GHG calculation methodologies
The UK approach for the RTFO

GBEP Taskforce meeting
7th March, Washington D.C
Jessica Chalmers, Low Carbon Vehicle Partnership
Two pieces of carbon reporting data are required in the monthly C&S reports from fuel suppliers:

<table>
<thead>
<tr>
<th>Batch number</th>
<th>Internal Batch number (optional)</th>
<th>Fuel type</th>
<th>Quantity of fuel (litres)</th>
<th>Biofuel Feedstock</th>
<th>Feedstock Origin</th>
<th>Social Level Land use on 30 Nov 2005</th>
<th>Carbon Intensity incl LUC g CO$_2$e / MJ</th>
<th>Accuracy level</th>
</tr>
</thead>
<tbody>
<tr>
<td>33006</td>
<td></td>
<td>Biodiesel</td>
<td>800,000</td>
<td></td>
<td></td>
<td></td>
<td>55</td>
<td>2</td>
</tr>
<tr>
<td>33008</td>
<td></td>
<td>Biodiesel</td>
<td>100,000</td>
<td></td>
<td></td>
<td></td>
<td>45</td>
<td>2</td>
</tr>
<tr>
<td>33009</td>
<td></td>
<td>Biodiesel</td>
<td>100,000</td>
<td></td>
<td></td>
<td></td>
<td>177</td>
<td>2</td>
</tr>
</tbody>
</table>
Carbon Intensity calculation boundaries

- Feedstock transport
- Biofuel production
- Biofuel transport
- Waste material
- Alternative waste management
- Cultivation & harvest
- Previous land use
- Alternative land use
- Product substitution by biofuel co-product

Assessed ex post by RTFO Administrator

Boundary for monthly carbon intensity calculation:

Excludes minor sources, from:
- Manufacture of machinery or equipment
- PFCs, HFCs, SF$_6$

Assessed by boundary extension

Assessed separately

Biofuel use

Fossil fuel reference system: LowCVP

Low carbon vehicle partnership
Calculation method – fuel chains

- Ethanol from:
  - sugar cane (Br, Moz, Pak, SA)
  - sugar beet (UK)
  - Molasses (Pak, SA, UK)
  - Wheat (Can, Fr, Ger, Ukr, UK)
  - Corn (Fr, USA)
  - Ethanol converted to ETBE
  - Biomethane from anaerobic digestion of MSW

- FAME biodiesel from:
  - Tallow (UK)
  - used cooking oil (UK)
  - palm oil (My, Ind)
  - Soy (Arg, Bra, USA)
  - Rapeseed (Aus, Can, Fin, Fr, Ger, Pol, Ukr, UK)

- HVO biodiesel from palm oil, soy and rapeseed
Calculation method – Reference Systems

- Alternative Waste Management
  - Default values set to zero
  - Companies that can demonstrate alternative waste management may claim credits
  - Renewable Fuels Agency has to approve a new waste

- Previous land use (or Direct land-use changes) reference date 31 Nov 05
  - Only applies to changes from forest or permanent grassland
  - No account of alternative land-use for existing agricultural systems
  - Land use in November 2005
  - Applies IPCC Tier 1 factors
  - Option to use Tier II / III systems

- Alternative land use
  - Used to determine emissions that would have occurred had the land been used for an alternative
  - Not covered within boundaries
  - Can be assessed ex-post

- Indirect land-use change (same as alternative land use)
  - Calculated by Administrator
  - Not part of company reporting

- Fossil fuel reference system
  - Based on Concawe/EUcar/JRC
  - Modifications to ensure consistent boundaries
Co-products are dealt with in a flexible way – system expansion preferred in RTFO

<table>
<thead>
<tr>
<th>Co-product</th>
<th>Fuel chains applicable to</th>
<th>End use</th>
<th>Substituted product</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm kernel olein</td>
<td>Palm to biodiesel</td>
<td>Wide range</td>
<td>Wide range</td>
<td>Market value</td>
</tr>
<tr>
<td>Palm kernel stearin</td>
<td>Palm to biodiesel</td>
<td>Wide range</td>
<td>Wide range</td>
<td>Market value</td>
</tr>
<tr>
<td>POME</td>
<td>Palm to biodiesel</td>
<td>Fertiliser</td>
<td>Other fertilisers</td>
<td>Within system boundaries</td>
</tr>
<tr>
<td>DDGS/WDGS</td>
<td>Wheat, corn to bioethanol</td>
<td>Animal feed</td>
<td>Soy meal</td>
<td>System expansion</td>
</tr>
<tr>
<td>Rape meal</td>
<td>Oilseed rape to biodiesel</td>
<td>Animal feed</td>
<td>Soy meal</td>
<td>System expansion</td>
</tr>
<tr>
<td>Soy meal</td>
<td>Soy to biodiesel</td>
<td>Animal feed</td>
<td>Feed wheat</td>
<td>System expansion</td>
</tr>
<tr>
<td>Palm stearin</td>
<td>Palm to biodiesel</td>
<td>Wide range</td>
<td>Wide range</td>
<td>Market value</td>
</tr>
<tr>
<td>Electricity</td>
<td>All</td>
<td>Marginal baseload elec</td>
<td>e.g. coal, nat gas</td>
<td>System expansion</td>
</tr>
<tr>
<td>Chemicals (glycerine)</td>
<td>Several</td>
<td>Wide range</td>
<td>Wide range</td>
<td>Market value</td>
</tr>
</tbody>
</table>
Default values – Data sets and N20 emissions

- International data sets are used to set single default values (e.g. IEA for emissions factors)
  - Consistent approach but some stakeholders concerned e.g. methane emissions from pipelines not included.

- N₂O emissions from soil for all crops are, by default, calculated on the basis of the amount of nitrogen fertiliser applied to the soil – using a co-efficient developed by the IPCC for the purposes of national GHG inventories:
  \[ \text{N}_2\text{O emissions} = 1.325\% \times \text{N fertiliser} \]
  - This approach does not take into account the nitrogen in crop residues.
  - More advanced approaches to calculating N₂O emissions would be allowed, provided they are consistent with IPCC guidelines on “Tier 3” approaches.
  - Based on comparisons with emissions measured from fields, the default approach would appear to significantly underestimate the N₂O emissions arising from soya beans (e.g. by 40 – 50%). This is due to the exclusion of crop residues from the methodology.
  - Soy beans treated as an exception in the methodology – crop residues included.
The magnitude of the default values has important implications for the effectiveness of the policy and the cost of compliance

- If default values are set too low:
  - Little incentive to report => no differentiation between chains
  - Underestimate carbon intensity (risk to industry and Govt)
  - Uncertain carbon savings from policy

- If default values are too high:
  - Incentive to report, but potentially high compliance costs
  - Overestimate carbon intensity => negative public perception

- From a policy perspective, default values should be set on the conservative side

- From a practical point of view, the magnitude of the default values could depend on
  - the contribution of the source to the overall carbon intensity
  - the ease of reporting actual data
How do you decide on what magnitude to set single default values at?

- Define worst possible, typical and best practice

- In practice for all chains: default values upstream of biofuel producer set at \textit{typical} level
The result is a practical and flexible approach that encourages the supply of more information.
LUC emissions are estimated using the 2006 IPCC Guidelines

Methodology for calculating emissions from LUC is based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (www.ipcc.ch)

Four types of LUC to Cropland are considered and need to be reported

- Forest land
- Grassland with agricultural use
- Grassland without agricultural use
- Cropland

Scientific evidence to calculate wetlands not available

Default values available based on:

- Land use in 2005
- Type of biofuel cropland (annual or perennial)
- Country in which land use change has occurred
Land use change assumptions

- For calculating changes in carbon stock in biomass (above ground) it is assumed:
  - Carbon stock immediately after LU conversion is zero
  - All biomass carbon is lost when annual crops harvested – but none when perennials harvested

- For calculating changes in carbon stocks in dead organic matter
  - Amount of dead wood/litter [carbon] stock under the old land use category is equal to average of the 3 IPCC default values given for each climate zone
  - The amount of dead wood/litter carbon stock for the new land use is zero

- For changes in carbon stocks in soil it is assumed that:
  - Default is mineral soils (except Indonesia)
  - Stock change factors for management regime and carbon input before and after land use = 1. Stock factor for land use system before the change was also assumed to be 1.
## Comparison of key methodological issues (i)

<table>
<thead>
<tr>
<th></th>
<th>UK</th>
<th>EC</th>
<th>Germany</th>
<th>Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fuel chains</strong></td>
<td>Biofuels</td>
<td>Biofuels and biomass to electricity</td>
<td>Biofuels (also considering biomass to electricity)</td>
<td>Biofuels and biomass to electricity</td>
</tr>
<tr>
<td><strong>Metric</strong></td>
<td>gCO₂ eq / MJ</td>
<td>gCO₂ eq / MJ</td>
<td>kgCO₂ eq / G J</td>
<td>gCO₂ eq / MJ</td>
</tr>
<tr>
<td><strong>WTW wheel system boundaries</strong></td>
<td>Full well to wheel approach with only minor emissions from machinery manufacturing &amp; maintenance excluded</td>
<td>Full well to wheel approach with only minor emissions from machinery manufacturing &amp; maintenance excluded</td>
<td>Full well to wheel approach with only minor emissions from machinery manufacturing &amp; maintenance excluded</td>
<td>Full well to wheel approach with only minor emissions from machinery manufacturing &amp; maintenance excluded</td>
</tr>
<tr>
<td><strong>Reference residue / waste management</strong></td>
<td>Assume zero default with option to prove otherwise (e.g. credit for avoided landfill)</td>
<td>Assume zero default</td>
<td>Assume zero default with <strong>no</strong> option to demonstrate actual numbers</td>
<td>Same approach as UK but biomethane may have a value</td>
</tr>
</tbody>
</table>
Comparison of key methodological issues (ii)

<table>
<thead>
<tr>
<th></th>
<th>UK</th>
<th>EC</th>
<th>Germany</th>
<th>Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annualised emission period</strong></td>
<td>20 years</td>
<td>20 years</td>
<td>20 years</td>
<td>20 years</td>
</tr>
<tr>
<td><strong>Indirect land-use change (incl. displacement, crop rotation etc)</strong></td>
<td>Not included in WTW (ex-post facto analysis)</td>
<td>Not included in WTW</td>
<td>Not included in WTW</td>
<td>Not included in WTW</td>
</tr>
<tr>
<td><strong>Co-product treatment</strong></td>
<td>Substitution (system expansion) for majority Market value where substitution and energy not applicable</td>
<td>Allocation by energy content (LHV)</td>
<td>Allocation by energy content (LHV)</td>
<td>Substitution in theory In practice almost all market value</td>
</tr>
<tr>
<td><strong>Fossil reference</strong></td>
<td>JRC Petrol – 84.8gCO$_2$eq/MJ Diesel – 86.4gCO$_2$eq/MJ</td>
<td>Average emissions reported in Fuel Quality Directive OR 83.8 gCO$_2$eq /MJ</td>
<td>JRC Petrol – 85kgCO$_2$eq/GJ Diesel – 86.2kgCO$_2$eq/GJ</td>
<td>JRC</td>
</tr>
</tbody>
</table>
Key issues and conclusions

Added value from a GBEP process:

- Agree high level principles as demonstrated in earlier slide – many similarities in Europe already e.g. boundaries, metric

- Spend time on:
  - Engaging developing countries – programme of activities needed
  - Co-product treatment – explore potential for agreement on substitution i.e. the substituted products and the relevant credits
    - Significant implications for other national schemes – need to engage with them

- Developing harmonisation and unity on other key issues
  - Land use change (direct) – agree the key assumptions based on IPCC guidelines
  - Indirect land use change – how?
    - N20 emissions – emissions from soy – can a Tier 1 approach work?

- Development of process to improve international data sets
  - N20 emissions – Tier 3 to be better defined
  - IEA data – emissions factors modifications
Any Questions?

Methodology Document
Technical Guidance
..soon..
The carbon calculator

Available from The Renewable Fuels Agency

www.dft.gov.uk/rfa
rfa.info@dft.gsi.gov.uk
020 7944 8555

LowCVP
low carbon vehicle partnership
## Spare slides

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Feedstock</th>
<th>UK(^1) Range represents different conversion processes</th>
<th>EC(^1) Range represents different conversion processes</th>
<th>Germany (without land use change in brackets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol</td>
<td>Wheat</td>
<td>-22% to 30%</td>
<td>0% to 67%</td>
<td>1% (32%)</td>
</tr>
<tr>
<td></td>
<td>Sugar cane</td>
<td>-36% to 71%</td>
<td>74%</td>
<td>-120 (67%)</td>
</tr>
<tr>
<td></td>
<td>Sugar beet</td>
<td>41%</td>
<td>35%</td>
<td>1% (19%)</td>
</tr>
<tr>
<td></td>
<td>Molasses</td>
<td>-10% to 53%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Corn</td>
<td>-28% to 42%</td>
<td>49%</td>
<td>20% (43%)</td>
</tr>
<tr>
<td>Biodiesel ME</td>
<td>Oilseed rape</td>
<td>17% to 36%</td>
<td>36%</td>
<td>9% (47%)</td>
</tr>
<tr>
<td></td>
<td>Soy</td>
<td>10% to 45%</td>
<td>*</td>
<td>-274% (62%)</td>
</tr>
<tr>
<td></td>
<td>Palm</td>
<td>48%</td>
<td>16% to 51%</td>
<td>-61% (70%)</td>
</tr>
<tr>
<td></td>
<td>UCO &amp; tallow</td>
<td>85%</td>
<td>77%</td>
<td>-</td>
</tr>
<tr>
<td>Biomethane</td>
<td>MSW &amp; manure</td>
<td>42%</td>
<td>75% to 85%</td>
<td></td>
</tr>
<tr>
<td>Biodiesel HVO</td>
<td>Oilseed rape</td>
<td>9% to 44%</td>
<td>45%</td>
<td>6% (44%)</td>
</tr>
<tr>
<td></td>
<td>Soy</td>
<td>1% to 40%</td>
<td>*</td>
<td>-281% (60%)</td>
</tr>
<tr>
<td></td>
<td>Palm</td>
<td>43%</td>
<td>24% to 60%</td>
<td>-66% (67%)</td>
</tr>
</tbody>
</table>

\(^1\)represents conservative rather than typical defaults

* the Commission agree with the UK that the approach to N20 emissions for soy should be readdressed but they propose this is done so through comitology.
Using different assumptions based on IPCC guidelines yields different results.
UK has also developed a carbon calculator software tool

- All default values in Technical Guidance will be in tool
- The tool will be desktop-based – downloadable from [www.dft.gov.uk/rfa](http://www.dft.gov.uk/rfa) shortly, but will automatically update when defaults change
- Will be possible to customise to enable more efficient use by different actors (e.g. oilseed crusher, commodity trader)
- Will record evidence for verification purposes
- Freely available (owned by UK Government)