



European Biomass Industry Association

Bio-energy and technologies for liquid biofuels production in Europe

Point of view of EUBIA

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Context

Several issues relate to the valorisation of biomass resources :

- Agricultural policies and food production
(global and structural food overproduction in EU)
- Need of energy sources
(indispensable for economic development)
- Water availability
(emerging problem)
- Desertification
(+6 million ha/year around the world)
- Market liberalisation and globalisation

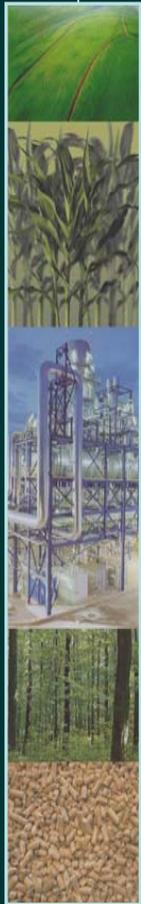




Introduction

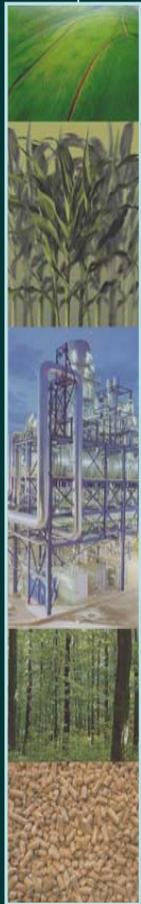
Why is biomass so interesting?

1. Renewable resource available virtually anywhere
2. Considerable potential in the long term (residues and plantation in the long term)
3. Capacity to penetrate all energy market sectors (heating, power & transport) as well as the basic chemicals market
4. Important related advantages:
 - net CO₂-neutrality;
 - decrease noxious gas emissions (SO₂, etc.);
 - favour employment in rural areas;
 - contributes to the fight against desertification.





Worldwide biomass resources



- **Worldwide biomass stock:** ~ 370 B TOE/a
- **World biomass production:**
 - Terrestrial: ~ 80 B TOE/a
 - Aquatic: ~ 20 B TOE/a
- **Estimation of biomass residues potential (2100):**
 - min: ~ 2.1 B TOE/a
 - med: ~ 6.6 B TOE/a
 - max: ~ 28.3 B TOE/a
- **Total Energy consumption (2000):** ~ 9.9 B TOE/a

B TOE: Billion of Tonnes Oil Equivalent (1 TOE ~ 2,4 t dry biomass)



Estimation of world future role of bioenergy

Different projections of future potential (Company/Year study)



Contribution (M Toe/year)	2025	2050
Shell (1996)	2,030	4,750
IPCC (1996)	1,720	6,700
Greenpeace (1993)	2,720	4,320
Johansson et al. (1993)	3,470	4,920
WEC (1993)	1,400	3,000
Dessus et al. (1992)	3,220	-
Lashof and Tirpak (1991)	3,100	5,130
Fisher and Schrttenholzer (2001)	8,350	10,750
Average Contribution	3,250	5,650



Biodiversity

Examples of photosynthetic efficiency* :

(* photosynthetic efficiency = crop energy content / solar radiation energy)

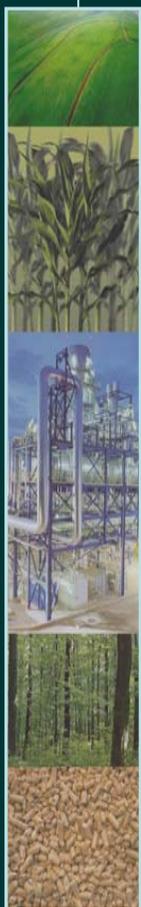


Global terrestrial biomass efficiency (average):	0.05 %
Sugar cane – Sweet sorghum plantations:	2.5 %
Sugar beet plantations:	2.1 %
North Europe forestry:	0.07-0.26 %
Reeds:	1 %
Eucalyptus:	0.9-1.7 %
Maximum in laboratory experiments:	7 %
Maximum (few hours) sweet sorghum:	27 %

An increase of **1%** in photosynthetic efficiency would provide **~100 MWh/ha.year**



European biomass resources



- **Current consumption (EU-15; 2001):**
 - Primary energy: ~ 1486 M TOE/a
 - Biomass: ~ 57 M TOE/a
(3.8%)
- **EU guideline regarding biomass use:**
 - for 2010 ~ 135 M TOE/a
 - for 2020 ~ 200 M TOE/a
- **Biomass potential (2050)**
 - UE-15 ~ 500 M TOE/a
 - UE-25 ~ 600 M TOE/a

M TOE: Million of Tonnes Oil Equivalent (1 TOE ~ 2,4 t dry biomass)

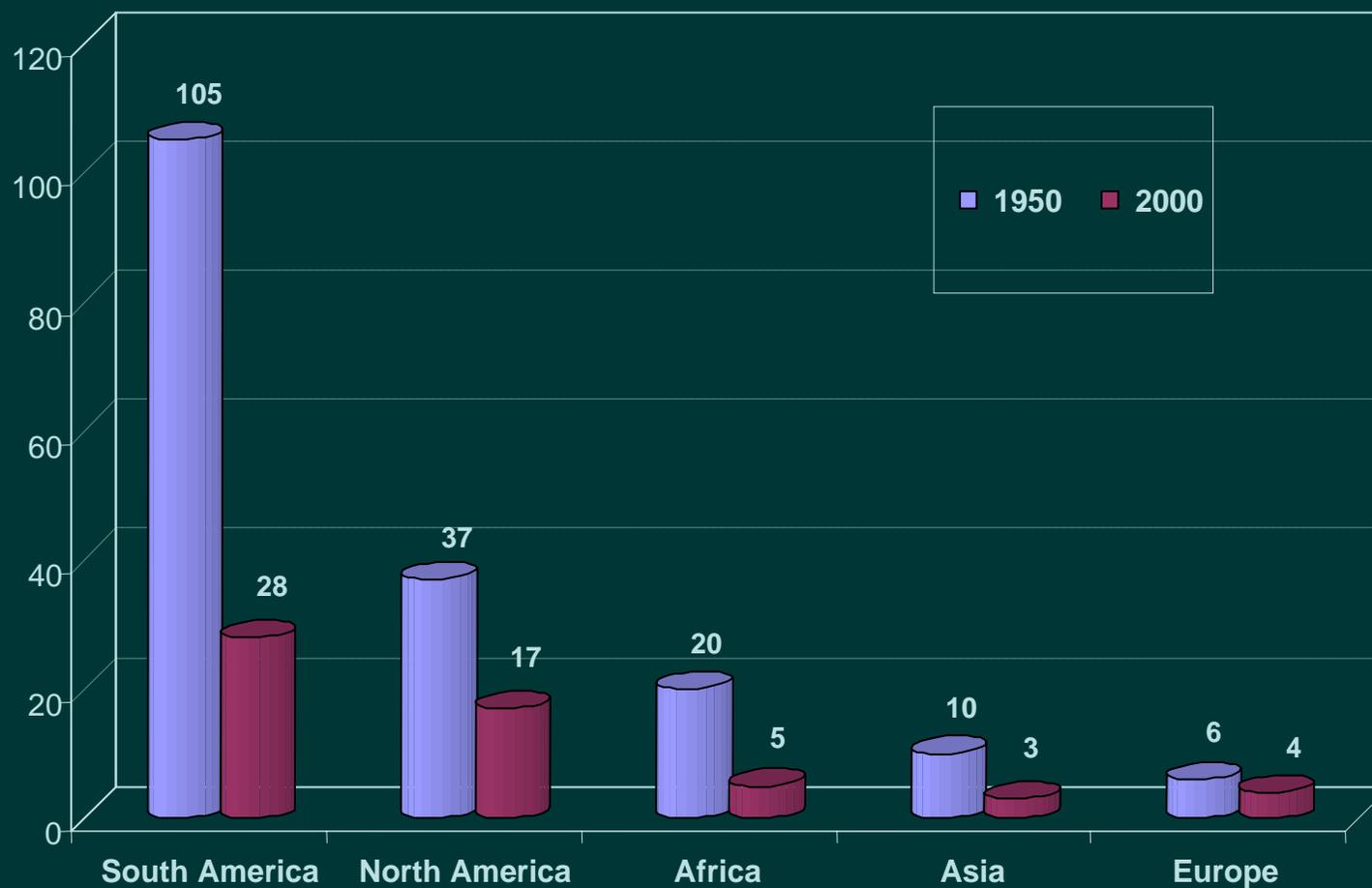


Water resources on the globe

Water availability



x 1000 cubic meter / person





To sum up

1

Depletion of fossil fuel resources :
~ 50% of recoverable petroleum
already consumed

2

Biomass resources are abundant and available almost anywhere in the EU and worldwide, but with water constraints.

3

The main biomass contribution will likely be directed to :

- the **heat production**
- the **strategic transport sector**
- **co-generation (heat and power)**





Bioenergy targets in Europe

Composition and objectives related to bioenergy in EU (MTOE)



Biomass resource	1995	2000	White Paper goals for 2010
Solid biomass	42,9	48,4	102
Gaseous biomass	1,2	1,8	15
Liquid biofuels	0,4	0,9	18
<i>Biodiesel</i>	<i>0,28</i>	<i>0,70</i>	-
<i>Bioethanol</i>	<i>0,08</i>	<i>0,20</i>	-
Total	44,5	51,1	135

Source: Kopetz, 2003 in Renewable Energy in Europe (EREC) Draft copy January 2004



EU framework for biofuels

European directive 2003/30/CE (May 2003) :

Promotion of the use of biofuels
and other renewable fuels for transport

Minimum proportion of biofuels and other
renewable fuels that should be placed on the
markets of each member state (in %*) :

By December 31 st 2005:	2 %
By December 31 st 2010:	5,75 %

**: calculated on the basis of energy content of all petrol and diesel for transport purposes placed on the markets at the corresponding date.*

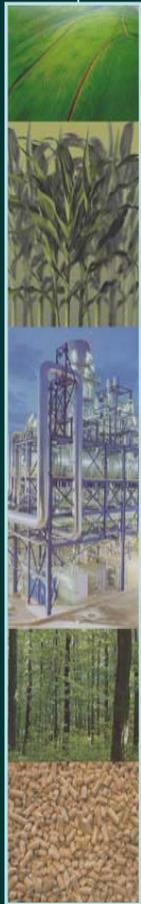


EU framework for biofuels

EU Directive 2003/30/CE :

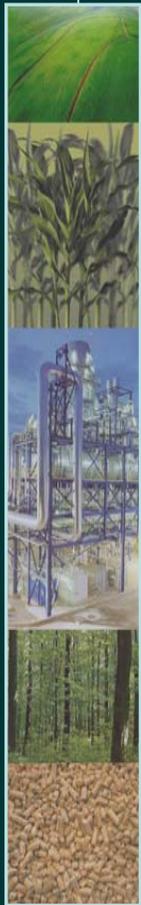
Biofuels with the major technical and economic potential:

- Bioethanol (+ bio-ETBE)
- Biodiesel
- Biogas
- Biomethanol (+ bio-MTBE)
- Biodimethylether (DME)
- Synthetic biofuels
- Biohydrogen
- Pure vegetable oil





Biofuels with the major technical and economic potential



- For each biofuel: **advantages** and **drawbacks** if compared between them or to other fuels
- The **economic aspect** will be the main driver of the penetration on the different energy market sectors
- Competitiveness will be based on the industrial costs of the end-products; an estimation for february 2004 (oil at 40 \$/bbl) is:

~ 350 - 450 €/TOE

(Variations according the country)



Best competitiveness levels for biofuels

(short term)

Bioethanol *(from sugar beets at 18 €/t)*

- Bioethanol dehydrated (100°): ~ **540 €/TOE**

Biodiesel *(without support)* ~ **930 €/TOE**

Biomethanol

Biohydrogen

- *(from residues at 20 €/t; $\eta \sim 37\%$)* ~ **550 €/TOE**

- *(from natural gas; $\eta \sim 63\%$)* ~ **290 - 500 €/TOE**

Biodimethylether ~ **600 (?) €/TOE**

Fischer-Tropsch ~ **700 (?) €/TOE**

*: 404 €/TOE in 1981 increased 2%/year



Bioethanol Competitiveness

World-wide Comparison

- **EU** has a large feedstock potential but is the less competitive on the international market without subsidies with an average production cost of hydrous bioethanol ~ **480 €/t**;
- The **USA** has large feedstock potential and better competitiveness level with an average production cost of hydrous bioethanol (from corn) ~ **300 €/t**;
- **Brazil** has an enormous potential for expanding the sugar-cane growing area (from 5 mio ha → 33 mio ha) and it has the most competitive production cost with an average level of ~ **112 €/t**;
- **China** has now a limited potential but it could increase considerably if a partial substitution of sweet-sorghum to corn (i.e. 1/3 of the cultivated area) could be feasible (+40 mio m³/year). The actual production cost (from corn) is ~ **400 €/t**. In the **south of China** from cassava should be much lower at ~ **260 €/t**;
- **South-East Asia** has a reasonable potential and a reasonable production cost of about **220 €/t** (hydrous bioethanol from cassava);
- **Australia** has a production cost of hydrous bioethanol from sugar-cane similar to USA level ~ **280 €/t**.





Bioethanol: promising & competitive biofuel

European Union



Bioethanol energy activity: very modest

Many countries (following E.C. directive) start to plan significant investments (in particular Germany)

Production cost of bioethanol from conventional crops (wheat, corn, sugar beets): approx. **400-500 €/t**

Estimated production cost of bioethanol from most promising crops (e.g. sweet sorghum): **approx. 250 €/t**

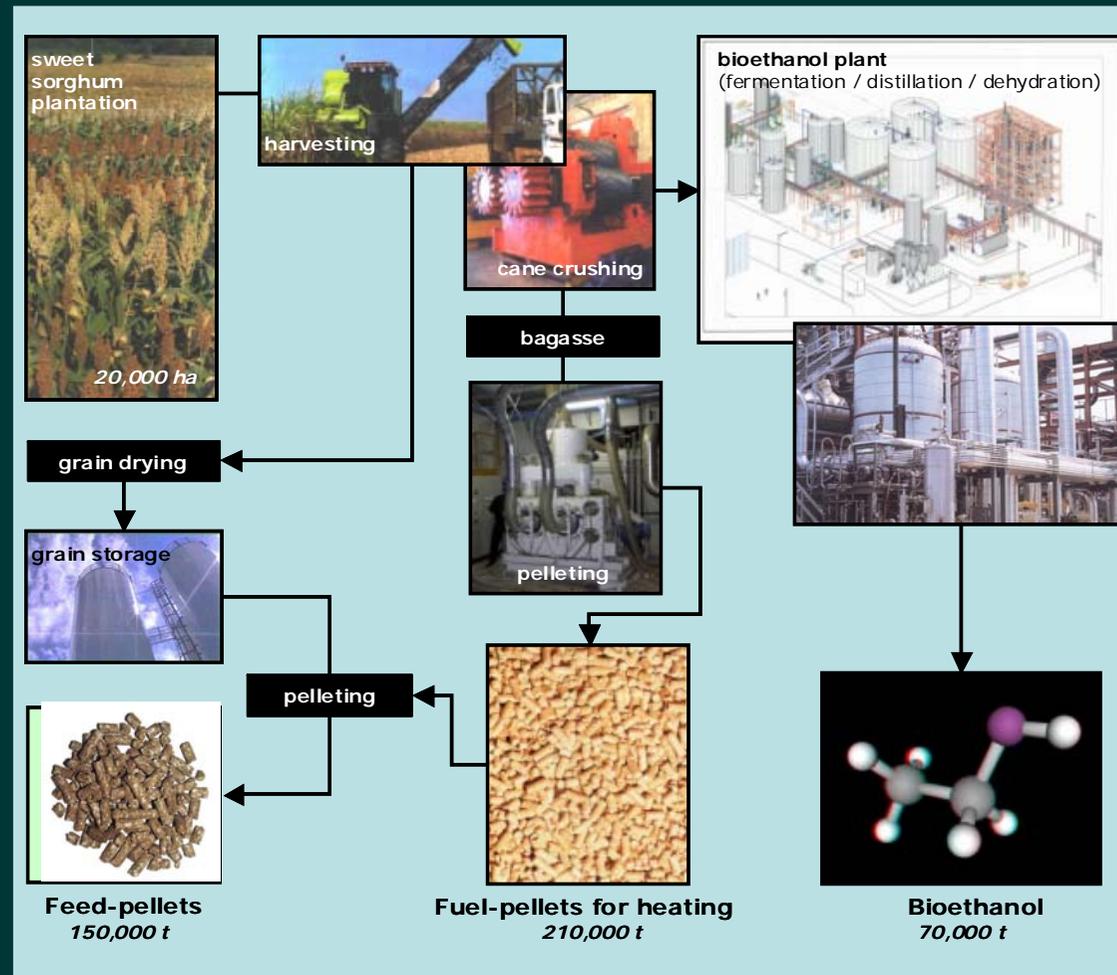
Market value:

- Europe: 590 €/t
- USA: 500 €/t



Integrated Bio-energy Complex

With simultaneous production of animal feed and fuel pellets, bioethanol can be produced at **250 €/t**.





Agricultural set-aside in the EU

- **Total area**

- EU-15	3,234,295	km ²
- CC-10:	738,574	km ²
TOTAL	3,972,869	km²

- **Total utilised agricultural area (UAA)**

- EU-15	131	million hectares
- CC-10:	36	million hectares
TOTAL	167	million hectares

- **Current set-aside area**

- EU-15	6	million hectares
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This corresponds to **4.7%** of the EU-15 UAA and to **3.6 %** of the current EU-25 UAA.





Agricultural set aside area in the EU-15



Source: European Commission, Directorate-General for Agriculture. (2002-2003)

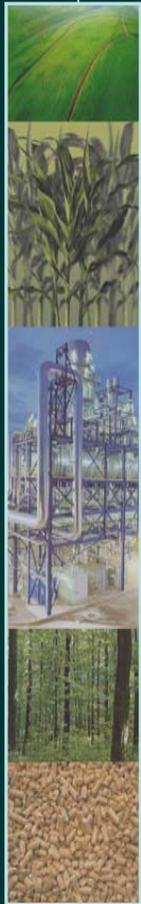


European set-aside energy potential

6 million hectares
set-aside (UE-15 - 2002/2003)

→ Theoretic potential comprised between
6 - 23 MTOE
of biofuels

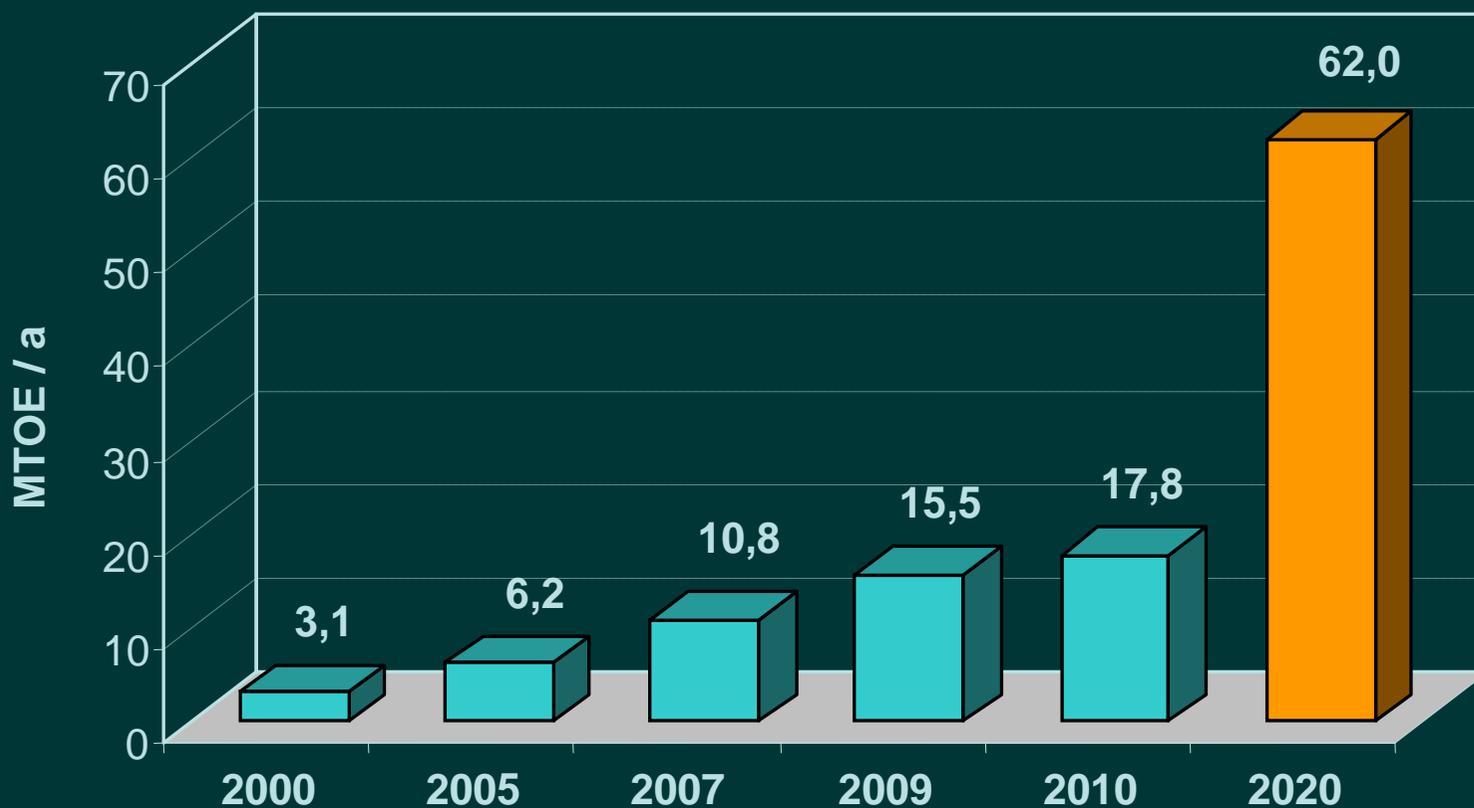
→ This corresponds to
1,9 – 7,4 %
of the final energy consumption
in the EU transport sector (312 MTOE in 2001)





Potential evolution of biofuels and alternative fuels in Europe

Target evolution for biofuels and alternative fuels in the EU



Total energy consumption in the transport sector (2001):
312 M TOE / year



Estimation of agricultural land needed for the 2020 objective (if covered exclusively by biofuels)



- **Assumption on the distribution of the 62 MTOE (2020 target):**

- 80% bioethanol + biomethanol (i.e. 49.6 MTOE)
- 10% biodiesel (i.e. 6.2 MTOE)
- 10% biohydrogen (i.e. 6.2 MTOE)

- **Average yields for each biofuel:**

- Bioethanol + biomethanol : 4.30 TOE/ha
- Biodiesel: 1.35 TOE/ha
- Biohydrogen: 3.30 TOE/ha

- **Corresponding areas to be cultivated yearly:**

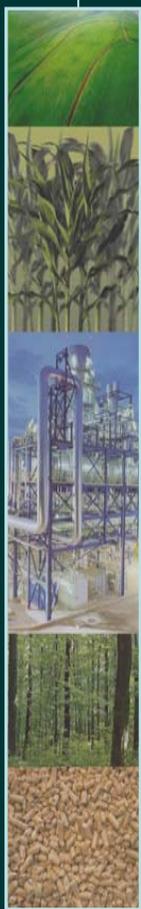
- For bioethanol + biomethanol : 11.53 M ha
- For biodiesel: 4.59 M ha
- For biohydrogen: 1.87 M ha

⇒ **Total agricultural area needed ~ 18 M ha/year**

This corresponds to approx. 11 % of total UAA of UE-25 (~ 167 M ha)



Employment related to bioethanol



• USA

~ 1 M TOE / year
bioethanol from maize

~ 7,980 jobs
agric. sector (54%)

~ 5,320 jobs
in industry and
services (36%)

~ 1,560 jobs
plant construction
(11%)

14,860 jobs

→ 1 job for 67 TOE bioeth./year

• **European Union** (estimation) ~ 20,100 jobs per M TOE eth./year

→ 1 job for 50 TOE bioeth./year

• **Brasil:** (for 1 M TOE bioethanol/year):

~ 63,000 jobs (agric. sector)

~ 25,240 jobs (industry)

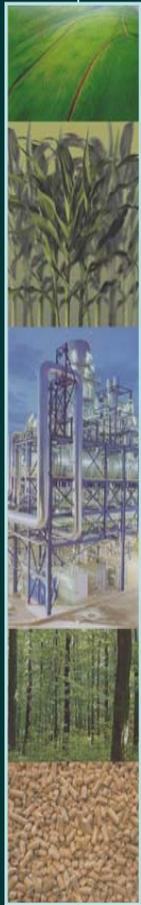
~ 88, 240 jobs TOTAL

→ 1 job for 7 TOE bioeth./year



Conclusion

- World-wide, the potential of biomass resources is very high and very promising.
- In particular, biofuels in the EU are expected to provide a considerable contribution to the transport sector (probably ~20% by 2020)
- Bioethanol is economically and in volume the most promising biofuel for transport.





14th European Biomass Conference and Exhibition

17 - 21 ottobre 2005 Parigi



More informations:
[www. Conference-biomass.com](http://www.Conference-biomass.com)