Biofuels - Opportunities and Challenges

Low Carbon Transport Investor Event
Carbon Trust

11th May 2009

Greg Archer
Managing Director
Low Carbon Vehicle Partnership

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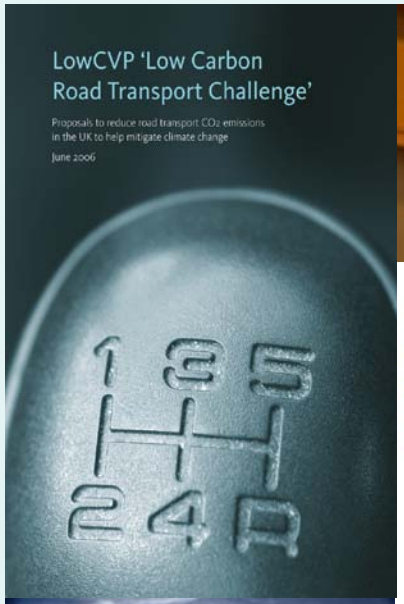
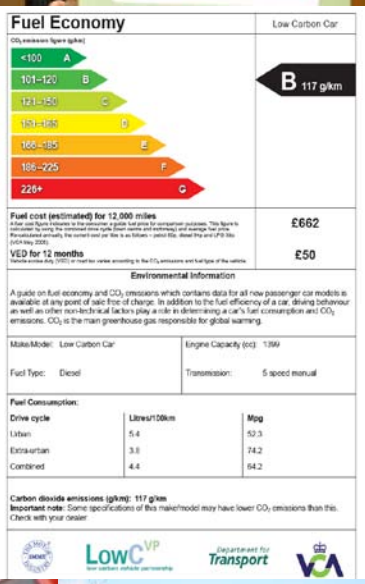
Low Carbon Vehicle Partnership

Accelerating a sustainable shift to low carbon vehicles and fuels in the UK

Stimulating opportunities for UK businesses





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Outline

- The renewable fuel challenge
- Policy drivers
- Biofuel feedstocks and pathways
- Biofuel markets
- Costs
- Environmental benefits and impacts
- Legislative drivers
- Opportunities and challenges for investors

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Renewable energy is a global economic driver

"Finding the new driver of our economy is going to be critical.

There is no better potential driver that pervades all aspects of our economy than a new energy economy…

…assuming obviously that we have done enough to just stabilize the immediate economic situation."

Barack Obama, 2008

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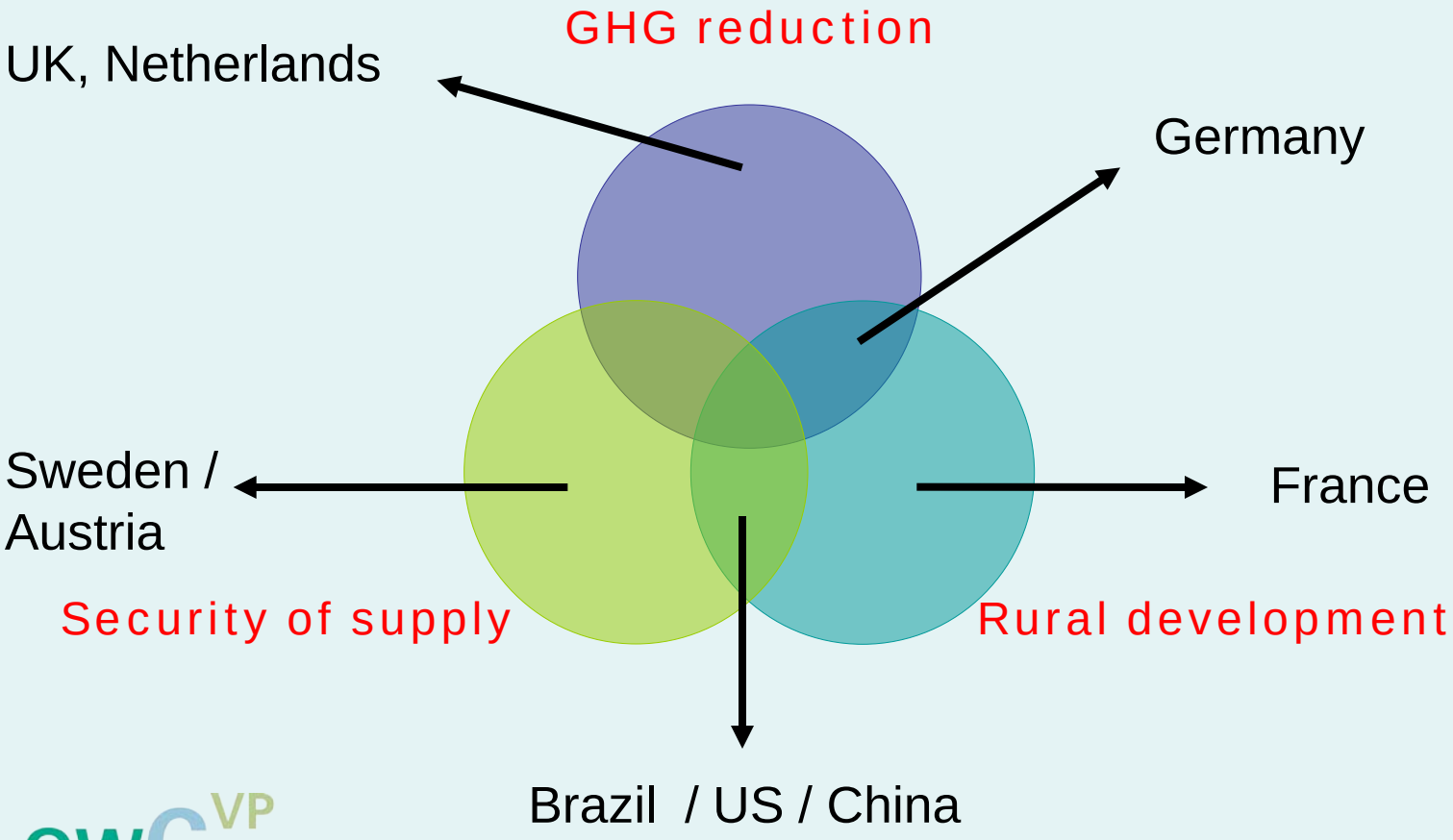
New Energy Finance 2009

3 policy drivers, 1 outcome .... increasing global biofuel demand

Principal biofuel policy drivers



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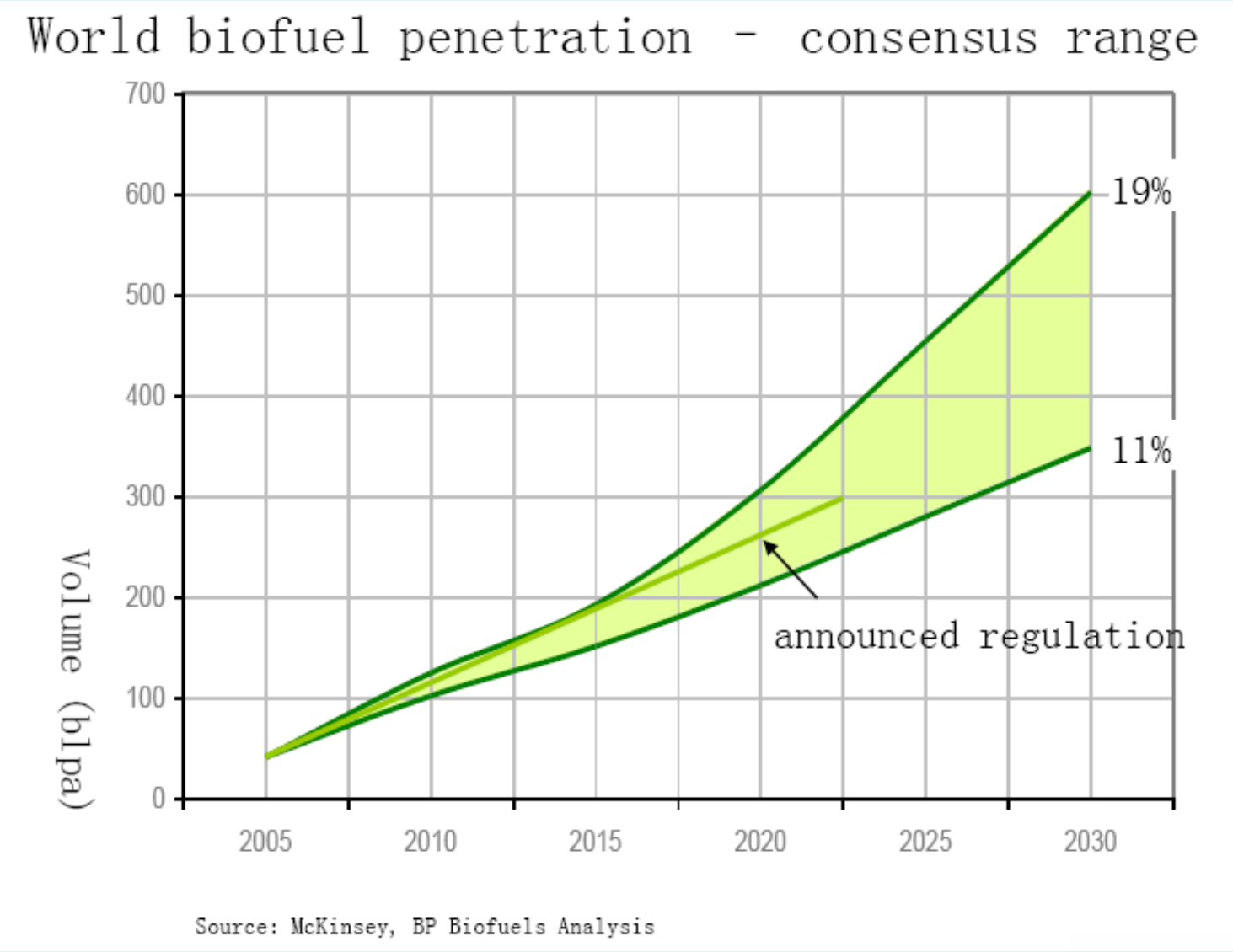
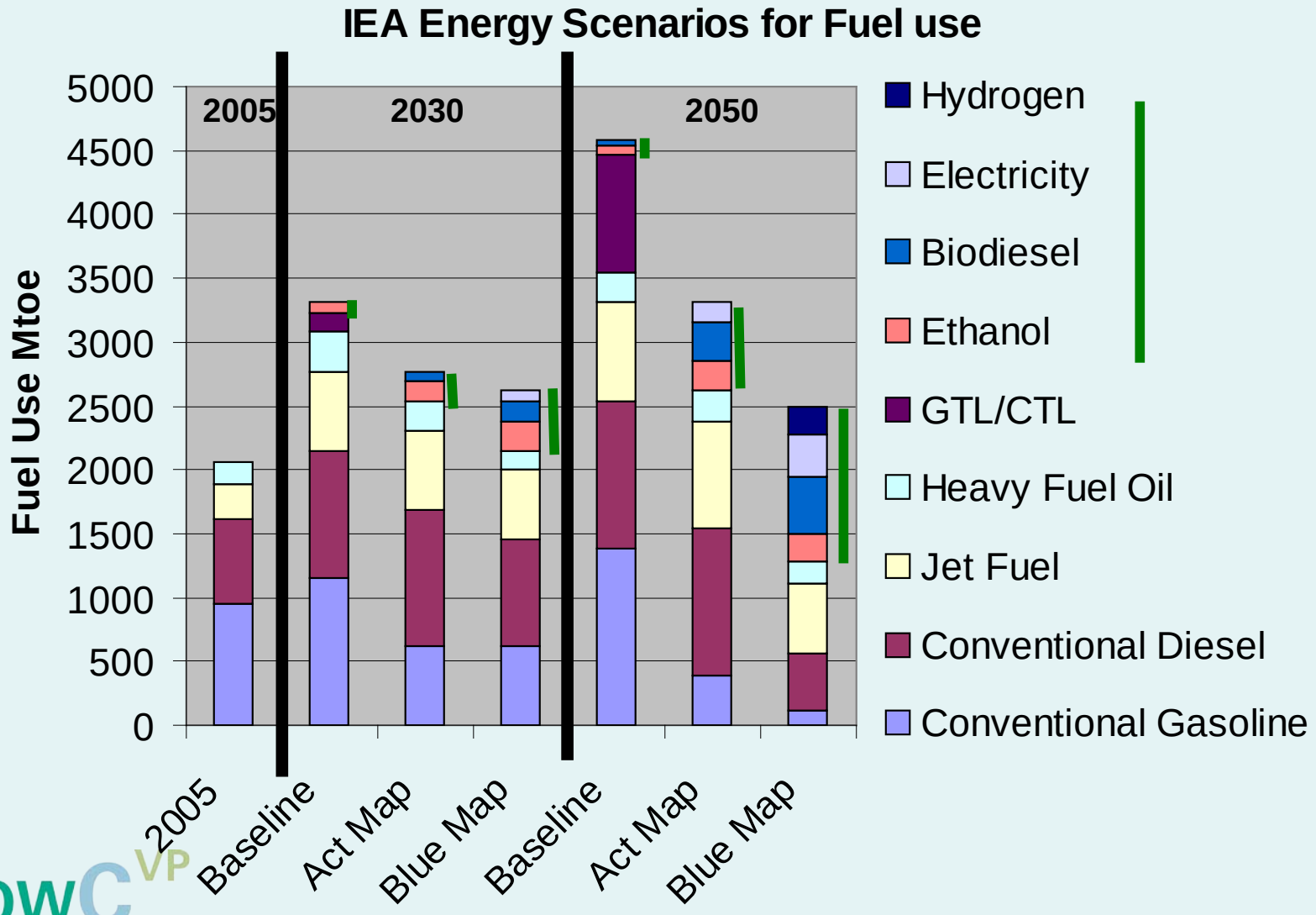
Global biofuel demand is expected to reach 10-20% transport fuel demand by 2030



Beyond 2020 IEA scenarios show an increasing penetration of renewable transport fuels to meet increasing demand



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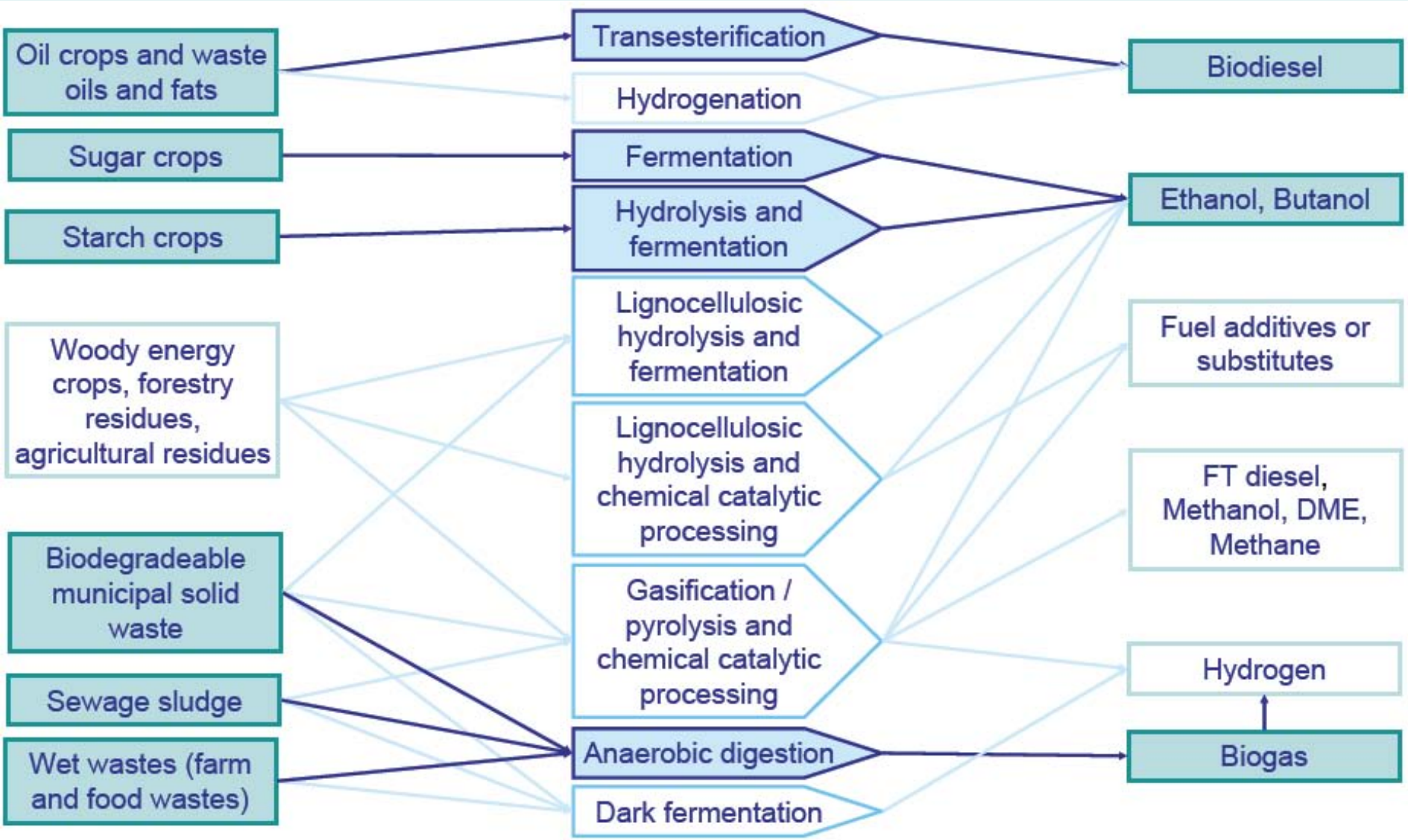
IEA 2008, Energy Technology Perspectives

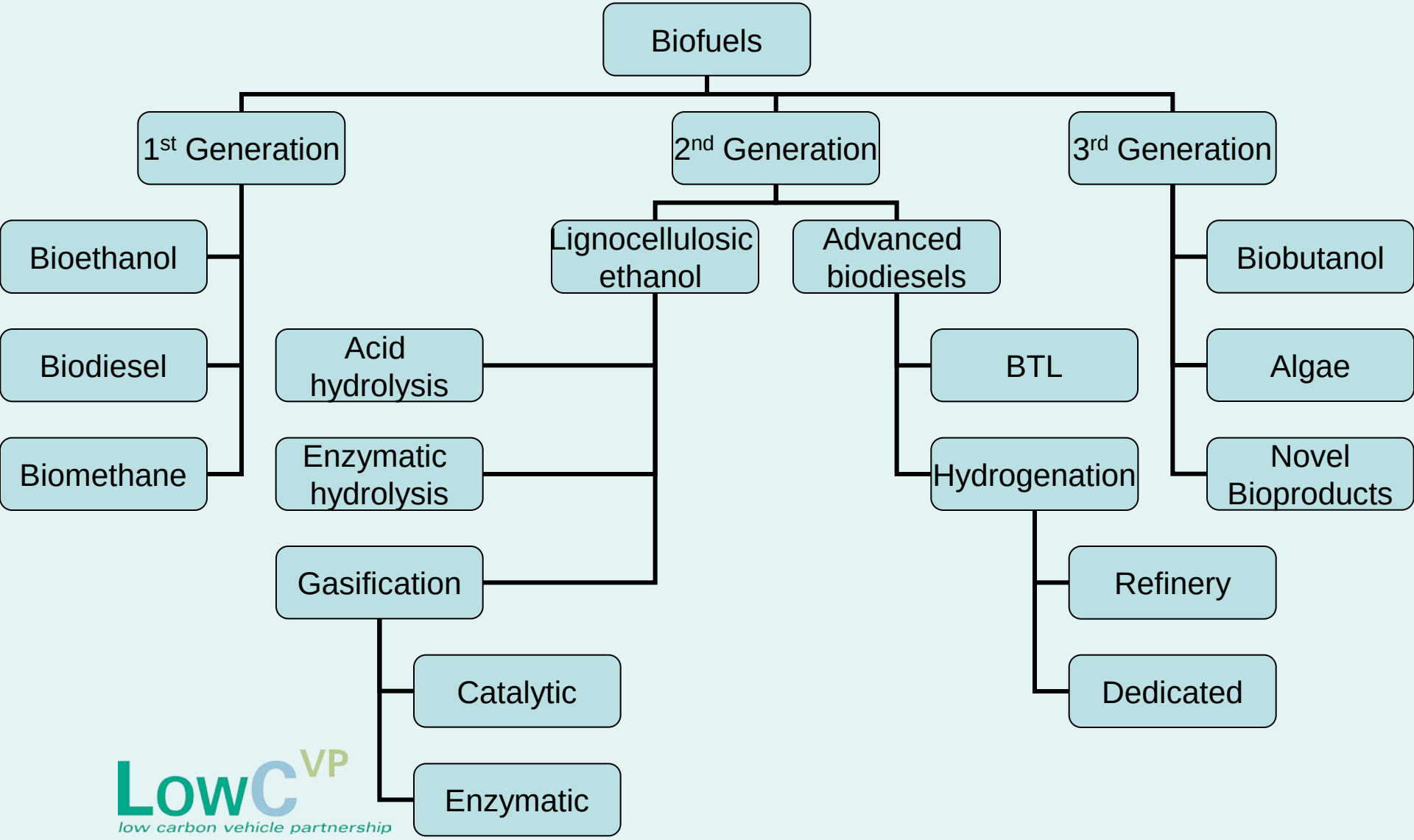
There are multiple feedstocks and pathways through which to produce biofuels

E4tech 2007



Commercially available, or 1st generation, routes are shaded blue, next generation routes are unshaded

Biofuel taxonomy is confusing



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Multiple feedstocks enable a globally diverse market – but 5 crops dominate

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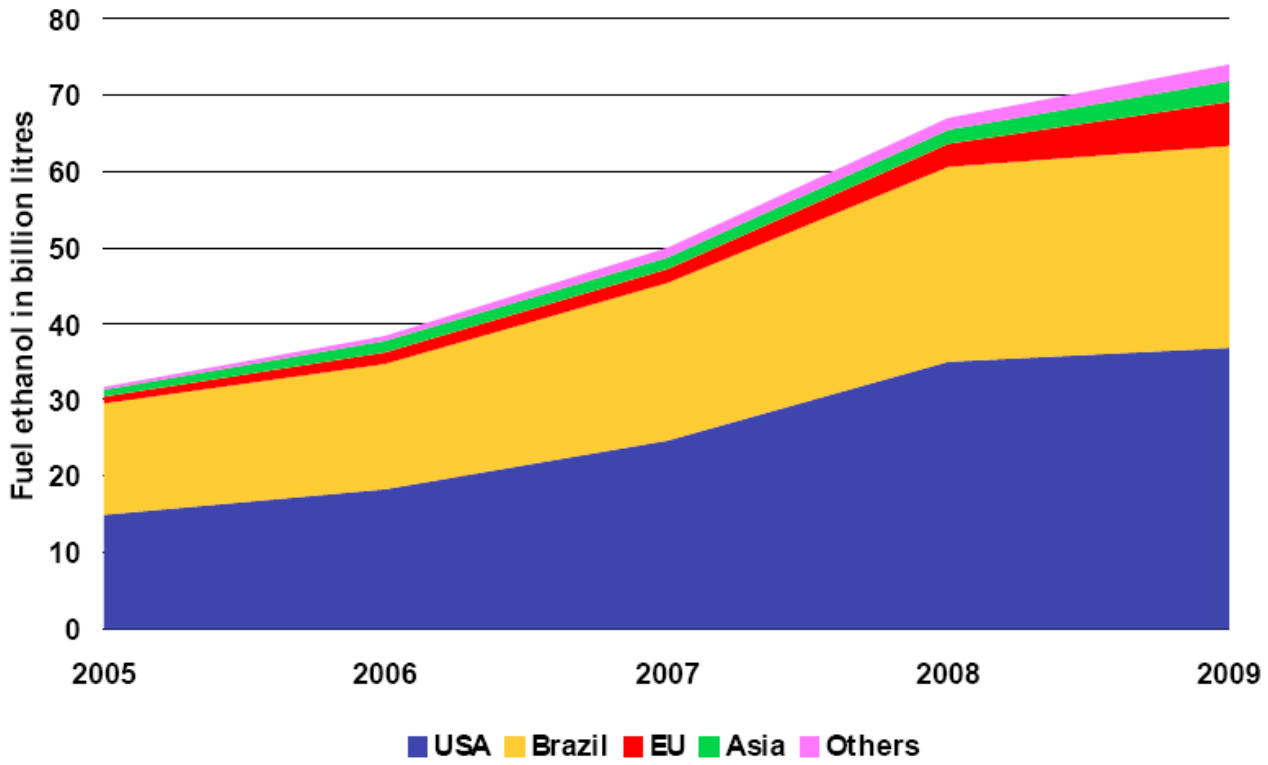
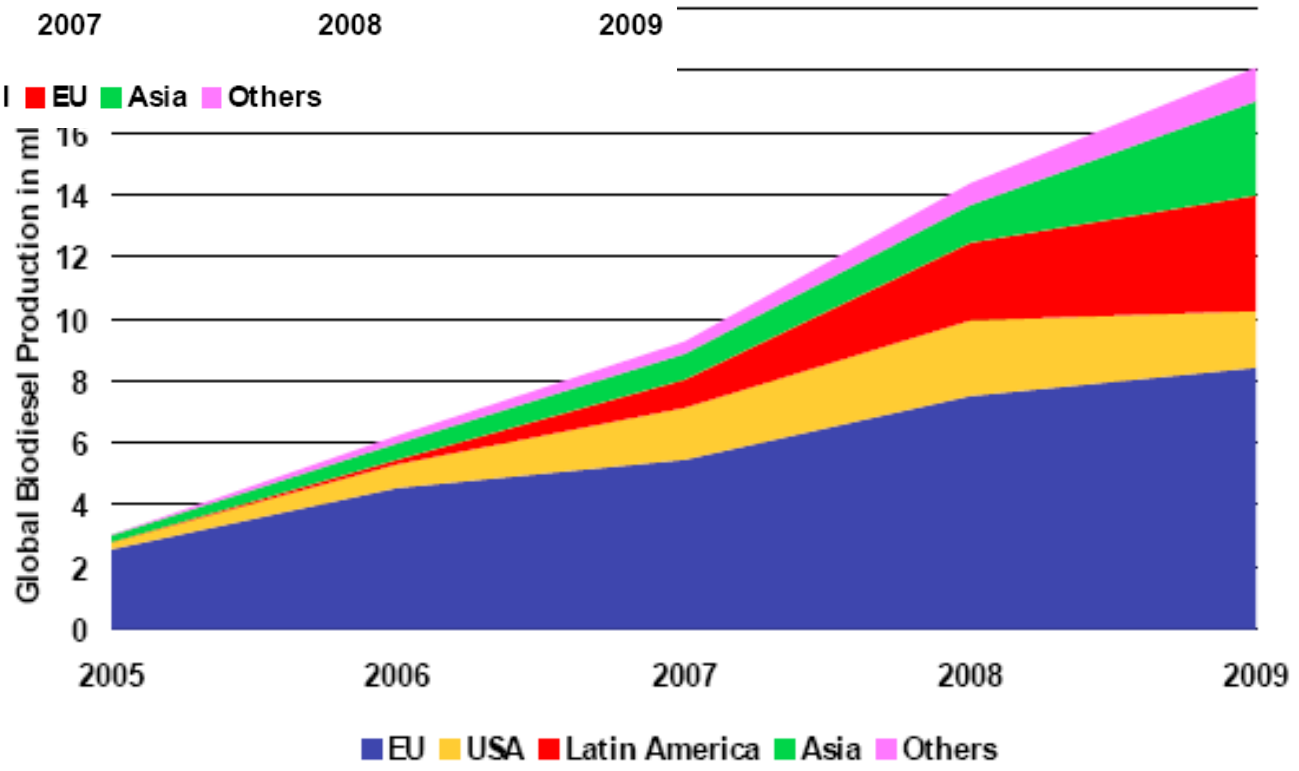


Global production of biofuels has increased rapidly

LMC 2009

Biodiesel

Bioethanol



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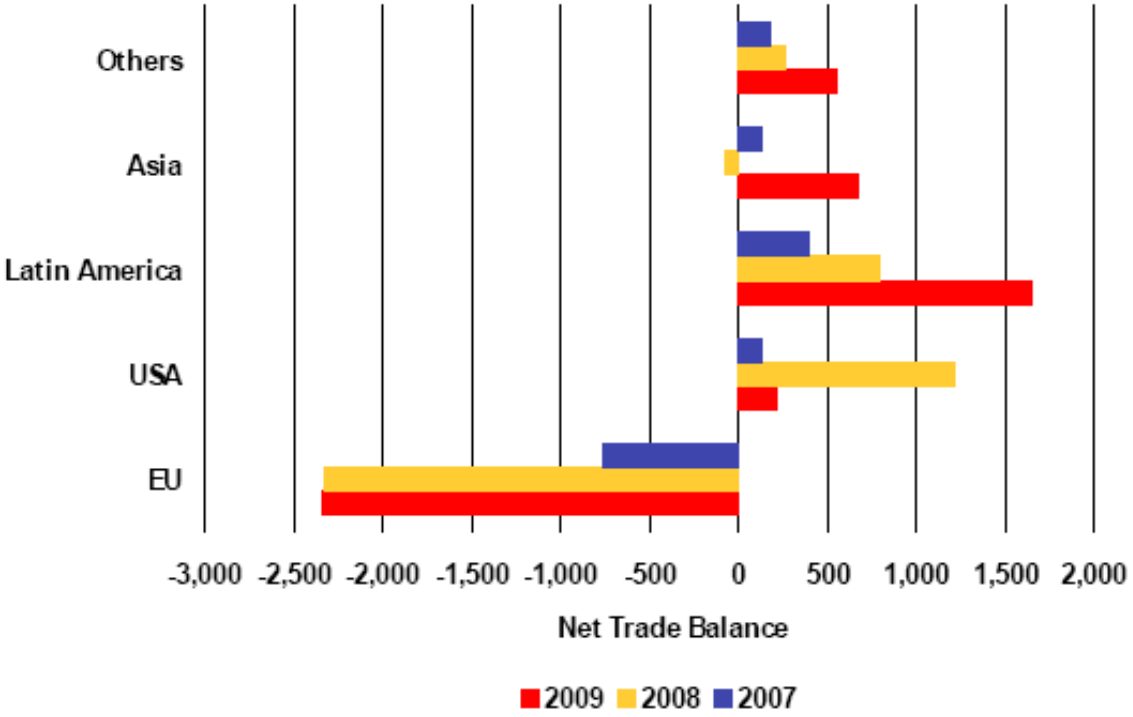
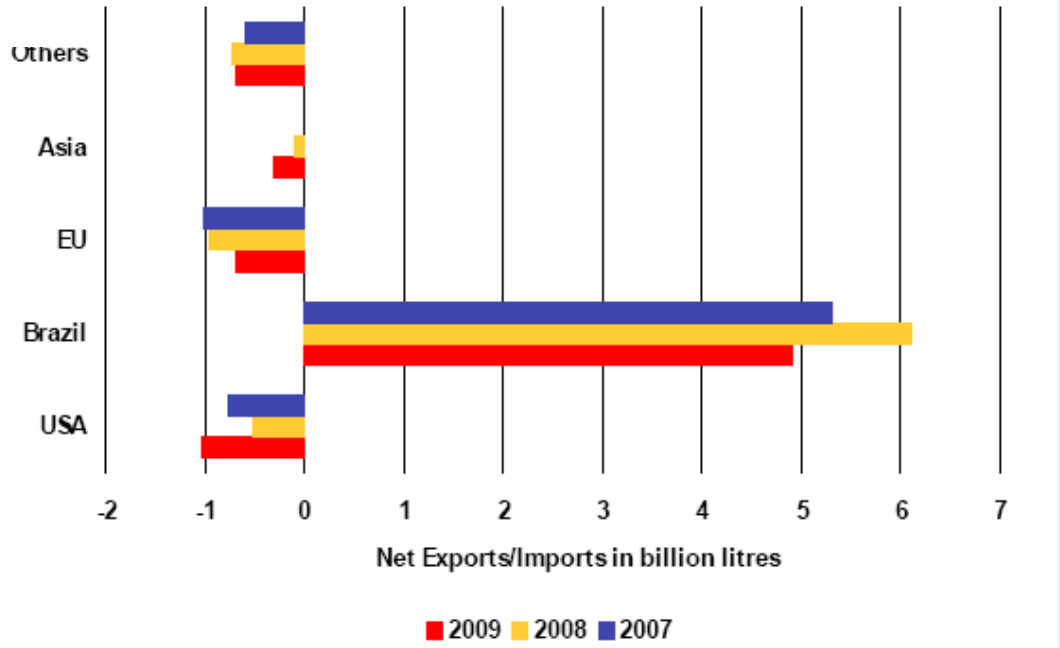


The EU is a major importer of biodiesel –

Brazil the major exporter of bioethanol

Biodiesel

Bioethanol



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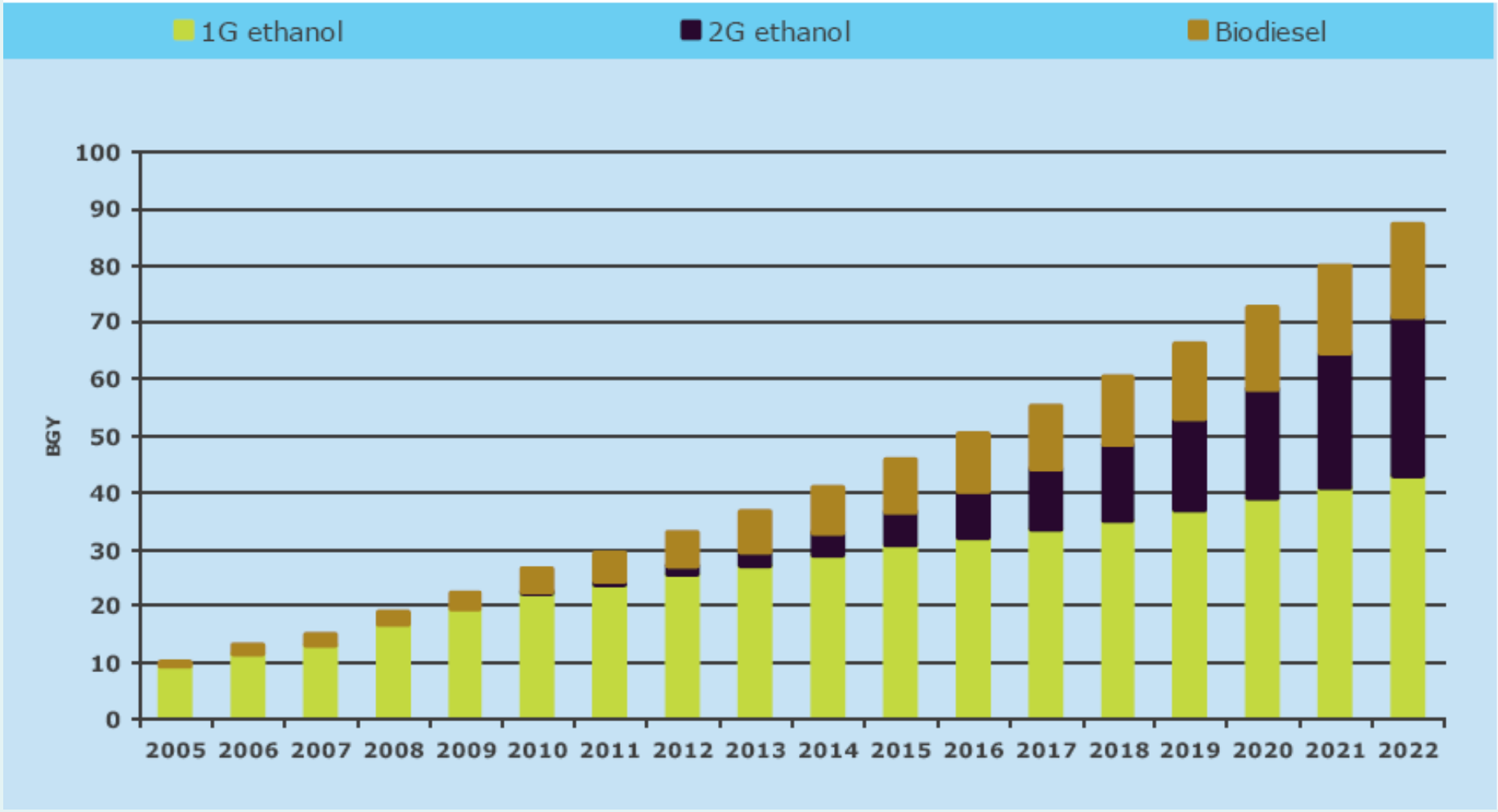
Global markets are expected to grow rapidly – notably for 2nd Generation Ethanol



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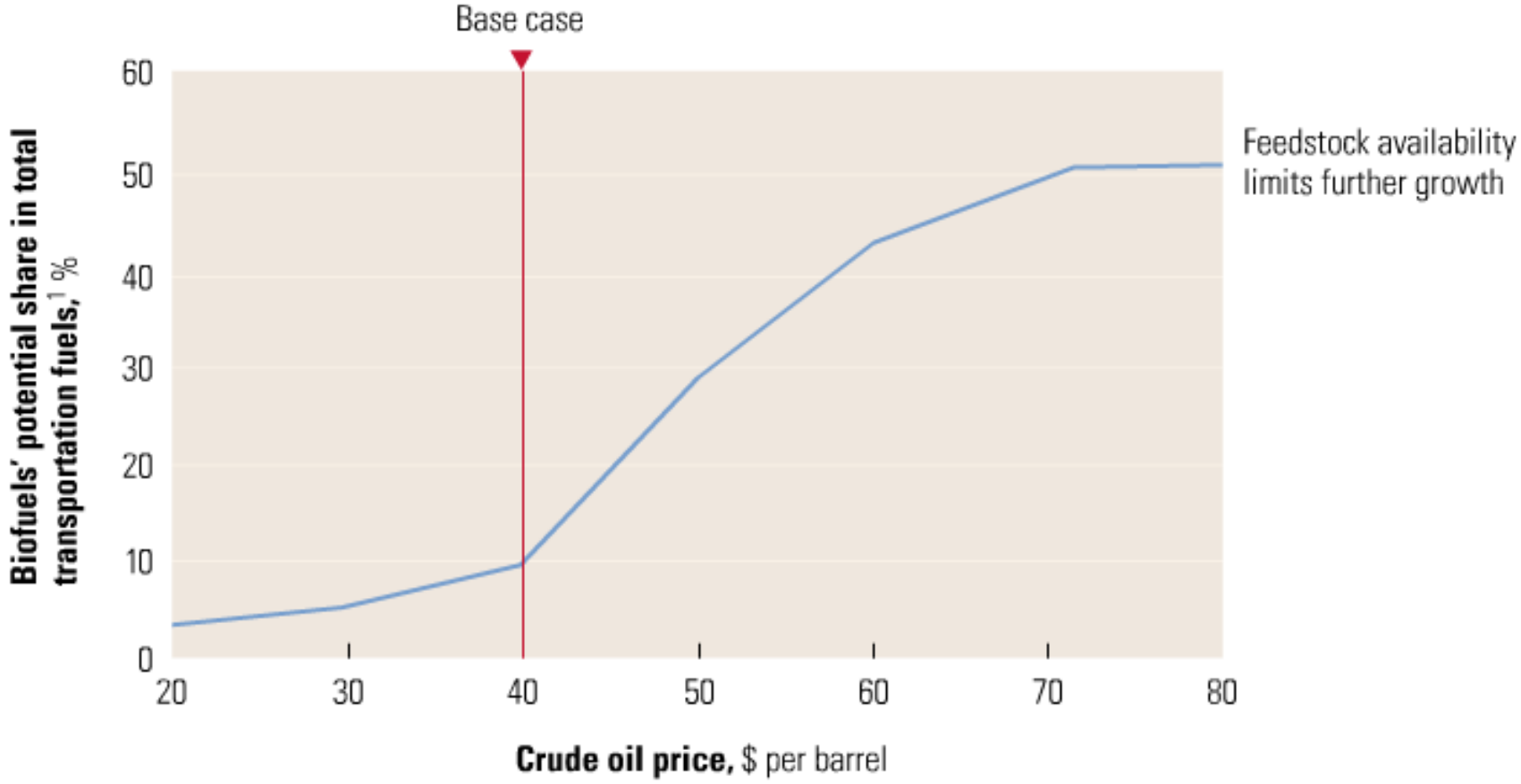
Biofuels future share of transport fuel markets is highly dependent upon oil (and feedstock) prices but ultimately constrained by land availability



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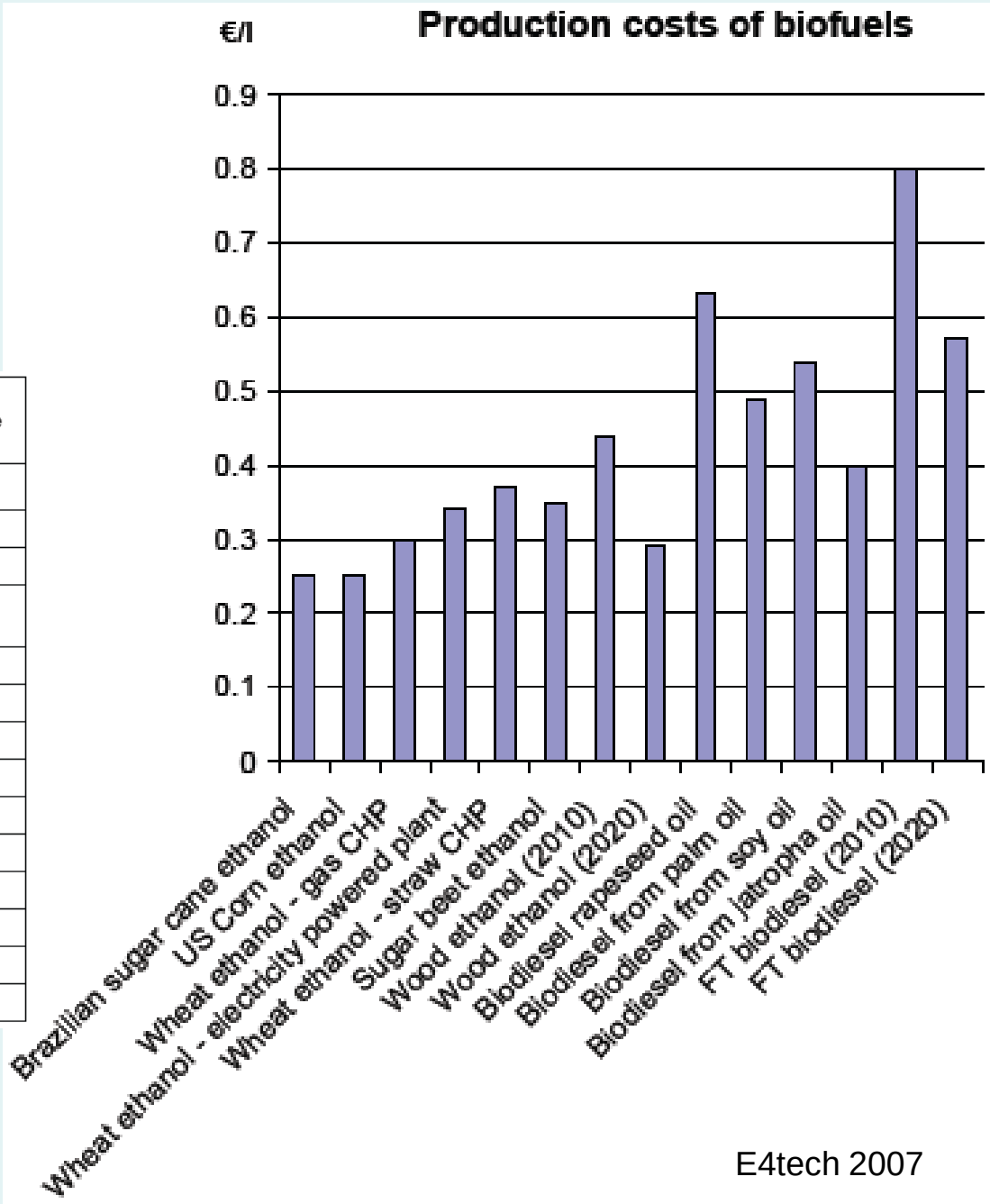
Mckinsey 2007

Cost thresholds with oil vary widely – most advanced technologies requiring >$100bbl

Oil price, $/bbl	Fuels which are competitive above this oil price
60	Brazilian sugar cane ethanol US corn ethanol Biodiesel (jatropha – estimate)
70	Wheat ethanol – with gas CHP plant Biodiesel (rape, palm, soy) **Wood ethanol (2020)**
80	Wheat ethanol - electricity powered plant
90	Sugar beet ethanol Wheat ethanol – with straw CHP plant **FT biodiesel (2020)**
100	Biodiesel (current rapeseed oil prices)
110	**Wood ethanol (2010)**
120	**FT biodiesel (2010)**

Biofuel production costs vary widely and have become volatile with feedstock market price fluctuations

Feedstock and process	€/GJ	€/l	Feedstock price, €/tonne (dry)
Brazilian sugar cane ethanol	11.8	0.25	55
US Corn ethanol	11.8	0.25	62*
Wheat ethanol - gas CHP	14.2	0.30	100
Wheat ethanol - electricity powered plant	16.2	0.34	100
Wheat ethanol - straw CHP	17.5	0.37	100
Sugar beet ethanol	16.3	0.35	25
Wood ethanol (2010)	20.6	0.44	42
Wood ethanol (2020)	13.4	0.29	42
Biodiesel rapeseed oil	18.8	0.63	600
Biodiesel from palm oil	14.6	0.49	450
Biodiesel from soy oil	16.0	0.54	500
Biodiesel from jatropha oil	11.8	0.40	350
FT biodiesel (2010)	23.2	0.80	50
FT biodiesel (2020)	16.5	0.57	50



E4tech 2007

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In the course of a year biofuels went from an environmental savour to pariah fuel

2006

2007

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There are better and worse ways of producing biofuels for crop-based feedstocks

British Sugar Wissingham
Ethanol from sugar beat
c60% GHG-saving
Indirect effects possible

Matto Grosso – Brazil
Deforestation for soy
GHG-emissions

US Corn
Minimal GHG-benefits
Significant indirect effects

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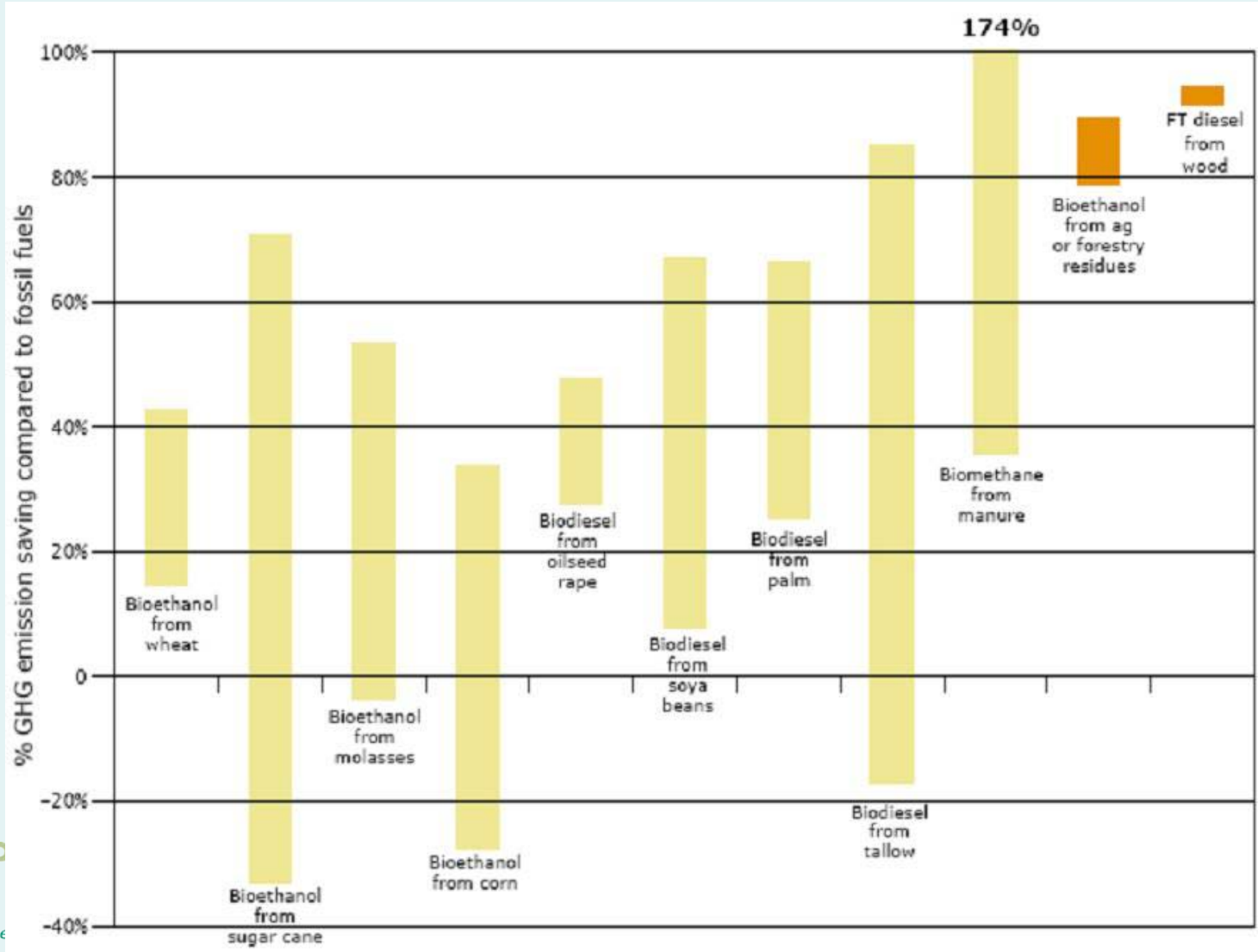
Biofuel GHG-savings vary widely between feedstocks & depending upon production processes



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Land use change emits significant quantities of GHGs – leading to long payback times for plantations

Fuel chain	Assumed country of origin	GHG saving excluding the impacts of land-use change	Carbon payback (years)	
		%	Grassland	Forest
Palm to biodiesel	Malaysia	46%	0 – 11	18 – 38
Soya to biodiesel	USA	33%	14 – 96	179 – 481
Sugarcane to bioethanol	Brazil	71%	3 – 10	15 – 39
Wheat to bioethanol	UK	28%	20 – 34	80 – 140

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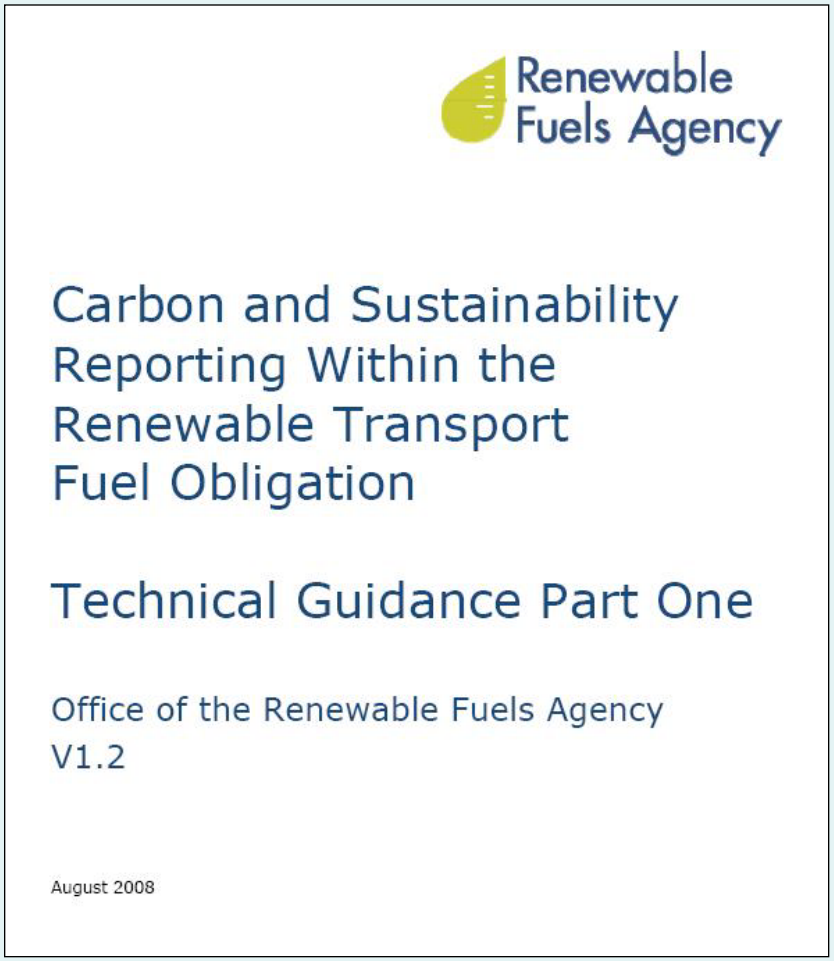
Gallagher Review 2008

UK operating the world's only national carbon and sustainability reporting scheme for biofuels

- Requirement of the UK Renewable Transport Fuels Obligation
- Encourages supply of more sustainable biofuels
  - Company performance published and compared against targets
- Increases awareness & understanding
- Practical but robust
- Non-discriminatory
- Developed through a multi-stakeholder process
  - Consultancy support from Ecofys / E4tech



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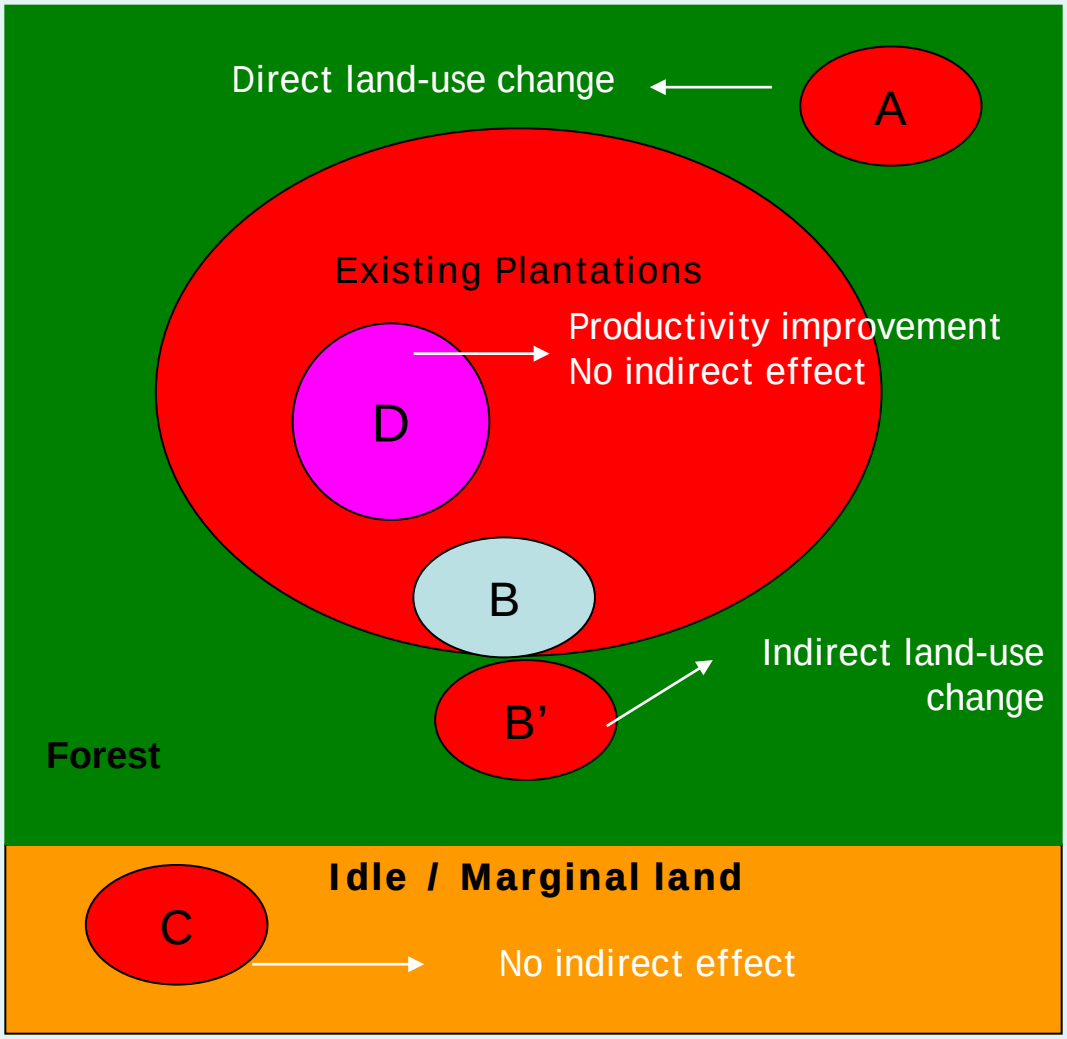
Widely varying company performance – ytd
RFA pressure has encouraged improved performance

Targets met ytd (out of 3)	***Fossil fuel company***	**Q2**
3	*ConocoPhillips Ltd*	3
	Mabanaft UK Ltd	3
	BP Oil UK Ltd	2
	Greenergy Fuels Ltd	3
	Harvest Energy Ltd	2
	Ineos Refining Ltd	1
	Petroplus Refining Teesside Ltd	2
	Prax Petroleum Ltd	0
2	*Shell UK Ltd*	2
	Chevron Ltd	1
	Esso Petroleum Company Ltd	0
	Murco Petroleum Ltd	1
	Topaz Energy Ltd	0
1	*Total UK Ltd*	1

RFA 2009

Indirect effects on land use and food prices have emerged as a key concern and future legislative driver



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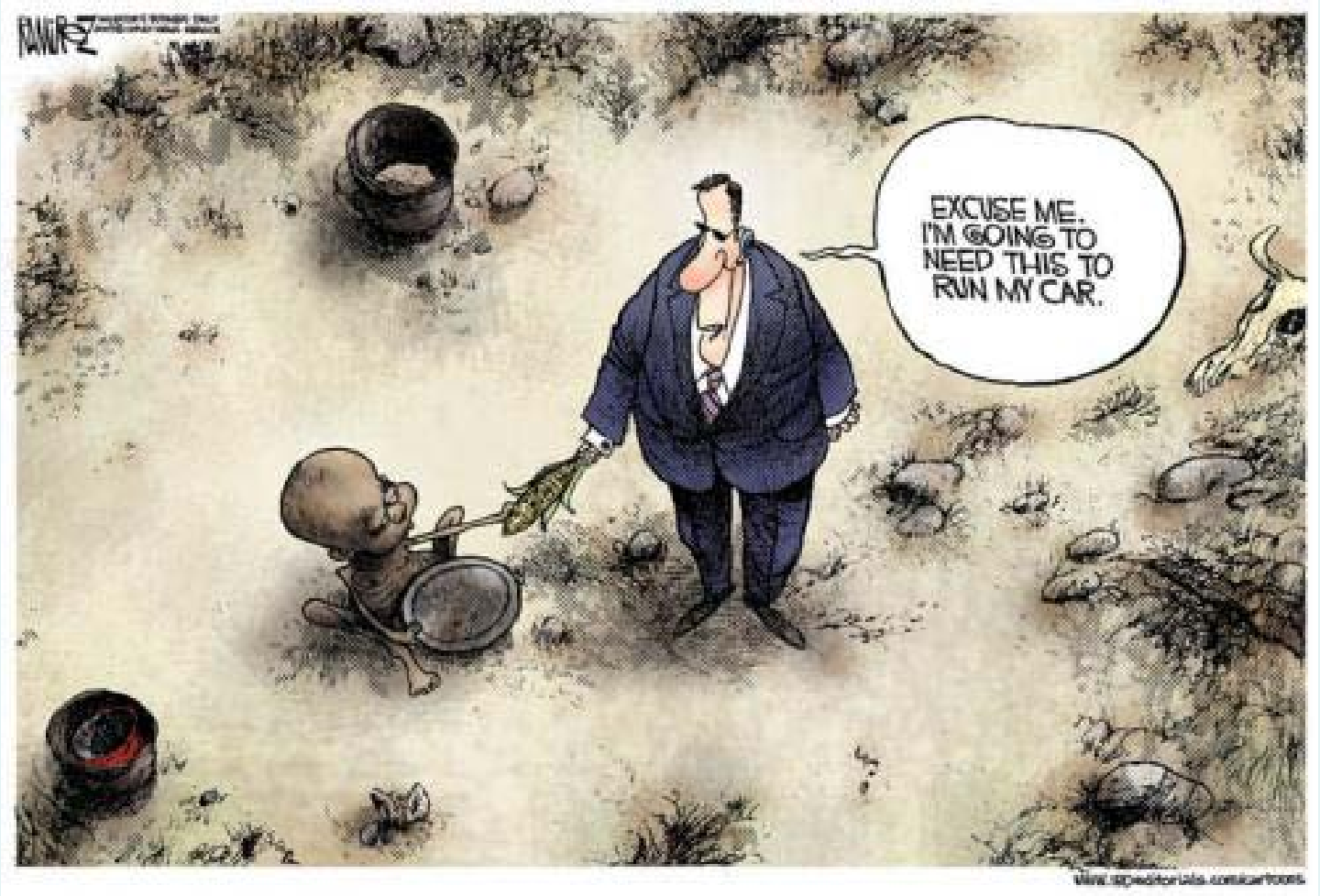
The rural development dilemma



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"Biofuels can only contribute GHG savings if significant emissions from land-use change are avoided and appropriate production technologies employed" - Gallagher Review, 2008

- There is a future for a sustainable biofuels industry - but:
- Feedstock production *must* avoid agricultural land that would otherwise be used for food production
  - Current policies will reduce biodiversity and may even cause greenhouse gas emissions
- The introduction of biofuels should be significantly slowed until adequate controls to address displacement effects are implemented and are demonstrated to be effective
- A slowdown and shift in biofuel feedstock production will reduce the impact of biofuels on food commodity prices that have a detrimental effect upon the poorest people

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EU Renewable Energy Directive introduces mandatory environmental standards

- Target of 10% renewable energy in transport by 2020.Transposition deadline likely November 2010
- Biofuels must fulfil the sustainability criteria
  - minimum GHG savings of 35%, rising to 60% by 2018
  - not from land with high biodiversity, primary forest, carbon stocks, wetlands
  - information on measures taken for soil, water and air protection – comitology
- Incentivises second generation biofuels
  - “wastes, residues, non-food cellulosic material, and ligno-cellulosic material shall be considered to be twice that made by other biofuels.” (and electric vehicles)
- Complementary FEL Quality Directive (FQD) requires fuel suppliers to reduce the lifecycle greenhouse gas emissions of road transport fuels
- 6% reduction by 2020 relative to a baseline of the EU average figure in 2010.
- FQD and to RED 10% target broadly aligned (around 5% GHG reduction if all 10% RED met by biofuels – with 60% GHG-saving)

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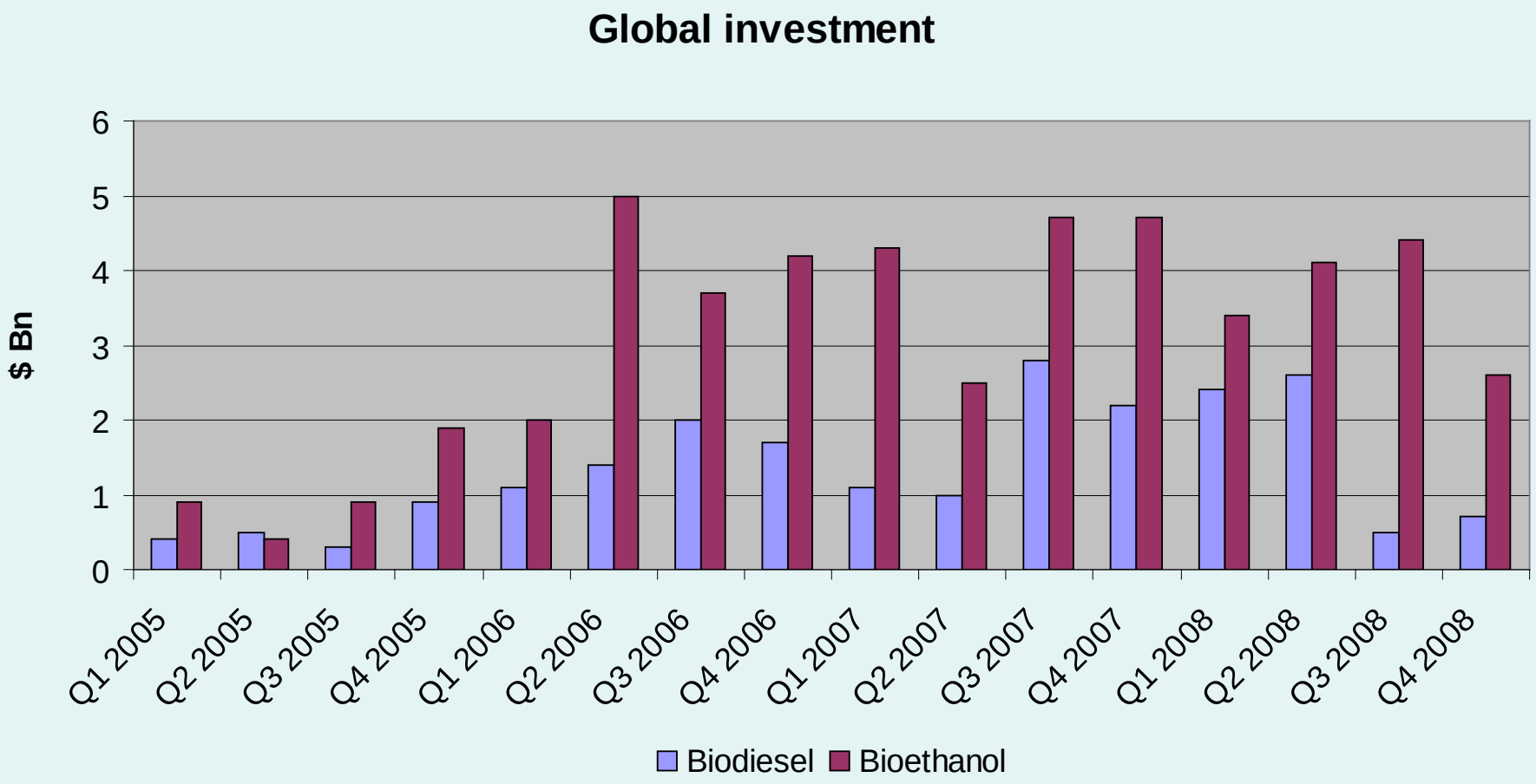
Global investment in bioethanol remains strong



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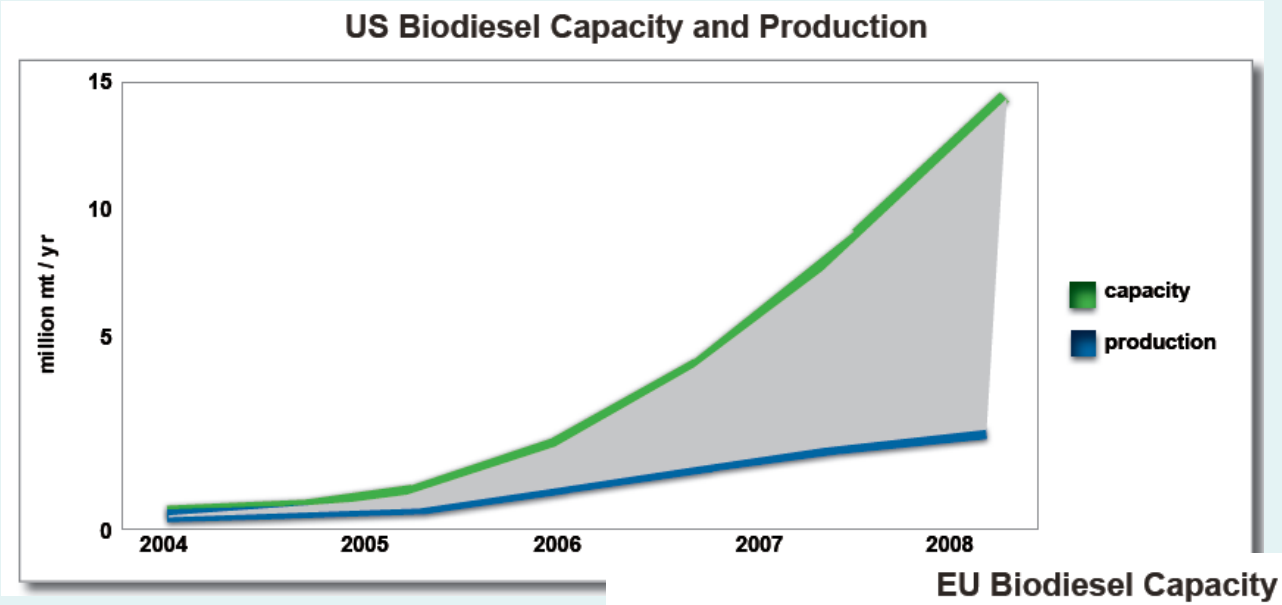
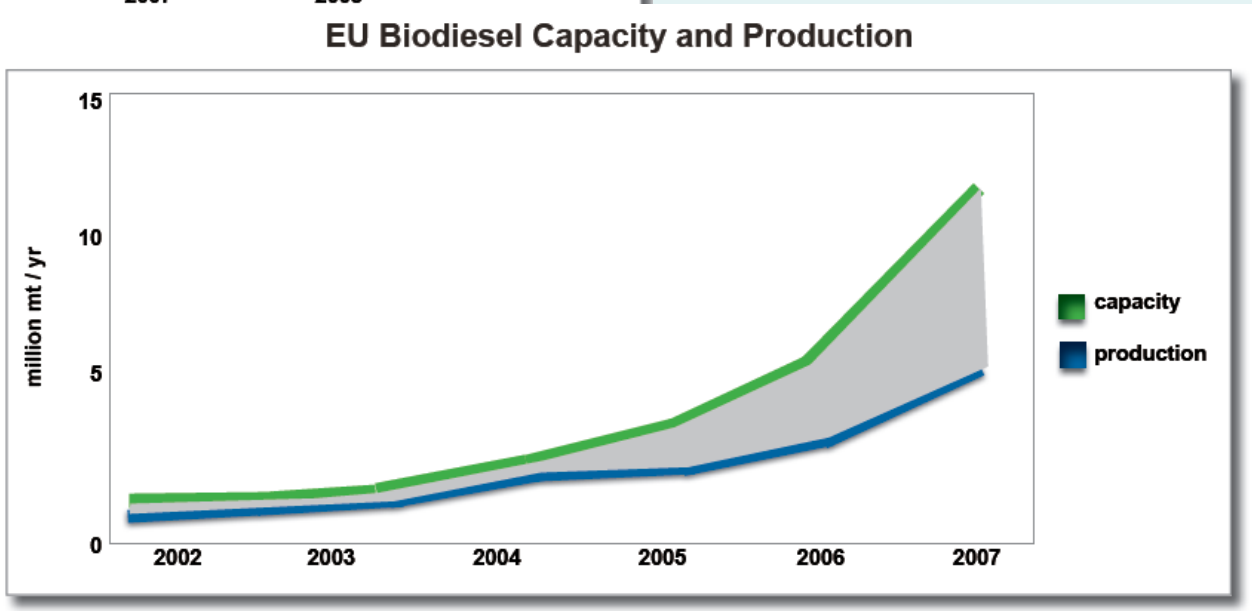
New Energy Finance 2009

Over capacity and "splash and dash" imports are having significant impacts on the EU biodiesel industry





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Observations for investors

- The period of high margins created by generous tax breaks is over
- Undeveloped tropical regions (with free-access to major markets) are attractive but have high risks and infrastructure challenges
- New technology will, in the longer term, significant reduce costs – for some feedstocks and production regions
- Biofuels with better GHG-savings will become increasingly attractive with new legislation in the EU and US
- Risk can be managed through building value through complex supply chains

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Key messages

- Biofuel demand is growing globally with several policy drivers and a strong legislative framework
- There are multiple feedstocks & pathways
- Costs are dominated by feedstock prices – most are only viable at oil prices >$60bbl
- Advanced technologies have significant prospects for yield improvements and cost-reductions – in the medium term
- There are important direct environmental effects which EU legislation will seek to manage.
- Low carbon intensity fuels will be incentivised in the EU and US
- Indirect effects remains a major challenge - ultimately biofuel production (excluding algae) will be constrained by land availability
- US / Brazilian investment in bioethanol remains strong – biodiesel over capacity is a major issue
- There are significant risks – but opportunities for investors

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Any Questions?

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