The Benefits of Using Landfill Gas at NASA Goddard Space Flight Center

Federal Environmental Symposium

October 30-31, 2019

Ouattara Fatogoma, Ph.D.
Kathleen Moxley
NASA Goddard Space Flight Center

Background – Goddard Space Flight Center (GSFC)

- Located in Greenbelt, MD
  - Laboratory facility where work consists of research, fabrication, and satellite tracking
- Marginal nonattainment area for O_3
  - 0.071 ppm <= Design value < 0.081 ppm
- Major source for NOx
  - NOx PTE => 25 tpy and located in Prince George's County (COMAR 26.11.02.01.C.(1)(c)(i))
- Area Source for Hazardous Air Pollutants (HAPs)
  - HAP < 10 tpy and combined HAPs < 25 tpy (COMAR 26.11.02.01.C.(1)(a)(i))
- Holds a Title V Part 70 Operating Permit
  - Title V Operating Permit limits total 12-month rolling sum heat input of boilers to 750,000 MMBtu

Background – GSFC

- Emissions Sources of Interest
  - Five 49.5 MMBtu/hr Boilers
    - Provide steam to buildings for heating, hot water, humidification, and process heating.
    - Burn natural gas
    - Burn #2 fuel oil during periods of natural gas curtailment
    - Three modified to burn landfill gas (LFG)
- Other Emissions Sources
  - #2 fuel oil Emergency Generators
  - Natural gas Space Heating Boilers
  - Semi-Conductor Facility
  - Aerospace Coating Shop
  - Electrochemical Plating Shop

GSFC LFG System

- Construction in 2002
- LFG use began in January 2003
- LFG from Sandy Hill landfill
  - ~5 miles from GSFC
  - Owned by Prince George's Co
  - 340 acre facility with 128 acres of municipal waste
  - Used to Flare ~100 MMBtu/hr of LFG
  - Received municipal waste starting in 1978
  - Closed in 2000

GSFC LFG System

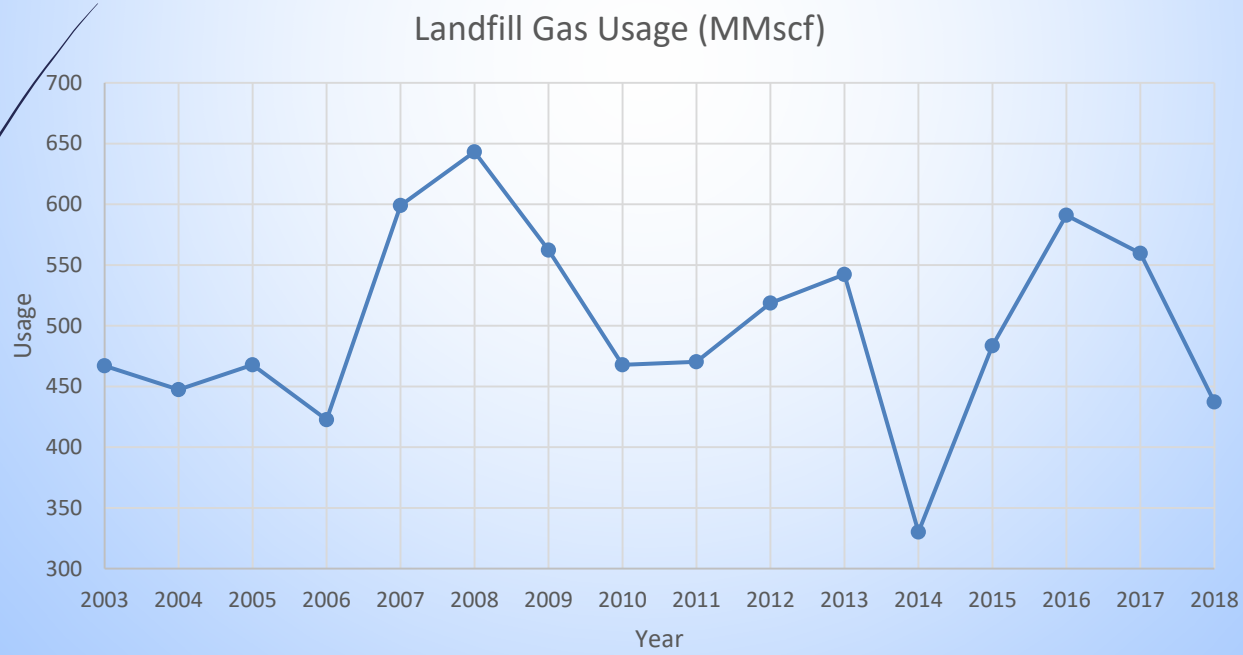
- Sandy Hill LFG Characteristics
  - product of anaerobic decomposition of solid waste in a landfill
  - 50% methane (CH_4), 40% carbon dioxide (CO_2), 2% Oxygen (O_2)
  - Heating value ~ 500 Btu/scf
- LFG Compressed at the landfill and piped to GSFC boiler plant

GSFC LFG System

- Three boilers modified to burn LFG
- Major concern corrosion
  - Corrosion
    - Caused by moisture combining with sulfur or chlorine in the gas
    - Installed a chiller/dryer at the Landfill to reduce LFG dew point temperature to 40°F
    - Maintain flue gas temperature > 280°F by insulating stacks
  - Flame Blowout
    - Add ~10% natural gas to prevent
  - LFG Outage

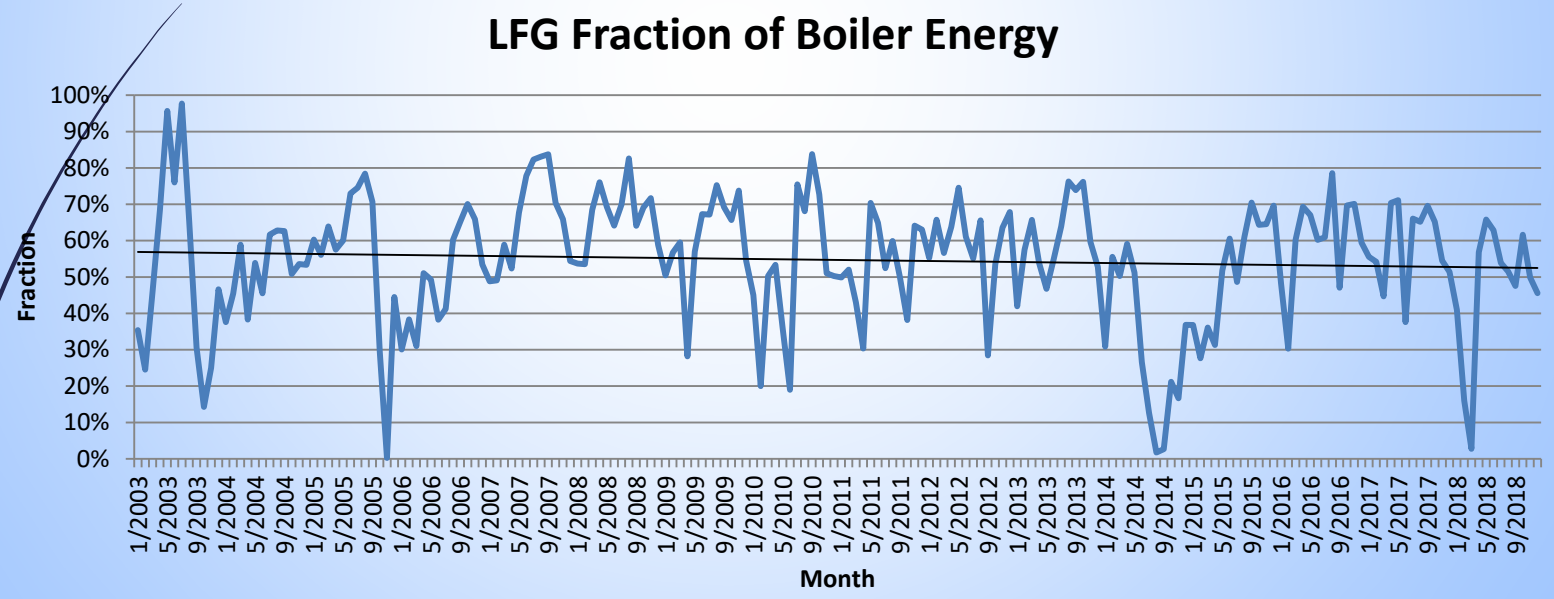
LFG Use at GSFC

- LFG annual Usage since January 2003
  - Monthly variation: 330,091,900 – 643,223,00 scf
  - 16-year total: 8,009,266,038 scf



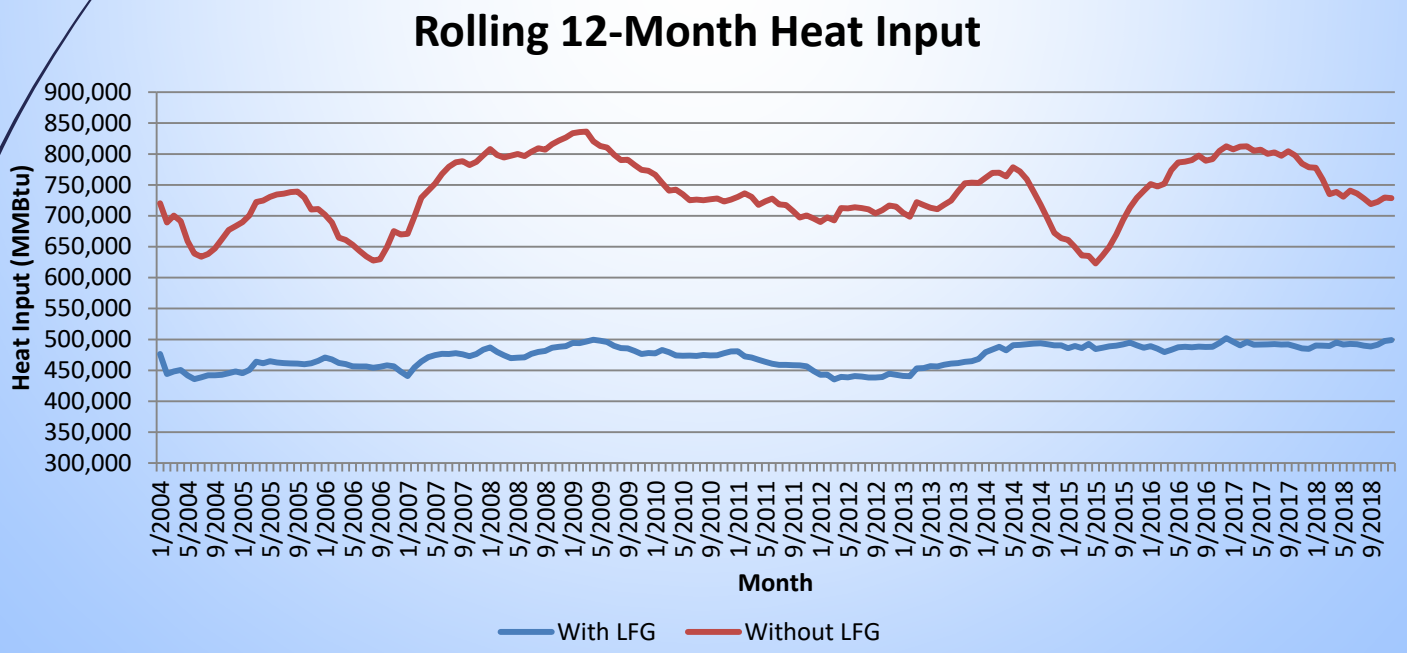
Landfill Gas Use at GSFC

- Since January 2003, LFG has accounted for 54% of the total energy input to the boilers



LFG Use Benefits

- Heat Input
  - With LFG less than limit (750,000 MMBtu/yr)
  - Without LFG (assume LFG usage is all NG) limit exceeded at the current usage



LFG Use Benefits

- NOx Emissions
  - 16-year NOx emissions reduction of 29% relative to the No LFG alternative
- Greenhouse Gas (GHG) Emissions
  - 2018 GHG Emissions from Combustion Sources
    - 26,686 metric tons CO_2e (include LFG)
    - Would have required GHG reporting > 25,000 metric tons threshold
    - LFG is biogenic therefore exempt from GHG calculations thus 2018 GHG emissions 15,581 metric tons CO_2e
    - GSFC exempt from GHG reporting

LFG Use Benefits

- Other GHG Emissions Benefits
  - From Landfill Methane Outreach Program (LMOP) Emission Reductions and Environmental and Energy Benefits for Landfill Gas Energy Projects model (June 2019)
  - The total 2019 benefits for a direct-use project using 8,009,266,038 scf of LFG since 2003 (1.37 MMscfd) are approximately equal to anyone of the following environmental benefits
    - Carbon sequestered by 155,187 acres of US in one year
    - CO_2 emissions from 306,764 barrels of oil consumed
    - CO_2 emissions from 14,842,883 gallons of gasoline consumed

LFG Use Benefits

- Removal of flared LFG emissions from the airshed
  - In the past 3,200-3,500 cfm (~100 MMBtu/hr) directly flared
  - Flaring creates high emissions of criteria pollutants and GHGs
- Lower GHG emissions with LFG fuel oil helps meet MD GHG reduction Goals

Challenges

- Availability of LFG
  - Landfill closed
  - LFG production uncertain
- GSFC growth
  - Increase steam usage

Questions????