Commercializing
Liquid Biofuels from Biomass

Task 39
IEA Bioenergy

Task 39 - Fortgeschrittene Biotreibstoffe

Bioraffinerien, Integration von Biotreibstoffen in Industrien

Die Teilnahme wird durch das BMVIT finanziert

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Highlights aus der Biomasseforschung, Wien, 2. Dezember 2010

bmvit IEA FORSCHUNGS KOOPERATION

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IEA Bioenergy Task 39

Commercializing Liquid Biofuels

- 16 Teilnehmerländer
- Ein weltweites Netzwerk internationaler Experten
- Ziel ist die Entwicklung und Verbreitung nachhaltiger Biotreibstoffe
- IEA Bioenergy ist neutral und unabhängig

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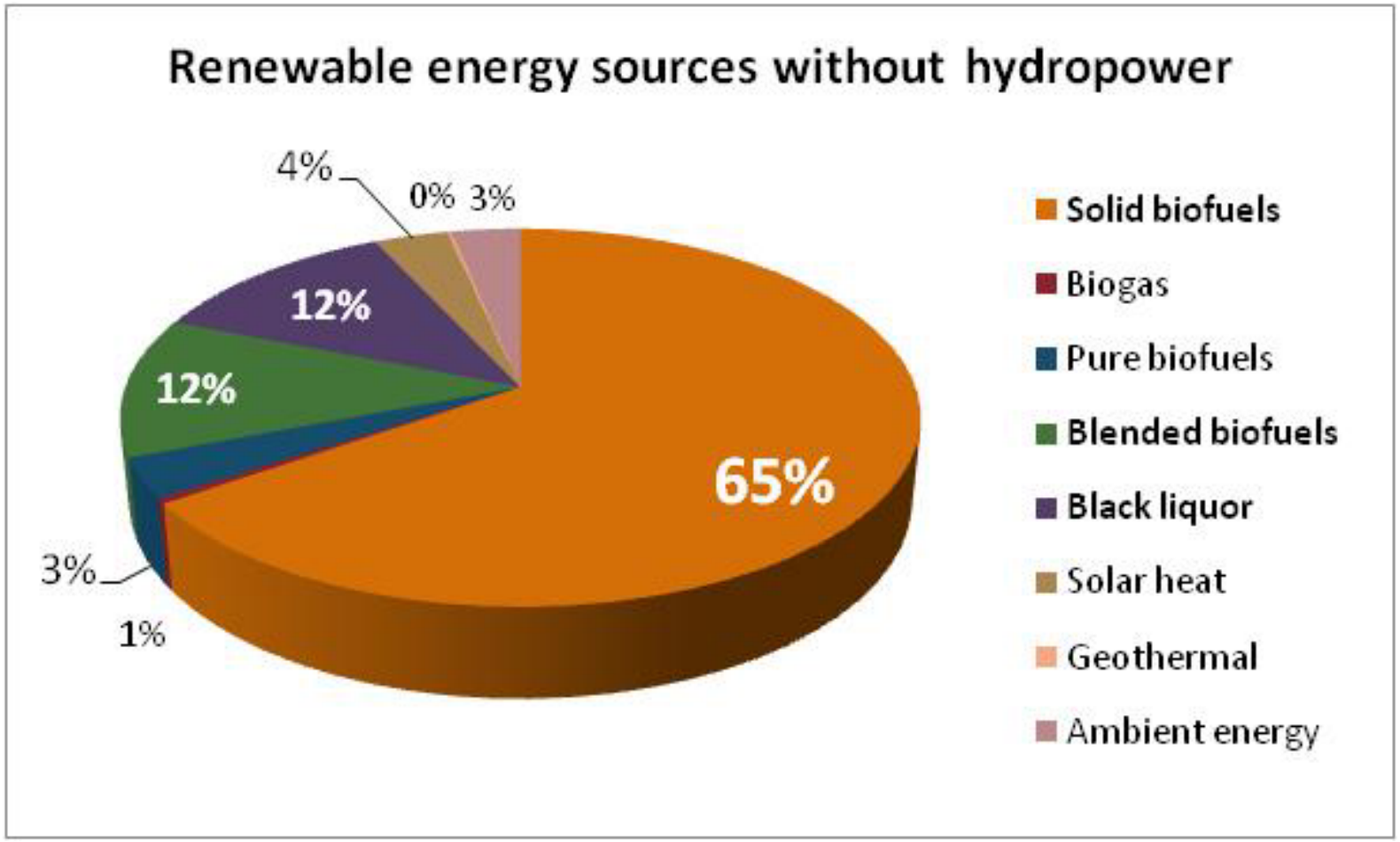
Erneuerbare Energie in Österreich



3. THE SET-PLAN ROADMAP ON LOW CARBON ENERGY TECHNOLOGIES

Seven roadmaps are proposed, built around a vision for the European energy system that by 2020 will have already embarked on a transition to a low carbon economy. These roadmaps put forward concrete action plans aimed at raising the maturity of the technologies to a level that will enable them to achieve large market shares during the period up to 2050. The main sectoral targets are:

- Up to 20% of the EU electricity will be produced by **wind energy technologies** by 2020.
- Up to 15% of the EU electricity will be generated by **solar energy** in 2020. However if the DESERTEC[5] vision is achieved, the contribution of solar energy will be higher, especially in the longer term.
- The **electricity grid** in Europe will be able to integrate up to 35% renewable electricity in a seamless way and operate along the "smart" principle, effectively matching supply and demand by 2020.
- At least 14% of the EU energy mix will be from cost-competitive, sustainable **bio-energy** by 2020.

http://ec.europa.eu/energy/technology/set_plan/doc/2009_comm_investing_development_low_

Österreichs Aktionsplan Erneuerbare Energie

- Den Endenergieverbrauch stabilisieren - 2020 derselbe Verbrauch wie 2005: 1 100 PJ
  - ⇒ - 22 % im Verkehr
  - ⇒ - 12 % bei Heizen und Kühlen
  - ⇒ - 6 % bei Strom
- Anstieg „Erneuerbarer“ von 328 PJ 2008 auf 388 PJ 2020:
  - ⇒ **51 % Bioenergie**
  - ⇒ **41.2 % Wasserkraft**
  - ⇒ 4.5 % Wind
  - ⇒ 0.3 % Photovoltaik

Bioenergie: leistet bereits heute einen wesentlichen Beitrag zur Energieversorgung

Kann ¼ - 1/3 zur Energieversorgung der Erde im Jahr 2050 beitragen

Die Herausforderungen

- Wettbewerb um Flächen für Nahrung, Rohstoff und Energie
- Steigerung der Produktivität bei der Erzeugung von Nahrung und Rohstoff durch besseres Landwirtschaften
- Steigerung der Wettbewerbsfähigkeit
- Aufbau von Infrastrukturen und leistungsfähiger Logistik
- Suchen nach Innovationen
- Unterstützung/ Forderung nachhaltiger Bioenergiepfade durch die Politik

Bioraffinerien

Die erste Generation

- Ethanol, Futtermittel und Strom
- Biodiesel, Futter, Dünger, Brennstoff, Rohstoff

Die zweite Generation

- Inbicon in Dänemark – Treibstoff, Futter, Brennstoff
- Bio-SNG, Strom und Wärme in Güssing

Integration

- Papier- und Zellstoffabriken
- Ko-Raffination von Pflanzenölen
- NextBtL

Neue Rohstoffe, neue Verfahren

- Algenroadmap

Effiziente Nutzung von Haupt-, Neben- und Koppelprodukten; Kostensenkung

British Sugar erzeugt aus 1,4 Mio. t Rüben 200 000 t Zucker, 100 000 t Futter, 40 000 t „Top soil“, 60 000 t Limex Düngemittel, Wärme für Glashäuser und speist Strom ein

We aim to transform raw materials into sustainable products

Beet supplies

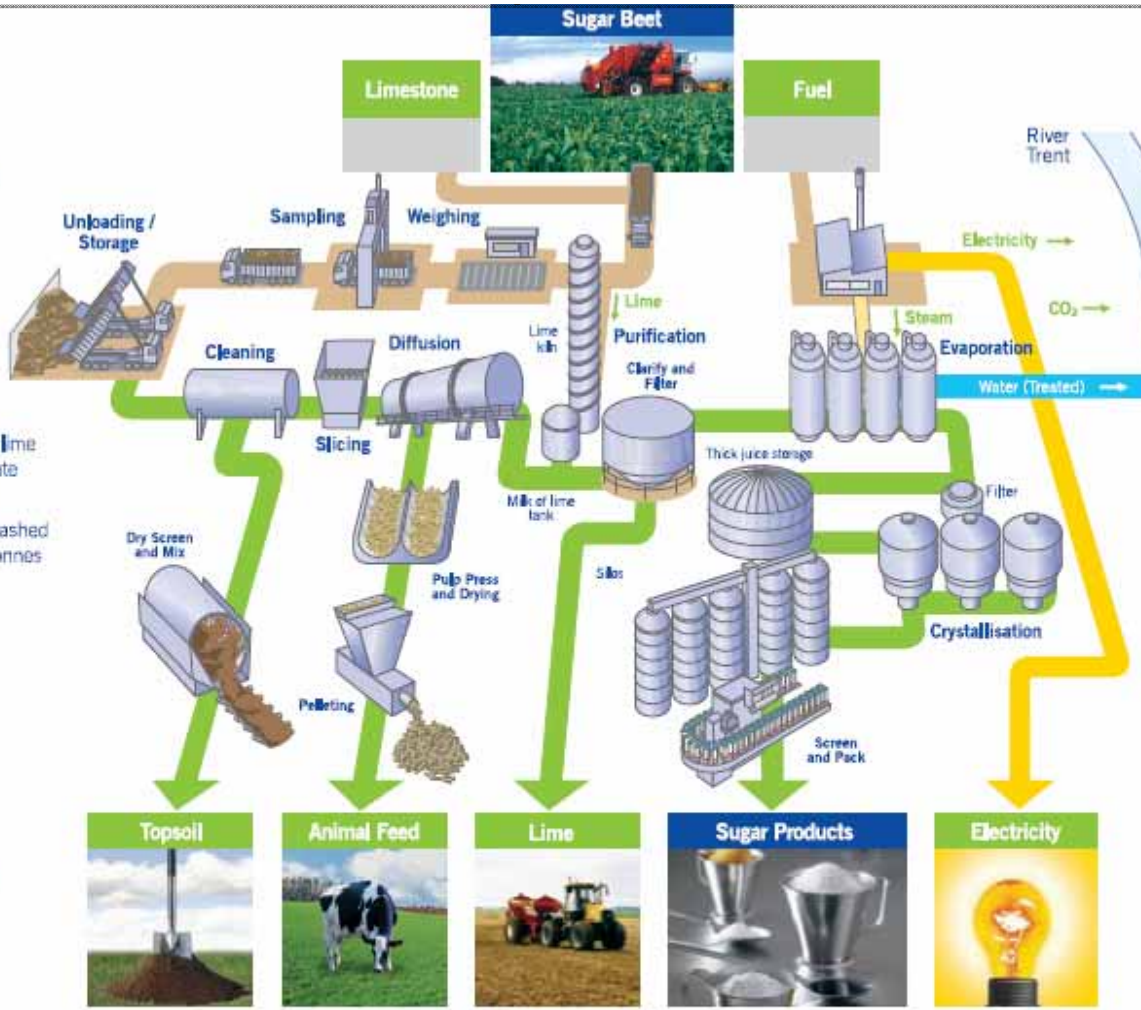
- 1.4 million tonnes of beet are produced at an average distance of 50km from the factory.
- 1,200 UK growers.

Purification

- First purification where milk of lime and CO_2 are added to precipitate calcium carbonate or chalk.
- Precipitated chalk is filtered, washed and pressed, producing 350 tonnes of LimeX per day.

TOPSOIL

- Soil is separated, dried, screened and blended.
- 40,000 tonnes produced and sold under the TOPSOIL brand each year.



Crystallisation

- Crystallisation takes place in vacuum pans which boil the juice at lower temperatures.
- Juice is 'seeded' with tiny sugar crystals to provide the nucleus for crystals to form and grow.

Power generation

- The boiler and power plant produces steam and electricity.
- Up to 3 MW exported into the local electrical grid.
- Rated under the government CHP environmental quality assurance scheme.

Molasses

- Molasses, the syrup left over from crystallisation, is added to animal feed.
- It is also sold as a feedstock to the yeast fermentation industry.

Animal feed

- Around 100,000 tonnes of dried animal feed sold each year.
- 'Supaflow' fat coated pellets.
- 25,000 tonnes of moist pressed pulp.

Sugar products

- Newark factory supplies 200,000 tonnes of sugar to food and drink manufacturers in the UK and Europe. 160,000 tonnes of dry granulated sugar is despatched in bulk each year.
- Silver Spoon packages 40,000 tonnes of retail sugar products at Newark.

LimeX

- Over 60,000 tonnes of LimeX sold annually under the LimeX70 brand.
- Around 1,700 tonnes of LimeX70 is further conditioned and sold under the Super LimeX70M brand.

Quelle: T. Hilber, BDI (2007)
www.fwf.ac.at/de/downloads/pdf/ampuls4-hilber.pdf

BioDiesel Bruck / Leitha

Kapazität:	15.000 t/a
Erweitert auf:	20.000 t/a
Start up:	1992
Rohstoff:	Rapsöl
Nebenprodukte:	Pharmaglycerin (80%) Feststoff-Dünger (Pulverform)

Sowie Futtermittel und Sonnenblumenschalen aus der Ölerzeugung

"AN EXAMINATION OF THE POTENTIAL FOR IMPROVING CARBON/ENERGY BALANCE OF BIOETHANOL"

Table 4-13 Comparison of GHG Emissions - Gasoline and Ethanol with CCS

Fuel	Gasoline	Ethanol			
Feedstock	Crude Oil	Corn			
Year	2015	2015		2015	
Process fuel		NG		Corn Stover	
		wo CCS	w CCS	wo CCS	w CCS
	g CO_2 eq/GJ (HHV)				
Fuel dispensing	90	142	142	142	142
Fuel distribution and storage	827	1,124	1,124	1,124	1,124
Fuel production	12,162	19,085	19,979	5,815	6,709
Feedstock transmission	968	1,031	1,031	1,193	1,193
Feedstock recovery	8,724	7,348	7,348	9,776	9,776
Land-use changes, cultivation	15	20,369	20,369	20,329	20,329
Fertilizer manufacture	0	6,215	6,215	6,215	6,215
Gas leaks and flares	1,688	0	0	0	0
CO_2, H_2S removed from NG	0	0	0	0	0
Emissions displaced	-137	-17,219	-45,719	-17,211	-45,711
Sub-Total	23,951	38,095	10,489	27,382	-223
Combustion emissions	64,813	1,973	1,973	1,973	1,973
Grand Total	88,764	40,068	12,362	29,355	1,750
% Reduction		-55%	86.0	-66%	-98%

1. Generation: O´Connor, S&T²

Höhere CO_2-Minderung durch bessere Technologie

O´Connor, S&T²

2nd Generation Biofuels

- The real benefit of 2nd generation biofuels is in their ability to process a wider range of feedstocks than the 1st generation biofuels.
- In most regions of the world the 1st generation fuels have not yet reached a limit on market share due to feedstock availability and thus the need to switch to other processes is not yet a major driving force.
- Given the length of time that will be required to commercialize some the 2nd generation processes it is appropriate that governments support their development well before they are required by the marketplace.

… aus Sicht Nordamerikas

Demonstration Plant 2009 – 100 MT/day

Input:
30,000 t wheat straw

Output:
5.4 mill. l ethanol
13,100 t lignin pellets
11,250 t C5-molasses

Die zweite Generation - Europa an der Spitze: Inbicon in Dänemark

Start of operation:
18 November 2009

Enzyme suppliers:
Danisco Genencor and Novozymes

Investment:
€53 mill., incl.
€10 mill. DK gov't support

Demonstration supported with €9.1 mill by EU 7th FP

1 MW BioSNG Demo Plant

Institute of Chemical Engineering

Working group: Zero Emission Energy Technology

Vom Labor in den Industriemaßstab:
Die Forschungsplattform in Güssing im Demonstrationsmaßstab erlaubt kostengünstige Entwicklung neuer und unterschiedlicher Technologien bis zur Marktreife

BioSNG Konsortium
CTU – Conzepte Technik Umwelt AG
Repotec GmbH
Paul Scherrer Institute
Technical University Vienna

The project BioSNG is co-funded by
the European Commission
Swiss electric research
Bundesförderung Österreich
WIBAG

Source: Research Projects, Biomass CHP Güssing
R. Rauch at TU Vienna Jour Fixe 18th November 2009

BORREGAARD'S BIO REFINERY – A SUSTAINABLE SOURCE FOR ETHANOL

Borregaard's bio refinery started in 1889 and its operations are founded on the company's unique competence in the manufacture of chemicals and specialty products based on full utilisation of natural raw materials. Scandinavian spruce timber from certified forests is the core raw material for the production of a range of products based on the different components in wood. The fibre is turned into cellulose, the binding agents are used for lignin products and vanillin, while the sugar compounds in the wood are fermented to bio ethanol.

From the plant in Sarpsborg, in southern Norway, Borregaard can offer technical grades of bio ethanol suitable for a range of applications:

Bioethanol

- Borregaard, Sarpsborg: 20 mill liters
  - 2.generation lignocellulosic
  - Norwegian spruce feedstock
  - Start up 1938
- No plants under construction or planned

DME-Produktion in Papierfabrik

- Chemrec & HaldorTopsøe planen DME-Produktion in Papierfabrik
- Synthesegas aus Ablauge
- Volvo und Delphi entwickeln Einspritzsystem für DME

Catalytic cracking of rapeseed oil to high octane gasoline and olefins

P. Bielansky , A. Reichhold, Ch. Schönberger, Vienna University of Technology

- Vegetable oils to the standard FCC-feed added
- Experimental test program in a FCC pilot plant with internal CFB
- Rapeseed oil added up to 100 m%
- Product spectrum was slightly modified
- Due to the oxygen in the oil water and CO_2 formed
- Oxygen free gasoline at high octane numbers
  - Total fuel yield of 65 %,
  - 23 % gas plus 42 m% gasoline

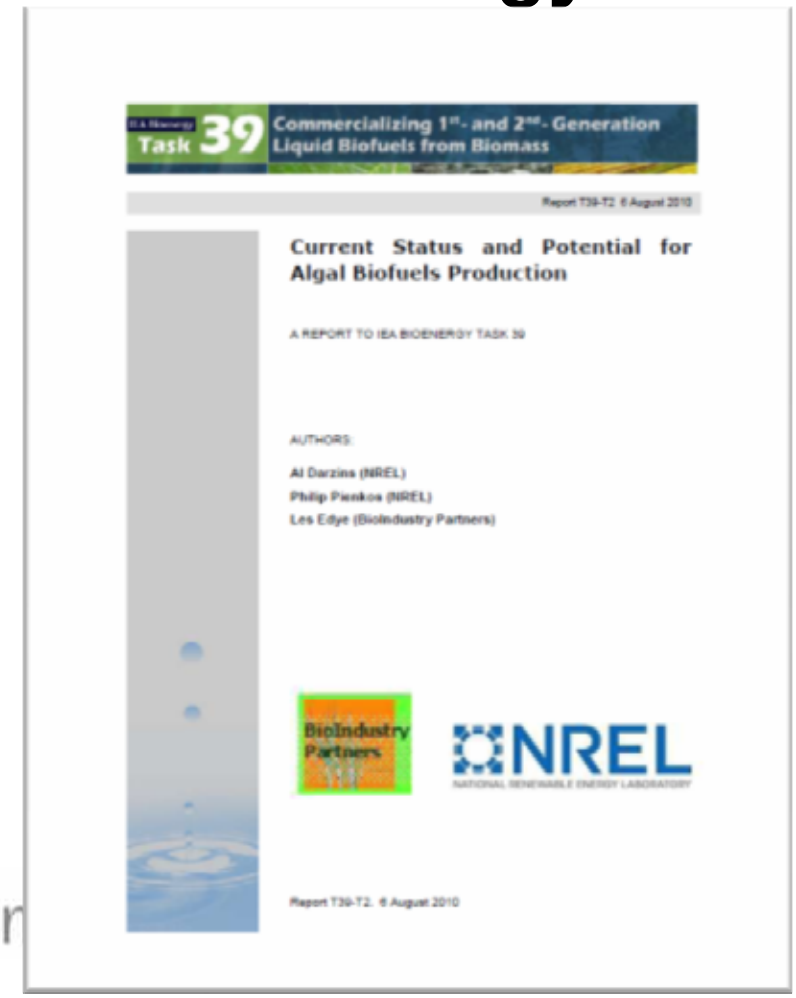
FCC -Fluid catalytic cracking
CFB - Circulating fluidized-bed

Raffinerietechnologie für Pflanzenöl: NextBtL von Neste Oil/ VTT-Anlage

Hydrierung von Pflanzenöl

- Erste Anlage (170 000t) seit 2007 in Finnland in Betrieb
- Zweite Anlage (170 000 t) seit 2009 in Finnland in Betrieb
- Großanlagen (800 000) in Singapur eröffnet, in Rotterdam in Bau

IEA Bioenergy Task 39 Algae Report



- Liquid biofuels from algae: technical and economic feasibility
- Authors: Task 39 colleagues
- Based on
  - NREL report to the Congress of the US
  - Economic analysis of large scale algal systems
- Public release due Nov 2010

Potential Benefits

- Rapid and efficient biomass production
- High lipid content
- No arable land required
- No potable water required
- CO_2 uptake like other biomass

Well-known Basic Concept

- Algae cultivation and harvesting
- High lipid content in algal biomass
- Oil recovery
- Conversion to FAME, HDRD, jet fuel

…but still no algal biofuels industry

Algal Cultivation

- Open ponds – photobioreactors
- Current commercial production ~9000 t/a
- Open issues:
  - Construction materials
  - Mixing
  - Optimal scale
  - Heating/cooling
- Suitable strains/ cultures

Algal Harvesting

- Currently no low-cost options
- Techniques:
  - Spontaneous settling
  - Auto flocculation
  - Flotation
  - …

Economic Analysis

- Currently not economically viable, but potentially viable
- Supporting regulations:
  - Emissions trading schemes
  - Carbon tax
  - Legislation to reduce CO_2 emissions
- Capture high value co-products

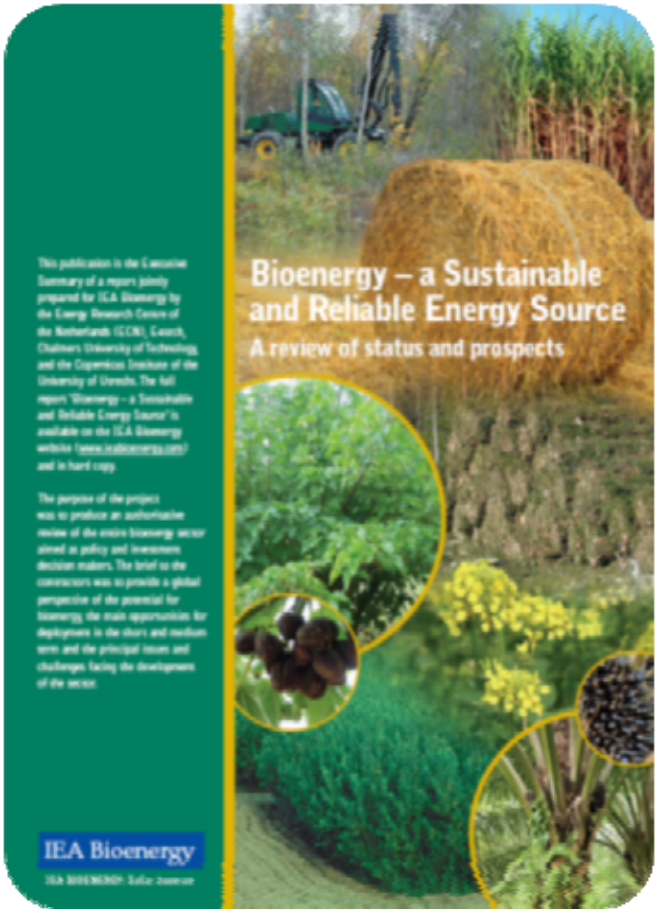
Potential Contribution

By 2030:

- Global transport fuel demand: 3.5 TL*
- Global biofuels production: 350 GL*
- Algal biofuels production 5% of biofuels supply by 2030

IEA Bioenergy confirms the role of Bioenergy.

- Sustainable biomass scenarios indicate an annual potential of 200 - and 500 EJ/yr.
- With a projected world primary energy demand by 2050 of 1000 EJ (500 EJ in 2008), bioenergy may contribute a quarter or even more to the future global energy mix



www.ieabioenergy.com/MediaItem.aspx?id=6360

Die Entwicklung hat gezeigt, dass

- Die Bedeutung von Biomasse als Rohstoff und Energie wächst
- Die verfügbaren Ressourcen beschränkt sind
- Rohstoff und Energie im Wettbewerb stehen und die Industrie unter steigenden Rohstoffpreisen leidet
- Einseitige Änderung von Rahmenbedingungen die Wettbewerbssituation verzerrt
- Die Kosten für Biomasse auch bei der Energie eine Barriere sind

Es ist daher angebracht

- Die Wertschöpfung entlang der Kette vom Rohstoffs bis zur Rezyklierung der Produkte am Ende ihres Lebenszyklus zu maximieren
- Für die jeweilige Verwendung den am besten geeigneten Rohstoff zu verwenden
- Intelligente Bioraffineriekonzepte zu entwickeln und sämtlich Stoff- und Energieströme wirtschaftlich zu nutzen
- Zur Kostensenkung Technologien in bestehende Industrien zu integrieren.


Vielen Dank für ihre Aufmerksamkeit
Wir freuen uns auf ihren Besuch bei den Highligths V Ende März 2011 in Wieselburg