Using FOG and Foodwaste to Increase Methane Production

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Terms

- Co-digestion –two or more inputs to digester
- FOG - FATS, OILS, and GREASE
- IKG - Inedible Kitchen Grease or trap grease
- Brown Grease - trap grease and sewer grease
- Yellow Grease - Used cooking oil from restaurants
- SSO –source separated organic (preconsumer) such as fruit and vegetable scraps
- CHP – Combined Heat and Power

Introduction and Overview

Why accept FOG and Food waste?

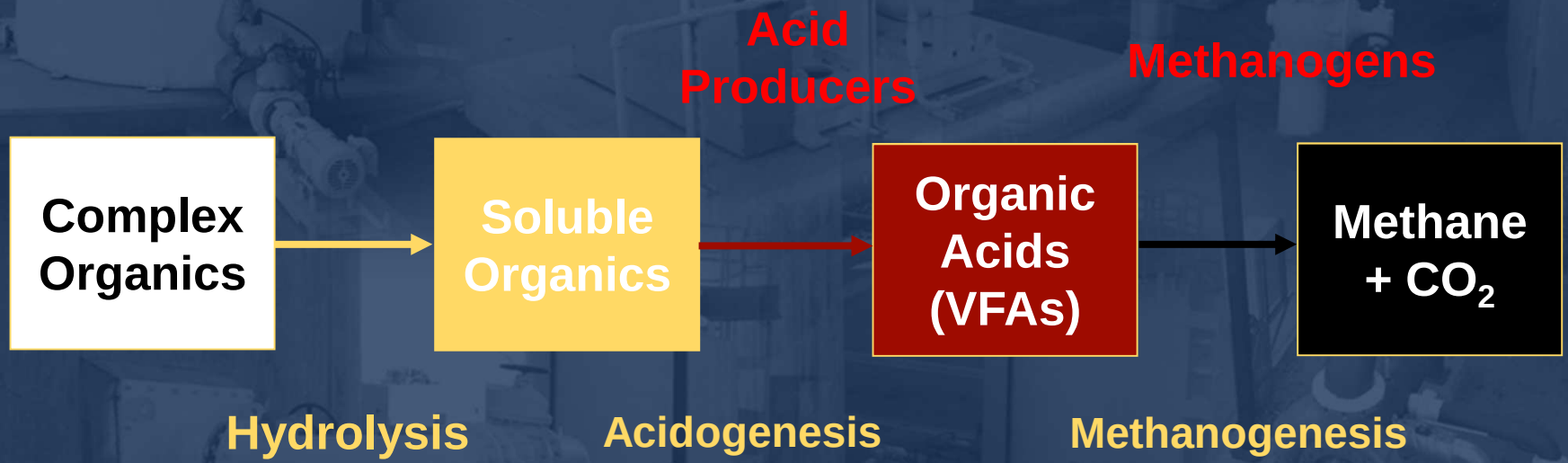
<u>FOG & Foodwaste will increase digester biogas production (more methane).</u>

Key Points

- Fats, Oils, and Greases (FOG) are very high energy feedstock to digesters.
- Separating FOG can eliminate problems in sewer collection systems.
- SSO food waste also a high energy feedstock.
- Utilize excess digester capacity and generate more biogas.

Anaerobic Digestion Process

Anaerobic digestion (simplified)



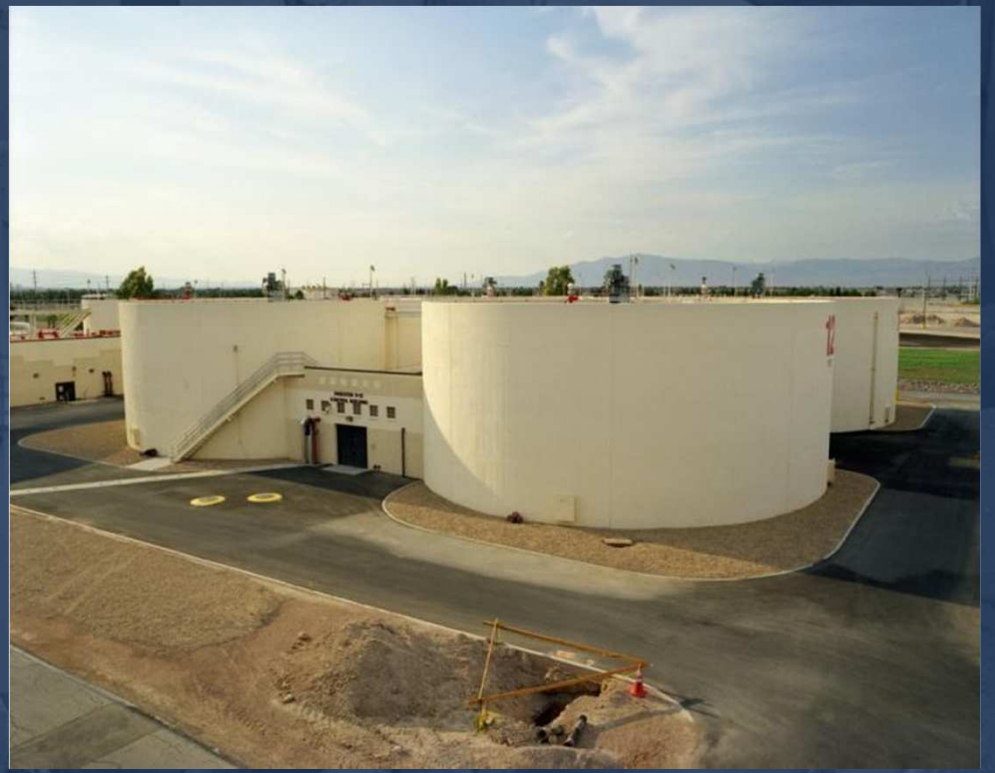
Biogas Production

	Gas yield per unit solids destroyed, m^3/kg (cu ft/lb)	Methane content (%)
Fat	1.2–1.6 (19–26)	62–72
Scum	0.9–1.0 (14.4–16)	70–75
Grease	1.1 (17.6)	68
Crude fibers	0.8 (12.8)	45–50
Protein	0.7 (11.2)	73
PS + WAS blend (typical)	0.8–1.1 (13–18)	60–70

Source: Design of Municipal Wastewater Treatment Plants, WEF, 2009

Anaerobic Digestion of Biosolids

Egg-Shaped Digesters



Conventional Digesters

How Can We Increase Digester Gas Production?

- Alternative Digestion or Biosolids Conditioning
- FOG / Food Waste
- Primary Treatment

FOG Receiving Designed by HDR

Napa Sanitation District FOG
Designed in 2011

City of Watsonville, CA
Designed in 2002

Case Study
Watsonville, CA

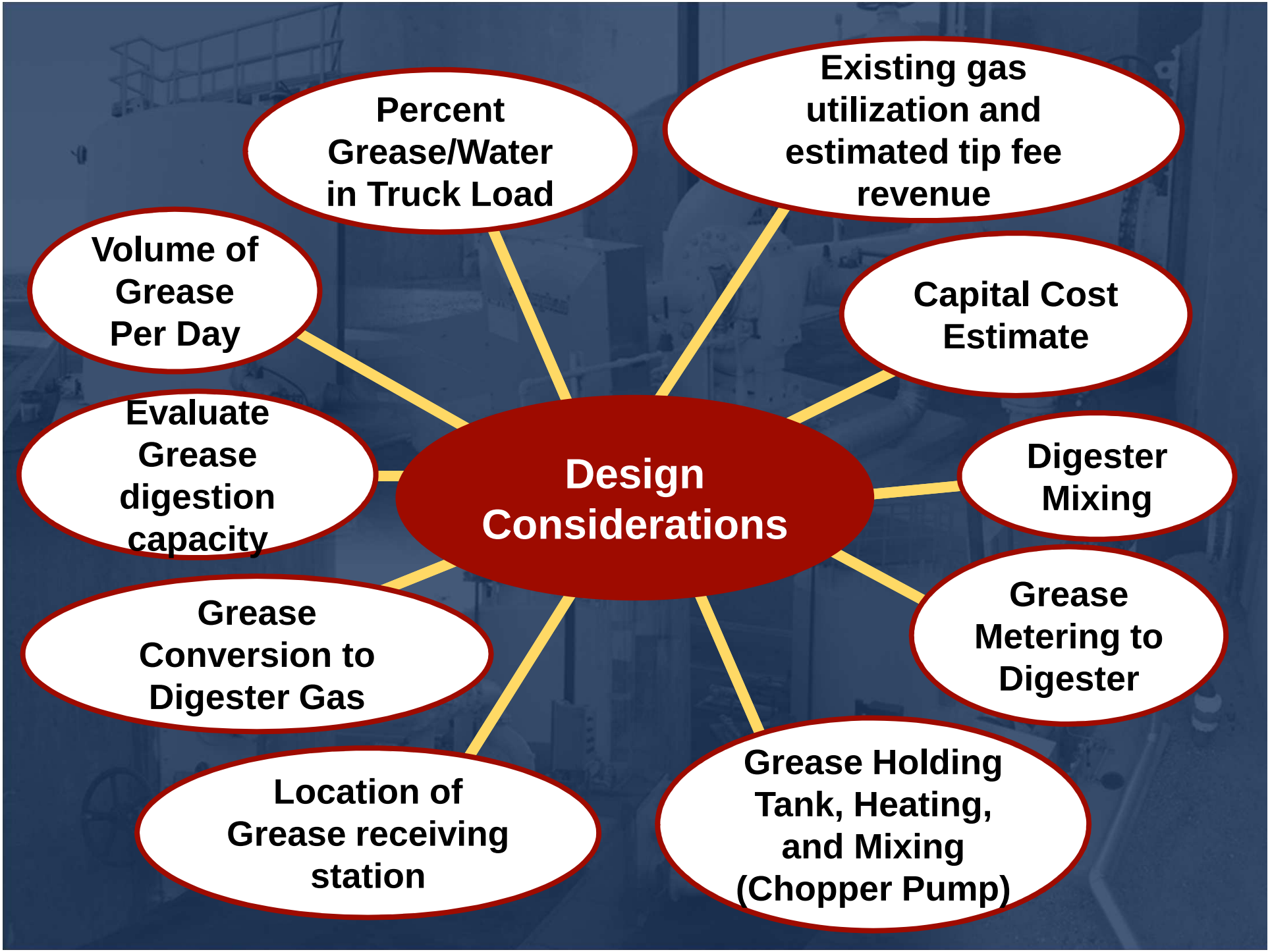
- Produce more biogas to utilize excess digester capacity
- Accept grease hauler truck loads – restaurant grease traps and other sources
- Project on-line January 2003: Compare 2002 thru 2006 digester gas production

Plant Description

- Average Daily Flow
  - 12.1 mgd Design
  - 7.4 mgd for 2002
  - 7.1 mgd for 2003
- Activated Sludge
- Digesters
  - Two 90-foot-diameter, 31.5 ft SWD, 1.5 MG each, primary/secondary operation
- Cogeneration System
  - One 600 kW engine generator, duel fuel digester gas/natural gas
- Digester Gas Storage Sphere (32-foot-diameter)

The Plan

- Feed grease to the primary digester to increase digester gas production and reduce natural gas purchases
- Cogeneration historically fueled with DG/NG
  - Fuels are blended at variable ratios, and adjusted one to two times daily
- Will grease digestion work?
  - Survey of other plants doing similar
- Watsonville has some similar experience with fruit waste digestion


Design Considerations
Percent Grease/Water in Truck Load
Existing gas utilization and estimated tip fee revenue
Volume of Grease Per Day
Capital Cost Estimate
Evaluate Grease digestion capacity
Digester Mixing
Grease Conversion to Digester Gas
Grease Metering to Digester
Location of Grease receiving station
Grease Holding Tank, Heating, and Mixing (Chopper Pump)

Design Criteria

Grease Holding Tank	11,000-gallon tank - Two 3,000 gallon loads/day
Grease Holding Tank Mixing Pump	Chopper Pump (300 gpm)
Digester Mixing Pump	Chopper Pump (5,000 gpm)
Grease Metering Pump	PD Pump (25 gpm)
Grease Holding Tank Heating System	Hot Water Piping Inside Tank (25 gpm)
Odor	Small Activated Carbon Canister at Top Manway

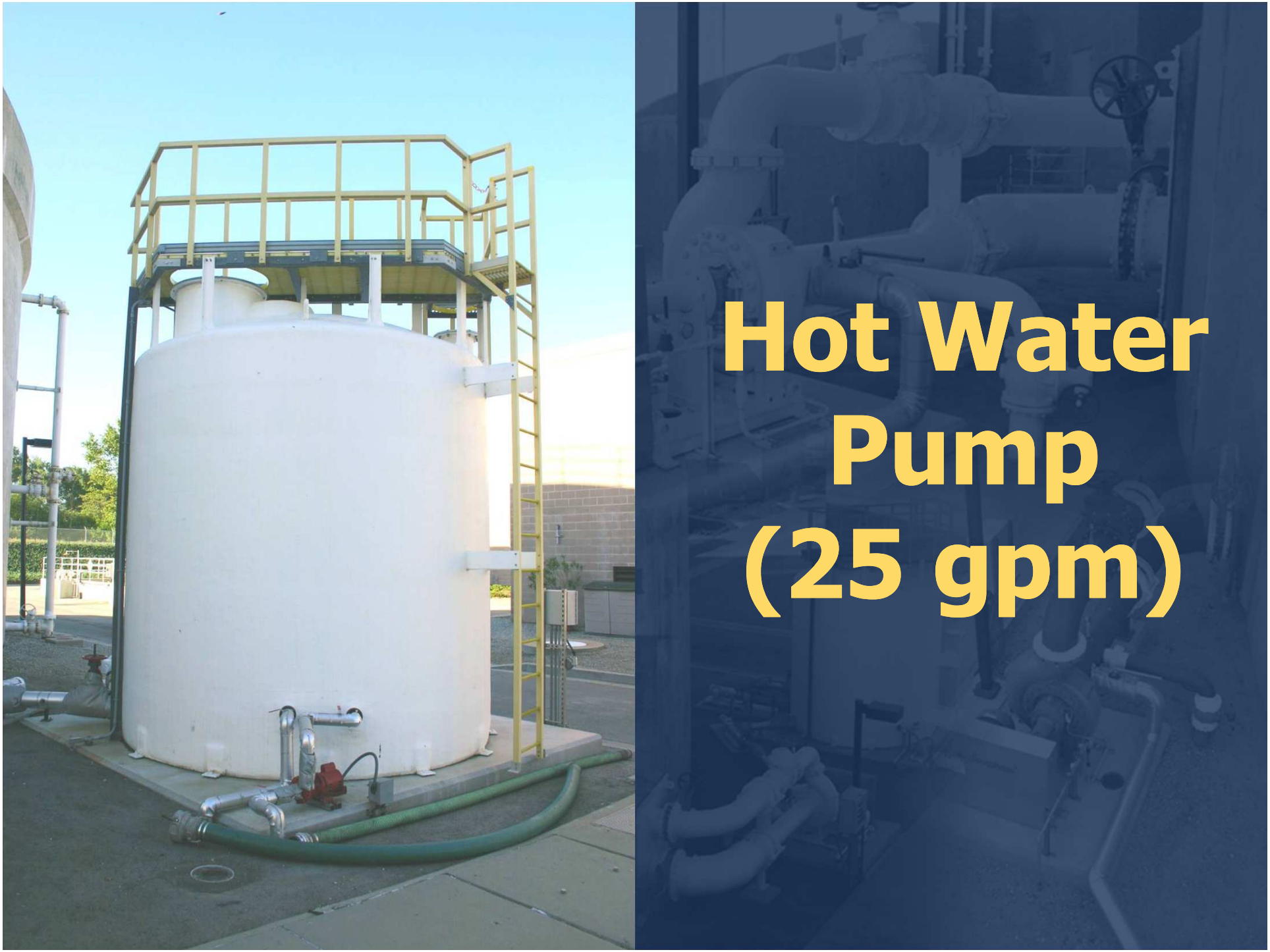
Design Criteria (continued)

- 6,000 gpd of grease mixture based on increase in digester gas production necessary to eliminate natural gas purchases
- Additional volatile solids loading to digester
- No increase in SRT in digester

Grease Holding Tank & Mixing Pump

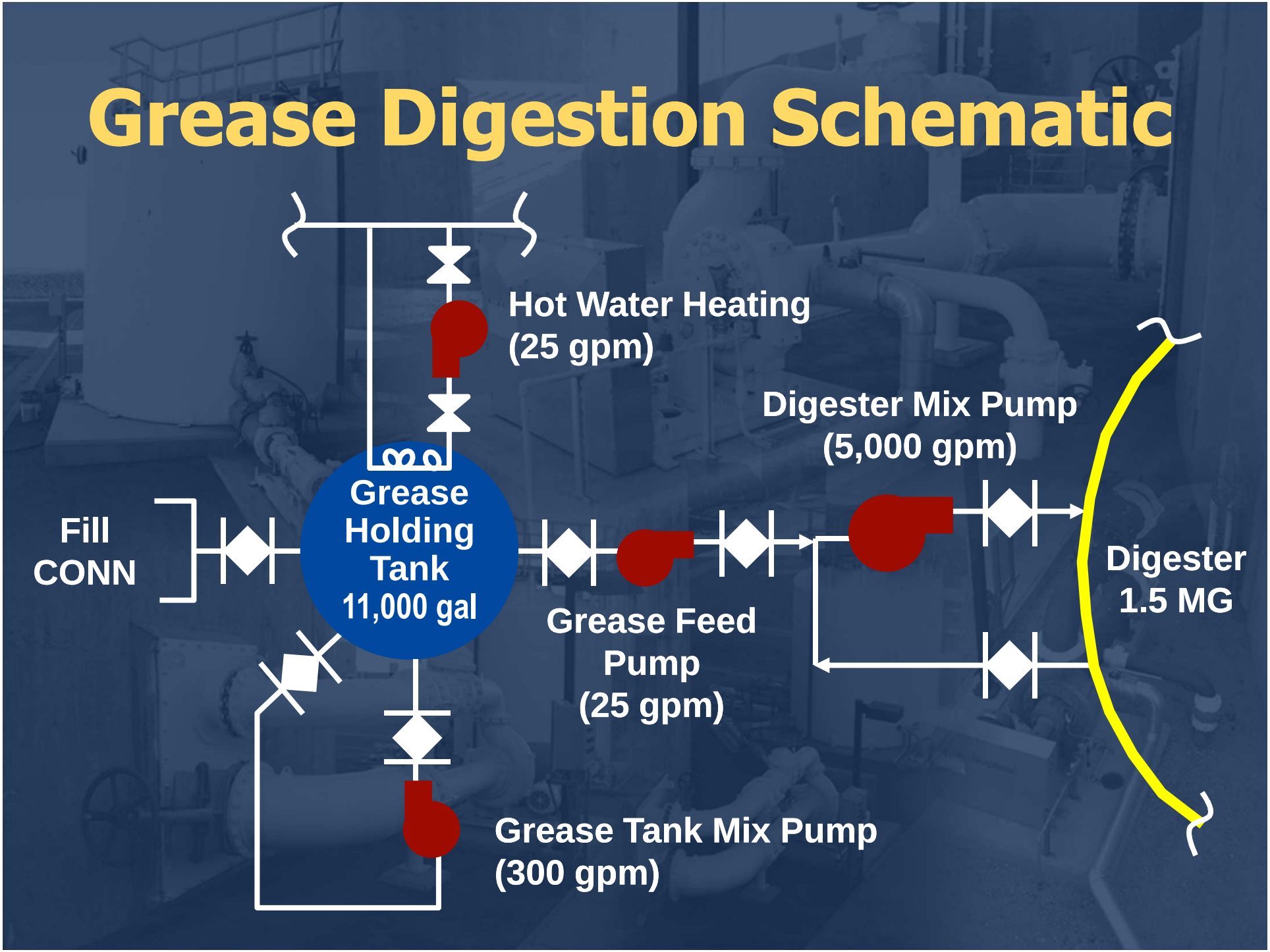
Grease Feed Pump (25 gpm)

Digester Mixing Pump (5,000 gpm)


Hot Water
Pump
(25 gpm)

Grease Unloading

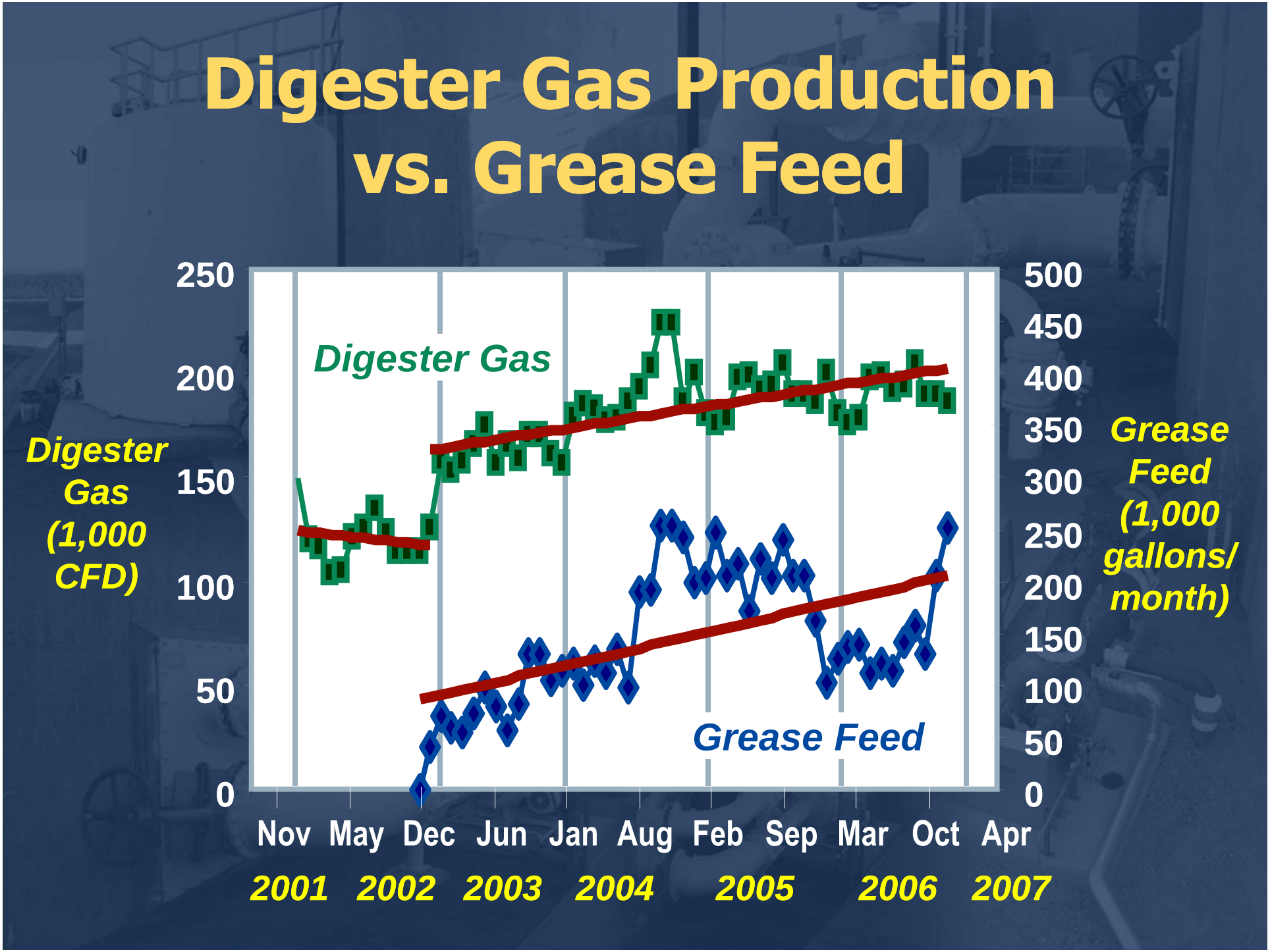
Grease Digestion Schematic



Project Economics

- Revenue is dependent upon natural gas avoided costs and grease tipping fees
- Maximum savings = Natural gas purchased for cogeneration plus tipping fees
- Capital cost = $270,000 actual
- Mixing energy savings – external pump mixing vs gas mixing (minor energy savings)
- O&M savings – gas mixing compressor not in use
- Grease tipping fees - $0.036/gallon

Digester Gas Production vs. Grease Feed



Results

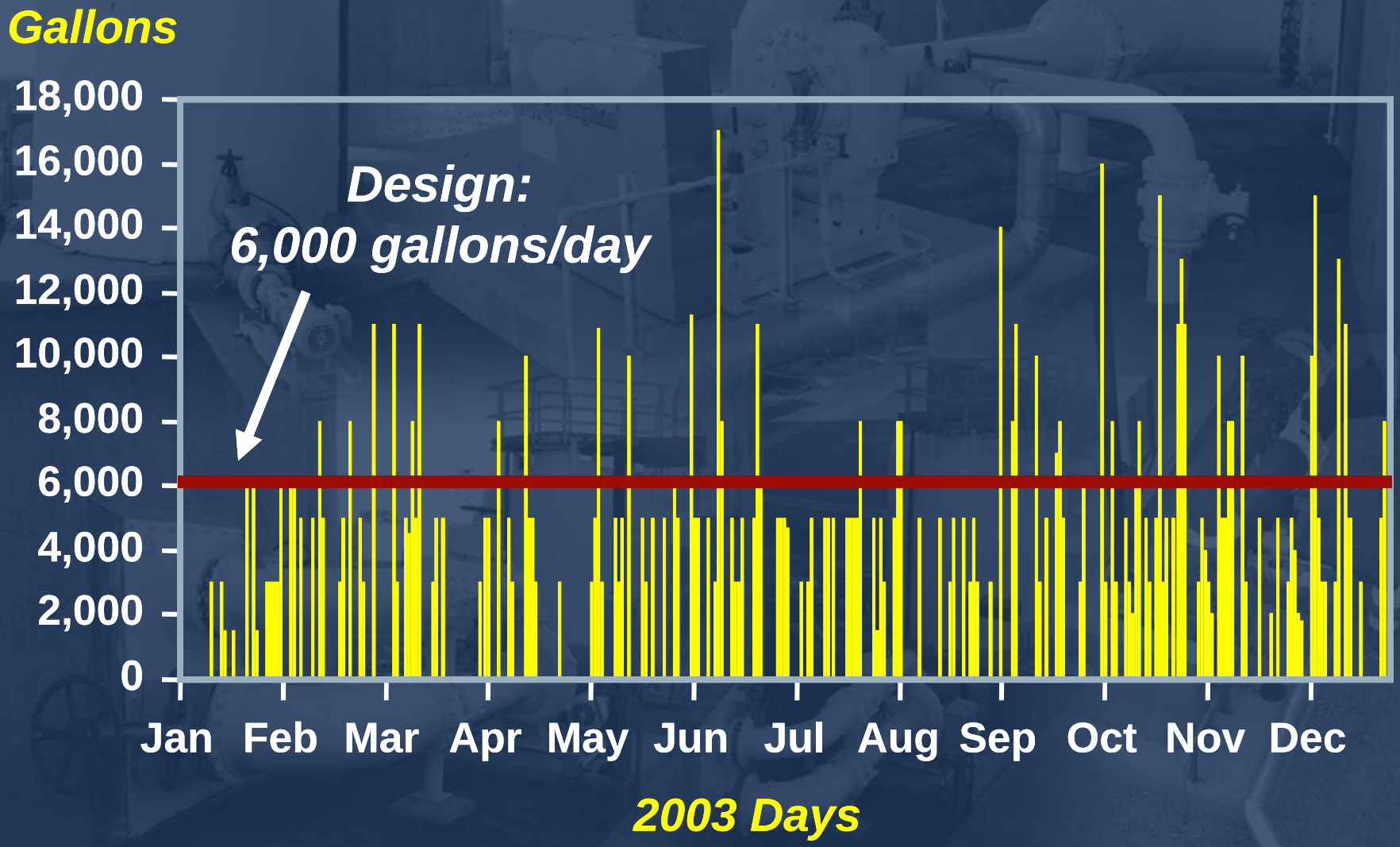
Startup - January 2003

**Build it and they will come –
if disposal fees are discounted**

Anticipated versus actual grease received

No tight control on grease delivery

2003 Daily Grease Loads



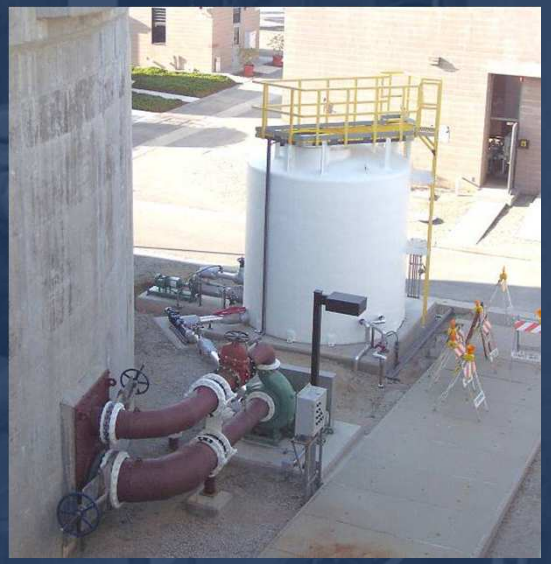
Grease/Water Mix

- Design assumption 40% grease
- 15% to 20% grease during first year of operation based on increased gas production

- Confirmation from other sources
- Increase acceptance from 6,000 gpd original design to 12,000-16,000 gpd
- Need to pump faster

Grease to Power Economics

- 17% grease, 83% water
- 100% volatile solids,
  100% digested
- 15 cf/lb volatile solids destroyed
- 600 btu/cf
- 32% engine-generator efficiency
- 120 KW per 3,000 gal load per day
- At $0.10/KWH - $288/day
- $0.096/gal



Summary of Grease Digestion Savings

Year	CFD NG	CFD DG	Grease Gal/Day	CFD NG Dec	CFD DG Inc	Grease Revenue	NG Savings	Total Savings
2002	98,124	113,250	0	0	0	$0	$0	$0
2003	84,150	143,204	2,612	13,974	29,954	$34,315	$61,207	$95,522
2004	71,250	179,998	5,232	26,874	66,747	$68,742	$117,708	$186,450
2005	65,017	166,457	6,471	33,107	53,206	$85,027	$145,010	$230,036
2006	68,668	185,868	4,526	29,456	72,618	$59,473	$129,018	$188,491
					Totals	$247,557	$452,943	$700,499

Next Time

- Intake Screen(s)
- Higher Capacity Digester Feed Pump
- Larger or second grease holding tank

FOG Digestion Can Increase Digester Gas by 50% to 100%

- Virtually 100% volatile solids destruction
- Highly degradable
- Relatively easy to accept, process, and find
- Very small increase in biosolids production
- May improve volatile destruction of primary/WAS

Food Waste Co-digestion

- Requires excess digester capacity . Same benefits. High energy, more biogas, minimal extra solids produced, additional revenue.
- Food Waste can be liquid such as cheese or yogurt whey. Feed to anaerobic digester reduces load on energy intensive secondary treatment.

Food Waste
Transfer Station Tipping Floor

SSO food waste is 30% solid and 70% liquid. Will require desizing and depackaging (Grinding/pulping)

Foodwaste Co-Digestion at WWTF in New York

- Two anaerobic digesters at municipal treatment facility with low industrial load
- Solution: Co-digestion - Adding primary solids and dairy wastes, e.g. yogurt and cheese whey from local manufacturers.
- Since 2002 after several upgrades to plant, Gloversville Johnstown WWTP have double VS load and electrcity output.
- CHP generating nearly all the electric power for the municipal WWTP plant.

FOG and Foodwaste

- Thank You
- QUESTIONS????

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