



**ICAO AVIATION AND SUSTAINABLE  
ALTERNATIVE FUELS  
WORKSHOP**



ICAO Headquarters, Montréal, Canada

18 to 20 October 2011

# The indirect effects of biofuels

Identifying truly sustainable  
alternative aviation fuels pathways

*Dr. Chris Malins, ICCT*



# The ICCT



- A council of leading clean transport regulators globally
- A staff of about 30
- Provides support to regulators through research and analysis



# Context



- Global Framework For Aviation Alternative Fuels First Edition 2009
  - Sustainable alternative fuels show promise of being an intrinsic part of an approach toward reducing the carbon footprint of aviation.
- European Advanced Biofuels Flight path Initiative
  - Efficiency gains are not enough to completely offset the carbon footprint of the aviation sector. Biofuels is the chief option and will play an important role in this respect.
- IATA Fact Sheet: Carbon-Neutral Growth
  - 6% mix of sustainable 2nd generation biofuels by 2020 would reduce emissions 5%.



# Opening thoughts



- Biofuel use that increases net global GHG emissions is a **really bad** GHG mitigation strategy
- Biofuel use that only marginally reduces net GHG emissions is a **really expensive** GHG mitigation strategy
- From now to 2050 biomass resources will be under increasing demand for road transport, power, food etc.
- There is no necessary climate benefit from using biofuel in a plane instead of a car or a power plant\*

*\*Subject to revision following full road transport electrification and 100% renewable electricity supply*



# Net carbon balance of biofuel use



- ‘Direct’ emissions:
  - Agriculture (fertiliser, pesticides, farm fuel, nitrous oxide emissions\*)
  - Processing
  - Transport and distribution
- A large-scale switch to biofuel use will also have significant indirect impacts, affecting the net GHG balance...

*\*If mitigating global warming is the objective, it's vital to consider all greenhouse gases*



- Indirect land use change (iLUC)
  - Carbon emissions
  - Biodiversity loss
  - Social impacts (can be positive and negative)
- Food vs. fuel (food price rises)
- Displacement of 'waste' streams that are already productively utilised
  - Displace animal fats -> more fuel oil or palm oil
  - Displace ag. residues may imply more fertiliser
  - Compete with heat and power sector for biomass



# Indirect land use change



- Demand for biofuel crops must be met by some combination of:
  - Increased production on existing agricultural land (yield increase)
  - Reduced consumption in other sectors (food vs. fuel)
  - Reducing global stocks (unsustainable)
  - Bringing new areas into production (iLUC)

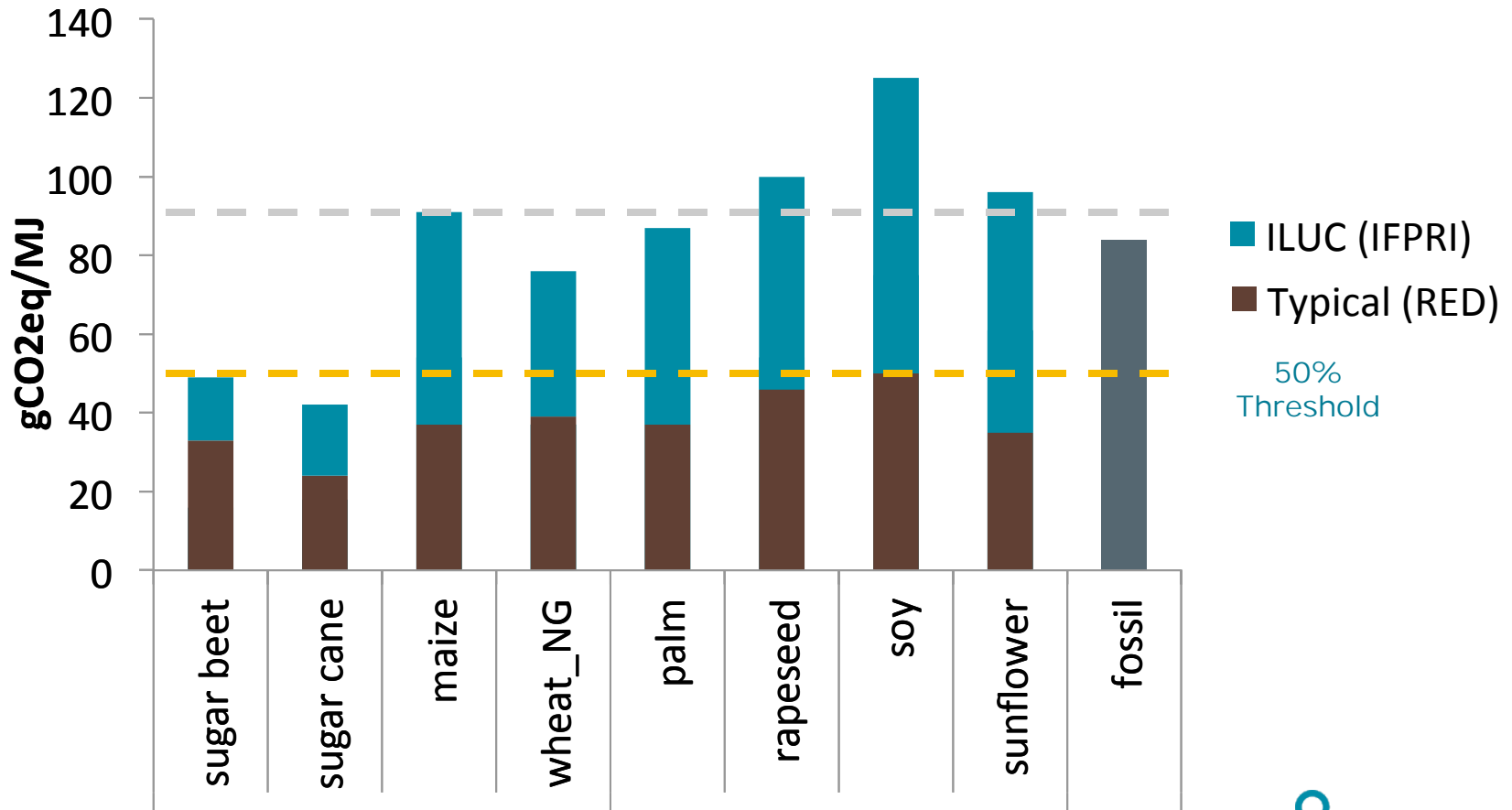


- Economic models are used to map out scenarios for iLUC:
  - Crops displace each other
  - Crops displace pasture for livestock
  - Biofuel production results in by-products (DDGS, oil meals)
  - Crop yield increase as prices increase
  - Crop yields are lower on newly cultivated areas
  - Demand in other sectors (incl. food) reduced as prices increase
  - Crops displace forest and grassland
- It is not a question of *whether* iLUC occurs, but of what area it affects and what the carbon consequences are





# Do biofuels reduce GHG-emissions compared to fossil fuels?



Slide courtesy of Bart Dehue, Ecofys



# iLUC and aviation pathways (examples)



- Thomson – babassu oil
- Iberia – camelina oil
- Continental – jatropha plus algae
- Finnair + Neste (*cancelled*) – palm oil?



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# Picking the winners



Pathway	Feedstock	Availability	Scalability	Indirect impacts?
Thermo-chemical (Fischer-Tropsch)	Pretty much anything	Limited, to date	Cellulosic biomass pathways will be scalable when commercially viable	Dependent on feedstock and criteria. For energy crops on good land could be high.
Hydrogenation	Camelina oil	Very limited	Unproven	Could be low for responsible projects, but on high value land comparable to other crops
	Babassu oil	Very limited	Unproven	
	Jatropha oil	Very limited	Poor record to date	
	Algal oil	Hardly any	High – if it ever happens!	Low if avoids high value land and minimises water consumption
	Palm oil	Enormous	Proven	Without further controls, severe (no net carbon saving, biodiversity loss, social conflict)



# Are the targets realistic?



- For industry targets, WEF says 13.6 Mbbl/day biofuel for aviation by 2050
- The IEA biofuel roadmap looks for 15.8 Mbbl/day by 2050 across all sectors (only 4.1 Mbbl/day for aviation)
- This needs over 100 Mha of land conversion (that's the size of Egypt, or Germany + Poland + Italy, or Iowa + Illinois + California + Colorado, even given 50% of fuels from wastes)
- IEA assume about 75% average carbon reduction by 2050; WEF assumes > 90% – both assume no land use change emissions
- Industry targets are more aggressive on both biofuel production and carbon intensity than the (already highly optimistic) IEA roadmap



## What would make these targets plausible?



- IEA calls for the world to:
  - ‘Adopt an overall sustainable land-use management system that aims to ensure all agricultural and forestry land is comprehensively managed ... to avoid negative indirect land-use change’
- They also call for:
  - focus on wastes and residues as feedstock;
  - maximising land-use efficiency by sustainably increasing productivity and intensity and choosing high-yielding feedstocks;
  - using perennial energy crops, particularly on unproductive or low-carbon soils;
  - maximising the efficiency of feedstock use in the conversion processes;
  - cascade utilisation of biomass, i.e. linking industrial and subsequent energetic use of biomass; co-production of energy and food crops.
- Aviation can’t make these things happen on its own!



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# How to get to sustainable aviation?



- The need that biofuels should be ‘sustainable’ is recognised
- Sustainable means:
  - Low direct emissions
  - Good agricultural practice
  - Avoiding indirect impacts
- Setting the standard:
  - An opportunity to get ahead of the game by committing to stringent standards (e.g. RSB + indirect effects module)
  - Without stringent standards, the industry will achieve neither the reality nor the perception of environmental responsibility
- Let’s be realistic
  - The framework for a sustainable 13.6 Mbbbl/day isn’t there, and may never be
  - Without it, rapid aviation biofuels expansion will be environmentally damaging, and fail to meet ambitious climate objectives
  - Focus on achievable short and medium term milestones more than 2050 targets that could do more harm than good



# Closing comments



- Indirect effects are real – a long term strategy cannot ignore them
- Using non-food crops, or even ‘wastes’, doesn’t make the problem disappear
- Aviation is not the only sector that could use these resources
- 80% aviation CO<sub>2</sub> emissions reductions from biofuels in 2050 looks difficult at best
- If price is allowed to be the key driver for picking biofuels, we will pick the wrong ones