European Commission

# ENER/C1/2015-438/4 - "Technical assistance concerning the reporting requirements on biofuels and bioliquids stemming from the Directive (EU) 2015/1513"

# FINAL STUDY REPORT

August 2017

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This Report has been prepared for the European Commission under CONTRACT NUMBER ENER/C1/SER/2015-438/4/SI2.735083

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# Index


- Objective
- Scientific ILUC research review. Overview and Methodology
- Type of ILUC studies and objectives
- Individual analysis for each reporting requirement
- Conclusions


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# 1. Objective

**Technical support with:**

*gathering comprehensive information on and systematic analysis of the latest available scientific research and the latest available scientific evidence on ILUC greenhouse gas emissions associated with production of biofuels and bioliquids.*

## Article 23 of the revised RED

- ✓ **Mean values** of the estimated ILUC emissions and the associated ranges.
- ✓ Information on and analysis of the available scientific research **results** regarding the ILUC in relation to **all production pathways.**
- ✓ Accompanied by an assessment of whether the **range of uncertainty** can be narrowed down.
- ✓ The possible **impact of EU policies**, such as environment, climate and agriculture policies, can be factored in.
- ✓ Technological developments and availability of data on use, economic and environmental impacts of biofuels produced from **dedicated energy crops**.

## Article 3 of the ILUC Directive

- ✓ **Best available scientific evidence** on ILUC greenhouse gas emissions associated with the production of biofuels and bioliquids.
- ✓ **Latest available information** with regard to key assumptions influencing the results from modelling of the ILUC GHG emissions associated with the production of biofuels and bioliquids.
- ✓ Possibility of setting out **criteria for the identification and certification of low ILUC-risk biofuels and bioliquids** that are produced in accordance with the EU sustainability criteria.

# 2. Scientific ILUC research review. Overview and methodology

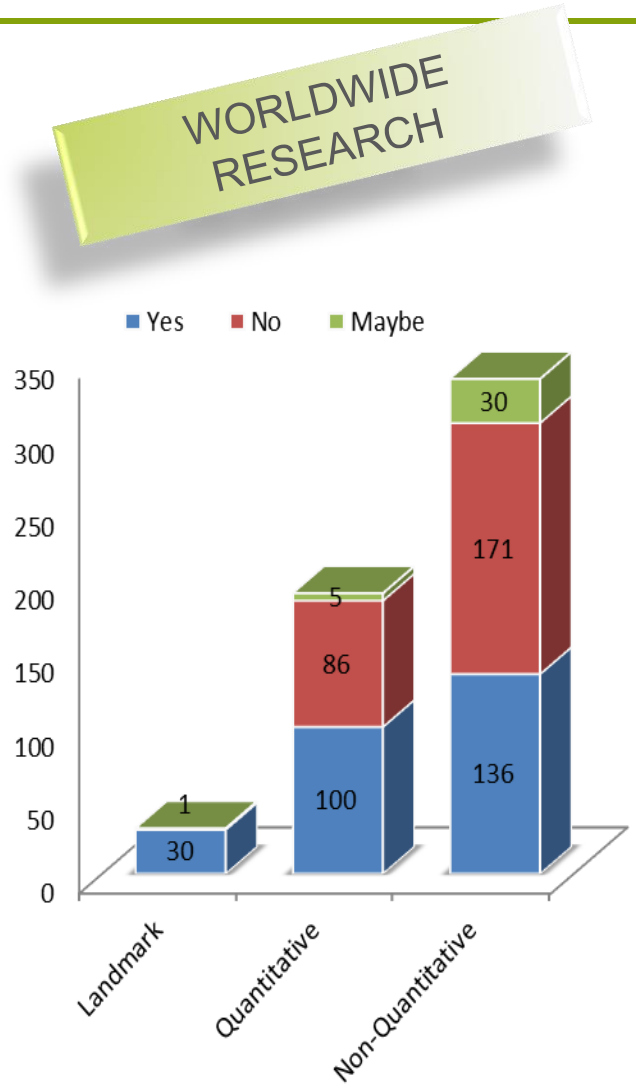
## Literature Search and Selection

- Search terms:
  - *"ILUC"* ***OR*** *"Indirect land use change"*
  - *"sustainability criteria"* ***AND*** *("bioenergy"* ***OR*** *"biofuels")*
  - *"land use change"* ***AND*** *("bioenergy"* ***OR*** *"biofuels")*

- **Initial literature search:** 1248 entries

| 1st Search | 1st Preselection | 2nd Preselection |
|---|---|---|
| **1248** | **559** | **302** |
| Landmark | 31 | 31 |
| Quantitative | 191 | 105 |
| Non- Quantitavie | 337 | 166 |

- **From research stakeholders survey:** 37 studies

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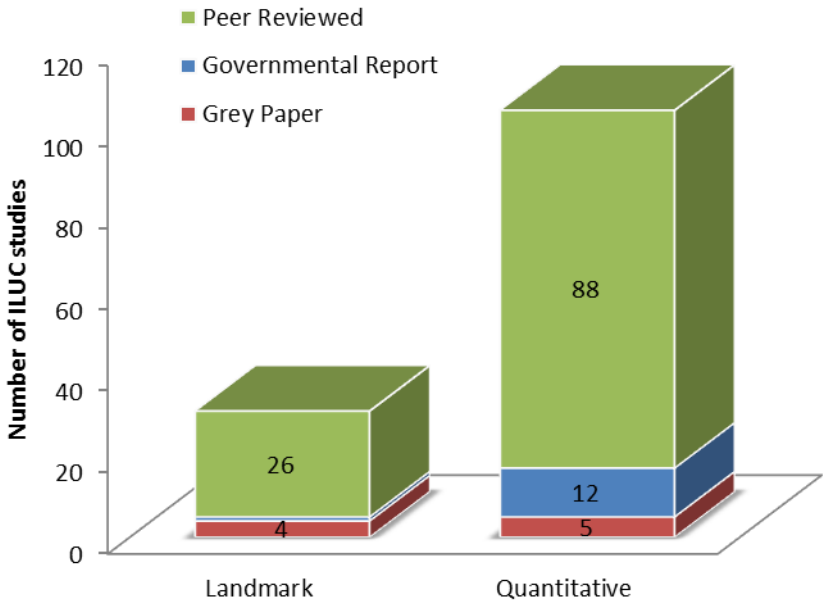
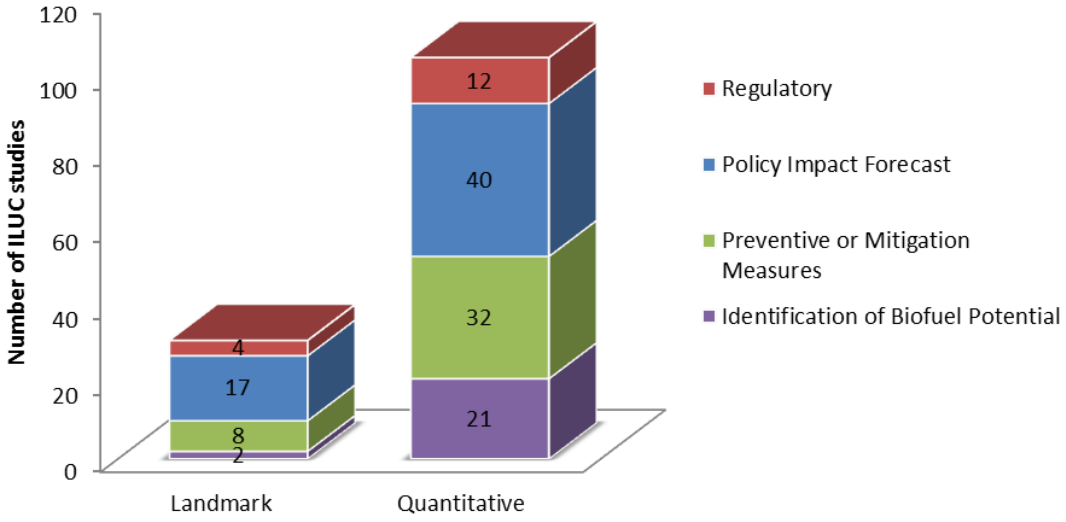
# 2. Scientific ILUC research review. Overview and methodology




42% of the papers aim at addressing Policy Impact Forecast, followed by Preventive or Mitigation Measures which represent 29%

Most of the latest ILUC related scientific researches are **Peer-Reviewed papers**

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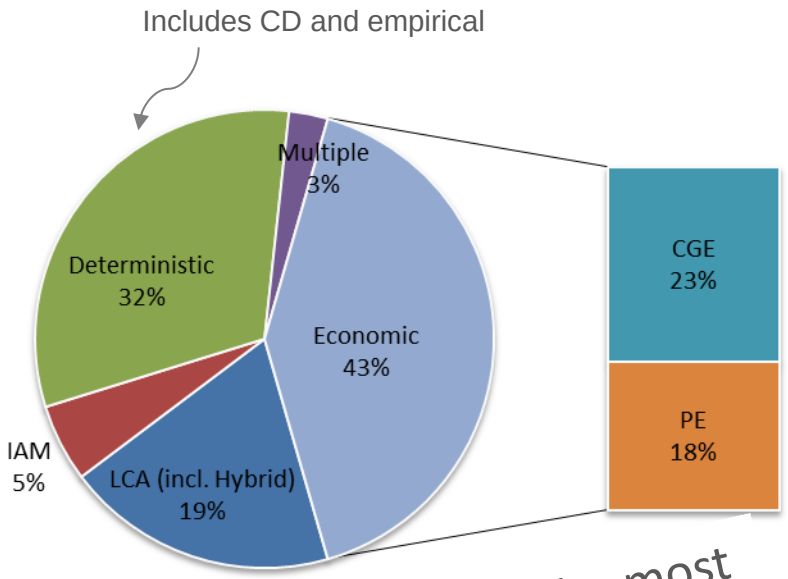
# 3. Type of ILUC studies and objectives

1. **Review Studies**
   - ✓ Discuss methods & policies
   - ✓ Compare results
2. **Original research**
   - ✓ Partial and General Equilibrium Models (PE/CGE)
   - ✓ Integrated Assessment Models (IAM)
   - ✓ Causal Descriptive Models (CD)
   - ✓ Hybrid-Life Cycle Assessments (LCA)
   - ✓ Empirical Approaches



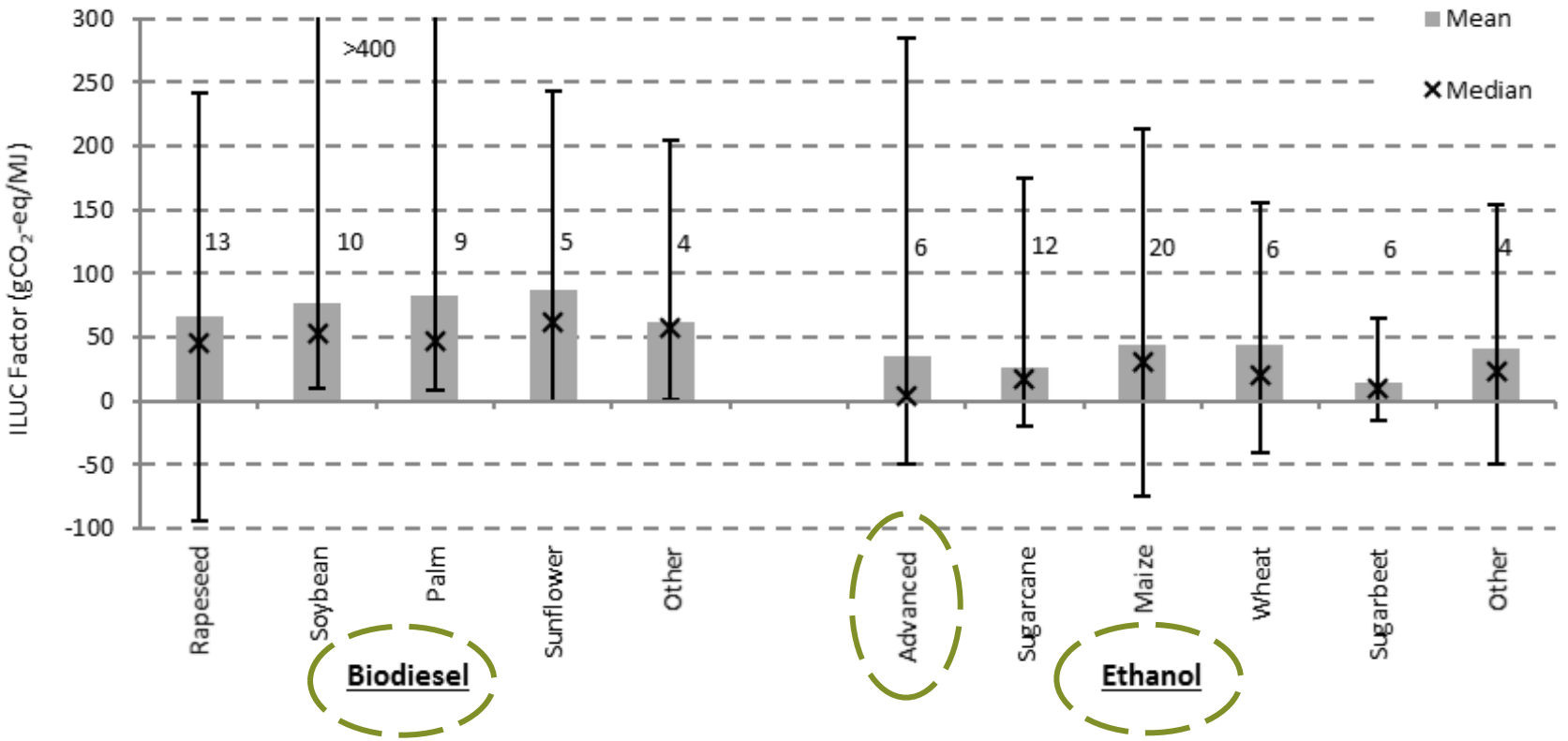

Economic Modelling is the most widespread, followed by Deterministic Approach and LCA

# 4. ILUC GHG emission factors results

## 30 studies reported quantitative ILUC emission factors

- ✓ **17 studies applied PE-, CGE- or IAM-models** (Al-Riffai et al., 2010; CARB, 2009; Dumortier et al., 2011; Edwards et al., 2010; Flugge et al., 2017; T W Hertel et al., 2010; D Laborde, 2011; David Laborde et al., 2014; Melillo et al., 2009; Moreira et al., 2014; Mosnier et al., 2013a; Richard J Plevin et al., 2010, 2015; T. Searchinger et al., 2008; Farzad Taheripour & Tyner, 2013; W. Tyner et al., 2010; Valin et al., 2015).
- ✓ **6 studies were based on Hybrid Life Cycle Assessments** (A.A. Acquaye et al., 2011; Adolf A Acquaye et al., 2012; Bento & Klotz, 2014; Boldrin & Astrup, 2015; Mullins et al., 2011; Prapaspongsa & Gheewala, 2016).
- ✓ **5 studies were based on empirical approaches** (Dunkelberg, 2014; Fritsche, Hennenberg, et al., 2010; Lywood, 2013; Overmars et al., 2015, 2011).
- ✓ **1 study used a causal descriptive model** (Baral & Malins 2016).
- ✓ **1 study used expert opinion** (CARB 2014).

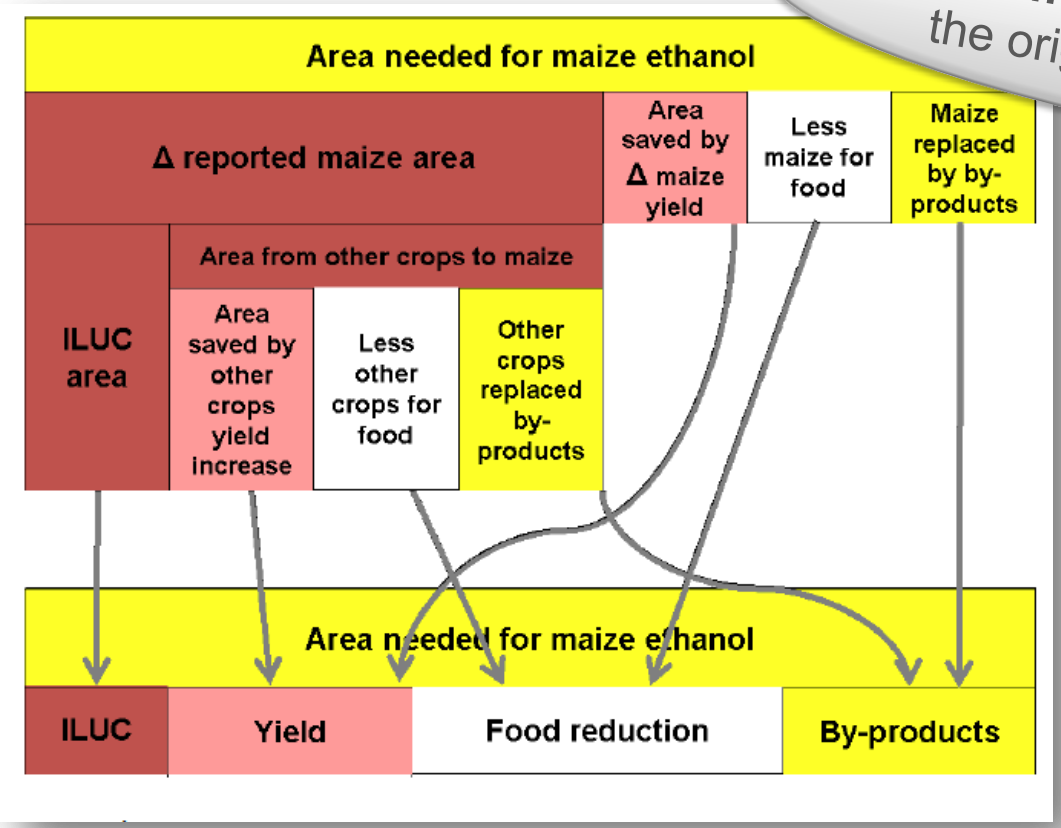
# 4. ILUC GHG emission factors results



# 5. General principles of ILUC research

## Decomposition approach

**Example** to better understand the origin of ILUC uncertainties




**Source:** Searchinger et al (2015).

However, **insufficient information** to decompose different studies

# 6. Uncertainty identified in ILUC estimations

**Empirical information on components for ILUC is very limited**

**Uncertainty on**

- ✓ Yield trend
- ✓ Reduced area because of increase in yields
- ✓ Reduced demand for non-biofuel crops
- ✓ How prices are affected by biofuel demand
- ✓ Type of land converted by agricultural expansion
- ✓ Relocation of production

- Most studies use Monte Carlo to analyze parametric uncertainty
- However, no objective information on probability distributions available
- Sometimes sensitivity analysis per parameter
- Most authors conclude that it is not plausible that uncertainty will be narrowed down in the near future

# 7. Taking by-products into account

**All studies take by-products into account**

- **Most non-economic approaches**

  → **Distribute land use** of the feedstock area over biofuels and by-products (with feed being the main by-product) based on **weight or energy share**

- **More complex economic models**

  → **Substitution** between by-products (e.g. rapeseed cakes, DDGS) and alternative animal feed is **modelled explicitly**

May generate complicated substitution processes

Different by-product accounting methods lead to very different ILUC factors

## 8. Factoring in the impact of EU policies

### Little or no information is available

- ✓ Agriculture
- ✓ Trade
- ✓ Environment and climate
- ✓ R&D and technology diffusion

## 9. Other indirect effects of the EU biofuel policy

### Focused on environmental impacts

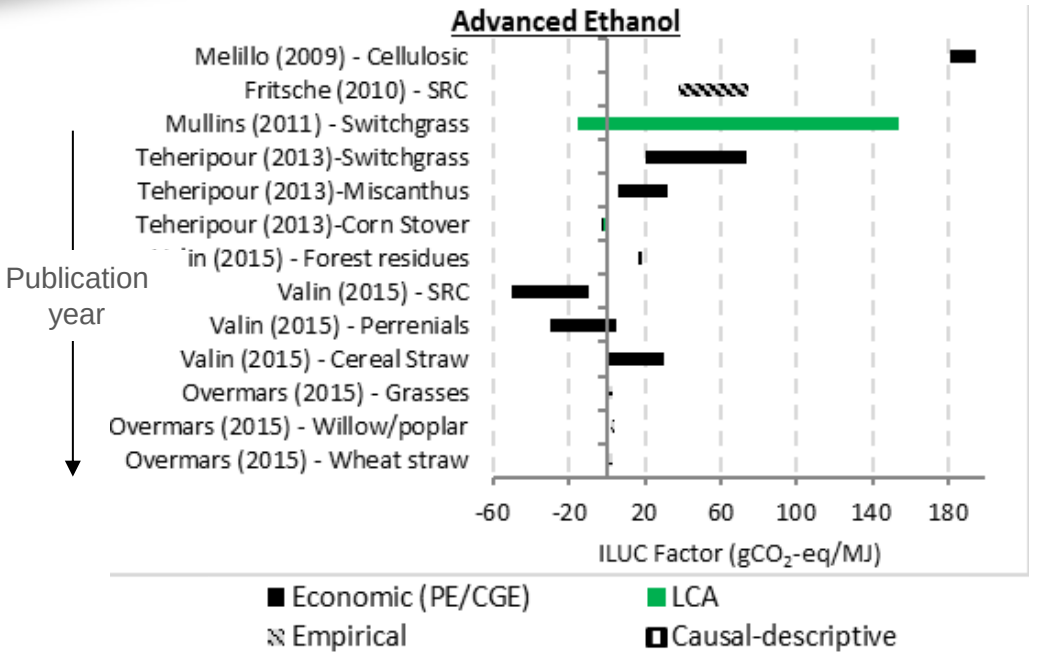
- ✓ Biodiversity
- ✓ Social impacts of increased agriculture commodity prices
- ✓ Indirect greenhouse gas emission impacts (e.g. for production of fertilisers which may be higher than those from carbon loss)

# 10. ILUC from dedicated energy crops

**Tend to have smaller ILUC factors than other biofuels**

- ✓ Median ILUC value: 5 $gCO_2$-eq/MJ
- ✓ Negative emissions if marginal areas are used for energy crops that sequester more carbon than the original vegetation
- ✓ The main feedstocks studied reporting ILUC GHG emissions include:

Limited number of studies



# 11. Main ILUC mitigation options and low ILUC-risk biofuels

## 4 options to mitigate ILUC effects

- ✓ **To prioritize the use of residues and by-products**: residues from crops and forests, secondary residues from industry & waste.
- ✓ To prioritize the use of feedstock produced on **abandoned, unused, marginal, fallow, under-utilised or polluted lands.**
- ✓ To **increase agricultural yields**, since improving the efficiency of agriculture**.**
- ✓ To **protect areas with high carbon stock and/or high biodiversity values**.

## Low ILUC-risk certification options

- ✓ Most **existing certification schemes do not explicitly deal with ILUC**, but several include **measures that avoid undesirable DLUC effects and indirectly avoid or compensate ILUC effects.**

# 12. Conclusions

- ✓ ILUC existence is generally agreed
- ✓ ILUC factors identified vary significantly → uncertainties are high
- ✓ Difficult to narrow uncertainties down
- ✓ Little information is available about the consequences of other EU-policies on ILUC GHG emissions
- ✓ Low ILUC-risk feedstocks, especially by using residues from forestry or agriculture may be relatively promising
- ✓ Certification of low ILUC-risk biofuels might need additional measures

Since biofuels are strongly driven by policy stimulation, their sustainability impacts are critically assessed.

Introduction of biofuels have been effective in revitalising the discussion about how to make agricultural and forest production systems more sustainable not in the least, in relation to land use efficiency improvement needs.

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