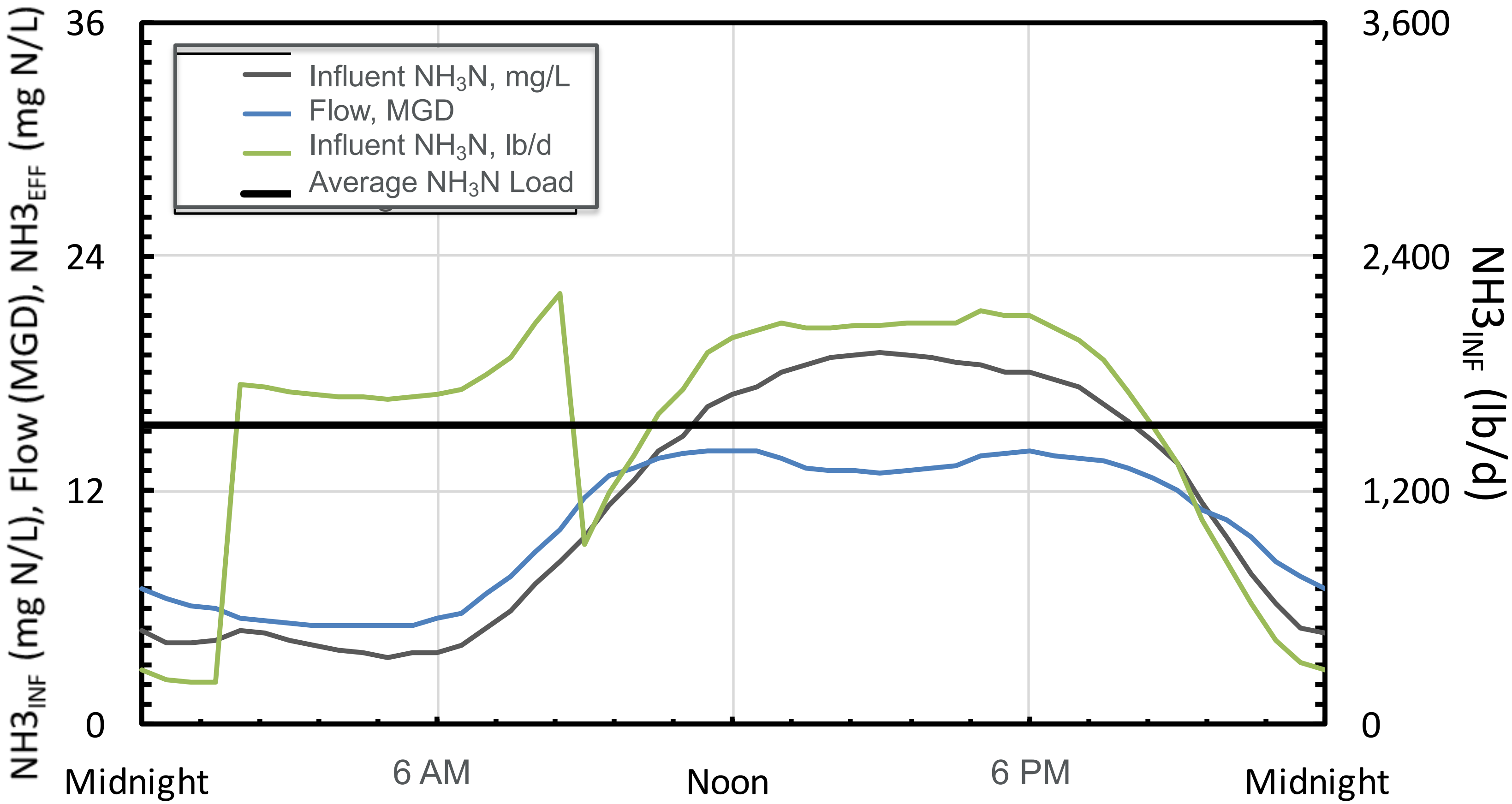
# Diurnal Variation in Flow, $NH_3$-N Concentration, and $NH_3$-N Load



# First-shift Dewatering Operation With No Return Equalization



# Dewatering in Early Morning Eliminates Bleed-Through

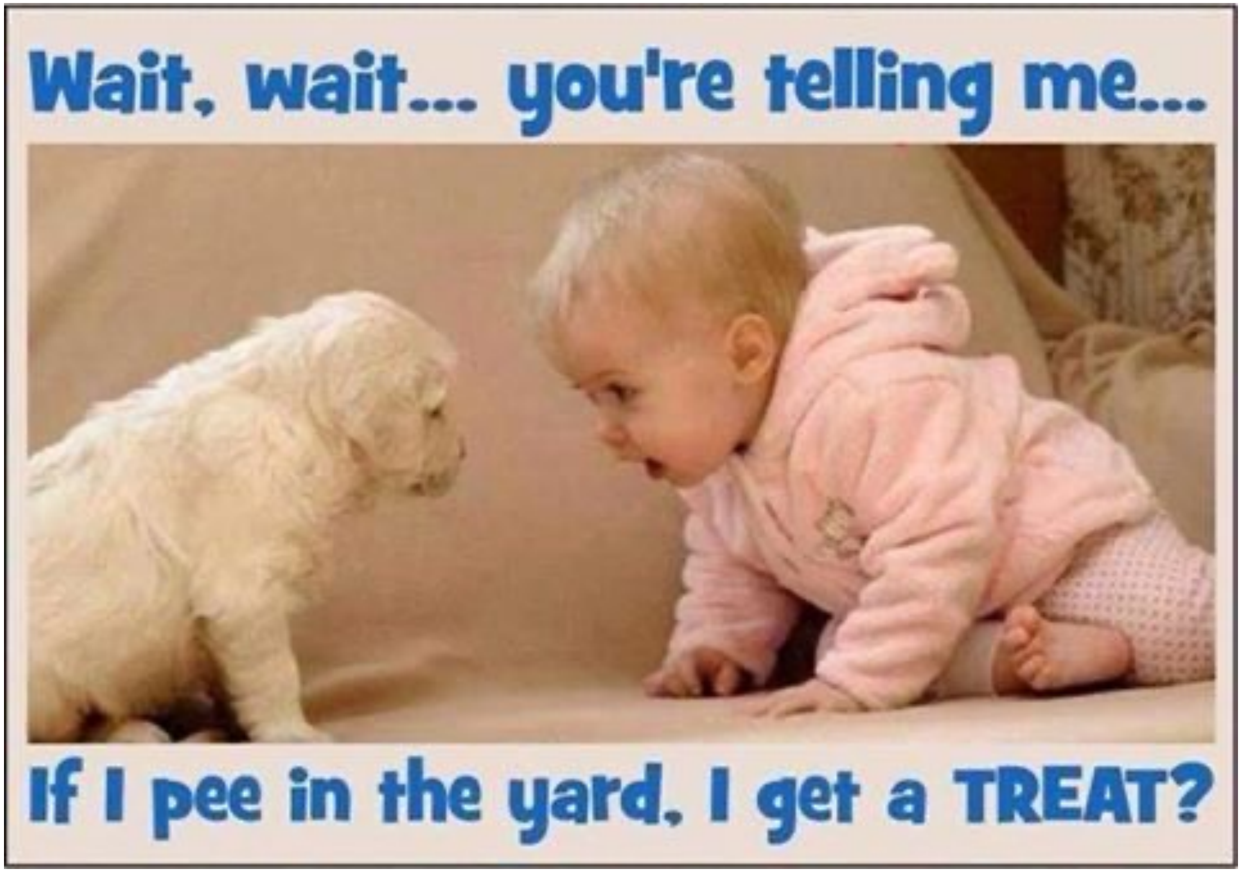


# Operational Considerations

**If you have a choice, what is the most efficient unit in the line-up?**

**Are you only scrubbing "odorous air" or are you scrubbing entire building volume?**

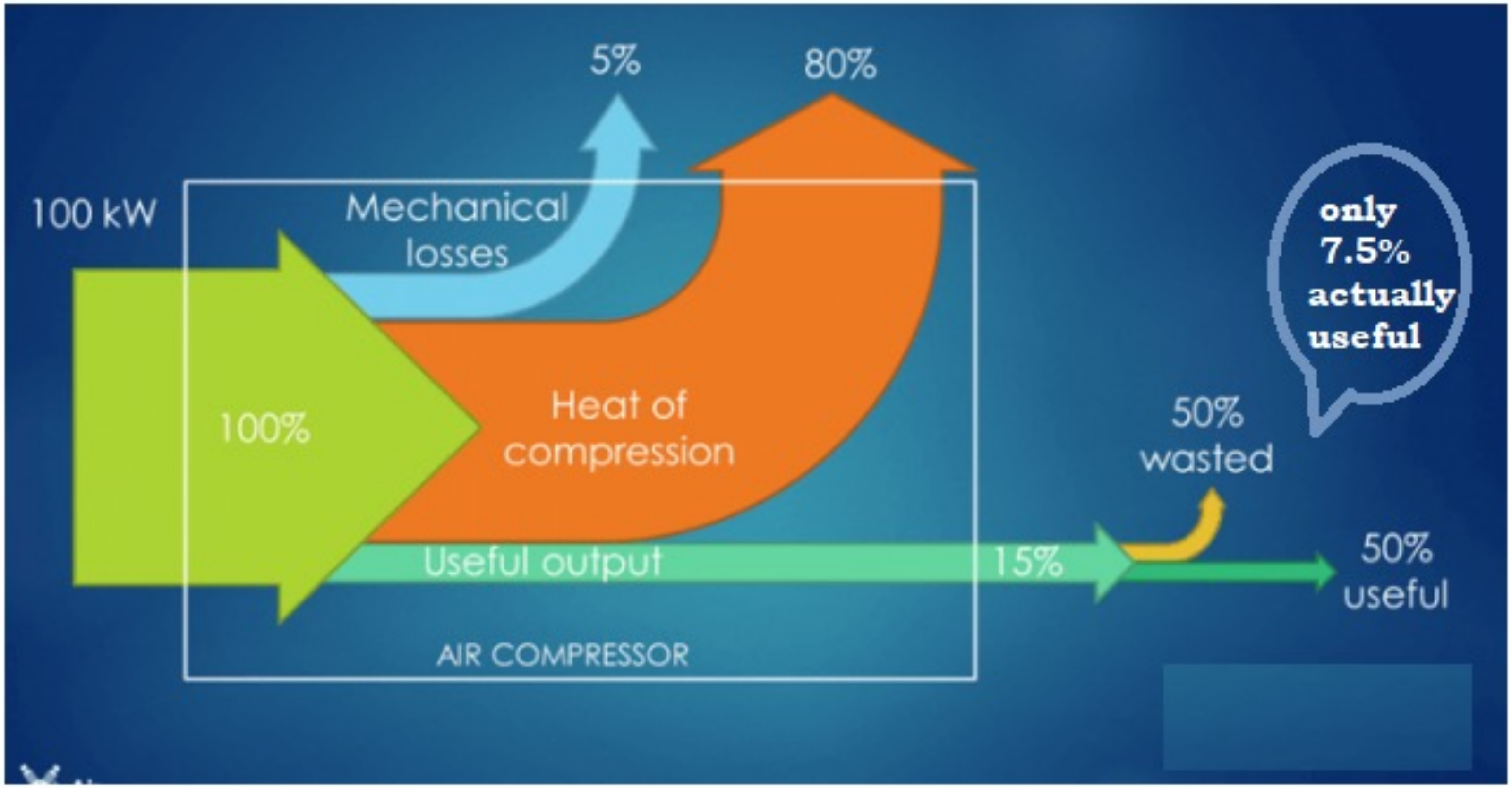
**Does cake handling equipment run continuous or only as needed?**


Wait, wait... you're telling me...
If I pee in the yard, I get a TREAT?

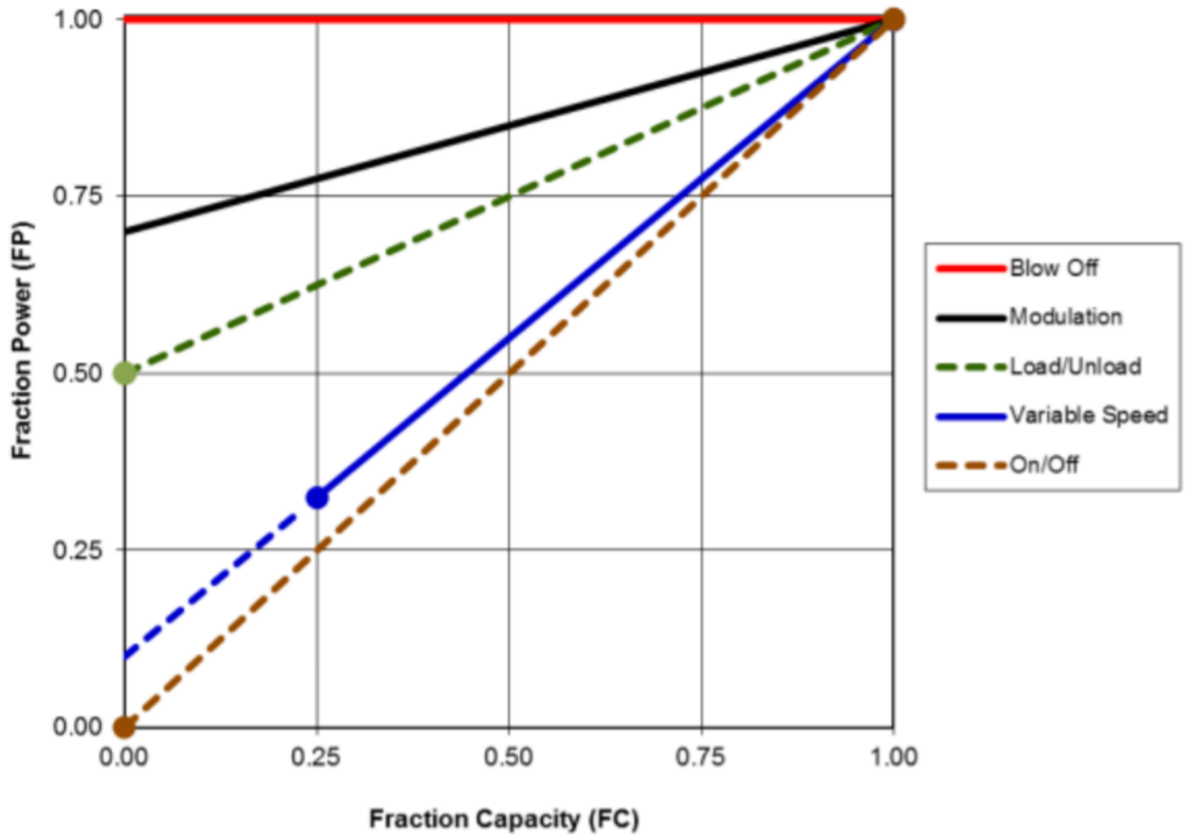
# Air Compressors……all Shapes & Sizes



# Compressor Energy Sankey Diagram



# Control Options & Performance



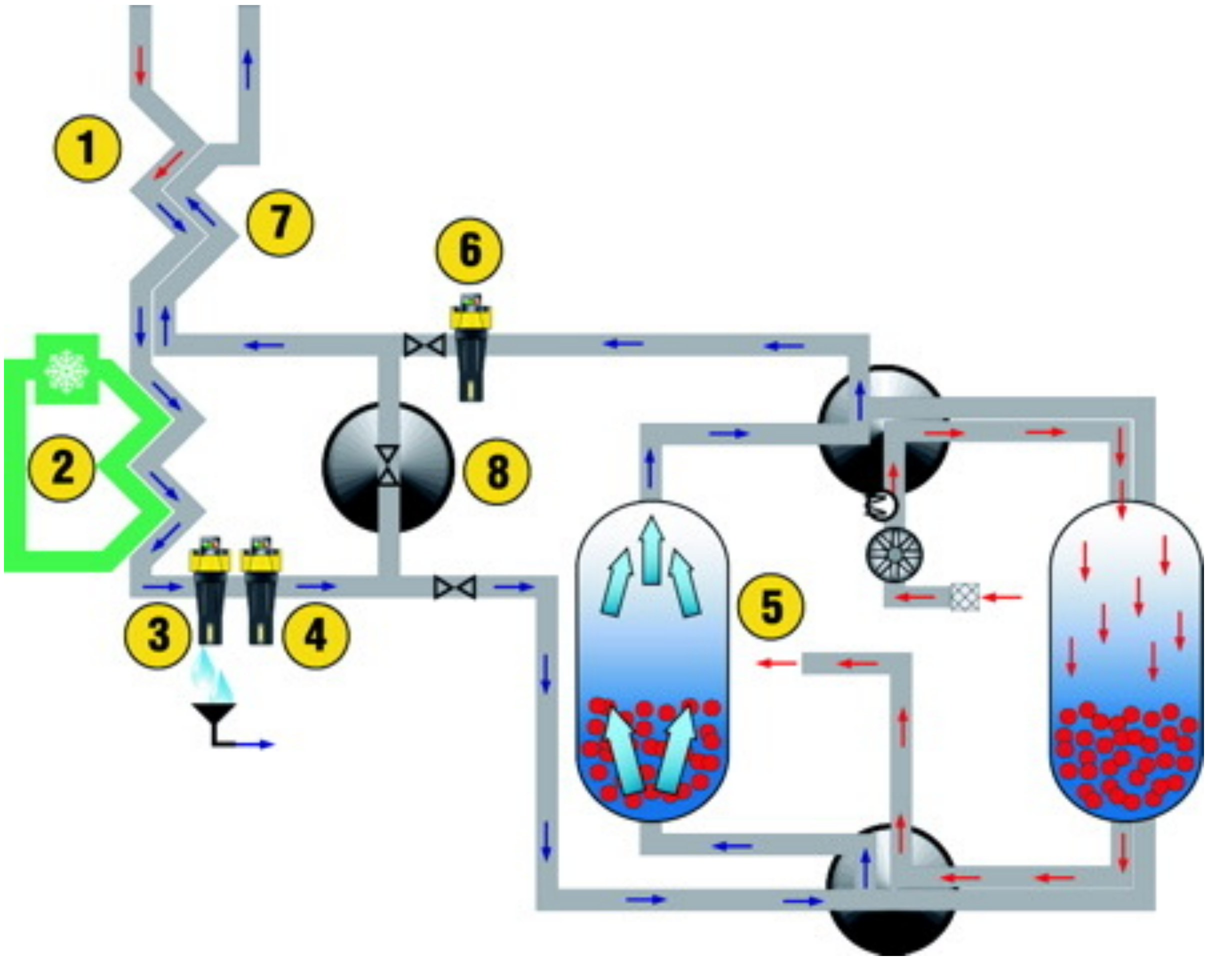
# Compressed Air Dryers

| Refrigerated vs. Desiccant Air Dryer Quick Reference Chart | | |
|---|---|---|
| | **Desiccant Air Dryers** | **Refrigerated Air Dryers** |
| Application | Metal finishing, paint lines, pharmaceutical, medical, food processing and other applications requiring ultra-dry air (ISO Quality Classes 1, 2 & 3); low-temperatures below freezing applications | Standard manufacturing and service application removes liquid water only(ISO Quality Classes 4, 5 & 6) |
| Typical Dew Point | -40°F to -100°F | +38°F |
| Initial Investment Cost | High | Low |
| Operating Cost | High to Moderate | Relatively Low |
| Maintenance Cost | Moderate | Low |

# Desiccant Dryer Cost Comparison

| Dryer Type | Purge % | Purge cfm | Equivalent kW | Heat/Blow kW | Annual kWh | Cost $ |
|---|---|---|---|---|---|---|
| Heatless | | | | | | |
| Externally Heated | | | | | | |
| Blower with CA cool | | | | | | |
| Blower no CA cool | | | | | | |

# Hybrid Dryer Process Schematic



# Compressed Air Opportunities

| | |
|---|---|
| **Pressure Limiting User** | Is one end-use driving up your pressure requirements?<br>What is the maximum pressure you actually require |
| **Compressor Checks** | Do you have more than one compressor?<br>Are they all operating, and do they have to be? |
| **Compressor Pressure Setpoints** | 2 psi = 1%<br>Minimize pressure reductions |
| **Filter & Dryers** | Dessicant or refrigerated?<br>Filters checked regularly |

# Evaluations

# Acknowledgments

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