Overview of European policies and technologies for bio energy development and greenhouses gas mitigation

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EU Policy 2007

- Increase security of supply
- Ensuring the competitiveness of European economies and the availability of affordable energy
- Promoting environmental sustainability and combating climate change
EU bio-energy policy

Support
• Support co production of fuels
• Heat and power
• Integrated bio-refineries (Use of all products)

Tools for support
• Through regulations
• Market based support
  – Biogas
  – Energy price 0.08€/Wh in Denmark
  – Energy price 0.15 €/Wh in Germany for small plants.
  – Special EU – aid to energy crops: 45€ per ha
EU - Research programmes

• Funding (not including demonstration) 200 M€
• Bio-fuels for transport 34%
• Bio-refineries 18%
• Gasification and H₂ production 23%
• Bio-residues and energy crops 5%
• Incineration 10%
• Others 10%
Biomass and energy conversion

- Oil seed rape
- Starch crops

1st generation bio-energy
- Bio-diesel
- Bio-ethanol

2nd generation bio-energy
- Bio-ethanol

Agricultural Waste
- Ligno-cellulose materials

Incineration
- Power
- Heat
Bioenergy potential in Europe

Potential bioenergy

Energy crops

Year
2010 2020 2030

Bioenergy potential, MtOE

0 50 100 150 200 250 300

Organic waste

Forestry

Biomass from Forest

Year
2010 2020 2030

Bioenergy potential, MtOE

0 5 10 15 20 25

Energy crops

Bioenergy potential, MtOE

Year
2010 2020 2030

Oil crops
Crop - ethanol
Crop - ligno cellulose ethanol
Crop - biogas
Perennial - grass, forestry

Organic waste

Year
2010 2020 2030

Solid agricultural residues
Animal slurry
Wood processing residues
Municipal solid waste
Other wastes

Wiesental et al. 2006
EU - Biomass for energy production

• Seven out of 25 countries provide about 80% of the land available for energy crops

Land available for bio energy crops, 1000 ha

Wiesental et al. 2006
Biogas production

Methane production, landfill & anaerobic digestion

50% of landfill methane is produced in UK
Manure treatment concepts
Limited amount Organic waste with digestible DM

Organic waste

Biogas

Solid-liquid separation

Solid

Liquid

Solid-liquid separation

faeces

slurry

urine
Ethanol production from plant residues

IBUS concept

From Charles Nielsen
Ethanol from wheat straw

- Soaking process
- Opening of lignocelluloses by heating to cellulose and hemicelluloses
- Liquification: Enzymes transform cellulose/hemicelluloses to glucose or xylose
- Ethanol production from glucose or xylose by yeast (GMO bacteria)
- Distillation
- Recycling of residual biomass for heat and power, feed – biogas production (Maxifuel)

- Transformation of 90% of cellulose and 75% hemicelluloses
- 0.49-0.5g ethanol pr g glucose or xylose (0.42 g today)
- Conversion rate is 40% (MJ ethanol per MJ biomass input).
Cost for producing ethanol using straw compared to using grain

From Lange L.
Novozymes
Incineration of animal manure

- **Tax:** Incineration of fibre fraction of separated manure or chicken manure is in Denmark not economical sustainable due to taxation.

- **No tax:** Incineration of the solid fraction from separation of anaerobic treated manure, UK

- **Dry matter content** is the challenge for incineration or thermal gasification.
Environment friendly technologies and energy production

Ammonia scrubbing

Increase DM

Ammonium fertilizer

Gas Power/Heat

Thermic gasification or incineration

Ash rich in P and K
Climate and bio-energy example
Biogas & GHG reduction

- Natural gas substitution: 2.3 mill. ton CO2 or 3% of the total CO2 emission

- Coal energy substitution: 2.9 mill ton CO2 or 4% of the total CO2 emission
Assessment of effect on environment

Copied from presentation of
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The same amount of biomass as input to facilitate either transport (1 mile) through ethanol production or heat & power through coal substitution.
Conclusion

Biomass for energy production shall contribute significantly to production of environmental technologies.

It is realised that

- Biomass for power generation – best for environment
- Biomass for heating is cheapest (District heating)

But bio fuels is in focus due to the urgent need for transport energy?

- The argument is that (1) biofuels Is used in a transition phase until other energy forms is available & (2) biofuel can be used in existing engines
- **BUT** the biomass resource base is limited and use for ethanol will happen at the expense of use for heat & Power. Therefore power and heat generation using the biomass is the better alternative - substitutingt fossil fuels (oil and gas) that can then be used in the transport sector.

The bio fuels in consideration

- Ethanol
- RME (Oil seed rape oil-methyl ester - ‘bio diesel’)
Kyoto – 1997
Kyoto agreement

Rio – 1992
Climate Convention

Copenhagen – December 2009
New GHG reduction targets?

Source Hadley centre