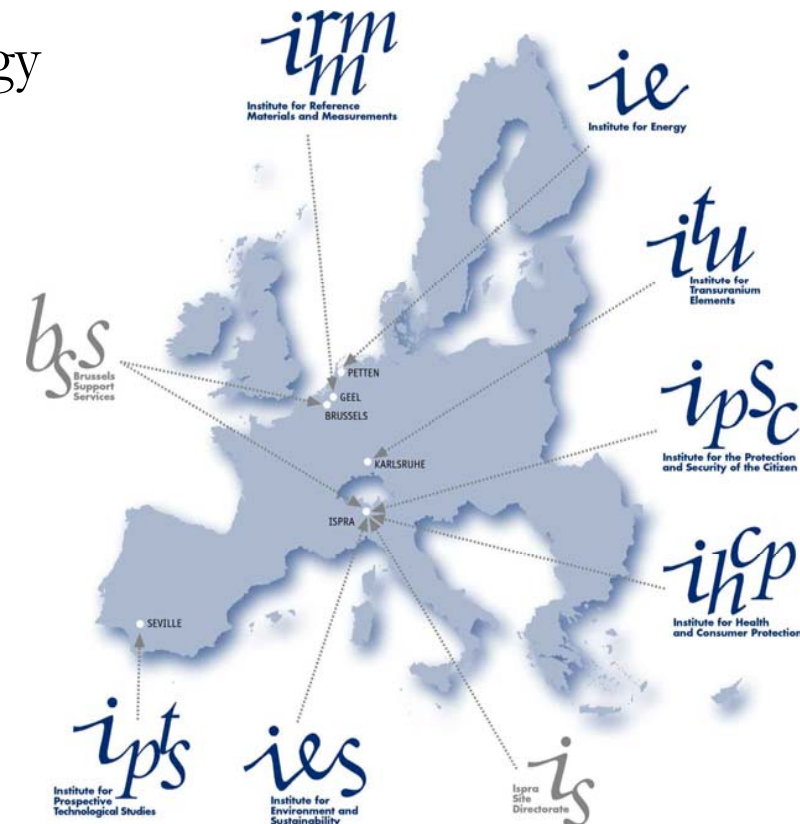


Accounting for GHG emissions from biofuels production and use in EU legislation

L.Marelli

European Commission – Joint Research Center

Institute for Energy



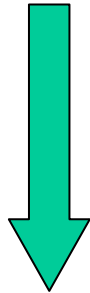
Argonne, 20-21 October 2009

Summary

1. What are regulatory bodies needs and how to
 - meet the target
 - ensure environmental goals
2. Which methodologies applied in EU to calculate GHG balance?
3. Uncertainties and future needs?

Directive 2009/28/EC (RES-D)

10% target for RES in transport



Important dates:

25 June 2009: entry into force

30 June 2010: MS to submit NREAPs

6 December 2010: MS to transpose Directive

Directive 2009/30/EC (FQD)

- 10% GHG reduction by fuel suppliers (6% through alternative fuels)
- Regulations on BF blends for Gasoline and diesel (e.g. E10 and B7)

Summary

- 1. What are regulatory bodies needs and how to**
 - meet the target**
 - ensure environmental goals**
2. Which methodologies applied in EU and which data ar available to calculate GHG balance?
3. Uncertainties and future needs?

Sustainability Criteria and Life-cycle GHG emissions calculation identical in the two Directives

<p>GHG Impact</p>	<ul style="list-style-type: none"> ❑ <i>Minimum 35% GHG Emissions saving (50% from 2017, 60% from 2018)</i>
<p>Biodiversity</p>	<ul style="list-style-type: none"> ❑ <i>not be made from raw materials obtained from biodiverse areas (including primary forests)</i>
<p>Land use</p>	<ul style="list-style-type: none"> ❑ <i>Not be made from land with high carbon stock (i.e. wetlands, forested areas...)</i> ❑ <i>Not be grown on peatlands</i>
<p>Good agricultural conditions</p>	<ul style="list-style-type: none"> ❑ <i>Requirement for good agricultural and environmental conditions (as defined in Annex III to Council Regulation 1782/2003) and social sustainability</i>

Preservation of Biodiverse areas (primary forests and Highly biodiverse grassland)	Definition of criteria and geographical ranges
Account for Carbon emissions from LUC and preservation of high C lands (Forested areas and wetlands)	Guidance to calculate actual values for carbon stock changes
Assessment of impacts on peat-lands	Methodology to assess the impact of peat-lands drainage
Respect of environmental and social requirements outside EU	Multilateral agreements and voluntary schemes
Rules for calculating GHG emissions saving for biofuels/biomass pathways	Up-date of existing default values and addition of new ones
Cultivation on severely degraded / contaminated land	(bonus of 29 gCO ₂ eq/MJ) – definition and thresholds of degraded/contaminated
Assessment of ILUC	Policy proposal on how to address ILUC in EU legislation
Encourage Biofuels made from waste, residues, non-food cellulosic and ligno-cellulosic material, algae	Additional benefits (will count double towards the target)

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GHG emissions saving calculated by:

1. Actual values \rightarrow Methodology in Annex V
2. Default values (if $e_l \leq 0$) \rightarrow from JEC –WTW input database
3. Combination of 1 + 2 \rightarrow Disaggregated default values in Annex V

$$1. \quad E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{sca} - e_{ccs} - e_{ccr} - e_{ee}$$

E = total emissions from the use of the fuel;
 e_{ec} = emissions from cultivation of raw materials;
 e_l = annualised emissions from carbon stock changes caused by land-use change;
 e_p = emissions from processing;
 e_{td} = emissions from transport and distribution;
 e_u = emissions from the fuel in use;

e_{sca} = emission saving from soil C accumulation via improved agricultural management;
 e_{ccs} = emission saving from carbon capture and geological storage;
 e_{ccr} = emission saving from carbon capture and replacement;
 e_{ee} = emission saving from excess electricity from cogeneration.

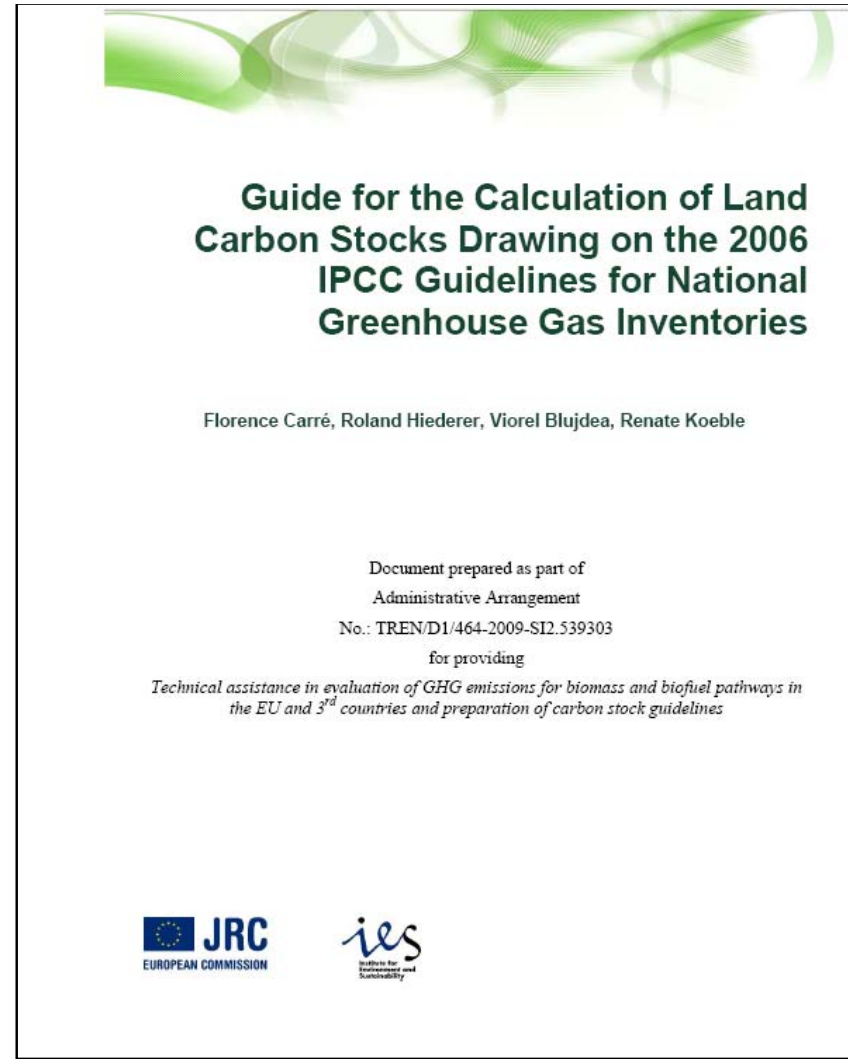
Additional data requirements to improve the methodology/reduce uncertainties/facilitate economic operators

- ***Guidance for the Calculation of Land C stocks (31/12/2009)***

JRC report - October 2009
(under evaluation of the
Commission's Services)

- ***Tool for the calculation of N₂O emissions from biofuels crops***

Now default values in
disaggregated e_{ec} factor



Biofuel production pathway	Typical GHG emission saving	Default GHG emission saving
sugar beet ethanol	61 %	52 %
wheat ethanol (process fuel not specified)	32 %	16 %
wheat ethanol (lignite as process fuel in CHP plant)	32 %	16 %
wheat ethanol (straw as process fuel in CHP plant)	69%	69%
sugar cane ethanol	71%	71%
rape seed biodiesel	45%	38%
palm oil biodiesel (process not specified)	36%	19%
palm oil biodiesel (process with methane capture at oil mill)	62%	56%
waste wood ethanol	80%	74%



= Typical + 40% increase on the estimated processing emissions

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- Accounting for by-products
 - ➔ purpose of LCA determines method
 - QUESTION: How to divide emissions between fuels and co-products?
- iLUC Emissions - “MARGINAL” thinking
 - The methodology for GHG emissions calculation doesn't include indirect effects for the moment
- *N₂O emissions*

- a. Substitution approach:** discount GHG emissions of the substituted product from the total “fuel + co-product” emissions
- b. Allocation approach:** emissions divided between fuel and co-product in proportion according to:
- mass
 - energy content (excluding residues)
 - Economic value

More appropriate for “policy analysis” purposes (e.g. JEC-WTW)

- It tells you how much GHG you save in the whole economy caused by a particular pathway to making biofuel
- does not say *in which sector* the GHG is saved

May bring to “non desired” effects:

- increase LUC by using co-products for energy (higher GHG saving) rather than for animal feed
- “undesired incentives”: GHG savings from by-products in all sectors are attributed to biofuel ⇒ the more by-products and the less biofuel you have, the better!
- investor’s uncertainty

- A processor makes biodiesel from oilseed. He calculates that he saves “G” tonnes CO₂ per tonne biodiesel.
- Now, suppose he decides to export half his vegetable oil to make detergent.
- Assume that 1tonne vegetable oil used for detergent saves the same GHG as making it into biodiesel.
- He gets 1/2G credit for his detergent export, so he is still saving G tonnes of GHG from the same quantity of oilseeds.
- But his only making half as much biodiesel, so now *per GJ biodiesel*, he is saving “2G” tonnes of GHG
- (and he is also saving 2G tonnes GHG per GJ detergent!)

The calculation for the GHG saved *in the transport fuel sector* should be **simpler** because it should not depend on the use of the by-products.....

SIMPLE RULE: The upstream emissions for making by-products are proportional to:

1. Their dry mass
2. Their Energy content
3. Their price (economic value)

None of the options is strictly rational, but there are some advantages compared to substitution:

- Allow Estimation *in the transport* sector (All options)
- no undesired incentives (the use of co-products is irrelevant) (All options)
- Doesn't change in time (like price) (1 and 2)
- Gives values more close to those calculated with “substitution” (2)

- **Diverting 1 ton EU wheat from food to bioethanol, doesn't change GHG emissions from that EU farm.**
- **BUT....is increasing emissions from *marginal* farming to fill the gap in the food market.....mostly outside EU**

marginal emissions from marginal extra production

=

emissions from yield intensification

+

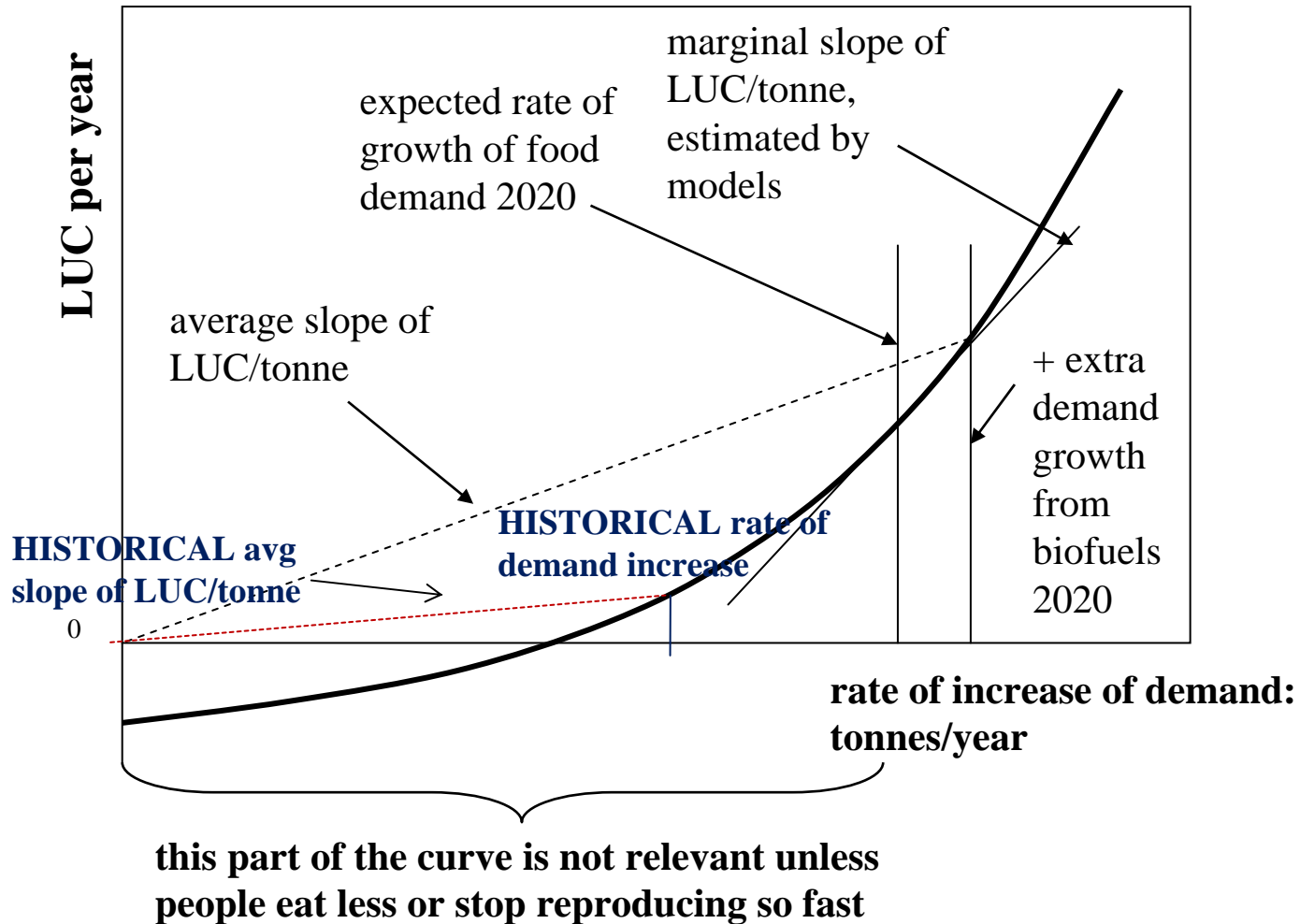
farming emissions on incremental land

+

land use change emissions

What needs to be considered!

...the average emissions on existing land is irrelevant!



HISTORICAL Average LUC is irrelevant for LUC estimates

1. CGE modelling exercise: CEPII/IFPRI/ESC
2. Partial equilibrium modelling exercise: JRC-IPTS
3. Survey of different models: JRC-IE

Intensive discussion going on within Commission and with stakeholders

MARGINAL CALCULATION INITIATIVE (JRC APPROACH)

How to address ILUC?  to what extent ILUC emissions differ:

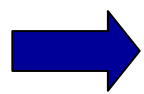
- a. by feedstock:
 - e.g. cereals vs vegetable oils sector
 - Rapeseed vs palm vs soy oil
- b. by geographical origin of the crop
 - US corn vs EU wheat

Marginal Calculation can be made on existing baseline:

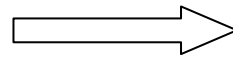
- marginal results for EU biodiesel-from-rapeseed (e.g. 1% shock)
- marginal results for EU bioethanol-from-wheat (e.g. 1% shock)
- marginal extra ethanol from US-corn
- marginal extra palm oil demand in EU (for biodiesel or pure plant oil use)
- “marginal” e.g. $[(\text{baseline} + 1\text{Mtoe extra Biodiesel made in EU}) - \text{baseline}]$
- Results expressed per marginal Toe of biofuels

Very preliminary results: type of feedstock is more important than its geographical origin in determining land use changes

- Policy analysis (assessment of the issue): modeling exercise
- Regulatory part (options to address the issue):



Including an “ILUC factor” in biofuels life cycle equations is an option



- Per crop?
- Per sector (e.g. veg oil)?
- per Country?

.... But no the only one considered by policy makers:

- a. Extend to other commodities/countries the restrictions on LUC applied to EU*
- b. International agreements on protecting carbon-rich habitats*
- c. Do nothing*
- d. Increase the minimum required level of GHG savings*
- e. Extending the use of bonuses*
- f. Additional sustainability requirements*

Increased crop demand affects N₂O emissions due to:

- changes in fertilizer application
- LUC
- yield increase (if obtained through additional fertilizer input)

ALL these impacts (direct and indirect) on **marginal** N₂O emissions has to be addressed to calculate net GHG emissions saving

3 types of N₂O fluxes:

- “on-field” emissions → direct fluxes
- “off-field” emissions → later stage in N-cascade
- “LUC” – N₂O fluxes → from decline of SOM

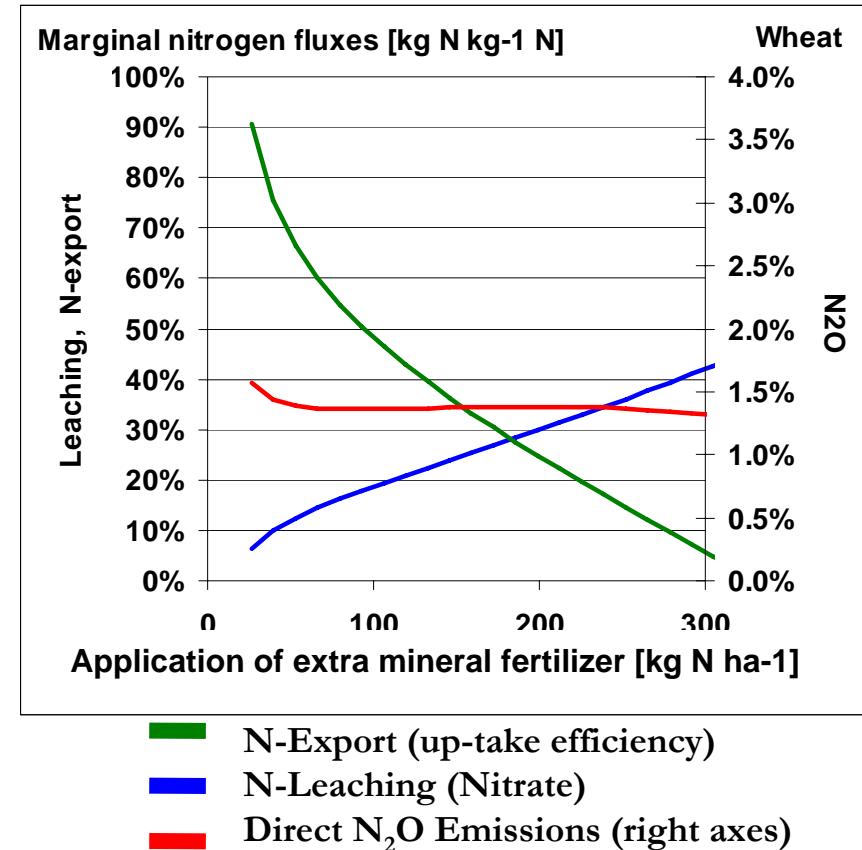
1. N₂O as consequence of intensification

JRC and University of Bonn work: DNDC-CAPRI meta-model to assess marginal EFs from agricultural soils as a function of N input.

(Britz and Leip, 2009. Agric. Ecosyst. Environ. 133 (3-4): 267-27)

Only a small fraction of extra N fertilizer would go into increased yields: most of it would be emitted to the environment.

Example of EU wheat



Is it “safe” to avoid LUC through intensification?

2. N₂O emissions from cultivation of crops

IPCC methodology gives estimates of on-field and off-field N₂O emissions
BUT average N₂O emissions in each country might be very different!

➡ Lack of data and country-specific emission factors

3 alternative approaches:

a. CRUTZEN: avg global E.F. (3-5%).

- less robust at local/regional level

- double counting if N is taken by crop is not “new” (but comes from manure application or atmospheric deposition)

b. Stehfest and Bowman (2006): statistical model – empirical approach

c. DNDC model (used in RES-D for calculation of e_{ec}) → data to be improved

3. N₂O emissions due to N mineralized in mineral soils

- May result from loss of soil C from LUC, but **are often NOT considered in modelling**

- EU set a target for the share of BF, but sustainability criteria have to be respected
- Economic operators, producers and farmers need additional tools to calculate GHG emission savings
- Main uncertainties still in the correct evaluation of GHG savings, due to marginal emissions from iLUC and marginal N₂O emissions .
- How to address iLUC in EU legislation is still under discussion .
- Coordination with non-EU regulations is fundamental.