The GBEP GHG Methodological Framework for Bioenergy

A dialogue with the private sector
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Background

- GHG methodologies taskforce established by GBEP steering committee in May 2007.

- Desired end result is flexible methodology for policy makers in all countries.

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Taskforce Work Plan

GBEP Steering Committee set forth 5 key elements of taskforce:

1. Review existing methodologies;
2. Develop a harmonised approach so GHG lifecycle assessments can be compared on an equivalent basis;
3. Encompass the full well-to-wheel lifecycle of transport biofuels;
4. Not indicate a preference for any particular existing methodology or feedstock, or to limit parameters; and
5. Define parameters and inputs to be considered when conducting a LCA and develop a good practice document.

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Approach

- The taskforce decided to develop a flexible “checklist” framework that could be applied to the LCA of bioenergy production and use.
- Work was based on accepted methods for undertaking environmental lifecycle analysis and GHG inventories, such as the ISO 14040 standards and the IPCC good practice guidance for land use change and forestry.
- Over the course of 14 months and 4 taskforce meetings, the taskforce produced a draft LCA checklist that will be presented to the GBEP Steering Committee next week.

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Components of the LCA

1. GHGs covered
2. Source of biomass
3. Land use changes due to bioenergy production
4. Biomass feedstock production on farms and in forests
5. By-products and co-products
6. Transport of biomass
7. Processing into fuel
8. Transport of fuel
9. Fuel Use
10. Comparison with replaced fuel

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Components of the LCA

For each component, a set of checklines were developed to allow for complete, transparent, and flexible reporting of greenhouse gas emissions.

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Steps 1 & 2: Introductory Information

Step 1: GHGs Covered

CO_2 ___

CH_4 ___

N_2O ___

HFCs ___

PFCs ___

SF_6 ___

Other _____

Please report global warming potential used for each GHG covered.

Step 2: Source of biomass

Non-waste __

Identify Feedstock: _____

Residue or Other Waste __

Identify Feedstock: _____

* Please explain definition of waste:

Substance that the holder intended to discard ___

Substance that had zero or negative economic value ___

Substance for which the use was uncertain ___

Substance that was not deliberately produced and not ready for use without further processing ___

Substance that could have adversely affected the environment ___

Other: _____

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Step 3: Land Use Change

Step 3: Land use change

Accounting for land use change in a lifecycle framework for estimating emissions for bioenergy is a complicated matter. Many institutions around the world are developing their methodologies. Some account for land use change in a single, holistic assessment while others sub-divide bioenergy-associated land use change into direct and indirect changes. Some further distinguish between indirect land use changes that are domestic versus those that are international. The reporting framework presented below is intended to be flexible in order to clarify which of these multiple approaches is taken by the methodology being described.

___ Direct land use changes are taken into account **OR**
___ Indirect land use changes are taken into account **OR**
___ A combination of both is included

Explain the choice.

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Step 3: Land Use Change

3a: Direct Land use Change

Direct land use changes, when they occurred, are accounted for (Y or N). If yes:

. . . .

3b: Indirect Land use Change

___ Domestic indirect land use change is taken into account **OR**
___ International indirect land use change is taken into account **OR**
___ Both are taken into account separately **OR**
___ Both are taken into account without making the distinction

Explain the choice.

Domestic indirect land use changes are accounted for (Y or N). If yes:

. . . .

International indirect land-use changes are accounted for (Y or N). If yes:

. . . .

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Step 3: Land Use Change

For each type of land use change considered:

1. Identify the reference period or scenario
   ___ Historic (identify year or period)
   ___ Business-as-Usual (BAU) scenario (identify time frame: _____)
   ___ Other (explain)
2. Describe how the methodology attributes this type of land use change to biofuels
3. Explain key reference assumptions and characteristics relevant to estimating GHG emissions from land use change. Examples include:

- System boundaries (such as sector, activity, and geographic coverage)
- For BAU scenarios, assumed trends in key variables and land uses
- Omitted emissions sources
- Time period over which land use change emissions are allocated

4. Briefly describe the type of land-use changes accounted for (2 – 3 paragraphs).
5. The following impacts of land use change are accounted for:
   Accounted for net changes of carbon stocks in:
   ___ living biomass, ___ dead organic matter, ___ soils
   ___ Changes in carbon stocks in products (such as harvested wood products)

Please provide the rationale for counting changes in carbon stocks, including assumptions regarding the permanence of the change {Note: this caveat has been expanded into a footnote, the wording of which is not yet agreed}

6. The methodology and data used are publicly available:
   Methodology (Y or N), Data (Y or N)

Step 4: Biomass Feedstock Production

Step 4: Biomass feedstock production

Focus on Direct Emissions:

1. Sources of direct GHG emissions and removals are accounted for:

___ Emissions from operating farm/forestry machinery

___ Emissions from energy used in irrigation

___ Emissions from energy used to prepare feedstocks (drying grains, densification of biomass, etc.)

___ Emissions from energy used in transport of feedstocks

___ CO2 emissions from lime/dolomite applications

___ N2O emissions resulting from the application of nitrogen fertilizers:

__direct; __volatilization; __runoff/leaching

___ CH4 emissions from lands (especially wetlands)

___ net changes in soil carbon stocks (due to cultivation practices, not land use change (step 3a.5)) Please provide the rationale for counting changes in carbon stocks, including assumptions regarding the permanence of the change {Note: this caveat has been expanded into a footnote, the language of which is not yet agreed}

___ Other (please specify)

2. For all checked, clarify assumptions and emissions reference values used

3. The methodology and data used are publicly available: Methodology (Y or N), Data (Y or N)

Focus on Embodied Emissions:

1. Sources of GHG emissions embodied in inputs accounted for:

___ Emissions embodied in the manufacture of farm/forestry machinery

___ Emissions embodied in buildings

___ Emissions embodied in the manufacture of fertilizer inputs.

___ Emissions embodied in the manufacture of pesticide inputs

___ Emissions embodied in purchased energy:

- ___ electricity
- ___ transport fuels
- ___ other (e.g., fuel for heat)

___ Emissions embodied in seed production

___ Other (please specify)

2. For all checked, clarify assumptions

3. The methodology and data used are publicly available: Methodology (Y or N), Data (Y or N)

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Step 5: By-products and Co-products

Step 5: By-products and co-products

By-products or co-products are produced (Y or N)

1. ___ By/Co-products from the biomass are accounted for.
2. ___ By/Co-products from non-biomass feedstocks are accounted for.
3. Explain definition of by/co-products: _____
4. An allocation method is used (Y or N):
   ___ Allocation by mass
   ___ Allocation by energy content
      Method to determine energy content: _____
   ___ Allocation by economic value
      Method to determine economic value: _____
   ___ Other allocation method
      Specify method: _____ Method to determine parameters needed: _____
5. A substitution method is used (Y or N)

Identify method used to determine the exact type of use/application of a co-product: _____

Identify method used to determine what product the co-product would substitute for and what the associated GHG emissions are for that product: _____

6. Another method or combination of methods is used (Y or N)
      Specify method: _____
      Method to determine parameters needed: _____
7. For relevant sections, clarify assumptions

Step 6: Transport of Biomass

Step 6: Transport of biomass
Biomass is transported from farm/plantation/forest to processing plant (Y or N)
If yes:
1. ___ The biomass transported in a different commodity type.
    1a. ___ A description of intermediate processing steps is available.
    1b. ___ Emissions associated with intermediate processing are accounted for (including, e.g., electricity used for processing).
2. ___ There is a multi-stage transport chain (e.g. truck to ship to truck or train).
    2a. List all stages in the transport chain.
    2b. Specify the stages for which emissions are accounted.
3. Transport from production site to use/processing plant is dedicated to this purpose (Y or N)
    If Yes:
        3a. ___ All transport emissions are included
    If No:
        3b. ___ A portion of transport emissions are allocated, and the allocation methodology is described.
4. ___ Return run of transport equipment is accounted for.
    4a. During the return run, transport equipment is:
    ___ empty ___ otherwise utilized
5. For relevant sections, clarify assumptions

Step 7: Processing into Fuel

Step 7: Processing into fuel
The biomass requires processing to produce fuel (Y or N)

1. ___ GHG emissions associated with material inputs used in the conversion process (e.g. chemicals, water) are accounted for.
2. ___ GHG emissions associated with energy used in conversion process are accounted for.
    2a. Specify the method used to account for grid-related emissions
        (e.g.average/marginal, national/regional, actual/future): _____
3. ___ GHG emissions from wastes and leakages (including waste disposal) are accounted for.
4. ___ Other GHG emissions from the process are accounted for.
    4a. List which ones: ___
5. ___ GHG emissions associated with the plant construction are accounted for.
    5a. Estimates of emissions associated with plant construction have been pro-rated to account for:
        ___ Other uses of the plant
        ___ Design life of the plant
        ___ Other parameters; specify which ones: _____
6. For relevant sections, clarify assumptions

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Step 8: Transport of Fuel

Step 8: Transport of fuel
Fuel is transported from processing plant to use site (Y or N)
If yes:
(please consider all emissions, including, for example, CH_4 emissions from biogas equipment)

1. ___ The fuel transported in a different commodity type.
    1a. ___ A description of intermediate processing steps is available.
    1b. ___ Emissions associated with intermediate processing are accounted for (including, e.g., electricity used for processing).
2. ___ There is a multi-stage transport chain (e.g. truck to ship to truck or train).
    2a. List all stages in the transport chain.
    2b. Specify the stages for which emissions are accounted.
3. Transport from the processing plant to the use site is dedicated to this purpose. (Y or N)
    If Yes:
        3a. ___ All transport emissions are accounted for.
    If No:
        3b. ___ Transport emissions are pro-rated; methodology for pro-rating is described.
4. ___ Return run of transport equipment is accounted for.
    4a. During the return run, transport equipment is:
    ___ empty ___ otherwise utilized
5. For relevant sections, clarify assumptions

Step 9: Fuel Use

For solid biomass and liquid and gaseous fuels used in stationary applications:

1. Analysis addresses electricity and/or heat (thermal energy)? (Y or N)
   1a. Facility is a CHP plant? (Y or N)
   1b. Electric efficiency of the use process _____
   1c. Thermal efficiency of the use process _____
   1d. Electricity sent to a general grid (Y or N)
   1e. In case of CHP, indicate method used to account for electricity and heat (i.e., allocation, substitution, etc.), as in LCA Step 5.
2. Specific emissions are addressed by the usage (Y or N)
   2a. Identify conversion/combustion technology
3. The technique specifically causes significant non-CO2 emissions of:

___ N2O (e.g. CFB-type boilers)
___ CH4, (e.g. low level technique or small-scale)
___ Other

   3a. Describe evidence to exclude the occurrence of such specific GHG emissions.
4. Biomass is tainted with fossil material (e.g. in case of waste sources) (Y or N)
   4a. If yes, provide analysis on degree of fossil content, if available
5. The analysis addresses a technology upgrade (e.g. pile burning to modern energy technology)
   5a. If yes, provide emissions data on the replaced way of biomass burning, if available.
6. For relevant sections, clarify assumptions

Step 9: Fuel Use

For transport fuels:

1. Miles (km) per energy unit are addressed (Y or N)
   1a. Miles (km) per energy unit: ____
   1b. Describe how energy efficiency is factored into fuel use analysis.
2. Tailpipe gas is addressed (Y or N). If yes, describe methodology:

e.g.: CO2 emissions associated with combustion source and feedstock sink are netted out; CH4 and N2O emissions from combustion are included.

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Step 10: Comparison With Replaced Fuel

Step 10: Comparison with replaced fuel

1. Identify Methodology for LCA of replaced fuel(s) / energy production system(s).
2. This methodology is publicly available (Y or N)
   If yes, provide references
3. Gases covered:
   CO2 ___ CH4 ___ N2O ___ HFCs ___ PFCs ___ SF6 ___ Other _____
   Please report global warming potential used for each GHG covered.
4. An LCA is performed on the replaced fuel(s) / energy production system(s). (Y or N)
   4a. If yes, list any sources of inconsistency between LCA of biofuel and LCA of replaced fuels/systems.
   4b. If no, identify the system boundaries.
5. Specify which sources of emissions embodied in infrastructure are accounted for and clarify assumptions.
   ___ Emissions embodied in buildings and facilities
   ___ Emissions embodied in transportation fleet and infrastructure
   ___ Emissions embodied in the manufacture of machinery
   ___ Other sources of emissions embodied in infrastructure (please specify)

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Step 10: Comparison With Replaced Fuel

I. Biofuel is used to replace transport fossil fuel (for stationary use, skip to section II)

6. Relevant characteristics of crude:

6a. Type of crude:
___ Conventional crude
___ Canadian oil sands
___ Canadian/Venezuelan heavy oil
___ Other
___ Not specified

6b. Origin of fuel (region, refinery, etc), if specified

6c. Other important fuel characteristics, if specified

6d. Applicability conditions of the replaced fuel characteristics
___ The reference fuel is a world average
___ The reference fuel applicable only to one region (specify region)
___ Other applicability conditions apply (please specify)

7. Emissions prior to extraction/production are accounted for (Y or N)

7a. If yes, specify pre-production sources included (e.g., geophysics, prospecting) and geographic/temporal coverage of analysis.

7b. Explain method for applying pre-production emissions to per barrel calculations.

8. Emissions from extraction/production are accounted for (Y or N)

8a. Direct and embodied emissions in extraction/production accounted for:
___ Fuel combustion from drilling
___ Fugitive methane emissions from equipment
___ Fuel combustion from turbines and compressors
___ Transportation emissions from helicopters and supply vessels
___ Use of electricity (e.g., gasoil or fuel oil generators)
___ Use of chemical inputs
___ Other

8b. Natural gas emissions accounted for:
___ Emissions from flaring natural gas
___ Emissions from combustion equipment (specify gases included)
___ Emissions from reinjection of natural gas
___ Emissions from direct use of natural gas
___ Emissions from other processing of natural gas
___ Emissions from gas processing point to remove liquids
___ Emissions from extracted liquids
___ Emissions from electricity production

8c. Describe method for allocating emissions between crude oil and natural gas production

8d. Emissions for other extraction/production by/co-products are accounted for (Y or N)

• If yes, describe methodologies for calculating emissions and for allocating emissions between crude and by/co-products.

9. Crude is transported to the refinery (Y or N)

9a. Specify transport distance and mode(s) of transport (pipeline, tanker, etc.).

9b. For internationally transported crude, specify whether domestic, international, or total transport emissions are accounted for.

• Describe use of country-specific parameters in calculating transport emissions.

9c. Fugitive emissions during transport are accounted for (Y or N)

9d. Return journeys of transport fleet are accounted for (Y or N)

9e. The production/transport system involves liquified natural gas (Y or N)

9f. Emissions from the regasification plant are accounted for (Y or N)

10. Refinery emissions are accounted for (Y or N)

10a. Describe assumptions on refinery characteristics (e.g., existing, typical, local average)

10b. Describe method for calculating direct refinery emissions

10c. Emissions embodied in chemicals (catalysts, solvents, etc.) are accounted for (Y or N)

• If yes, describe method.

10d. Fugitive emissions accounted for (Y or N)

• If yes, describe method.

10e. Emissions for hydrogen production are accounted for (Y or N)

• If yes, specify the production process.

10f. Emissions for purchased and generated electricity are accounted for (Y or N)

• If yes, specify electricity mix of the purchased electricity

10g. Emissions from wastes and leakages are accounted for (Y or N)

• If yes, describe method

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10h. Emissions for refinery by-products and co-products are accounted for (Y or N)

• If yes, describe methodologies for calculating emissions and for allocating emissions between fuel and by/co-products.

11. Fuel is transported or distributed prior to use (Y or N)

11a. Specify transport distance and mode(s) of transport (truck, tanker, etc.).

11b. For internationally transported fuels, specify whether domestic, international, or total transport emissions are accounted for.

• Describe use of country-specific parameters in calculating transport emissions.

11c. Fugitive emissions during transport are accounted for (Y or N)

11d. Return journeys of transport fleet are accounted for (Y or N)

12. Fuel use emissions are accounted for (Y or N)
(please consider consistency with Step 9)

If no:

12a: Please explain how equivalency with the biofuel system is defined (e.g. lower heating value)

If yes:

12b: Please explain how equivalency with the biofuel system is defined.
Do you refer to energy content of the fuel ___
Do you refer to Miles (km) per energy unit ___

12c: Describe how energy efficiency is factored into fuel use analysis.

12d: Tailpipe gas is addressed (Y or N). If yes, describe methodology.

13. Please identify any elements of the fossil fuel LCA not included in the above questions and describe methodology used to calculate emissions.

Step 10: Comparison With Replaced Fuel

II. Stationary use of biofuel for electricity/heat

7. Describe technologies, methodologies and data for calculating the extraction/production/transport of replaced energy source, using Transport Fuel questions 6-11, above, as guidance where appropriate.

8. Fuel use emissions are accounted (Y/N)
(please consider consistency with Step 9)

If no:

8a: Please explain how equivalency with the biofuel system is defined (e.g. lower heating value of utilized fuel)

8b: What type of fossil fuel is assumed to be replaced by the biofuel system? Explain the assumption.

If yes:

8c: Please explain how equivalency with the biofuel system is defined.

Do you refer to energy content of the fuel (Y/N)

Do you refer to useful energy taking end use efficiency into account (Y/N)

If yes:

8d: Which method is used to define the production of replaced electricity/heat?

___ national average mix

___ marginal production

___ other _____

please explain your choice and assumptions.

8e: Report energy efficiency for electricity generation, and/or heat generation and describe how it is used in emissions analysis.

8f: Describe methodology for calculating evaporative emissions.

8g: Describe conversion/combustion technologies and method for calculating associated emissions, including trace gases.

9. Please identify any elements of the fossil fuel LCA not included in the above questions and describe methodology used to calculate emissions.

Step 10: Comparison With Replaced Fuel

Step 10: Comparison with replaced fuel

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3. Gases covered:
   CO2 ___ CH4 ___ N2O ___ HFCs ___ PFCs ___ SF6 ___ Other _____
   Please report global warming potential used for each GHG covered.
4. An LCA is performed on the replaced fuel(s) / energy production system(s). (Y or N)
   4a. If yes, list any sources of inconsistency between LCA of biofuel and LCA of replaced fuels/systems.
   4b. If no, identify the system boundaries.
5. Specify which sources of emissions embodied in infrastructure are accounted for and clarify assumptions.

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Next Steps

- Perform test applications of the framework
- Solicit stakeholder feedback
- Disseminate the framework through the GBEP website
- Improve the framework in response to user experience
- Consider future work

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