



CHP PLANT BASED ON WET WOOD GASIFICATION – PUIDOUX (CH)

Caimi Giulio – 5th Biomass for Swiss Energy Future Conference
WSL Birmensdorf 04.09.2018



CONTENT

- Project's genesis
- District heating in Puidoux
- Gasification process and technical solution
- Plant's erection
- First operational feedbacks

PROJECT'S GENESIS

History

2013: Puidoux municipality wanted to use their forest wood for heat 3 important infrastructure projects (schools, swimming pool and gym)

2014: Feasibility study for a district heating

2015: Romande Energie Services was awarded to develop the district heating.

Requirement of the municipality

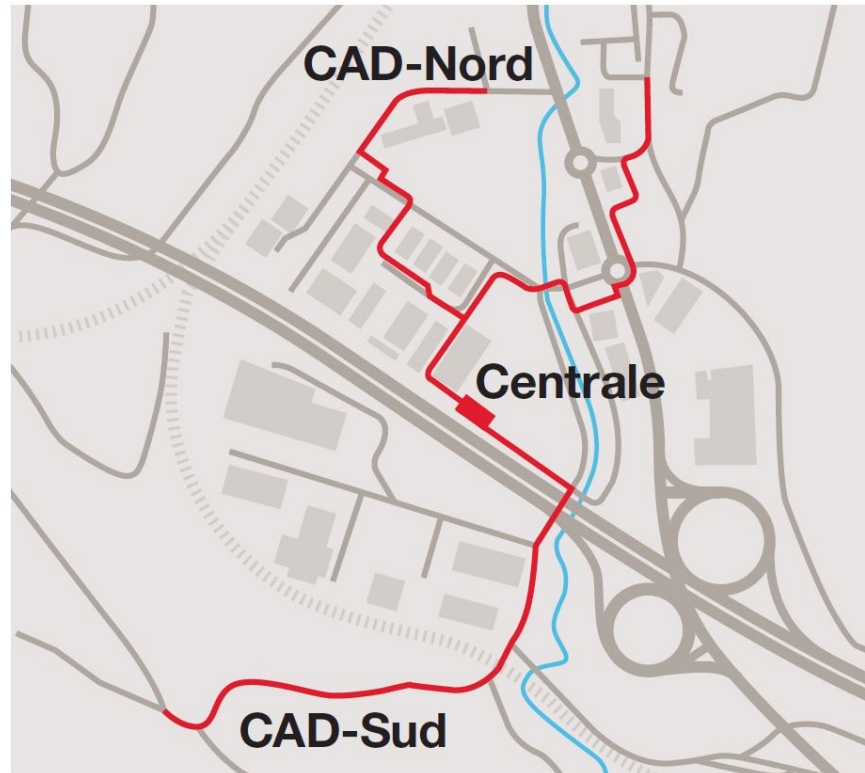
- Use and valorization of the forest wood of the region
- Wood should be payed correctly to develop the regional forest industry
- Heat price should be competitive

Romande Energie technical solution

- Combined heat and power plant (CHP)
- Gasification of humid wood: to have higher electrical efficiency.

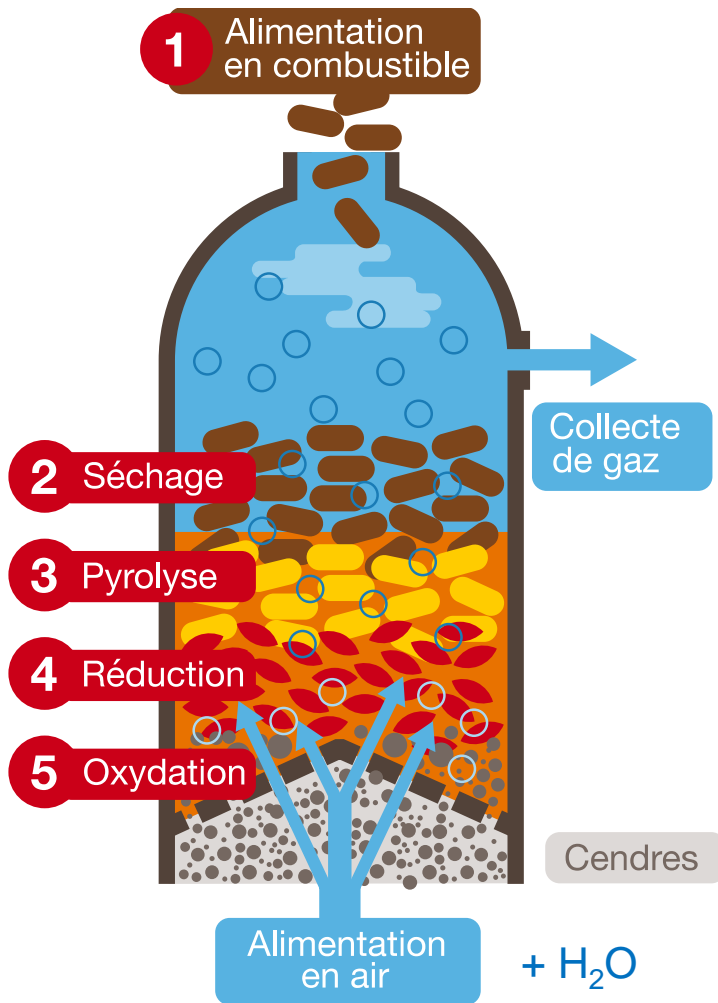
DISTRICT HEATING (CAD IN FRENCH)

- Realization: 7.2016 – 2.2018
- Commissioning CAD Nord – 10.2017
- Commissioning CAD SUD – 02.2018
- Connection heat clients :
10.2017 – 09.2018



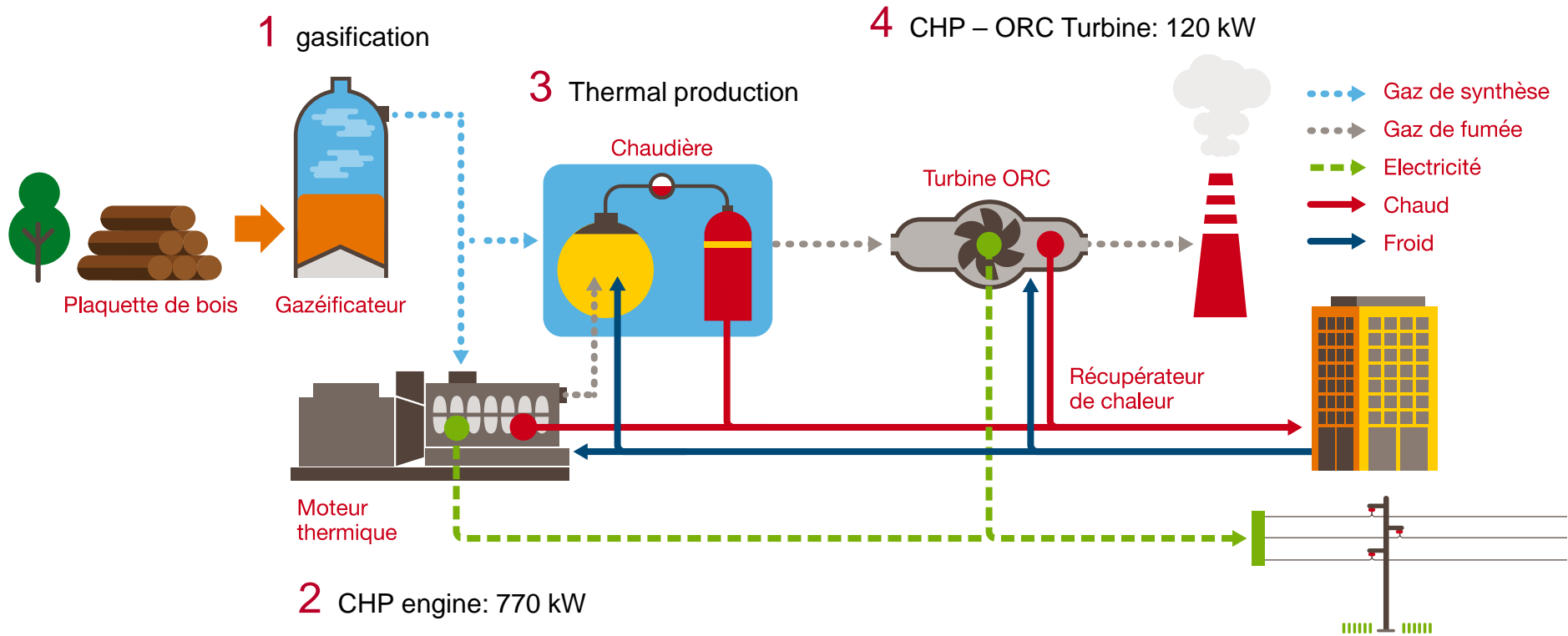
Key Points	Now	Future
# clients	27	~40
Sold Energy [GWh/an]	7.6	10
Subscribed power [MW]	4.2	5.2

UPDRAFT GASIFIER FUNCTIONAL PRINCIPLE

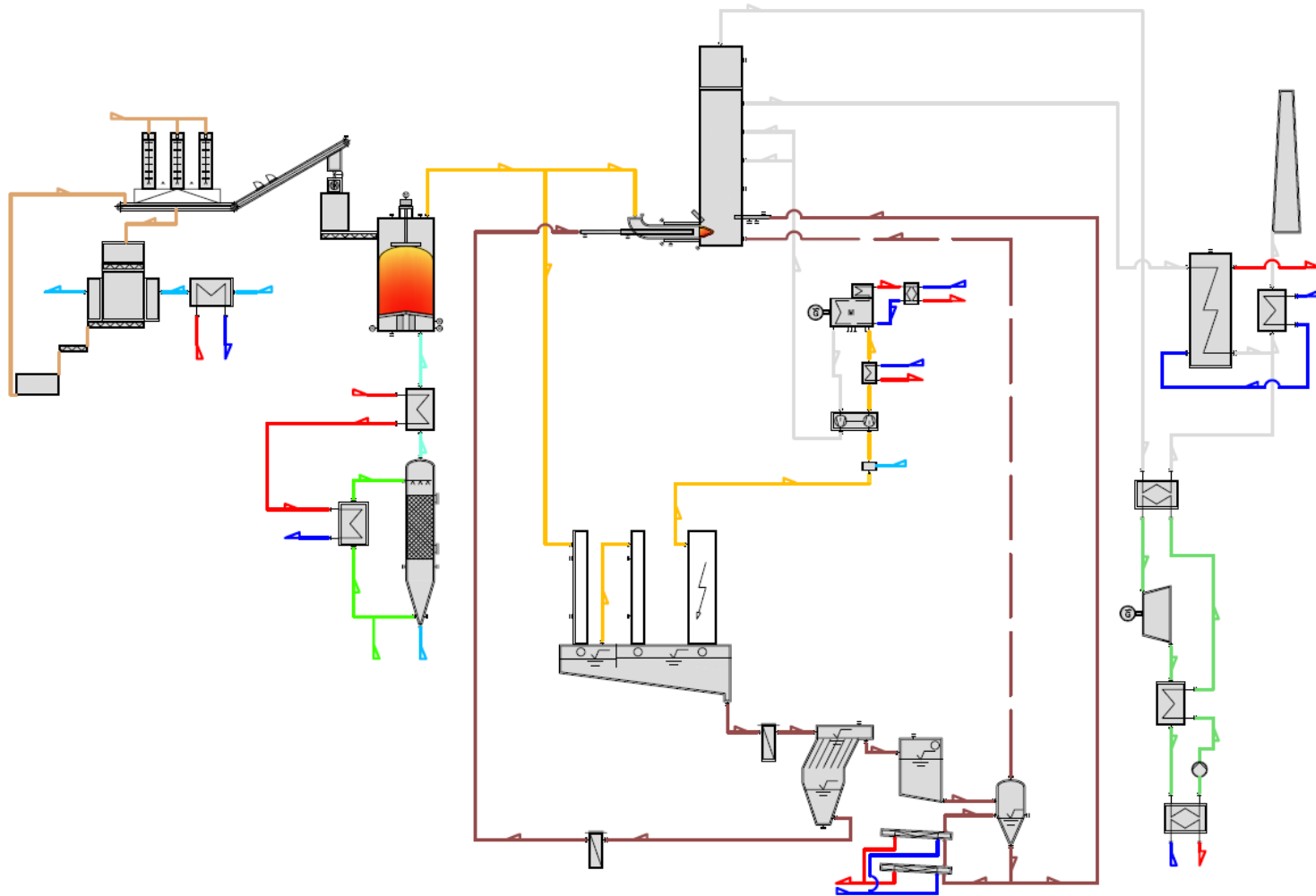


- 1 Wet wood inlet.
- 2 Wood drying.
- 3 Pyrolysis.
- 4 Reduction: $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{CO}, \text{H}_2 \text{ und } \text{CH}_4$
- 5 Oxidation: thermic energy production and CO_2 production for the reduction.

SOLUTION'S MODULARITY



FUNCTIONAL PRINCIPLE



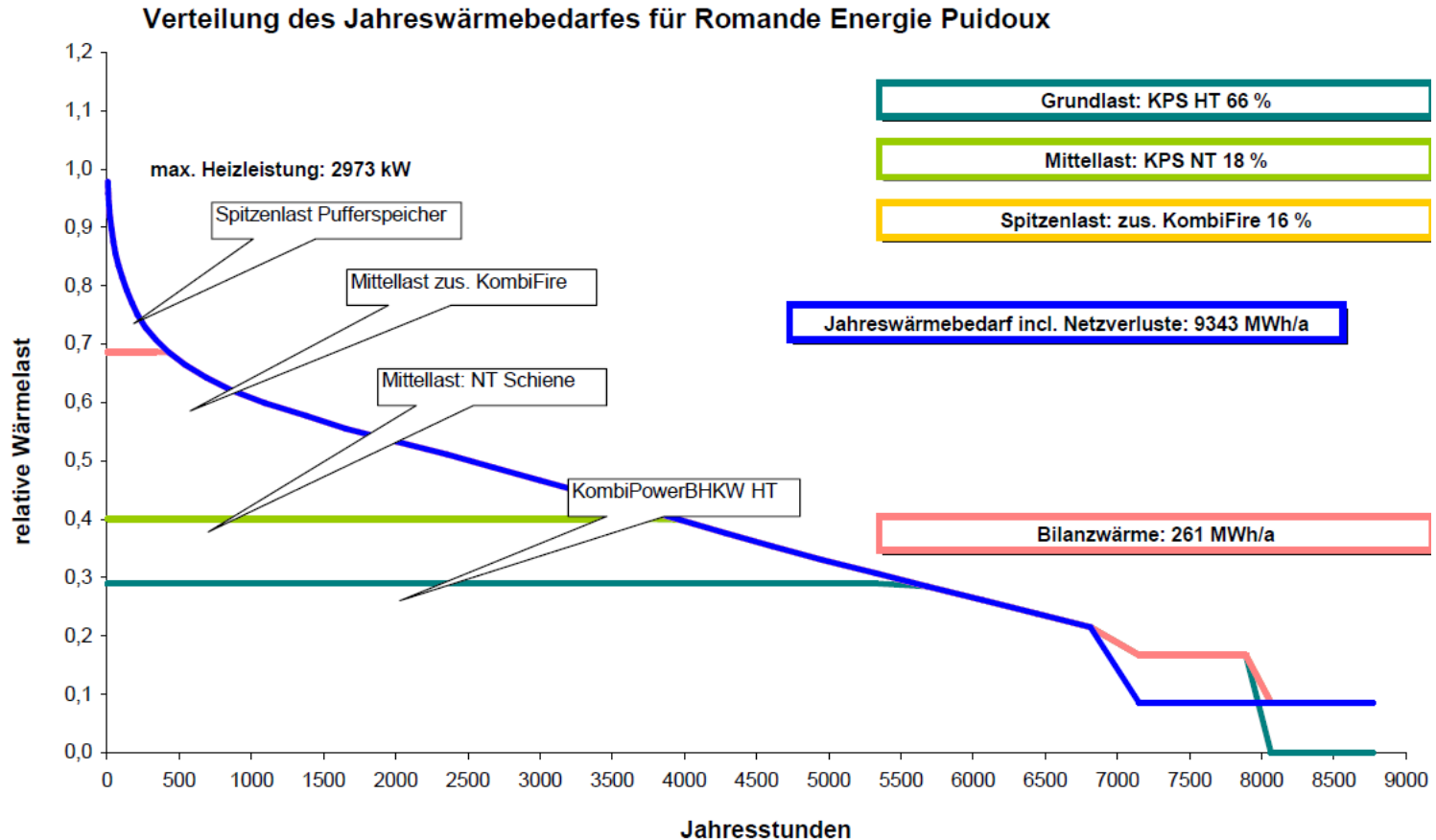
PERFORMANCE DATA

- Gas composition : 27% CO, 18% H₂, 4% CH₄, N₂ et CO₂.
- Calorific value of the syngas: 1.79 kWh/Nm³
- Gasifier efficiency (whole cycle): 84 - 86%
- Electrical efficiency engine: Jenbacher416 - 39.2%
- Electrical efficiency ORC Turbine: Dürr Cyplan -17.6%
- Total electrical efficiency: 31.8 % (890 kW / 2800 kW)
Comparison : ORC plant 14-16%.

LOAD POINTS – CHP

<u>Point of charge</u>	<u>P_wood</u>	<u>P_thermal</u>	<u>P_electricity</u>
Heat ONLY	500 kW	430 kW	0
Heat und electricity – minimum load	1550 kW	640 kW @ 85 °C	90 kW (ORC) + 380 kW (Engine)
Heat und electricity – normal load (100% electricity)	2800 kW	1151 kW @ 85 °C 382 kW @ 60 °C	120 kW (ORC) + 770 kW (Engine)
Heat und electricity – maximal load (100% heat)	4500 kW	2632 kW @ 85 °C 404 kW @ 60 °C	120 kW (ORC) + 770 kW (Engine)

THERMAL ENERGY VALORSATION

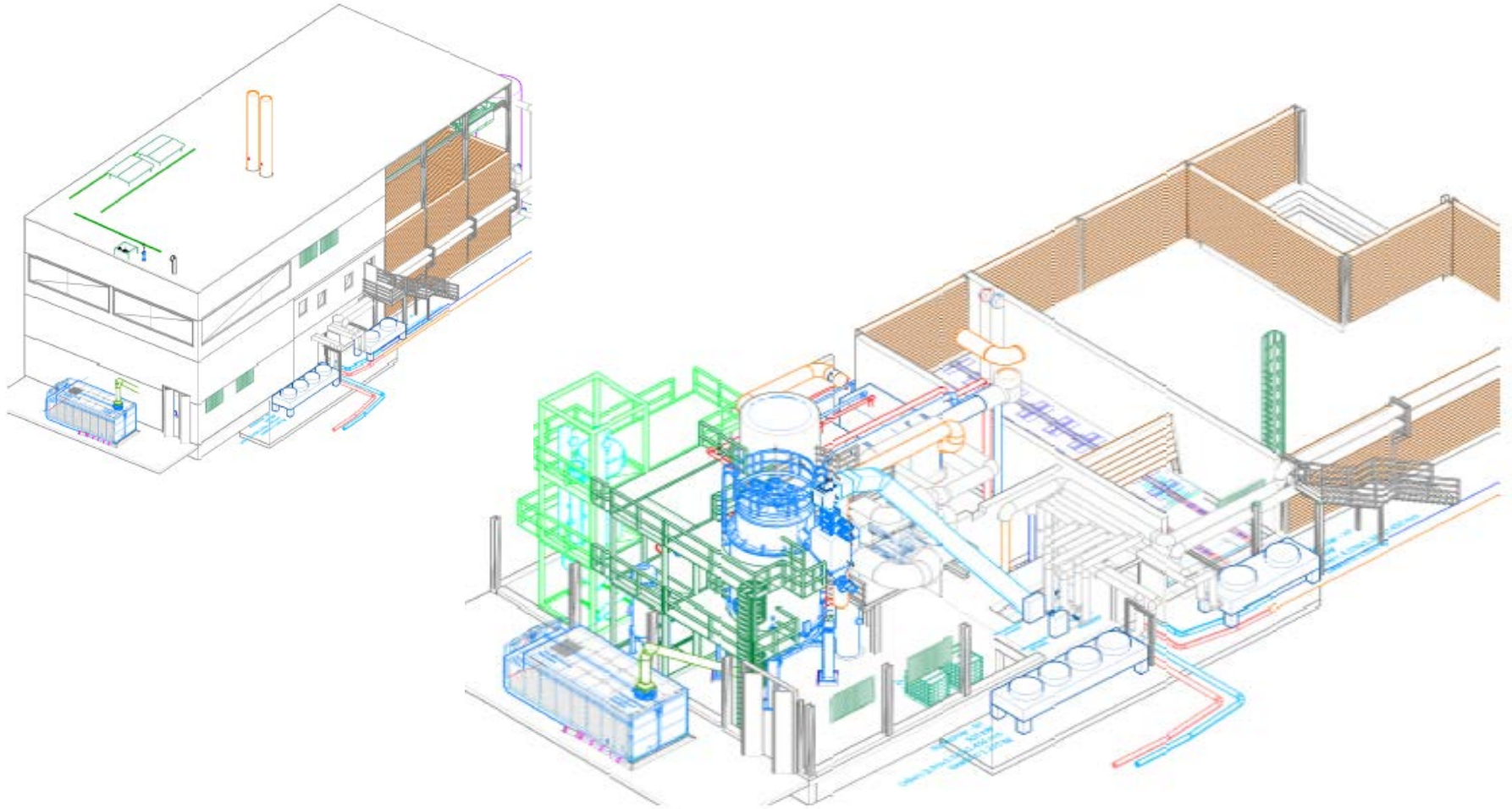


	Wood	fossile
Combustible repartition	92%	8%

PROJECT'S KEY POINTS - SUMMARY

Parameter	
Gasifier power	4.5 MW
<i>Gasifier power – Loadpoint 100% electricity production</i>	<i>2.8 MW</i>
<i>Gasifier power – additional power</i>	<i>1.6 MW</i>
Wood Thermal power (high T)	2.6 MW
Back-up power (Fossil)	3.2 MW
Power of district heating (design)	5.2 MW
Energy sale – (design)	10 GWh/an
Electrical power	890 kW
Electrical production (brutto)	5.5 GWh/an

PLANT LAYOUT



PLANT'S ERECTION

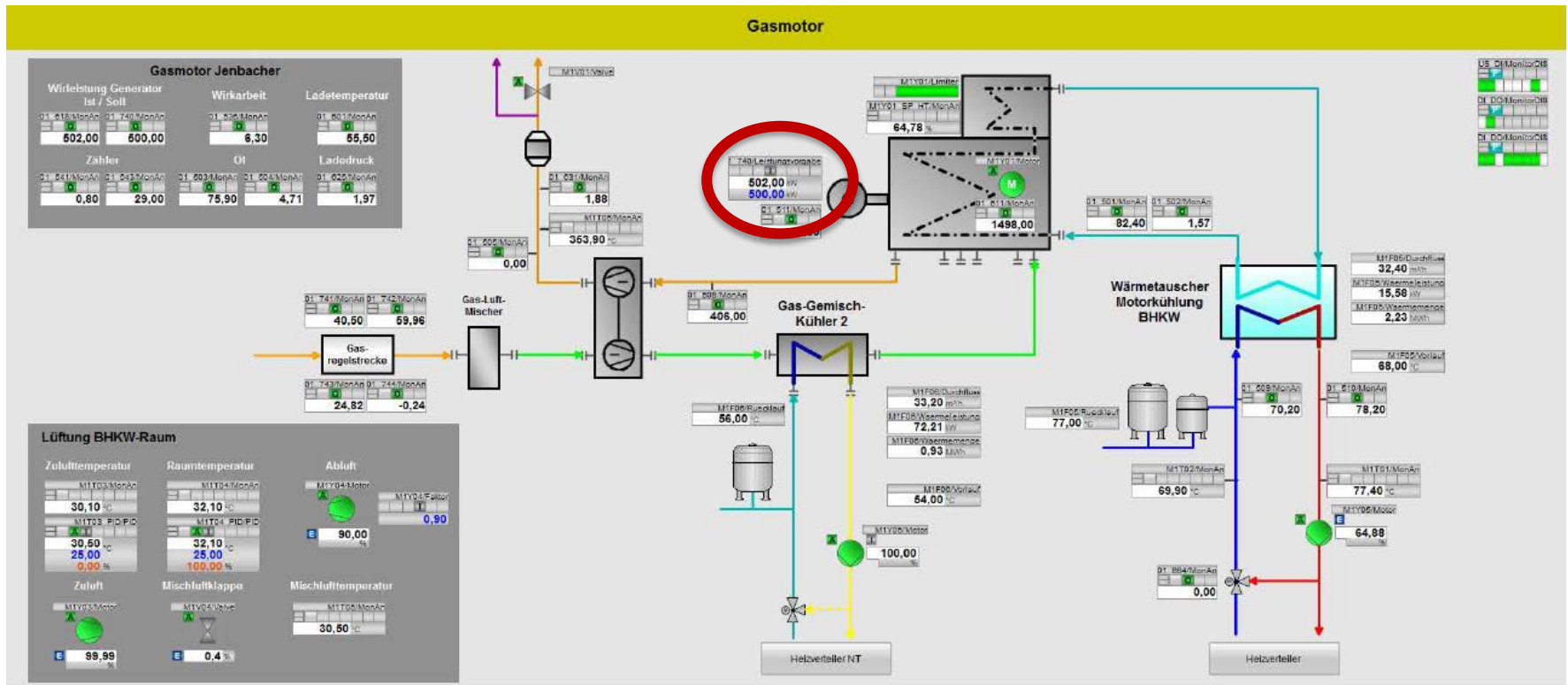


CHP - REALISATION



FIRST OPERATIONAL FEEDBACKS:

- Commissioning - Gasifier: 1.2018
- Commissioning ORC: 02.2018
- Commissioning Engine: 07.2018 – Only partially tested up to 500 kW (because of heat this summer). Carry-on the commissioning from 10.2018



FIRST OPERATIONAL FEEDBACKS :

- Thermal production 10.01.2018 – 25.07.2018 – operation for 4238 h:
- Stable and reliable.
- Excellent partial load (minimum)
- Some Trips (50) – operational lost 96 h
- Corrosion because operation at too low level for long time (no engine and district heat not completed)

ORC:

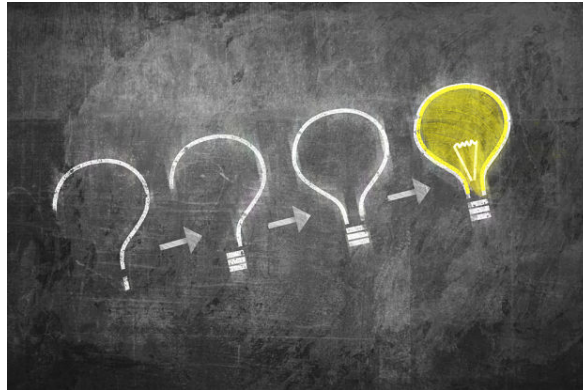
- Power of 120 kW demonstrated
- Stable and reliable.
- Some perturbations → reparation work.



TAKE AWAY

- Utilisation of **forest wood** : no need to dry the wood
- **CHP**: ideal use of wood: first electricity and then heat.
- **Gasifier**: technological innovation and high electrical efficiency.
- **Maximal electrical efficiency production**: first engine and then ORC turbine

THANK YOU FOR YOUR ATTENTION



Giulio CAIMI

Project manger

ROMANDE ENERGIE SERVICES