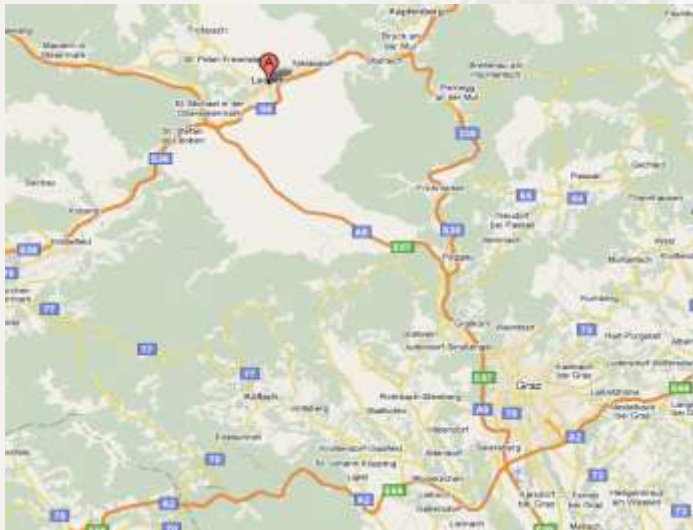




Leoben in Austria - LE

Model: 3 x TD 1500
Client: Mayr-Melnhof
Start-up: April 2005
Localisation: Leoben – Austria
Fuel: Wood chips
Electric power: 3 x 1500kWe
Thermal power application: drying systems
Thermal power: 23 MWth
Water temperature: 75 - 95° C
Boiler supplier: Kohlbach



Context / Special Features

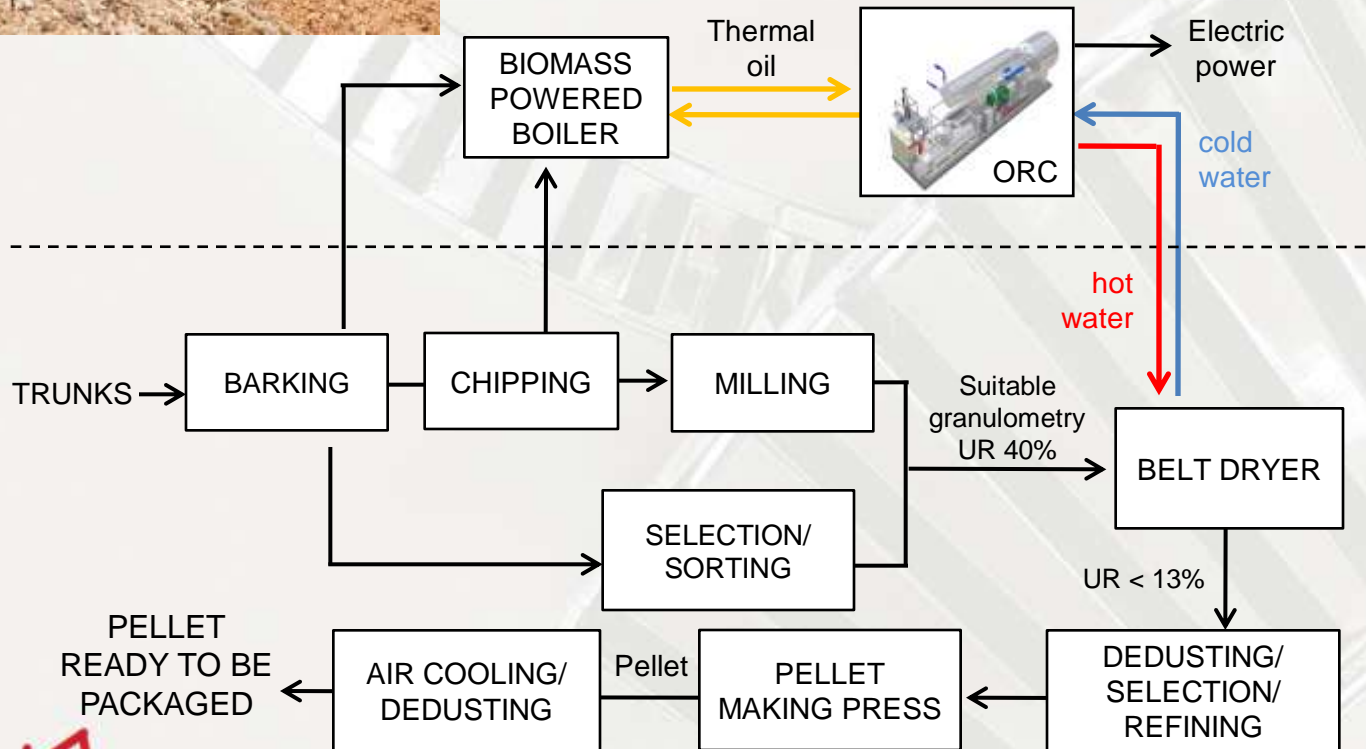
- **Biomass-fueled thermal oil boiler:**
 - 32,5 MW biomass input power
 - 28 MW thermal oil output power
- **3 x Turboden 1,5 MWe units:**
 - el. capacity 4,5 MWe
 - annual electricity production: 36 GWh
 - hot water capacity: 23 MWth
 - annual heat production : 192 GWh
- **Heat users:**
 - Lumber drying kilns
 - Pellet plant (75 000 t/year)
 - Office space heating



Turboden ORC Technology Woodpellet production



Wood Pellet Production



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Pellet process and Turboden ORC integration



The integration between the **Turboden ORC** and an existing or brand new Pellet manufacturing process gives the possibility to ***diversify the business*** producing, at the same time, Pellet and Electrical Energy from Renewable Sources (i.e. biomass)



Dimensioning Parameters

•Source: *Bioenergy International* May 2011,
Prodesa Medioambiente –
“Cogeneración y producción de pellet”

ORC Size	Pellet production capacity**
Turboden 10 CHP Split (4100 kWth)	30.000 t/y*
Turboden 14 CHP Split (5340 kWth)	42.000 t/y*
Turboden 22 CHP Split (9598 kWth)	85.000 t/y
Turboden 30 CHP Split (13636 kWth)	120.000 t/y

Sample case:**

- ORC Unit: **Turboden 10 CHP** integrated in a Pellet plant
- Pellet production capacity = 4 tons/h
- Pellet production = 30.000 tons/y
- Biomass Consumption = 57.500 tons/y
- Boiler installed = 5,2 MWth
- Electrical power installed = 1 MWeI
- Thermal power output = 4.1 MWth at 60/80°C

**Assuming Turboden CHP and Belt dryer configuration



Erta in Spain - EA

Model: TD 7 CHP
Client: ERTA - Energías Renovables de Tarazona
Start up: 2011
Location: Tarazona della Mancha - Spain
Fuel: Wood chips
Electric power: 729 kW_e
Thermal Use: drying belt in pelletisation process
Thermal power: 3145 kW_{th}
Water Temperature: 60-80 °C

Boiler supplier: Sugimat



Context / Special Feature

A/ Pelletisation process

- Annual production: 30000t/year
- 4 silos of 500t each for bulk distribution
- 15kg bags production
- Max pellet production: 4 t/h
- Hot water to dry saw from 50% to 10%

B/ Specificity: Application Pellet

- General contractor: PRODESA
- belt dryer supplier: Swiss Combi
- Pelletisation system supplier: Promill





Biomass

Main References

Example of Pellet application

Pontedeva in Spain - PD

Model: TD 6 CHP

Client: Prodesa Medioambiente

Start up: 2012

Location: Pontedeva - Spain

Fuel: Forestal Biomass

Electric power: 617 kWel gross

Thermal Use: drying belt in pelletisation process

Thermal power: 2600 kWth

Water Temperature: 60-80 °C

Special Feature

Annual production: 20000 t/year

Pellet production capacity: 2.5 t/h





Corana in Italy - IP

Model: TD 12 HRS
Client: Italiana Pellets SpA
Start up: 2011
Location: Corana (PV)
Fuel: Wood chips
Electric power: 999 kW_e
Thermal power: 3040 kW_{th}
Water Temperature: 25-35 °C

Special Feature

Pellet production capacity: 100.000 t/a





Mudau in Germany - MU

Model: T1100
Client: BIO-ENERGIE MUDAU GMBH & CO.KG
Start up: June 2006
Location: Mudau - Germany
Fuel: Wood chips
Electric power: 1187kWe
Thermal Use: drying belt in pelletisation process
Thermal power: 5335kWth
Water Temperature: 60-85 °C
Boiler supplier: Kohlbach



Context / Special Feature

A/ Pelletisation process

- Max pellet production: 6t/h
- Hot water to dry saw from 50% to 10%

B/ Specificity: Application Pellet

- Biomasse boiler: 6570 kWth
- Cogénération withORC:
5335kWth
1187 kWe (brut); 1124 kWe (net)
- belt dryer supplier: Stela
- Pelletisation system supplier: Salmatec

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Turboden ORC Technology MDF production



A quick overview on the wood panel industry

In the furniture industry different kind of panels are used. Basically these kind of products are made by little wood fibers and glue in order to give to the product some specific features like low weight and good mechanical resistance





A quick overview on the wood panel industry

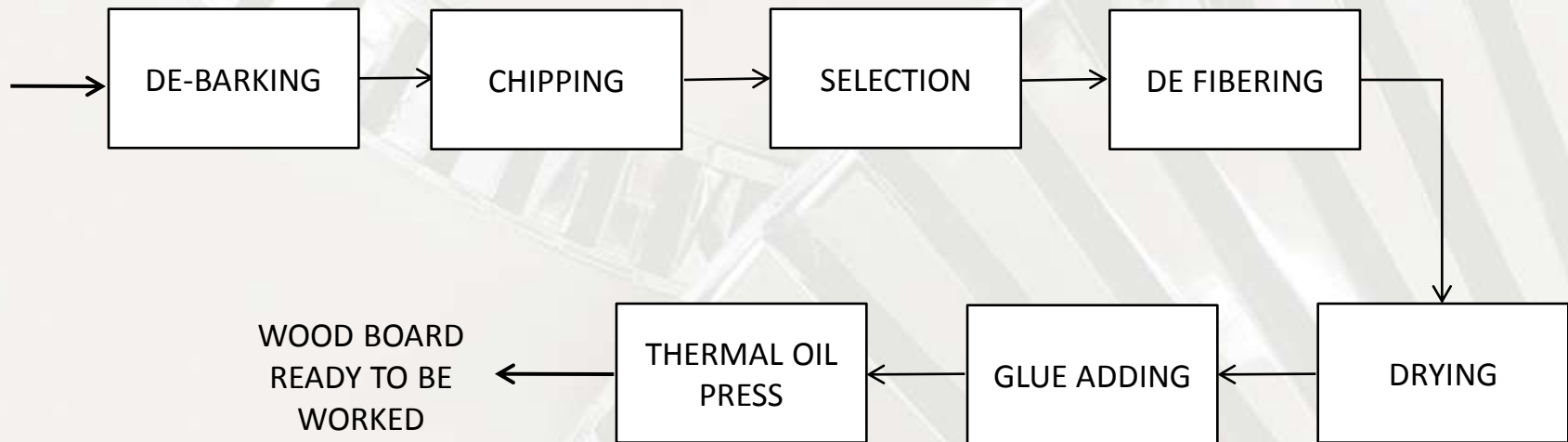
In the wood panel industry there are basically five kind of products:

- 1) MDF (Medium Density Fiber);
- 2) OSB (Oriented Strand Board);
- 3) PB (Particle Board);
- 4) IB (Insulation Board);
- 5) PB (Pallet Blocks).





The production process

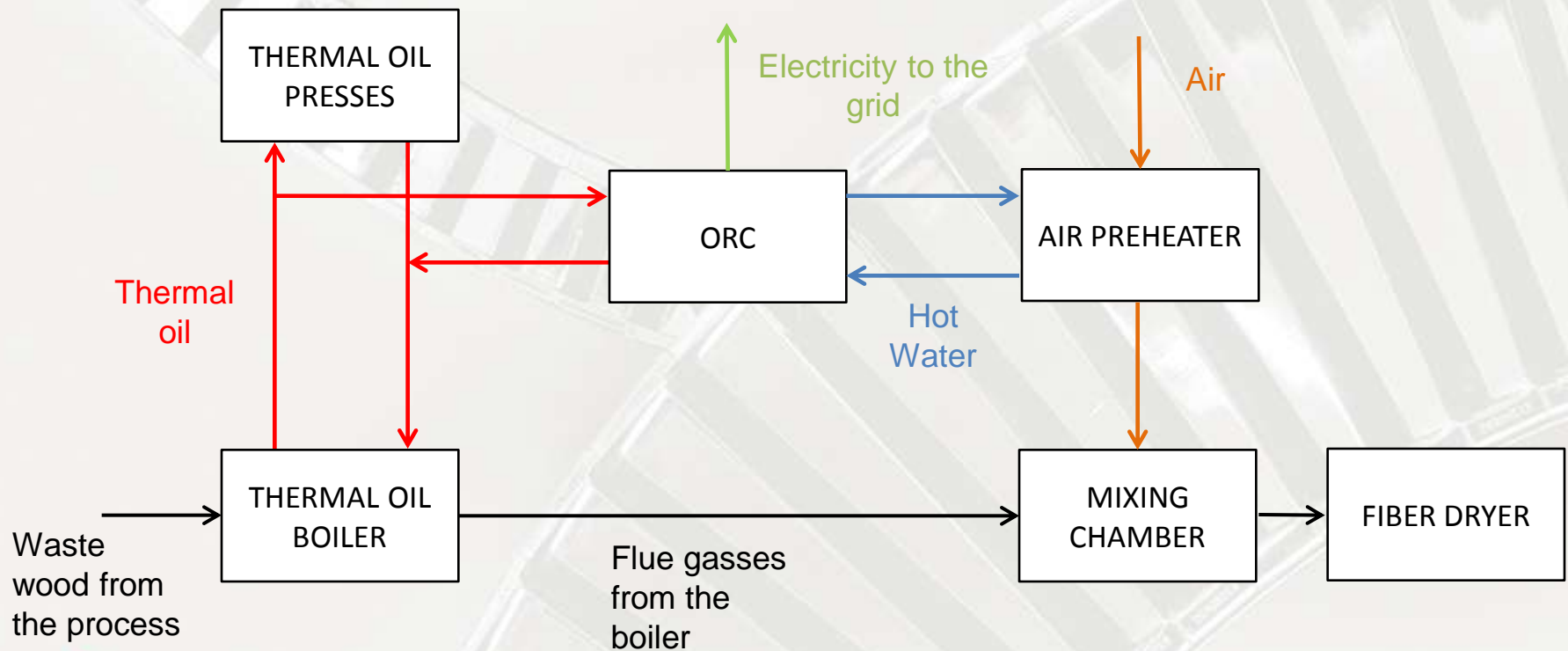


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Where to install an ORC in a MDF process

In the wood panel industry usually a thermal oil boiler is already installed because the presses need thermal oil at 260 – 280°C





Case study 1: MDF Hallein GmbH (Austria)



Customer: MDF Hallein GmbH & Co KG

Location: Hallein Austria

Started up: Nov 2005

Model: T1500 CHP

Electric Power: 1,45 MWe

Thermal Power to the cooling water circuit: 7700kWth

Water Temperature (in/out): 90°- 110°C

Fuel: waste biomass from the process

Application: Industrial process (production of MDF panels)



Case study 2: Kastamonu Entegre (Turkey)



Customer: Kastamonu Entegre

Location: Gebeze (Turkey)

Start up (expected): June 2012

Model: Turboden 10 HR - cogenerative

Electric Power: 955 kWel

Thermal Power to the cooling water circuit: 5500 kWth

Water Temperature (in/out): 73°- 93°C

Fuel: waste biomass from the process

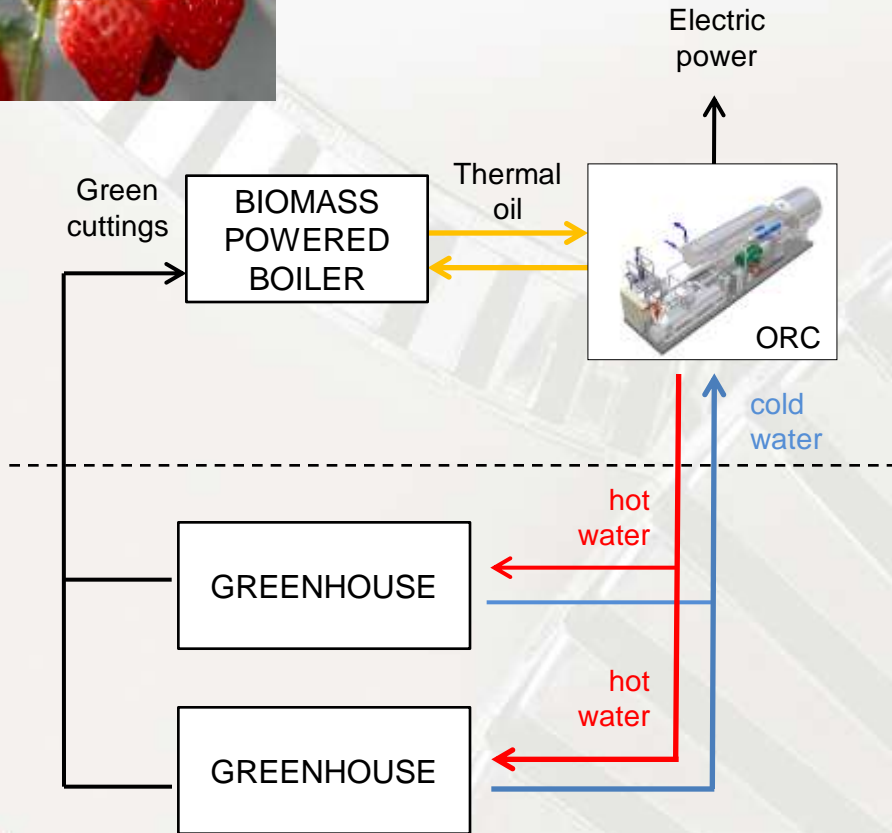
Application: Industrial process (production of MDF panels)



Turboden ORC Technology Greenhouses



Greenhouses



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Alperstedt in Germany - MW

Model: T1500
Client: AGO AG - TOMSTAR
Start-up: 12/2006
Localisation: Alperstedt- Germany
Fuel : Virgin wood chips
Electric power: 1691kW_e
Thermal power application: greenhouse heating
Thermal power: 8120 kW_{th}
Water temperature: 60-90 °C
Boiler supplier: Mawera



Context / Special Feature

Business: Vine tomatoes greenhouse
Greenhouse size: 100.000m²
Yearly production: 4.800 t
Nominal thermal power: 8.120 kW_{th}
CO₂ saving: 14.000 t/year
Website: tomstar.gbt-alperstedt.de





Turboden ORC Technology Industrial applications



Example of Industrial application : **CAVANNA Power Plant**

Predosa - in Italy (CN)

Model: Turboden 12 HRS Split

Client: Esseti Energia Srl

Start-up: November, 2011

Location: Predosa (AL), Italy

Fuel : Virgin Wood Chips

Electric power: 1,000 kW

Net Electric Efficiency: 23.2 %

Cooling Source: Water /air

Water temperature: 25°- 35°C

Thermal power application: Space Heating

Boiler supplier: Uniconfort



Context / Special Feature

- **Business :** Wood for Roofing
- **Yearly Biomass Consumption :** 16,000 ton
- **Future Development :** Pre-heating for drying chambers and space heating for new offices.



Turboden ORC Technology Agro-industrial applications

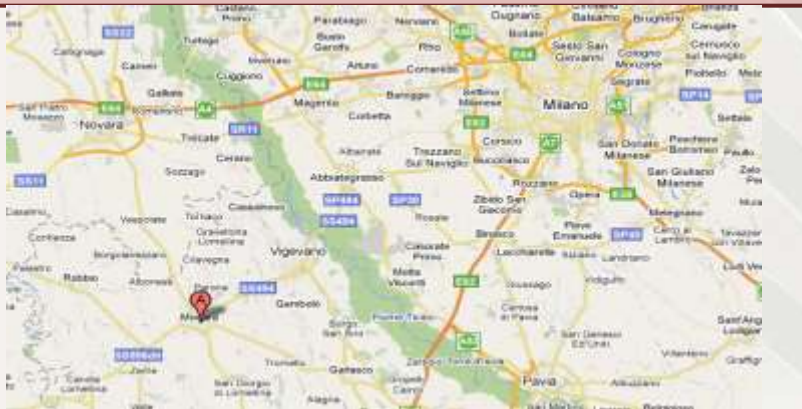


Biomass Main References

Example of Industrial application: **PARBORIZ Power Plant**

Mortara in Italy - PB

Model: T600 CHP
Client: Parboriz Spa
Start-up: July 2008
Localisation: Mortara (PV) Italy
Fuel : Rice husk
Electric power: 600 kW
Thermal power application: Production of parboiled rice
Thermal power: 2.8 MW
Water temperature: 60°- 80°C
Boiler supplier: Classen Apparatebau Wiesloch GmbH
Availability > 99%





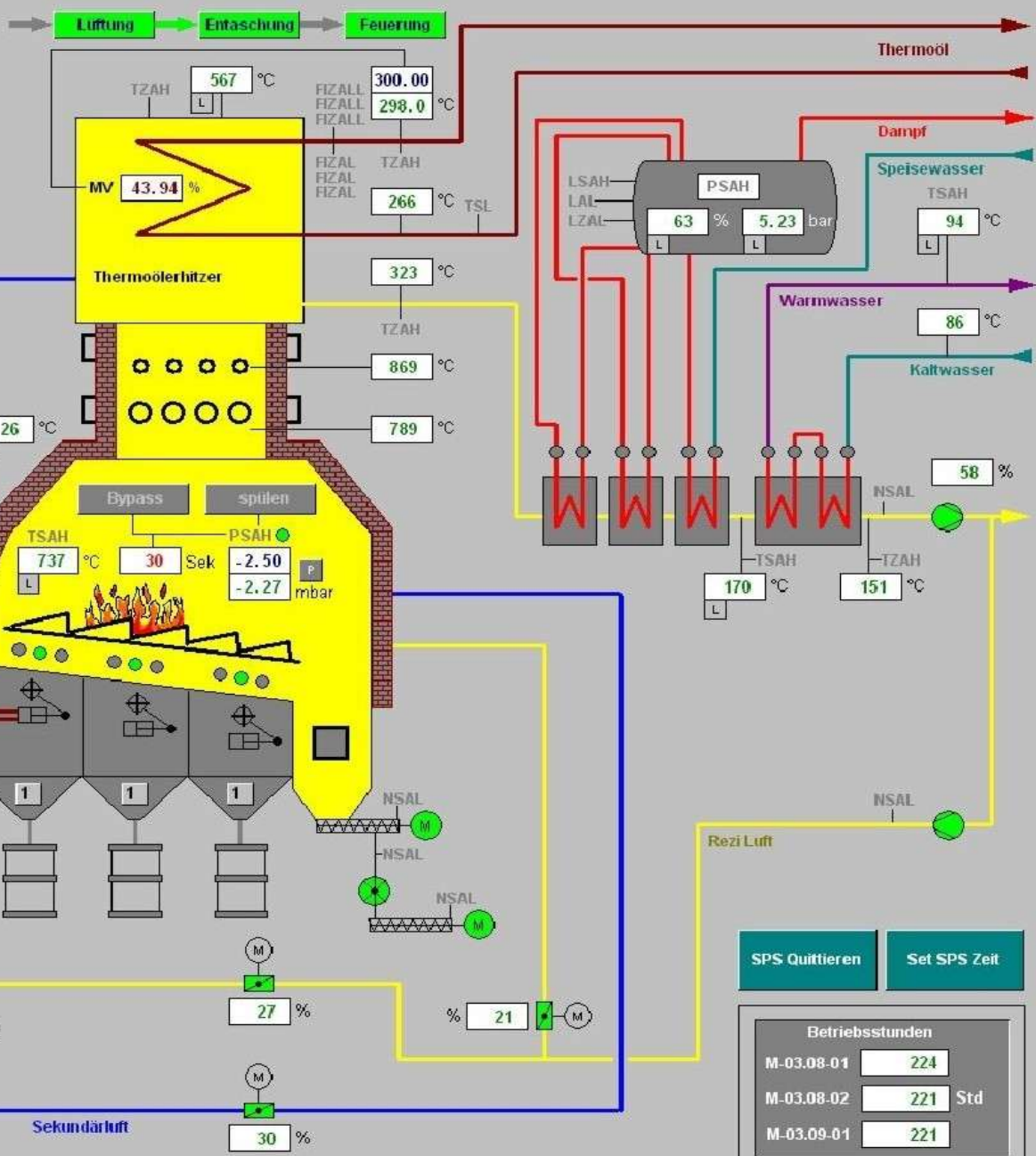
Schnittstelle CAW << Parboriz	Schnittstelle CAW >> Parboriz
Notumwälzpumpe bereit	TZAH Vorlauftemp.Öl
LSAL Notkühlwasser	TZAH Temp.Erhitzer Austritt
LAL Ausdehnungsgefäß	Freigabe Beschickung
Freigabe Entschungung	PSAH Dampfrommel
Stopp Feuerung	LISH Beschickung
Stopp Feuerung+Lüftung	LISL Beschickung
	LZAL Dampfrommel
	Anforderung Löschwasser
	Feuerung aktiv
	Sammelstörung

Druckluft **Brennstoff** **Löschwasser**

600 Sek 600 Sek

PSAL

Offset	0.0	1.0	1.0	-0.0
%	33.2	34.2	34.2	33.2
	33	33	33	32



LISH **Desieren** LISH

26 °C

LISL

NSAL 4 3 2 1

31 °C

PSAH

Notbetrieb Hydraulik

PSAH

LAL LSAL 600 Sek

TSAH TSL 0 Sek

Hydraulik Rost

Rost	1	2	3	
Pause	124	357	397	Sek
Rest	100	143	167	Sek
Zyklen	28.39	10.00	9.00	1/Std

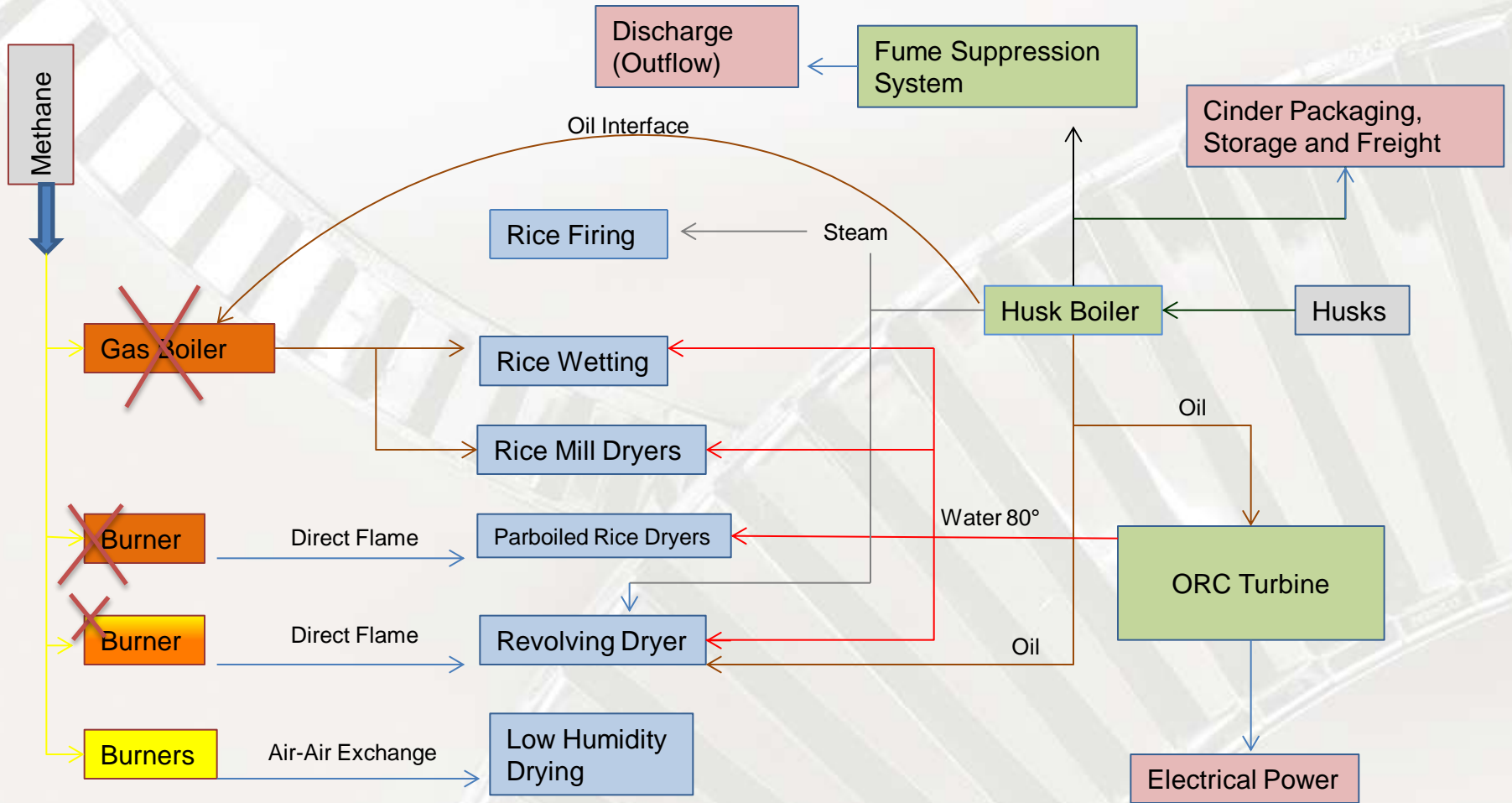
SPS Quittieren Set SPS Zeit

Betriebsstunden	
M-03.08.01	224
M-03.08.02	221 Std
M-03.09.01	221



Biomass Main References

Example of Industrial application: **PARBORIZ Power Plant**



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In operation

Parboiled Rice Production

New

Not in operation