Recent developments in Denmark

Anders Evald

Henrik Houmann Jakobsen

dk-TEKNIK ENERGY & ENVIRONMENT

www.dk-TEKNIK.dk

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Denmark is....

- **Not the capital of Sweden.....,**
- **but a small European country adjacent to Germany and connected to Sweden by a bridge.**

Overview

1. Political framework conditions
2. Companies and institutions active in biomass combustion R&D
3. Ongoing and finished R&D projects
4. Market development
5. Recent biomass combustion systems implemented

Political framework conditions (1)

- New government November 2001
- Less government support to energy RD&D
- Substantial cuts in energy programmes in the fiscal budget
- Cost efficient energy supply in focus
- Renewable energy to survive under market conditions
- Danish climate obligations according to the Kyoto protocol expected to be met by Joint Implementation, Clean Development Mechanism and quota trading
  (Only to the extent it's cheaper than by domestic meassures)

Political framework conditions (2)

- **Department of Energy and Environment split into DOEnv. and Ministry of Trade and Industry**
- **We are all waiting for first substantial energy policy document from the new government: a strategy for Denmarks actions to meet the obligations according to the Kyoto agreement**

Programme reductions

Programme	Government support before	Government support after
Development and information of RE	20 M Euro	0 M Euro
Energy research	14 M Euro	5 M Euro
Utilites energy research	10 M Euro	10 M Euro
Energy savings and fuels switch in industry	19 M Euro	0 M Euro
Investment grants for biomass CHP	4 M Euro	0 M Euro
JI and CDM	0 M Euro	17 M Euro

The actors on the scene:

Recent changes:

- **CBT (Centre for Biomass Technology) continues as a network, based on consultancy fees, project tasks etc. (www.videncenter.dk/uk/)**
- **FLS Miljø biomass power activities are sold out to BURMEISTER & WAIN ENERGY A/S, owned by Italian STF (www.bwe.dk)**

Ongoing and finished R&D projects

1. Quality characteristics of Biofuel Pellets
2. The Pellet Handbook
3. Corrosion in wood fired boilers
4. Follow-up programme for biomass CHP plants
5. Combustion of low-contamination waste wood in wood industry
6. Separation and recycling of ashes from biomass energy systems

1. Quality characteristics (1)

- **Recipies for several low cost pellets produced from low lost material was developed**
- **Some of these showed resonable combustion characteristics (slaggging, fouling and combustion quility) AND low costs**
- **Report so far in paper version**

Quality characteristics (2)

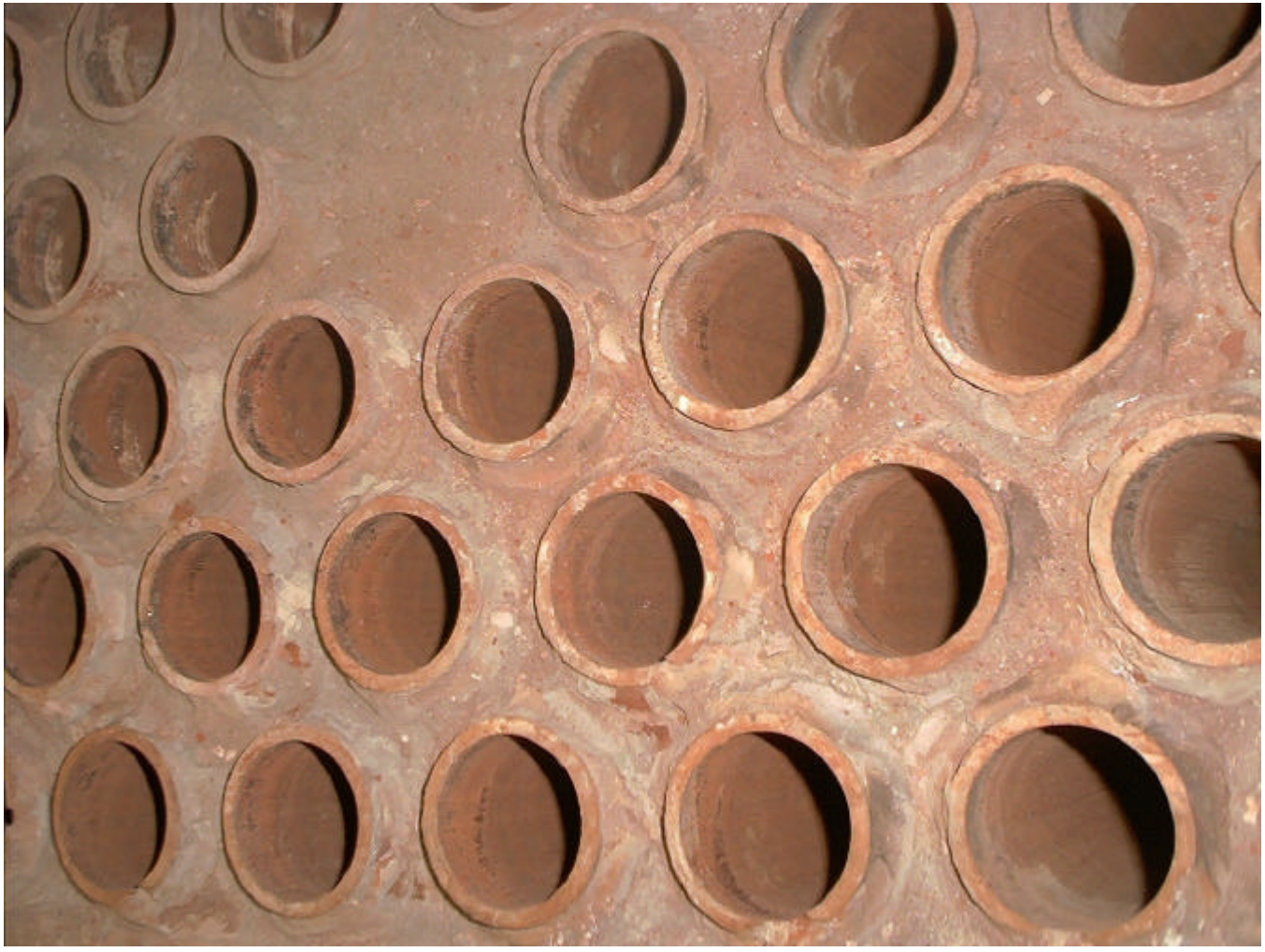
Pellet type	Composition	DKK/GJ	Dust fouling	Combustion quality
R1	Straw + Al(OH)3 1%	70.25	10	10
R2	Straw + kaolin 2%	71.71	10	6
R3	Straw + CaO 1% +	70.51	10	10
R4	2/3 straw, 1/3 wood + limestone 5%	75.05	8	4
R5	2/3 straw, 1/3 wood + Al(OH)3 5% +	87.68	10	2
R6	2/3 straw, 1/3 wood + limestone 5% +	79.19	3	3
R7	2/3 grain screening, 1/3 wood + limestone 5% +	74.90	4	2
R8	2/3 grain screening, 1/3 sunflower + limestone 5% +	74.04	4	2
R9	2/3 grain screening, 1/3 sheanut + limestone 5% +	76.34	4	2
R10	Grain screening + limestone 5% +	69.10	5	2
R11	2/3 grain screening, 1/3 wood + limestone 3% +	71.68	2	2
R12	2/3 grain screening, 1/3 shea nut + limestone 3%	69.56	2	1
Pellets of sawdust		79.17	1	1
Pellets of dried logs		69.20		

2. The wood pellet handbook

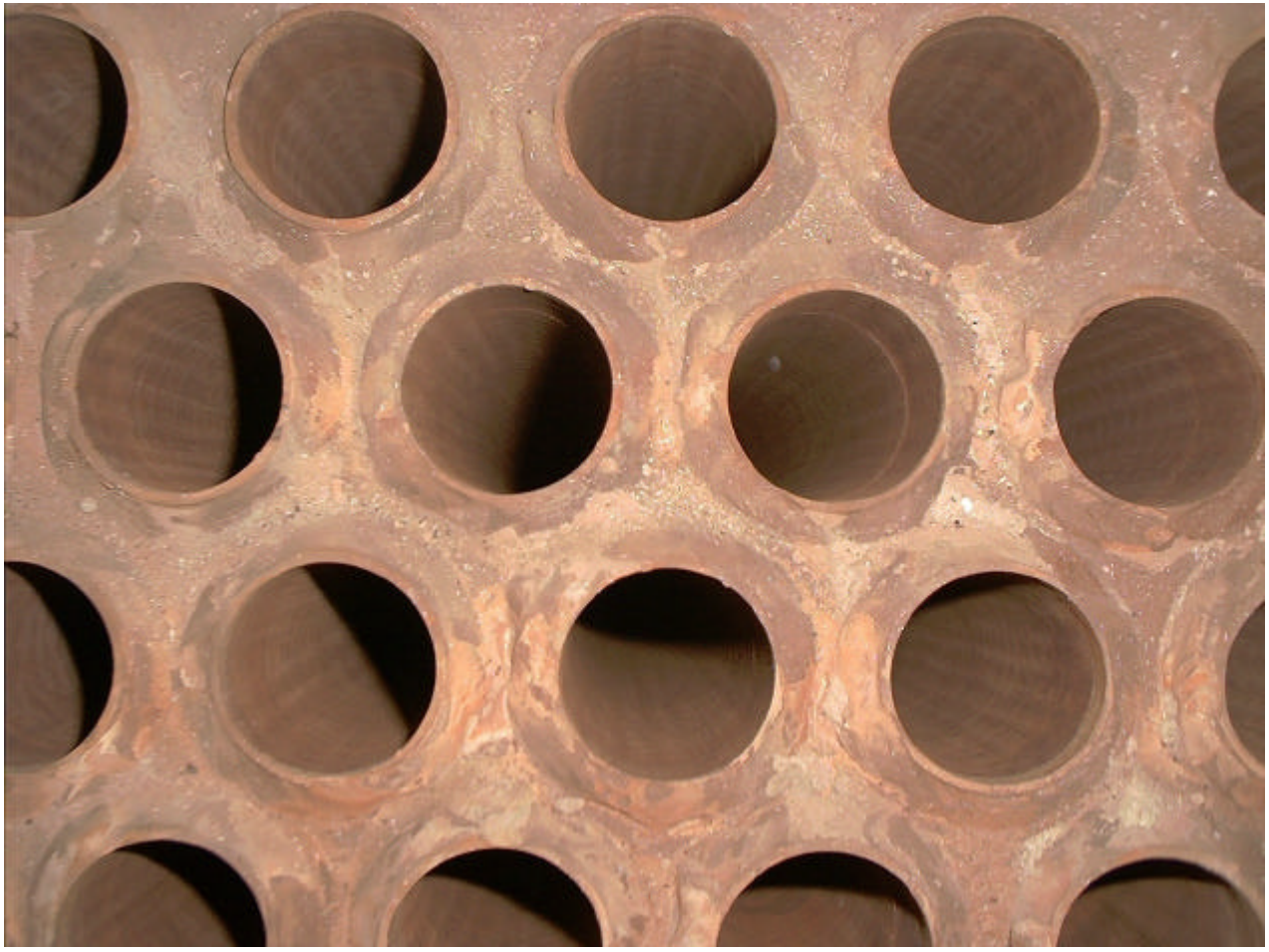
- **Complete reference to wood pellet issues:**
  - Properties
  - Legislation
  - Combustion
  - Markets
  - Design and engineering of wood pellet boilers and systems
- **In Danish (sorry folks!)**
- **www.pellets.dk-teknik.dk**

3. Corrosion (1)

Corrosion (2)



Corrosion (3)



Corrosion (4)

- **Convection tubes often corroded by 1 mm/year, lifetime often 3-5 years, as low as 2 years on wood chip fired hot-water boiler for moist wood chips**
- **3 different hypotheses on cause**
  - Sulphuric acid
  - Saline fouling
  - Organic acids
- **Main recommendation: raise boiler operating temperature to minmum 85-90oC (inlet temperature on boiler water)**
- **Other recommendations:**
  - watch out for red fly ash
  - air preheating
  - reduced water in wood chips
  - flue gas reciculation
- **www.fjernvarmen.dk go to F&U konto / Report 2001-04**

4. Follow-up programme sample data

November 2002	Heat + el efficiency, %	Electric efficency, %
Ansager	0	0
Assens	82	23
Ensted	-	48
Grenaa	95	19
Harboøre	101	2
Haslev	90	22
Hjordkær	98	11
Høgild	48	14
Junckers 7	-	16
Junckers 8	-	28
Masnedø	83	23
Måbjerg	81	24
Rudkøbing	89	21
Sakskøbing	89	29
Slagelse	-	27

5. Low-contamination waste wood

- **Investigation into environmental effects of combustion of industrial wood waste with limited and well-defined contaminations**
- **Finding no 1: No indication of an increase in NOx emissions from combustion of wood waste containing even hugh concentrations of glue (fibre boards)**
- **Precondition: good combustion condition**
- **To be published by Danish EPA on www.mst.dk**

6. Ash separation and recycling (1)

- **A survey into ash volumes, ash properties, ash handling costs and handling scenarios**
- **Appromately 70,000 ton of ashes to be handled in 2030**
- **New energy systems are expected to establish separate ash handling systems**
- **Fractionated ash handling removes barriers for ash recycling**

Ash separation and recycling (2)

2000 Ash in ton/year	Total ash production	Distributed in agriculture or forestry	Landfill
Straw fired district heating	13.440	10.750	2.690
Woo fired district heating	2.570	0	2.570
Wood pellet ditstrict ehating	560	0	560
Large straw fired power and CHP	14.230	9.930	4.300
Industrial CHP	1.500	0	1.500
I alt	32.300	20.680	11.620

Market developments

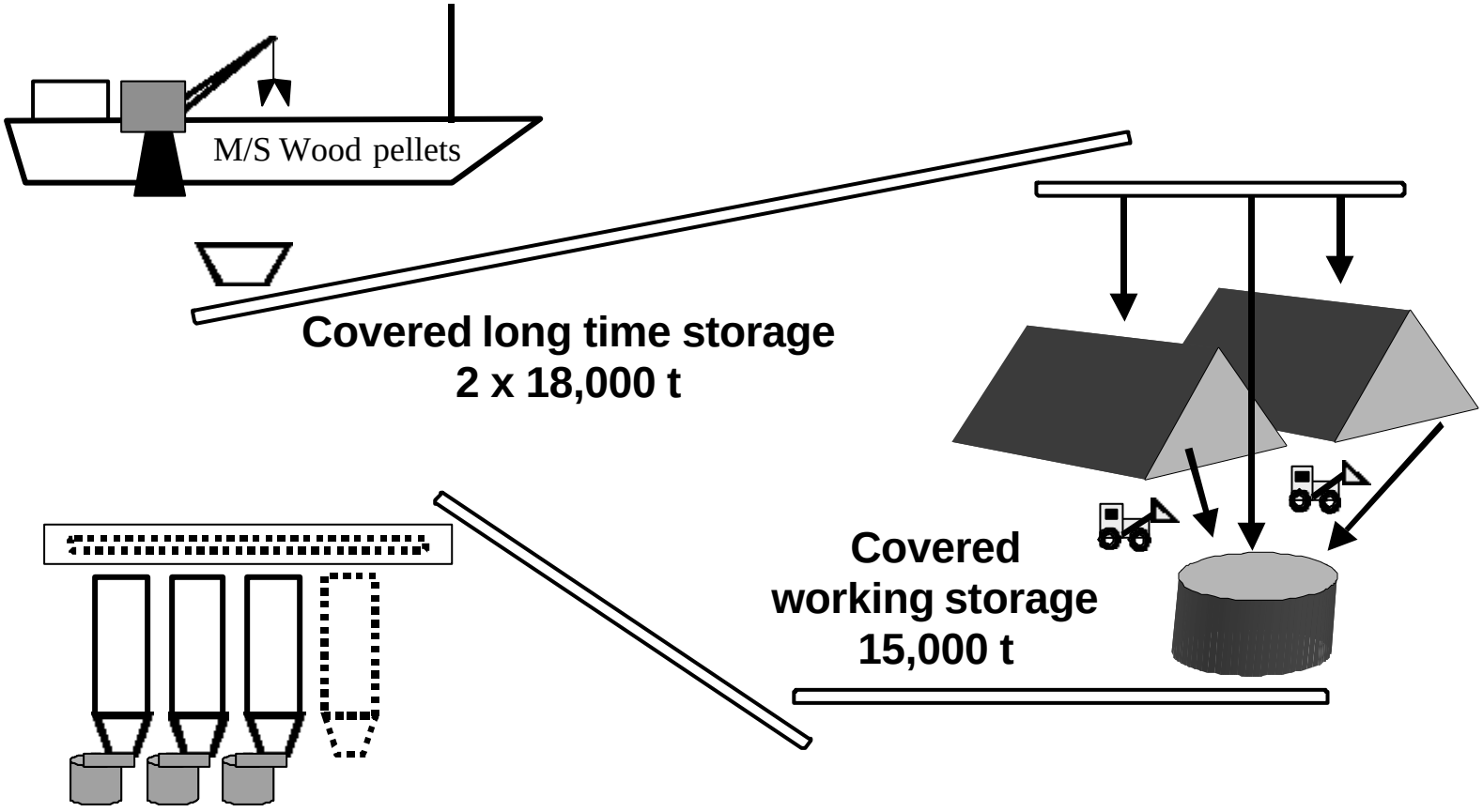
- **Huge increase in wood pellet comsumption in domestic sector**
- **Huge increase in straw in utilities sector**
- **Huge increase in wood pellets in utilities sector**
- **Huge inclease in wood chips in utilities sector**
- **Wood pellets prices much higher that 2 years ago**
- **Stable price on straw and wood chips**
- **Increasing import**

Recent biomass combustion systems

- **Avedøre unit II (separate straw boiler, wood dust)**
- **Herning CHP (wood chips on grate)**

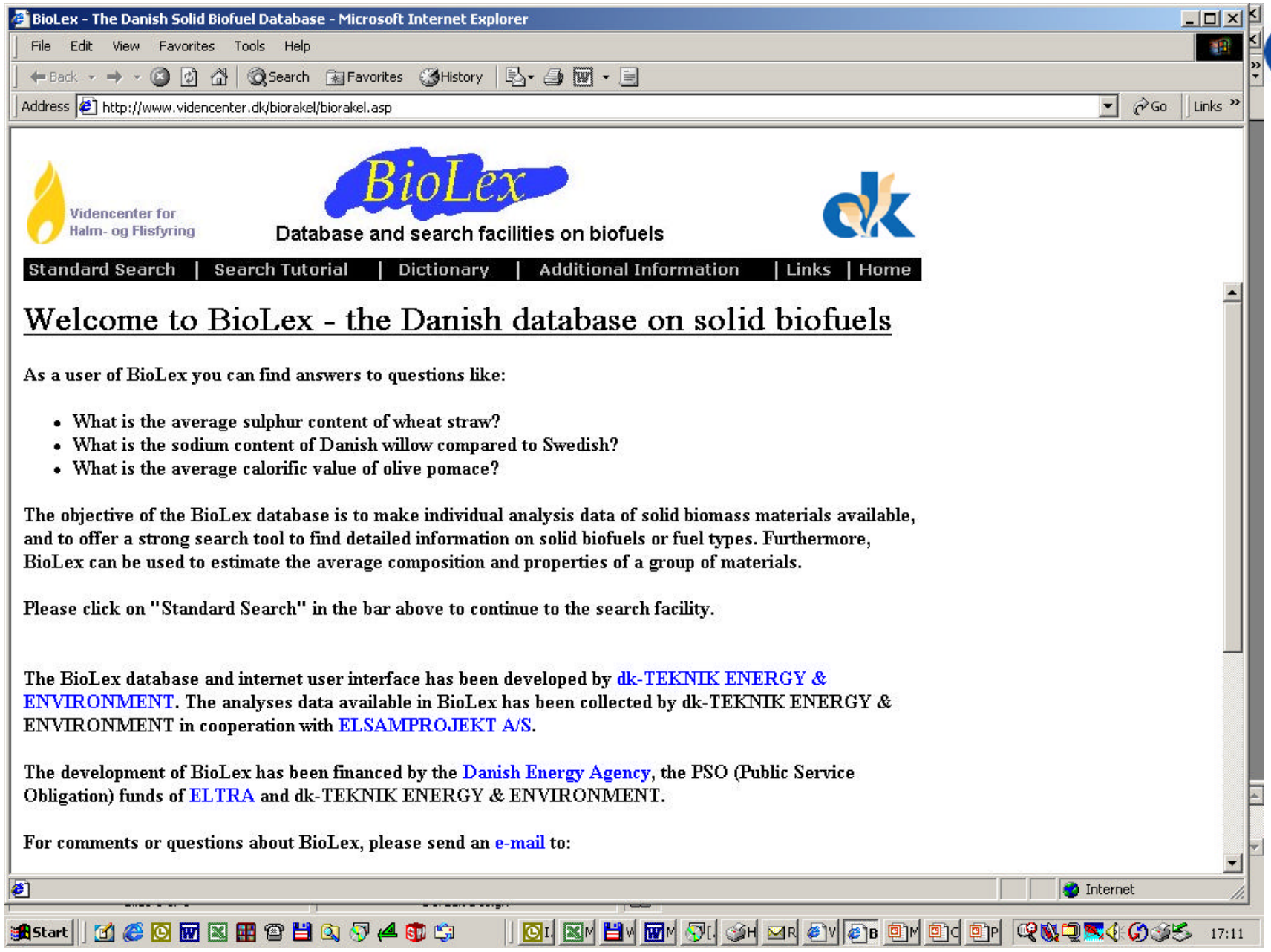
Avedøre Power Station

Fuel Handling of Wood Pellets at AVV2



Herning CHP

- 200,000 t of wood chips/year
- 75% of wood as chips from forestry plantations in Jutland
- 25% of wood from other sources e.g. whole trees
- 80 truckloads/day
- 13,000 m3 storage (3 days)
- Revised plant designed for 45% wood chips and 55% natural gas
- 9 x 10 m grate installed in boiler


BioLex - The Danish Solid Biofuel Database - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites History
Address http://www.videncenter.dk/biorakel/biorakel.asp
Go Links
Videncenter for Halm- og Flisfyring
BioLex
Database and search facilities on biofuels
Standard Search | Search Tutorial | Dictionary | Additional Information | Links | Home
Welcome to BioLex - the Danish database on solid biofuels
As a user of BioLex you can find answers to questions like:
What is the average sulphur content of wheat straw?
What is the sodium content of Danish willow compared to Swedish?
What is the average calorific value of olive pomace?
The objective of the BioLex database is to make individual analysis data of solid biomass materials available, and to offer a strong search tool to find detailed information on solid biofuels or fuel types. Furthermore, BioLex can be used to estimate the average composition and properties of a group of materials.
Please click on "Standard Search" in the bar above to continue to the search facility.
The BioLex database and internet user interface has been developed by dk-TEKNIK ENERGY & ENVIRONMENT. The analyses data available in BioLex has been collected by dk-TEKNIK ENERGY & ENVIRONMENT in cooperation with ELSAMPROJEKT A/S.
The development of BioLex has been financed by the Danish Energy Agency, the PSO (Public Service Obligation) funds of ELTRA and dk-TEKNIK ENERGY & ENVIRONMENT.
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