

Biofuels

Biofuels and transportation
Does it solve all problems?

Biofuels

Biofuels and transportation

Ranking

According Jacobson 2009

RECOMMENDED

Wind-battery-electric vehicles	1
Wind- hydrogen fuel cell vehicles	2
Concentrated Solar Power battery-electric vehicles	3
Geothermal battery-electric vehicles	4
Tidal battery-electric vehicles	5
Photovoltaic battery-electric vehicles	6
Wave battery-electric vehicles	7
Hydrogen battery-electric vehicles	8

NOT RECOMMENDED

Carbon capture and storage battery-electric vehicles	9
Nuclear-battery-electric vehicles	10
Corn-Ethanol 85	11
Cellulosic-Ethanol 85	12

Ranking of major proposed energy-related solutions to global warming, air pollution mortality, and energy security while considering other impacts of the proposed solutions, such as on water supply, land use, wildlife, resource availability, thermal pollution, water chemical pollution, nuclear proliferation, and undernutrition.

[1] Mark Z. Jacobson: Review of solutions to global warming, air pollution, and energy security. Energy Environ. Sci., 2009, 2, 148 - 173, DOI: 10.1039/b809990c <http://www.rsc.org/publishing/journals/EE/article.asp?doi=b809990c>

Biofuels

Ranking

Although hydrogen fuel cells vehicles (HFCVs) are much less efficient than attery-electric vehicles (BEV)s, wind-HFCVs are still very clean and were ranked second among all combinations.

Hydroelectricity is also a load balancer.

Cellulosic- and corn-E85 were ranked lowest overall and with respect to climate, air pollution, land use, wildlife damage, and chemical waste. Cellulosic-E85 ranked lower than corn-E85 overall, primarily due to its potentially larger land footprint based on new data and its higher upstream air pollution emissions than corn-E85. Whereas cellulosic-E85 may cause the greatest average human mortality, nuclear-BEVs cause the greatest upper-limit mortality risk due to the expansion of plutonium separation and uranium enrichment in nuclear energy facilities worldwide.

The largest consumer of water is corn-E85. Due to its similar cancer risk but enhanced ozone health risk in the base emission case, a future fleet of E85 may cause a greater health risk than gasoline. E85 increased particle mass and number relative to E5. It increased emission of ethanol, acetaldehyde and formaldehyde in aerosol and fog water.

The use of wind, CSP, geothermal, tidal, PV, wave, and hydro to provide electricity for BEVs and HFCVs and, by extension, electricity for the residential, industrial, and commercial sectors, will result in the most benefit among the options considered.

[1] Mark Z. Jacobson: Review of solutions to global warming, air pollution, and energy security. Energy Environ. Sci., 2009, 2, 148 - 173, DOI: 10.1039/b809990c
<http://www.rsc.org/publishing/journals/EE/article.asp?doi=b80999>

Biofuels

Biofuel

Biofuels

Algae fuel • Bagasse • Babassu oil • Jatropha • Biobutanol • Biodiesel • Biogas • Biogasoline • Cellulosic ethanol • Ethanol fuel • Stover • Straw • Vegetable oil

Energy from Foodstock

Hemp • Maize • Corn stover • Rapeseed • Sorghum bicolor • Soybean • Sugarcane • Sunflower

Non-food Energy Crops

Arundo • Big bluestem • Chinese tallow • Duckweed • Jatropha curcas • Miscanthus giganteus • Switchgrass • Pongamia pinnata • Wood fuel

Technology

Bioconversion • Biomass heating systems • Biorefinery • Fischer-Tropsch process • Industrial biotechnology • Pellet mill • Pellet stove • Thermal depolymerization

Concepts

Cellulosic ethanol commercialization • Energy content of biofuel • Energy crop • Energy forestry • EROEI • Food vs. fuel • Sustainable biofuel

Biofuels

Biofuel

Primary energy sources

Possible candidates for primary energy sources include terrestrial solar and wind energy, solar power satellites, biomass, nuclear fission, nuclear fusion, fission-fusion hybrids, and fossil fuels from which carbon has been sequestered.

Non primary power sources

Non-primary power technologies that could contribute to climate stabilization include efficiency improvements, hydrogen production, storage and transport, superconducting global electric grids, and geoengineering.

All of these approaches currently have severe deficiencies that limit their ability to stabilize global climate. New technological options that can allow both climate stabilization and economic development are needed.

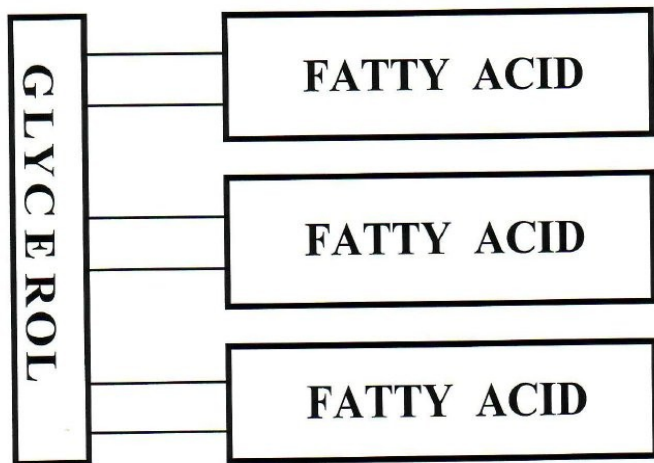
Advanced Technology Paths to Global Climate Stability: Energy for a Greenhouse Planet Science 1 November 2002: 981 981-987.

<http://www.sciencemag.org/cgi/content/abstract/298/5595/981>

Biofuels

Biodiesel

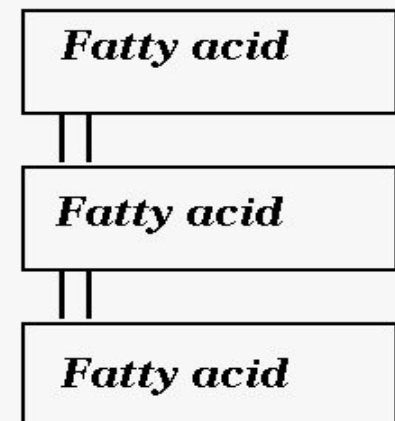
Some people use the two terms, "soy-diesel" and "bio-diesel," interchangeably. In certain regions of the United States, soy-diesel refers to crude soybean oil that is filtered and maybe clarified. But in other regions, both terms refer to biodiesel fuel that has been properly processed (or transesterified) from soybean oil. There are major differences between the two terms and failing to recognize the differences may spell disaster for your diesel engines running on soy-diesel that is unprocessed soybean oil.



*Glycerol not suitable as fuel
DISCARDED*



Esterified oil suitable as Bio-Diesel



Biofuels

23.10.2009: **Biofuel may increase greenhouse gases as a result of a flaw of the climate accounting** [1]

Searchinger and colleagues 2009 stress that the climate accounting treats all bioenergy as carbon neutral. This flaw was also included climate regulations 2003/87 of the EU [2] and the The American Clean Energy and Security Act of 2009 [3]. The authors point to the fact that these regulations count biofuel as 100% reduction, and do not count CO₂ emitted from tailpipes and smokestacks when bioenergy is being used, and also does not consider the CO₂ emission from land use, burning of wood and energy crops.

The authors say that counting bioenergy from any biomass as carbon neutral, so as handled by the climate accounting, large-scale land conversion for bioenergy is favoured regardless of the actual net emissions. This will lead to further increase of greenhouse gases. The area covered by fuel crops will be higher than the area used for food crops by the end of this century, say the authors. Increase of biofuel crop can only take place by deforestation, with the loss of trees which are important carbon sinks. On the other fuel crops may use the area of food crops, increasing the use of fertiliser ammonium nitrate which decomposes in the soil releasing nitrous oxide N₂O which is a stronger greenhouse gas as CO₂. To avoid such undesirable development, the authors suggest global rules to protect forests and to avoid overfertilisation. Should this not be introduced all over the globe the climate will breakdown, say the authors.

Biofuel will cause food and water scarcity [4]

Bio fuel, such as ethanol and biodiesel compete with food crops resulting in rising prices of food staples. Robert Service points to an additional problem of biofuel crops which may pinch water supplies and worsen water pollution. The already serious shortage of water will even be worsened by a wide shift from crude oil to biofuel.

[1] Searchinger, Timothy D. et al: Climate Change: Fixing a Critical Climate Accounting Error. Science 23 October 2009: Vol. 326. no. 5952, pp. 527-528. Doi: 10.1126/science.1178797
<http://www.sciencemag.org/cgi/content/summary/326/5952/527>

[2] European Commission, Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003, Official Journal of the European Union L 275, 25.10.2003
<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:275:0032:0046:EN:PDF>

[3] The American Clean Energy and Security Act of 2009, H.R. 2454, 111th Cong., 1st Sess. (as passed by U.S. House of Representatives July 2009).
http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=111_cong_bills&docid=f:h2454pcs.txt.pdf

[4] Service, Robert F.: Green Energy: Another Biofuels Drawback: The Demand for Irrigation. Science 23 October 2009: Vol. 326. no. 5952, pp. 516 – 517. Doi: 10.1126/science.326_516
<http://www.sciencemag.org/cgi/content/summary/sci;326/5952/516>

Biofuels

Total energy consumption in China and Europe

- Primary energy consumption in China rose from 1990 to 2005 around 127%. Most important primary energy carrier is coal (70%), followed by oil (20%). The comparison to OECD Europe shows large differences concerning the most important sources of energy (less coal, higher portion of oil, gas and nuclear power).
- Primary energy consumption per capita doubled 1990-2005 in China. The rise in OECD Europe was only 5%, in Germany there was a decrease around 10%. Nevertheless, energy consumption per capita is still much smaller in China than in Europe.

[http://www.ifeu.org/verkehrundumwelt/pdf/IFEU_et_al\(2008\)_Transport_in_China_GB.pdf](http://www.ifeu.org/verkehrundumwelt/pdf/IFEU_et_al(2008)_Transport_in_China_GB.pdf)

Biofuels

The estimated final energy consumption for the transport sector is about 1/3 higher than the official statistical values

- From 1990 to 2005, final energy consumption of the transport sector in China rose by factor 3.5.

Main energy carriers of the transport sector in China are gasoline (33%), diesel (52%), fuel oil (8.7%), kerosene (5.6%) and electricity (1.1%).

- In China the transport sector consumed 17% of the total final energy in 2003. This is still a lower share than in Europe (27%) or Germany (24%).

Biofuels

Railways

Typical long distance passenger trains in China have 18 wagons. The average weight per wagon is 48 tons. The capacity per wagon is about 100 seats [ICT 2007]. Therefore the average weight per seat is less than 0.5 tons, which is below an average long distance train in Germany (e.g. IC about 0.8 tons/seat, ICE more than 1 ton/seat). The average load factor is about 70%.

The high speed passenger train is a motor unit with 8 wagons and 610 seats. The total weight is 400 tons. The average load factor is about 70%. The maximum speed on the new lines is 200 km/h. Two units can be connected to a long train.

For the estimation of the specific energy consumption, the Chinese high speed train can be compared with a German ICE 3 (8 wagons; total weight 409 t; 456 seats). With a similar total weight the Chinese train has a seat capacity which is 35% higher than the German ICE.

The specific energy consumption per seat-km is estimated based on European trains. In Germany, the energy consumption of IC and ICE trains with a maximum speed of 200 km/h is about 30 Wh per gross ton km [IFEU 2006]. Similar values can be found at other European railways [IFEU 2008]. In this study we use the same value as best estimate for Chinese trains.

For 2020 for all trains in China a reduction of specific energy consumption of 12% is estimated compared to 2005 [ICT 2007].

	Final Energy Cons.	Capacity	PE	CO ₂	Source
	kWh/km	Persons	MJ/Pkm	g/Pkm	
Long Distance Train, Germany	24.2	700.0	0.38	21.8	IFEU 2006
Highspeed Train, Germany	11.5	410.0	0.31	17.7	IFEU 2006
Long Distance Train China	30.0	1800.0	0.19	15.0	ICT 2007, IFEU Estimation
Highspeed Train China	11.4	610.0	0.21	16.9	ICT 2007, IFEU Estimation
PE: Specific primary energy consumption with full capacity utilization					
CO ₂ : specific CO ₂ Emissions with full capacity utilization					

Biofuels

Benzene and carbon monoxide [1]

Limit value for benzene and carbon monoxide should reach 0 % by 1 January 2010.

[1] Directive 2000/69/EC relating to limit values for benzene and carbon monoxide in ambient air.
<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:313:0012:0021:EN:PDF>

Biofuels

More tight emission limits and higher requirements on fuel quality have led to a decrease in traffic emissions in urban areas in Germany despite an increase in vehicle mileage. This decrease also shows up in the development of urban air quality in respect to benzene and carbon monoxide (CO) at highly exposed streets. Measured values for these pollutants already comply with future EU air quality standards. For nitrogen dioxide (NO₂) and particulate matter (PM₁₀), however, no such decrease can be observed. Today's air quality limits for PM₁₀ as well as future air quality limits for NO₂ will therefore be exceeded at many sites. For nitrogen oxides, the development of the calculated emissions is identical with the sum of all measured nitrogen oxide concentrations. While the concentrations of nitrogen monoxide decreased very strongly, NO₂ values remained almost unchanged. For the pollutant concentration, however, besides the NO_x emissions also the interaction with ozone and the amount of direct NO₂ traffic emissions is of importance. These complex interdependencies can lead to an increase in NO₂ concentrations despite a decrease in NO_x emissions.

The contribution of traffic emissions to a PM₁₀ concentration varies much depending on the local and regional environment. Furthermore, the meteorological conditions have a considerable influence. Besides direct exhaust emissions also emissions from traffic abrasion and resuspension as well as secondary particles contribute to PM₁₀ concentrations. Secondary particles are formed from nitrogen oxides, sulphur dioxide and ammoniac.

These complex interactions have to be considered for an effective reduction of NO₂ and PM₁₀ concentrations. The identification of appropriate measures and modelling of respective effects therefore requires broad background knowledge as well as an elaborate methodology.

Biofuels

Limit values for sulphur dioxide

Limit values must be expressed in $\mu\text{g}/\text{m}^3$. The volume must be standardised at a temperature of 293 °K and a pressure of 101,3 kPa.

	Averaging period	Limit value
1. Hourly limit value for the protection of human health	1 hour	325 microg/m ³ , not to be exceeded more than 24 times a year.
2. Daily limit value for the protection of human health	24 hours	125 microg/m ³ , not to be exceeded more than 3 times a year.
3. Annual limit value for the protection of vegetation	1 year	20 microg/m ³ NO _x

Upper and lower assessment thresholds

Sulphur dioxide

	Averaging period	Limit value
Upper assessment threshold	60% of 24-hour limit value (75 microg/m ³ , not to be exceeded more than 3 times in any calendar year)	60% of winter limit value (12 microg/m ³)
Lower assessment threshold	40% of 24-hour limit value (50 microg/m ³ , not to be exceeded more than 3 times in a year.	40% of winter limit value (8 microg/m ³)

Limit values for nitrogen dioxide and oxides of nitrogen

	Averaging period	Limit value
1. Hourly limit value for the protection of human health	1 hour	200 microg/m ³ NO ₂ , not to be exceeded more than 18 times a year.
2. Annual limit value for the protection of human health	1 year	40 micro g/m ³ NO ₂ ,
3. Annual limit value for the protection of vegetation	1 year	30 microg/m ³ NO _x

Upper and lower assessment thresholds

Nitrogen dioxide and oxides of nitrogen

	Hourly limit value for the protection of human health (NO ₂)	Annual limit value for the protection of human health (NO ₂)	Annual limit value for the protection of Vegetation(NO _x)
Upper assessment threshold	70% of limit value (140 microg/m ³ , not to be exceeded more than 18 times in any year)	80% of limit value (32 microg/m ³)	80% of limit value (24 microg/m ³)
Lower assessment threshold	50% of limit value (100 microg/m ³ , not to be exceeded more than 18 times in any year.	65% of limit value (26 microg/m ³).	65% of limit value (19,5 microg/m ³).

Biofuels

Council Directive 1999/30/EC [1]

Limit values for particulate matters [PM10]

	Averaging period	Limit value
24 hour limit value for the protection of human health	24 hours	50 µg/m ³ PM10, not to be exceeded more than 7 times a year.
Annual limit value for the protection of human health	1 year	20 µg/m ³ PM10

Particulate Matters

Upper and lower assessment thresholds for PM10

	24-hour average	Annual average
Upper assessment threshold	60% of limit value (30 microg/m ³ , not to be exceeded more than 7 times in any year)	70% of limit value (14 microg/m ³)
Upper assessment threshold	40% of limit value (20 microg/m ³ , not to be exceeded more than 7 times in any year)	50% of limit value (10 microg/m ³)

Limit values for lead

	Averaging period	Limit value
Annual limit value for the protection of human health	1 year	0,5 µg/m ³ .

The upper and lower assessment thresholds for

	Averaging period
Upper assessment threshold	70% of limit value (0,35 microg/m ³)
Lower assessment threshold	50% of limit value (0,25 microg/m ³)

[1] Council Directive 1999/30/EC
<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1999:163:0041:0060:EN:PDF>

Biofuels

Bioalcohol

Brazil is the world's second largest producer of ethanol fuel and the world's largest exporter. Together, Brazil and the United States lead the industrial production of ethanol fuel, accounting together for 89% of the world's production in 2008. In 2008 Brazil produced 24.5 billion litres (6.47 billion U.S. liquid gallons), which represents 37.3% of the world's total ethanol used as fuel.

E20-E25 and E100

The Brazilian car manufacturing industry developed flexible-fuel vehicles that can run on any proportion of gasoline (E20-E25 blend) and hydrous ethanol (E100). Introduced in the market in 2003, flex vehicles became a commercial success, reaching a record 94% share of all new cars sales in August 2009. As of July 2009, the fleet of flex-fuel cars and light commercial vehicles had reached 8,25 million vehicles, representing 23.4% of Brazil's registered light motor vehicle fleet. The success of "flex" vehicles, together with the mandatory E25 blend throughout the country, have allowed ethanol fuel consumption in the country to achieve a 50% market share of the gasoline-powered fleet by February 2008. Considering diesel-powered vehicles, sugarcane ethanol represented 16.7% of the country's total energy consumption by the automotive sector in 2007.

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Hydrated alcohol and anhydrous alcohol

Hydrated alcohol: It has 7% of water and 93% ethyl alcohol.

Anhydrous alcohol: It has a maximum of 0.7% water and is used to blend with gasoline.

Sucrose extracted from sugarcane accounts for little more than 30% of the chemical energy stored in the mature plant; 35% is in the leaves and stem tips, which are left in the fields during harvest, and 35% are in the fibrous material (bagasse) left over from pressing.

Most of the industrial processing of sugarcane in Brazil is done through a very integrated production chain, allowing sugar production, industrial ethanol processing, and electricity generation from byproducts.

The typical steps for large scale production of sugar and ethanol include milling, electricity generation, fermentation, distillation of ethanol, and dehydration.

Biofuels

Sugar cane industry impact on water quality of Brazilian rivers

The Ipojuca river, a river in Northeast Brazil extending from west to east, is situated in the semiarid interior and rainy coastal zone of Pernambuco state.

The dominant impacts on water quality of the river are domestic sewage input in the upper catchment and sugar cane cultivation and processing in the lower catchment. The river's self-purification capacity has severely changed to the worse in the lower course. One reason is the use of stillage (wastewater from cane processing) for fertilization and irrigation (fertigation). The river's main ecological problems are water heating, acidification, increased turbidity, oxygen imbalance, and increased coliform bacteria levels.

To determine the impact of the sugar cane industry on the river, the Brazilian bio-alcohol program must be subject to a critical evaluation. Environmentally friendly sugar cane cultivation methods need to be developed, and sugar cane factories must use waste-reducing technologies and water cycling processes in order to protect the region's water resources.

Biofuels



Biofuels

Sugarcane bagasse in Brazil

One Hectare of sugarcane in Brazil produces 80 tons of raw product/year. It equals 6,400 litres of ethanol and 11.2 Tons of bagasse. Which may be converted to 2,600 litres ethanol using enzymes from fungus *Penicillium echinulatum*, found in insects which feed from wood.

Biofuels

Biobutanol

Butanol is presently manufactured from petroleum. Historically (early 1900s – 1950s) biobutanol was manufactured from corn and molasses in a fermentation process that also produced acetone and ethanol and was known as an ABE (acetone, butanol, ethanol) fermentation. However, as demand for butanol increased, production by fermentation declined mainly because the price of petroleum dropped below that of sugar when the USA lost its low-cost supply from Cuba around 1954. BFL has developed and patented a process which makes fermentation derived butanol more economically viable and competitive with current petrochemical processes.

Butanol is used primarily as an industrial solvent.

Butanol is also a replacement for gasoline as a fuel, to an even greater degree than ethanol, due to more favorable physical properties, economics, safety and the fact that it works without having to modify the engine of your personal car.

Biofuels

Switchgrass and similar plants have the potential to produce more energy than equivalent amounts of crops like corn that have been bred for food. Additionally, high-cellulose plants don't need fertilization and, because they are inedible, their use wouldn't affect food supplies.

These fuel plant crops also don't need much water and, conceivably, could be grown on land too dry for food crops. Like corn ethanol or soybean diesel, fuel made from these plants would result in lower tailpipe emissions than standard car gas. Synthetically produced fuels could also displace regular gas over time, the report stated.

Contrary to other recent studies, the report also found that both corn ethanol and soybean biodiesel supply more energy than is consumed in producing them. Corn ethanol delivers 25 percent more energy, while soybean diesel gives off 93 percent more energy than is required to harvest the crop and process the plants.

Biofuels

Butanol properties

- Higher energy content (110,000 Btu's per gallon for butanol vs. 84,000 Btu per gallon for ethanol). Gasoline contains about 115,000 Btu's per gallon.
- Butanol is six times less “evaporative” than ethanol and 13.5 times less evaporative than gasoline, thereby eliminating the need for very special blends during the summer and winter months.
- Butanol can be shipped through existing fuel pipelines where ethanol must be transported via rail, barge or truck
- Butanol can be used as a replacement for gasoline gallon for gallon e.g. 100%, or any other percentage.

Biofuels

30 bis 40 million hectare of the total area of 170 Millionen hectare of the country were made desolate. Visionaries hope to recultivate it with Jatropha.

72 % of Indias population lives in the countryside and 58% earns it s living from agriculture.

70% of the growing demand of crude oil must be imported.

60 million roadsters are running on its roads.

1.2 billion inhabitant.

India will introduce stringent environmental rules.

Klaus Becker claims that 11 million hectares of Jatropha may supply oil to replace 20 % of imported Diesel oil. The pilot project has planted 5 hectare at the arid Chorvadla region. A new plantation arises in Orissa/East India where more rain falls. It will be supervised by the Central Salt & Marine Chemicals Research Institute.

NZ Aviation and Boeing aviation biofuel [2]

In the race to develop a viable aviation [biofuel](#), Air New Zealand and Boeing are banking on the jatropha plant to deliver the cost-effective, green alternative they need.

The soaring cost of world oil, pushing up jetfuel costs around 70 per cent in the last year alone, and an increasing focus on the greenhouse gas emissions from air travel have the industry under intense pressure to find a cheaper, more environmentally-friendly alternative.

Air New Zealand and Boeing are planning a three-hour test flight in the next few months, running one of four jumbo-jet engines on fuel from jatropha oil produced at a research facility in Hawaii, the LA Times reports. The airline has announced a goal to supply 10 per cent of its aviation fuel needs from biofuels by 2013.

Early estimates suggest that jatropha oil could be produced for as little as \$43 a barrel, compared to more than \$120 a barrel for crude oil currently

Biofuels

Jatropha, the biofuel plant [1]

Vallabha Bhai in their small town Chorvadla in Gujarat/India plants Jatropha which produces oily nuts. Bhai hopes that the Jatropha plant regenerates the soil which, later on, could permit the cultivation of millet, gossypium, or vegetables.

Klaus Becker, Professor at der University of Hohenheim/Germany, together with Pushpito Ghosh, Director of the Central Salt & Marine Chemicals Research Institute“ (CSMCRI), in Bhavnagar introduce resistant varieties jatropha from Mali and Mexico. The German carmaker Daimler sponsors the project with 750.000 Euro. Daimler tries to increase its production in India.

The Jatropha adds to the cocoa fibre project in Brazil and the Abaca fibre project at the Philippines, all integrated in a sustainable chain. Jatropha was integrated as a project of sustainability of Daimler, which also embraces cocos fibre at the Amazon delta in Brazil, an aids-project in South Africa or the plantation of Abaca fibre at the Phillipines.

<http://blogs.ft.com/energy-source/2009/06/23/bps-jatropha-interest-continues-to-wane/>

Biofuels

BP bails out of BioDiesel [1]

BP looks to be moving further away from its involvement in the biodiesel crop jatropha. Its joint venture into jatropha planting with D1 Oils, a UK company which has interests in a quarter of the world's jatropha crops, because of an insufficient level of interest from potential investors.

BP meanwhile is cutting back its investments in other key solar projects, and its total spending on renewables will fall from \$1.4bn last year to \$500m - \$1bn this year.

A recent Dutch study found it required more water than other biofuel crops, and there have long been concerns about its suitability for cultivation - ironically, one of the plant's strengths was its ability to grow in marginal lands.

The first half of 2009 has not been a difficult time to raise money for anything. And if nothing else, its existing crops, which take five years to mature, will be much closure to yielding income by late next year. [2]

But what about waning support for biofuels in general? Amid concerns about the sustainability of biofuels, Germany last week decided to cut its biodiesel targets. Small says support is still strong in the UK and Europe, and that in any case the company is exposed to a variety of markets, including countries where its crops grow in the developing world, which spreads the political risk.

20,00 litres water to produce 1 litre jatropha bioDiesel

A new Dutch study shows it uses 20,000 litres of water to produce one litre of jatropha biodiesel - more than the other crops used for biodiesel, rapeseed and soybean; and a lot more than ethanol crops such as maize (corn).

And cellulosic ethanol might be getting the jump on it.[3]

[1]Operation Brechnuss Biodiesel. Sueddeutsche Zeitung 08.10.2004
<http://www.sueddeutsche.de/wirtschaft/63/346900/text/>

[2] Air NZ sees biofuel salvation in jatropha. Carbonpositive. June 6, 2008.
<http://www.carbonpositive.net/viewarticle.aspx?articleID=1114>

[3] BP's jatropha interest continues to wane. June 23, 2009.
<http://blogs.ft.com/energy-source/2009/06/23/bps-jatropha-interest-continues-to-wane/>

Biofuels

Third generation of biofuels [1]

Cyano Biofuels emerged from the Biology-Institute of the Humboldt-University/Berlin. It is backed by the US-corporation Algenol Biofuels. According to Heike Enke Cyano Biofuels utilises enhanced cyanobacteria which are more effective in utilising sun energy as terrestrial plants. These phototrophic organisms metabolize sun light, CO₂ and water into ethanol.

A positive effect of the technology is the high demand of CO₂. In production scale, this technology can considerably participate in reducing green house gases. Cyano Biofuels modified genetically the bacteria in a way that they produce alcohol instead carbohydrates which must be fermented to alcohol, the way of the sugar cane in Brazil.

The company bought 40 000 hectares in a desert area of Mexico for the installation of sunlight transparent bioreactors which will start their production in 10 years. A yield of 220 million gallons (5.6 million barrels) alcohol are expected per year.

[1] Berlin Online November 20, 2009.

<http://www.berlinonline.de/berliner-zeitung/archiv/.bin/dump.fcgi/2009/1120/mutmacherjetztundhier/0443/index.html>

Biofuels

US activities

The US Navy invested \$ 8.5 million in a research company developing fuel from algae. US-Biotechnology-Company Solarzyme is active in this field.

Cyanobacteria are oxygenic photosynthetic gram negative bacteria formerly known as blue green algae, as they were long thought to belong to the plant kingdom. A feature shared by cyanobacteria and plants is their ability to perform photosynthesis. According to the endosymbiont theory cyanobacteria are in fact the origin of chloroplasts, the organelles which harbour the plant's photosynthetic machinery.

Cyanobacteria are a new, mostly idle source of natural material which features the synthesis of diverse bioactive substances, hence being of great pharmaceutical interest.

Biofuels

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Cyanobacteria are a new, mostly idle source of natural material which features the synthesis of diverse bioactive substances, hence being of great pharmaceutical interest.

Cyanobacteria occur frequently in freshwater and show an impressive diversity in the production of small bioactive peptides, i.e. the microcystins and related molecules. Many of these compounds are produced by thiotemplate mechanism underlying the non-ribosomal peptide synthesis pathway.

The understanding of the (micro) evolution of the genes involved in the synthesis of bioactive metabolites is also relevant to solve problems with water resources deteriorated by toxic cyanobacteria. Rainer Kurmayer is working on this subject.

Most of the research and development is being done by a group around Prof. Dr. Thomas Börner (Dept. of Genetics) of the Humboldt-University/Berlin.

Biofuels

Abengoa Bioenergy

The Global Ethanol Company [1]

Abengoa is a technology company, with presence in over 70 countries worldwide; applying innovative solutions for sustainability in the infrastructure, environment, and energy sectors.

Abengoa's portfolio of products includes solar energy and bioethanol production, hydrogen technologies, construction of renewable energy facilities, water desalination, recycling of industrial waste, and IT consulting and system development.

Bioethanol not only drastically reduces greenhouse gas emissions, but its production provides employment in rural areas, allows countries to gain greater independence from oil, increases energy diversification, and ensures the fuel supply.

A blend of 85% bioethanol (E85) enables a 45% to 70% reduction in greenhouse gases for each kilometer driven (*).

[1] http://www.abengoabioenergy.com/bioethanol/pdf/abengoa_en.pdf

(*)Sources: [1] Edwards, R., J.-C. Griesemann, J.-F. Lariv and V. Mahieu. Well-to-Wheels analysis of future automotive fuels and powertrains in the European context, EUCAR, CONCAWE, JRC. 2006.

[2] Lech n, Y., et al.: An lisis del ciclo de vida de combustibles alternativos para el transporte. Fase I. An lisis de Ciclo de Vida comparativo del etanol de cereales y de la gasolina. Energ a y cambio clim tico . Ciemat. 2003.

[3] Wang, Michael Fuel-Cycle Assessment of Selected Bioethanol Production Pathways in the United States (November 2006) argonne National Laboratory. (The document can be found at the following link:<http://www.transportation.anl.gov/pdfs/TA/377.pdf>).

[4] Liska et al, Improvements in life Cycle Energy Efficiency and Greenhouse Gas Emissions of Corn Ethanol , journal of industrial Ecology, January, 2009.

Biofuels

According to ABENGOA: Bioethanol is currently the only real alternative for eliminating our addiction to oil. It improves energy independence and diversification, reduces greenhouse gas emissions, and guarantees fuel supply (*).

The production of bioethanol contributes to the growth of local economies and to the global redistribution of income, creating jobs in rural areas and allowing farmers to raise their incomes. Also, there is enough land in the world to produce cereal-based bioethanol in a sustainable way for years to come.

In the near future, second-generation ethanol from biomass will significantly exceed the production of cereal-based bioethanol (*).

(*) Sources: [1] Commission of the European Communities, An EU Strategy for Biofuels-Impact Assessment, Communication from the Commission . 2006.

[2] Merrill Lynch, Francisco Blanch Biofuels driving global oil supply growth , June 2008.

(*) Sources: [1] International Energy Agency, Benefits of Bioenergy . IEA Bioenergy: ExCo: 2005.

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[4] European Commission, Directorate-General for Agriculture and Rural Development. The impact of a minimum 10% obligation for biofuel use in the EU-27 in 2020 on agricultural markets . 2007.

[5] On economic impacts: Urbanchuk, John, LECG, LLC.2008 Contributions of the Ethanol Industry to the Economy of the United States. February 23, 2009. (see the document at the following

link: http://www.etahanolrfa.org/objects/2187/2008_ethanol_economic_contribution.pdf)

[6] On availability of land: J.E. Campbell et al. The Global Potencial of Bio Bioenergy on Abandoned Agriculture Lands . Environ. Sci. Technol. 42 (15). 5791-5794, 2008).

Biofuels

According to ABENGOA: Bioethanol is cheaper than gasoline, thus saving consumers expenses at the pump (*).

A blend of 85% bioethanol (E85) enables a 45% to 70% reduction in greenhouse gases for each kilometer driven (**).

(*) Sources: [1] www.icispricing.com and www.platts.com as of June 4th, 2008, resulting price of bioethanol exclusive of any tax relief cheaper than gasoline.

[2] <http://www.cmegroup.com> as of December 12, 2009, resulting price of bioethanol exclusive of any tax relief cheaper than gasoline.

(**) Sources: [1] Edwards, R., J.-C. Griesemann, J.-F. Lariv and V. Mahieu. Well-to-Wheels analysis of future automotive fuels and powertrains in the European context , EUCAR, CONCAWE, JRC. 2006.

[2] Lech n, Y., et al.: An lisis del ciclo de vida de combustibles alternativos para el transporte. Fase I. An lisis de Ciclo de Vida comparativo del etanol de cereales y de la gasolina. Energ a y cambio clim tico . Ciemat. 2003.

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(The document can be found at the following link: <http://www.transportation.anl.gov/pdfs/TA/377.pdf>)

[4] Lista et al. Improvements in life Cycle Energy Efficiency and Greenhouse Gas Emissions of Corn Ethanol , journal of industrial Ecology, January, 2009.

Biofuels

U.S. Armed Forces goes “green”

The Green Strike Group

Army has pursued “zero footprint” base camps, and the Air Force is looking into a variety of alternative propellants that could be turned into jet fuel. Now the Navy is going green, signing a memorandum of understanding with the USDA to demo a **Green Strike Group** of biofuel- and nuclear-powered vessels by 2012.

By 2020, the Department of the Navy also plans to halve the fossil fuel consumption entirely, across the entire force. That means ships, aircraft, tanks, shore vehicles and naval bases will all be switching to a half alternative fuel diet

<http://www.popsoci.com/technology/article/2010-01/navy-pledges-green-strike-group-2012-cut-fossil-fuel-use-half-2020>

The End