

## Country Report Denmark

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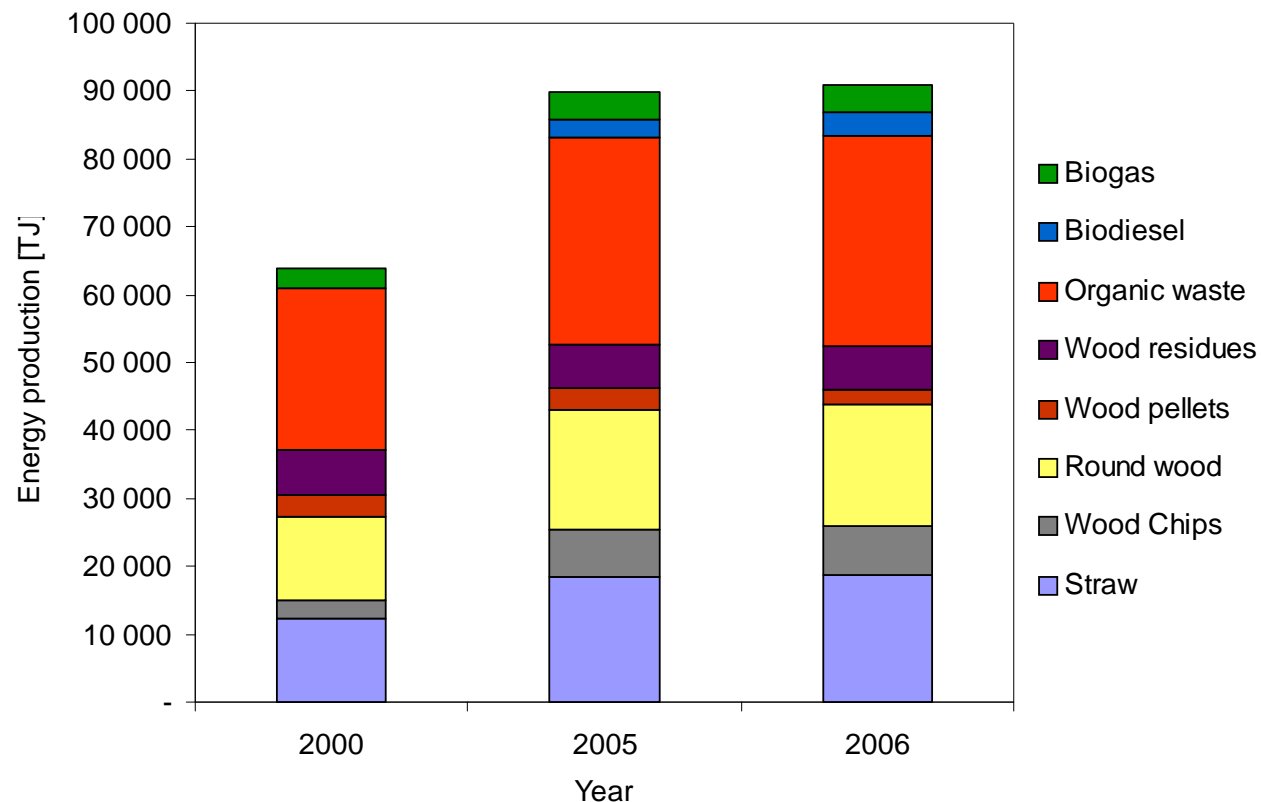
### 1. Introduction

- Denmark have and extensive use of biomass for CHP but so far no biorefineries (according to the IEA Task 42 definition)
- Currently strong political and research focus on production and utilization of biomass for energy

Focus of the presentation is on:

- Listing main industrial players in Denmark using biomass for energy or other products – although not currently biorefineries they could play a role in future biorefineries
- National programs for energy and biorefinery-related research
- Providing an overview of main players within the “biomass-to-energy” area and their interaction

### 2. Current national biomass use



Biomass covers 11% of total energy consumption in Denmark

Country Report “Identification Current Processing Potential and Mapping Existing Biorefineries”

### 3. Biomass-related national policy goals

#### **Biomass Action Plan (from 1993/1997)**

- Use of 1.4 mio. tons of biomass for power generation from 2000

#### **Non-food and feed Strategy (from 2006)**

- Proposal for research strategy – development of plants, microorganisms and enzymes to produce chemicals, materials and energy from biomass.  
*So far the strategy has not been implemented in policies.*

#### **Danish Energy Plan 2025 (from 2007)**

- Renewable energy to cover **30 %** of energy in 2025 (2-fold of present)
- Renewable biofuels for the transportation sector **10 %** in 2020
- Full scale demonstration plant for 2nd generation biofuel ready in 2010
- 3 year test period using biodiesel in public transportation
- Energy development and demonstration program 2007-2010
  - 100 mio. € in total
  - *25 mio. € dedicated for 2nd generation biofuel*

### 4. Mapping of Existing Biorefineries

*Primary agricultural sector (small-scale initiatives)*

- Biogas - currently around 31 farm plants and 20 centralized plants – Solum and Xergi main suppliers of technical solutions in Denmark. Input is manure, industrial waste (slaughterhouse) and main output electricity.

## 4. Mapping of Existing Biorefineries

*Food industry (sugar, starch, oleochemistry, bioethanol, biodiesel, ...)*

- Danisco/Genencor – Traditional sugar production from sugar beet (290,000 tons sugar/yr, molasses and beet pulp), enzymes and ingredients
- CP Kelco – production of pectins and carrageenan by extraction from citrus fruits, apples and seaweed. A main waste product is a fiber rich pulp from the filtration.
- AKV Langholt – production of starch from potatoes
- KMC – Processing of potatoes for e.g. starch (775,000 tons potatoes/yr – 133,000 tons starch, waste product potato pulp)
- Emmelev Mølle – biodiesel production from rapeseed (80,000 tons/yr), glycerol and feed from by-products
- Daka – production of biodiesel from animal waste (slaughterhouse), facility for producing 50,000 tons/yr under construction (ready end 2007)

### 4. Mapping of Existing Biorefineries

*Non-food Industry (materials, products, ...)*

- Hartmann – Moulded-fibrepackaging

### 4. Mapping of Existing Biorefineries

#### *Feed Industry*

- Agroferm – production of lysin for animal feed by fermentation of green juices from green pellet production
- Dangrønt – production of green pellets and green juices from grasses, investor in Agroferm



### 4. Mapping of Existing Biorefineries

#### *Pulp/paper Industry*

- Dalum Papir A/S – Recycling of paper. Production 140,000 tons fine paper/yr. Use of biomass for partly covering heating and electricity demand. Rest products are used as fertilizer and in the cement industry.

### 4. Mapping of Existing Biorefineries

*Petrochemical Industry, incl. Conventional Oil Refineries*

- Statoil oil refinery (5,5 mill tons/yr). Statoil presently only distributor of gasoline containing ethanol (5%) in Denmark. Involved in several biomass to bioethanol projects, including building of demonstration facility.
- Shell oil refinery (3,5 mill tons/yr)
- Haldor Topsoe/Topsoe fuel cells – Catalysts, gasoline from syngas (TIGAS), fuel cells

### 4. Mapping of Existing Biorefineries

#### *Power Production Industry*

- DONG Energy – power and heat production from biomass combustion. Involved in several projects with conversion of biomass to ethanol or other liquid fuels and integration with the power plant.
- Vattenfall - power and heat production from biomass combustion

The main biomass feedstocks are straw and wood chips. Municipal solid waste is also used.

### 4. Mapping of Existing Biorefineries

*Others:*

- Novozymes – enzymes for modification and hydrolysis of plant fibers and polysaccharides
- Danisco/Genencor – enzymes for modification and hydrolysis of plant fibers and polysaccharides

### 5. RTD-activities

#### *National and EC Projects*

- *National programs for funding energy research (not only biomass related)*

Sponsor	2007	2008
Ministry of Transport and energy (6)	25	27.7
Danish Agency for Science, Technology and Innovation (DSF-EnMI) (8)	14	12.5
PSO-fund (4)	20.7	20.7
Højteknologifonden (3)	7.5	9.6

Amounts in mio. €

Numbers in brackets indicate number of projects involving use of biomass for energy or products

### 5. RTD-activities

#### *National and EC Projects*

- *Examples of larger national projects*
  - “From sugar to polyester” – use of biomass for production of chemicals. (Højteknologifonden, 1.2 mio €)
  - “2. generation biofuel for future cars” – Optimisation of bioethanol production from biomass and integration of processes. (Højteknologifonden, 3 mio €)
  - “Renescence – waste to fuel and energy” – Flexible process for production of heat, power and liquid fuel from biomass and waste. (PSO, 3.9 mio €)
  - “Bio.REF” – Biorefinery for sustainable reliable economical fuel production from energy crops. (DSF-EnMi, 1.7 mio €)
  - “Improved applications of renewable resources for industrial non-food purposes” (Danish Ministry of Food, Agriculture and Fisheries, 5.5 mio €)

### 5. RTD-activities

#### *National and EC Projects*

##### •FP5:

- BIOTROLL – Integrated biological treatment and agricultural reuse of olive mill effluents with the concurrent recovery of energy sources
- BIOPACK – Proactive biobased cheese packaging
- EUROPECTIN – Upgrading of sugar beet pectins by enzymatic modification and molecular farming
- ENHANCE – Green chemicals and biopolymers from rapeseed meal with enhanced end-performances
- IBUS – Integrated Biomass Utilisation for production of Biofuels

##### •FP6:

- BIOCOMP - New Classes of Engineering Composite Materials from Renewable Resources
- NANOBIOCHARIDES - Nanotechnologies for Bio-inspired polySaccharides: biological decoys designed as knowledge-based, multifunctional biomaterials
- ECOBINDERS - Eco-friendly, emission-free, moisture resistant and 100% renewable binders
- SUSTAINPACK -Innovation and Sustainable Development in the Fibre Based Packaging Value Chain
- FLEXFUEL - Demonstration of a flexible plant processing organic waste, manure and/or energy crops to bio-ethanol and biogas for transport

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### 5. RTD-activities

#### *Pilot Plants*

- DONG Energy – 1 ton/h pilot plant for production of bioethanol and solid fuel from wheat straw. A liquid waste stream is to be concentrated and used as animal feed.
- BioGasol – pilot plant for integrated production of bioethanol, hydrogen and biogas from biomass



### 5. RTD-activities

#### *Demonstration Plants*

No demonstration plants in operation

- DONG Energy in collaboration with Statoil, Danisco/Genencor and AgBioEnergy plans to build a demonstration plant using 4 ton grain and 4 ton straw per h for production of bioethanol, solid fuel (for CHP) and feed – expect operation in 2009
- BioGasol plans to build demonstration plant with capacity of 100,000 tons of wet biomass per year with production of 10 mill l bioethanol, 10,000 tons pellets and 4 mill m<sup>3</sup> biogas – expected operation in 2009
- Danish Biofuel Holding plans to build a conventional bioethanol plant with capacity of 170 mio l/yr – expected operation 2009/2010. Planning to integrate with heat and power plant and biodiesel production.

## 6. Major National Stakeholders

*Industry, SMEs, Institutes, Universities, NGOs, GOs and their Interactions (scheme)*

Industries:

- Novozymes, Danisco/Genencor, DONG Energy, Vattenfall, Xergi, Haldor Topsoe, Daka, CP Kelco

SMEs:

- BioGasol, Emmelev Mølle, Solum, Bioscan

Research institutes/Universities:

- University of Copenhagen (KU), Technical University of Denmark/Risø (DTU/Risø), University of Southern Denmark (SDU), Aarhus University/Danish Institute of Agricultural Sciences (AU), Danish Technological Institute

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## 6. Major National Stakeholders

*Industry, SMEs, Institutes, Universities, NGOs, GOs and their Interactions (scheme)*

GO:

- Danish Energy Authority, Ministry of Food, Agriculture and Fisheries, Energinet.dk, The Danish Agency for Science, Technology and Innovation, Højteknologifonden

NGO:

- The Danish Agriculture Association, The Danish Forest Association, Confederation of Danish Industries/Danish Energy Industries Federation, CBMI (Innovation Centre for Bioenergy and Environmental Technology), DANBIO (Danish Biomass Association), Danish Biogas Association

### 6. Major National Stakeholders

