

# Biofuels technology: A look forward

Growth and Development Policy Conference :  
*New Data, New Approaches, and New Evidence*

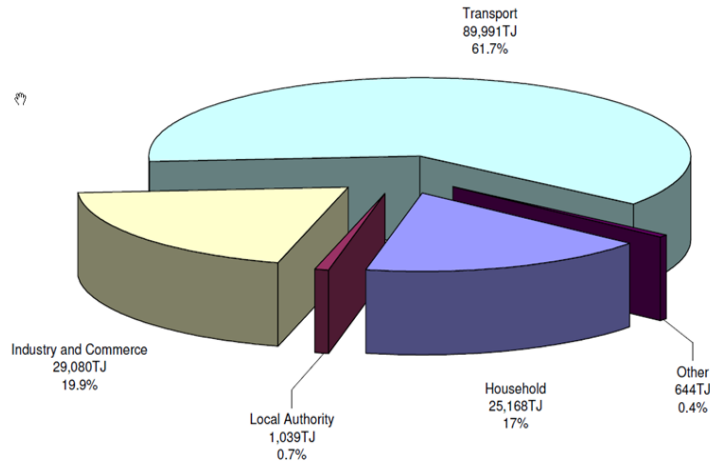


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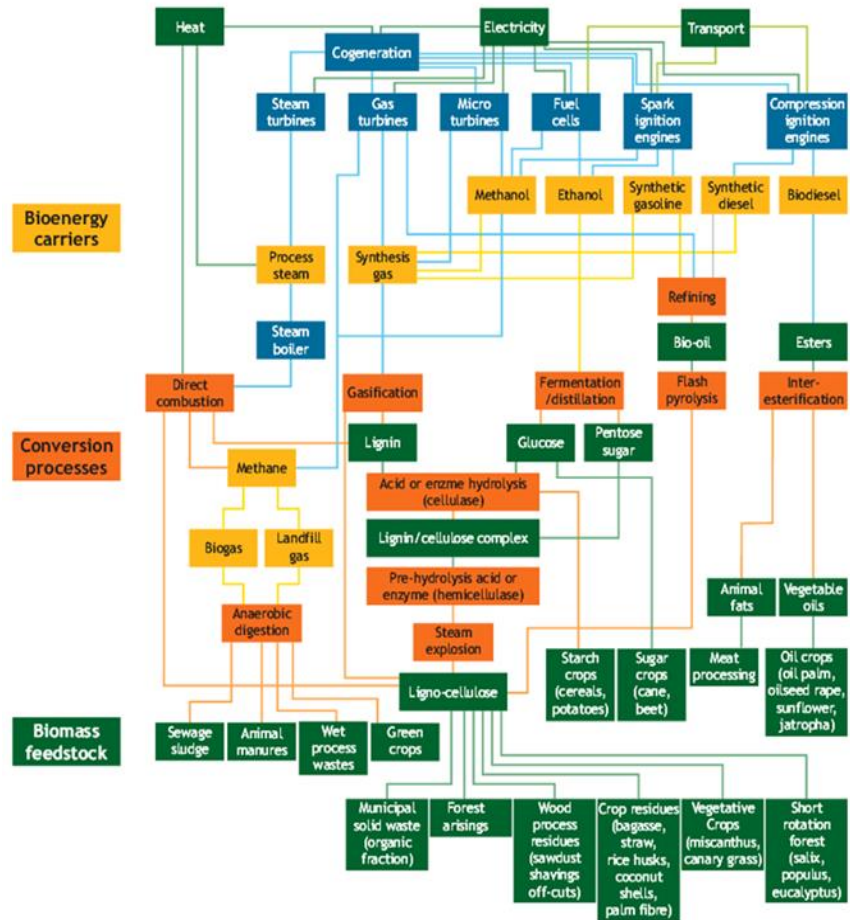
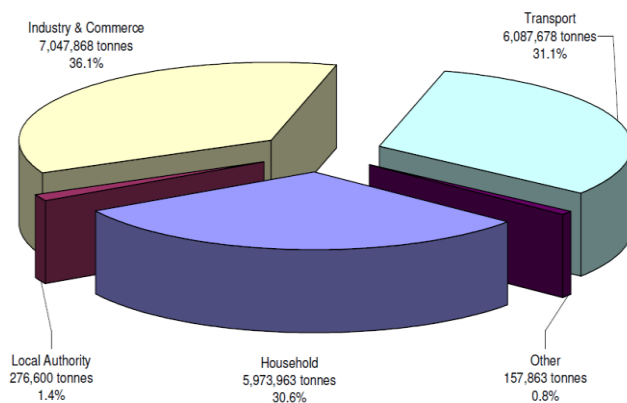


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# Transport is significant user of energy (petroleum fuels) and GHG emissions

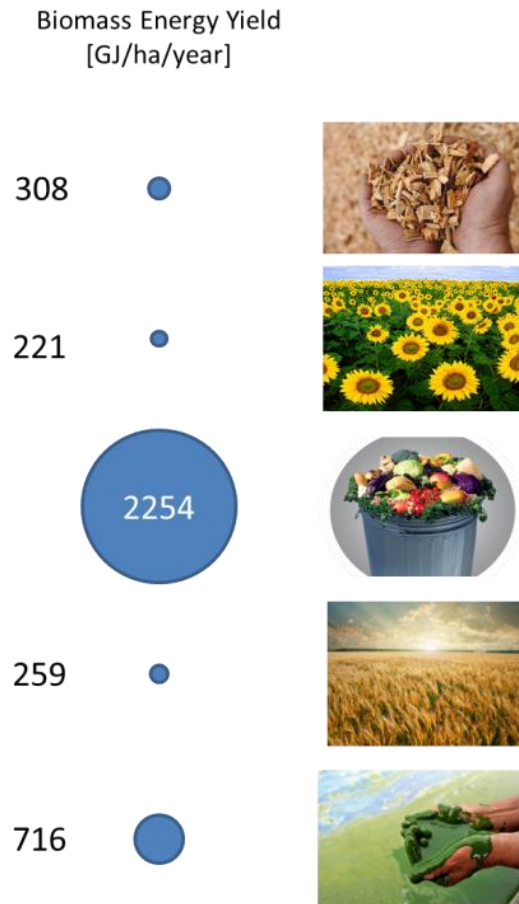


*Top: Energy demand by end use*  
*Bottom: GHG emissions*



Biofuels part of energy system

# Biomass feedstock for biofuels



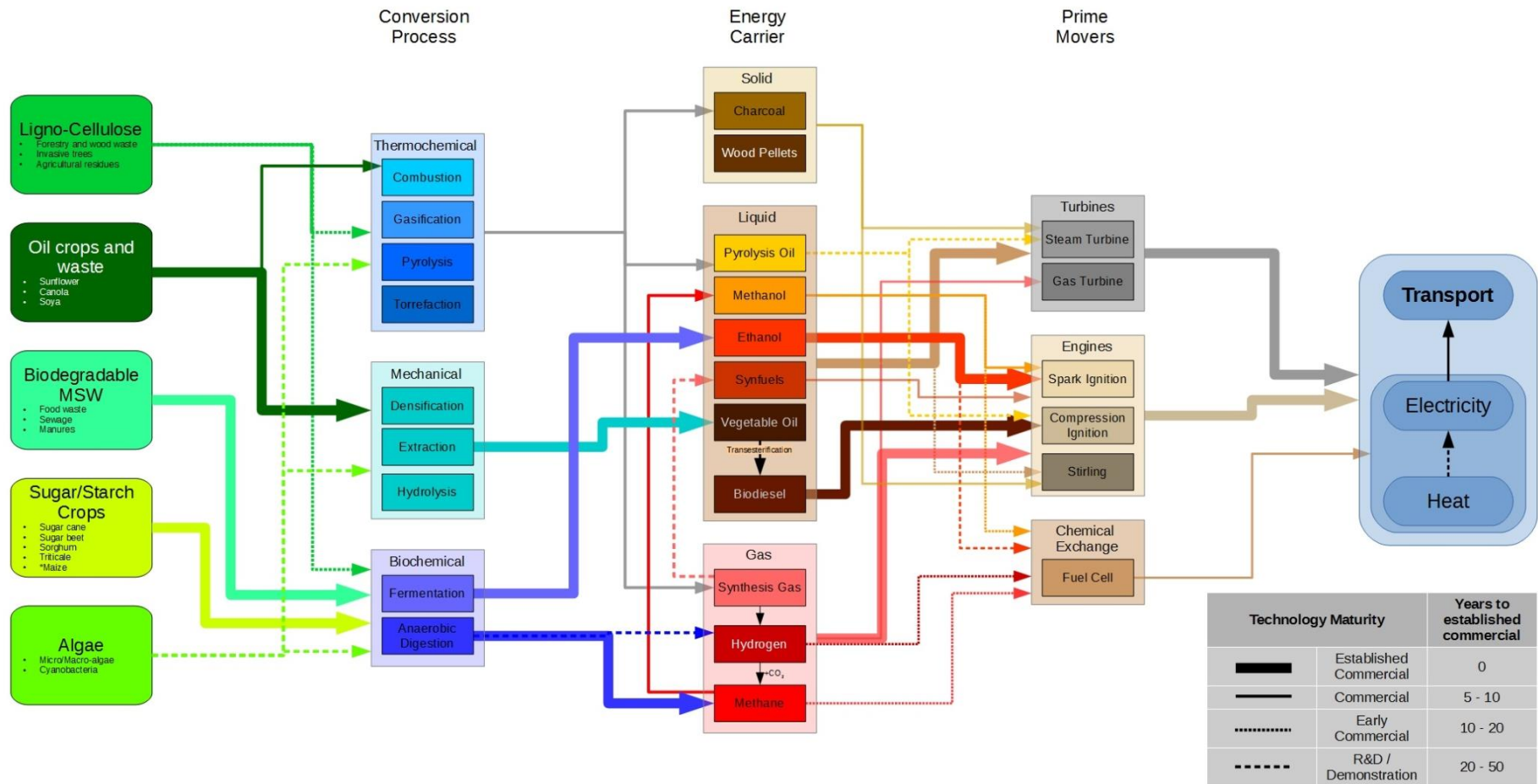
Biomass feedstocks for Biofuels:  
Land area a limiting/critical issue  
Optimal biomass yields: GJ/ha

➤ Wastes are limited in supply!

➤ Various processing routes  
...and biofuel products



# Biofuels technology commercialisation : *a look forward*



Biofuels are energy carriers to provide energy services

# Biofuels technology : *Conventional*

	Conventional
Description	<p>First generation biofuels such as bioethanol, biodiesel and biogas are produced sugary/starchy biomass. Can replace or blend with fossil fuels.</p> <p><b>Currently commercially established.</b></p>
Feedstock	Food crops, food waste and sewage
Energy carrier	<b>Bioethanol, Biodiesel, Biogas</b>



# Biofuels technology: *Advanced*

	Advanced
<b>Description</b>	Second generation biofuels are produced from ligno-cellulosic biomass .Third generation biofuels are from algae. Various stages of commercialization ranging from R&D to early commercial.
<b>Feedstock</b>	Forestry and Agriculture residues and wastes; Non-food crops (grasses, shrubs and trees). Algae
<b>Energy carrier</b>	Bioethanol, Biodiesel, Biogas Synfuels (methanol, DME) and Bio-SNG Algal fuels



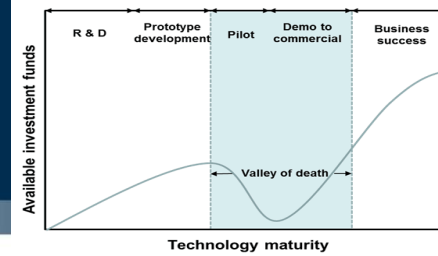
# Biofuels technology

## *Alternative biofuels*

	Alternative
<b>Description</b>	Non-carbon fuels such as hydrogen (combustion or fuel cell ) and battery storage for electric vehicles. Require renewable energy resources to achieve carbon-emission reductions benefits. At demo- and early commercial stage mainly as a result of energy storage constraints.
<b>Feedstock</b>	Hydrogen from synthesis gas and anaerobic digestion. Electricity charge from solar, wind or other renewables ideally or municipal electricity alternatively
<b>Energy carrier</b>	Hydrogen (IC and fuel cell) Battery storage for electric vehicles



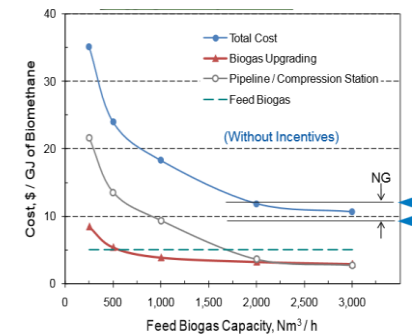
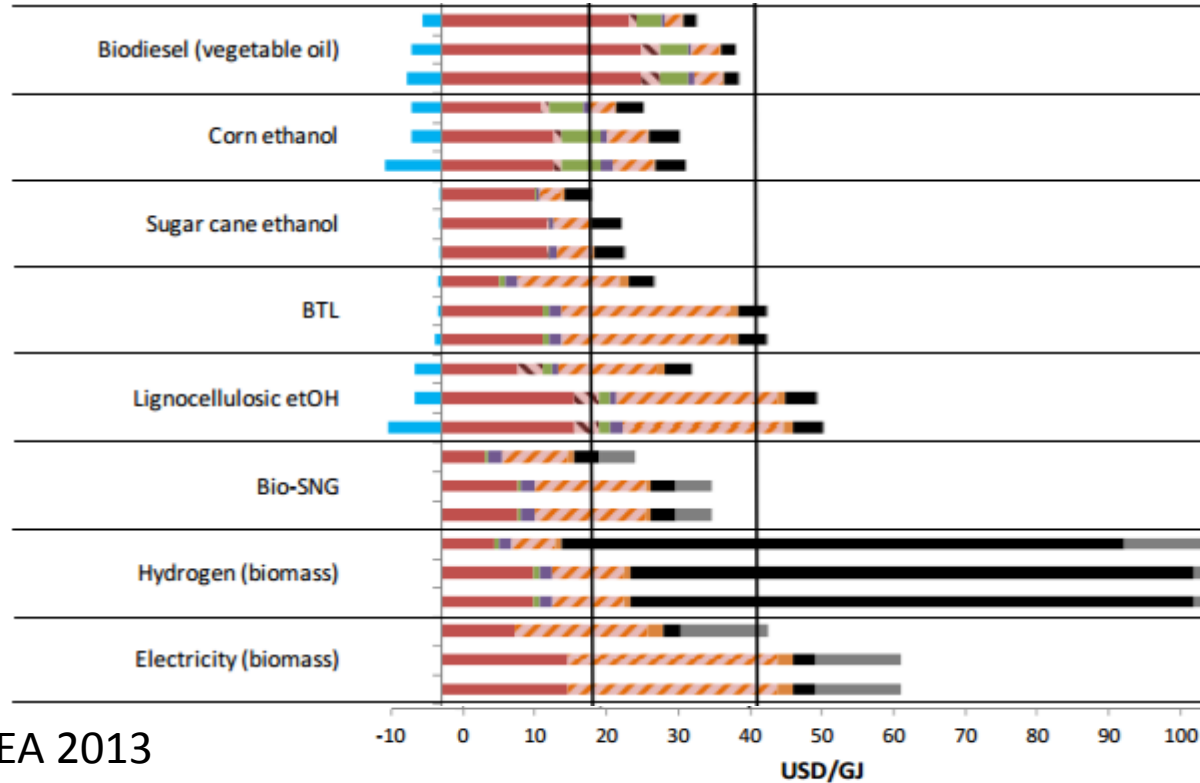
# Barriers of future biofuels technology: Cost



## Life cycle costing

>Well to wheel

- Biofuels cost varies
- Biomass feedstock large cost component
- Economies of scale



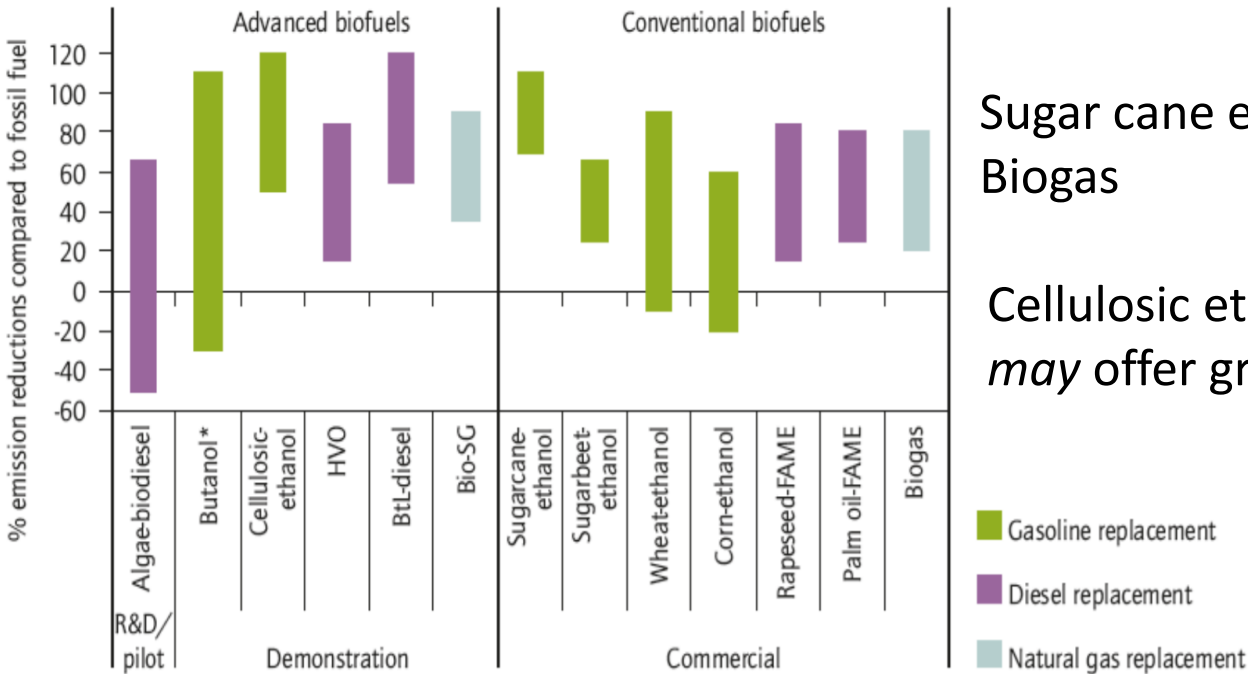
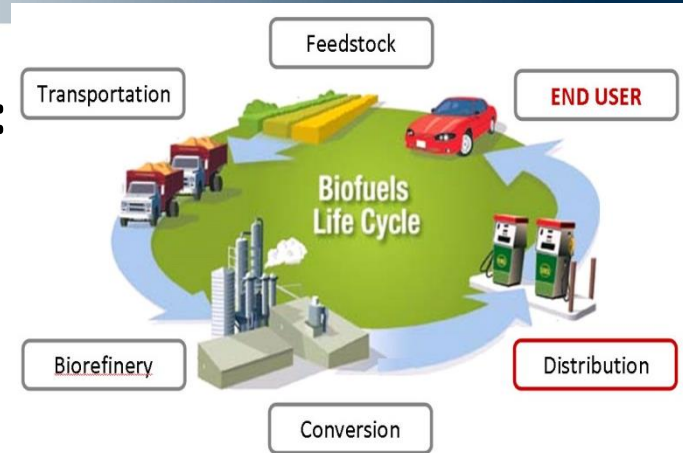
Cannot compete with petrol/diesel

.....unless subsidised/green premium



# Barriers of future biofuels technology: *GHG emissions*

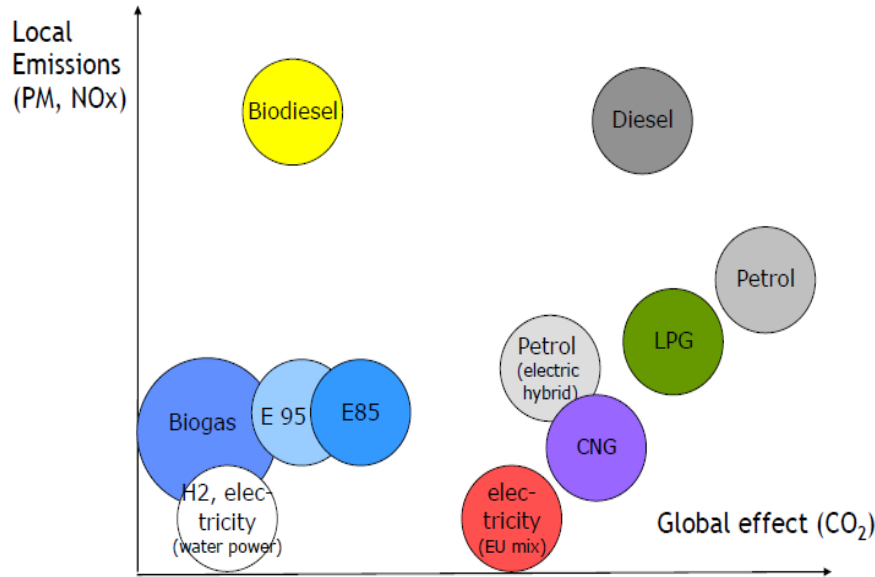
## Carbon reduction compared to fossil fuels: Life cycle Assessment (well to wheel)



Sugar cane ethanol, Rapeseed canola, Biogas

Cellulosic ethanol, BTL, Bio-SNG *may* offer greater carbon reductions

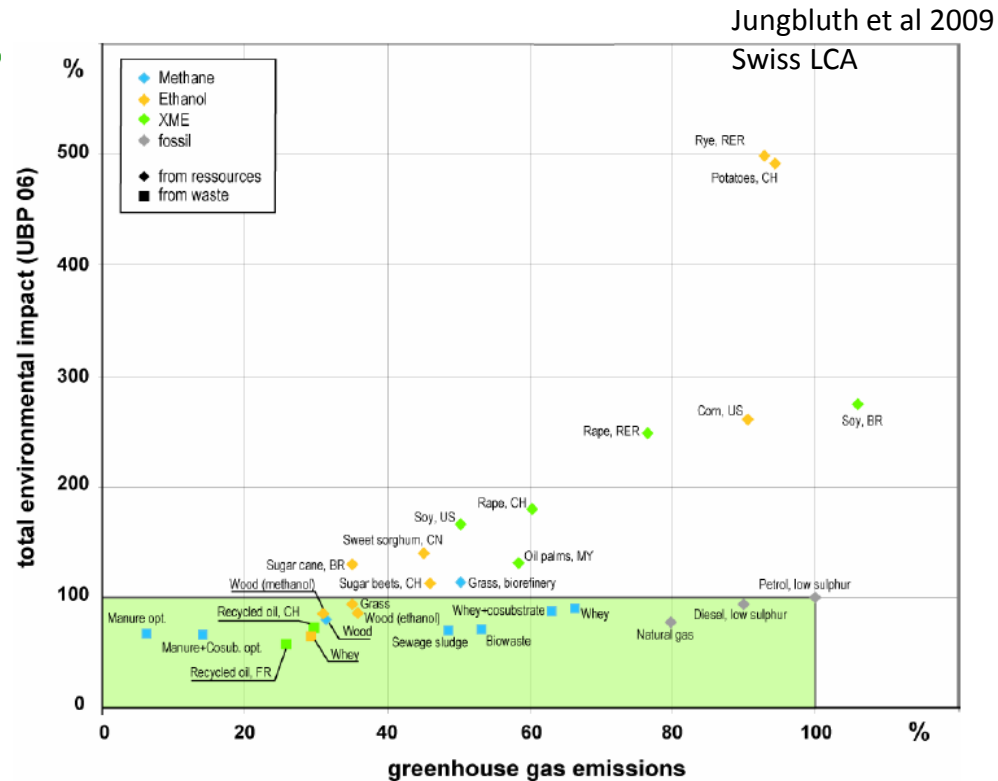
# Biofuels benefits: Reduction in Carbon emissions *and* pollution



A project to stimulate the use of biogas as fuel for city buses, aiming to reduce environmental impact.



FINANCED BY THE EUROPEAN UNION (European Regional Development Fund)



➤ Both GHG and pollutions savings depend on technology pathway

Best options **avoid** costs from wastes disposal and pollution, and LUC

# Barriers of future biofuels technology: *Ecological and social impacts*

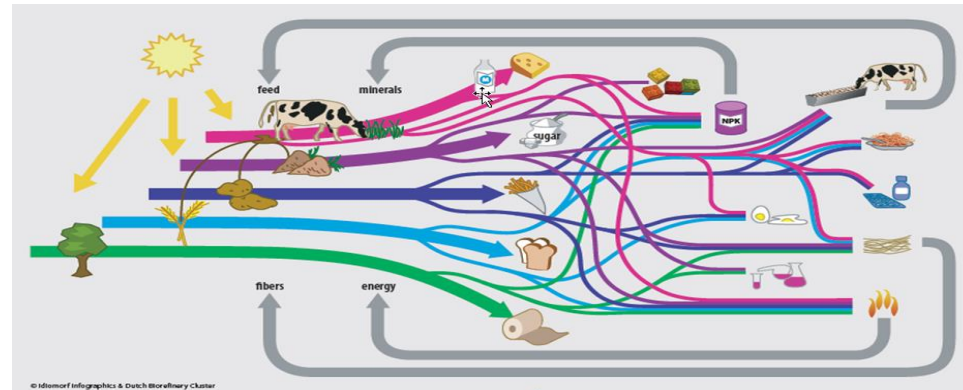
## FOOD **OR** FUEL?

Nearly a billion people will go hungry tonight, yet this year the U.S. will turn nearly 5 billion bushels of corn into ethanol. That's enough food to feed 412 million people for an entire year.

8 BUSHELS OF CORN = 21.6 GALLONS OF ETHANOL FUEL OR ENOUGH FOOD TO FEED A PERSON FOR A WHOLE YEAR



## Competition with food.....



- ❖ Land, water and agriculture/forestry inputs
- ❖ Biodiversity and Ecosystem impacts

# Biofuels sustainability?

## *Assessing the benefits of biofuels*



- Assess **performance** on the basis of a **Green economy** (*Low carbon, resource efficient and socially inclusive*)
- **Sustainability** assessment and **certification** (RSPO, Bonsucro, RSB, ISCC etc)

Green economy development opportunities	Green economy development criteria		
	Low-carbon	Resource efficient	Socially Inclusive
<b>Food resilience and security</b>	<ul style="list-style-type: none"> <li>*Reduce the fossil fuel and fertilisers requirements for agriculture</li> <li>*Improve the energy efficiency and renewable energy supply in the food supply chain</li> </ul>	<ul style="list-style-type: none"> <li>*Efficient use of water, land and soil nutrients/fertiliser</li> <li>*Food gardens and agriculture at the urban edge</li> <li>*Reducing waste in the food supply chain</li> </ul>	<ul style="list-style-type: none"> <li>*A city where none goes hungry and has access to affordable nutritious food.</li> </ul>
<b>Integrating infrastructure and spatial planning</b>	<ul style="list-style-type: none"> <li>*Integrated plans to increase urban efficiency through transit oriented development, urban densification and compaction,</li> <li>*Optimise the development of low carbon infrastructure for accessible and affordable transportation, accommodation, public services and other amenities (i.e. transit oriented development).</li> </ul>	<ul style="list-style-type: none"> <li>*Productive landscapes and more efficient, resilient and equitable settlement forms, where previously degraded land has been regenerated, and where biodiversity and the ecosystem services provided by our green infrastructure are protected and enhanced.</li> <li>*Integrate spatial planning transport and communications with the development of a Smart city<sup>8</sup></li> </ul>	<ul style="list-style-type: none"> <li>*Addressing vulnerable households and communities with the provision of basic services and mobility (transport)</li> <li>*Optimal use of land to improve living standards and mobility for large numbers of people</li> </ul>
<b>Increasing Mobility and access to low carbon transportation</b>	<ul style="list-style-type: none"> <li>*Adopt Green transport fuels<sup>9</sup> at scale</li> <li>*Increase mass transit (Rea Vaya, BRT) and non-motorised transport systems</li> </ul>	<ul style="list-style-type: none"> <li>*Optimised logistics</li> <li>*Integrated transport and transit systems</li> <li>*Transit Oriented Development</li> </ul>	<ul style="list-style-type: none"> <li>*Mass transit systems accessible and affordable to all</li> </ul>
<b>Integrated Water Resources Management</b>	<ul style="list-style-type: none"> <li>*Reduce the energy and infrastructure needed for water harvesting, treatment and reticulation</li> </ul>	<ul style="list-style-type: none"> <li>*Increase demand side management, water efficiency and water conservation</li> <li>*Increased re-use, and recycling of water</li> <li>*Diversification of water supply sources to address scarcity</li> </ul>	<ul style="list-style-type: none"> <li>*Intensify integrated water resources management (IWRM) to address water issues in a participatory and inclusive manner to ensure "water for all"</li> </ul>
<b>Integrated Waste management</b>	<ul style="list-style-type: none"> <li>*Integrated waste and wastewater management to reduce energy demand and carbon emissions</li> <li>*Waste disposal and treatment with the provision of bioenergy (i.e. biogas)</li> </ul>	<ul style="list-style-type: none"> <li>*Waste prevention and reduction through Green product design and procurement</li> <li>*Zero waste to landfill through waste reuse, recovery and recycling.</li> <li>*Reclamation of water and nutrients from waste and wastewater treatment</li> </ul>	<ul style="list-style-type: none"> <li>*Inclusive and universal solid waste and sewage disposal, collection and sanitisation</li> </ul>
<b>Energy efficiency and Green energy (renewable, clean energy)</b>	<ul style="list-style-type: none"> <li>*Increase energy efficiency and demand side management measures</li> <li>*Diversify the energy mix with increased low-carbon, renewable energy supply systems</li> </ul>	<ul style="list-style-type: none"> <li>*Develop low carbon and resource efficient infrastructure and Green buildings</li> <li>*Measure the performance of energy system in terms of the resource inputs (i.e. land, water, energy)</li> </ul>	<ul style="list-style-type: none"> <li>*Clean, renewable energy services available and affordable to all</li> </ul>



# Biogas for mobility and a Low-carbon development zone



- ❖ **Conventional biofuels commercially established-** Replace petrol, diesel and natural gas with little additional infrastructure and vehicle modification. Blended (5%) with existing fuels to facilitate gradual uptake and adoption (20-30% max).
- ❖ **Advanced biofuels are at various stages of commercialisation-** Access a wider range of biomass resources (ligno-cellulose via biochemical and thermochemical conversion). Algal biofuels.
- ❖ **Alternative fuels- hydrogen and battery storage for electricity storage** are at demo and early commercial stage- may be 'game changer'. Range and requirement for energy input from renewables
- ❖ The **environmental benefits of biofuels**, such as the **reduction in carbon emissions and other pollutants** requires **LCA**
- ❖ Other issues will also determine market uptake of biofuels. **Cost-competitiveness with current fossil fuels** and **avoiding competition** for land and biomass to produce food, feed, fibre and fine chemicals in the developing **bio-economy**. **Biorefinery** developments offer an improved integration of these product streams.

# Thanks!

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[www.biossam.org](http://www.biossam.org)



Food



Feed



Chemicals



Materials



Fuels

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