Sustainability and Ecology

The sustainable production of biofuels is an important topic. The European Union has therefore developed sustainability criteria for the production of biofuels. These are to ensure that biofuels achieve a minimum contribution to reducing greenhouse gas emissions. These criteria include an evaluation of the cultivation of biomass, the production of transport fuels and solid fuels as well as applications in combined heat and power plants. Consideration is given to factors such as crop yields, use of fertilisers, transport, energy requirements and the particular fossil fuel which can be replace

Biofuels must be capable of reducing greenhouse gas emissions over the whole of their life cycle by at least 35% (and from 2017, by 60%).

Biofuel producers and traders must be able to prove that the relevant sustainability criteria applicable to the use of biomass are complied with. At present, an international system of certification for biofuels is being developed. Currently, food and feedstuff production is not required to meet these sustainability criteria.

The outlook

In order to achieve further reductions in emissions, the EU has agreed a target of 10% renewable energy use in the transport sector by 2020.

Achievable CO_2 reductions through blending with biofuels:

	Required biofuel amounts	CO_2 saving	Spec. CO_2 saving
5.75 % (indicative target of the EU for 2010	Ethanol 1st gen. : 1.2m tonnes Biodiesel/HVO : 2.6m tonnes	4.87m tonnes	3.85 g/km

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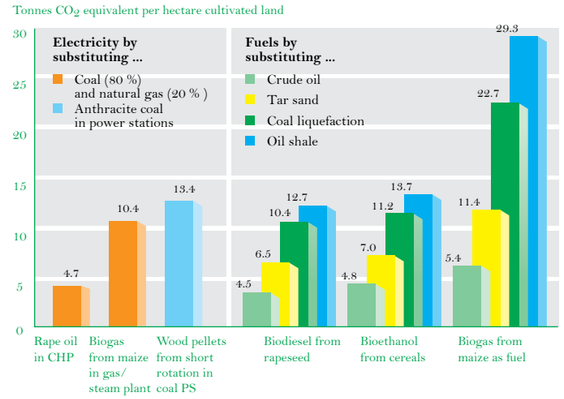
Greenhouse gas emissions avoided through biofuels and electricity from bioenergy



Source: WBGU; own calculations; position: 6/2009

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Intelligent Energy Europe

Biofuels

Biofuels – our fuel for the future

Biofuels make an important contribution to solving the problem of climate change. In addition, they contribute significantly to the security of energy supply in Europe, which is 98% dependent on fossil fuels. Road transport itself is the cause of about one quarter of all CO_2 emissions. On the other hand, the use of biofuels in petrol and diesel engines is almost CO_2 neutral. This means that no more CO_2 is released than was taken up in the biomass from which the fuel is produced.
The resulting CO_2 balances may be different, depending on the type of crop, the cultivation and production processes and the origin of the particular fuels.

The raw materials

Biofuels are liquid or gaseous power fuels produced from organic substances/biomasses. Crop plants which are rich in oil or contain starch or sugar, such as rape, sunflower, soybean, jatropha, cereal and maize, sugar beet and sugar cane are suitable for biofuel production.
In addition, algae and plant materials rich in cellulose such as wood or straw can be used to produce biofuels.

The so-called first generation biofuels include biodiesel, vegetable oil and ethanol. The second generation fuels include methane from biogas (feed-in) and synthetic or Biomass-to-Liquid (BtL) fuels.

Reserves

The currently known mineral oil reserves will only last another 40 to 50 years or so if the present increase in consumption remains constant. Regionally produced biofuels make a contribution to lowering reliance on the import of raw materials, as mineral oil becomes in short supply and more expensive in the mid- to long-term. Should the contribution of biofuels become greater, then the upward trend in conventional fuel prices may even be countered. At present, the production capacities in Europe and America are being expanded.

Fuels

Biofuels are used as either pure fuels or as blended admixtures.

Pure plant oil (PPO), (vegetable oil) can only be used as a fuel in converted diesel engines.
Biodiesel - rapeseed methyl ester (RME/FAME) as a pure fuel (B100) is better suited to the requirements of diesel engines than vegetable oil. Approved heavy goods vehicles and buses may fill up on this without any problems. PPO and FAME are not permitted as sole fuel in all EU countries (e.g. France).
Bioethanol can be used as a pure fuel (so-called E85) in specially-adapted flex-fuel engines.
Biogas is used compressed in natural gas powered vehicles in the form of biomethane. It is a requirement that the biogas is refined to meet natural gas standards. Biogas-powered vehicles are characterised by lower pollution emissions compared to petrol or diesel vehicles. With regard to the yield per hectare of cultivated land, the energy content and range of biogas fuel are particularly favourable.
BtL fuels are synthetic or Biomass-to-Liquid fuels, the so-called 'second generation fuels'. These fuels are still undergoing research and development but can be made from various raw materials such as cellulose or wood. Such designer fuels are tailored to meet the requirements of the engines.

Valuable byproducts and residues

The manufacture of biofuels results in the production of additional valuable byproducts such as glycerine and/or protein feeds which can help to reduce imports of feedstuffs (e.g. soybean).

Rapeseed/biodiesel:	Rape cake used as a protein feed for cattle. Glycerine as a raw material in the chemical and cosmetic industries.
Bioethanol:	Mash (biogas), DDGS as feedstuff for cattle, pigs and poultry
Biogas:	Fermentation wastes as fertiliser (nutrient recirculation)

Blends

Nowadays, we purchase biofuels with every tankful because these are added to comply with regulations on biofuel quotas. Mandatory **blending** requires that there is a defined ratio of biofuel to fossil fuel in the mixture. The amounts of the biofuel admixtures are laid down at European and national levels under the EU Fuel Quality Directive.
Up to 5% bioethanol (so-called E5) may be blended with normal petrol and no marking or labelling is required at the filling station. Because of the lower energy content, 5% bioethanol by volume corresponds to an energetic proportion of 3.25%.
Since 2009 in **Europe**, regulations have permitted the blending of up to 7% biodiesel (so-called B7) in normal diesel and this must be indicated at the pump. This amount of 7% biodiesel in mineral oil diesel corresponds to an energetic proportion of 6.3%.

Energy yield per hectare of cultivated land

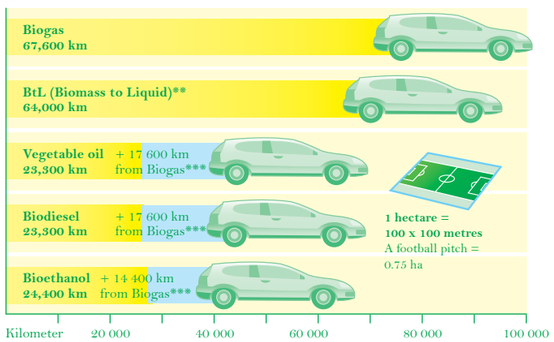
	Yield (l/ha x yr)	Fuel equivalent (l/ha x yr)	GJ (ha x yr)
Rapeseed	1,480	1,420	51
Biodiesel	1,550	1,410	51
Bioethanol from cereal	2,560	1,660	54
from sugar beet	6,240	4,050	132
from sugar cane	6,460	4,200	137
from lignocellulose (e.g. wood)	990	640	21
BtL	4,030	3,910	135
Biomethane	3,560*	4,980**	178

*based on maize,**[kg/ha per year]

Source: FNR Biofuels

Round the world on biofuel

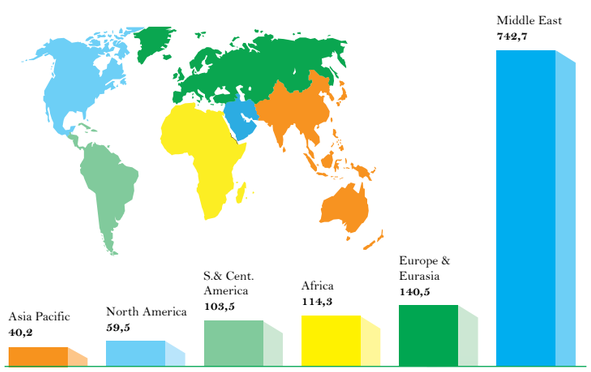
Driving performance of a car* with the yield from one hectare of energy crop



*Consumption: 6.1 l/100km diesel, 7.4 l/100km petrol
**Synthetic biofuel; ***Utilisation of coproducts and byproducts, e.g.straw. Position: 10/2007

Source: FNR e.V.

Proved reserves at end 2005 - Thousand million barrels



Source: www.bp.com; 2005