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Development of Technologies and Innovations

Biofuels Conference, Berlin, May 17th

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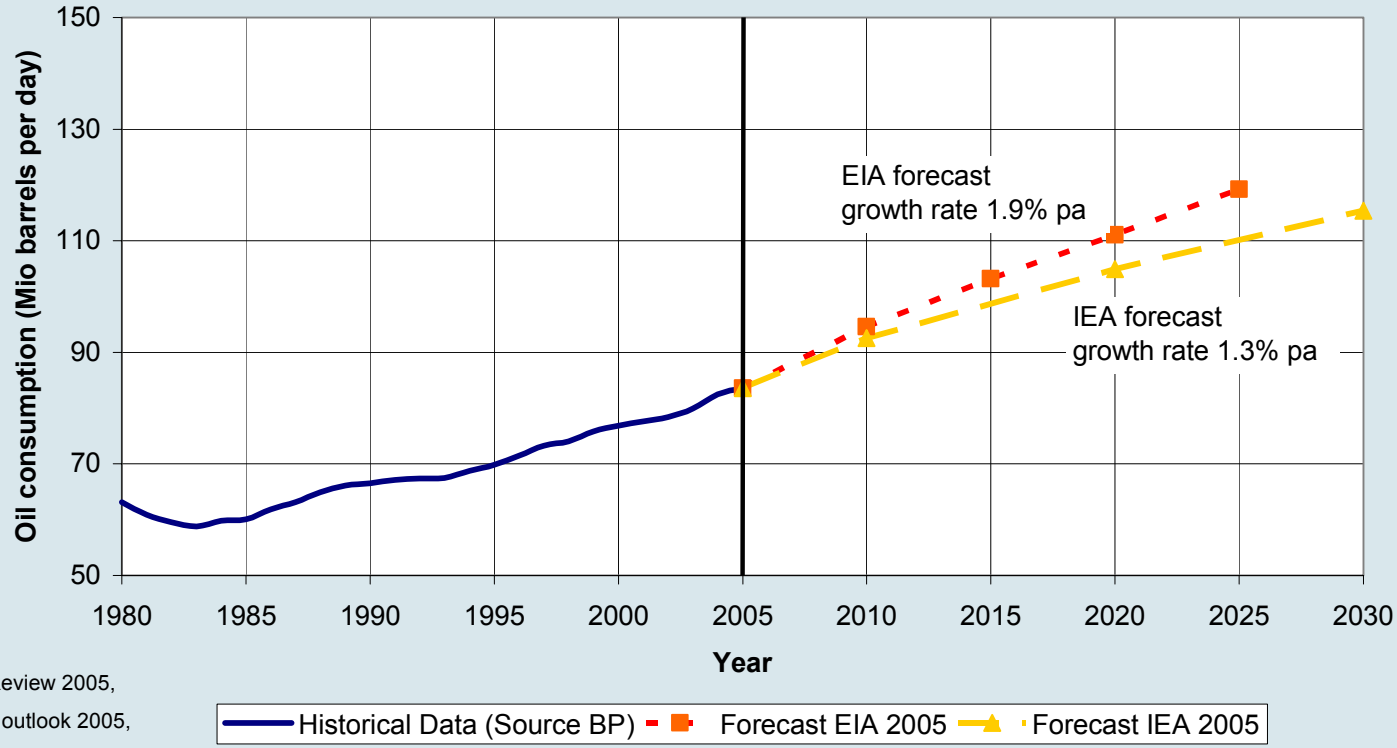
Content

- Motivation for Biofuels
- Overview Near Term Biofuel Options
- DC Position regarding Biofuels
- DC Biofuel Activities
- Conclusions

Growth of World Oil Demand Continues

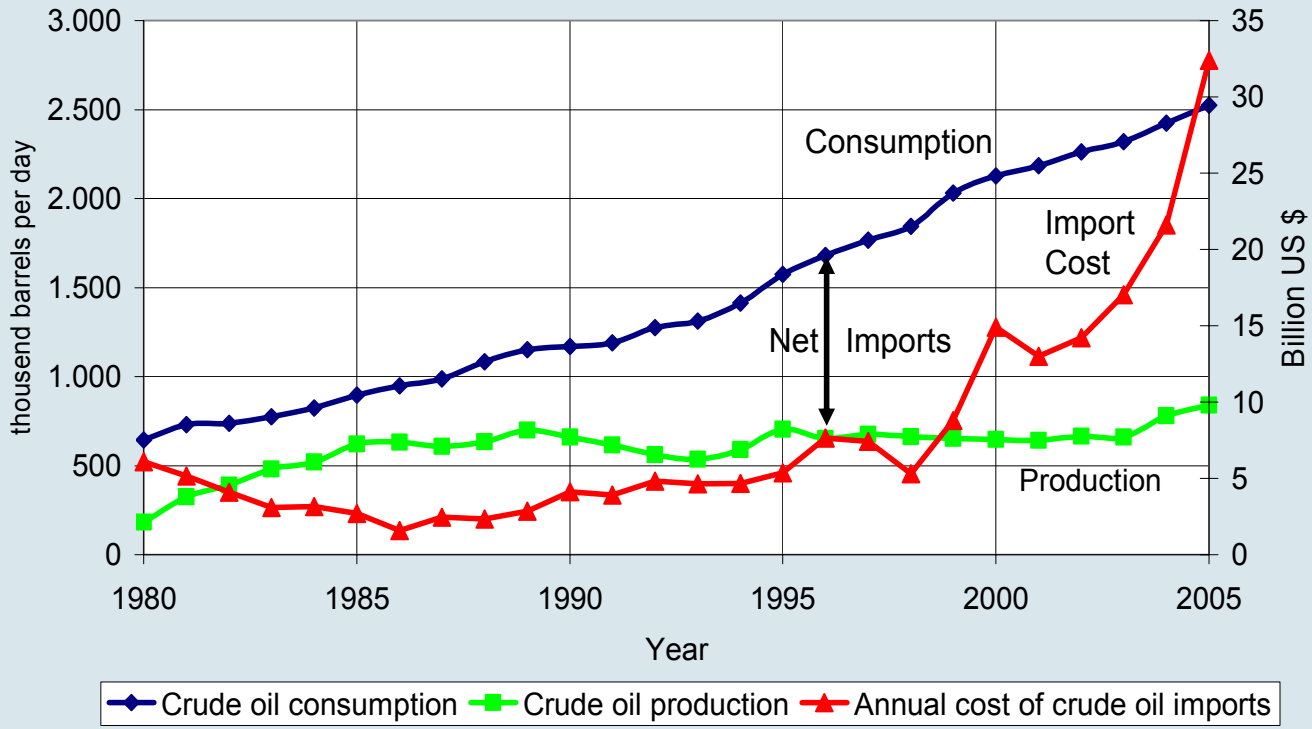
Oil consumption is expected to grow by 40% to 50% in the next 25 years in the "business as usual" scenarios.



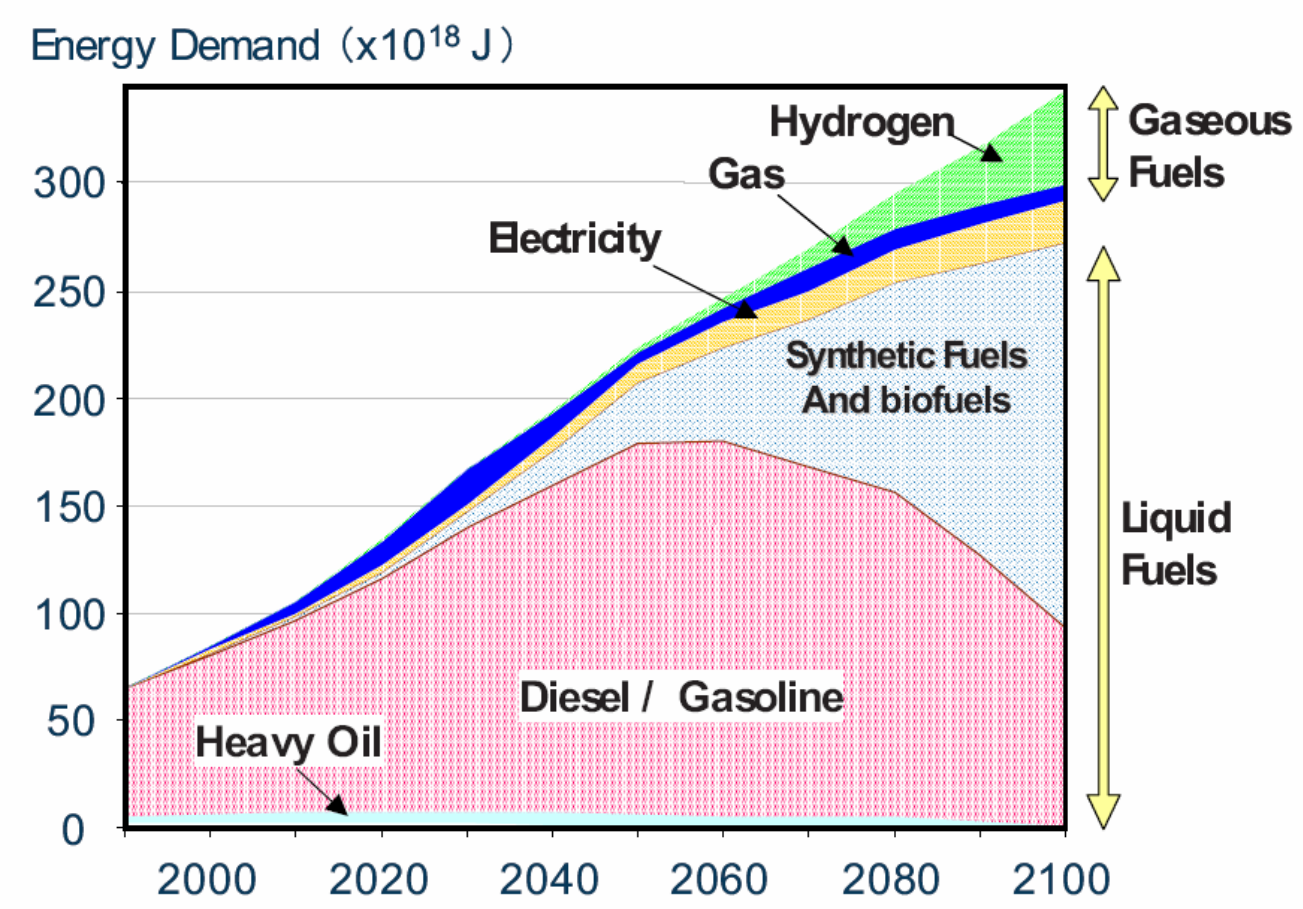
Sources: BP Statistical Review 2005,
EIA International Energy outlook 2005,
IEA World energy outlook 2005

Dependence of Oil Imports: Example India

The gap between India's oil consumption and the indigenous oil production capacities widens from year to year.



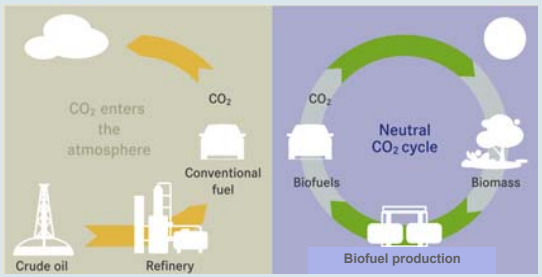
Future Energy Demand



Source: Shell

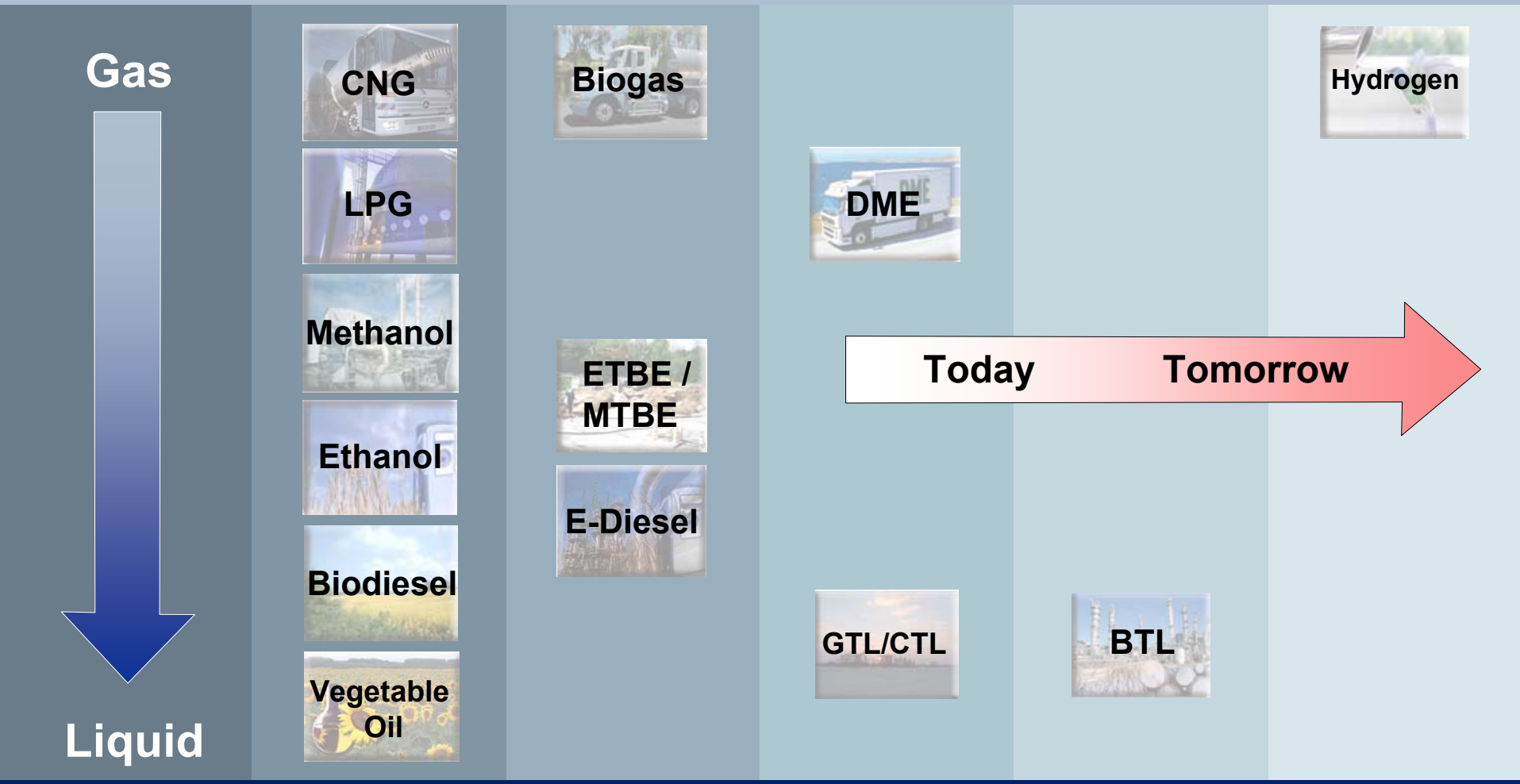
Motivation for the Usage of Biofuels

Biofuels have many advantages



- Reduction of GHG-emissions
- Support for domestic agriculture
- Reduced dependence from oil imports
- Employment effects
- Emission reduction

Alternative Fuel Options



Top 5 Assessment Criteria for Alternative Fuels

Energy Security	Is the production of this fuel alternative completely domestic or is import necessary?
Substitution Potential	How much fossil fuel can be substituted?
Infrastructure / Powertrain	Does the fuel require a new infrastructure? Does the fuel require adapted propulsion technology?
Emissions	Does the fuel offer emission reduction potential?
CO_2 Reduction Potential	Is CO_2 Balance better or worse than other alternative fuel options ?

1st Generation Biofuels

1st Gen. Biofuels (e.g. Biodiesel / Bio-Ethanol):

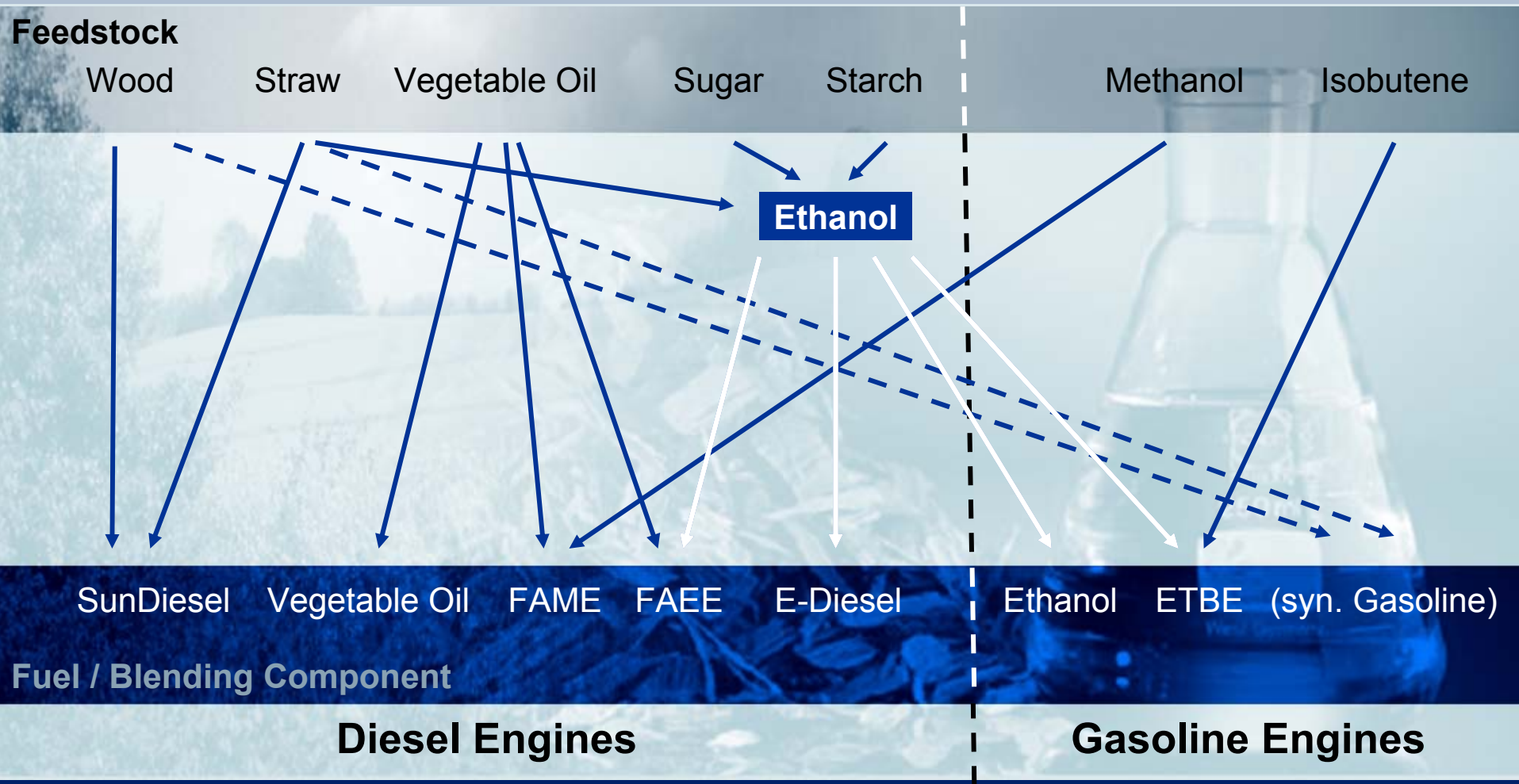
- Available on the market today
- Domestic production possible
- Limited substitution potential
- Limited CO_2-reduction potential
- Utilizes only part of the crop

2nd Generation Biofuels

2nd Gen. Biofuels (e.g. BTL / Eco-Ethanol):

- Available on the market soon (small quantities)
- Domestic production possible
- Higher substitution potential
- High CO_2-reduction potential
- Utilizes entire crop
- Also utilization of waste possible
- No competition with food production
- Synthetic fuels potential enabler for new combustion concepts

Feedstock can be used for variety of Biofuels



Biofuels for Diesel Engines
Biodiesel

Feedstock: vegetable oil obtained e.g. from rapeseed (Europe) or jatropha (India):

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- Around 50% less CO_2 in well-to-wheel balance
- Virtually no sulfur and no aromatic hydrocarbons
- Reduced PM emissions
- Biodegradable
- Best used in blending ratios up to 10%

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- Material incompatibility with some rubbers and plastic materials
- Currently no technology for usage of neat Biodiesel in Euro 4 LD-vehicles available

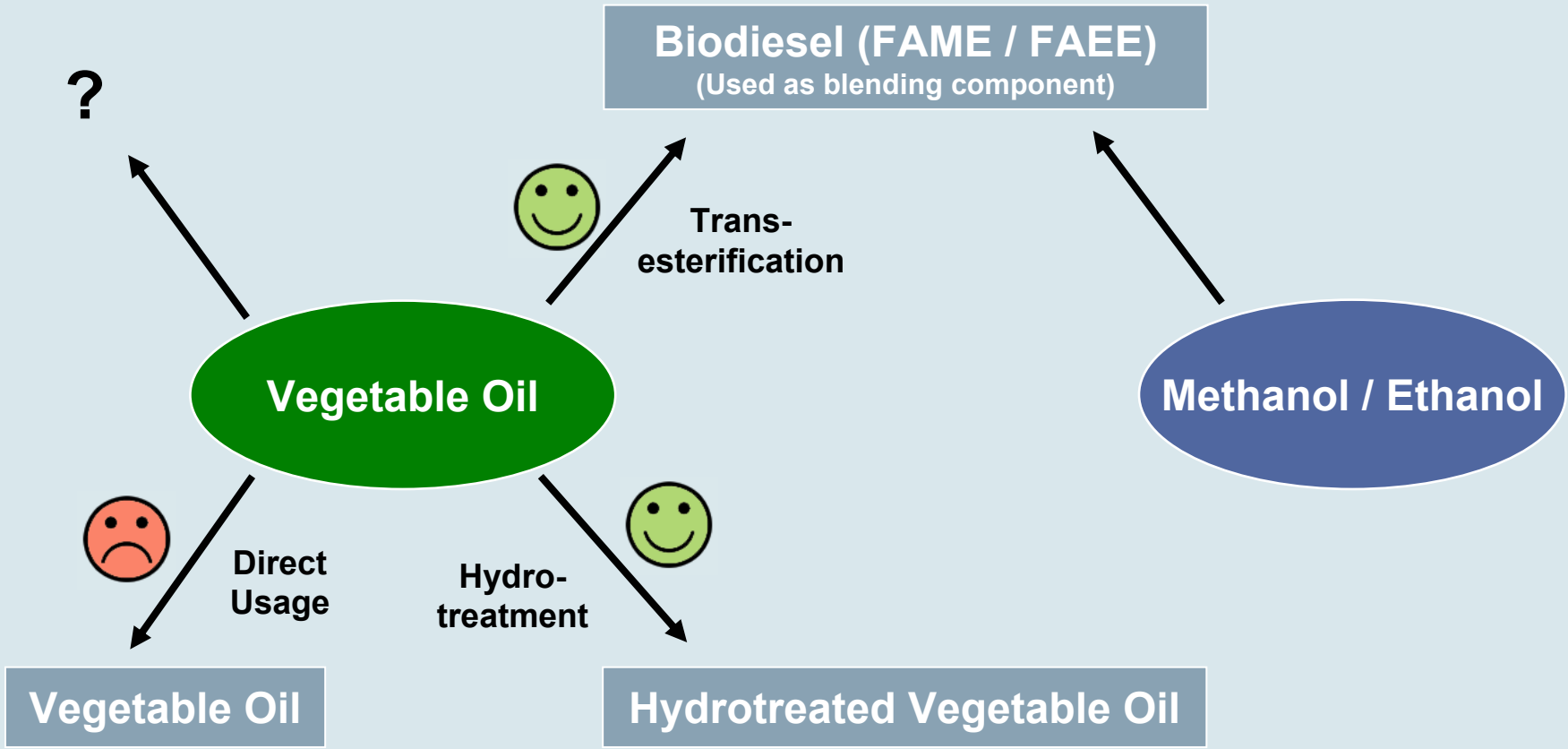
Biofuels for Diesel Engines
Biodiesel – Main Issues

Main Biodiesel quality criteria

- Impurities (Glycerin, methanol, water, catalyst residuals, glyceride)
- Oxidation stability, biological stability (Bacteria, microorganism)

➔ High importance of Biodiesel Quality ensurance (e.g. AGQM)

Evaluation of Diesel Biofuel Options



Biofuels for Diesel Engines
SunDiesel – Pros and Cons

- Ultra clean fuel (zero sulfur, zero aromatics, …)
- Very high Cetane number (> 70)
- No additional infrastructure required (Blending ratio: 0 – 100%)
- Directly usable in existing vehicle fleet (maximum advantages)
- High CO_2-reduction potential (up to 95%)
- Can be made from indigenous sources
- High yield (about 3-4 tons of SunDiesel per hectare)

Biofuels for Gasoline Engines
Ethanol

Feedstock: crops containing sugar and starch (e.g. corn, sugar beets, potatoes, cereals):

+

- Up to 65% CO_2-reduction, however, well-to-wheel balance depends on feedstock and process
- Possibility to use domestic renewable resources
- Limited emission reduction potential
- Use of ethanol and gasoline possible (flex-fuel)
- Can be used as blend in gasoline

-

- Not all production processes show similar CO_2-reduction potential
- Increases vapour pressure of gasoline, if blended
- Water absorption capability can result in mixture separation
- Corrisiveness requires adapted materials

2003: 3.2L Mercedes Benz C320 Sport Sedan

2002: Dodge Caravan

2004: 2.7L Chrysler Sebring Sedan

Biofuels for Gasoline Engines
Ethanol

- Today, Mercedes-Benz gasoline vehicles up to E10 (max. 10 percent ethanol) can be provided worldwide.
- Utilization of ETBE is preferred over utilization of Ethanol. In the future, mixtures of Ethanol and ETBE blends to increase biofuel-share of gasoline is a viable option
- In markets with infrastructure of E85, Mercedes-Benz offers Flexible Fuel Vehicles
- Those vehicles could be offered in any market of growing popularity and developing infrastructure.
- In the future, ethanol might be produced from straw with much better CO2-balance

2003: 3.2L Mercedes Benz C320 Sport Sedan

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Recent DC Activities Regarding Alternative Fuels

- DaimlerChysler acknowledes the necessity of alternative fuels, in particular biofuels.
- In November 2005, DaimlerChrysler announced to prepare it‘s vehicles for blending ratios up to 10%.
- With it‘s activities on synthetic fuels and biofuels, DaimlerChrysler is among the leaders to promote the utilization of fuel alternatives.

asfe
alliance for synthetic fuels in europe

DaimlerChrysler
RENAULT
Sasol Chevron
VOLKSWAGEN AG


fourth environmental forum Magdeburg 2005

Magdeburg Statement

The United Nations Environment Programme (UNEP) and DaimlerChrysler AG share an aim of promoting sustainable approaches to mobility. One way is through dialog amongst technical experts, politicians, NGOs, and others concerned with reducing the environmental and social problems of arising from the transport of goods and people while making sure that mobility services are available to increasing numbers of people.

Through the Environmental Forum in Magdeburg, DaimlerChrysler and UNEP have offered such a platform for discussion and information exchange on sustainable mobility four times since the first Environmental Forum was organized in 1999.

DaimlerChrysler is well established as an active player in the alternative fuels discussion. Continue effort regarding utilization of alternative fuels as an enabler for low emissions and lower CO_2.

DaimlerChrysler's BTL Cooperation

SunDiesel (Cooperation DaimlerChrysler - CHOREN Industries since 2001)

Ultra clean biofuel with high potential

- Substitution potential ca. 20% of European fuel demand
- CO_2 – Reduction potential (Europa) up to 200 mio. tons by utilization of SunDiesel
- Free of sulfur and aromatics, ultra clean combustion
- Sucessful vehicle fleet tests since 2003 at DaimlerChrysler
- August 2005: Start of Shell / Choren cooperation for SunDiesel production

Choren Industries GmbH

„SunDiesel"- Fuel pump in Stuttgart-Möhringen

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Biofuels from Eroded Soils in India

CSMCRI

Goal

- production of biodiesel from indigenous Jatropha plant
- using eroded wasteland not suitable for food production
- using state of the art agricultural technique for best harvest

Status

- co operation between University Hohenheim, CSMCRI, India, DaimlerChrysler and DaimlerChrysler India started in January 2003
- funding from Deutsche Investitions- und Entwicklungsgesellschaft (DEG)

Benefits

- Recovery of wasteland
- Creating local jobs and purchasing power
- aid sustainable mobility in rural districts of India
- Demonstration of the feasibility and practicality of renewable fuels

Biodiesel from Eroded Soils

CSMCRI

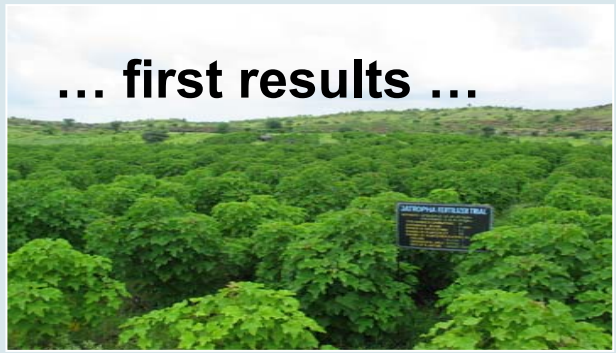
Scientists explaining Nursery Preparation to Farmers

Farmers being shown Jatropha plantation

Scientists conducting Farmers Training

Jatropha Biodiesel Project
Stages of a Success Story

CSMCRI



Most Important Oil Plants for Biodiesel Production

The worldwide dominating feed stock for biodiesel production is Rape seed, followed by Sun flower, Soy bean, Oil palm. Jatropha as feedstock for biodiesel is still under development

Rape Seed

Sun Flower

Soy bean

Oil Palm

Jatropha

Comparison of European Norm 14214 and Indian Standard 15607 for Biodiesel

		EN 14214		IS 15607		
Property	Unit	Min	Max	Min	Max	Test method
Ester content	% (m/m)	96,5	-	96,5	-	prEN 14103d
Density at 15 °C	kg/m3	860	900	860	900	EN ISO 3675EN / ISO 12185
Viscosity at 40 °C	mm2/s	3,5	5,0	2,5	6,0	EN ISO 3104
Flash point	-C	101	-	120	-	ISO / CD 3679e
Sulphur content	mg/kg	-	10	-	50	-
Carbon residue (on 10% distillation residue)	% (m/m)	-	0,3	-	0,05	EN ISO 10370
Cetane number	-	51,0	-	51,0	-	EN ISO 5165
Sulphated ash content	% (m/m)	-	0,02	-	0,02	ISO 3987
Water Content	mg/kg	-	500	-	500	EN ISO 12937
Total contamination	mg/kg	-	24	-	24	EN 12662
Copper strip corrosion (3h at 50 °C)	rating	Class 1	Class 1	Class 1	Class 1	EN ISO 2160
Oxidation stability, 110 °C	hours	6	-	6	-	pr EN 14112k
Acid value	mg KOH/g	-	0,5	-	0,5	pr EN 14104
Iodine value	-	-	120	to report		Pr EN 14111
Linolenic acid methyl ester	% (m/m)	-	12	-	-	pr EN 14103d
Polyunsaturated (>= 4 double bonds) methyl esters	% (m/m)	-	1	-	-	-
Methanol content	% (m/m)	-	0,2	-	0,2	pr EN 14110l
Ethanol content	% (m/m)	-	-	-	0,2	-
Monoglyceride content	% (m/m)	-	0,8	-	-	pr EN 14105m
Diglyceride content	% (m/m)	-	0,2	-	-	pr EN 14105m
Triglyceride content	% (m/m)	-	0,2	-	-	pr EN 14105m
Free glycerolb	% (m/m)	-	0,02	-	0,02	pr EN 14105m / pr EN 14106
Total glycerol	% (m/m)	-	0,25	-	0,25	pr EN 14105m
Alkaline metals (Na+K)n	mg/kg	-	5	to report		pr EN 14108 / pr EN 14109
Calcium and Magnesium	mg/kg	-	-	to report		EU method under development
Phosphorus content	mg/kg	-	10	-	10	pr EN14107p

The European norm EN14214 ensures adequate Biodiesel quality for reliable vehicle operation

The Indian norm IS 15607 is almost identical

Potential Activities to Promote Biofuels

- Transfer of biofuel standards to transitional countries
- Technology demonstration (Fleet tests, Ride & Drive)
- Partner with local authorities
- Lighthouse projects