GBEP
Capacity Building Workshop on GHG LCA and Policy Applications
Tokyo - 15 November 2011

How to measure GHG emissions from bioenergy production and use: field measurements and calculators

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in cooperation with

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OVERVIEW

Introduction

Part 1:
Major issues in the 10 steps of the GBEP methodological framework for GHG LCA

Part 2:
Different approaches to conducting LCA of bioenergy

Part 3:
Human and institutional capacity required to conduct LCA

Part 4:
Quick overview of policy and other applications

Conclusions
Ranges of GHG emissions per unit energy output (MJ) from major modern bioenergy chains compared to current and selected advanced fossil fuel energy systems (land use related net changes in carbon stocks and land management impacts are excluded)

Estimated GHG savings of current biofuel

Note: current technologies are shown in yellow, advanced technologies in orange

Part 1: The GBEP methodology framework

10-step framework

Key questions of this part

→ Which steps embed the **major sources** of emissions and sinks and mitigation potential?

→ Which steps are connected with **major methodological choices** and their potential impacts on results
Part 1: The GBEP methodology framework

10-step framework

1. GHGs covered
2. Source of biomass
3. Land use change
4. Biomass feedstock production
5. Transport of biomass
6. Processing into fuel
7. By-products and co-products
8. Transport of fuel
9. Fuel Use
10. Comparison with replaced fuel

All steps are essential! However, some are major and some are minor. Sources by trend are mostly major in case by case and mostly minor.
Part 1: The GBEP methodology framework

Step 1: GHGs covered

The user is asked to provide Global Warming Potential values and/or a clear reference for the GHGs included in the analysis. IPCC SAR values are assumed unless otherwise indicated. This is necessary to ensure consistency between reports and the repeatability of reported calculations.

<table>
<thead>
<tr>
<th></th>
<th>IPCC 1995</th>
<th>IPCC 2001</th>
<th>IPCC 2007</th>
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<tr>
<td>CO₂</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>CH₄</td>
<td>21</td>
<td>23</td>
<td>25</td>
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<tr>
<td>N₂O</td>
<td>310</td>
<td>296</td>
<td>298</td>
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</table>

**Table T3.2: Lifetimes, radiative efficiencies and direct (except for CH₄) global warming potentials (GWP) relative to CO₂ (Table 2.14)**

<table>
<thead>
<tr>
<th>Industrial Designation or Common Name (year)</th>
<th>Chemical Formula</th>
<th>Lifetime (years)</th>
<th>Radiative Efficiency (W m² ppb⁻¹)</th>
<th>Global Warming Potential for 20 yr</th>
<th>Global Warming Potential for 100 yr</th>
<th>Global Warming Potential for 500 yr</th>
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<td>Carbon dioxide</td>
<td>CO₂</td>
<td>See below</td>
<td>1.4 x 10⁻⁴</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Methane</td>
<td>CH₄</td>
<td>12</td>
<td>3.7 x 10⁻⁴</td>
<td>21</td>
<td>72</td>
<td>25</td>
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<tr>
<td>Nitrous oxide</td>
<td>N₂O</td>
<td>114</td>
<td>3.0 x 10⁻¹</td>
<td>310</td>
<td>230</td>
<td>236</td>
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<tr>
<td>Substance controlled by the Montreal Protocol</td>
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<td></td>
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<tr>
<td>CFC-11</td>
<td>CCl₃F</td>
<td>45</td>
<td>0.25</td>
<td>3,800</td>
<td>6,730</td>
<td>4,730</td>
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<tr>
<td>CFC-12</td>
<td>CCl₂F₂</td>
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<td>0.32</td>
<td>8,100</td>
<td>11,000</td>
<td>10,000</td>
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<td>14,400</td>
<td>14,400</td>
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<td>0.18</td>
<td>5,310</td>
<td>7,370</td>
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<td>Halon-1301</td>
<td>CBr₃F</td>
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<td>0.32</td>
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<td>6,400</td>
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<td>CBr₂F₂</td>
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<td>0.3</td>
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<td>1,890</td>
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<td>Methanol</td>
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<td>505</td>
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<td>273</td>
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<td>HFO-124</td>
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<td>0.22</td>
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<td>908</td>
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<td>HFC-1341b</td>
<td>CH₃C₂F₄</td>
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<td>0.14</td>
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<td>0.2</td>
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<td>122</td>
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<td>23,800</td>
<td>30,000</td>
<td>23,600</td>
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<td>Nitrogen trifluoride</td>
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<td>17,200</td>
<td>20,700</td>
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<td>0.28</td>
<td>8,650</td>
<td>12,200</td>
<td>12,200</td>
</tr>
</tbody>
</table>
Step 2: source of biomass

Significance:
Use of waste/residue avoids feedstock production
However use of waste/residue can cause emissions due to the loss of carbon stocks.

Methodological issues:
Distinction between waste and non-waste bioenergy
→ The user is asked to specify the definition of “waste” biomass to ensure transparency at this critical point.
Step 2: source of biomass

„A range of studies has shown that where feedstock is produced without land-use change (either direct or indirect) most biofuels achieve net GHG savings. Current biodiesel technologies generally achieve a 40 - 50% saving compared to that of conventional diesel. The range of savings from current bioethanol technologies is much wider, from -20% to 80% depending upon: feedstock, rates of fertiliser application; type of other energy source (coal, gas or biomass); heat and power source (simple boiler, CHP or advanced turbine) and the specific use of co-products. “

Step 3: Land use change

3a. Direct LUC:

Significance:
if DLUC is given, it is mostly a major source or sink. Within the majority of cases DLUC might not be given.

Methodological issues:

- Data availability (on-site nearly unfeasible → rely on IPCC tier 1)
- Temporal aspect (reference year; annualization)
- Land categories (change of status; forest = forest)
- Degraded land (definition?)
Step 3: Land use change

3a. Direct LUC: example
Jatropha FAME for different options in terms of land use change and annualisation

![Graph showing the impact of land use change on CO2 emissions](chart.png)
Step 3: Land use change

3b. *indirect LUC*:

**Significance:**
Within the range of published approaches in many cases a major source (in few cases a sink).

**Methodological issues:**
There is a plenty of
→ to be tackled separately within the ILUC workstream.
Step 4: Biomass feedstock production

Significance:
One of the major sources.
(fertilizer production, N₂O emissions, land machines).

Methodological issues:
• Data for N-fertilizer are key
• given that upstream production chains are embodied. (applies also for step 6)
• N₂O emission modeling has relevant impact on results
• Crop rotation systems
• Soil management – how to include good practice (long term aspect)
Step 4: Biomass feedstock production

Major source N$_2$O emissions:
Method under discussion, some approaches lead to values >x2

Source: Köble, R. 2011
JRC
slightly modified by IFEU
Step 5 & 8: transport of biomass and fuel

Significance:
In most cases only minor contributions are related to transport processes (<10% of the life cycle result). Extended truck transports (some 100 km) plus far transcontinental shipping can enhance the relevance.

Methodological issues:
• Return run considered (empty or loaded)
Step 6: processing into fuel

Significance:
Depends strongly on the degree and nature of the processing and on type of fuel for process energy (fossil, non-fossil) as well as energy efficiency.

Methodological issues:
- System modelling – simplification (eg. “black box”) vs. complex modelling.
- Cut-off rule to limit the amount of inputs to be regarded.
- Treatment of process waste (downstream).
Part 1: The GBEP methodology framework

GHG savings arising from production of wheat to ethanol using different production processes

Step 7: by-products and co-products

Significance:
Depends on quantity and quality of by-/co-product.

Methodological issues:
• Choice of general approach (allocation, substitution).
• System boundary (point of allocation or substitution)
• Line between by-/co-product and waste/residue? (see also step 2)
Part 1: The GBEP methodology framework

Step 7: by-products and co-products

Example: RME, diverse approaches for glycerine

![Graph showing kg CO₂-Eq. per GJ for different scenarios]

- **Balance after subst.**
- **Transport to fuel storage for admixture**
- **Conversion step II**
- **Transport between conversion steps**
- **Conversion step I**
- **Transport of biomass**
- **Production of biomass**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>LHV Allocation</th>
<th>Price Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole chain</td>
<td>45.3</td>
<td>41.2</td>
</tr>
<tr>
<td>Subst. best case</td>
<td>-1.27</td>
<td></td>
</tr>
<tr>
<td>Subst. med. case</td>
<td>20.3</td>
<td></td>
</tr>
<tr>
<td>Subst. worst case</td>
<td>45.2</td>
<td></td>
</tr>
</tbody>
</table>
Step 9: use of fuel

Significance:
Important because this defines the functional unit of bioenergy.
Maybe be not a major source for transport fuel (+/- identical use efficiency).
Can be major source for stationary use

Methodological issues:
• transport fuel: tailpipe gas (non-CO$_2$ GHG) considered? data?
• Stationary use:
  - CHP considered?
  - non-CO$_2$ GHG emissions considered?
Step 10: Comparison with replaced fuel

Significance:
Crucial aspect! Represents the whole life cycle for the substituted system.

Methodological issues:
- Identification of the replaced fuel system.
- Timeline, attributional/consequential approaches.
- How to minimize inconsistencies between bioenergy system (1-9) and replaced system (10).
Part 2: Different approaches to conduct an LCA of bioenergy

Key content in this part

➔ Different methods for calculating lifecycle emissions, with different levels of data requirements and country capacity

➔ Data requirements and potential sources of data for LCA of bioenergy
Part 2: Different approaches to conduct LCA of bioenergy

LCA work is data work
There are different levels of data

→ direct (field) measurements, meaning actual values

→ Activity data referring to rough typology of processes to be combined with default emission factors (e.g. IPCC or other databases)

→ Data from integrated calculator tools offering pre-calculated values at different degrees of specification.
Part 2: Different approaches to conduct LCA of bioenergy

an LCA for bioenergy encloses various levels

- LUC
- Feedstock production
- Processing
- Use
- Agro-inputs
- Process inputs
- Waste disposal
- Co-product

Integration along the production chain
Integration at the level of a single step
Overall integration
Part 2: Different approaches to conduct LCA of bioenergy

Measured field data:
- rarely cover a whole life cycle
- refer to a single step in principle

e.g. biomass feedstock production:
  field data on yield and agro-inputs (fertilizers …)

e.g. land use change:
  Field data for LUC-derived C stock changes based on satellite images/remote sensing

e.g. processing:
  example

\[ \text{Diagram} \]
Part 2: Different approaches to conduct LCA of bioenergy

Measured field data
Example “processing step”

Process data: demand on inputs
(per product unit):
- electricity ... kWh
- heat ... MJ
- chemical A ... kg
- chemical B ... kg
- etc. ... 
- feedstock ... kg

on-site energy plant
x g CO$_{2eq}$/kWh

Feedstock

Electricity
x g CO$_{2eq}$/kWh

Fuel
x g CO$_{2eq}$/kg

Chemical A
x g CO$_{2eq}$/kg

measured by process operator
Part 2: Different approaches to conduct LCA of bioenergy

Combining activity data and appropriate emission factors

→ might be a sensible compromise between actuality and referring to broader averages (e.g. based on statistical data)

→ might not cover the number of processes since the categories of activities are too generic

→ Still requires the final overall chain integration

→ Existing emission factors mostly refer to „Northern“ conditions and might not be appropriate for (sub-) tropical production.
→ need to have measured data for the South.
Data from integrated calculator tools offering pre-calculated values:

- There is a number of such calculators around, all designed to enable operators to perform GHG calculations for bioenergy.

- Some refer directly to legal regulations (RED, LCFS)

- Some offer high flexibility, some offer widely integrated pre-calculated results

EXAMPLES
Part 2: Different approaches to conduct LCA of bioenergy

Calculator tools for bioenergy:

→ EU-RED related:
  - BioGrace (initiated by research institutes)
  - RSB-EU (stakeholder driven)
  - RTFO-Tool (UK)
  - BioNachTHG (DE)
  - Calcugei (ES)

→ Other legal relations:
  - GREET-Model (Californian LCFS)
  - EMPA-Model (Swiss regulation)

→ “independent” Tools:
  - RSB general tool,
  - GEF-biofuel GHG calculator
### Overview Results

<table>
<thead>
<tr>
<th>All results in g CO₂eq / MJ Ethanol</th>
<th>Non-allocated results</th>
<th>Allocation factor</th>
<th>Allocated results</th>
<th>Total</th>
<th>Actual/Default</th>
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<tbody>
<tr>
<td>Cultivation eₚ</td>
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<td></td>
<td></td>
<td>11,5</td>
<td>A</td>
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<td>Cultivation of sugarbeet</td>
<td>16,16</td>
<td>71.3%</td>
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<td>Processing eₚ</td>
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<td>28,4</td>
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<td>Ethanol plant</td>
<td>37,03</td>
<td>71.3%</td>
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<td>Transport of sugarbeet</td>
<td>1,11</td>
<td>71.3%</td>
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<td>Transport of ethanol</td>
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<td>1,10</td>
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<td>Filling station</td>
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<td>Land use change eᵣ</td>
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<td></td>
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### Calculation per phase

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<tr>
<th>Cultivation of sugarbeet</th>
<th>Quantity of product</th>
<th>Calculated emissions</th>
<th>Info</th>
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<tbody>
<tr>
<td></td>
<td>Yield</td>
<td>Emissions per MJ ethanol</td>
<td>per kg sugarbeet</td>
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<tr>
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<td>Yield</td>
<td>g CO₂, g CH₄, g N₂O, g CO₂eq</td>
<td>g CO₂eq</td>
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<td>Sugar beet</td>
<td>68,860 kg ha⁻¹ year⁻¹</td>
<td>280,605 MJ sugar beet ha⁻¹ year⁻¹</td>
<td>1,000 MJ / MJ sugar beet, input</td>
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<tr>
<td>Moisture content</td>
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<td>Energy consumption</td>
<td>Diesel</td>
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<td>N-fertiliser (kg N)</td>
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<td>Manure</td>
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<td></td>
<td>0,31 0,00 0,00 0,00</td>
</tr>
<tr>
<td>K₂O-fertiliser (kg K₂O)</td>
<td>134,9 kg K₂O ha⁻¹ year⁻¹</td>
<td></td>
<td>0,47 0,00 0,00 0,00</td>
</tr>
<tr>
<td>P₂O₅-fertiliser (kg P₂O₅)</td>
<td>59,7 kg P₂O₅ ha⁻¹ year⁻¹</td>
<td></td>
<td>0,38 0,00 0,00 0,00</td>
</tr>
<tr>
<td>Pesticides</td>
<td>1,30 kg ha⁻¹ year⁻¹</td>
<td></td>
<td>0,08 0,00 0,00 0,00</td>
</tr>
<tr>
<td>Seeding material</td>
<td>Seeds- sugarbeet</td>
<td>6 kg ha⁻¹ year⁻¹</td>
<td>0,09 0,00 0,00 0,14</td>
</tr>
<tr>
<td>Field N₂O emissions</td>
<td>3,27 kg ha⁻¹ year⁻¹</td>
<td></td>
<td>0,00 0,00 0,02 0,00</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>7,19 0,01 0,03</td>
</tr>
</tbody>
</table>

### Emission reduction

<table>
<thead>
<tr>
<th>Allocation factors</th>
<th>Emission reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol plant</td>
<td>71.3% to ethanol</td>
</tr>
<tr>
<td></td>
<td>28.7% to Sugar beet pulp</td>
</tr>
<tr>
<td>Fossil fuel reference (petrol)</td>
<td>83.8 g CO₂eq/MJ</td>
</tr>
<tr>
<td>GHG emission reduction</td>
<td>52%</td>
</tr>
</tbody>
</table>

*Calculations in this Excel sheet...*

*strictly follow the methodology as given in Directives 2009/28/EC and 2009/30/EC*

Follow JEC calculations by using GWP values 25 for CH₄ and 298 for N₂O

*Note: each emission is calculated separately with the rules strictly followed from JEC calculations by using GWP values.*

*GBEP GHG workshop – Tokyo 15 Nov 11*

Horst Fehrenbach – GBEP GHG workshop – Tokyo 15 Nov 11

GBEP GHG workshop
### Part 2: Different approaches to conduct LCA of bioenergy

#### Biodiesel from palm oil

<table>
<thead>
<tr>
<th>Setting 19</th>
<th>Setting 20</th>
<th>Setting 21</th>
<th>Setting 22</th>
<th>Setting 23</th>
<th>Setting 24</th>
<th>User-defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>Indonesia</td>
<td>Colombia</td>
<td>Malaysia</td>
<td>Indonesia</td>
<td>Malaysia</td>
<td></td>
</tr>
<tr>
<td>Smallholders</td>
<td>Plantation</td>
<td>Smallholders</td>
<td>Plantation</td>
<td>Smallholders</td>
<td>Plantation</td>
<td></td>
</tr>
<tr>
<td>Intermediate inputs</td>
<td>High inputs</td>
<td>Intermediate inputs</td>
<td>High inputs</td>
<td>High inputs</td>
<td>High inputs</td>
<td></td>
</tr>
<tr>
<td>No POME use</td>
<td>No POME use</td>
<td>No POME use</td>
<td>No POME use</td>
<td>No POME use</td>
<td>No POME use</td>
<td></td>
</tr>
</tbody>
</table>

#### Overview results

<table>
<thead>
<tr>
<th>Land use change</th>
<th>Setting 19</th>
<th>Setting 20</th>
<th>Setting 21</th>
<th>Setting 22</th>
<th>Setting 23</th>
<th>Setting 24</th>
<th>User-defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting 19</td>
<td>Setting 20</td>
<td>Setting 21</td>
<td>Setting 22</td>
<td>Setting 23</td>
<td>Setting 24</td>
<td>User-defined</td>
<td></td>
</tr>
<tr>
<td>Direct land use change in [g CO₂ eq / ha]</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Indirect land use change in [g CO₂ eq / ha]</td>
<td>24.7</td>
<td>23.2</td>
<td>21.1</td>
<td>18.6</td>
<td>17.7</td>
<td>17.7</td>
<td>17.7</td>
</tr>
</tbody>
</table>

**Cultivation**

<table>
<thead>
<tr>
<th>Setting 19</th>
<th>Setting 20</th>
<th>Setting 21</th>
<th>Setting 22</th>
<th>Setting 23</th>
<th>Setting 24</th>
<th>User-defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivation of FFBs in [g CO₂ eq / ha]</td>
<td>11.9</td>
<td>14.8</td>
<td>11.4</td>
<td>13.2</td>
<td>11.5</td>
<td>11.5</td>
</tr>
</tbody>
</table>

**Processing**

<table>
<thead>
<tr>
<th>Setting 19</th>
<th>Setting 20</th>
<th>Setting 21</th>
<th>Setting 22</th>
<th>Setting 23</th>
<th>Setting 24</th>
<th>User-defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil mill in [g CO₂ eq / ha]</td>
<td>30.6</td>
<td>30.6</td>
<td>29.4</td>
<td>27.3</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Biodiesel plant in [g CO₂ eq / ha]</td>
<td>21.1</td>
<td>21.1</td>
<td>18.6</td>
<td>17.7</td>
<td>17.7</td>
<td>17.7</td>
</tr>
</tbody>
</table>

**Transports**

<table>
<thead>
<tr>
<th>Setting 19</th>
<th>Setting 20</th>
<th>Setting 21</th>
<th>Setting 22</th>
<th>Setting 23</th>
<th>Setting 24</th>
<th>User-defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFB to oil mill in [g CO₂ eq / ha]</td>
<td>2.5</td>
<td>2.5</td>
<td>2.4</td>
<td>2.3</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Palm oil to biodiesel plant in [g CO₂ eq / ha]</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>FAME to filling station in [g CO₂ eq / ha]</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
</tbody>
</table>

**GHG emissions allocated in [g CO₂ eq / MJ]**

<table>
<thead>
<tr>
<th>Setting 19</th>
<th>Setting 20</th>
<th>Setting 21</th>
<th>Setting 22</th>
<th>Setting 23</th>
<th>Setting 24</th>
<th>User-defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>81.7</td>
<td>83.2</td>
<td>75.2</td>
<td>73.1</td>
<td>43.7</td>
<td>43.6</td>
<td>43.6</td>
</tr>
</tbody>
</table>

**GHG emissions allocated in [kg CO₂ eq / ha oil palm]**

<table>
<thead>
<tr>
<th>Setting 19</th>
<th>Setting 20</th>
<th>Setting 21</th>
<th>Setting 22</th>
<th>Setting 23</th>
<th>Setting 24</th>
<th>User-defined</th>
</tr>
</thead>
</table>

**Fossil fuel comparator in [g CO₂ eq / MJ fossil fuel]**

<table>
<thead>
<tr>
<th>Setting 19</th>
<th>Setting 20</th>
<th>Setting 21</th>
<th>Setting 22</th>
<th>Setting 23</th>
<th>Setting 24</th>
<th>User-defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>83.8</td>
<td>83.8</td>
<td>83.8</td>
<td>83.8</td>
<td>83.8</td>
<td>83.8</td>
<td>83.8</td>
</tr>
</tbody>
</table>

**GHG savings in [g CO₂ eq / MJ]**

<table>
<thead>
<tr>
<th>Setting 19</th>
<th>Setting 20</th>
<th>Setting 21</th>
<th>Setting 22</th>
<th>Setting 23</th>
<th>Setting 24</th>
<th>User-defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>0.6</td>
<td>8.6</td>
<td>10.7</td>
<td>40.1</td>
<td>40.2</td>
<td>40.2</td>
</tr>
</tbody>
</table>

**Input data per step**

**STEP 1 - GHG emissions from land use changes**

Do direct land use changes occur (only user-defined)?

If land use changes occur, go to sheet 'LUC' and calculate respective GHG emission. Enter emissions manually in line 38.

Which emissions arose from direct land use changes (only user-defined)?
Conclusion at this step:

- Measured field data are always very welcome but they will always refer to a selected part of the chain which needs to be integrated including a number of data.

- Flexible calculator tools may incorporate measured field data, while they facilitate the chain integration.

- However the calculator tools are not harmonized (just some of them are), hence results vary between the tools.
Part 2: Different approaches to conduct LCA of bioenergy

Comparison of RSB-RED tool and BioGrace tool

<table>
<thead>
<tr>
<th>GHG emissions (disaggregated)</th>
<th>GHG emissions (total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivation (W-EtOH)</td>
<td>W-EtOH</td>
</tr>
<tr>
<td>Processing (W-EtOH)</td>
<td>RME</td>
</tr>
<tr>
<td>Transport (W-EtOH)</td>
<td>PME</td>
</tr>
<tr>
<td>Cultivation (RME)</td>
<td>Fossil Ref</td>
</tr>
<tr>
<td>Processing (RME)</td>
<td></td>
</tr>
<tr>
<td>Transport (RME)</td>
<td></td>
</tr>
<tr>
<td>Cultivation (PME)</td>
<td></td>
</tr>
<tr>
<td>Processing (PME)</td>
<td></td>
</tr>
<tr>
<td>Transport (PME)</td>
<td></td>
</tr>
</tbody>
</table>

W-EtOH: ethanol from wheat
RME: rapeseed oil methylester (Biodiesel from rapeseed oil)
PME: palm oil methylester (Biodiesel from palm oil)

Source: Hennecke et al. 2011
Data requirements and potential sources of data for LCA of bioenergy

Requirement in general:
→ data shall be fit for purpose, i.e.:
  • well documented and transparent
    (particularly measurements)
  • They have to be reliable and taken from recognized sources
    (particularly background data)
  • Consistent with the overall methodological set-up
    (e.g. in terms of GHG coverage, allocations, system boundaries etc.)
Part 2: Different approaches to conduct LCA of bioenergy

Exemplary data bases:

→ **International:**
  - IPCC  (carbon stocks for LUC; emission factors)
  - FAOSTAT  (agricultural systems)
  - CORINAIR  (generic, also transport and industrial systems)

→ **Proposed by national (community) initiatives**
  - ELCD (EU)
  - US LCI (US)
  - PROBAS (DE)
  - BioGrace Standard values  (if recognized by EU Commission)

→ **From research institutions**
  - ECOINVENT (CH)
  - GEMIS (DE)

→ **From industrial institutions**
  - IFS (fertilizer data)
Part 3:
Human and institutional capacity required to conduct an LCA
At first this is a question of the goal and scope: what is the purpose of the LCA and its results?

- **GHG value for legal support scheme**
  - e.g. EU RED, LCFS
  - Requires watertight unambiguous rules and data
  - Rulemaker in charge to provide framework and „tools“

- **GHG value for policy decision support**
  - e.g. GBEP (IND1) appl.
  - Requires a reasonable set of rules and guidance
  - Policy makers could make reference to existing framework or „tools“

- **GHG value for research reasons**
  - Shall refer to the ISO Standards 14040/44 or 14067
  - Scientists should be capable enough …
Part 3: Human and institutional capacity required to conduct LCA

Capacity needed for LCA in policy decision support:

Institutional capacities:

- Responsible Authority (who is in charge? Who is the driver?)
- Include environmental Departments (if other department is the driver)
- Use existing capacities in environmental and climate change issues
- Get connected with other GHG related national reporting systems (synergies)
- Created – promote Networks – getting relevant stakeholders (companies, NGO, research) involved
Part 3: Human and institutional capacity required to conduct LCA

Capacity needed for LCA in policy decision support:

**Human capacities:**

- established capacity centers at national level such as:
  - University Institutes
  - national research laboratories
  - independent experts or institutes
  - (associated external corporation partners)

  Have to cover expertise in LCA, how to get to data, how to work on data

- Administrative office responsible for the issue.
  - Responsible officer
    - needs to have basic understanding of LCA, GHG calculation,
    - general aspects on data handling.
    - basics about the calculator tool (in case there is one in place)
Part 4: Overview of policy and other applications

- legal regulations requiring GHG LCA for bioenergy
- Voluntary systems
- Others
There are a number of legal regulations in place requiring GHG LCA for bioenergy

- EU RED/FQD (each consignment – default or actual values)
- US RFS2 (EPA manages the calculations)
- Californian LCFS (CARB manages the calculations),
- German law, (under EU RED but slightly modified)
- UK RTFO (under EU RED but earlier started with reporting system)
- Switzerland

- Many countries are about to introduce something (at least at voluntary level)
There are some (voluntary) certification systems in place including a GHG LCA for bioenergy

- **RSB** (RED related and also general)
- **ISCC** (RED related)
- **RTRS** (RED related and also general)
- **Bonsucro** (RED related and also general)
- **GGL Green Gold Label** (driven by energy industry)
- **US system**

- not a system but standards:
  - **prEN 16214** (RED related)
  - **ISO 13065**
  - **NTA 8080** (Dutch Standard, RED related)

- not to forget: **IEA Bioenergy Task 38 Tool**
Last not least: international support schemes like

- **the CDM process**
  at least GHG mitigation performance in a more qualitative sense to achieve carbon finance through CDM through climate funds
  UNFCCC scheme for biofuel from degraded land

- **The GEF**
  intention to include GHG information within a project screening tool;
  objective: to enable the GEF and its Implementing Agencies (IA) to assess on the basis of the Project Identification Forms (PIF) if a biofuel project meets the Global Environmental Benefits (GEB) and additional benefits
The GBEP-10-step framework includes the essential components of a GHG LCA for bioenergy

It does NOT
- provide “ready-to-use” schemes;
- determine on methods;
- provide data (or refer to a specific databank).

The applicant is supposed to be skilled in LCA

However it offers a common ground of major/minor working items facilitating a consistent building up of capacities for partners at global scale.
CONCLUSIONS (2)

Capacity building options:
Supporting a partner

• to strengthen its human and institutional capacities (experts, administrative level),
• to identify the demand for GHG calc. for bioenergy (own policy goals, compliance with other schemes if wishful)
• and to develop a GHG assessment approach according to his needs
• to make use of existing data, schemes or tools (as long as appropriate and compliant with own goals)
• to identify data gaps and how fill such.
THANK YOU FOR LISTENING

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www.ifeu.de

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