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Biomass cogeneration : Activities and experiences with plants based on biomass gasification

Gammel & Duvia

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Gammel Duvia Engineering

❖ COMPLETE ENGINEERING SERVICES FOR THE TENDERING, INTEGRATED DESIGN AND REALISATION OF BIOMASS POWER PLANTS IN PARTNERSCHIP WITH GAMMEL ENGINEERING GMBH

❖ PROJECT DEVELOPMENT

❖ BUSINESS PLANS/ DUE DILIGENCES

❖ TECHNICAL AND ECONOMICAL EVALUATION OF EMERGING TECHNOLOGIES

❖ BUSINESS DEVELOPMENT

❖ PROPOSAL MANAGEMENT/OPTIMISATION ON INTERNATIONAL MARKETS

STRONG TECHNICAL AND COMMERCIAL BACKGROUND IN THE BIOMASS COGENERATION, GEOTHERMAL AND INDUSTRIAL HEAT RECOVERY SECTORS.

MORE THAN 10 YEARS OF INDUSTRY EXPERIENCE WITH LEADING EUROPEAN PARTNERS AND CUSTOMERS.

Standard turnkey plant „Pezzolato Energia“: based on fixed bed downdraft gasifier

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Background of the project

Pezzolato with headquarters in Envie (CN) is a company active since 1976 in the production design amd sale of biomass treatment devices (chipping machines, splitting machines, sawmill machines).

In 2013 Pezzolato decided to evaluate the opportunity to enter the energy cogeneration market with main focus on small gasification plants (< 200 kWel).

Pezzolato headquarters in Envie (CN)

Gammel Duvia Engineering was selected as consultant for:

- Tecnology and market analysis of European market for «small biomass gasifiers».
- Evaluation of potential business models and partners.
- Tecnology and market analysis of European market for «small biomass dryers».
- Business development strategy and negotiation with specific customers.

Selected technology provider

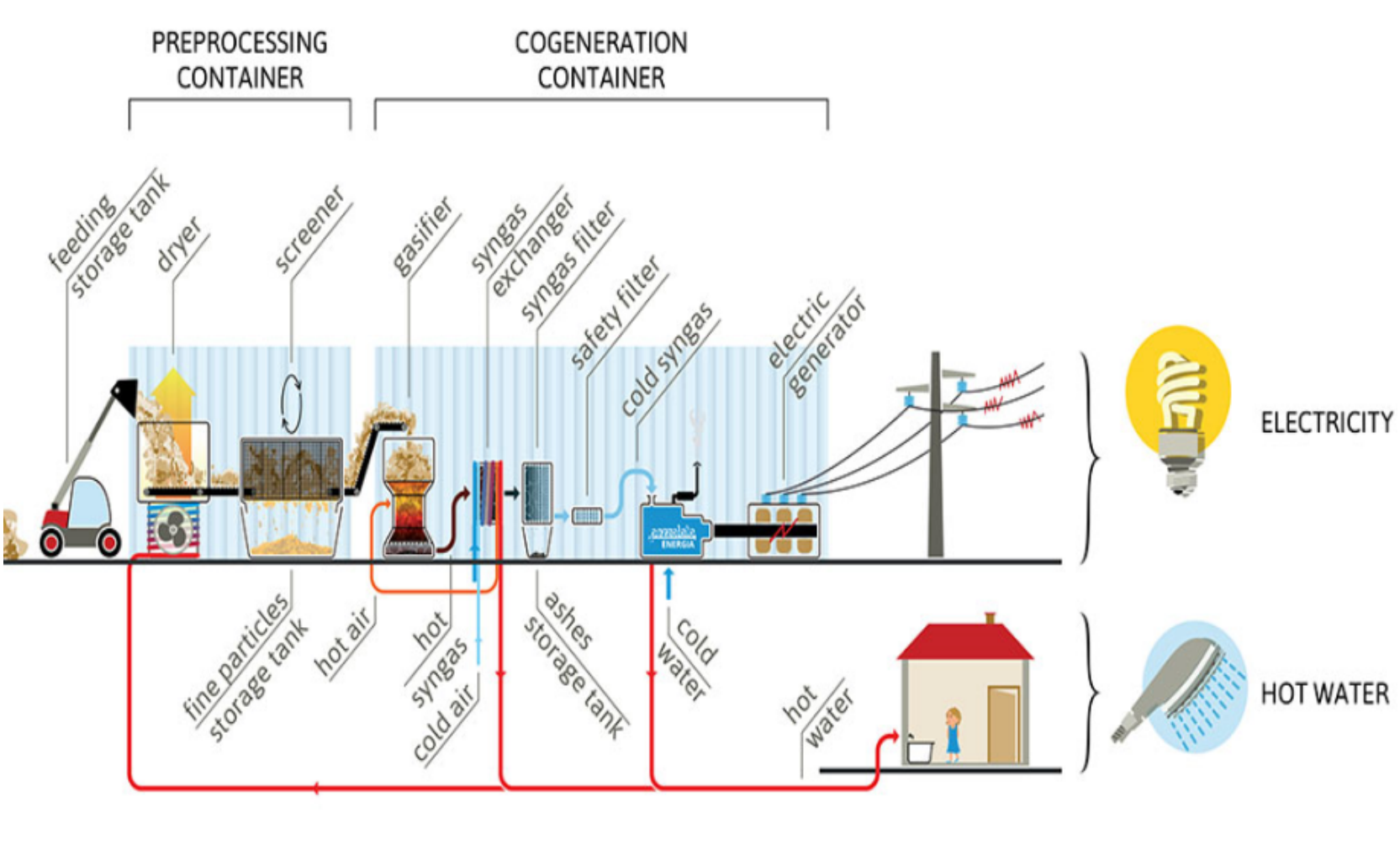
After evaluation of over 50 potential suppliers Spanner Re2 (Germany) has been selected as technology provider:

- Cogeneration system based on fixed bed downdraft gasifier coupled with dry singas cleaning and 5,7 l gas motor.
- Standard product with 45 kWel gross power.
- Standard module size suitable for placing into containers.
- > 250 reference plants and > 2.000.000 operation hours runtime.
- High biomass quality requirements for optimal operation (humidity content < 10%, low fines content).
- Preferred scope of supply limited to standard core system (without dryer, installation, building, grid connection, etc).

Standard Spanner gasification module and gas motor

Pezzolato turnkey plant: system concept

Pezzolato is proposing a turnkey supply based on Spanner gasification tecnology and proprietary solutions for drying and conditioning of the Biomass. Plant size 50 – 300 kWel.



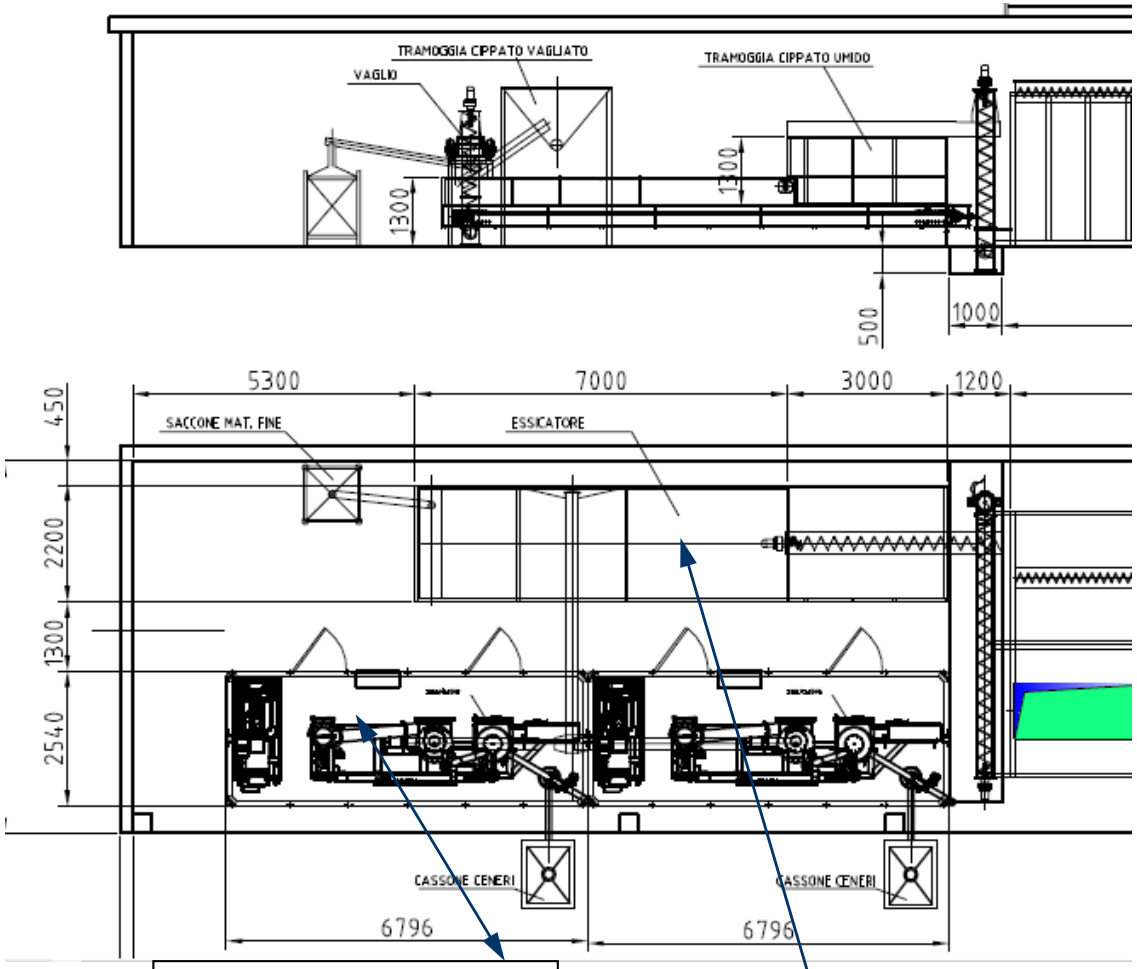
Pezzolato turnkey system: Separation of fines

Sieved material suitable as gasifier fuel

Separated fines useful for small boilers or pellet prodution

Pezzolato turnkey system: «static dryer»

Pezzolato turnkey system: Example lay out 100 kWel



Cogeneration container

«dynamic» dryer

- Gasifiers and biomass conditioning module with auxiliary equipment placed into transportable containers/skids.
- Vibrating sieve for removing fine particles from the fuel.
- Drying with hot air :

  a) «static» :drying in the storage tank for small plants.

  b) « dynamic» : drying on a moving bed with controlled bed height and drying time.
- Automatic extraction of the dry biomass from the dryer.
- Wet material buffer according to customer request.

Added value of Pezzolato turnkey systems

- Reliable partner with long experience in the wood sector.
- Plant items are tested and installed into transportable containers in the Pezzolato factory.
- Quick and easy installation.
- No unexpected costs and clear responsabilities due to turnkey supply.
- Possibility to use wet wood (up to 50% humidity) thanks to built in drying system.
- Automatic separation of fines Small size chipper specifically designed for gasification plants avaliable on request.
- Possibility to rely on an existing italian sales and after sales structure.

Actual Status

Pezzolato has installed a first reference unit (45 kWel) at his headquarters in Envie (CN) in Q3/2013.

Initially the reference plant has been used for operational tests with different biomass types/qualities and delevolpment of propretary solutions for dryer/ biomass pretreatment. Commercial operation from Q2/2014.

Supply of first customer unit (45 kWel) to Prato (turnkey system including gasifier,dryer, biomass pretreatment and special small size chipper Model PTH 250) planned June 2014.

Pezzolato PTH 250 chipper for the Prato plant

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Fixed bed updraft gasifier developed by partner Gammel Engineering

KOMBI FIRE SYSTEM®

KOMBI POWER SYSTEM®

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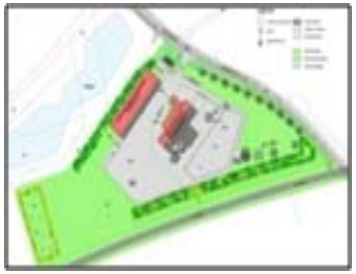
Gammel: selected experiences

Gammel Engineering has more than 20 years of experience in the engineeering of bioenergy systems. Among the references there are more than 20 biomass cogeneration plants with different tecnological solutions and heat uses.

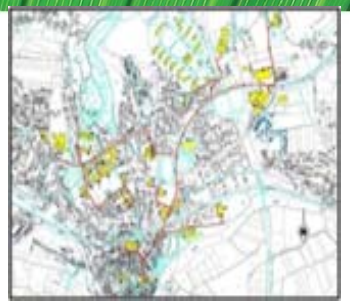
Plössberg
(Heat for pellet production; 2000 kW; ORC)



Ruderatshofen
(drying of animal food and district heating; 2000 kW; ORC)

Weissenhorn
(heating and high temperature process heat; 600 kW, ORC)

Gammel: selected experiences



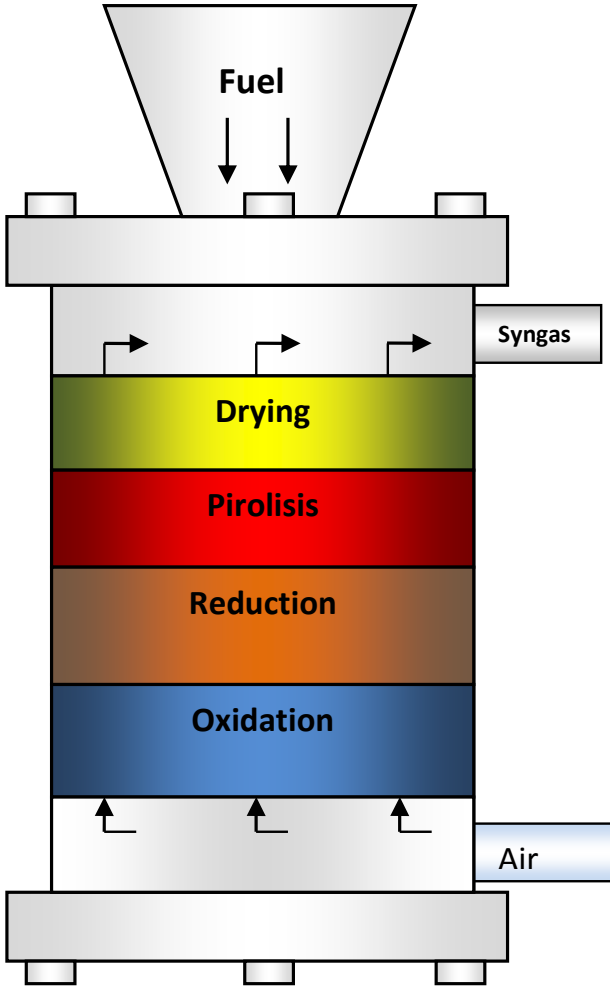
Cham
(Disctrict heating and process steam
1500 kWel; steam turbine)

Taufkirchen
(district heating ; 4500 kW; steam turbine)

Sauerlach
(District heating ; 500 kWel; ORC)

Wolnzach
(From heat only to cogeneration; 450 kW;ORC)

Updraft gasifier : Theory



Drying (consumes heat , λ = 0)

Pirolisis (consumes heat , 400 – 700˚C, λ = 0)

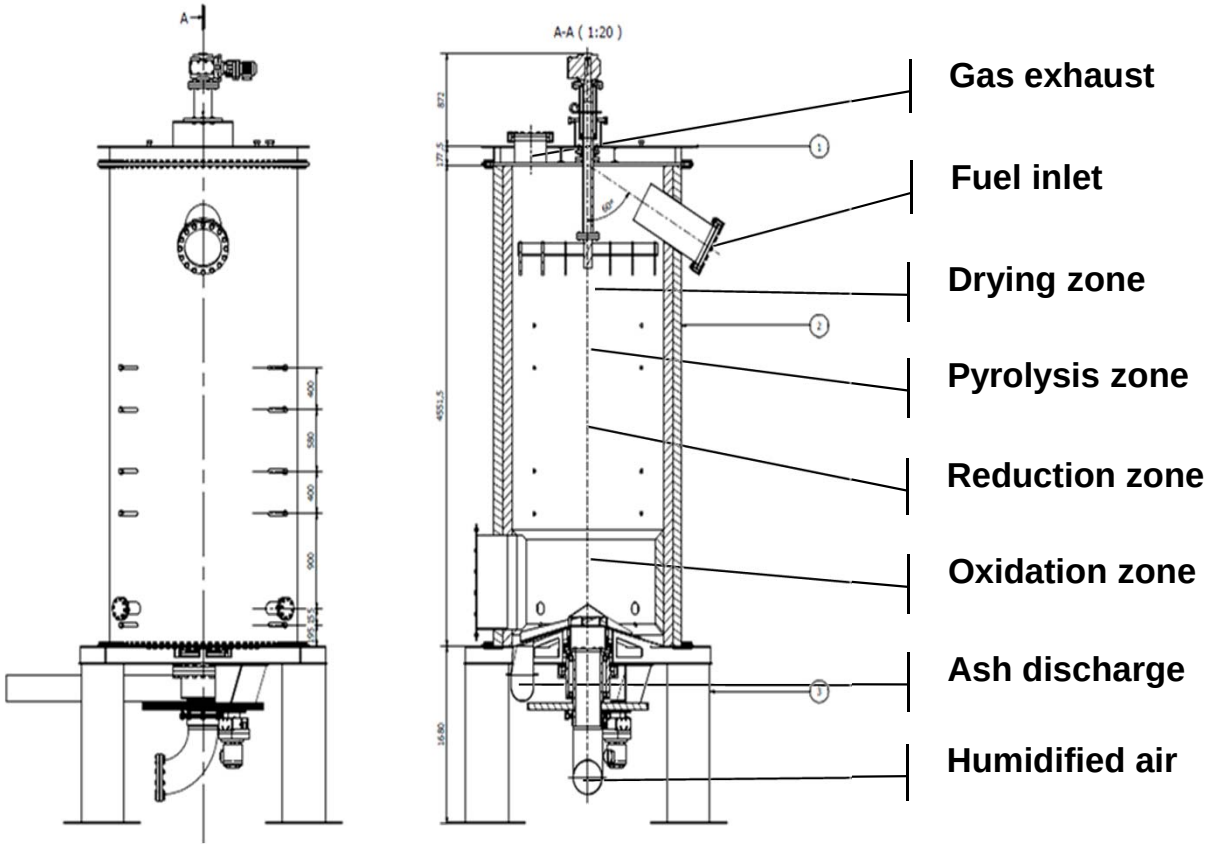
Reduction (700- 900˚C)

Oxidation (delivers heat,700 – 900˚C, λ < 1)

Tars (liquid at ambient temperature) are produced mainly in the pirolisys zone and do not pass high temperature zones afterwards

- Relatively high tar content in producer gas.
- Heat transfer to drying and prilolisis zones by the hot syngas coming form the oxidation zone.
- Low quality Biomass (30 – 50% water content) and relevant small particle and ash content is acceptable.

Updraft gasifier: actual design



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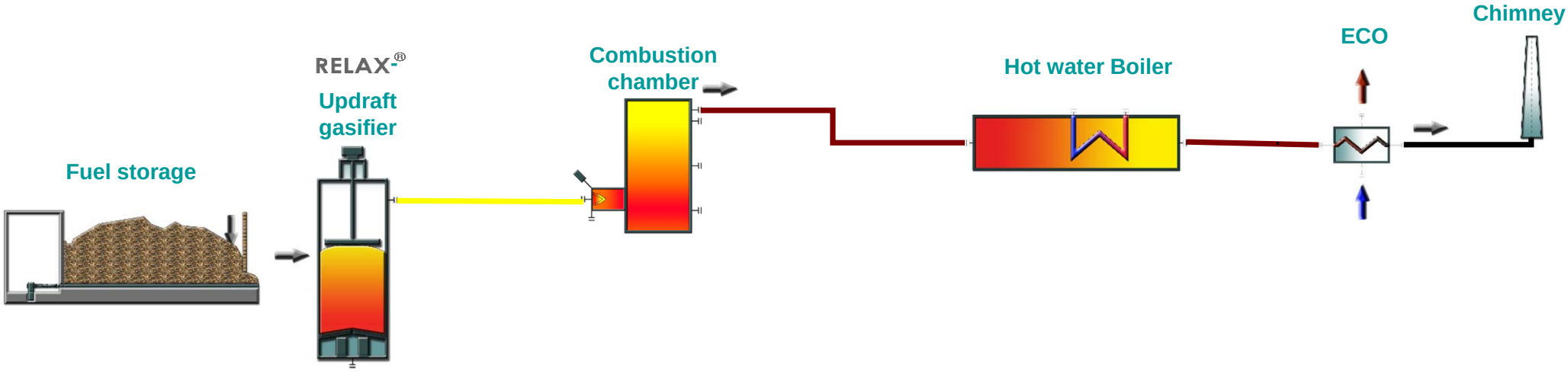

Basic considerations for the paradigm shift:

- ✓ Low-dust firing => no filter required
- ✓ Clean combustion far below the emission limit values
- ✓ No special requirements for wood chip quality
- ✓ Minimizing the amount of ash, avoidance of filter ash
- ✓ Quick adjustment as gas firing
- ✓ Excellent partial load behavior
- ✓ Flexibility for change of demand
- ✓ Expandable to an energy-efficiency system with combined heat and power

Tyical emissions: Measured values

Industrie Service

Zusammenfassung

Anlage	**Biomasseheizkraftwerk, mit Biomasse befeuerte Holzvergasungsanlage**
Betriebszeiten	ganzjährig, ausgenommen Revisionsarbeiten, 7 d/Woche, ca. 6.500 h/Jahr
Emissionsquelle	Schornstein Holzvergasungsanlage
Emissionskomponenten	Gesamtstaub, CO, NO_x, Gesamt-C

Quelle	Messkomponente	Einheit	Maximaler Messwert minus Up	Maximaler Messwert plus Up	Emissions-begrenzung	Betriebs-zustand
BMHKW	Kohlenmonoxid (CO)	g/m³ N,tr	0,01	0,01	0,15	Volllastbetrieb
BMHKW	NOx als NO2	g/m³ N,tr	0,23	0,26	0,25	Volllastbetrieb
BMHKW	Gesamtstaub	mg/m³ N,tr	1	2	50	Volllastbetrieb
BMHKW	Gesamt-C	mg/m³ N,tr	0	5	10	Volllastbetrieb

n.n. = kleiner Bestimmungsgrenze

Values show complete combustion with neglegible content of dust and Carbon residues from incomplete combustion.

NOx value is driven by N content in fuel.

Values achieved with primary measures without the need of fluegas treatment !

Typical Biomass: pictures from the plants

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Reference plant : Naturenergie Hersbruck (Bavaria)

GAMMEL ENGINEERING

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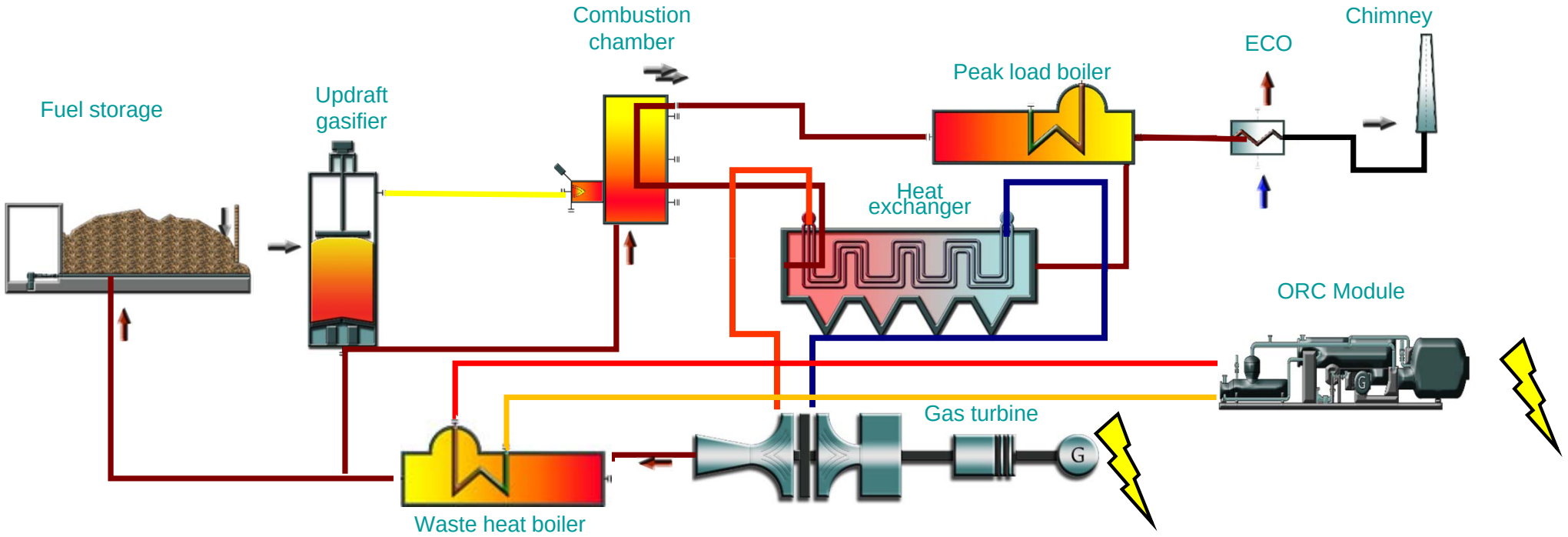
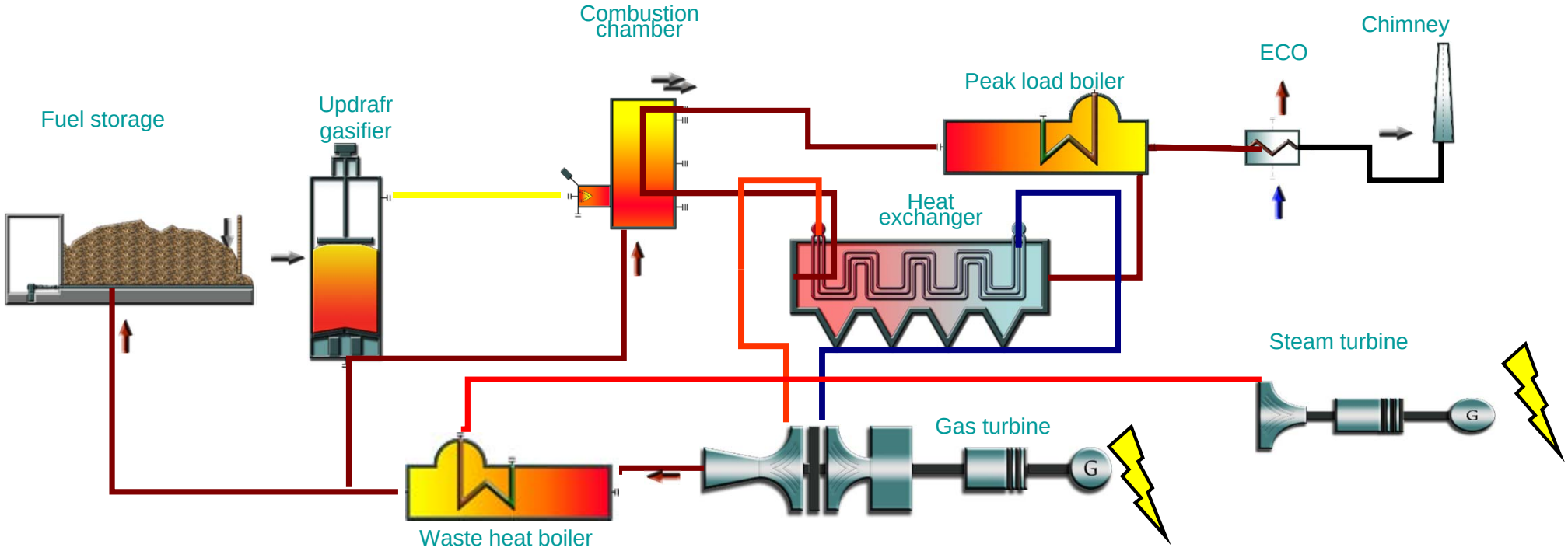


Generator output total	**345**
Useful heat output total	**850**
Electrical system efficiency gross total	**23%**
Thermal system effeiciency	57%
Total system efficiency gross	**80%**

Solution with hot air turbine and ORC
Hot water system started up Q1/2013
Hot air turbine started up Q2/2013
ORC started up Q2/2014

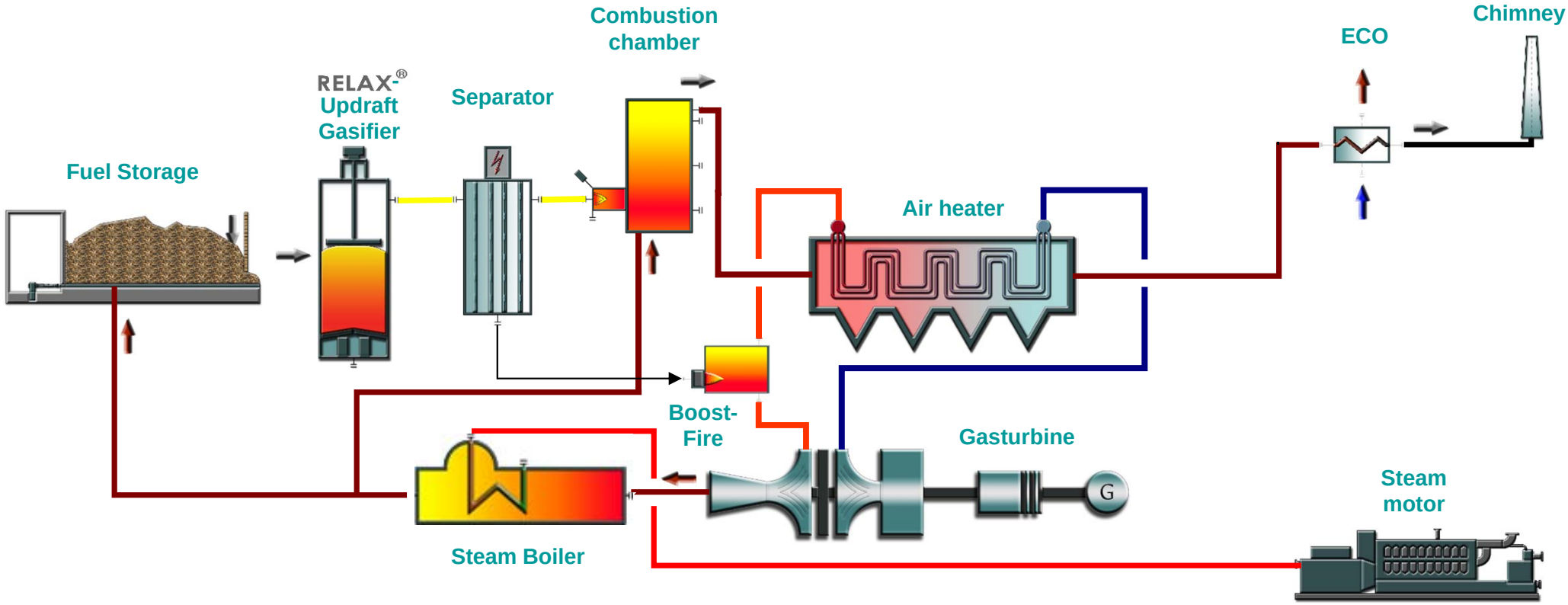
Reference plant : Arco Energy – Moos (Bavaria)



Generator output total	**345**
Useful heat output total	**850**
Electrical system efficiency gross total	**23%**
Thermal system effeiciency	57%
Total system efficiency gross	**80%**

Solution with hot air turbine and steam turbine
Hot air turbine started up Q3/2014
Expansion with Steam turbine planned Q4/2014

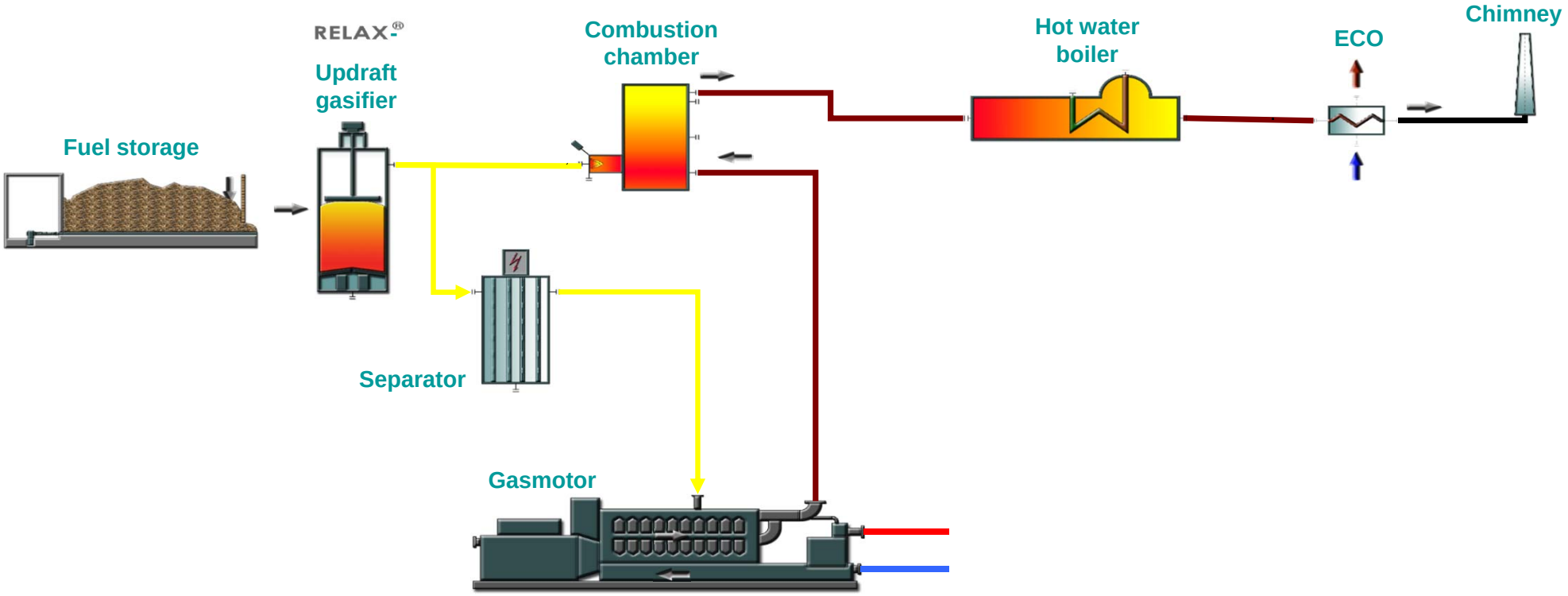
Reference plant : Max Bögel – Neumarkt (Bavaria)



Generator output total	**2.450**
Useful heat output total	**4300**
Electrical system efficiency gross total	**30%**
Thermal system effeiciency	52%
Total system efficiency gross	**82%**

Solution with hot air turbine, „Boost fire“
and steam motor
Started up Q4/2013

Reference plant: Bad Füssing(Bavaria)



Generator output total	**450**
Useful heat output total	**900**
Electrical system efficiency gross total	**25%**
Thermal system effeiciency	50%
Total system efficiency gross	**75%**

Solution with gasmotor and peak load boiler
Planned startup June 2014

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Thank you for your attention!

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