**Original Flowchart**

**Land Directly Converted to Grow Biofuel Feedstocks**

- Are you addressing:
  a. Is indirect land-use accounted for?
  b. If so, how?

**Land Indirectly Converted as a Result of Biofuels**

- Are you addressing:
  a. Is indirect land-use accounted for?
  b. If so, how?

**On-farm/forest Elements (to farm/forest gate)**

- Are you addressing:
  a. Have you taken into account changes in inventory of above ground biomass (use IPCC methodologies)?
  b. Have you addressed net carbon emissions?
  c. Deforestation (e.g., slash and burn)?
  d. Deforestation by burning?
  e. Maintenance burning?
  f. Neutral (more or less) to carbon emission?
  g. Forest replaced by off seed trees?
  h. Deforestation w/energy recovery?
  i. Have you analyzed net carbon sequestration?
  j. Perennial energy crops on degraded lands (e.g., Jatropha)?
  k. What other factors have been considered?
  l. Annual crops or perennial crops?
  m. Have you considered changes in inventory of soil carbon?
  n. Net carbon emission from soil degradation (native lands going under the plow)?
  o. Net carbon accumulation from change in cropping system (i.e., to no till)?
  p. Net carbon accumulation from change from annual to perennial?

**How is the biomass feedstock produced?**

- Are you addressing:
  a. On-farm/forest Elements (to farm/forest gate)

**Are there any bioproducts/coproducts?**

- Are you addressing:
  a. Processing Energy
  b. Processing Plant to Distribution
  c. Liquid Fuels Usage: Wells to Wheels
  d. Solid Biomass Fuel Usage

**Processing Energy**

- Are you considering:
  a. What is the energy content of production supplies?
  b. Energy use in processing cycle?
  c. What is the energy expended in plant construction?

**Process Plant to Distribution**

- Are you addressing:
  a. Average transportation to retailer?
  b. Other?

**Liquid Fuels Usage: Wells to Wheels**

- Are you addressing:
  a. Miles per energy unit?
  b. Tailpipe emissions?

**Solid Biomass Fuel Usage**

- Are you addressing:
  a. Electricity?
  b. Heat/Energy?

**Biofuel LCA Compared to Fossil Fuel LCA**

- Are you addressing:
  a. Crude oil extraction, type of crude could impact emissions (e.g., tar sands, heavy vs. light crude), and treatment of associated natural gas (flaring vs. capture)?
  b. Crude transport?
  c. Refining, energy use and allocation between co-products?
  d. Fuel transport and distribution?
  e. Tailpipe emissions?
1. What are the GHGs covered?
2. Is the biomass a waste (i.e., municipal waste, grease, manure)?
3. Is there land use change?
4. How is the biomass feedstock produced?
5. Are there any biproducts/coproducts?
6. Is the biomass transported away from production site?
7. Does the biomass need to be processed into fuel?
8. Does the fuel need to be transported for use?
9. What are the GHG Emissions from Fuel Use?
10. How does it compare to fuel replaced?
Boxes 1 & 2: Introductory Information

1. GHGs covered
   - CO₂ __
   - CH₄ __
   - N₂O __
   - HFCs __
   - PFCs __
   - SF₆ __
   - Other __________

2. Source of biomass
   - Waste __ (begin at Box 6)
   - Non-waste __ (begin at Box 3)

* Please explain definition of waste:
  1. _____ Substance that the holder intended to discard.
  2. _____ Substance that had zero or negative economic value.
  3. _____ Substance for which the use was uncertain.
  4. _____ Substance that was not deliberately produced and was not ready for use without further processing.
  5. _____ Substance that could have adversely affected the environment.
  6. Other: _____
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.

Added introductory question:
___ Direct land use changes are taken into account OR ___ Indirect land use changes are taken into account OR ___ A combination of both is included

I. Direct land use changes are accounted for (Y or N). If yes:

1. Identify the reference period or scenario
   _____ Historic (identify year or period)
   _____ Business-as-Usual (BAU) scenario (identify time frame: _________)
   _____ Other (explain)

Describe how the methodology attributes this type of land use change to biofuels

Explain key reference assumptions and characteristics relevant to estimating GHG emissions from direct land use change. Examples include (but are not limited to) identifying or describing:
- 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

2. Briefly describe the type of direct land-use changes accounted for (2 – 3 paragraphs). Examples include (but are not limited to) identifying or describing:
   - Areas of land that change land use by type (such as forest, grassland, peat lands, pasture, to feedstock production)
   - Carbon stocks, before shift to feedstock production, on lands that change land use by type

3. The following impacts of direct land use change are accounted for:
   - Accounted for net changes of carbon stocks in:
     _____ living biomes, _____ dead organic matter, _____ soil
     _____ Changes in carbon sequestration in products (such as harvested wood products)

4. The methodology and data used are publicly available: Methodology (Y/N), Data (Y/N)
### 3. Land use changes due to bioenergy production

**Box 3b**

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

1. Identify the reference period or scenario
   - ____ Historic (identify year or period)
   - ____ Business-as-Usual scenario (identify time frame: ________)
   - ____ Other (explain)

Describe how the methodology attributes this type of land use change to biofuels

Explain key reference assumptions and characteristics relevant to estimating GHG emissions from domestic indirect land use change. Examples include (but are not limited to) identifying or describing:

- System boundaries
- For BAU scenarios, assumed trend in key variables and land uses
- Rules or methods used to assign indirect land use changes to biofuels (Such as, whether emissions allocated to products using a marginal, average, or other approach)
- Time period over which land use change emissions are allocated

2. Briefly describe the type of domestic indirect land-use changes accounted for (2 – 3 paragraphs). Examples include (but are not limited to) identifying or describing:
   - Areas of land that change land use by type (such as forest, grassland, peat lands, pasture, to commodity production)
   - Carbon stocks, before shift to feedstock production, on lands that change land use by type

3. The following impacts of indirect domestic land use change are accounted for:
   - Accounted for net changes of carbon stocks in:
     - ____ living biomes, ____ dead organic matter, ____ soil
     - ____ Changes in carbon sequestration in products

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

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

1. Identify the reference period or scenario
   - ____ Historic (identify year or period)
   - ____ Business-as-Usual scenario (identify time frame: ________)
   - ____ Other (explain)

Describe how the methodology attributes this type of land use change to biofuels

Explain key reference assumptions and characteristics relevant to estimating GHG emissions from international indirect land use change. Examples include (but are not limited to) identifying or describing:

- System boundaries (such as sector, activity, and geographic coverage)
- For BAU scenarios, assumed trend in key variables and land uses
- Rules or methods used to assign international indirect land use changes to domestic biofuels (Such as, whether emissions allocated to products using a marginal, average, or other approach)
- Time period over which land use change emissions are allocated

2. Briefly describe the type of international indirect land-use changes accounted for (2 – 3 paragraphs). Examples include (but are not limited to) identifying or describing:
   - Areas of land that change land use by type (such as forest, grassland, peat lands, pasture, to commodity production)
   - Carbon stocks, before shift to feedstock production, on lands that change land use by type

3. The following impacts of international indirect land use change are accounted for:
   - Accounted for net changes of carbon stocks in:
     - ____ living biomes, ____ dead organic matter, ____ soil
     - ____ Changes in carbon sequestration in products

4. The methodology and data used are publicly available: Methodology (Y/N), Data (Y/N)
### Box 4: Biomass feedstock production

#### 4. Biomass feedstock production on farms and in forests

**Focus on Direct Emissions:**

Sources of direct GHG emissions are accounted for:
- [ ] Emissions from operating farm/forestry machinery
- [ ] Emissions from energy used in irrigation
- [ ] Emissions from energy used in preparing feedstocks (drying grains, densification of cellulosic biomass, etc.)
- [ ] Emissions from energy used in transport of feedstocks
- [ ] CO₂ emissions from lime/dolomite applications
- [ ] On-farm N₂O emissions from nitrogen fertilizers (direct, volatilization, runoff/leaching)
- [ ] CH₄ emissions from lands (especially wetlands)
- [ ] Other (please specify)

For all checked, clarify assumptions

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

**Focus on Embodied Emissions:**

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 electricity
- [ ] Emissions embodied in the production of seeds
- [ ] Other (please specify)

For all checked, clarify assumptions

The methodology and data used are publicly available: Methodology (Y/N), Data (Y/N)
### Box 5: By-products and Co-products

#### 5. By-products and co-products

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>____ By/Co-products from the biomass are accounted for.</td>
</tr>
<tr>
<td>2.</td>
<td>____ By/Co-products from non-biomass feedstocks are accounted for.</td>
</tr>
<tr>
<td>3.</td>
<td>Explain definition of by/co-products: ____</td>
</tr>
<tr>
<td>4.</td>
<td>____ An allocation method is used</td>
</tr>
<tr>
<td>4a.</td>
<td>____ Allocation by mass</td>
</tr>
<tr>
<td>4b.</td>
<td>____ Allocation by energy content</td>
</tr>
<tr>
<td></td>
<td>Method to determine energy content: ____</td>
</tr>
<tr>
<td>4c.</td>
<td>____ Allocation by economic value</td>
</tr>
<tr>
<td></td>
<td>Method to determine economic value: ____</td>
</tr>
<tr>
<td>4d.</td>
<td>____ Other allocation method</td>
</tr>
<tr>
<td></td>
<td>Specify method: ____</td>
</tr>
<tr>
<td></td>
<td>Method to determine parameters needed: ____</td>
</tr>
<tr>
<td>5.</td>
<td>____ A substitution method is used</td>
</tr>
<tr>
<td></td>
<td>Method to determine the exact type of use/application of a co-product: ____</td>
</tr>
<tr>
<td></td>
<td>Method to determined what product the co-product would substitute for and what the associated GHG emissions are of that product: ____</td>
</tr>
<tr>
<td>6.</td>
<td>____ Another method or combination of methods is used</td>
</tr>
<tr>
<td></td>
<td>Specify method: ____</td>
</tr>
<tr>
<td></td>
<td>Method to determine parameters needed: ____</td>
</tr>
</tbody>
</table>

For relevant sections, clarify assumptions
### Box 6: Transport of Biomass

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 stages emissions are accounted.

3. Transport from the production site to the 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

For relevant sections, clarify assumptions
## Box 7: Biomass Processing

### 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 the energy used in the 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: _____
Box 8: Transport of Fuel

8. Transport of fuel

Fuel is transported from processing plant to use site (Y or N)

If yes:
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, and the 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

For relevant sections, clarify assumptions
Box 9: Fuel Use

9. Fuel use

For solid biomass and liquid and gaseous fuels used in stationary applications:
Are you addressing electricity and/or heat (thermal energy)?

If yes:
- Is it a CHP plant? (Y/N)
- Electric efficiency of the use process ____
- Thermal efficiency of the use process ____
- Electricity sent to a general grid (Y/N)

(Following questions interfere with the scope of Subgroup 2 “co-products” and sub-group 4 “replaced comparators”)

In case of CHP;
- Indicate which method is used to account for both – electricity and heat – vis-à-vis box 5

Remark 1: the method for accounting electricity and heat is connected with the question concerning the “replaced comparator” (Box 10). The subgroup discussed the diverse options and tended to treat electricity and heat like equal co-products with specific benefits.

Are you addressing specific emissions by the usage?
- Which conversion/combustion technology is applied?
Is the technique specifically causing significant emissions of N2O (e.g. CFB-type boilers)
CH4, (e.g. low level technique or small-scale)?
If presumed to do not; is there enough evidence to exclude the occurrence of such specific GHG emissions?
- Is the biomass tainted with fossil material? (e.g. in case of waste sources)
If yes; Do you have analysis concerning the degree of fossil content?

(Following questions also partly interfere with the scope of Subgroup 4, Box 10 “replaced comparators”)
Are you addressing a technology upgrade (e.g. pile burning to modern energy technology)?
If yes;
- Do you have emission data on the replaced way of biomass burning?

For transport fuels:

1. Are you addressing miles (km) per energy unit?

If yes, ask ...
...describe how energy efficiency is factored into fuel use analysis.

2. Are you addressing tailpipe gas?

If yes, ask ...
how does method account for tail pipe emissions?
e.g.: are CO2 emissions associated with combustion source and CO2 associated with feedstock sink netted out.
e.g.: are CH4 and N2O emissions from combustion accounted?
Box 10: Comparison with Replaced Fuel

10. Comparison with replaced fuel

1. Identify Methodology.
2. This methodology is publicly available (Y or N)
3. Are you addressing the LCA of fossil fuel? (Y or N)

For crude oil:
1. Specify type of crude (e.g. tar sands, heavy oil, pre-salt):
   __________________________________________
2. ___ There is an associated natural gas
2a. Treatment of associated natural gas:
    ___ flaring    ___ reinjection    ___ processing/direct use
2b. ___ There is a natural gas processing point to remove liquids
2c. ___ Emissions from extracted liquids are accounted for
2d. ___ Emissions for electricity production are accounted for
3. ___ The crude/natural gas is transported
   3a. Transportation is:  ___ domestic   ___ international   ___ both
   3b. Emissions are accounted for:
        ___ domestic    ___ international
   3c. ___ Fugitive emissions during transport are accounted for
   3d. ___ Country-specific parameters are included in emission calculations for domestic transport.
   3e. ___ Return journeys of transport fleet are accounted for, when appropriate.
4. ___ The production/transport system involves liquified natural gas
   4a. ___ Emissions from the regasification plant are accounted for
5. ___ Fuel production includes a refining process
   5a. ___ Direct refinery emissions are accounted for
   5b. ___ Embodied refinery emissions (plant, machinery) are accounted for
   5c. ___ Energy embodied in chemical products (catalizers, solvents, etc.) are accounted for
   5d. ___ Fugitive emissions are accounted for
   5e. ___ Emissions for hydrogen production are accounted for
6. ___ There are significant co-products produced
   6a. ___ Emissions associated with co-products are accounted for
   6b. ___ These accounting methodologies are publicly available

Subgroup Note: need to add a blue box for solid fuels