

Landfills and GHG Accounting at EPA

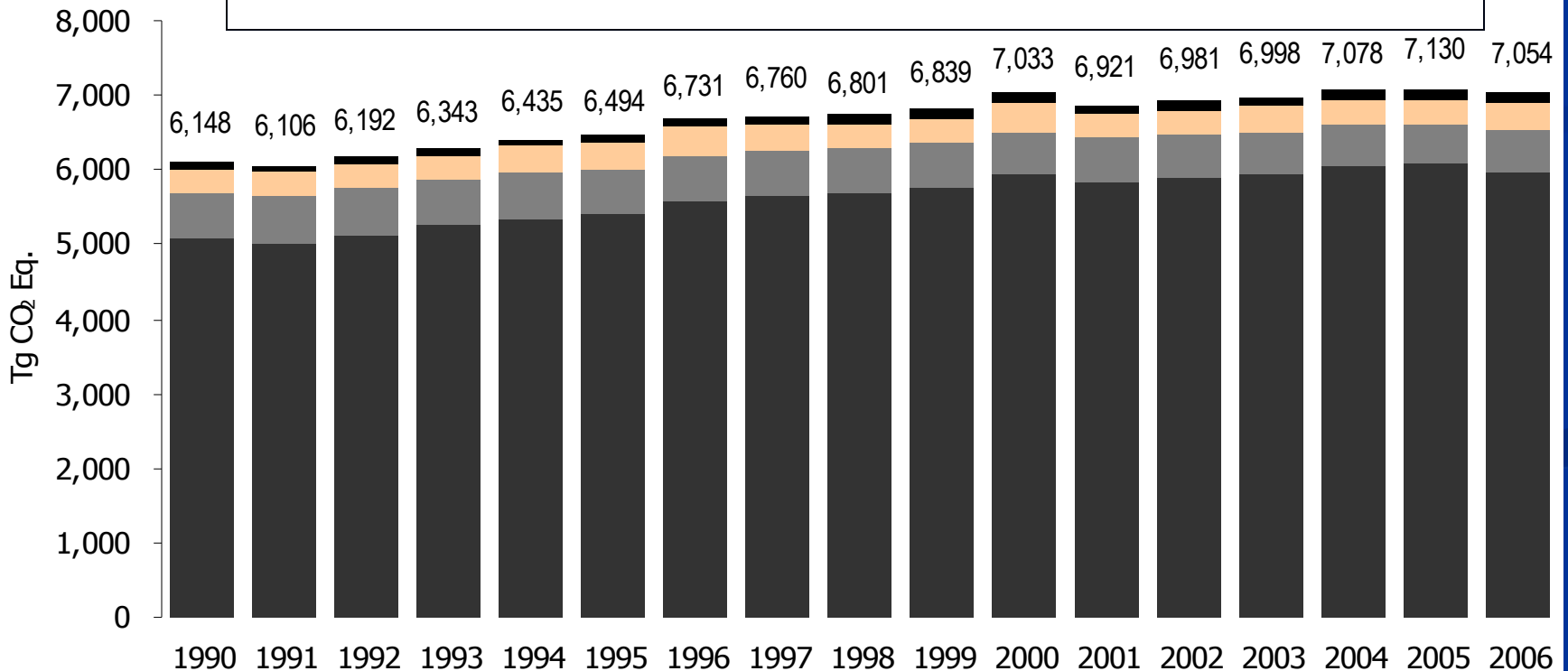
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Inventory of U.S. GHG Emissions and Sinks

- Annual reporting requirement under UNFCCC
- Estimates starting from 1990
- Total emissions are 7,054 MMTCO₂e
 - 2006 total, most recent finalized estimate
- Emissions increased 14.7% from 1990-2006



Landfill Emissions in the U.S.

- Landfill methane emissions 125.7 MMTCO₂e
- 2nd largest source of methane in U.S.
 - Largest is enteric fermentation
- 23% of U.S. methane emissions
- 2% of U.S. total emissions

Methodology Overview

Estimate MSW generation for 1940-2006

Estimate Industrial LF generation for 1940-2006

Estimate MSW and Industrial LF disposal for 1940-2006

Estimate methane generation

IPCC FOD model

Estimate methane recovery

LMOP DB

EIA DB

Flare vendors

Subtract methane recovery (assume 99% combustion efficiency)

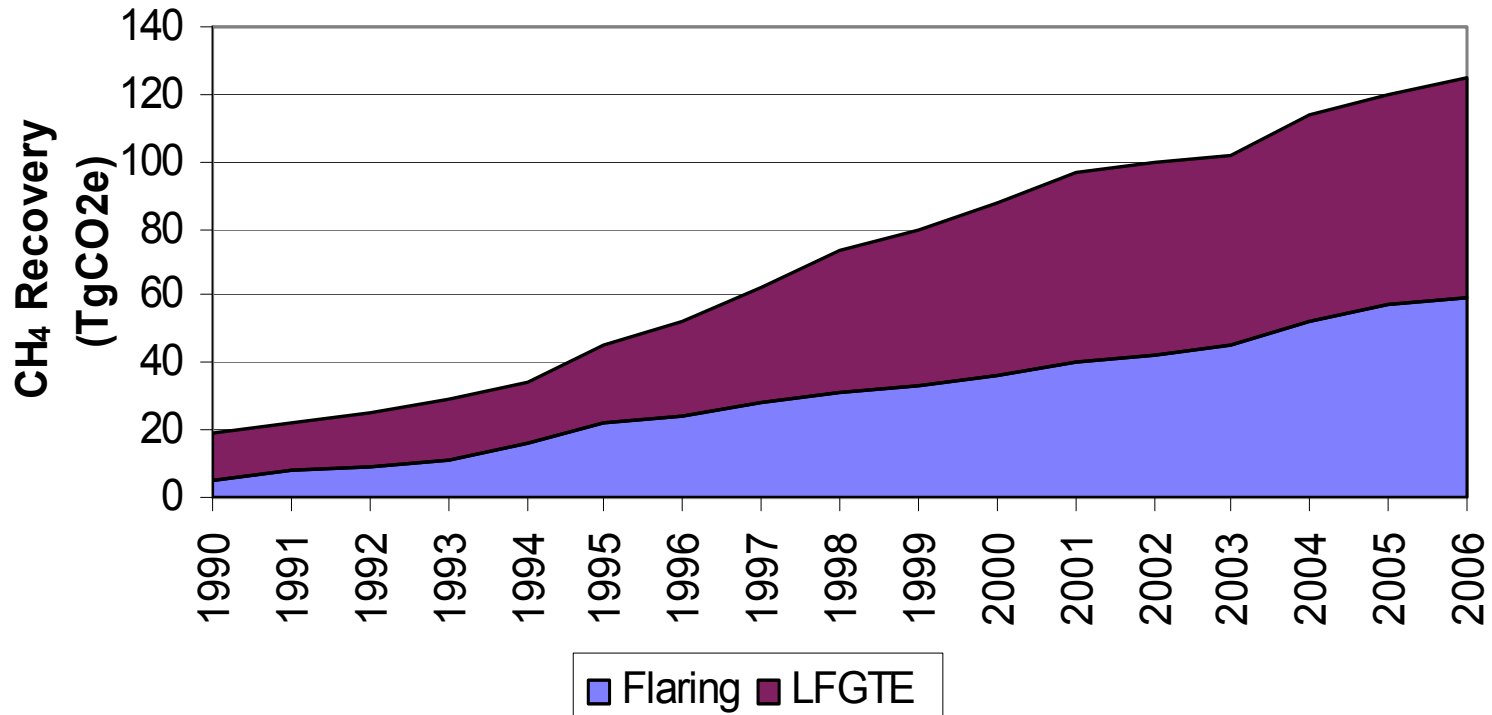
Subtract methane that is oxidized (10% of uncollected gas)

Emissions Avoided by CH₄ Recovery

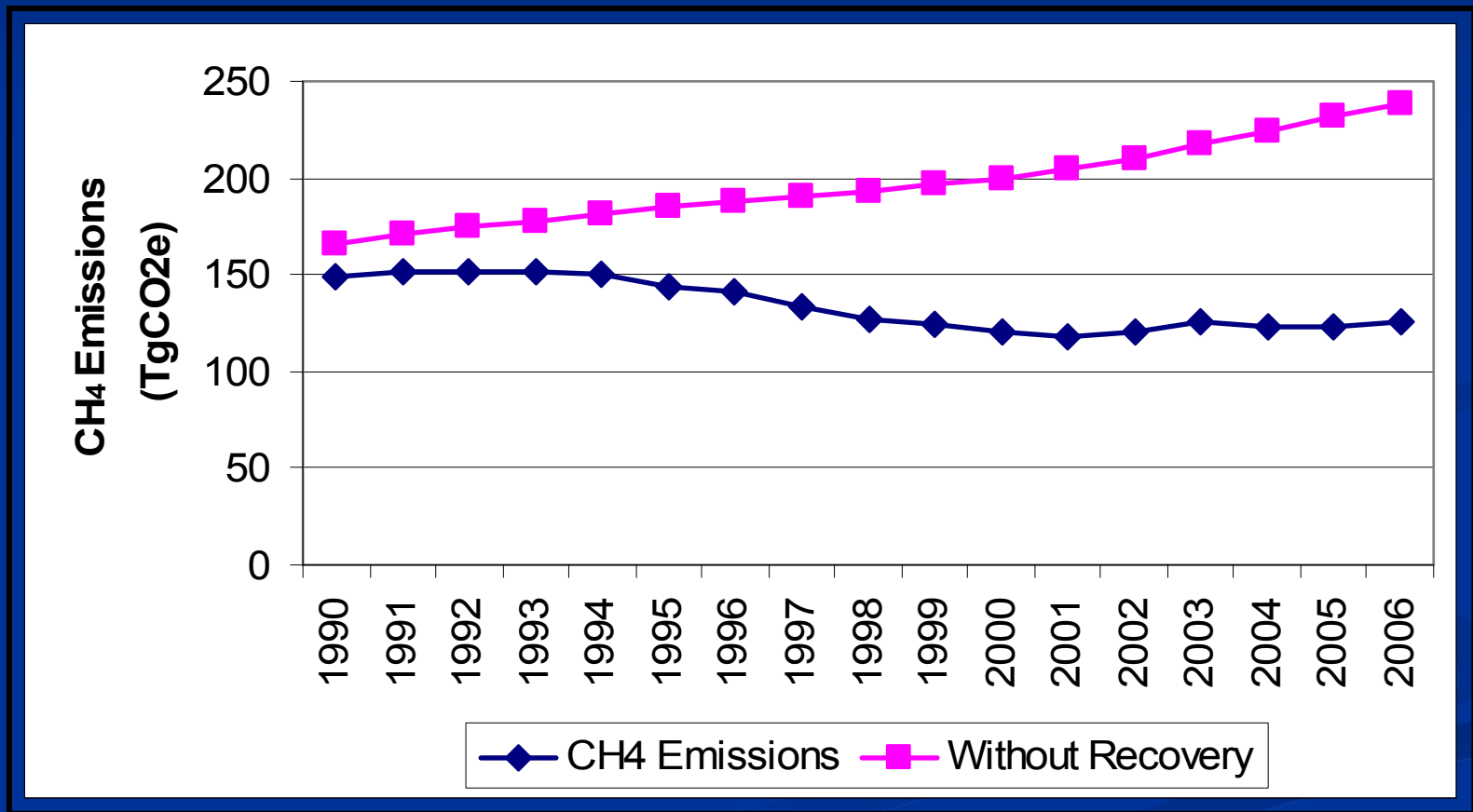
Example from 2006 emissions calculations (Tg CO₂e)

MSW Landfills	248.6
Industrial Landfills	16.2
Total Potential Emissions	264.7
Recovered	
Gas-to-Energy	(65.3)
Flared	(59.8)
Oxidized	(14.0)
Total Reductions	(139.1)
Net Emissions	125.7

CH₄ Recovery is Increasing



Effect of CH₄ Recovery on National Landfill Emissions



1990-2006 Trend

MSW Landfills

increases in population (19%) and per capita waste generation rate (2%)

increase in waste diversion

Industrial Landfills

24% increase in food processing wastes landfilled

7% increase in pulp and paper wastes landfilled

Recovery

5X increase in CH₄ recovered for energy

12X increase in CH₄ recovery by flaring

Waste Generation and Disposal

■ MSW

- Biocycle (2006) for 1989-2006
- EPA (1993) for 1960 to 1988
 - Used to estimate 1940's waste as well

■ Industrial

- Lockwood-Post Directory (Pulp and Paper)
- USDA National Agricultural Statistics Service (Food Processing Waste)

Estimate CH₄ Generation

IPCC FOD model

L_0 (as DOC in IPCC model) and k (3 different climates)

MSW country-specific L_0 , Industrial uses IPCC DOC

- Based on RTI 2004, EPA 1998, SWANA 1998, Peer, Thorneloe, and Epperson 1993

K calculated with FOD model and L_0 , found to increase with annual precipitation

- Waste quantity for each climate zone based on % population
- $MCF = 1$ (managed SWDS)
- $DOC_f = 0.5$
- $CH_4 \% = 0.5$

Estimate CH₄ Recovery

- EIA 1605(b)
 - data on landfill gas flow and energy generation for landfills with LFGTE projects
- LMOP database
 - data on landfill gas flow and energy generation for landfills with LFGTE projects
- Flare Vendors
 - range of landfill gas flow for given flare size
- Databases compared to avoid double-counting reductions
- Double counting of flares/LFGTE avoided by subtracting reductions associated for LFGTE projects with no identified flare
- No gas recovery from industrial landfills
- Apply 99% destruction efficiency

GHG Inventory: Your Input

- Public comment period will begin in about a month
- Past comments have been very useful
 - Identified errors
 - Identified improved sources of data
 - Helps us to prioritize improvements to the Inventory

More Information on GHG Inventories

- Inventory of U.S. Greenhouse Gas Emissions and Sinks

<http://www.epa.gov/climatechange/emissions/usinventoryreport.html>

- IPCC National Greenhouse Gas Inventories Programme

- <http://www.ipcc-nggip.iges.or.jp/>

Landfills and Carbon Offsets

- EPA Climate Leaders
 - Voluntary program
 - Encourages internal emissions reductions
 - Also allows Partners to use offsets to meet emissions reductions targets
 - Must use EPA's guidance on offsets

Calculating LFG Emissions Reductions

- Different approach than inventory
 - No estimate of generation (no use of FOD model)
- Emissions reductions are the difference between baseline and project
- Based on measured flow to gas combustion device
 - Consistent with most other protocols
- Emissions reductions = methane combustion minus cover soil oxidation
 - 10%

Calculating Reductions from End Use of LFG

- Four end use project types included in protocol
 - Generation of hot water or steam from boilers (onsite and offsite)
 - Generation of electricity (Displacing onsite fossil fuel use)
 - Delivery of captured methane into a pipeline system or conversion to CNG or LNG
 - Other direct uses
 - e.g., furnaces, kilns, engines, space heaters, chillers

More Information

- Climate Leaders Offsets Guidance

<http://www.epa.gov/climateleaders/resources/optional-module.html>

- Landfill Offsets Protocol

<http://www.epa.gov/climateleaders/documents/resources/draft-landfill-offset-protocol.pdf>

- Draft protocol for emissions reductions from energy use of methane

<http://www.epa.gov/climateleaders/documents/resources/EndUseOffsetProtocol.pdf>