

Incentivising the use of biofuels in the European Union – finding the right level?

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Overview

- Policy context
- Theoretical Framework
- Benefits
- Marginal costs of biofuels
- Marginal cost of CO₂ mitigation
 - Subsidy
 - Excise duty
 - Import tariffs
- Conclusions

Policy Context – GHG emissions from Transport

- Kyoto Protocol: EU to reduce GHG emissions by 8% by 2008-2012 compared with 1990
- Transport emissions growing fast
- EU Emissions trading scheme since January 2005- Transport sector not included
- Main EU instruments to reduce GHG from passenger cars:
 - 1) Voluntary Agreements
 - 2) Proposed vehicle tax harmonisation
 - 3) Car-labelling
- New regulations from 2012

Policy Context - Biofuels

- *Commission's Green Paper: Towards an European Strategy for the Security of Energy Supply (2001):* 20% substitution by alternative fuels in the road transport sector by the year 2020
- Dual purpose - security of supply and greenhouse gas emissions (and support employment in rural areas).
- *White Paper on transport (2001)* called for dependence on oil (currently 98 %) in the transport sector to be reduced by using alternative fuels such as biofuels.
- Biofuels Directive 2003/30/EC substitution targets for EU- 2% in 2005 and 5.75% in 2010.
- Proposed 10% target by 2020.

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Theoretical framework

- Policy measure cost-benefit analysis:

$$\Sigma MC \leq \Sigma MB$$

$$\Sigma MC = MC_p + MC_e$$

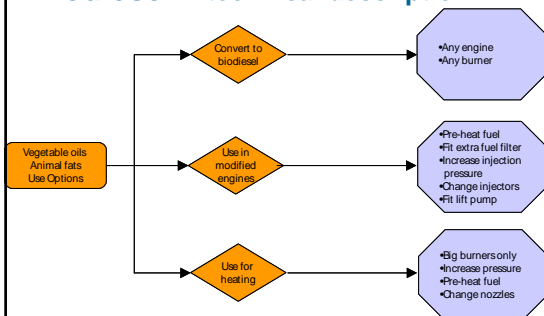
$$\Sigma MB = MB_f + MB_g + MB_s + MB_r$$

Ignoring MC_e and $MB_s + MB_r$

We estimate whether $MC_p - MB_f \leq MB_g$

$(MC_p - MB_f) / \text{tonne CO}_2 \text{ saved} \leq \text{value of CO}_2 \text{ reduction per t CO}_2$ then this policy makes sense from a GHG viewpoint

Biodiesel – technical description



Schematic diagram of production of biofuel from vegetable oil and animal fats (SEI, 2003)

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Marginal benefits – GHG emissions

	Feedstock	CO ₂ g/km saved ¹ (range)	% CO ₂ emissions saved	Best estimates ²
Bioethanol	Sugarbeet	37.8-187.8	16%-82%	55%
Bioethanol	Wheat	43.7-174.0	19%-76%	67%
Biodiesel	RME	88.5-116.4	44%-66%	52%

1. Based on petrol and diesel Opel Zafira MTA: 7.4 and 5.4L/100km respectively
2. Sheffield values in NOVEM study

Estimated GHG savings compared to transport fossil fuels

Biofuel	% CO _{2eq} savings		
	low	Best estimate	high
1. Bioethanol			
Sugar crops	-20%	-39%	-73%
Starch crops	21%	-14%	-32%
Lignocellulosic crops	-79%	-79%	-80%
Lignocellulosic residues	-83%	-83%	-83%
Brazilian sugar cane	-74%	-92%	-115%
2. Biodiesel			
Oil seeds	-18%	-45%	-64%

Marginal benefits – Market value

Fuel substituted	Cost price*	Market price (excise duty and VAT)
	€/1000Litres	€/1000Litres
Petrol	517	1272
Diesel	560	1134

* Fuel prices are weekly spot prices taken for week 19/12/2007 from the EU Oil Bulletin.

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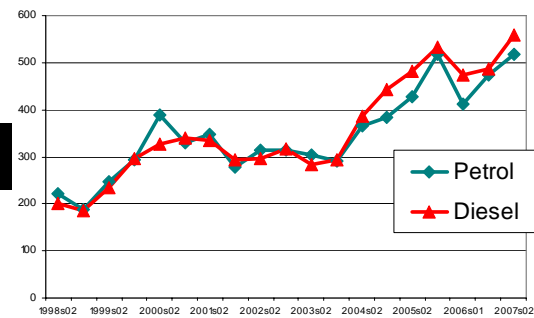
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Marginal costs of Biofuels (UK DfT, 2003)

Option & Fuel type	Feedstock	Source	Costs, €/1000litre			Total (energy eq.)
			Production	Distribution	Total	
Biodiesel*	Oil seeds	US	500.0	48	548	649
		EU15	619	46	665	788
Biodiesel	Oil seeds- UK production	US	500	92	592	701
		EU15	619	84	703	833
Bioethanol*	Wood –acid hydrolysis	US	322	45	367	602
Bioethanol	Straw – acid hydrolysis	EU15	618	42	660	1082
Bioethanol	Wheat	EU15	450	42	492	806
Bioethanol	Corn	US	235	45	279	458
Bioethanol	Sugar cane	Brazil	189	45	234	384
Bioethanol	Sugar cane- UK production	Brazil	657	69	727	1191
Bioethanol	Sugar beet	EU15	512	42	554	908

* Energy ratio of 0.61 and 0.844 for bioethanol and biodiesel rel. to petrol and diesel

Petrol and diesel prices 1998-2007 Net taxes, EU15



Current costs of biofuels

	Resource	Cost at filling station (€ ₂₀₀₇ /1000litres)		
		lower	Ref	higher
Bio-ethanol	Sugar crops	935.3	1351.3	1982.0
	Starch crops	864.8	1253.4	1680.0
	Lignocellulosic crops	1226.7	1546.7	2601.9
	Lignocellulosic residues	1123.8	1405.7	2384.8
	Brazilian sugar cane	116.9	294.0	351.0
Biodiesel	Oil seeds	806.9	1010.1	1167.1
	Usedoil/fat	377.9	485.6	582.8

Source: VIEWLS project, Jungmeier et al. (2004)

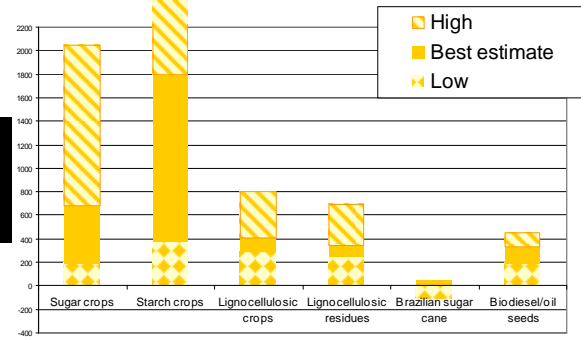
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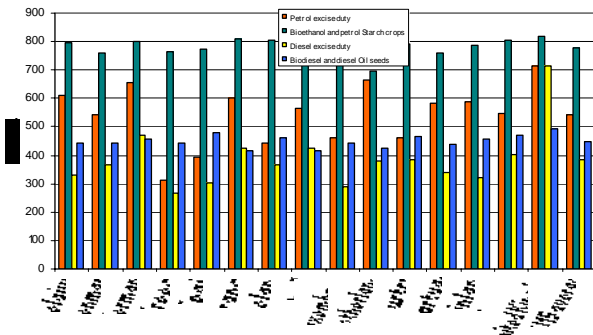
Marginal costs of CO₂ mitigation - subsidy

Biofuel	Biofuel delivery Cost €/1000 litres	Fossil fuel cost price €/1000 litres	Cost difference €/1000 litre	CO ₂ savings t/1000litres	€/CO ₂ saved
RME (EU15 oilseed)	787.6	347.0	440.65	1.7	258.5
Bioethanol (wheat)	806.3	368.4	437.95	2.1	209.1
Bioethanol (beet)	907.9	368.4	539.55	1.7	317.3

Marginal cost of CO₂ emissions reductions - subsidy of price difference



Marginal costs of CO₂ mitigation – excise duty remission



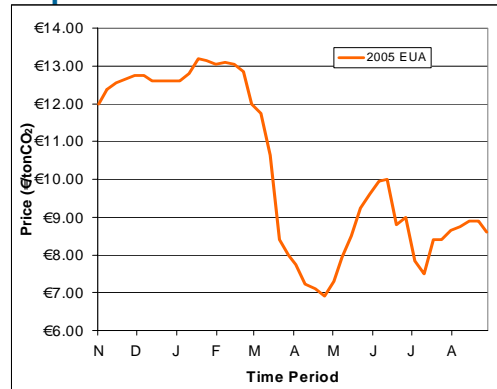
Marginal costs of CO₂ mitigation – excise duty remission

Fuel	€/tCO ₂	Ireland
1. Bioethanol		
Sugar crops	440	358.83
Starch crops	1321	1076.49
Lignocellulosic crops	217	176.47
Lignocellulosic residues	207	169.08
Brazilian sugar cane	187	152.62
2. Biodiesel		
Oil seeds	288	275.06

Marginal costs of CO₂ mitigation – Imports

- Some countries (mainly Brazil to date) produce biofuels at much lower cost than in EU
- Using UK DfT values it is estimated that cost price of bioethanol from Brazil is currently 384€/1000L
- This could be competitive with fossil fuels.

Comparison with other sectors



Other impacts

JRC Report estimates:

- Benefits: security of Supply = 10-130€/toe
- Benefits: employment = increase of 0.1% EU employment – considered to be approximately neutral
- Costs: potential additional costs through replacement of agricultural and setaside land

Other options: biomass for energy?

- Substituting biomass for fossil fuels in electricity production reduces CO₂ emissions by up to twice as much as biofuels used for transport (Börjesson et al 1998).
- The cost of CO₂ reduction for biofuels is estimated as three times higher than for biomass (Wahlund 2004).
- Fuel pellets in heat and power production provide the cheapest solution for CO₂ reduction.
- The EU Biofuel Directive focuses on biofuel promotion which may result in future possible technology lock-ins (Sandén and Azar 2005).

References

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Conclusions

- Policy instruments should be chosen based on economic efficiency and environmental effectiveness – benefits should outweigh costs
 - Remission of excise duty or direct subsidy of price difference costs ~ €288-1321/tCO₂ emissions saved
 - Biomass for electricity and heating is a less expensive way to reduce GHG emissions
 - Imported biofuels could be viable without support
 - 10% target achieved with excise duty remission would imply approximately €18 billion in lost revenues today.
- ➔ **Biofuels are likely not a cost-effective measure to mitigate CO₂ emissions.**