CIBE

atee
ASSOCIATION TECHNIQUE ENERGIE ENVIRONNEMENT

Journée technique
le jeudi 25 octobre 2018
à AMIENS - ÉTOUVIE (80)

ADEME
Agence de l'Environnement et de la Maîtrise de l'Energie

Chaufferie biomasse et écart de température d'eau : les solutions de la performance

Condensation biomasse via pompe à chaleur : mise en œuvre et retour d'expérience

Juha Järvenreuna, Directeur Général de Caligo Industria Oy

Le document est présenté en anglais, mais une version française traduite sera diffusée


CALIGO
CLEAN EFFICIENCY
CIBE Seminar 25.10.2018

Caligo Industria Oy

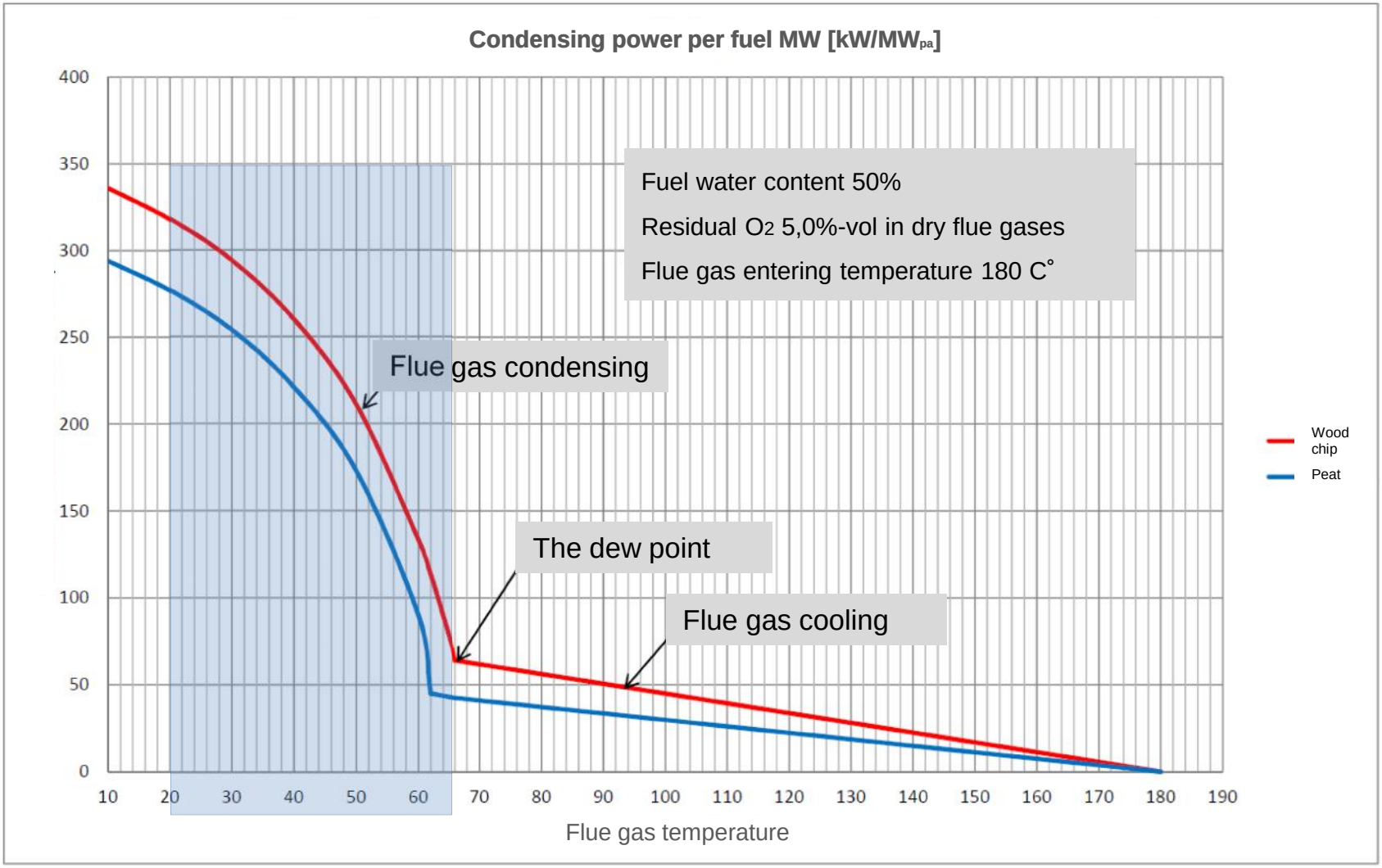
- Established 1.8.2013.
- Owners Elomatic Oy (51%) and the management (49%).
- Facilities in Turku and Jyväskylä, Finland.
- Own R&D facilities for prototyping and testing.
- Personnel 7 engineers + purchased engineering resources from Elomatic.
- Own personnel education MSc. of thermodynamics, process engineering, automation and chemistry.
- Minimum 5-30 years of experience from thermodynamics engineering and scrubber technologies.
- Manufacturing outsourced to experienced service partners.
- Key markets in Nordic countries and France.

CALIGO
CLEAN EFFICIENCY


Still today huge amount of re-usable heat and money is lost to the sky through the chemneys of world's energy plants.
170 C°
We provide innovative and economically sensible solutions to energy companies for proper flue gas treatment and efficient waste heat recovery.
30 C°
CALIGO
CLEAN EFFICIENCY

Latent heat

Key power element in condensing thermodynamics

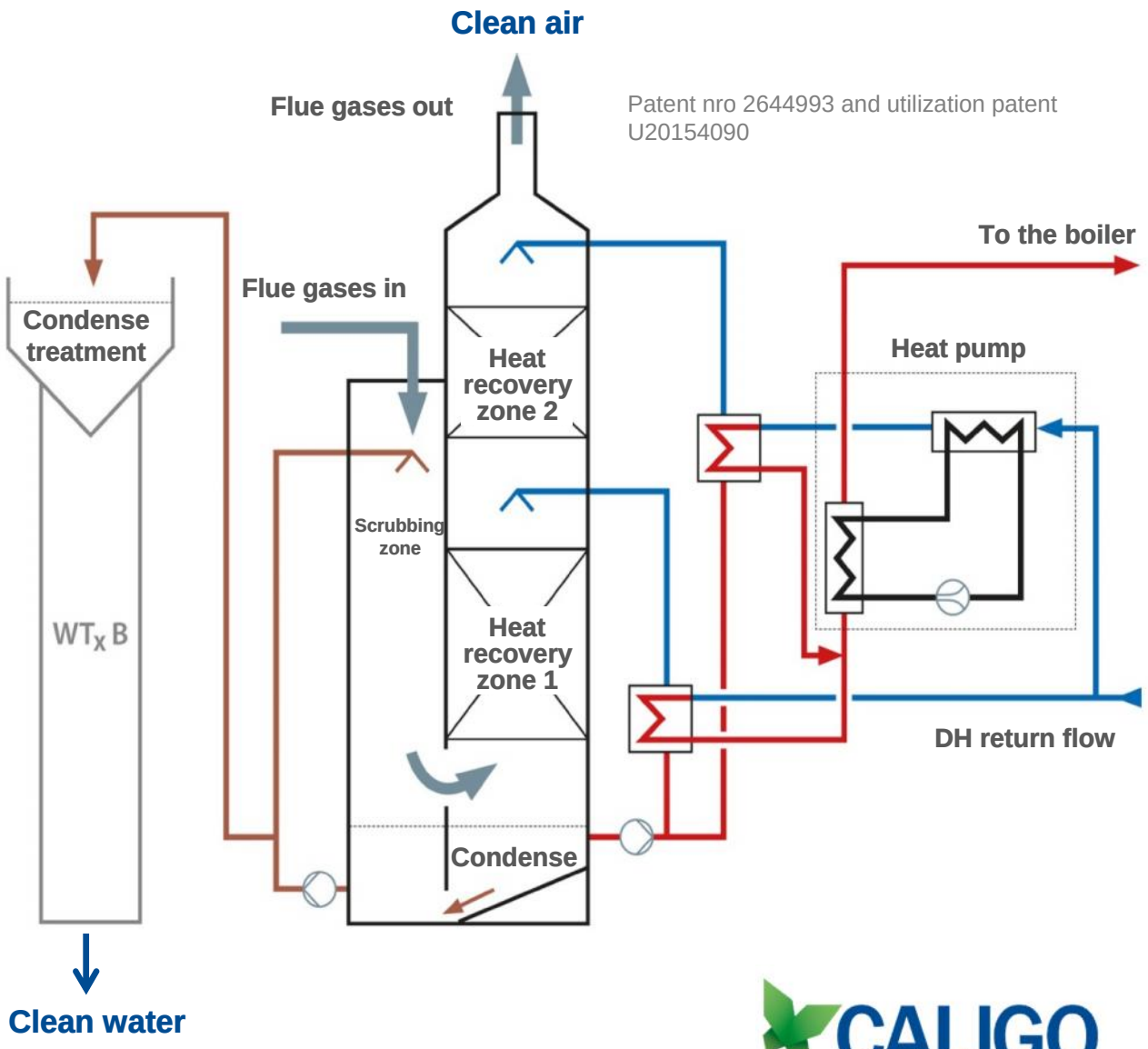


CALIGO
CLEAN EFFICIENCY

Thermodynamics behind the patented application

Elomatic patent nr. 2644993

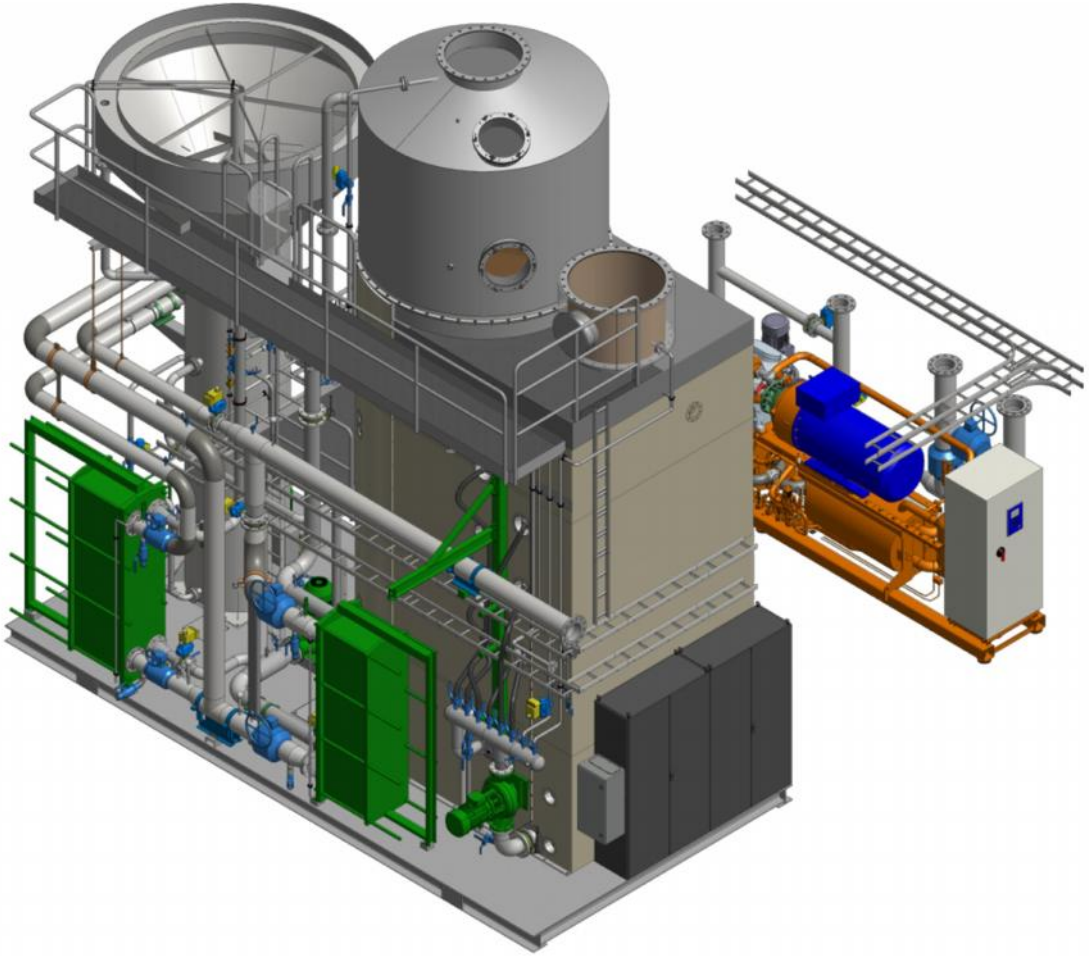
- District heating return flow is used as basic flue gas cooling media.
- The flue gas moisture content starts to condensate when the dew point is reached.
- Condensing process releases remarkable amount of heat from the flue gases.
- Heat energy is transferred via heat exchangers back to district heating network.
- Lower condensate circulation provides cooling and condensing when district heating return flow temperature is low enough.
- Upper condensate circulation is connected to the heat pump which cools down the return flow especially when the return flow temperature is high. PHP mode fits up to 63 C˚ return flow temperatures.
- Heat energy is not lost while cooling by heat pump. Instead, it's transferred by heat pump ammonia circulation back to district heating network.
- The heat pump application ensures high level of condensing in the condenser unit regardless of the return flow temperature level.
- Flue gas exit temperature after the PHP scrubber in the chimney is typically between 30 - 40 C˚.
- PHP scrubber COP_h –value is typically between 11 - 30 depending on the plant operating conditions.



CALIGO
CLEAN EFFICIENCY

Caligo CSXPHP key benefits

- PHP model always utilizes the minimum size of heat pumps -> System CAPX cost is the lowest possible.
- The Caligopack heat pump applications have the highest COPh values available -> System OPEX cost is the lowest possible!
- Dynamic optimization of the heat recovery performance through the plant operating window ensures the maximum earnings on annual basis.
- Full integration of the heat pump module with the condensing scrubber ensures the highest reliability of the system.
- Plug and play product manufactured and tested at the manufacturer – no assembly and testing at the site!



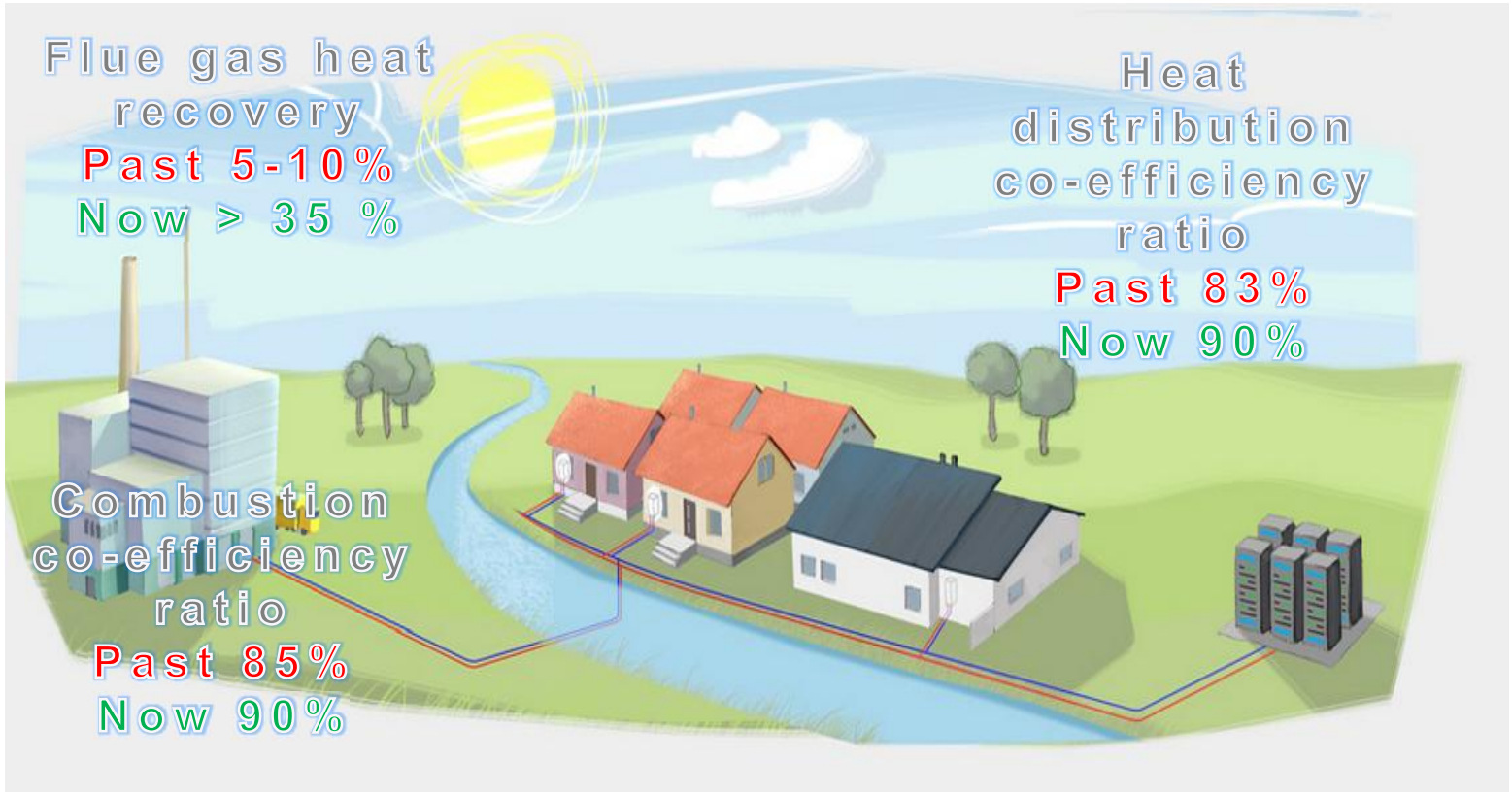
CALIGO
CLEAN EFFICIENCY

Case Kauhava, Finland

10 MW bioenergy plant built and commissioned in 2015 including Caligo PHP scrubber system

Case Kauhava, Finland

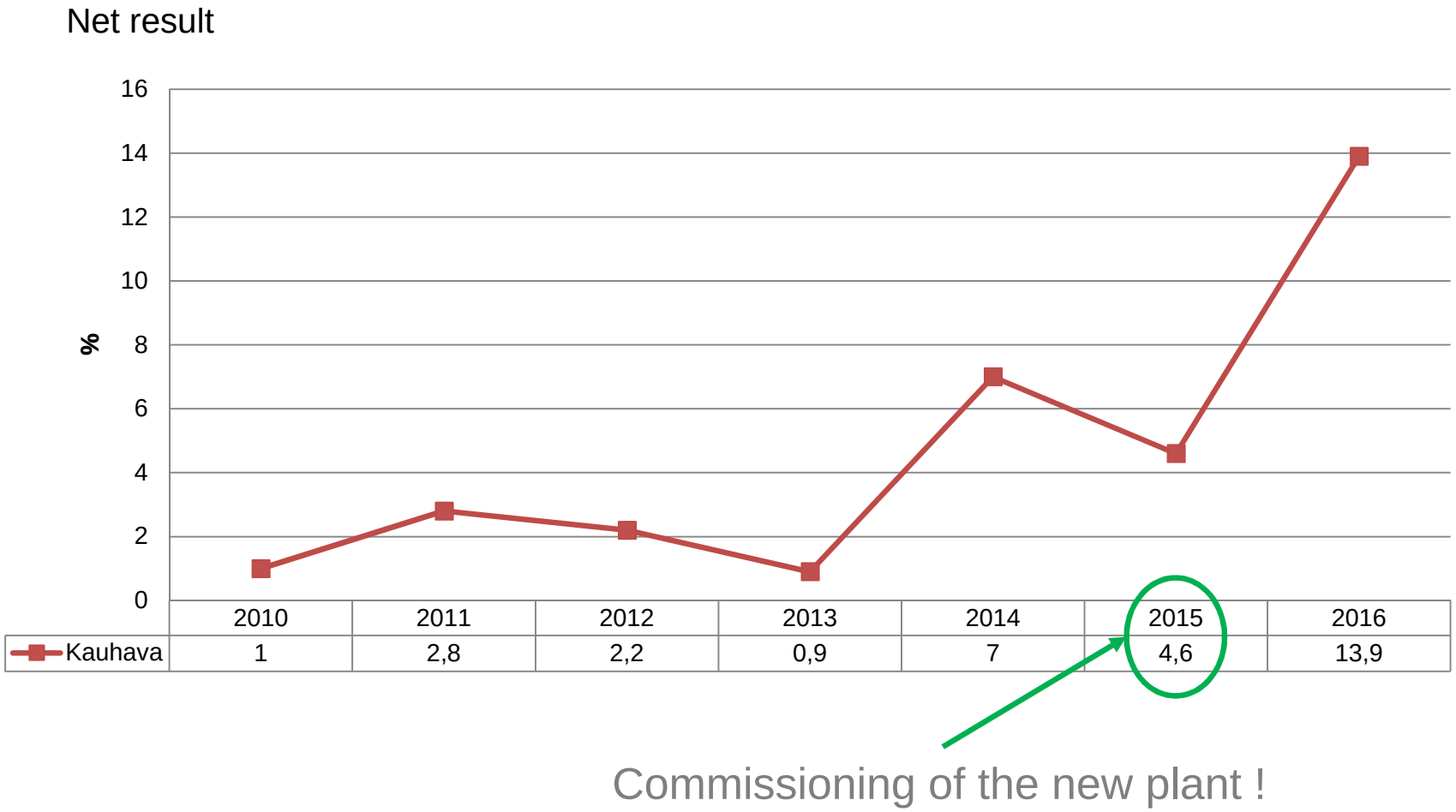
Energy efficiency improvement set as core target in new built plant project



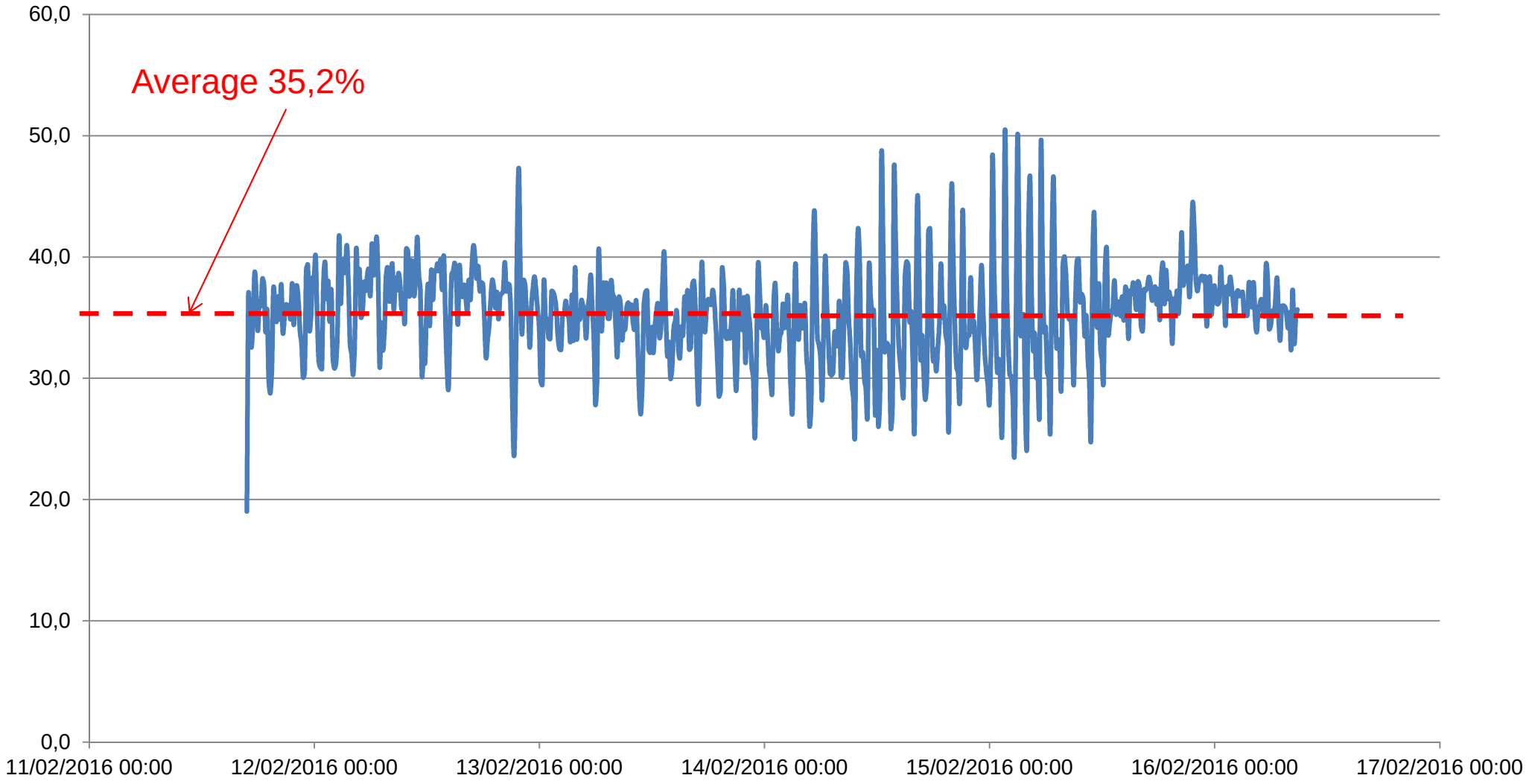
Today, every third fuel delivery truck is skipped!

Case Kauhava, Finland

Net result development 2010-2016



Kauhava 10 MW plant flue gas heat recovery

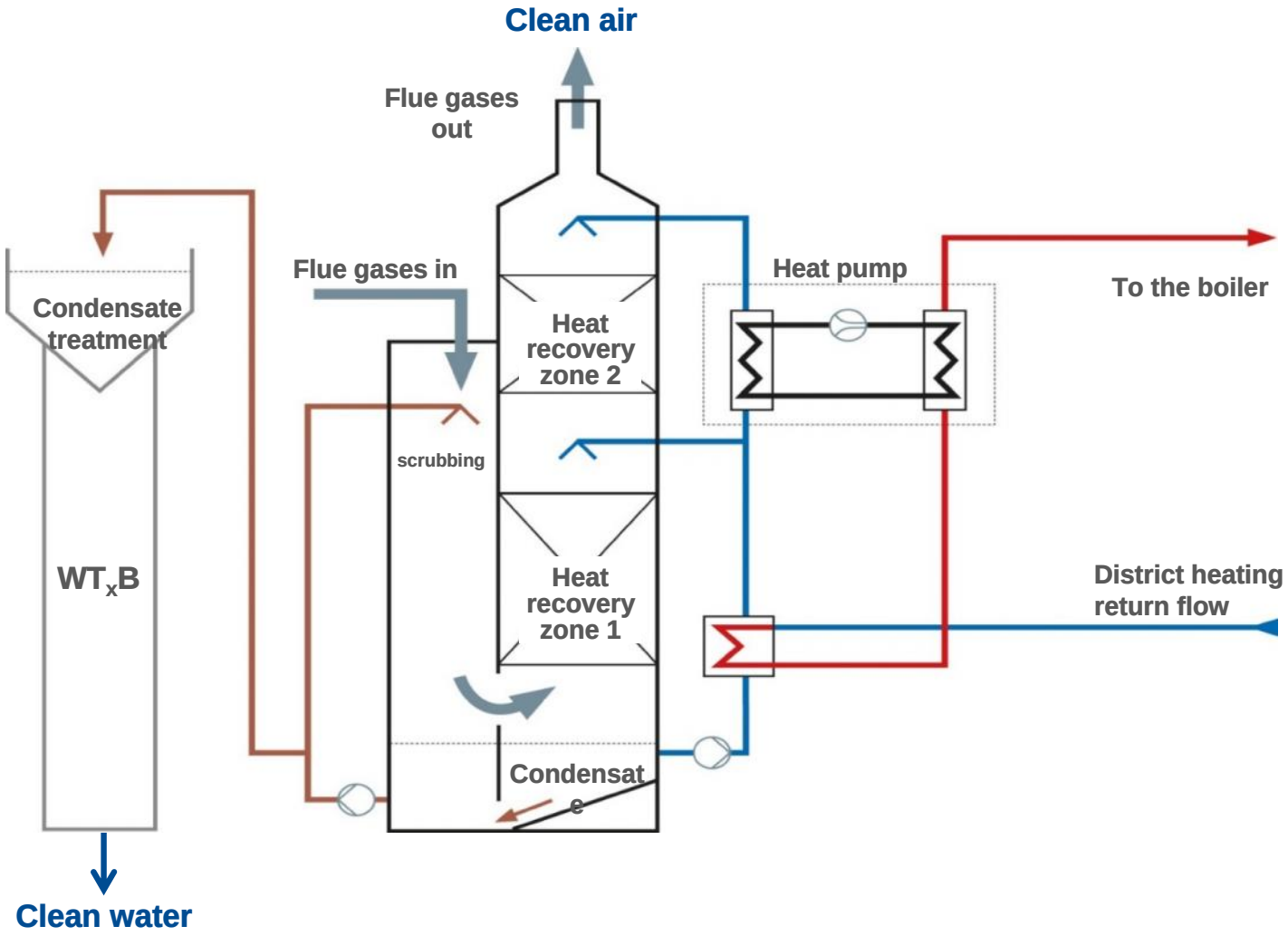


CALIGO
CLEAN EFFICIENCY

SHP Heat pump scrubber

”Traditional way” at high DH return temperatures

- Therodynamic principles are the same as with patented application.
- Fits to sitautions, in which the DH return temperatures are high, above 63 C.
- All the heat recovery transmitted through the heat pump application -> oversized heat pump required.
- Due to high DH return temperature levels, 60 bars heat pump applications used.
- Relatively low system COPh values -> Own electricity consumption on high level.



CALIGO
CLEAN EFFICIENCY

- ✓ Annual combustion nominal power level hours = 3500 hours
- ✓ Fuel moisture 50 % - m (wood chips)
- ✓ Fuel purchase price 22 eur / MWh
- ✓ Electricity purchase price 75 eur / MWh

Case Kauhava, Finland

PHP and SHP model comparisons

		Caligo PHP at 50 C° DH return	Caligo SHP at 50 C° DH return	Caligo PHP at 60 C° DH return	Caligo SHP at 60 C° DH return	Wood chip combustion
Bio combustion energy	[MWh/a]	35 000	35 000	35 000	35 000	35 000
Caligo heat recovery	[MWh/a]	10 549	11 183	8 120	10 685	-
Own electricity consumption	[MWh/a]	514	1 628	612	1 487	-
Fuel savings	[eur/a]	257 864	246 026	198 489	261 201	-
Scrubber electricity cost	[eur/a]	38 588	122 100	45 938	111 563	-
Sustaining and servicing costs	[eur/a]	8 000	22 000	8 000	22 000	-
Total COPh		20.5	6.9	13.3	7.2	-
OPEX costs	[eur/MWh]	4.4	12.9	6.6	12.5	25 - 30

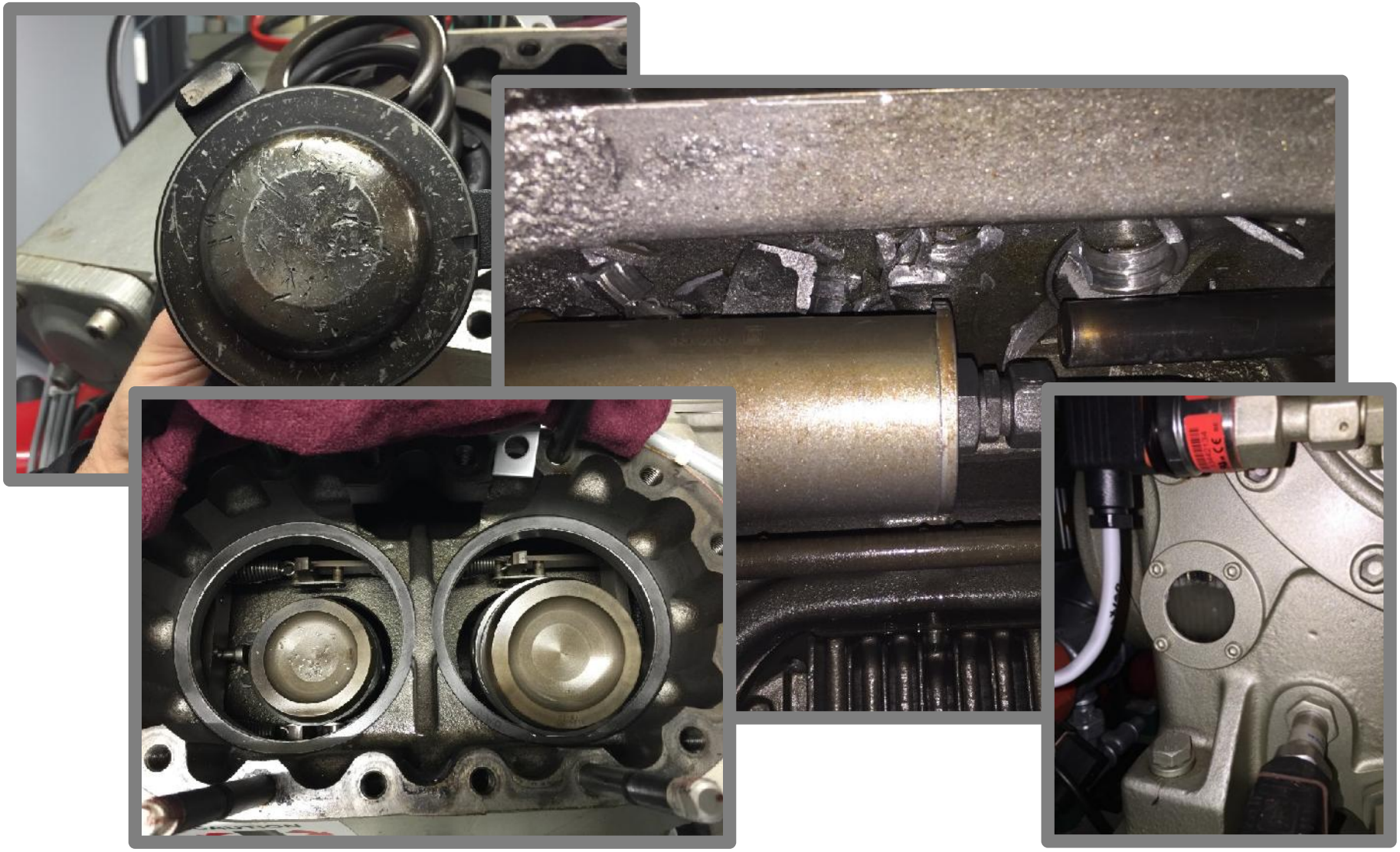
Remark 1: OPEX costs are based on year 2017 price information and are indicative only.

Remark 2: COPh = System heat recovery (MWh) divided by the system's own electricity consumption (MWh)

CALIGO
CLEAN EFFICIENCY

Critical thermodynamic integration

True experience and smooth integration of a heat pump with a condensing scrubber is a ”must”!



References

The latest Caligo heat pump scrubber installations

CALIGO
CLEAN EFFICIENCY

Case Nummela

CLIENT	Adven Oy
PLANT	Nummela 8MW DH plant
FUEL	Wood chips
CALIGO PRODUCT	CS50D20PHP104WT22 (scrubber with heat pump)
DELIVERY YEAR	2014
HEAT RECOVERY	32 %
ELECTRICITY CONS.	Below 110 kW
SO_2 DISPOSAL	Above 95 %
IN/OUT PARTICLES	150/50 mg/nm3
SOLIDS IN COND.	Below 10mg/l
CONDENSATE pH	6-10

CALIGO
CLEAN EFFICIENCY

Case Kauhava

CLIENT	Kauhavan Kaukolämpö Oy
PLANT	Kauhava 10MW DH plant
FUEL	Wood chips with high water content (60%-m)
CALIGO PRODUCT	CS40D22PHP106WT26-ESC (scrubber with heat pump and enhanced scrubbing module)
DELIVERY YEAR	2015
HEAT RECOVERY	33 %
ELECTRICITY CONS.	Below 160 kW
SO_2 DISPOSAL	Above 95 %
IN/OUT PARTICLES	300/40 mg/nm3
SOLIDS IN COND.	Below 10mg/l
CONDENSATE pH	6-10

CALIGO
CLEAN EFFICIENCY

Case Sotkamo

CLIENT	Vapo Oy
PLANT	Sotkamo 15MW CHP plant
FUEL	Peat
CALIGO PRODUCT	CS50D26PHP108WT30 (scrubber with heat pump)
DELIVERY YEAR	2015
HEAT RECOVERY	30 % (planned)
ELECTRICITY CONS.	Below 190 kW
SO_2 DISPOSAL	Above 95 %
IN/OUT PARTICLES	150/50 mg/nm3
SOLIDS IN COND.	Below 10mg/l
CONDENSATE pH	6-10

CALIGO
CLEAN EFFICIENCY

Case Alajärvi

CLIENT	Alajärven kaukolämpö Oy
PLANT	Alajärvi 9 MW bioplant
FUEL	Wood chip and peat
CALIGO PRODUCT	CS50D22PHP106WT34 (scrubber with heat pump)
DELIVERY YEAR	2016
HEAT RECOVERY	30 %
ELECTRICITY CONS.	Below 190 kW
SO2 DISPOSAL	Above 95 %
IN/OUT PARTICLES	300/50 mg/nm3
SOLIDS IN COND.	Below 10mg/l
CONDENSATE pH	6-10

Case Paimio

CLIENT	Paimion lämpökeskus Oy
PLANT	9 MW bioboiler
FUEL	Wood chip
CALIGO PRODUCT	CS50D22PHP106WT34 (scrubber with heat pump)
DELIVERY YEAR	2017
HEAT RECOVERY	over 30 % (planned)
ELECTRICITY CONS.	180 kW
SO2 DISPOSAL	Above 95 %
IN/OUT PARTICLES	50/50 mg/nm3
SOLIDS IN COND.	Below 10mg/l
CONDENSATE pH	6-10

CALIGO
CLEAN EFFICIENCY

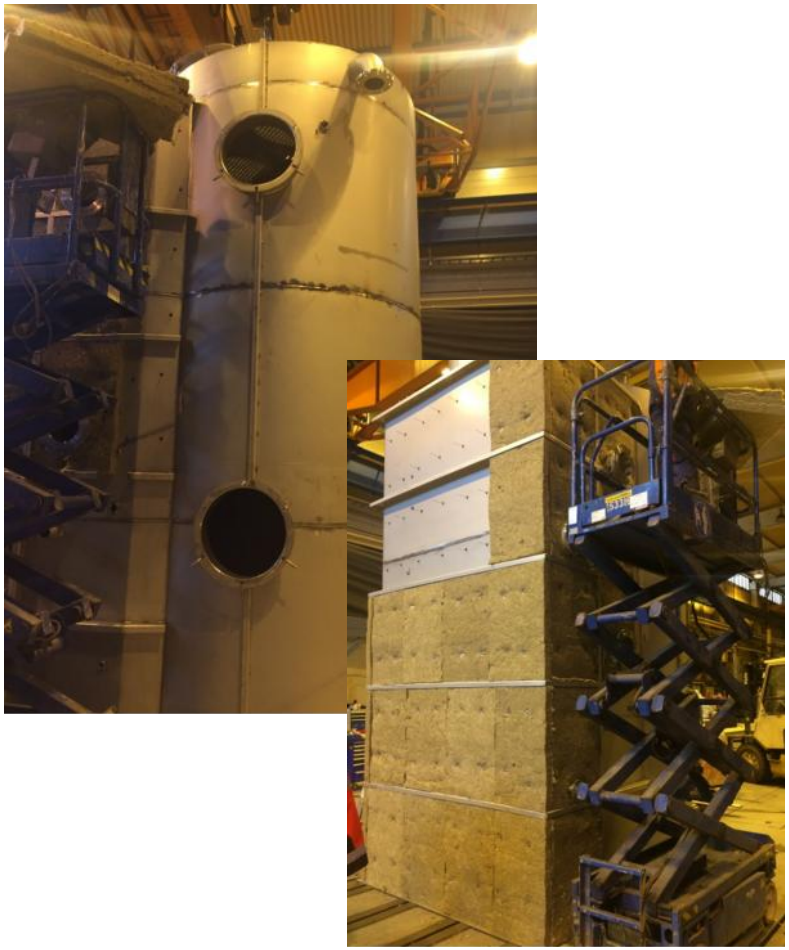
Case Nivala

CLIENT	Nivalan Kaukolämpö Oy
PLANT	25 MW bioboiler
FUEL	Wood chip
CALIGO PRODUCT	CS055DS32BWTS16-CC (scrubber with heat pump connectivity)
DELIVERY YEAR	2017
HEAT RECOVERY	25 % (planned)
ELECTRICITY CONS.	45 kW
SO2 DISPOSAL	Above 95 %
IN/OUT PARTICLES	50/50 mg/nm3
SOLIDS IN COND.	Below 10mg/l
CONDENSATE pH	6-10

CALIGO
CLEAN EFFICIENCY

Case Dalkia Tours, France

CLIENT	Dalkia
PLANT	9,5 MW bioboiler
FUEL	Wood chip
CALIGO PRODUCT	CS055DS22HPS712WTS16 (scrubber with two heat pumps)
DELIVERY YEAR	2018
HEAT RECOVERY	over 25 % (planned)
ELECTRICITY CONS.	Below 515 kW
SO2 DISPOSAL	Above 95 %
IN/OUT PARTICLES	50/50 mg/nm3
SOLIDS IN COND.	Below 10mg/l
CONDENSATE pH	6-10



CALIGO
CLEAN EFFICIENCY

Thank you!

CALIGO
CLEAN EFFICIENCY