The history

Weiss GmbH founded in Germany by the Weiss brothers as a producer of combustion systems

- 1922
- Weis delivers its first District Heating plant
- 1980
- Nordfab A/S, a Danish supplier of wood working filtration systems, acquires Weiss A/S
- 1987
- A.P. Møller-owned DISA A/S acquires Nordfab A/S
- 1991
- Due to a change in strategic direction, Nordfab agrees to sell Weiss to management. Weiss A/S is established.
- 1996
- Weiss Sp. z o.o. is established in Poland.
- 1998
- Erhvervsinvest and Dansk Kapitalanlæg acquire the majority of the shares of Weiss A/S
- 2002
- A.P. Møller-owned DISA A/S acquires Nordfab A/S
- 2009
- Nordfab agrees to sell Weiss to management. Weiss A/S is established.
- 2009
- Weiss A/S is established.
- 2013
- In December 2013 ODIN's acquisition of Weiss A/S

Facilities and production sites

Hadsund - DK (HQ)
- Key activities:
  - Sales
  - Basic design
  - Project management
  - Installation & commissioning
  - Service
- ~40 employees in Hadsund

Odense - DK
- Key activities:
  - Production
  - Administration
  - The Danish production unit in Odense has a capacity of 7,000m²
- ~85 employees in Odense

Ostrowiec - PL
- Key activities:
  - Design
  - Project engineering
  - Production (expanding)
  - The Polish production unit in Ostrowiec has a capacity of 7,000m²
- ~95 employees in Ostrowiec
WHY BIOFUELS?

LOW PRICE
INDEPENDENCE FROM GAS SUPPLY
AVAILABILITY
ENVIRONMENTALLY FRIENDLY
LOW EMISSIONS OF CO₂

Shavings Sawdust
Pellets
Municipal waste
Straw
Wood chips
Bark
Briquette
Weiss addresses two main fuels: biomass and waste

Completed Weiss projects (2010-2013)*

Current ongoing Weiss projects*

**Biomass**
- Biomass is the organic material of recently living plants which also includes organic byproducts etc.
- Power generation from biomass can be achieved with a wide range of feedstock which has different properties

**Waste**
- Waste-to-Energy plants use municipal solid waste for heat and electricity generation
- This includes all household or domestic refuse and similar light commercial, industrial and institutional waste

**Key Points**
- Within recent years biomass has accounted for a large majority of the revenues
- However, waste is a significant part of Weiss’ current project portfolio

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*Based on Project revenues
Source: Management information
TYPES OF BIOMASS BOILERS

Weiss can offer following standard types:

- **Hot water boilers:** Central / District heating
- **Steam boilers:** Process industry
- **CHP boiler:** Combined Heat and Power

Area of use:
- District heating, buildings
- Grain mills, Process industry
- Wood treatment plants
- Agriculture
- Food processing.
WEISS PLANTS WORLD-WIDE

48 USA
2 Canada
2 Faroe Island
3 Greenland

1 Ireland
2 Scotland

1 Singapore
2 Russia
11 Netherlands
161 Denmark
31 Sweden
97 Denmark

139 Germany
56 Poland
1 Belarus

3 Czech Republic
3 Slovakia
5 Ukraine

21 Romania
6 Bulgaria
6 Austria
139 Slovakia

5 Hungary
8 Lithuania
3 Latvia
1 Estonia

331 Finland
45 Finland

52 Norway
97 Sweden

1 Singapore
2 Russia

1 Ireland
2 Scotland

1 Singapore
2 Russia
11 Netherlands
161 Denmark
31 Sweden
97 Denmark

139 Germany
56 Poland
1 Belarus

3 Czech Republic
3 Slovakia
5 Ukraine

21 Romania
6 Bulgaria
6 Austria
139 Slovakia

5 Hungary
8 Lithuania
3 Latvia
1 Estonia

331 Finland
45 Finland

52 Norway
Experiences during 30 years with straw combustion

**Development in straw fired boiler furnace**
- First plant installed to Danish farmer in 1981
- 1st generation of straw furnace developed during 1980s
- 2nd generation developed during 1990s. Typically size DH 2-3MWt
- 3rd generation launched 2010. Typically size DH 6-12MWt and for industrial purposes 10-36MWt in one or more parallel boiler lines.

**Development in straw logistics and straw in-feed**
- 1st generation: infeed of complete bale => low efficiency, high flue gas emissions.
- 2nd generation: infeed of grinded straw => generating sparks from stones, high wear and tear, high electrical energy consumption.
- 3rd generation: infeed of loose straw => high efficiency, low electrical consumption, improved flue gas emissions.

Today approx. 50% (by number!) of all DH plant in DK are burning straw
1st generation straw fired boiler
2nd generation straw fired boiler

- Developed to fulfill increased requirement to boiler line efficiency and availability
3rd generation straw fired boiler, <8MWt

- Developed to fulfill increased requirement to flue gas emissions. Possibility of infeed of alternative fuel in bulk above straw layer.
3rd generation straw fired boiler, >8MWt

- Developed to fulfill increased requirements for flue gas emissions, boiler plant size and to fully automate storage logistic
Today’s boiler house fuel logistic and straw infeed equipment
Storage area, for 36MWt boiler plant
Example of today’s hot water boiler design

SNCR branch

Standstill heating branch
Example of today’s hot water boiler design
Design of boiler and boiler furnace

- Ensure right dimensioning of furnace and boiler passes
- Optimize boiler efficiency
- Ensure high boiler availability. Increase time between overhaul/manual cleaning.

Mass and heat balance is prepared by Process department in Hadsund, Denmark
Experiences with sourcing straw in DK

- Sale of straw has become an important income for the farmers.
- Baling <18% water content. A shower of rain before baling, advantage.
- Dry storage capacity is a challenge. Development in farming => free storage.
- Combined “in house” and “field storage”.
- In house storage, a challenge in Central Europe. Virgin market. No tradition.
- The increasing size of the straw fired boiler plants => high logistic demand.
- Farmers are clever people!! Ensure strict delivery control from day 1.
- Straw delivery contracts.
  - DH heating plant signing contract with group of joint farmers
  - The group has a “coordinator” responsible for the contact to the DH plant.
  - The coordinator arranges the yearly delivery plan to the DH plant.
  - The farmers are paid individually when delivering the straw bales.
  - Water content in delivered straw < 15% => Bonus price.
  - Water content in delivered straw 15-18% => Nominal price.
  - Water content in delivered straw 18-20% => Price reduction.
  - Each farmer returns ashes to his field. Proportional with straw delivered.
Requirements to straw quality

- Round bales. “No go” in modern energy plants
  - Challenge in virgin biomass markets
- Square bales:
  - Reduced transport costs
  - High availability in fuel storage
  - High availability in boiler infeed/furnace
- Straw bale parameters:
  - Bale Size (LxWxH) 2,4 x 1,2 x 0,7/0,9/1,3
  - Water content: <20%
  - Bale weight: 500-600kg
- “out of scope” consequences:
  - Unstable transport and storing
  - Reduced boiler house availability
  - Reduced boiler furnace efficiency
  - Increase unburned straw in ash discharge
  - Risk of back-fire!
CEN norm for straw bales

CEN 14961

Table 12 — Specification of properties for straw bales

<table>
<thead>
<tr>
<th>Dimension (mm)</th>
<th>Height (L₁)</th>
<th>Width (L₂)</th>
<th>Length (L₃)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P₁</td>
<td>1300</td>
<td>1200</td>
<td>2200</td>
</tr>
<tr>
<td>P₂</td>
<td>1300</td>
<td>1200</td>
<td>2400</td>
</tr>
<tr>
<td>P₃</td>
<td>600 to 900</td>
<td>1200</td>
<td>2400</td>
</tr>
<tr>
<td>P₄</td>
<td>1500</td>
<td>1200</td>
<td>1500 to 2750</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bale density (kg/m³)</th>
<th>BO130</th>
<th>BO100</th>
<th>BO105</th>
<th>BO165</th>
<th>BO165+</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 135</td>
<td>≤ 150</td>
<td>≤ 165</td>
<td>≤ 165</td>
<td>&gt; 165</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Moisture (w-% as received)</th>
<th>M₁₆</th>
<th>M₁₆⁺</th>
<th>M₂₀</th>
<th>M₂₀⁺</th>
<th>M₃₀</th>
<th>M₃₀⁺</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 16 %</td>
<td>≤ 16 %</td>
<td>≤ 23 %</td>
<td>≤ 23 %</td>
<td>≤ 30 %</td>
<td>≤ 30 %</td>
</tr>
<tr>
<td></td>
<td>No part over 23 %</td>
<td>Parts over 23 % acceptable</td>
<td>No part over 30 %</td>
<td>One or more parts over 30 %</td>
<td>No part over 35 %</td>
<td>One or more parts over 35 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ash (w-% of dry basis)</th>
<th>A₀₅</th>
<th>A₁₀</th>
<th>A₁₀⁺</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 5 %</td>
<td>≤ 10 %</td>
<td>&gt; 10 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Species of biomass</th>
<th>Has to be stated</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Net calorific value, qₑᵤₑₑₑ (MJ/kg as received) or energy density, Zₑₑₑₑ (kWh/m³ loose)</th>
<th>Recommended to be specified</th>
</tr>
</thead>
</table>

| Particle size distribution or structure | It is recommended to declare production methods that influence the size of the straw particles. This is for instance weather the crop has been trash or oscillation or weather it has been chopped. |
What kind of fuel are we designing for…?

- Straw fired boiler furnace is different from wood fired furnace.
- Dry bio fuels
- Wet bio fuels
- Compromising the feed stock results in compromising both the availability and efficiency.
Future challenges, stricter emission requirements

Typically emission requirement of today:

- CO < 250 mg/Nm³
- SOx < 1000 mg/Nm³
- NOx < 650 mg/Nm³
- Dust < 40 mg/Nm³

Related to 11% O2

Future considerations:

- SNCR system for NOx reduction
- Flue gas condenser systems, for reduced flue gas temperature
Reference installation on the Central European market - straw fired boiler installation

- Some examples....

- Vinprom Peshtera, BG, 10+14MWt boiler line
- SIS Industries, BG, 12MWt boiler line
- Almagest, BG, 12MWt boiler line
- Agropolychim, BG, 2x14MWt boiler line
- Hungrana, HU, 2x14MWt boiler line
- EVN, A, 3MW boiler line
3,5MWt straw fired hot water boiler installation in Denmark

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissioning year</td>
<td>2013</td>
</tr>
<tr>
<td>Fuel</td>
<td>straw</td>
</tr>
<tr>
<td>Capacity</td>
<td>3,5 MW</td>
</tr>
<tr>
<td>Fuel consumption (20%)</td>
<td>950 kg/h</td>
</tr>
<tr>
<td>Hot water production</td>
<td>105 C</td>
</tr>
<tr>
<td>Operation pressure</td>
<td>3 bar</td>
</tr>
<tr>
<td>Efficiency at 100% and boiler load at 20% fuel moisture</td>
<td>91%</td>
</tr>
<tr>
<td>Availability</td>
<td>98%</td>
</tr>
</tbody>
</table>
36MWt straw fired steam boiler installation in Hungary

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissioning year</td>
<td>2012</td>
</tr>
<tr>
<td>Fuel</td>
<td>straw</td>
</tr>
<tr>
<td>Capacity</td>
<td>3 x 12 MW</td>
</tr>
<tr>
<td>Fuel consumption (20%)</td>
<td>3 x 3,379kg/h</td>
</tr>
<tr>
<td>Steam production</td>
<td>3 x 18 t/h</td>
</tr>
<tr>
<td>Operation pressure</td>
<td>13 bar</td>
</tr>
<tr>
<td>Efficiency at 100% and boiler load at 20% fuel moisture</td>
<td>87%</td>
</tr>
<tr>
<td>Availability</td>
<td>98%</td>
</tr>
</tbody>
</table>
28MWt straw fired boiler installation in Hungary
PRODUCE ENERGY FROM RESOURCES YOU ALREADY HAVE!

- THANK YOU

www.weiss2energy.eu