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Effects of Landfill Gas Emissions Reduction Strategies

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On-Site Emissions Reduction at WA Landfills

- Scenarios that cause landfills to reach WA CAR thresholds
  - Effects of collection efficiency, and methane oxidation and combustion on emissions
- On-site GHG emissions reduction for landfills
  - Effect of including biogenic CO_2 emissions from LFG combustion on achieving emissions reduction
  - Effects of organics diversion from landfills

Meet WA CAR GHG Emissions Threshold?

- Causes:
  1. Low LFG collection efficiency due to GCCS "under-performance"
  2. Model calculation method causes high LFG generation, low collection efficiency estimate
  3. Amount of waste in place too small for NSPS to require LFG collection (Tier 2)
  4. Large amount of waste in place – high emissions despite efficient LFG collection

Comparison of Conditions Reaching 70,000 Mg/Year

Mg CO_2e Emitted*	Collection Efficiency**	Oxidation	LFG Generated (scfm @50%)	LFG Collected (scfm @50%)
70,000	95%	35%	2,302	2,187
70,000	75%	25%	1,602	1,201
70,000	75%	10%	1,450	1,088
70,000	50%	10%	1,020	510
70,000	0%	10%	640	0

*Includes biogenic CO_2 from LFG combustion (assumes LFG is 50% CH_4, 50% CO_2)
**Assumes 99% destruction efficiency

Emissions of 70,000 Mg/Year

Parameter	High (95%) Collection Efficiency		Low (50%) Collection Efficiency	
LFG Generation (scfm)[1]	2,302		1,019	
LFG Recovery (scfm) [1][2]	2,187		510	
Oxidation (%/Mg CH_4)	35%	197 Mg	10%	248 Mg
Methane Emissions (Mg)	470		2,257	
Methane Emissions (Mg CO_2e)	11,762		56,426	
Biogenic CO_2 Emissions from LFG Combustion (Mg CO_2)	58,238		13,573	
% Emissions from Biogenic CO_2	83%		19%	

Notes:
(1) Values are adjusted to 50% methane content
(2) Assumes 99% destruction efficiency

Emissions of 100,000 Mg/Year

Parameter	High (95%) Collection Efficiency		Low (50%) Collection Efficiency	
LFG Generation (scfm)[1]	3,288		1,456	
LFG Recovery (scfm)[1][2]	3,124		728	
Oxidation (%/Mg CH_4)	35%	280 Mg	10%	355 Mg
Methane Emissions (Mg)	672		3,224	
Methane Emissions (Mg CO_2e)	16,800		80,610	
Biogenic CO_2 Emissions from LFG Combustion (Mg CO_2)	83,200		19,390	
% Emissions from Biogenic CO_2	83%		19%	

Notes:
(1) Values are adjusted to 50% methane content
(2) Assumes 99% destruction efficiency

Emissions at 75% Collection Efficiency

Emissions Threshold	70,000 Mg CO_2e		100,000 Mg CO_2e	
LFG Generation (scfm)[1]	1,602 scfm		2,288 scfm	
LFG Recovery (scfm)[1][2]	1,201 scfm		1,716 scfm	
Oxidation (%/Mg CH_4)	25%	487 Mg	25%	696 Mg
Methane Emissions (Mg)	1,520		2,172	
Methane Emissions (Mg CO_2e)	38,000		54,290	
Biogenic CO_2 Emissions from LFG Combustion (Mg CO_2)	32,000		45,710	
% Emissions from Biogenic CO_2	46%		46%	

Notes:
(1) Values are adjusted to 50% methane content
(2) Assumes 99% destruction efficiency

Effects of Diversion – Wet Site

- 150,000 tpy MSW disposal 1990-2040
  - Use 75% collection efficiency; 10% OX
  - Exceeds WA CAR thresholds in 2029 (~6 million TIP)
- Waste diversion starting in 2018 to remain below threshold
  1. Bulk waste model – need to reduce tonnage by 25%
     - Doesn't need to be organic waste
  2. Theoretical – Run negative models using separate k, DOC values: 17.5% diversion targeting organics
     - Green: 4% of total waste (~60% of disposed green)
     - Paper: 7.5% of total waste (~50% of disposed paper)
     - Food: 6% of total waste (~30% of disposed food)

Effects of Diversion – Dry Site

- 260,000 tpy MSW disposal 1990-2040
  - Use 75% collection efficiency; 10% OX
  - Exceeds WA CAR thresholds in 2029 (~10 million TIP)
- Waste diversion starting in 2018 to remain below threshold
  1. Bulk waste model – must reduce tonnage by 55%
  2. Theoretical: 25% diversion targeting organics
     - Green: 5% of total waste (~75% of disposed green)
     - Paper: 10% of total waste (~67% of disposed paper)
     - Food: 10% of total waste (~50% of disposed food)

Large WIP Sites

- Exceed thresholds at higher collection efficiencies
  - Large sites cannot meet standard even with very efficient controls and low methane emissions
  - Option to achieve collection efficiency standard would better reflect achievement of emissions reduction

Waste Diversion

- Waste diversion is a long-term strategy
  - Historical WIP limits effects of future diversion on emissions reduction
  - High diversion rate increases required to bend down LFG generation curve
  - Method of modeling LFG generation for GHG emissions may limit crediting of emissions reduction from organics diversion (dry climates)

Other Strategies

- Increase oxidation to 25% or 35%
  - Effect of collection efficiency improvements – lower CH_4 flux
  - Early closing of disposal cells and install final cover – 95% collection efficiency (HH-8)
- Sell LFG to be combusted off-site – avoid biogenic CO_2 emissions
  - Medium-Btu direct-use projects
  - CNG for vehicle use
  - Upgrade to high-Btu pipeline quality

Closing

Cover of Feb. 2, 1970 Time Magazine announcing first Earth Day

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OPEN DISCUSSION / Q&A

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