ISWA/UNEP Workshop on GHG and SLCP Emission Quantification Methodologies

September 19-20, 2013 Paris

Workshop Report

Contents

Background

On September 19-20, 2013 the International Solid Waste Association (ISWA) and the United Nations Environment Programme IETC (UNEP) organised a workshop in Paris on the quantification methods for greenhouse gas (GHG) and short-lived carbon pollutants (SCLP) emissions from waste activities. The workshop was kindly hosted by Veolia Environment.

Objective of the Workshop

The objective of the workshop is to bring together experts and practitioners to discuss and evaluate available GHG and SLCP emission quantification methodologies.
An aim of the workshop will be to gather input to establish guidelines for understanding and using the different approaches to evaluating GHG and SLCP emissions and how it can be applied with a focus on the city level. The guidelines will present the characteristics of the various tools: intended use; required input data; required user competence; ease of use; applicable waste activities; gases considered; geographic perimeter; etc.

A number of reliable reporting and quantification tools of GHG emissions from waste activities exist today. These tools all have varying objectives, boundaries and scopes (e.g. Life Cycle Assessment, Carbon Footprint, annual reporting tools, project methodologies; etc.). The choice of an accounting mechanism depends on the scope of the reporting, but all rely on the same basic operational data generated by specific waste management technologies.

The Workshop included some introductory presentations to frame the discussions. Break-out sessions followed to allow the participants sufficient time to exchange on the identified themes.

UNEP and ISWA the hosts of this event are both Partners of the Climate and Clean Air Coalition (CCAC) Municipal Solid Waste Initiative. This Initiative was organized to be a catalysing force to reduce emissions of short-lived climate pollutants across the municipal solid waste sector by providing and implementing a comprehensive collection of resources for cities, including technical assistance, information exchange, networking, and training.

The CCAC is working with the world's largest leading cities to undertake a variety of efforts to tackle the largest sources of emissions from waste, including capping and closing open dumps, capturing and utilizing landfill gas, and proper waste handling, organics management and recycling.

A key starting point for these cities is the identification of appropriate quantification tools to demonstrate the emission reductions from the above referenced actions. The output from this workshop will be helpful for input into the CCAC work as well as other city programmes being implemented around the world.

Presentations

Session 1 : Emission Quantification and general principles
Chair: Mushtaq Memon

1. Introduction, Objective of workshop and desired outcomes Gary Crawford, ISWA, Veolia
2. Overview of GHG Quantification tools for the waste sector / Key factors/ indicators/ challenges to consider in emission quantifications Terry Coleman, ERM
3. Stratus Report – Evaluation of Quantification Tools Joseph Donahue, Stratus

Session 2: Overview of Existing Quantification Tools & Evaluation Criteria
Chair: Marlene Sieck, Federal Environment Agency

Tool Presentations (15 min for each speaker to present the strengths of their tools, possible upgrades for use at city level)
1. Solid Waste Management GHG Calculator –German Financial Development Corporation Regine Vogt - IFEU
2. GHG Calculator for Solid Waste - IGES Tool Nirmala Menikpura - Institute for Global Environmental Strategies (IGES)
3. EpE Waste Sector Protocol Alexandra Lalet, Suez Environnement
4. Including other aspects in a quantification tool – going beyond long-term climate change with a focus on Short-Lived Climate Pollutants, including Black Carbon Johan Kuylenstierna, University of York

Session 3: Introductory presentations
Chair: Gary Crawford

1. CCAC Municipal Solid Waste Initiative and what do cities/users need in a quantification tool? Hingman Leung, Environment Canada and Mushtaq Memon, UNEP

The Presentations can be accessed in the ISWA Knowledge Base here
and the CCAC MSW Knowledge Platform here

Breakout Sessions

TOPIC 1: Developing a quick evaluation calculator for initial city assessments

Group members:

Robin Curry, Queen's University Belfast
Johan Kuylenstierna, University of York
Albaba Bala, Observatorio Punto Verde
Jan Manders, EFWC
Peter Simoes, Gemeente Amsterdam - Afval Energie Bedrijf
Nirmala Menikpura, IGES
Nikos Gargoulas, EPEM

Day 1: Scoping and initial outline.

[Quick] City Assessment.

Who will be using this tool?

Waste managers, planners, city policy makers, National governments, NGO's, Researchers/academics

What primary input data will be required?

Population, waste quantities (generated and collected), waste composition, treatment methods, recycling rates and type and amount of energy consumption for operational activities.

What input data can be default values?

Everything else (with options to move on to detailed/default pages from each primary input point, giving the users the opportunity of changing these values). [Default values must include **all** emissions associated with waste processes (both waste management and energy consumption), and **all** generated wastes, both collected and uncollected (controlled and uncontrolled)]. Any data can be default data to start with, but should be replaceable by own data which user should be encouraged to collect (e.g. waste composition, fate of uncollected waste).

How to include Black Carbon (Health/SLCP)?

This should be all emissions associated with incomplete combustion (dioxins, PM 2.5's)

GHG's Long-term
SLCP's Short term

How to reconcile these?

Topic 1: Developing a quick evaluation calculator for initial city assessments.

Day 2: Specific recommendations

[Route map] – [Concrete steps]

Only one tool – harmonisation.

What is more important?
One Tool or One peer-reviewed, harmonised data set?

What level of details do we need – what do the users want the tool for?

Starting point:

[Rapid assessment] (Starting with simple Excel tool for orientation)

Which unfolds to offer a:

[Detailed analysis of each option] (final level of detail depends on user needs)

Design principles for a 'Nested' model

One sheet, one tool; usability/usefulness; inventory/data harmonisation; transparency (for both calculations and data sources)

Data/inventories/ownership

Data: peer reviewed inventories for emission factors, published with guidance for use (possibly later expanded to harmonized emission factors, for example, 5 world regions).

Whenever possible, it is better to use location specific/country specific default values/emissions factors e.g. grid emission factors.

Model: Open Source?

Process [Ask User Groups]

Model Development Group; followed by:

Implementation Group.

Preliminary design

[Needs and Wants]

Step 1: Second-guess user needs, followed by;

Step 2: Pre-design consultations.

Further aspects from follow up discussions:

Excel tool could be IGES- or KfW-Tool or quickly designed new one (not very complicated to do) for decision support especially for developing countries; industrial countries with existing integrated SWM system have different needs which could be addressed with further progress in detailed analysis; and

Monitoring and reporting would need different calculations (esp. landfill), but could be either integrated in Excel tool or done in separate tool which can be combined via user interface.

TOPIC 2*:* Establishing a more detailed city "benchmark"

Group members:

Tom Frankiewicz (U.S. Environmental Protection Agency), co-chair
Hingman Leung (Environment Canada), co-chair
Joe Donahue (Stratus Consulting)
Therese Schwarz (University of Leoben)
Lighea Speziale (Confederation of European Waste-to-Energy Plants)
Judith Wolf (German Federal Environment Agency)

Summary of Key Points

- Establishing benchmarks (i.e., consistent approaches to data collection and measurement) across cities is critical. This involves developing methods that clarify what data should be collected, how it should be collected, and how it should be recorded.

- With respect to what data needs to be collected, it is agreed that there are basic data that need to be consistently collected for each city. These data will serve as performance indicators that can be tracked over time, beginning with (1) the initial city assessment, (2) an options analysis (e.g., which could be conducted with a dedicated tool), (3) workplan development, and (4) continuing through implementation and regular reporting. For each performance indicator, there needs to be an agreed-upon definition and data collection methodology.

- A number of these performance indicators should be directly linked to SLCP emissions reductions, and some of these SLCP-focused indicators will be qualitative (e.g., whether an SCLP emissions baseline has been established, or a plan has been adopted to reduce SLCP emissions). Others will be quantitative (e.g., estimates of the quantity of methane or black carbon emissions reduced).

- It is also desirable to consistently track performance indicators that are not directly tied to SLCP emissions. For example, cities should track indicators that demonstrate progress in moving along the solid waste management hierarchy (e.g., estimates of solid waste collection coverage and efficiency, waste generation rates, and recycling rates).

- For some indicators, binary (i.e., "yes/no") ratings will suffice for an initial rapid assessment. However, it is expected that more detailed ratings (e.g., quantitative absolute or percentage estimates) will be provided in subsequent assessments, such as annual update reports.

- Recommendations to the CCAC MSW Initiative Secretariat:

    - The CCAC MSW Initiative Secretariat should coordinate reviews of city assessments, workplans, and any city reports to ensure that the data collection and reporting methods are of consistent quality.

    - The CCAC MSW Initiative Secretariat should facilitate collaboration between implementing partners, to encourage the development of improved and consistent methods for data collection.

- The existing World Bank City Assessment Tool should be adapted to reflect the recommendations of Group 1, and the considerations on benchmarking presented by Group 2 (above). This will provide an improved and harmonized template for conducting city assessments.

Complete Notes – Day1

Discussion areas

- What is benchmarking?
    - Emissions
        - Current level (business as usual)
        - Reductions (changes, emissions reduction credits, certified emissions reductions)
    - Goal
        - City-level
        - Project-level
- What is consistent measurement (i.e., benchmarking)?
    - Consistent methodology/criteria
    - Do we call these indicators?
        - Parameters
        - Index
        - What is needed for results?
        - GHG, sustainability, water, air quality, agriculture
- Performance indicators
    - Moving up waste hierarchy
    - Desired activities – material use (reduce, reuse, recycle)

Elements of a City Assessment

- Baseline
    - Waste volume/characteristics
    - Treatment
- Emissions level
- Performance indicators
    - Reductions
- What data do we absolutely need?

Minimal Data Elements/Quality

- Waste generated
- Waste collected
- Waste composition
- Waste treatment/handling
- For each of these elements, need agreed-upon definitions and methodology

Key Points

- Benchmarking
    - Consistent level of measurement, assessment
- Methodology
    - Minimal level of consistency or quality
    - Data elements, collection
- City assessments
    - Common core elements

- Performance indicators
    - Indicators – separate from reductions/emissions (qualitative)

General Recommendations/Questions for CCAC

- Steps/Considerations to improve consistency
    - MSW Initiative review – lead partners and secretariat
    - Collaboration of partners/implementers
- What happens after the assessment
    - MRV
    - Long-term

Complete Notes - Day 2

Concrete Recommendations

1. Existing World Bank assessment tool + Group 1 recommendations + Group 2 benchmarking considerations = improved and harmonized quick assessment for CCAC and more
2. Baseline (business as usual) assessment and options analysis
    a. Projection
    b. Estimate reduction potential
    c. Workplan
    d. Decision-making tool
        i. Basic cost-benefit analysis
        ii. Non-quantitative considerations
        iii. Co-benefits
            1. Options analysis – activities for SLCPs
                a. Common thread: harmonizing and agreeing on:
                    i. Values
                    ii. Tradeoffs
                    iii. Weighting
                    iv. Indicators
            2. Identifying appropriate and priority activities
3. Implementation
    a. Checklist to add consistency to workplans
    b. Indicators to show progress
        i. Residues management
        ii. Collection system
            1. Increased collection rates
                a. Collection coverage
                b. Collection efficiency
            2. Reduced generation rates
        iii. Sanitary landfills
        iv. Source collection/separation (depends on cost-benefit analysis)
        v. LFG collection systems
        vi. Flue gas systems
        vii. Recycling rates
            1. Increased quantity of material recycled
        viii. Organics management
        ix. Reductions in open burning

x. Leachate management
xi. Policies and planning
    1. Integrated solid waste plans
    2. Bans on practices (e.g., open burning/dumping)
xii. Establishment of SLCP baselines

c. Indicator types
    i. Binary for quick, initial assessment
    ii. Detailed quantitative estimates for follow-up assessments (e.g., annual reporting)

d. Indicators relate to the MSW management hierarchy
    i. Indicators enable tracking progress in moving up MSW management hierarchy
    ii. Indicators also enable evaluation of progress over time; tracking when and how cities move along hierarchy; for comparison purposes

TOPIC 3: Key considerations for tool(s) for regular monitoring and verification

Group Members

Marlene Sieck, Federal Environment Agency
Mushtaq Memon, UNEP
Ylva Engqvist, UNEP CCAC Secretariat
Emily McGlynn, US State Department
Alexandra lalet, Suez Environment
Sophie Bonnard, UNEP

Tool options:

- Epe Tool recommended (*but maybe too detailed?)*
- Need to consider if this is the right starting point? Is this the right level of detail needed
- Open source tools – some additional existing like EPA; AP42

Considerations

- Need to harmonise tool(s) around common input data set
- Emission Factors – mostly European data
- need to know which emission factors are the most consequential
  e.g. what do we really need to get right, what default values can be used?

Additional needs

- Training for cities – online training tools (WB offered to develop some e-learning tools)
- CCAC Mentor cities could help with use of tools and data gathering
- Data submission process (CCAC could set up a central repository)
- Emission factors for burning waste (& activities involving biggest emissions)

Suggestions

- Additional tabs in EpE tool for black carbon (how can it be included)? and for uncollected waste and how it is managed – burned, dumped.
- Also to include less efficient less technical practices/technologies (IGES/Nirmala could maybe help)
- Identify a base tool then have implementers modify the tool; develop a hybrid to suit needs
- Development of an emission Factor Database (some existing literature that can be used, particularly for the most consequential aspects; CCAC is developing an emission database for all initiatives, waste might need to add with a more detailed listing)

TOPIC 4: Key recommendations for quantifying fugitive landfill methane emissions (using existing first order decay models)

Participants:

Mark Verlohr, Veolia
Ozge Kaplan, US EPA
Terry Coleman, ERM
Rachael Williams, ISWA
Gaïa Ludington, Gevalor

Objective

The overall purpose of the group was to establish guidelines on how to accurately quantify the fugitive landfill methane emissions from landfills. The document will provide critical parameters on how to establish baseline emissions, key modeling techniques, available accessible models to be able to demonstrate the likely or actual improvements achieved by moving from open dumping or no gas collection to a comprehensive landfill gas collection system.

Reasons for focussing on fugitive methane emissions from landfill

The methane emissions from solid waste management activities i.e., landfills contribute to 15% of global anthropogenic methane emissions. Methane being a more potent gas than CO2 has a higher GHG impact factor and also considered as one of the short lived climate pollutant. The mitigation of SLCPs are essential in reducing GHGs and mitigating short terms possible impacts of climate change.

Furthermore the nature of the emissions (fugitive) requires the use of theoretical models instead of direct measurement for quantification. As a result, data on fugitive CH_4 emissions from landfills is less reliable than data on other direct GHG emissions from other parts of the waste sector.

Fugitive methane emissions should thus be reported separately as an independent category of direct GHG emissions.

Basics of calculation

In order to estimate the fugitive methane emissions of a landfill it is necessary to calculate two parameters:

1. The amount of methane generated by the anaerobic decomposition of waste in the landfill (calculated using theoretical decay models, as currently difficult to measure - technologies exist, but are not satisfying).

2. The amount of methane captured by the landfill operator and recovered for electricity production or direct use (sale via pipeline, etc.) or burnt in a flare (data based on measurements).

Fugitive CH_4 emissions are then calculated as follows:

Potential CH4 release = CH_4 generation as of theoretical model - effectively captured CH_4

Some of this CH4 will then be oxidized into CO2 in the landfill before reaching the atmosphere. Thus,

Fugitive CH_4 = Potential CH_4 released * (1 - Oxidation factor)

The participants focused on point 1. Depending on the model utilized, the amount of methane generated could represent either all the waste in the landfill starting from the initial disposal or per ton of waste disposed into the landfill and its corresponding full life cycle emissions. These are critical distinctions in terms which model to select and use.

The second point, the most accurate quantification of the amount of methane captured/treated at a landfill is necessary. It should however be noted that for the correct measurement of methane volumes, adequate and reliable equipment is critical. Although readily available on the market, such equipment is currently not present at many landfills. In addition, the gas collection requirements and how policies are written greatly influence when the operators start collecting gas, and therefore these impact the amount of gas collection.

With regard to the oxidation factor, the participants agreed that the standard value of 10% currently used by many models (including the IPCC) is acceptable, although recent work by Bognor and others in France had estimated rates for some sites as substantially higher. it is still debatable.

The landfill gas model

The participants agreed that the First Order Decay (FOD) models that are currently used by many tools are a good basis, and that there is no need to develop a new model. Examples for existing models are: IPCC, NGERS, CDM (ACM0001), LandGEM etc.

The focus of the work should be on the reliability of the main input parameters to these models. These are:

1. Waste composition
2. Climatic data: rainfall (evapotranspiration) / temperature
3. Operational parameters: capture start date, daily / final cover, compaction, leachate levels, etc.

Waste composition

For a first rough estimation of the CH_4 generated, the IPCC regional default data on waste composition (see table below) may be a reasonable basis, however good quality local data is needed for a more precise evaluation. In some cases the IPCC aggregate methodology seems to overestimate the fugitive emissions so users must be cautious on this.

Default DOC	0,4	0,24	0,15	0,43	0,2	0,24	0,05	0,39	0			
Select3	13									Generation Rate (tonnes/cap/yr)	Fraction MSW disposed to SWDS	Regional Average DOC (wt fraction)
	Percent Waste Composition Data											
	Paper/ card board	Textiles	Food waste	Wood	Garden / park	Nappies / Diapers	Sewage sludge	Rubber / leather	All other, inerts			
Asia: Eastern	18,8	3,5	26,2	3,5				1,0	47,0	0,55	0,55	0,14
Asia: South-central	11,3	2,5	40,3	7,9				0,8	37,2	0,21	0,74	0,15
Asia- Southeast	12,9	2,7	43,5	9,9				0,9	30,1	0,27	0,59	0,17
Asia- Western & Middle East	18,0	2,9	41,1	9,8				0,6	27,6	0,42	0,68	0,19
Africa: Eastern	7,7	1,7	53,9	7,0				1,1	28,6	0,29	0,69	0,15
Africa: Middle	16,8	2,5	43,4	6,5					30,8	0,29	0,69	0,17
Africa: Northern	16,5	2,5	51,1	2,0					27,9	0,29	0,69	0,16
Africa: Southern	25,0		23,0	15,0					37,0	0,29	0,69	0,20
Africa: Western	9,8	1,0	40,4	4,4					44,4	0,29	0,69	0,12
Europe: Eastern	21,8	4,7	30,1	7,5				1,4	34,5	0,38	0,90	0,18
Europe: Northern	30,6	2,0	23,8	10,0					33,6	0,64	0,47	0,21
Europe: Southern	17,0		36,9	10,6					35,5	0,52	0,85	0,17
Europe: Western	27,5		24,2	11,0					37,3	0,56	0,47	0,19
Oceania: Austrailia & New Zealand	30,0		36,0	24,0					10,0	0,69	0,85	0,28
Oceania: Other Oceania	6,0		67,5	2,5					24,0	0,69	0,85	0,14
America: North	23,2	3,9	33,9	6,2				1,4	31,4	0,65	0,58	0,19
America: Central	13,7	2,6	43,8	13,5				1,8	24,6	0,21	0,50	0,19
America: South	17,1	2,6	44,9	4,7				0,7	30,0	0,26	0,54	0,16
Caribbean	17,0	5,1	46,9	2,4				1,9	26,7	0,49	0,83	0,17

Table 1: IPCC default data on waste composition (source: IPPC waste model – xls file)

Local data can be obtained from:

1. National data if available (examples are: MODECOM France, GasSim / DEFRA UK, etc.) and if representative for the specific site.

2. Studies performed within university research in the country or at the site concerned.

3. Field studies (on-site waste characterizations) specifically performed for the purpose.

One of the main challenges in obtaining useful data lies in the heterogeneity of waste and thus in the representativeness of collected samples. Several statistical methodologies have been developed around the world to make sure that the data on waste composition and generation is representative (see links to MODECOM in France and Mexican Standard below) and can be used as reference.

The guidelines to be developed by the ISWA/UNEP workgroup should take advantage of waste composition data already available and collected in different countries and pool these data. However, representativeness of the data must be checked as a prerequisite.

Other default data, such as k values (kinetic constants – degradation speed) and DOC values (Degradable Organic Content) can be taken from the IPCC default data as well.

Characteristics of the tool(s) to be used

Fugitive CH_4 emissions from landfill, as compared to GHG emissions from other waste treatment technologies, are generated over a long period of time (they are generally assumed to be significant for at least 30 years, and it usually takes more than 100 years for 99% of the theoretical methane yield to be produced). As a result, the tool to be used for quantifying fugitive emission should enable the user to do both:

1. Calculate the emissions of a certain quantity of waste during the lifetime (e.g. 30 years) of a landfill in order to be able to compare those emissions with other treatment technologies that generate immediate emissions (e.g. incineration).

2. Calculate annual emissions of a landfill, including those from waste deposited in previous years for yearly monitoring purposes.

This can be achieved easily based on the existing models by adapting the way results are displayed.

Furthermore the tool should:

1. Be an Excel open source tool in order to be usable by, and accessible to, a wide audience.

2. Via one simple data input page, allow the user to choose between using defaults and site specific data. Either putting in the strict minimum amount of data to obtain a first, rough estimation based on the default data in the tool. Or providing detailed, site specific data (site and operational characteristics, waste composition, climate, etc.) for one or more paramenters to obtain a more precise result (within the limitations of the modelling exercise).

3. Link the output data to a simple, GHG reporting tool such as the EPE Protocol.

4. Highlight the parameters that are sensitive (most affect the reliability of the result of the calculation of emissions) in order to make the user is aware of the importance of reliable data for these. Also, the user should be informed about the quality / reliability of the default data provided (e.g. via a traffic light system).

Additional comments:

Veolia has performed investigation work on waste compositions in France, the UK, Hong Kong, Australia and Israel for its internal emission reporting. The results can be made available to the work group.

Annex 1: Tools and References

IPCC waste model (xls file)

NGERs model (xls file)

MODECOM (French waste characterization methodology)

Links:

IPCC website:

http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html

http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/IPCC_Waste_Model.xls

CDM websites:

http://cdm.unfccc.int/methodologies/DB/EYUD9R1ZAUZ2XNZXD3HQH18OK3VWIV

http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v6.0.1.pdf

NGERs websites:

http://www.climatechange.gov.au/climate-change/greenhouse-gas-measurement-and-reporting/company-emissions-measurement/technical/national-greenhouse-and-energy-reporting-measurement-technical-guidelines-2013

http://www.cleanenergyregulator.gov.au/national-greenhouse-and-energy-reporting/forms-and-calculators/Pages/default.aspx

Mexican standard on waste generation (statistics):

http://148.206.53.231/bdcdrom/GAM06/GAMV15/root/docs/NMX-090.PDF

World Bank website:

http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTURBANDEVELOPMENT/EXTUSWM/0,,contentMDK:21274918~isCURL:Y~menuPK:463861~pagePK:210058~piPK:210062~theSitePK:463841,00.html

US EPA Landfill Methane Outreach Program:

http://www.epa.gov/lmop/

Publications and tools:

http://www.epa.gov/lmop/publications-tools/index.html

LandGEM model:

http://www.epa.gov/ttn/catc/products.html#software

LMOP developed site specific landfill models for eight countries/regions in the world including, central America, China, Columbia, Ecuador, Mexico, Philippines, Thailand, Ukraine.

http://www.epa.gov/lmop/publications-tools/index.html#a01

Annex 2: Participant List

First	Last	Organisation	Country
Alba	Bala	Observatorio Punto Verde	Spain
Sophie	Bonnard	UNEP CCAC Secretariat	France
Terry	Coleman	ERM	UK
Gary	Crawford	ISWA/Veolia	France
Robin	Curry	Queen's University Belfast	UK
Joseph	Donahue	Stratus Report	USA
Ylva	Engqvist	UNEP CCAC Secretariat	France
Tom	Frankiewicz	US-EPA	USA
Nikos	Gargoulas	EPEM	Greece
Stephen	Hammer	World Bank	USA
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Lighea	Speziale	CEWEP	Belgium
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