U.S. EPA Solid Waste Greenhouse Gas Inventory: Background

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Rachel Schmeltz

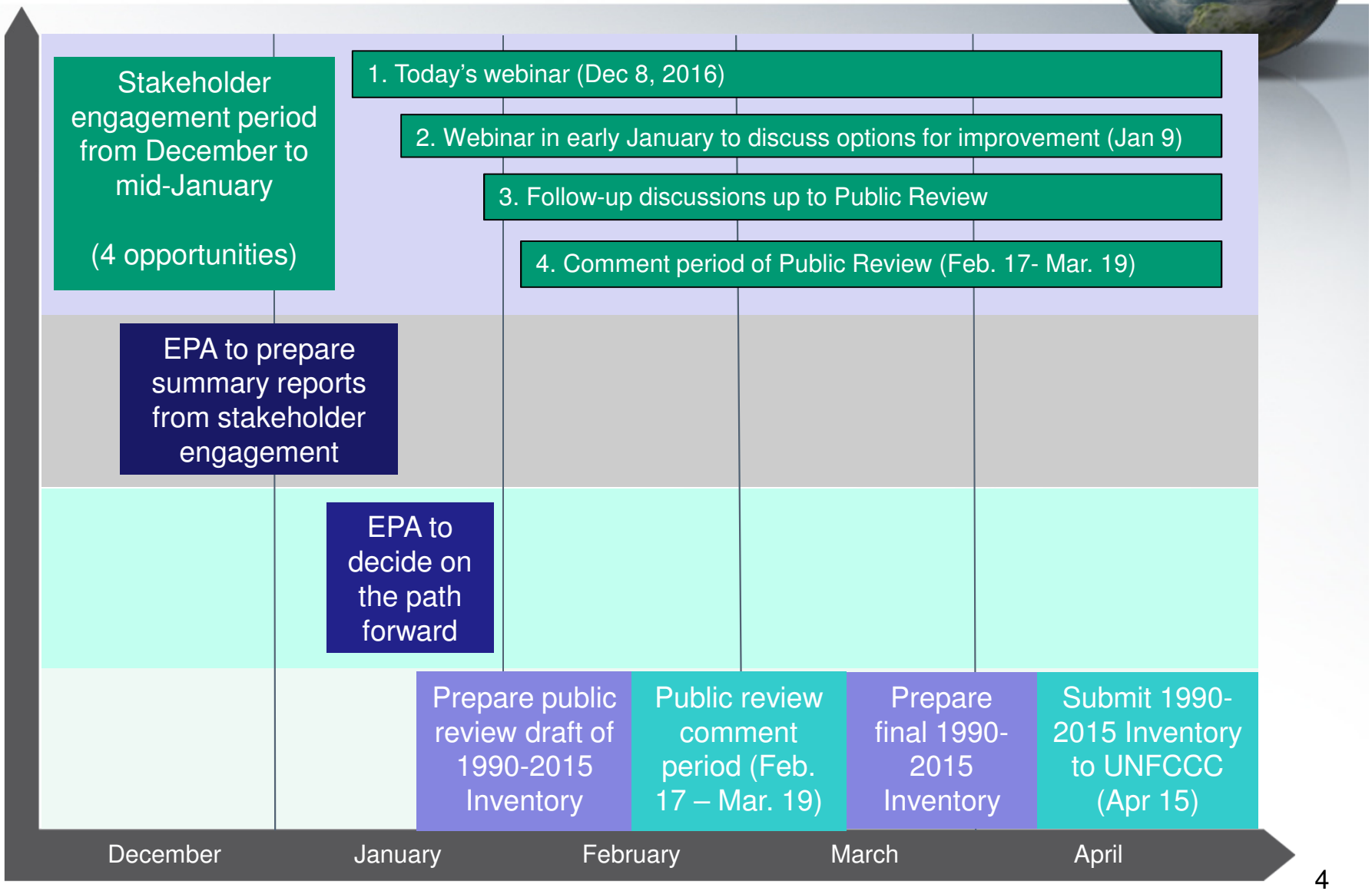
Agenda

- Purpose of the stakeholder engagement and planned events
- How does EPA account for GHG emissions from landfills
  - Greenhouse Gas Reporting Program
  - How EPA prepares the landfill methane emissions inventory (methodology and data sources)
  - Q&A
- Incorporating additional GHGRP data in the Inventory
- Specific areas for stakeholder input
- Q&A

Purpose of the Stakeholder Engagement

- To engage with stakeholders on the data submitted by facilities under the GHGRP Subpart HH for MSW Landfills and the application of this information as direct inputs to the MSW landfill methane emissions estimates in the 1990-2015 U.S. GHG Inventory.
- Three specific areas for facilities reporting to the GHGRP:
  - **Reported annual waste disposal quantities**
  - **Methane generation estimates (Equation HH-1)**
  - **Methane oxidation values**
- How to consider the same data elements for facilities that do not report to the GHGRP.

Schedule of Events



Input requested

In advance of our next webinar, we would appreciate your input on the following:

1. Use of the GHGRP annual waste disposal data in methane generation equation
2. Use of the methane generation equation with respect to the DOC value
3. Proper way to account for annual waste disposal data for facilities not reporting to the GHGRP

Input includes, but is not limited to, data on:

- Quantities of waste types disposed at individual or groups of landfills
- How the waste composition has changed over time
- Tipping receipts documenting the fraction of inerts
- Statistics on the changing waste composition

Accounting for Landfill Methane Emissions by the EPA

How does the US EPA Account for MSW Landfill Emissions?

- Solid Waste Inventory (solid waste portion of the Inventory of U.S. GHG Emissions and Sinks)
- Subparts HH (Municipal Solid Waste Landfills) of the Greenhouse Gas Reporting Program (GHGRP)

Overview of the EPA's GHG Inventory

- Conducted annually since 1990 to meet UNFCCC requirements
- Impartial and policy-neutral
- Follows IPCC 2006 Guidelines for compilation and calculation
- Uses a combination of secondary datasets
- Top-down national GHG emissions from all sectors
- Current and archived U.S. GHG inventories available at: http://www.epa.gov/climatechange/emissions/usinventoryreport.html

Overview of the EPA GHGRP

- Created by an EPA regulation issued in 2009
- The goal is to collect accurate and timely data on GHG emissions to inform future climate policy decisions
- Annual monitoring requirements for applicable MSW landfills began in 2010 with first reports due in 2011
- Overall, ~1,230 MSW landfills and ~115 industrial waste landfills reporting
- Monitoring and reporting only, no control or use requirements

Which MSW landfills must report under the GHGRP?

- Not all MSW landfills have to report
  - Definition in 40 CFR 98.6
  - Excludes RCRA Subtitle C or TSCA hazardous waste landfills, C&D waste landfills, and industrial waste landfills
  - Industrial landfills covered by separate subpart TT
- Accepted waste since January 1, 1980
  - Covers both open and closed MSW landfills
- Methane generation ≥ 25,000 metric tons CO_2e/yr
  - Applicability based on CH_4 generation, not CH_4 emissions

Comparison of the GHG Inventory to the GHGRP

Data Element	U.S. GHG Inventory	GHGRP for MSW landfills
Applicability	Entire U.S. economy (all GHG emissions)	Facilities meeting threshold (85–95% of landfill GHG emissions)
Waste generation data	Aggregated national data, "top down"	Facility-specific data, "bottom up"
CH_4 generation	IPCC waste model, default inputs, 3 climate types	IPCC waste model with facility-specific inputs, and CH_4 recovery
CH_4 emissions, no gas collection	$Generation_{CH4}$ - Oxidation	$Generation_{CH4}$ - Oxidation
CH_4 recovery	Estimated from 4 secondary databases = high uncertainty	Direct measurements of landfill gas flow rates and composition = low uncertainty
CH_4 emissions, with gas collection	Based on modeled methane generation estimate	2 calculation approaches, one of which uses directly measured CH_4 recovery data

Preparation of the Solid Waste Inventory using the IPCC 2006 Guidelines

IPCC Good Practice Guidance Promotes Cross-Country Comparability

- Parties to the UNFCCC are required to submit inventories of all anthropogenic GHG emissions from sources and removals from sinks.

- Follow the good practice guidance outlined by the IPCC
  - Same sectors
  - Comparable methodologies
  - Promotes comparability between sectors and across countries

IPCC Tiered Approach

- **Tier 1**
  - Designed to use readily available national or international statistics and apply default emission factors and activity data
- **Tier 2**
  - Uses a combination of country specific factors and default factors
  - For example, historical waste disposal data and IPCC-recommended oxidation factor
- **Tier 3**
  - Uses more detailed or country specific methodologies and data (e.g., models or measurement approach)
  - For example, facility-specific data, including waste disposal data, and waste type-specific DOC and k values

Used by the US Inventory

First Order Decay Method

- The first order decay (FOD) method is the recommended approach for all 3 Tiers under the IPCC 2006 Guidelines

- IPCC developed a Waste Model that incorporates the FOD method
  - Available through the IPCC 2006 GL home Volume 5: Waste, ipcc-nggip.iges.or.jp/public/2006gl/vol5.html

Modeled Methane Generation Equation

$$G_{CH4} = \sum_{x=S}^{T-1} \left\{ W_x \times DOC \times DOC_f \times MCF \times F \times \frac{16}{12} \times \left(e^{-k(T-x-1)} - e^{-k(T-x)} \right) \right\}$$

where

G_{CH4} = Total amount of methane generated in a given year

T = Year for which generation is calculated

x = Year in which waste was disposed

S = Start year of calculations or waste disposal

W_x = Quantity of waste disposed in a given year

DOC = Degradable organic content (specific to waste types)

DOC_f = Fraction of DOC dissimilated

MCF = Methane correction factor

F = Fraction of methane, by volume, in generated landfill gas

16/12 = conversion factor from CH_4 to C

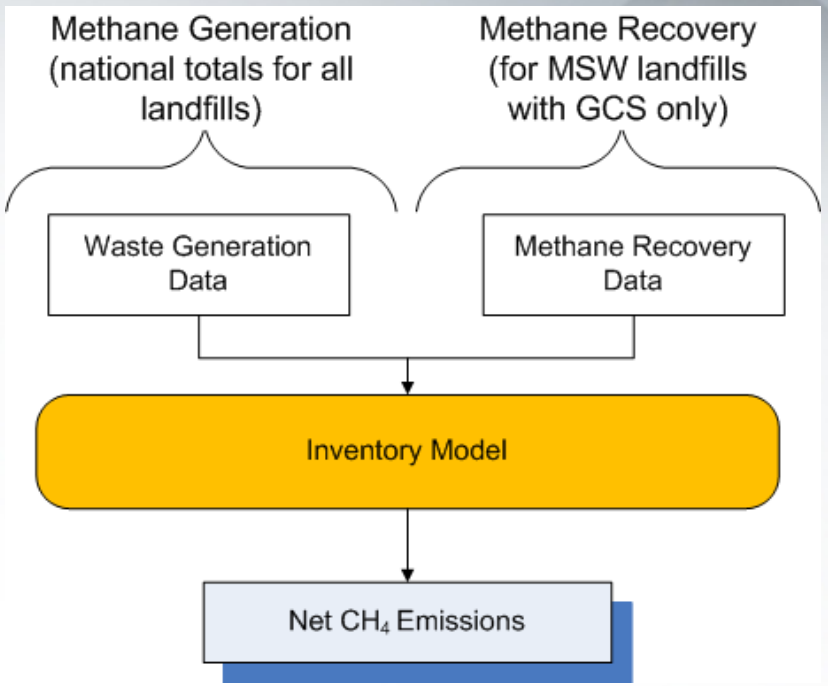
k = Decay rate constant (yr^{-1})

Key data needs

Details on the IPCC 2006 Waste Model

Key Inputs to the Solid Waste Inventory Model

- CH_4 generation
  - estimated from national waste disposal quantities (i.e., not landfill-specific)
- CH_4 recovery
  - from MSW landfills with gas collection and control systems (i.e., is landfill-specific)



$$CH_4 \text{ Emissions} = [\sum_x G_{CH4x,T} - R_T] \bullet (1 - OX_T)$$

[Equation 3.1 from IPCC 2006 GL Volume 5, Chapter 3: Solid Waste Disposal]

Emission Factor / Parameter Summary

Emission Factor / Parameter	Recommended IPCC Default Value	Value Used in the US Inventory
DOC (degradable organic carbon)	Varies by waste type	0.20285 (bulk MSW)
DOCf (fraction of DOC)	0.5	0.5
MCF (methane correction factor)	Varies by SWDS; 1.0 for managed landfills	1.0
F (fraction of methane in the landfill gas)	0.50	0.50
OX (oxidation fraction)	0.10	0.10
k (decay rate)	Varies by climate zone	3 k values; a k value is applied to the percentage of population assumed to reside in 1 of 3 precipitation zones
R (Recovered methane)	Country-specific	Landfill-specific
Time delay	6 months	6 months

Parameters Sheet (DOC, DOCf, MCF, F, k, OX)

Parameters

Country: USA
Region:

Please enter parameters in the yellow cells. If no national data are available, copy the IPCC default value.
Help on parameter selection can be found in the 2006 IPCC guidelines

	IPCC default value		Country-specific parameters	
			Value	Reference and remarks
Starting year		1950	1940	
DOC (Degradable organic carbon)				
(weight fraction, wet basis)	**Range**	**Default**		
MSW, dry	0.18-0.32	0.20280548	0.203	
MSW, normal	0.18-0.32	0.20280548	0.203	
MSW, wet	0.18-0.32	0.20280548	0.203	
			0	
			0	
			0	
Industrial waste, pulp & paper	0.36-0.45	0.15	0.150	
Industrial waste, food	0-0.54	0.26	0.260	
DOCf (fraction of DOC dissimilated)		0.5	0.5	
Methane generation rate constant (k)				
($years^{-1}$)	**Range**	**Default**		
MSW, dry		0.02	0.02	
MSW, normal		0.038	0.038	
MSW, wet		0.057	0.057	
			0	
			0	
			0	
Industrial waste, pulp & paper		0.06	0.06	
Industrial waste, food		0.185	0.185	
Delay time (months)		6	6	
Fraction of methane (F) in developed gas		0.5	0.5	
Conversion factor, C to CH_4		1.33	1.33	
Oxidation factor (OX)		0	0.1	
Parameters for carbon storage				
% paper in industrial waste		0%	0%	
% wood in industrial waste		0%	0%	
calculations for Bulk waste option only:				

... Parameters | MCF | Activity | Amnt_Deposited | Amnt_Deposited_IND

→ Country

→ Start year

→ DOC (degradable organic carbon)
- Bulk waste
- Waste by composition

→ k (methane generation rate constant)

→ Delay time

→ OX (oxidation fraction)

U.S. k Values

- Tailored k values to the % of the population living in dry, moderate, and wet precipitation zones
- k values were derived from the same landfill dataset used by EPA in AP-42 to develop default Lo value used in the Inventory

Precipitation range (inches/year)		k (yr^{-1})
Dry	<20	0.020
Moderate	20-40	0.038
Wet	>40	0.057

Precipitation Range (inches/year)	% of Population Living in Each Precipitation Range						
	1950	1960	1970	1980	1990	2000	2010
<20	10	13	14	16	19	19	18
20-40	40	39	37	36	34	33	44
>40	50	48	48	48	48	48	38

DOC (Degradable Organic Carbon)

- US Inventory calculates the DOC value from an EPA-developed Lo=100 m^3/Mg of mass

$$G_{CH4} = \sum_{x=S}^{T-1} \left\{ W_x \times DOC \times DOC_f \times MCF \times F \times \frac{16}{12} \times \left(e^{-k(T-x-1)} - e^{-k(T-x)} \right) \right\}$$

Lo . . . conversion calculations . . .

DOC = 0.202805

  - Based off landfill-specific data (n=52) from the 1980's and 1990's
  - Lo has been observed to vary from 6 to 270 m^3/Mg, depending on the organic content of the waste material

"This Lo value was recommended because it provided the best agreement between emissions derived from empirical (measured) data to predicted emissions."

Source: EPA AP-42 Background Document (https://www3.epa.gov/ttnchie1/ap42/ch02/draft/db02s04.pdf)

DOC (cont.)

Bulk MSW data:

- In all Inventory years, we use a DOC for bulk MSW = 0.202805
- We assume that the IPCC waste composition data generally represents US landfills:

Waste composition data:

- DOC values are used for each waste type included in the table below
- There is no bulk MSW DOC value under this option

Percent Waste Composition Data for North America (IPCC, 2006)								
Paper/ card board	Textiles	Food waste	Wood	Garden/ park	Nappies/ Diapers	Sewage sludge	Rubber / leather	All other, inerts
23.2	3.9	33.9	6.2	--	--	--	1.4	31.4

Defaults Sheet (IPCC 2006, DOC value and % by waste type)

IPCC REGIONAL DEFAULT VALUES FOR WASTE COMPOSITION, WASTE GENERATION, AND FRACTION DISPOSED

	Default DOC	0.4	0.24	0.15	0.43	0.2	0.24	0.05	0.39	0			
	Select3	16											
		Percent Waste Composition Data									Generation Rate (tonnes/cap/ yr)	Fraction MSW disposed to SWDS	Regional Average DOC (wt fraction)
		Paper/ card board	Textiles	Food waste	Wood	Garden / park	Nappies / Diapers	Sewage sludge	Rubber / leather	All other, inerts			
1	Asia: Eastern	18.8	3.5	26.2	3.5				1.0	47.0	0.55	0.55	0.14
2	Asia: South-central	11.3	2.5	40.3	7.9				0.8	37.2	0.21	0.74	0.15
3	Asia- Southeast	12.9	2.7	43.5	9.9				0.9	30.1	0.27	0.59	0.17
4	Asia- Western & Middle East	18.0	2.9	41.1	9.8				0.6	27.6	0.42	0.68	0.19
5	Africa: Eastern	7.7	1.7	53.9	7.0				1.1	28.6	0.29	0.69	0.15
6	Africa: Middle	16.8	2.5	43.4	6.5					30.8	0.29	0.69	0.17
7	Africa: Northern	16.5	2.5	51.1	2.0					27.9	0.29	0.69	0.16
8	Africa: Southern	25.0		23.0	15.0					37.0	0.29	0.69	0.20
9	Africa: Western	9.8	1.0	40.4	4.4					44.4	0.29	0.69	0.12
10	Europe: Eastern	21.8	4.7	30.1	7.5				1.4	34.5	0.38	0.90	0.18
11	Europe: Northern	30.6	2.0	23.8	10.0					33.6	0.64	0.47	0.21
12	Europe: Southern	17.0		36.9	10.6					35.5	0.52	0.85	0.17
13	Europe: Western	27.5		24.2	11.0					37.3	0.56	0.47	0.19
14	Oceania: Austrailia & New Zealand	30.0		36.0	24.0					10.0	0.69	0.85	0.28
15	Oceania: Other Oceania	6.0		67.5	2.5					24.0	0.69	0.85	0.14
16	America: North	23.2	3.9	33.9	6.2				1.4	31.4	0.65	0.58	0.19
17	America: Central	13.7	2.6	43.8	13.5				1.8	24.6	0.21	0.50	0.19
18	America: South	17.1	2.6	44.9	4.7				0.7	30.0	0.26	0.54	0.16
19	Caribbean	17.0	5.1	46.9	2.4				1.9	26.7	0.49	0.83	0.17

Parameters | MCF | Activity | Amnt_Deposited | Recovery_OX | Results | HWP | Stored_C | Theory | Defaults | Food | Garden | Paper ...

IPCC 2006 range is 0.12 to 0.28. US Inventory value of 0.2028 is near the midpoint of this range.

MCF (Methane Correction Factor)

- Accounts for the fact that unmanaged SWDS produce less CH_4 from a given amount of waste than anaerobically managed landfills
- In 1940, we model 6% managed, 94% uncategorized
- Ratio changes over time until 100% is managed for years 1980 to date

Type of SWDS	IPCC MCF Default Value
Managed – anaerobic	1.0
Managed – semi-aerobic	0.5
Unmanaged – deep (> 5m) and/or a high water table	0.8
Unmanaged – shallow (< 5m)	0.4
Uncategorized SWDS	0.6

Annual Waste Disposal Quantities

- For years 1989 to date,
  - Use a combination of data from the State of Garbage (SOG) surveys and US Census data (population)
- Waste generation by state from SOG surveys (voluntary)
- Estimate waste generation for missing states in the SOG surveys using waste per capita
- Apply a disposal factor (~65%)

This method introduces a lot of uncertainty, but the SOG surveys have been the only publicly available nationwide data source.

Activity Sheet
(where waste disposal data are entered)

MSW activity data

Enter population, waste per capita and MSW waste composition into the yellow cells. They grey cells are historical data for the US (from th
Help and default regional values are given in the 2006 IPCC Guidelines.

7	IPCC Regior	650	1000	58%	34%	0%	23%	6%	4%	0%	33%	100%
8		650		100%	11%	40%	49%	0%	0%	0%	0%	100%
9					Composition of waste going to solid waste disposal sites							
10	Year	Population	Waste per capita	Total MSW	% to SWDS	MSW, dry	MSW, moderate	MSW, wet	Wood	Textile	Nappies	Plastics, other inert	Total
11		millions	kg/cap/yr	kt	%	%	%	%	%	%	%	%	(=100%)
66	1994			256,601	100%	19%	34%	48%	0%	0%	0%	0%	100%
67	1995			256,543	100%	19%	34%	48%	0%	0%	0%	0%	100%
68	1996			263,424	100%	19%	34%	48%	0%	0%	0%	0%	100%
69	1997			273,757	100%	19%	34%	48%	0%	0%	0%	0%	100%
70	1998			285,259	100%	19%	34%	48%	0%	0%	0%	0%	100%
71	1999			297,078	100%	19%	34%	48%	0%	0%	0%	0%	100%
72	2000			298,766	100%	20%	33%	48%	0%	0%	0%	0%	100%
73	2001			304,167	100%	20%	33%	48%	0%	0%	0%	0%	100%
74	2002			301,974	100%	20%	33%	48%	0%	0%	0%	0%	100%
75	2003			308,784	100%	20%	33%	48%	0%	0%	0%	0%	100%
76	2004			321,066	100%	20%	33%	48%	0%	0%	0%	0%	100%
77	2005			327,973	100%	20%	33%	48%	0%	0%	0%	0%	100%
78	2006			332,642	100%	20%	33%	48%	0%	0%	0%	0%	100%
79	2007			326,638	100%	20%	33%	48%	0%	0%	0%	0%	100%
80	2008			315,579	100%	20%	33%	48%	0%	0%	0%	0%	100%
81	2009			293,272	100%	20%	33%	48%	0%	0%	0%	0%	100%
82	2010			304,395	100%	18%	44%	38%	0%	0%	0%	0%	100%
83	2011			302,171	100%	18%	44%	38%	0%	0%	0%	0%	100%
84	2012			300,269	100%	18%	44%	38%	0%	0%	0%	0%	100%
85	2013			306,843	100%	18%	44%	38%	0%	0%	0%	0%	100%
86	2014			265,896	100%	18%	44%	38%	0%	0%	0%	0%	100%
87	2015								0%	0%	0%	0%	0%
88	2016								0%	0%	0%	0%	0%

Instructions | Parameters | MCF | **Activity** | Amnt_Deposited | Amnt_Deposited_IND | Recovery_OX | Results | Results M

MSW Sheet
(where methane generation is calculated)

Methane calculation from: Bulk waste, moderate climate

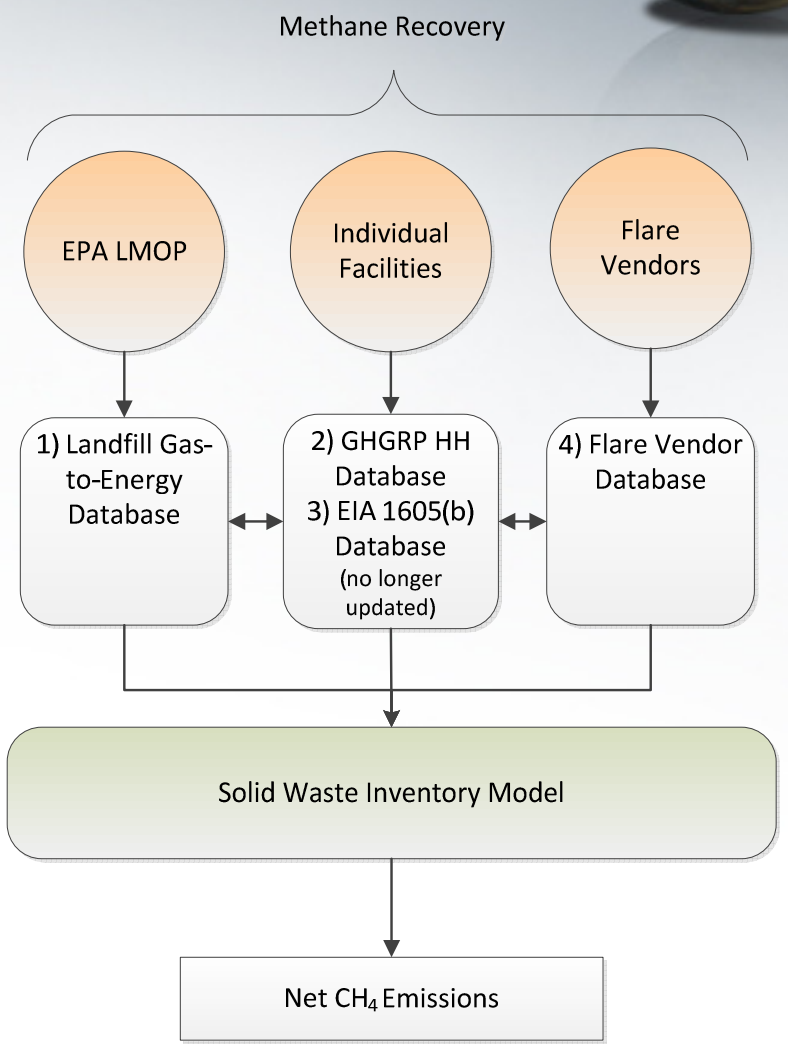
		National values
DOC	DOC	0.202805476
DOCf	DOCf	0.500
Methane generation rate constant	k	0.038
Half-life time ($t_{1/2}$, years):	h = ln(2)/k	18.2
exp1	exp(-k)	0.96
Process start in deposition year. Month M	M	13.00
exp2	exp(-k*((13-M)/12	1.00
Fraction to CH4	F	0.500

Year	Amount deposited	MCF	Decomposable DOC (DDOCm) deposited	DDOCm not reacted. Deposition year	DDOCm decomposed. Deposition year	DDOCm accumulated in SWDS end of year	DDOCm decomposed	CH_4 generated
	W	MCF	D = W * DOC * DOCf * MCF	B = D * exp2	C = D * (1-exp2)	H = B + ($H_{last\ year}$ * exp1)	E = C + ($H_{last\ year}$ * (1 - exp1))	Q = E * 16/12 * F
	Gg	fraction	Gg	Gg	Gg	Gg	Gg	Gg
1940	33,578	0.62	2,125	2,125	0	2,125	0	0
1941	33,905	0.63	2,159	2,159	0	4,205	79	53
1942	34,273	0.63	2,196	2,196	0	6,244	157	105
1943	34,732	0.64	2,240	2,240	0	8,251	233	155
1944	35,152	0.64	2,281	2,281	0	10,225	308	205
1945	35,550	0.65	2,336	2,336	0	12,180	381	254

Theory | Defaults | Food | Garden | Paper | Wood | Textiles | Nappies | Sludge | MSW | Industry

Methane Recovery (R)

- Recovery data comes from a combination of 4 databases
  - Directly reported
  - Indirectly reported
- Added the GHGRP HH data to the 1990-2013 Inventory
- Because of the variety of sources, there are uncertainties



OX (Oxidation Factor)

- Fraction of CH_4 from the landfill that is oxidized by methanotrophic microorganisms as the CH_4 in the landfill gas is emitted from the landfill
- Ranges from 0 to 100% depending on management practices
- IPCC recommends 10% for managed sites (used by the US)

	Amount of Methane Recovered from SWDS	Fraction recovered methane	Methane oxidised (OX)
IPCC default	0		0.1
Year	kt		Fraction
1994	2136.2	0.21	0.10
1995	2362.9	0.23	0.10
1996	2585.5	0.24	0.10
1997	3100.8	0.28	0.10
1998	3660.8	0.32	0.10
1999	4108.4	0.35	0.10
2000	4320.1	0.36	0.10
2001	4725.4	0.38	0.10
2002	4950.9	0.39	0.10
2003	5093.9	0.39	0.10
2004	5305.7	0.39	0.10
2005	5495.1	0.40	0.10
2006	5754.5	0.41	0.10
2007	6004.5	0.41	0.10
2008	6266.5	0.42	0.10
2009	6602.7	0.44	0.10
2010	7463.1	0.49	0.10
2011	7624.5	0.49	0.10
2012	7947.1	0.51	0.10
2013	7973.1	0.50	0.10
2014	7924.8	0.50	0.10

... Parameters | MCF | Activity | Amnt_Deposited

Results Sheet (net methane emissions)

	B	C	D	E	M	N	O	P
10		Methane generated						
11	Year	MSW, dry	MSW, moderate	MSW, wet	Methane recovery		Methane emission	
12		A	B	C	L		M = (K-L)*(1-OX)	
13		kt	kt	kt	kt		kt	
64	1989	758	2,904	4,556	0		7,396	
65	1990	792	3,002	4,714	797		6,940	
66	1991	835	3,089	4,874	1,008		7,011	
67	1992	877	3,172	5,023	1,286		7,007	
68	1993	919	3,258	5,177	1,625		6,957	
69	1994	964	3,352	5,344	2,136		6,771	
70	1995	1,009	3,445	5,508	2,363		6,839	
71	1996	1,053	3,534	5,663	2,585		6,899	
72	1997	1,098	3,626	5,822	3,101		[illegible]	
73	1998	1,144	3,724	5,991	3,661		6,478	
74	1999	1,192	3,827	6,171	4,108		6,374	
75	2000	1,243	3,937	6,362	4,320		6,499	
76	2001	1,296	4,038	6,541	4,725		6,435	
77	2002	1,350	4,141	6,720	4,951		6,534	
78	2003	1,402	4,238	6,885	5,094		6,687	
79	2004	1,455	4,337	7,052	5,306		6,784	
80	2005	1,510	4,442	7,233	5,495		6,921	
81	2006	1,566	4,549	7,416	5,755		6,998	
82	2007	1,621	4,656	7,597	6,004		7,083	
83	2008	1,675	4,754	7,757	6,266		7,127	
84	2009	1,724	4,840	7,889	6,603		7,064	
85	2010	1,766	4,903	7,973	7,463		6,461	
86	2011	1,804	5,058	7,966	7,624		6,483	
87	2012	1,841	5,204	7,956	7,947		6,348	
88	2013	1,876	5,343	7,943	7,973		6,471	
89	2014	1,913	5,484	7,941	7,925		6,672	
90	2015	1,939	5,575	7,881	0		13,855	
91	2016	1,900	5,367	7,444	0		13,240	
92	2017	1,863	5,167	7,032	0		12,655	
93	2018	1,826	4,974	6,642	0		[illegible]	
94	2019	1,789	4,789	6,274	0		11,567	

... Parameters | MCF | Activity | Amnt_Deposited | Amnt_Deposite

Q&A on the Preparation of the Solid Waste Inventory

Incorporating additional GHGRP data in the 1990-2014 Inventory

Additional and Relevant Subpart HH Data

- Additional facility level data reported under the GHGRP are available for use in the Inventory methodology, including
  - Annual waste disposal data
  - Methane generation estimates (Equation HH-1)
  - Methane oxidation values

Annual waste disposal data (GHGRP)

- Facilities reporting under the GHGRP must report annual waste disposal quantities (determined using an approved method) for 50 years prior to the current reporting year

- Three waste type options can be used to report
  - Bulk waste option
  - Modified bulk waste option
  - Waste composition option

Methane Generation and DOC

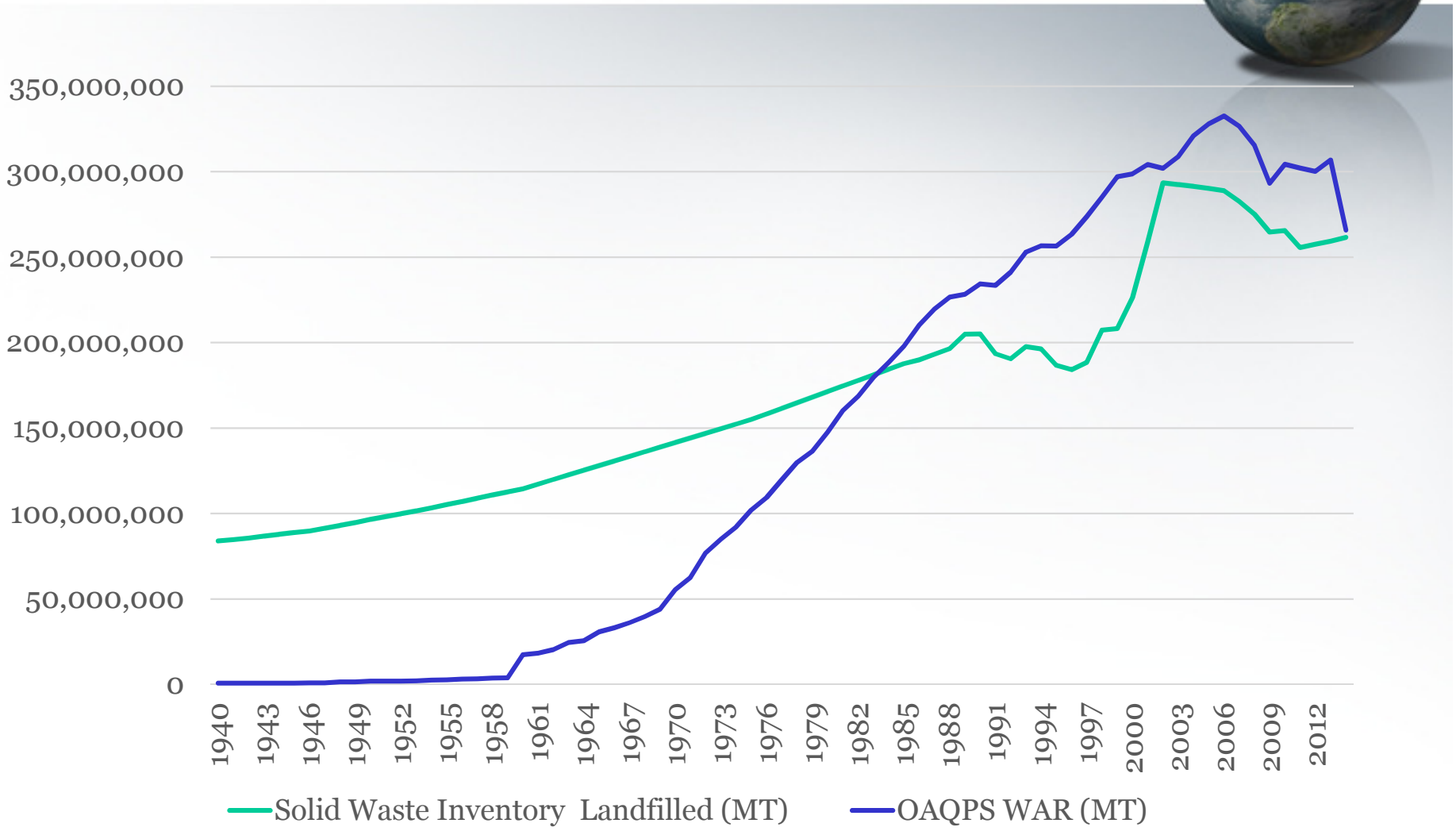
- Equation HH-1 is the same equation used by the Inventory to calculate methane generation
- The GHGRP DOC values are included in Table HH-1; all landfills must use these values depending upon whether and how they can break down their waste.

Waste Type		DOC in used Solid Waste Inventory	DOC used for GHGRP for MSW Landfills
Bulk MSW		0.20285	0.20
Modified Bulk MSW	Bulk MSW, excluding inerts & C&D waste	NA	0.31
	Inerts	NA	0
	C&D waste	NA	0.08
Waste Composition	9 different waste types, no bulk MSW option	NA	Ranges from 0 for inerts to 0.43 for wood and straw

For the Draft 1990-2014 Inventory

- Replaced the SOG waste generation data and waste disposal factor with facility-reported data and NSPS/EG dataset developed by OAQPS
  - For facilities reporting under the GHGRP, used direct values
  - For facilities not reporting under the GHGRP, NSPS/EG dataset used LMOP waste acceptance rates (WARs)
- Rationale:
  - SOG surveys no longer updated on a regular basis, resulting in great uncertainty
  - Align with the dataset used by OAQPS in their rulemaking
  - Strive to use higher tier activity data to improve Inventory estimates

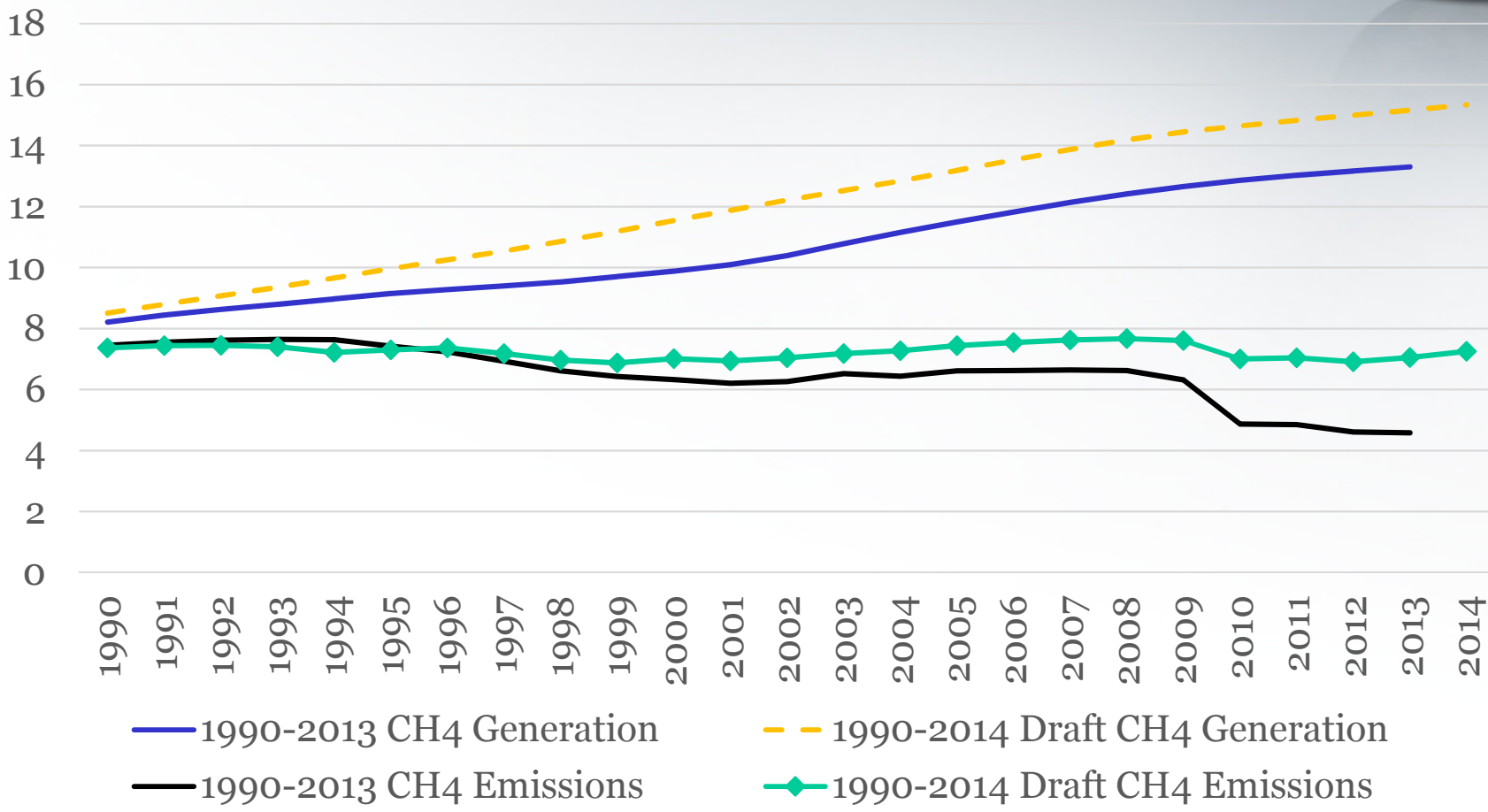
Annual waste disposal data (metric tons) between the two sources



Application of the FOD model to the NSPS/EG waste disposal data

- We assumed the total quantity of waste from the NSPS/EG data set was bulk waste and used same average DOC value for total (i.e., 0.20285)
- This means we applied the DOC value to the fraction of inerts too (assumed 31% of total MSW disposed based on IPCC waste composition for North America)
- This is similar to what has been in the past with the SOG data

Draft 1990-2014 Results vs. Final 1990-2013 Results (MMT)



Draft 1990-2014 Inventory Results

- Significant differences in net methane emissions compared to the previous Inventory
- Mainly due to increase in methane generation from GHGRP waste disposal data (because we subtract recovery from generation)
  - Average increase in emissions of 14% across the time series
  - Significant increase for 2010-2013 ranging from 20% to 52% compared to the same years in the previous Inventory

Industry Comments on the Draft 1990-2014 Inventory

- Possible error in the numbers or calculations, but hard to tell because underlying data is not published on the EPA Web site
  - EPA applied the FOD model to the total quantity of waste disposed when we should have instead subtracted out the inert waste disposed since it does not contribute to methane generation
  - EPA may be undercounting methane recovery now
- EPA did not explicitly state they would use the GHGRP waste disposal data in the Planned Improvements section of the previous year's Inventory
- Previous Inventory results showed a larger impact on methane emissions reductions due to landfill gas collection and control
- Should have engaged in a stakeholder process similar to what was done for the oil & gas Inventory

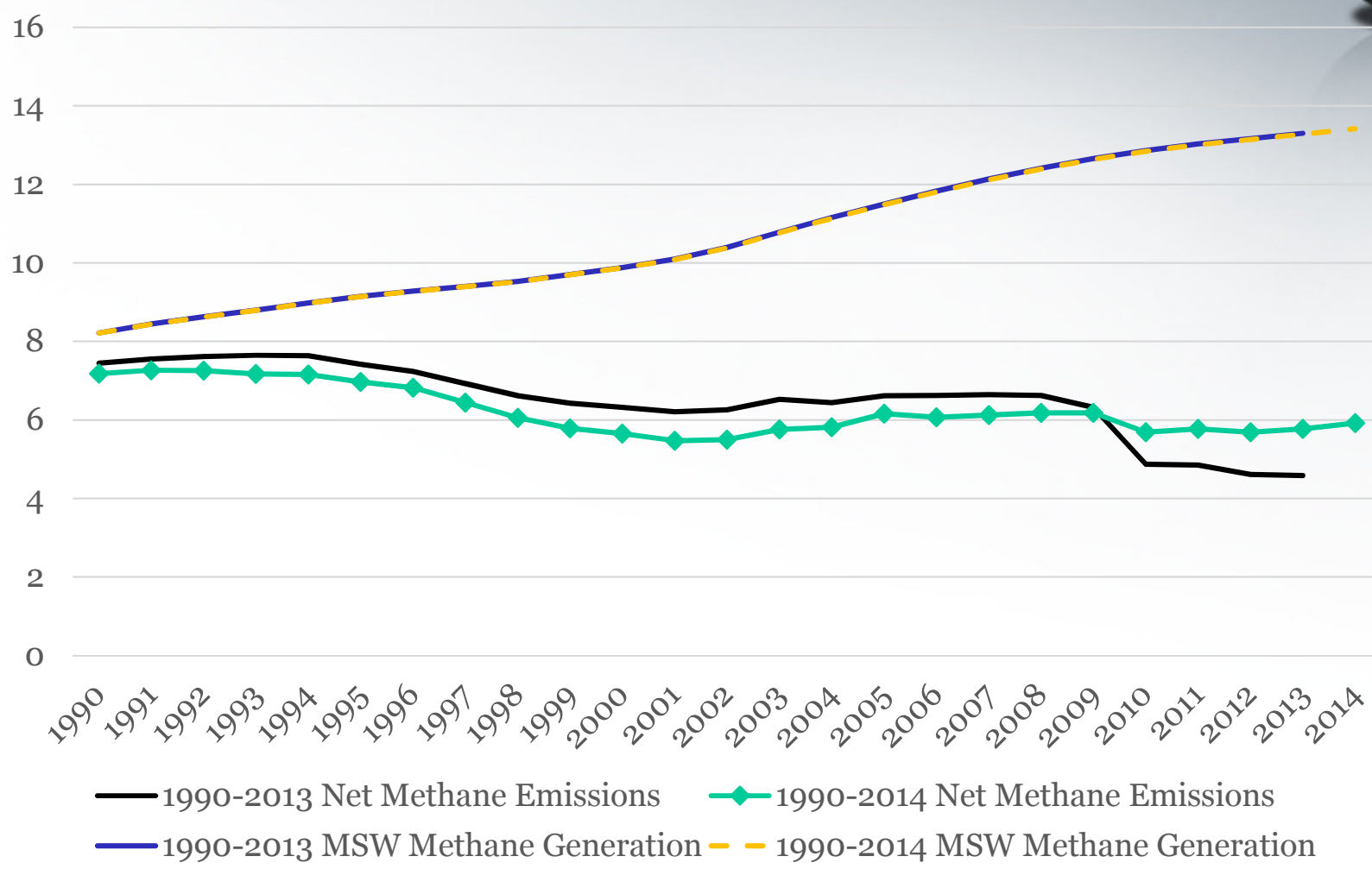
GHGRP Waste Type Data

Waste Type Option	Assumed based on reported DOC values	Actual
Bulk Waste	85%	56%
Modified Bulk Waste	14%	14%
Waste Composition	1%	30%

How EPA finalized the 1990-2014 Inventory

- EPA decided to revert back to the old methodology and initiate a stakeholder engagement process to inform the best way to use GHGRP data in the Inventory
- Used extrapolated waste generation data from the SOG survey and a disposal factor of 65% (all based on 2011 SOG waste generation and disposal data)

Final 1990-2014 vs. 1990-2013 Results (MMT)



Areas for stakeholder input

Input requested

In advance of our next webinar, we would appreciate your input on the following:

1. Use of the GHGRP annual waste disposal data in methane generation equation
2. Use of the methane generation equation with respect to the DOC value
3. Proper way to account for annual waste disposal data for facilities not reporting to the GHGRP

Input includes, but is not limited to, data on :

- Quantities of waste types disposed at individual or groups of landfills
- How the waste composition has changed over time
- Tipping receipts documenting the fraction of inerts
- Statistics on the changing waste composition

Next Steps

- Provide input by December 23, 2016 to Rachel Schmeltz:
  - Use of the GHGRP annual waste disposal data
  - Use of the methane generation equation with respect to the DOC value
  - Proper way to account for annual waste disposal data for facilities not reporting to the GHGRP
- Will share aggregated feedback in the next webinar (expected Jan. 9)
- This is not a formal consensus-based process

Q&A

More Information

Rachel Schmeltz

Schmeltz.Rachel@epa.gov

Kate Bronstein

kbronstein@rti.org