Boiler Emissions Analysis

Baseline Emissions = LFG fired in boilers
New Emissions Scenario = Natural gas fired in boilers, LFG flared

LFG Energy Boiler Projects
Total Estimated MMBtu/hr of LFG Utilized = 1,896
Project Count = 60

Emissions Source	Pollutant	Baseline	New Scenario	Increase
Boiler Emissions (tpy)	Fossil CO2	0	873,972	873,972
	CO	same		0
	PM	same		0
	NOx	same		0
	SO2	115	4.4	-111
	Hg	same		0
Flare Emissions (tpy)	Fossil CO2	-	0	0
	CO	-	5,540	5,540
	PM	-	126	126
	NOx	-	295	295
	SO2	-	115	115
	Hg	-	0.0022	0.0022
Overall Emissions Increase (tpy)	Fossil CO2			**873,972**
	CO			**5,540**
	PM			**126**
	NOx			**295**
	SO2			**4.4**
	Hg			**0.0022**

LFG Energy Boiler-Steam Turbine Projects
Total Estimated MMBtu/hr of LFG Utilized = 2,499
Project Count = 17

Emissions Source	Pollutant	Baseline	New Scenario	Increase
Boiler Emissions (tpy)	Fossil CO2	0	1,151,726	1,151,726
	CO	same		0
	PM	same		0
	NOx	same		0
	SO2	152	5.8	-146
	Hg	same		0
Flare Emissions (tpy)	Fossil CO2	-	0	0
	CO	-	7,301	7,301
	PM	-	165	165
	NOx	-	389	389
	SO2	-	152	152
	Hg	-	0.0030	0.0030
Overall Emissions Increase (tpy)	Fossil CO2			**1,151,726**
	CO			**7,301**
	PM			**165**
	NOx			**389**
	SO2			**5.8**
	Hg			**0.0030**

Assumptions and Rationale:

1. To estimate boiler and flare emissions, emission factors were applied to the total estimated amount of LFG utilized (MMBtu/hr) for boiler projects and boiler-steam turbine projects from the LMOP database (as of Sept 20, 2011). Emissions for individual boilers and boiler projects were not analyzed.

2. CO2 - All CO2 generated from LFG (combustion of CH4 and generation of CO2 from decomposition of MSW) was considered biogenic and not included in the calculations. CO2 generated from combustion of natural gas as a fossil fuel (non-biogenic) was included in the calculations using an emission factor of 53.02 kg CO2/MMBtu (116.9 lb CO2/MMBtu) from Subpart C of the Greenhouse Gas Reporting Program (GHGRP).

3. CO, PM & NOx - For combustion by-products CO, PM & NOx, emission factors for LFG-fired boilers and natural gas-fired boilers were not found to be statistically unique and, in addition, they vary by individual boiler instead of fuel type. Therefore, for this analysis, it was assumed that CO, PM & NOx emissions from boilers would not change when the fuel is switched from LFG to natural gas. Emissions of CO, PM & NOx were estimated for LFG being flared using emission factors from AP-42 (Table 2.4-5) of 750 lb CO/million dscf methane, 17 lb PM/million dscf methane, and 40 lb NOx/million dscf methane.

4. SO2 emissions were estimated for the baseline and new emissions scenario because the amount of SO2 emitted from combustion in a boiler or flare varies by the fuel type. The decrease in SO2 boiler emissions is a result of LFG typically containing higher levels of sulfur than natural gas. SO2 emissions for LFG-fired boilers and flares were estimated using a default sulfur content of 46.9 ppmv for raw LFG from AP-42 (pg 2.4-8) and assumes all sulfur compounds in LFG are converted to SO2 during combustion. SO2 emissions from natural gas-fired boilers were estimated using an emission factor of 0.6 lb SO2/million scf from AP-42 (Table 1.4-2).

5. Mercury (Hg) - Emission factors for Hg for LFG-fired boilers and natural gas-fired boilers were not found to be statistically unique. The amount of Hg in LFG and natural gas was found to be very similar since Hg passes through combustion devices and the amount emitted varies by the amount of Hg in the fuel itself. Therefore, for this analysis, it was assumed that Hg emissions from boilers would not change when the fuel is switched from LFG to natural gas. Emissions of Hg were estimated for LFG being flared using a default Hg concentraion of 2.92E-04 ppmv from AP-42 (Table 2.4-1).

6. A gross capacity factor of 90% was applied to all of the emission calculations to account for loss of energy production due to problems in the gas collection system, problems with project equipment, weather related interruptions of the local utilities, and shutdowns at the energy consumer end of the system.

References:

AP-42 (LFG) - Chapter 2 (Solid Waste Disposal), Section 2.4 (MSW Landfills), November 1998.
http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s04.pdf
AP-42 (Natural gas) - Chapter 1 (External Combustion Sources), Section 1.4 (Natural Gas Combustion), July 1998.
http://www.epa.gov/ttn/chief/ap42/ch01/final/c01s04.pdf
Greenhouse Gas Reporting Program (GHGRP) - 40 CFR 98, Subpart C, Table C-1 (Default CO2 Emission Factors and High Heat Values for Various Types of Fuel), Default natural gas (weighted U.S. average) CO2 emission factor.
http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=4069608504fe50a3a5715cd4da0bae39&rgn=div6&view=text&node=40:21.0.1.1.3.3&idno=40