# GHG savings of food/feed crop vs non-crop renewable fuels

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PRESENTATION FOR RTFA

# Agenda

Context

Regulatory Framework

Actual Values

A “meritocratic” approach to renewable fuels
- Difficult wastes management
- Accounting for iLUC

Food vs non-food biofuels – A False Dichotomy?

The potential of Low Carbon Agriculture

# Glossary of Acronyms

CCUS: Carbon Capture, Use & Storage

CI: Carbon Intensity *(a measure of carbon emissions from the production and use of fuels, typically expressed in grams of CO2-equivalent per MJ)*

GHG: Greenhouse Gases

KPI: Key Performance Indicator

iLUC: indirect Land Use Change

LCA: Life-Cycle Assessment

LCFS: Low Carbon Fuel Standard *(California regulation based on direct reduction in carbon emissions in Transport)*

REDII: Renewable Energy Directive #2 *(the prevailing regulation governing the use of biofuels and renewable fuels across EU27 Member States)*

RTFO: Renewable Transport Fuels Standard *(UK regulation)*

WtW: Well-to-Wheel *(a methodology for calculating the holistic carbon emissions from a product across its lifespan, from production to disposal after use)*

# Context

A perception exists that advanced biofuels produced from the conversion of waste or cellulosic feedstocks are fundamentally better in terms of GHG savings than conventional biofuels coming from food crops.

Example: T&E UK response to the RTFO consultation April '21:

*"Policy should also be directed to shifting production from first generation crop-based biofuels to advanced fuels that have much better carbon savings and lower risks of indirect land use change (ILUC)"*

This presentation endeavours to review the factual basis for this claim, look at existing evidence to compare the range of GHG emissions savings from both conventional and advanced biofuels, and reflect on policy choices and implications.

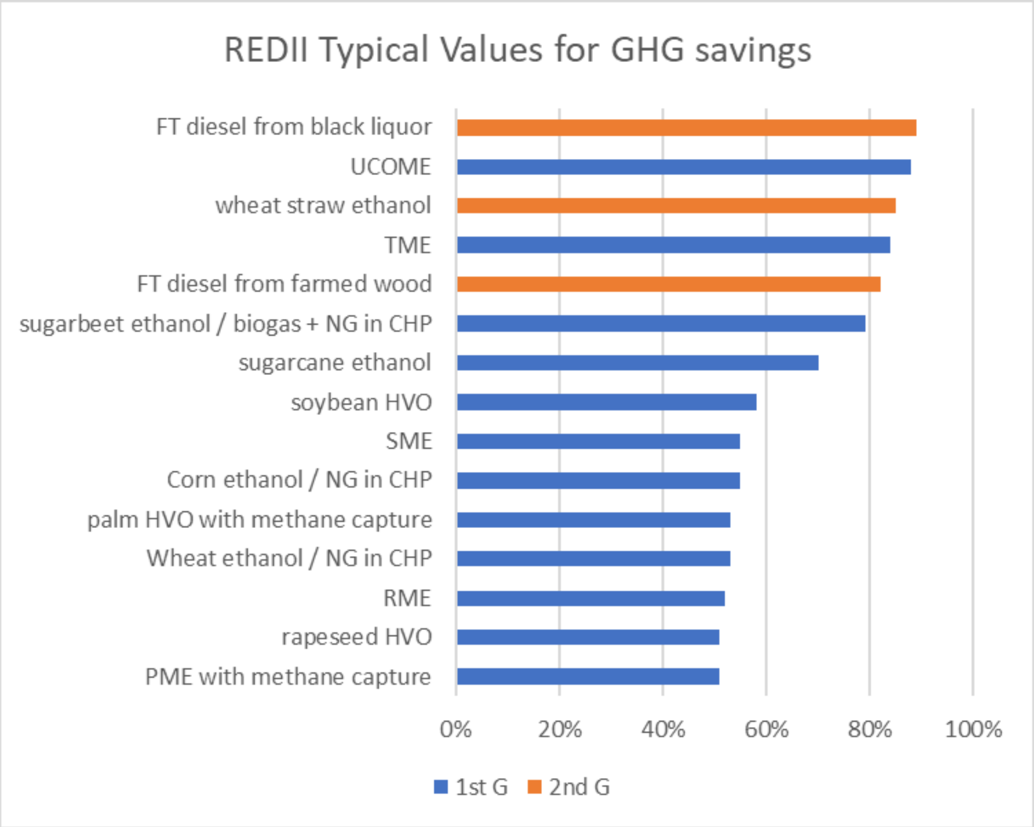
# Regulatory Framework

REDII provides a range of GHG typical values for conventional and Advanced[1] renewable fuels.

Although these tend to favour Advanced, it shows a continuum without a clear divide between the two categories.

REDII has a structural bias: Default values (the ones that operators can use to demonstrate compliance) penalise food-crop biofuels by being typically 5-10% lower than Typical values, while they are identical in the case of Advanced.

REDII Typical values also fail to properly represent the potential of carbon management in modern agriculture.

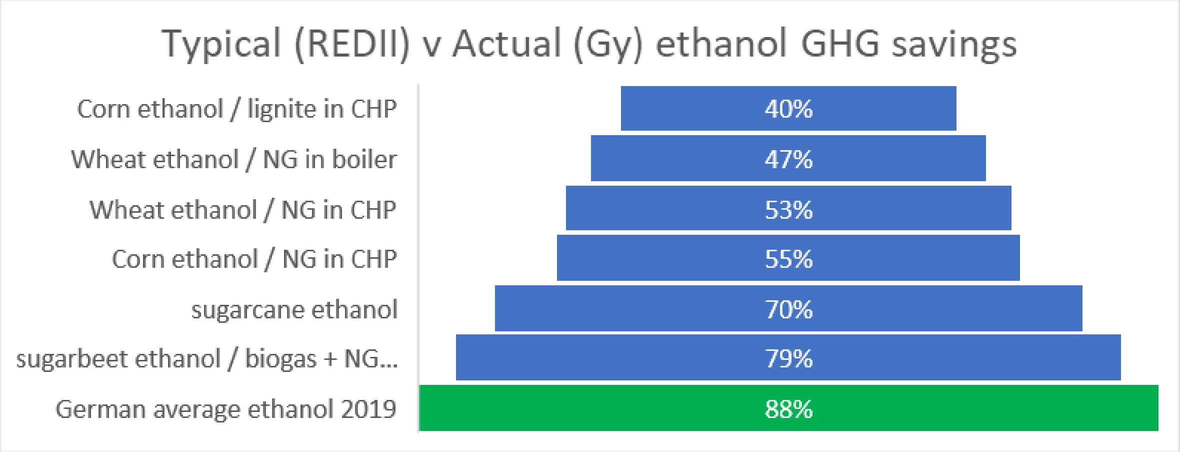



[1] Advanced definition as per feedstocks listed in REDII Annex IX part A

# Actual Values

Producers are finding innovative ways to drive down the carbon intensity of their products. As a result, **actual** values for food/feed-crop biofuels are significantly better than REDII typical values.

For example, the German Federal Agency in charge of biofuels (BLE) reports average GHG savings for ethanol of 88%, vs REDII typical values of 40-79%. UK statistics show a similar trend.




The GREET model (arguably the most sophisticated LCA model in the world) is also showing the potential for actual values of crop biofuels to be significantly better than REDII baseline *(Source: Argonne National Laboratory).*

# Aiming for Meritocracy

Since the foremost aim of renewable fuels is to lower CO2 emissions in Transport, assessing and rewarding these fuels on **true** WtW GHG savings is the "meritocratic" approach.

Benefits:

- Directly measures and drives the ultimate goal – reducing carbon emissions
- Technology-neutral,  does not pick winners
- Enables market forces to optimise the most economic path to the carbon reduction target

In this context, artificial distinctions between so-called 1$^{st}$ generation and 2$^{nd}$ generation, food-crop, waste, advanced (etc…) are confusing and ultimately unhelpful.

The challenge is to provide the most accurate representation of GHG "merit" for every type of renewable fuel. This raises a number of hard questions, for example:

**1) Recognising and rewarding the socially beneficial use of difficult wastes**

**2) The impact of iLUC**

# How to reward difficult wastes?

Context: The disposal of certain types of wastes as renewable fuels feedstocks brings multiple benefits to Society. Ideally, a “meritocratic” approach to biofuels incentivisation through GHG credits needs to reward these appropriately.

Where it works…

*Example 1: MSW*
*Where tipping fees exist and can be avoided by using Municipal Solid Waste to produce liquid fuels, they can contribute significantly to project economics and provide recognition for the benefit of clean waste disposal.*

*Example 2: Manure in CA*
*Manure, which would otherwise release significant quantities of bioCH4, benefits strongly in the California LCFS as a biogas feedstock, with GHG savings **multiple of 100%**, ie highly negative CI (-200/300 $gCO2_e$/MJ).*

Where it doesn’t…

*Example 3: Fatbergs*
*Trapped grease in sewers (aka “fatbergs”) creates multiple problems; blocked drains and sewers, costly interventions, emergency disposal in landfill etc. The full benefit of avoiding these through regular collection as bio feedstock isn’t currently reflected in GHG credits.*

# iLUC is the hardest variable

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Indirect land use change impacts are notoriously difficult to model, and scientists have been debating this topic for the last 15 years.

It is therefore virtually impossible to agree on the "right" amount of carbon debt which should be imputed to various feedstocks (cultivated or collected).

<u>What do we know?</u>

- that this "iLUC carbon debt" will vary greatly by crop, and within a certain crop by region *(Source: GLOBIOM model)*

- that the best policy to reduce iLUC effects is a **holistic land management policy** protecting the high carbon / high biodiversity land areas of the world,

- reversely, that the lack of such land management policies WILL lead to deforestation and loss of habitat **regardless of the use of food crops for renewable fuels.**

**→ if biofuel sustainability requirements do not drive change in Agriculture, what will?**

# Food vs non-food biofuels – A False Dichotomy?

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Beware of false binary choices…

Food vs Fuel

Conventional vs Advanced

Agriculture vs Nature


The Answer is often to be found in a Third Way…

# The Third Way? Towards a system approach to Agriculture

Agriculture = land use for the production of food, energy & materials

No dogma -> land use for the production of energy is not fundamentally “inferior” to the production of food. Equally, carbon emissions are not “less bad” when related to food.

Optimum use of land likely to be found in **multi-purpose strategies** – co-production of food and energy and materials

- E.g. sugarcane producing sugar, ethanol and (bagasse into) green power
- Wheat producing feed proteins (DDGS), ethanol and biomass (straw)

Optimum use of land, combined with strategies to minimise wastage of agricultural products (in particular food waste), means

- reduced iLUC risk
- integration of ecosystem services in the “objective function”
- Addressing the vast amounts of **near-abandoned land** across Europe (~20M ha*) and beyond

**Source: EU Science Hub*

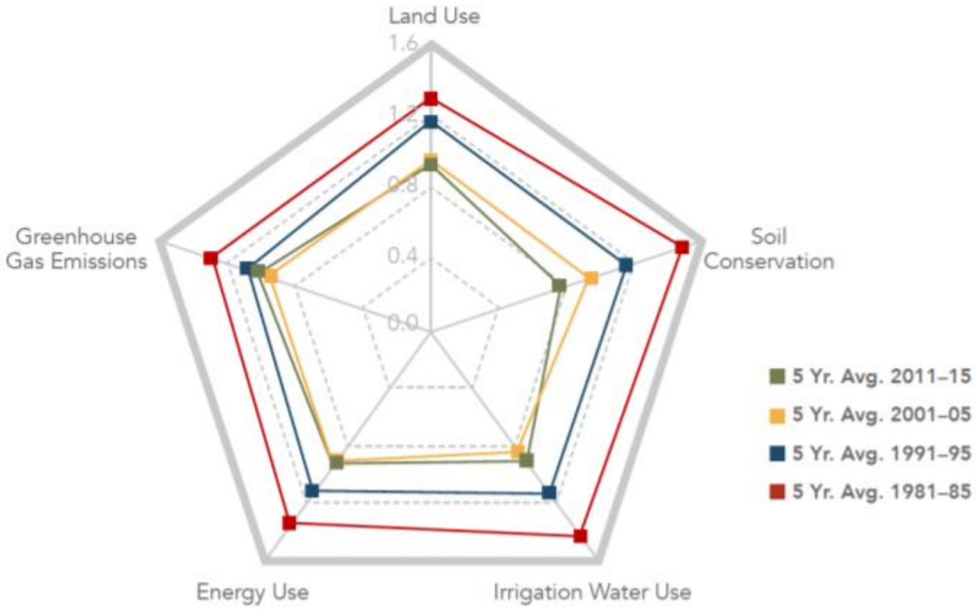
# GHG savings potential for crops

Agriculture has been on a long-term journey to improve its sustainability KPIs

Example: US corn for grain (*Source: “Field to Market” report 2016)*

A lot of these improvements have been driven by the requirements of the biofuels market.

**Regenerative Agriculture** is now developing as a very innovative, fast-evolving scientific and technical discipline.



# Low Carbon Agriculture

Regenerative Agriculture has the potential to sequester **15 to 22 Gtons** of $CO2_e$ between 2020 and 2050 (*Source: Project Drawdown*) through a combination of practices:

- no tillage
- diverse cover crops
- in-farm fertility (no external nutrients)
- no pesticides
- multiple crop rotations
- integration of livestock

*"Together, these practices increase carbon-rich soil organic matter. The result: vital microbes proliferate, roots go deeper, nutrient uptake improves, water retention increases, plants are more pest resistant, and soil fertility compounds. Farms are seeing soil carbon levels rise from a baseline of 1 to 2 percent up to 5 to 8 percent over ten or more years, which can add up to 25 to 60 tons of carbon per acre."*

# UK Low Carbon Agriculture in action…

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Now in its' 12th year and continuing to focus on renewable & low carbon energy solutions + best practice in energy management.

- AD & Biogas
- Biomass
- Energy Crops
- Energy efficiency
- Energy storage
- Finance
- Heat Pumps
- Hybrid Systems
- Hydropower
- Low-emission vehicles & machinery
- Policy
- Optimisation and Maintenance
- Solar
- Wind


Providing guidance on environmental land management, climate friendly farming & carbon management.

- Achieving Net Zero
- Biodiversity
- Carbon sequestration
- Forestry
- Natural Capital
- Soil Health
- Reducing GHGs through improved productivity
- Policy compliance
- Waste management


Highlighting the technology innovations available to help improve performance and create a profitable & sustainable farming future.

- Artificial Intelligence (AI)
- Automation Technology
- Data management tools
- Drones
- Precision Farming
- Robotics
- Sensors
- Software


Returning for its' 3rd year to explore low carbon transport and machinery options, together with related opportunities.

- Low-carbon transport & machinery options
- Utilising power and/or gas generated onsite
- Becoming part of the charging network
- The market for biofuels
- Hydrogen as a fuel source
- Policy Developments
- Costs, tax implications and other financial considerations

# Conclusions

Both crop and non-crop renewable fuels offer very attractive reductions in carbon emissions from Transport.

There isn't a fundamental divide in performance between the two categories, and actual GHG performance is greatly impacted by specific features of each production facility – logistics, energy source, and agronomy practices in the case of crop feedstocks.

iLUC is a difficult issue to quantify but has to be addressed primarily by land management policies; *ideally, countries which do not demonstrate good land management should not have the opportunity to sell their domestic agricultural output for renewable fuels.*

The potential for improving further the GHG performance of conventional feedstocks is enormous, and is a crucial driver of change in the wider Agri sector.

Modern practices and technologies, allied with a system approach to co-optimising production of food, energy and materials, have the ability to re-define the relationship between Agriculture and Nature.

This is before considering the potential of CCUS to deliver another big step change in GHG performance, for both conventional and advanced technologies.

# References

GREET model: Argonne GREET Publication : Shifting agricultural practices to produce sustainable, low carbon intensity feedstocks for biofuel production (anl.gov)

Project Drawdown: https://www.drawdown.org/solutions/regenerative-annual-cropping

4 per 1000 Initiative: Welcome to the"4 per 1000" Initiative | 4p1000

Field to Market report: National Indicators Report 2016 - Field To Market

Storing carbon in soils (*French*): Comment favoriser le stockage de carbone dans les sols agricoles ? (terre-net.fr)

Abandoned land: Agricultural Land Abandonment in the EU within 2015-2030 | EU Science Hub (europa.eu)

GLOBIOM model: Introduction — GLOBIOM documentation (iiasa.github.io)