

**Interdisciplinary Bilateral Winter and Summer School on
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OVERVIEW OF BIOMASS TECHNOLOGIES AND THEIR ASSESSMENT

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RESEARCH QUESTION

What are the potentials of biomass and the different technologies using biomass in the Czech Republic and Austria?

DEFINITION OF BIOMASS

- According to ÖNORM M 7101 biomass in Austria is understood as organic, non-fossil material, which comprises every living and growing substance in nature and their waste materials.
- Generally biomass is chemically bonded energy from the sun introduced by photosynthesis. Due to this fact using biomass to supply energy is CO₂-neutral and therefore technologies using biomass are part of regenerative energy sources.

SOME TECHNOLOGIES AND THEIR ASSESSMENT

Biodiesel

- plant seeds
- mixed with sodium hydroxide and methanol
- fat acid methyl ester
- plants used:
 - palm trees
 - corn
 - used vegetable oil etc.



Bioethanol

- fermentation process using plants like sugar cane or corn
- enzymes are used for reaction
- product: Ethanol



Assessment of biofuels 1. generation

- CO₂-emission balance
- small harvest output
- competition with food production
- lack of resources in our countries – new dependence
- problems with materials of engines in cars
- combustion of biodiesel releases less emissions
- biodiesel is not as dangerous for water than fossil fuel and is bioagredable

Gasification of solid biomass

- **Generally there are two different technologies:**
 - energy amount for the reaction is provided by a partly combustion of the biomass itself
 - needed heat for gasification is offered indirectly
- **The biomass gasification can be combined with many further processes:**
 - Fischer-Tropsch-synthesis
 - production of synthetic natural gas.



Assessment of Gasification and linked technologies

- Gasification and resulting technologies are still in development.
- possibility to influence the composition of the fuel.
- emissions of BtL are free of aromates and sulphur and the
- NO_x- and partikel emissions are reduced in compensation to fossil fuels.
- 1 L of BtL-fuel subsitutes 0,97 L of commercial diesel.

Biorefinery

- Green Biorefinery represents a “multi-product”-system based on grassland utilization.
- Grass is the educt for many products, like proteins, lactic acid, fibres and biogas.
- Comparing green biorefinery with biodiesel or bioethanol:
 - no competition with food
 - using the whole plant
 - cost-benefit-equetation is better than for biodiesel and bioethanol
 - reactivation of fallow land and therefor supports maintenance of cultural landscape



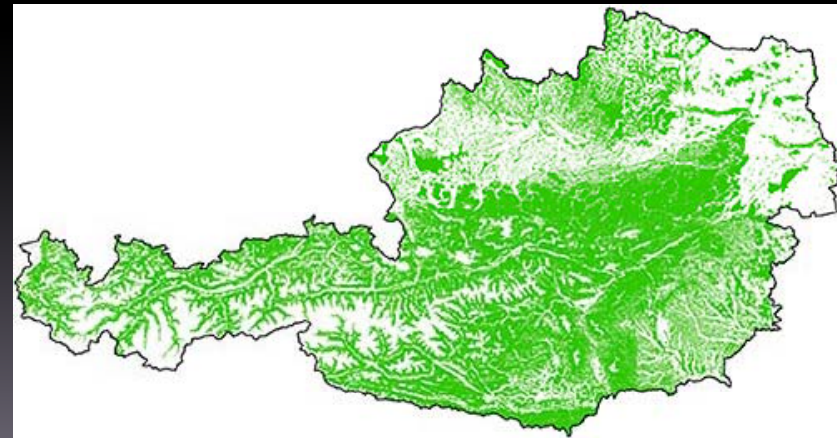
AUSTRIA

Wood

- 47 per cent of Austria's area are forests



- 3,3 Mio hectares in Austria are used for forestry.
- 19 Mio solid cubic meters were cut down (2006)
- amount is growing by 31 Mio solid cubic meters every year
- greatest source of energy for Austria.



Energy plants for fuel

- not the most efficient way to use biomass
- not enough area to grow enough plants to satisfy the
- need of energy for mobility in Austria
- imports of energy plants from other countries would be necessary



Raw material for Biorefining

- Estimations show huge potential of grass in Austria
- The amount of grass is between 500.000 to 100.000 t dry mass per year
- Second place behind wood
- Great variety of products
- Essential fragment in a renewable energy mix for Austria

Czech view:

Biomass is renewable organic materials,
such as wood, agricultural crops or wastes
and municipal wastes

CLASIFICACION:

- **Waste biomass**

- Vegetal wastes
- Wood wastes
- Industrial production organic wastes
- Animal production wastes
- Municipal organic wastes

- **Biomass intentionally produced for energy production purposes**

- Energy plants
- Fast growing tree species

POSSIBILITIES FOR PRODUCING

Due to the big extension of field, which is used for agriculture and forest (87% from the whole area), the Czech Republic has very good conditions for the growth of energy plants. However, there is a lack of specialized machines needed for the cultivation of fast growing tree species. The purchase of the required technology would cause the price increase of the produced energy. Therefore, the focus in production of biomass plants in the Czech Republic is rather on so called energy plants. Growing of energy plants only requires common techniques, which are used during the classic plants cultivation, they have short vegetative period, they are easier to plant, and it is possible to process them for non-energetic purposes as well.

AMOUNT OF USABLE BIOMASS

Biomass fuel type	Mil. tons
Wood wastes	1,7
Rape straw	2,5
Fast growing tree species & energy plants	1
Municipal waste	1,5
Combustible waste from industrial production	1
TOTAL	7,7

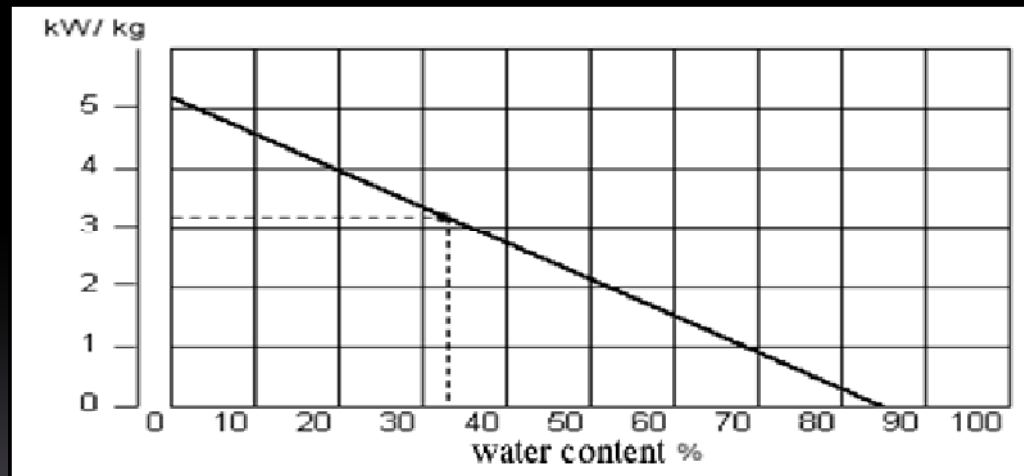
AREA OF AGRICULTURE FIELDS

Area required for production of food plants	Thousands of ha
Arable land	2626
Grass field, pasture land	422
Culture in the agriculture field	75
TOTAL	3123
Free fields for other purpose	
Arable land	465
Grass field, pasture land	523
TOTAL	988

PROPERTIES OF BIOMASS

Biomass as fuel – heating power of dried wood is 15 to 19 MJ/kg

Calorific value depends on percentage water content:



HEAT EFFICIENCY OF BIOMASS

Type of combustible	Water amount (%)	Heat value (MJ/kg)	Density [kg/m ³]
Wood chunk	10	16.41	375
Wood chunk	20	14.28	400
Wood chunk	30	12.18	425
Wood waste	10	16.4	170
Wood waste	20	14.28	190
Wood chips	30	12.18	210
Wood chips	40	10.10	225
Cereal straw	10	15.50	120
Corn straw	10	14.40	100
Flax straw	10	16.9	140
Rape straw	10	16.0	100

HEAT EFFICIENCY OF FUELS

Type of the fuel	Heat value [MJ/kg]	MG/dm ³	Density [kg/dm ³]
Oil	43.97	32.53	0.74
Diesel fuel	42.5	36.97	0.87
Light furnace oil	42.5	36.97	0.87
Heavy furnace oil	41.45	39.36	0.95
Black coal	24	-	-
Brown coal	14.6	-	-
Firewood (20% H ₂ O)	14.23	5.5	0.4
Cereal strew (10% H ₂ O)	15.49	1.86	0.12

CHEMICAL ELEMENTS IN BIOMASS

Solid fuels with less than 15% of water content:

Type of fuel	Amount of dry mass turning into gas	C[%]	O[%]	H[%]	N[%]	S[%]	Cl[%]
Strew	75-80	44	35	5	0.5	0.1	0.2
Wood	70-75	43	37	5	0.1	0	0
Wood coal	23-25	71	11	3	0.1	0	0
Brown coal	47-57	58	18	5	1.4	2	0
Black coal	24-28	73	5	4	1.4	1	0

BIOMASS PROCESSING POSSIBILITIES

Thermo-chemical transformation	Pyrolysis (Gas, oil production)
	Gasifying (Gas production)
Bio-chemical transformation	Fermentation (ethanol production)
	Anaerobic rot out (production of biogas)
Mechanic-chemical transformation	Oil pressing (Oil, liquid fuel production)
	Raw bio-oil processing (biodiesel, oil products)
	Milling, crushing, pressing (solid fuels production)

THERMO-CHEMICAL TRANSFORMATION

= Gasifying

Wood briquets
and pellets:



Instrumentality for
producing heat:

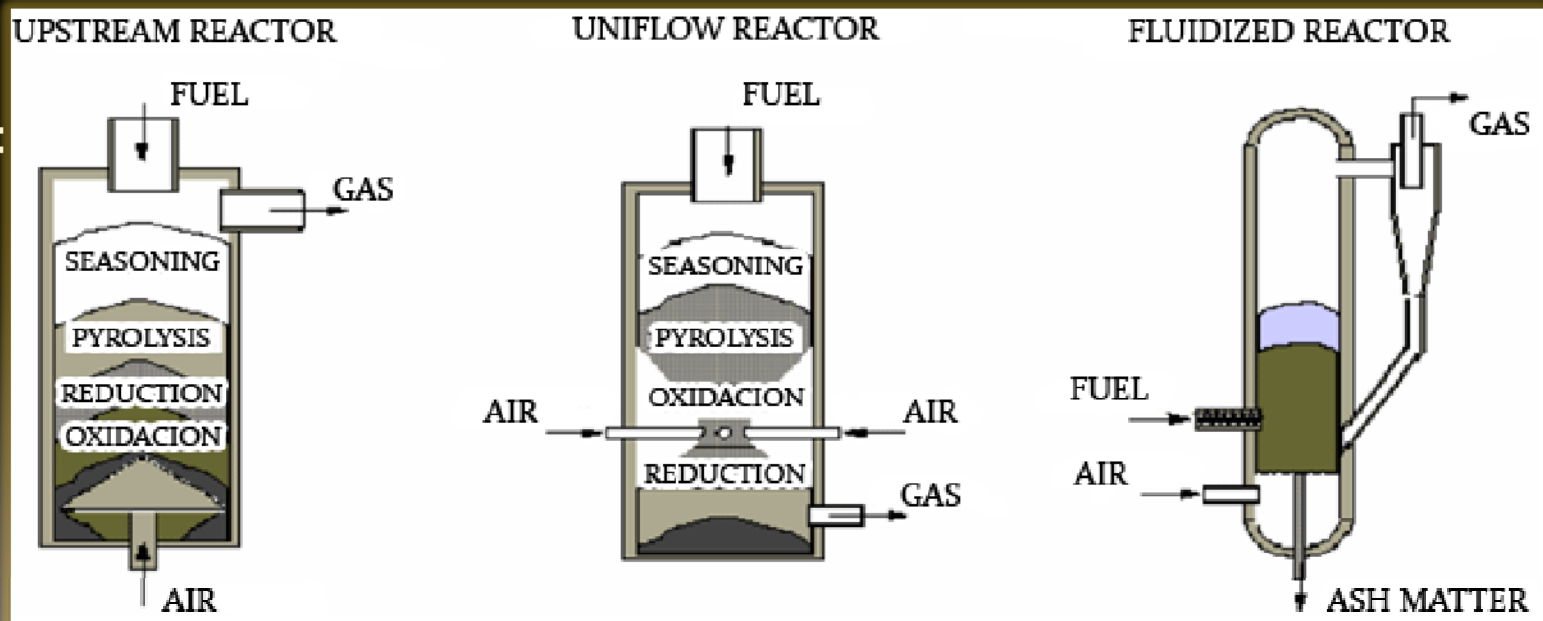


POWER PLANT WITH GASIFYING TECHNOLOGY

- Preparation and transport of the fuel
- Reactor for gasifying
- Gas cleaner and mix system
- Turbine, resp. combustion motor

It is common to combust biomass together with coal. The proportion of biomass is then about 5-20%.

Types
of reactors:



BIOMASS PRODUCTION IN THE CEZ GROUP

Thermal power plant	2007 (MWh)	2006 (MWh)	Year to year increase
Tisova	41297	31346	32%
Porici	79247	57427	38%
Dvur Kralove	12732	2104	505%
Hodonin	115966	62708	85%
Other CEZ power plants in the CR	0	9851	-
Total in the Czech Republic	249239	163436	52%
Skawina	101680	-	-

BIOCHEMICAL TRANSFORMATION

Ethanol is product of sugar fermentation requiring moisture environment. Theoretically from 1 kg can be derived about 0.65 l of clean ethanol. In reality it is usually 90-95%.

Biogas is product of decomposition of organic materials (dung, plants, bilge water, ...) in closed tanks without the access of air. Organic material decompose into inorganic substances and gas by anaerobic bacteria.

Bacterias:

- Psychrophil
- Mezophil
- Thermophil

MECHANICAL-CHEMICAL TRANSFORMATION

Bioethanol - Under the high temperature and catalyses treatment the pressed rape oil changes into mehtylester. This product is called the biodiesel of the first generation, and because its production is more expensive than common diesel fuel, it is mixed with some oil derivates or with linear alpha ethylenic hydrocarbon. This product is then called biodiesel of the second generation and has a competitive price comparing with diesel fuel. The condition remains that it must contain at least 30% of the rape oil methylester.

BIOMASS USAGE IN THE CZECH REPUBLIC

Solid biomass makes up to 90% of all renewable energy resources used for thermal energy production. The biggest amount of biomass is used to heating the households, usually the biomass is combusted mixed with coal. The biggest number of furnaces for biomass combustion can be found in the South Bohemia countryside.

On the so called green energy production, biomass has a 21% share.

Biogas makes 5% share on green energy production. The biggest share in biogas production has capital city Prague.

Bio fuels are currently produced almost only from rape oil. Rape is being growth in the area of 265 000 ha. Share in the overall fuel market was in 2004 2.46%, which is unfortunately significant decrease from 1999 (5.15%)