Renewable Fuels from Biogas

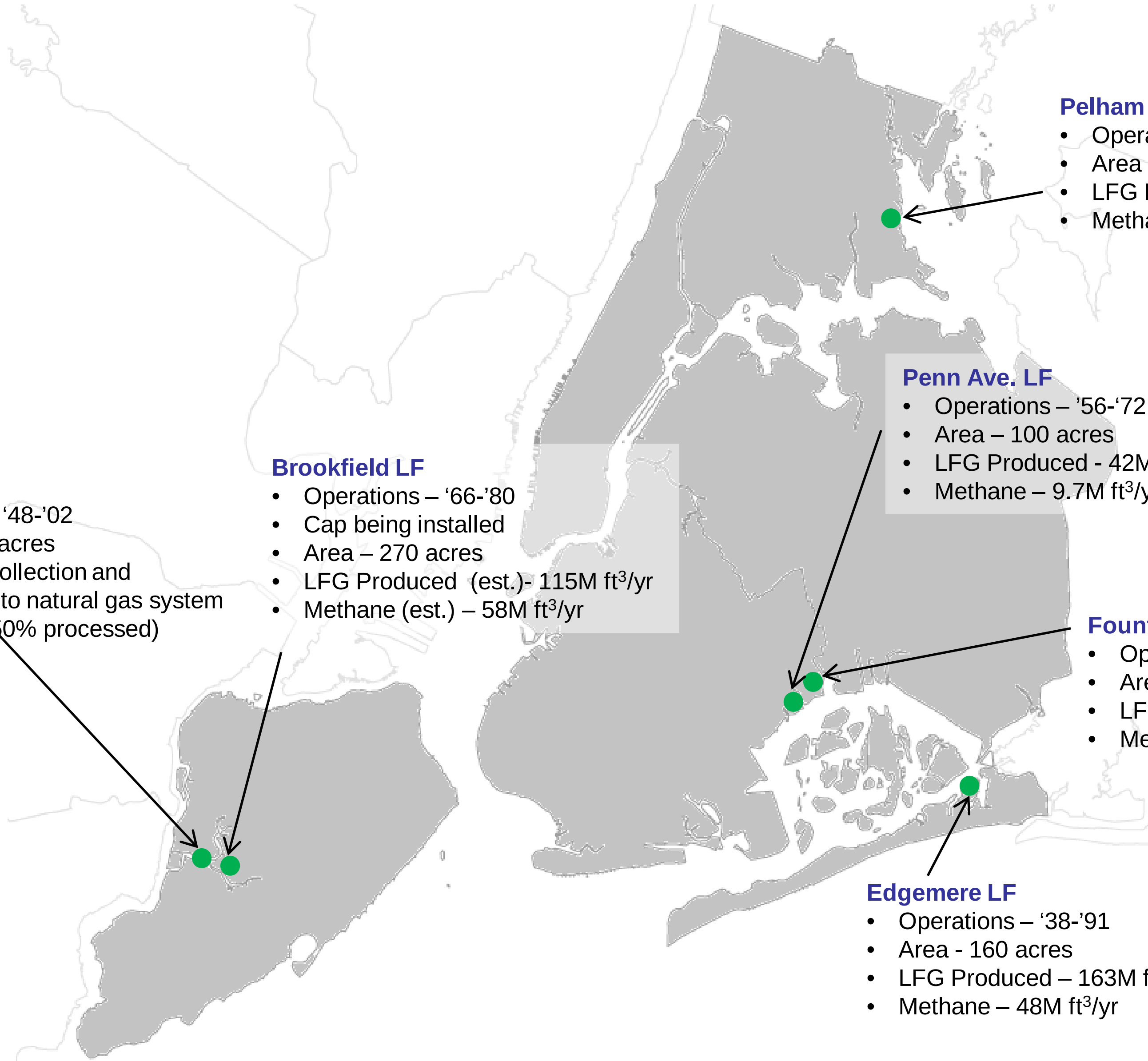
Connecticut Power and Energy Society

Anthony J. Fiore, M.P.H.

Chief of Staff, Operations

NYC Landfills

NYC Environmental Protection



Pelham Bay LF
- Operations - ‘63-‘78
- Area – 80 acres
- LFG Produced – 192M ft^3/yr
- Methane – 84M ft^3/yr

Penn Ave. LF
- Operations – ’56-‘72
- Area – 100 acres
- LFG Produced - 42M ft^3/yr
- Methane – 9.7M ft^3/yr

Brookfield LF
- Operations – ‘66-’80
- Cap being installed
- Area – 270 acres
- LFG Produced (est.)- 115M ft^3/yr
- Methane (est.) – 58M ft^3/yr

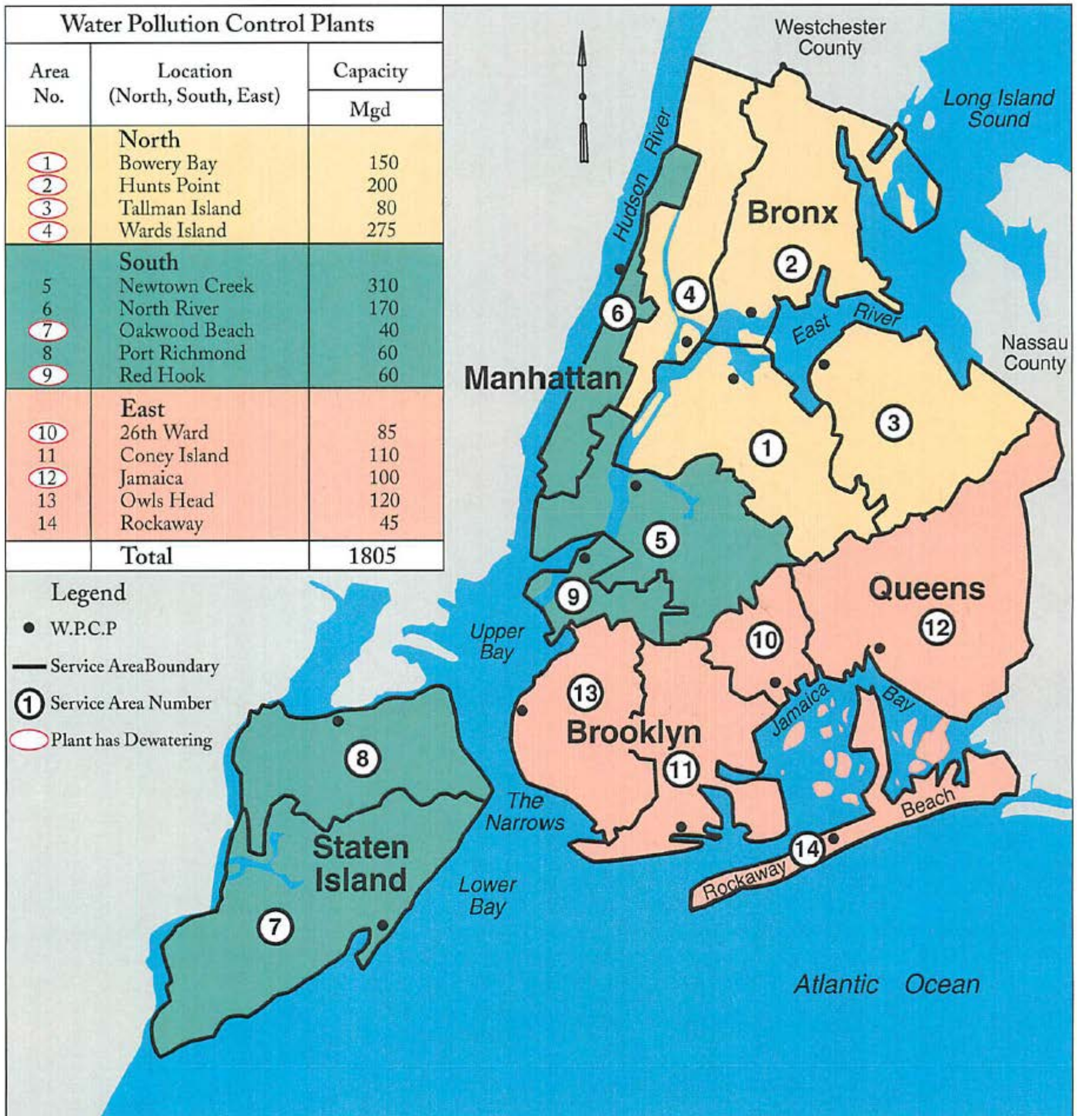
Freshkills LF
- Operations – ‘48-’02
- Area - 2,200 acres
- Landfill gas collection and distribution into natural gas system
- 365M ft^3/yr (50% processed)

Fountain Ave. LF
- Operations - ‘63-’85
- Area - 280 acres
- LFG Produced - 973M ft^3/yr
- Methane - 254M ft^3/yr

Edgemere LF
- Operations – ‘38-’91
- Area - 160 acres
- LFG Produced – 163M ft^3/yr
- Methane – 48M ft^3/yr

System Overview

New York City Plant Locations and Capacities



Water Pollution Control Plants		
Area No.	Location (North, South, East)	Capacity Mgd
	North	
1	Bowery Bay	150
2	Hunts Point	200
3	Tallman Island	80
4	Wards Island	275
	South	
5	Newtown Creek	310
6	North River	170
7	Oakwood Beach	40
8	Port Richmond	60
9	Red Hook	60
	East	
10	26th Ward	85
11	Coney Island	110
12	Jamaica	100
13	Owls Head	120
14	Rockaway	45
	Total	1805

History of Cogeneration Use

Mater Plan:

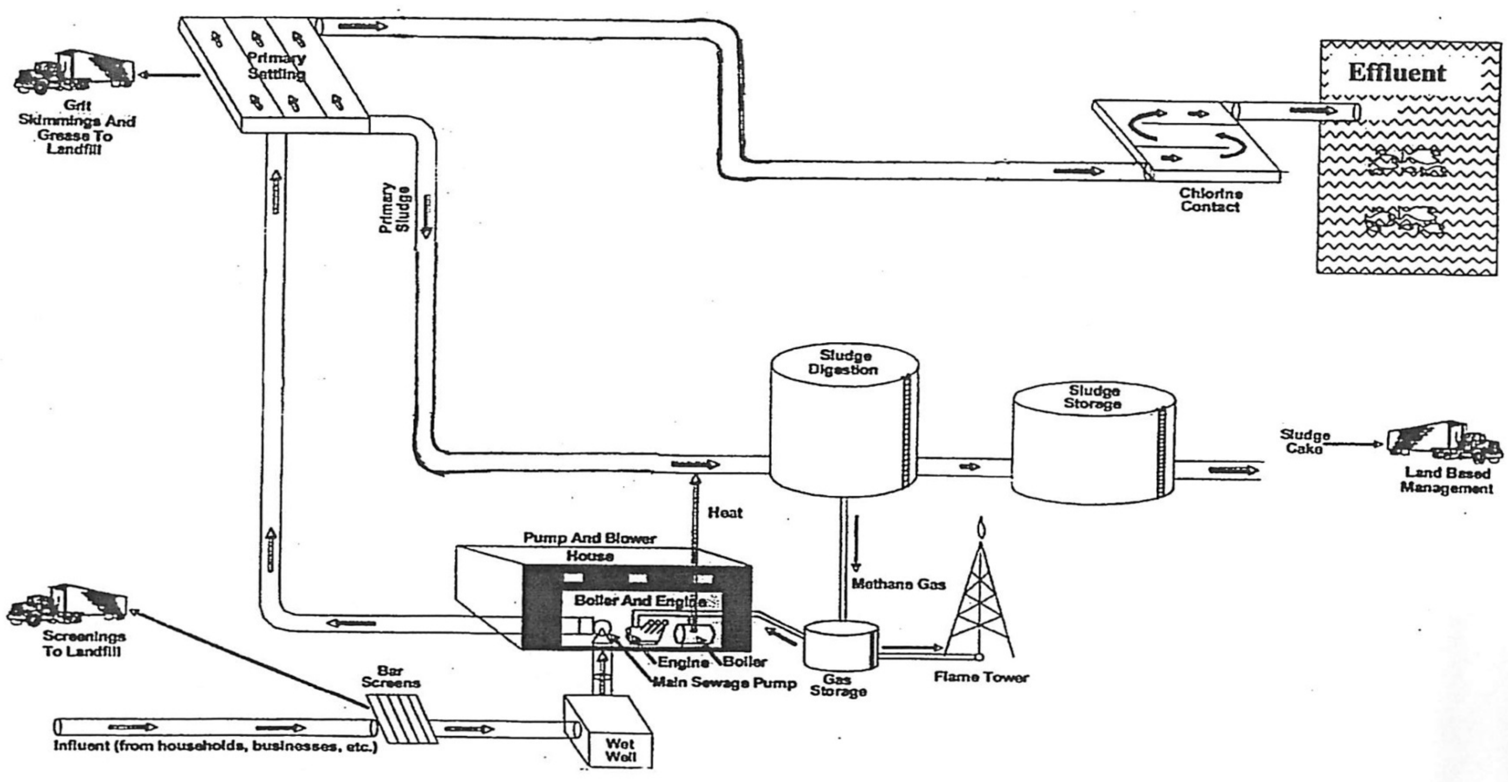
- Original Master Plan WWTP design concept included anaerobic digestion and use of biogas as a fuel source for cogeneration.
  - Coney Island WWTP was one of the first to use digester gas as an energy source to operate the plant
- 1950's and 1960's
  - 9 out of 12 WWTPs had some form of cogeneration which met most of the energy process needs
- 1980's
  - The North River, Coney Island, Owls Head, Tallman Island and Newton Creek WWTP's operated with engines

Enterprise DGSR-46 Dual Fuel Engine

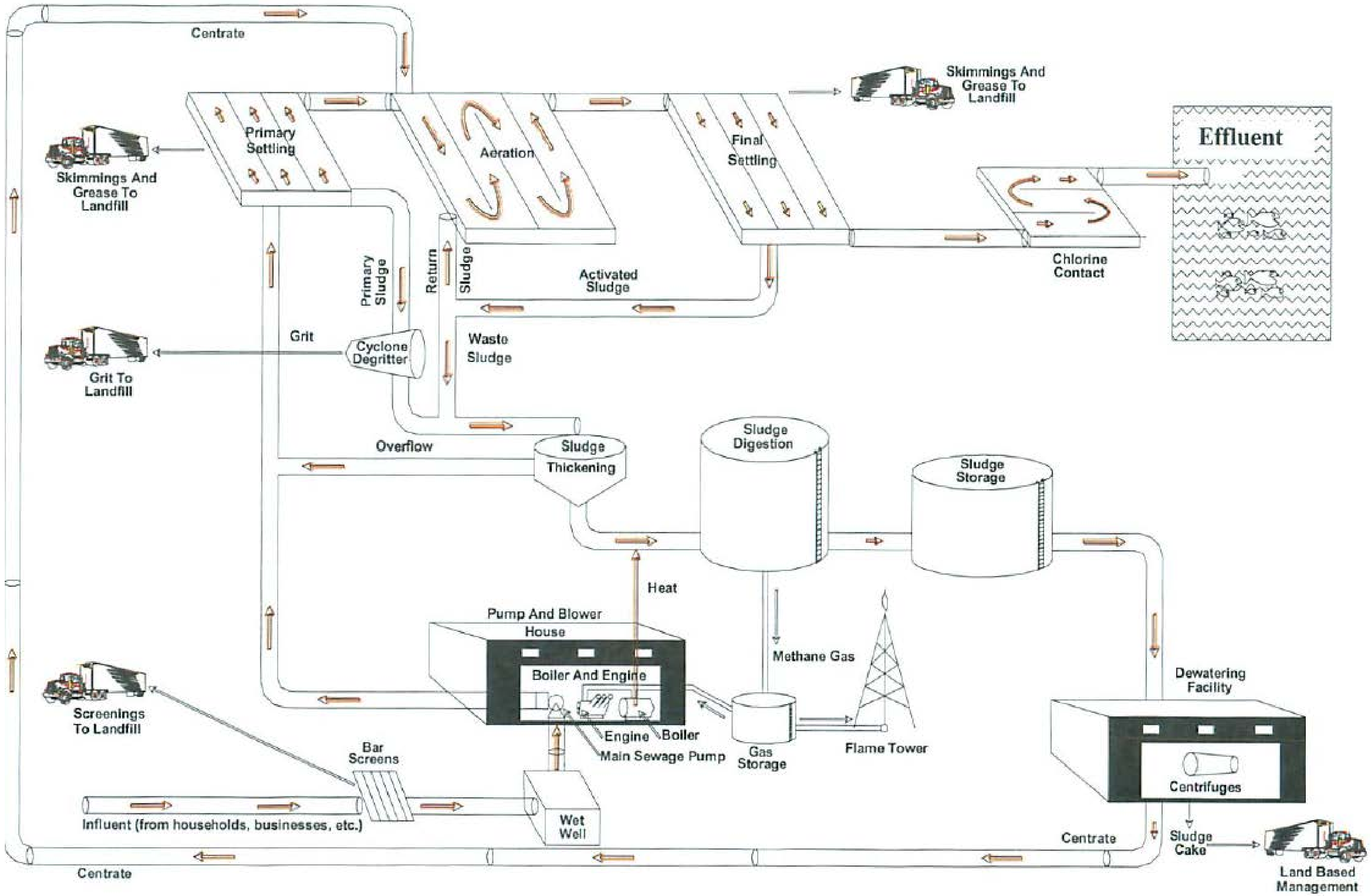
Mirrless Blackstone KP-5 major dual fuel engine

Process Layout of NYC WWTP - Original

Process Layout of an Old Typical NYC Wastewater Treatment Plant



Process Layout of NYC WWTP - Current



History of Cogeneration Use (Continue)

- 2000's
  - 2 fuel cells (200 kW each) were installed at the Red Hook WWTP in 2003
  - 1 fuel cells (200 kW) was installed at the Oakwood Beach WWTP in 2003
  - 2 fuel cells (200 kW each) were installed at the 26th Ward WWTP in 2003
  - 3 fuel cells (200 kW each) were installed at the Hunts Point WWTP in 2004.

Fuel Cells at the 26th Ward WWTP

Fuel Cells at the Hunts Points WWTP

Current Status of Cogeneration

- North River WWTP
  - Ten engines were installed (turbo charged dual fuel each 2246 hp/1600 kw)
    - 5 direct drive engines for the main sewage pumps
    - 5 direct drive engines for the blowers
  - Waste heat recovery:
    - Recovery of heat from engine for sludge heating, service water, and HVAC needs

Current Status of Cogeneration (Continue)

- Owls Head WWTP
  - Three engine generators were installed (turbo charged dual fuel each 2246 hp/1600 kw)
  - These cogeneration units have been in service for last 25 years
  - The plant is deriving 40% of total electric power from engine generators
  - Waste heat recovery:
    - Recovery of heat from engine for sludge heating, service water, and HVAV needs
  - Plant will be using two engine generators simultaneously to increase the cogeneration capacity.

Current Status of Cogeneration (Continue)

- Tallman Island WWTP
  - Five direct drive pump engines- DeLaval dual fuel 2 @ 520 hp, 3 @ 546 hp installed
  - Five direct drive blower engines- DeLaval 1,013 hp each
  - The plant is using most of the electric power from the engine generators
  - Waste heat recovery:
    - Recovery of heat from engine for sludge heating, service water, and HVAC needs

Current Status of Cogeneration (Continue)

- Coney Island WWTP
  - Four engine generators were installed (turbo charged dual fuel each 2246 hp/1600 kw)
  - These cogeneration units has been in service for last 25 years
  - The plant is deriving > 80% of total electric power from engine generators and utilize 100% digester gas production at plant
  - Waste heat recovery:
    - Recovery of heat from engine for sludge heating, service water, and HVAC needs

Forward thinking - Integration into WWTPs

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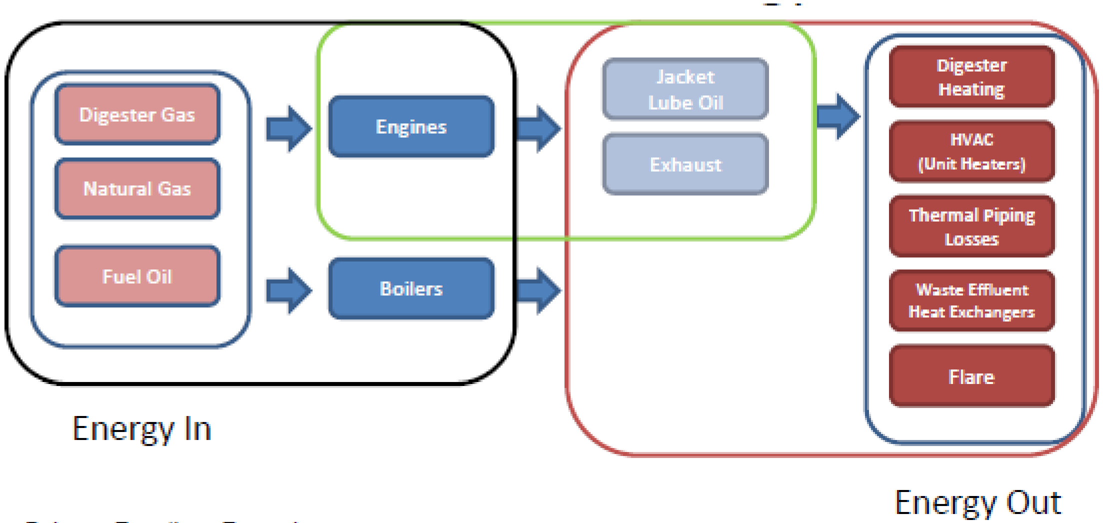
- **<u>Challenges</u>**
  - Air emissions
  - Public Acceptance
  - Space Limitation
  - Working in parallel with grid
  - Capital Cost
  - Technologies are more complicated and evolving quickly
  - Site specific issues

- **<u>Benefits</u>**
  - Mitigation of increasing electrical rates
  - Reliability
  - Flexibility in operations
  - Possible elimination of fuel oil and associated regulatory requirements
  - Reduce greenhouse gas emissions
  - Participation in demand response programs for additional revenue stream

Recommendations

- Perform a thorough feasibility study
  - Detailed electric and thermal profiles need to be created
  - Use as fine-grained data as available (15-minute interval metering data, thermal hourly load profiles)
  - Validate with energy balance



Energy Balance Equations Examples

Digester Gas + Natural Gas + Fuel Oil = Digester Heating + HVAC +Thermal Piping Losses +Waste Effluent Heat Exchangers +Flare

Digester Gas + Natural Gas + Fuel Oil = Engine + Boilers

Digester Gas + Natural Gas + Fuel Oil = Engine Power + Jacket Lube Oil + Exhaust

Jacket Lube Oil + Exhaust + Boilers = Digester Heating +HVAC+ Thermal Piping Losses + Waste Effluent Heat Exchangers

Recommendations (continued)

- Tightly define scope of project
- Run sensitivity analysis for a range of forward energy prices
- Size appropriately
- Factor in potential revenue streams from demand and market response programs
- Consider stand-by tariff rates
- Work closely with utility early on
- Consider extraneous benefits

Questions to Ask

- Is a cogeneration application at the plant a technically, operationally and economically viable alternative for consideration?
- Under what circumstances does the proposed cogeneration system become uneconomic?
- What is the estimated total project cost and total installed capacity for the installation of this project?
- What are the economics for the cogeneration plant investment based upon a range of future energy cost projections?
- What are the right financial metrics to measure the project (e.g., simple payback, ROI, IRR, NPV, etc…)?
- What are the three greatest risks to viability of the cogeneration project?
- What is the cogeneration system's net impact to the plant's greenhouse gas emissions and to the plant's air permit?
- Is there a negative impact in terms of a greater volume of emissions, noise, traffic, and risk of a catastrophic event on the site and to the neighbors of the cogeneration system versus the present equipment?
- Where will the cogeneration equipment be located?
- How long will the project take to design, permit, and construct?

- In an effort to reduce greenhouse gas (GHG) emissions, foster and develop local renewable energy resources and position New York City to be a leader in delivering innovative solutions in a new low carbon economy, National Grid and DEP are working together to deliver this renewable gas project at the Newtown Creek Wastewater Treatment Plant (Plant).

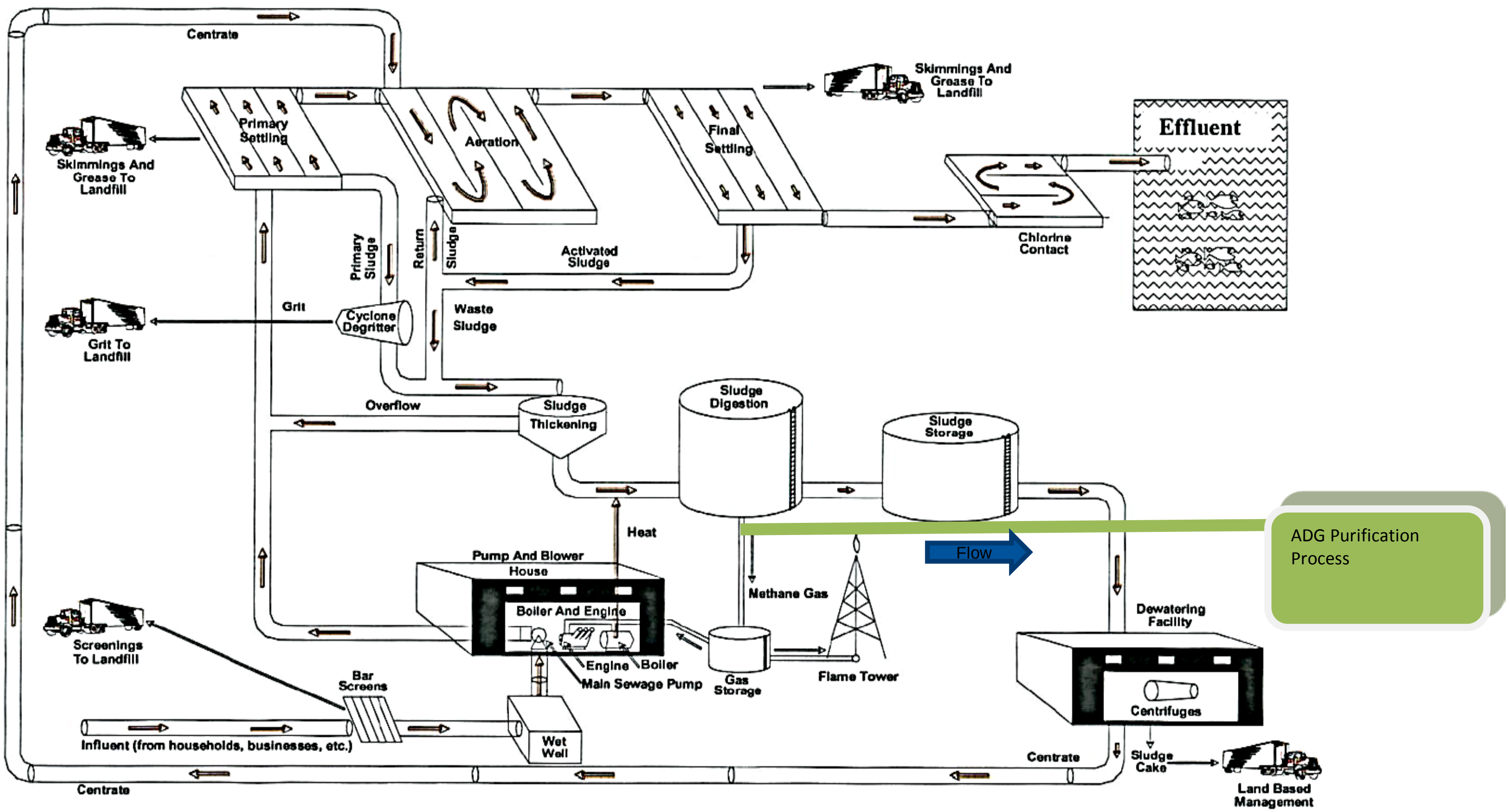
- This is a frontier project for the utilization of renewable gas, and is one of the **first examples** in the U.S. of a municipal or private water utility partnering with a natural gas utility to inject treated anaerobic digester gas from a wastewater treatment plant into the local gas distribution system.

- The wastewater treatment process produces a significant amount of anaerobic digester gas (ADG), **enough to heat 2,500 homes a year**. This ADG is used at the Plant on a limited basis but for the most part it cannot be used by DEP in its current state. The excess ADG not used at the Plant is flared into the atmosphere.

A Case Study– Plug and Play

- ❖ National Grid will install a purification system to remove carbon dioxide and unwanted compounds from DEP's ADG produced at the Plant. The resulting gas will be injected directly into National Grid's gas distribution system for consumption by local customers.

Process Layout of a Typical New York City Water Pollution Control Plant

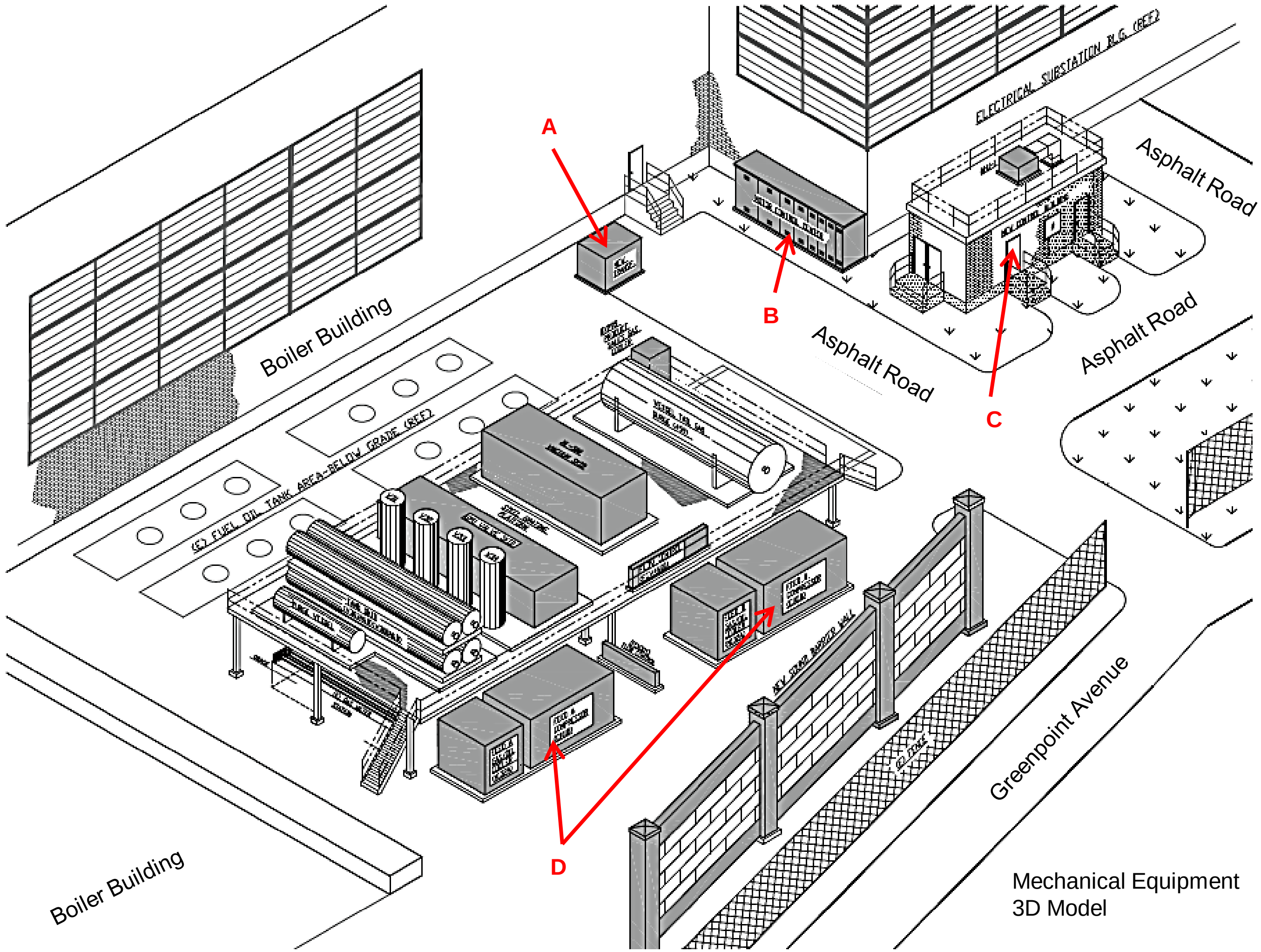


Case Study - Environmental Benefits

- Beneficial use of the ADG helps to achieve GHG reduction targets proposed by both NYC and National Grid.
- Using the Plant's ADG will offset National Grid's purchase of natural gas generated from traditional sources.
- This will result in a GHG reduction of approximately 15,000 metric tons of CO_2 per year.
- Equivalent to the removal of almost 3,000 vehicles from the road.
- Will provide enough gas to heat approximately 2,500 homes per year.

Case Study - Project Description

- Total footprint is approximately 7,000 ft^2.
- Other equipment includes:
  - A. A small transformer;
  - B. A motor control center;
  - C. A small monitoring station; and
  - D. Two compressors.



Mechanical Equipment 3D Model

19

Case Study - Design Considerations

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- ❖ Acoustic enclosure on compressors and sound mitigating screening wall to reduce noise levels and meet or exceed NYC Noise Prevention Code.
- ❖ Process shutdowns revert ADG back to Plant flares consistent with current operations.
- ❖ Designed and constructed to same codes as any other commercial project.
- ❖ Minimal waste streams, typically oil changes & filters.
- ❖ No odors due to this project.
- ❖ No permanent gas storage or tank farm.
- ❖ Minimal vehicles needed for operation; site is designed for temporary, off-street vehicle parking.

20

Case Study - Construction

- Construction is expected to begin Summer of 2013.

- Standard daytime construction hours planned.

- Construction will include:
  - Site preparation: footings, foundations, pads
  - Rigging and setting of the skid mounted equipment
  - Plumbing work to run piping and valving
  - Electrical connections
  - Gas main extension from project site to Russell & Calyer Street intersection
  - Monitoring station

Case Study - Operation

- Facility commissioning is expected in 2013.
- Equipment will be electronically monitored by National Grid staff 24/7.
- A National Grid technician will visit the site daily during the work week.
- Monitoring equipment will be tied into the Plant's Control Room.
- Plant personnel will perform visual inspections during their routine rounds.
- Facility will be operated to maximize gas throughput thereby providing the greatest benefits.
  - Reduce greenhouse gas emissions
  - Sustainable fuel that can be used in existing natural gas appliances
  - A renewable energy project cost competitive with traditional supply sources
  - New revenue stream to City in time of economic downturn

Case Study - City Contribution to Project

- Preferential electricity rates through NYPA
- Free Land
- Use of existing infrastructure
- Labor with certificates that meet FDNY regulatory requirements
- O&M assistance
- Free water and sewer connections

Questions and Answers