



# NATURAL REFRIGERANTS

## CUSTOMISED INDUSTRIAL HIGH PRESSURE NH<sub>3</sub> HEAT PUMPS

Presented by Jan Boone,  
COO MAYEKAWA EMEA

**MAYEKAWA**

DOC.2019-290 R.5

50. Međunarodni kongres i izložba o KGH, Beograd, 4-6.12.2019  
50th International HVAC&R Congress and Exhibition, Belgrade, 4-6 Dec. 2019

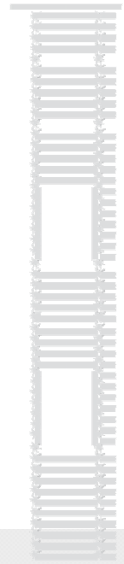
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Customised NH3 high pressure heat pump

## "Natural Five" Refrigerants and Product Solutions



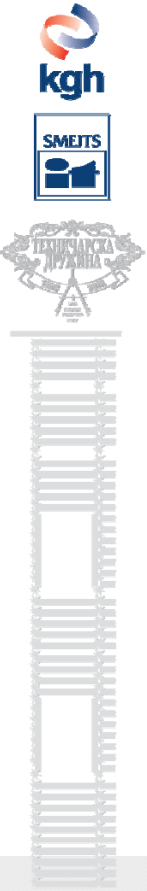
Refrigerant (Natural Five)	NH <sub>3</sub> R-717	CO <sub>2</sub> R-744	HC Hydrocarbon	H <sub>2</sub> O R-718	Air R-728
90°C		Utility hot water			
60°C	Utility hot water Heating		Utility hot water Heating HVAC	Heat recovery	
10°C	Chilled water Ice making	Chilled water Ice making		Chiller	
-15°C	Cold storage, Freezer, Fish boat				
-25°C	Specific Refrigeration needs				
-40°C	Freezer, Freeze-dry, Super Low temp storage				
-50°C			Cryogenics		Cryogenics
-60°C					
-100°C					
Notes	<ul style="list-style-type: none"> <li>• Conventional system</li> </ul>	<ul style="list-style-type: none"> <li>• Eco-Cute</li> </ul>	<ul style="list-style-type: none"> <li>• Nat'l Proj.</li> <li>• Butane + Propane</li> </ul>	<ul style="list-style-type: none"> <li>• Nat'l Proj.</li> <li>• Adsorption</li> <li>• Heat recovery</li> </ul>	<ul style="list-style-type: none"> <li>• Nat'l Proj.</li> <li>• Air-cycle</li> </ul>



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# NH3 HEAT PUMP COMPRESSORS



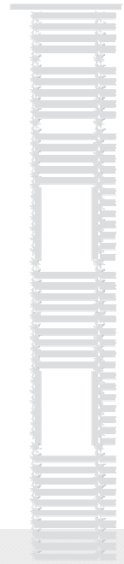
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# FIELD CASE

NH3 high pressure heat pump  
using waste heat from process to district heat



# INTRODUCTION

Starting point,  
2014

CP Kelco -manufacturer of food industry ingredients-  
uses distillation of alcohol in the process where  
the final condensate is usually released in large quantities of waste heat via  
cooling towers,  
established a cooperation with VEKS (West-Copenhagen district network)

AIM

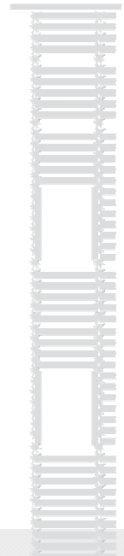
Obtaining efficient and flexible heat reclaim system

without limiting production operations

nor increase operational costs for CP Kelco,

together with a cost-effective and stable supply of Green energy  
to the local District Heating Network of VEKS and its customers.

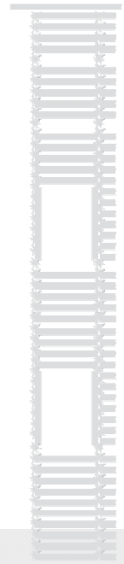
Project rated to achieve payback period of around 4 years.



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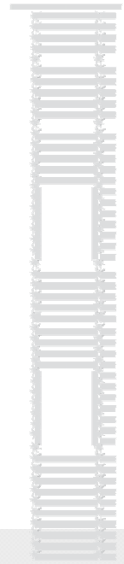
3000KW +85° C	The system is a combination of :  direct heat transfer through highly efficient heat exchangers and the incorporation of two 1,5 MW MYCOM ammonia heat pumps.
Which choice & why	NH3 Most suitable NF.  NH3 charge max. 500 kg NH3 in the plant.  NH3 is standard application for the Contractor.
NH3 +87,5° C  +61,7° C	To produce the water of 85° C NH3 is needed to condens at 87,5° C(48,9 bara).  To use the heat source at max.75° C NH3 is needed to evaporate at max.61,7° C (26 bara)



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Consultant	Realisation was done with Consultant VIEGAND&MAAGOE :  specialists in energy efficiency projects, who explored, analysed, shaped and managed the project from start to finish.
Contractor	Project was realised with SVEDAN INDUSTRI in Denmark Mayekawa's contractor for Denmark since more than 20 years.
Timeframe	
2016 order	Plant extension had to be executed in 2017.
F.A.T.	August 2017
ready	2017
S.A.T.	2018





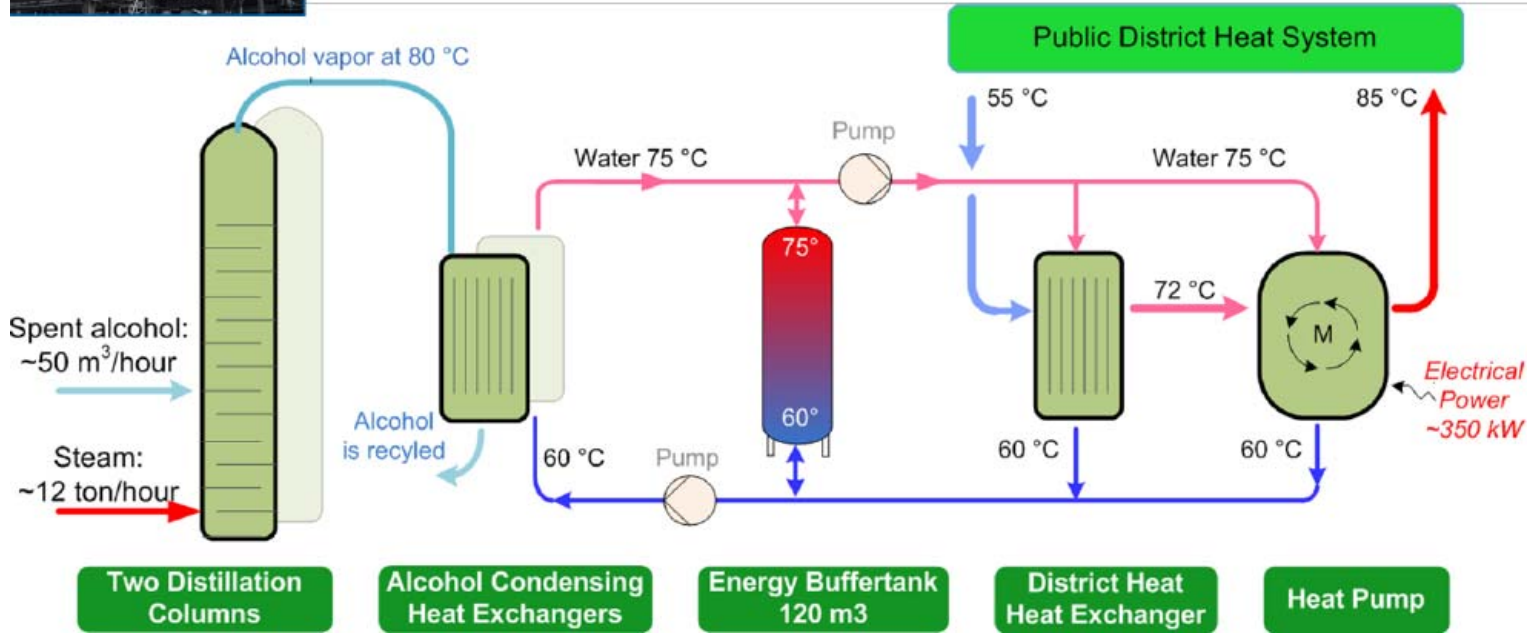
– CP KELCO

UTILIZING WASTE HEAT FROM PROCESS TO DISTRICT HEAT





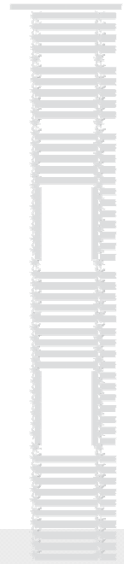
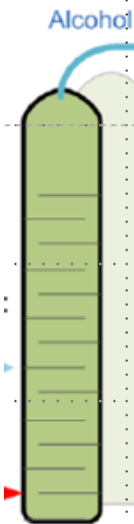
# SYSTEM PROCESS FLOW



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SYSTEM DESIGN DETAILS		REF.SO80.333		
HEAT OUTPUT	HOT WATER FOR DISTRICT HEATING			
	water	outlet	°C	85
		return	°C	72
	capacity		kW	3338
HEAT SOURCE	high temperature alcohol			
	water	inlet	°C	75
		outlet	°C	60
	capacity		kW	3019
COMPRESSORS	type	high pressure reciprocating		
	model	N4HS		
	quantity	2		
DRIVE MOTORS	power	kW	250	C1
VFD		kW	250	C2
NH3	charge	kg	150	each
		g/kW	90	
	circuit		individual	



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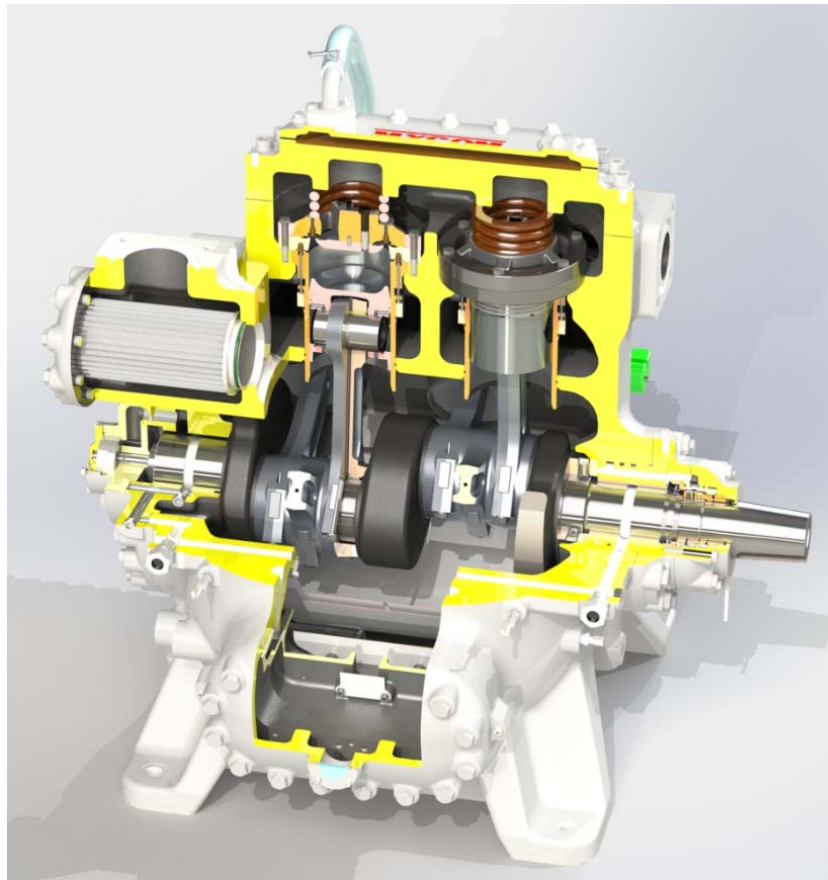


DESIGN DATA	C1		C2		TOTAL
heat output			87,5		TC
TC(°C)	81		1686		QC(kW)
QC(kW)	1652		85		Tw(°C)
TW(°C)	72	78,5			
motor power					
kW	155		185		340
heat source					
			75		Tw(°C)
TW(°C)	60	67,5			3019
RT(kW)	1507		1512		
TE(°C)	58		61,7		
COPh	10,66		9,11		9,82



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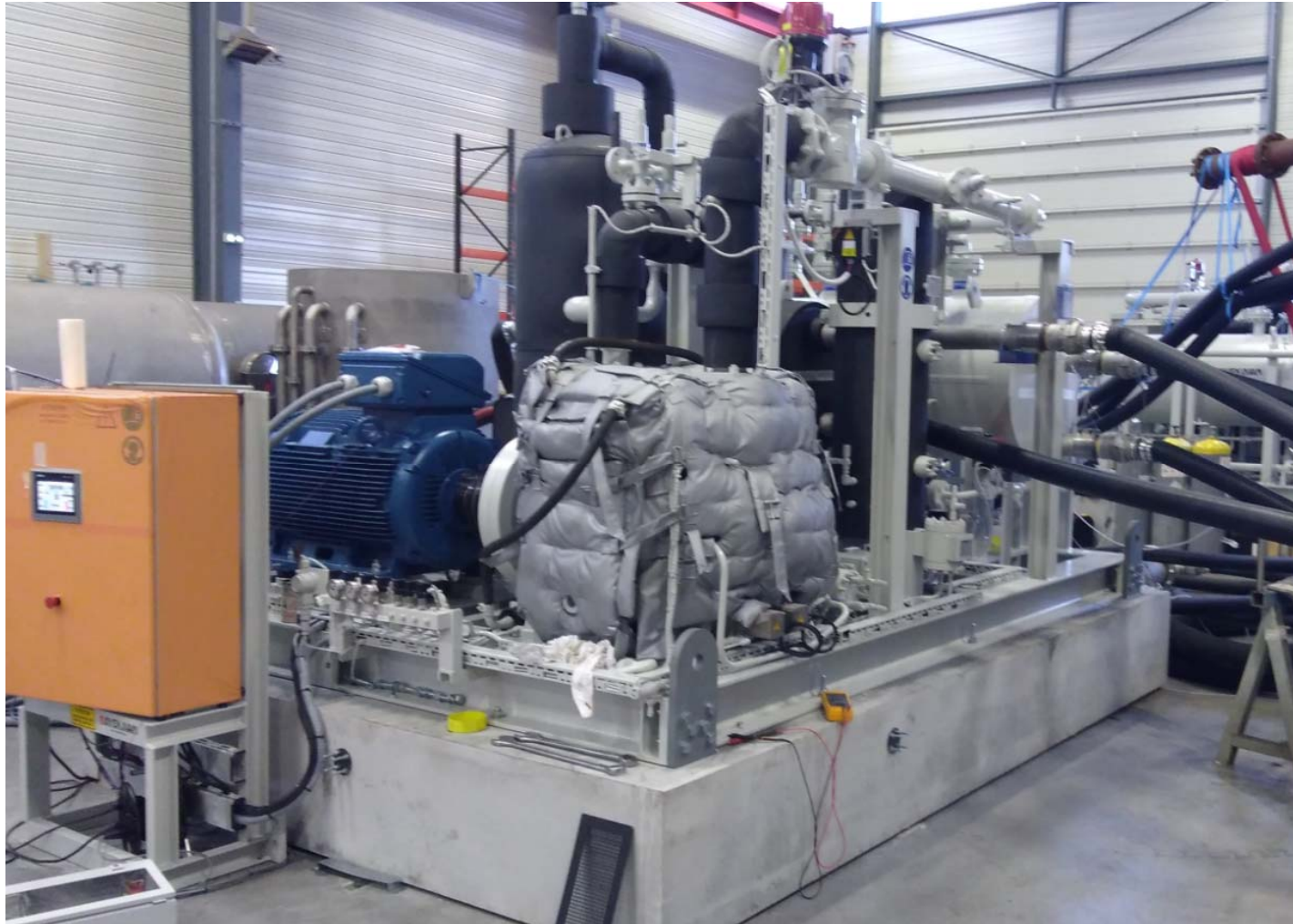
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F.A.T. AUGUST 2017 (cooperation CEMAFROID)

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## NATURAL REFRIGERANTS

Customised NH<sub>3</sub> high pressure heat pump



150 kg NH<sub>3</sub>/unit  
90g/kW



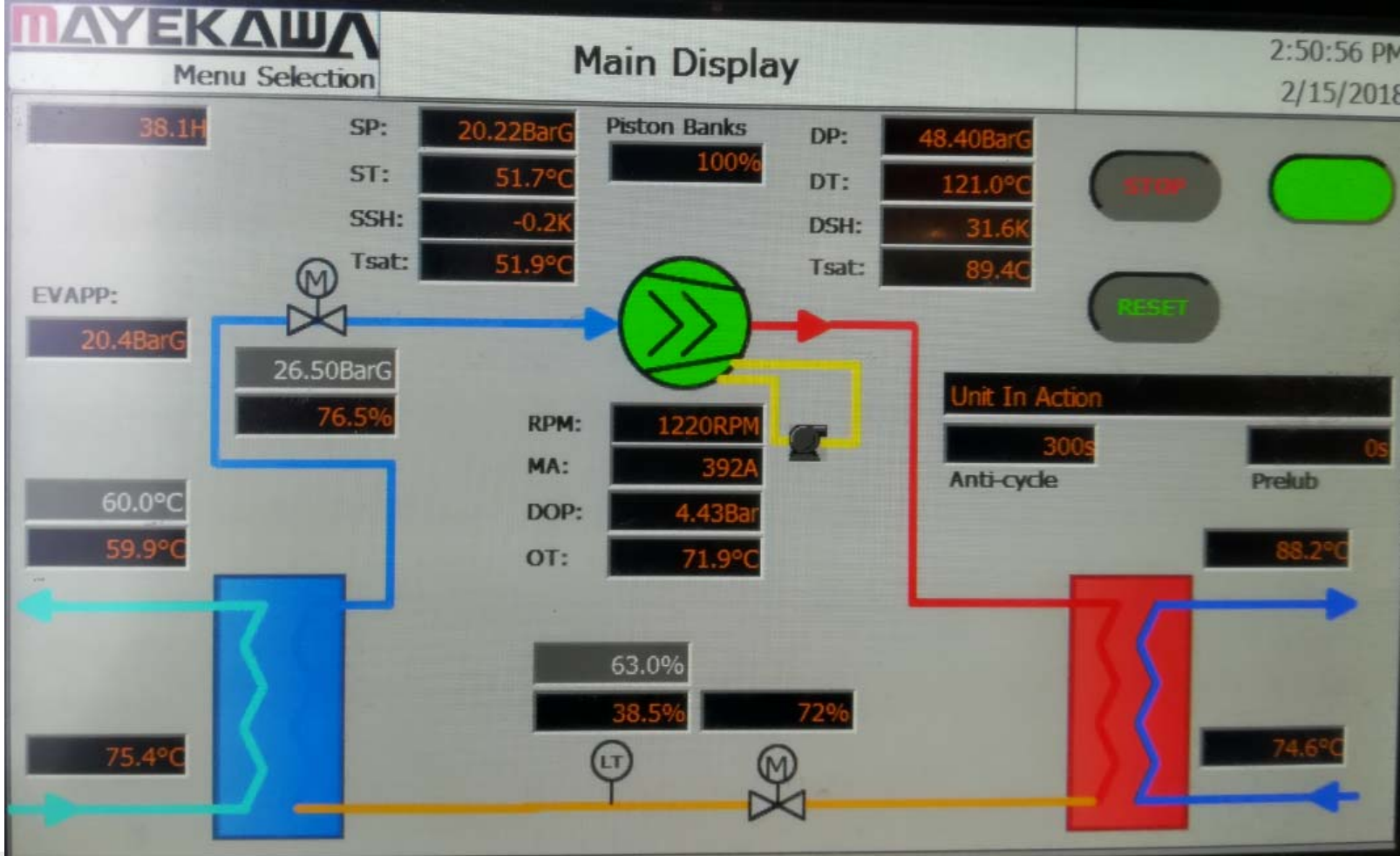


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51,9

89,4



59,9

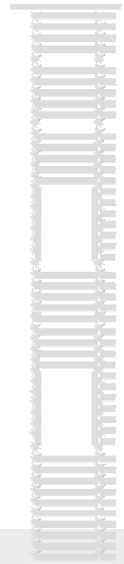
75,4

88,2

74,6



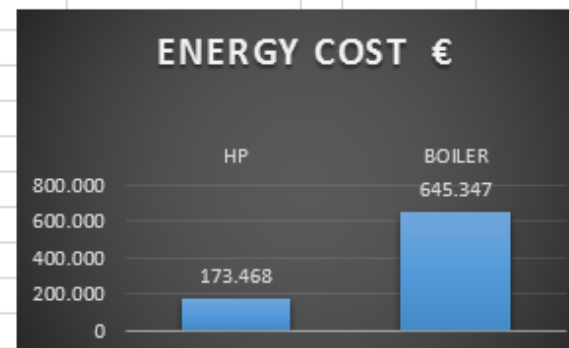
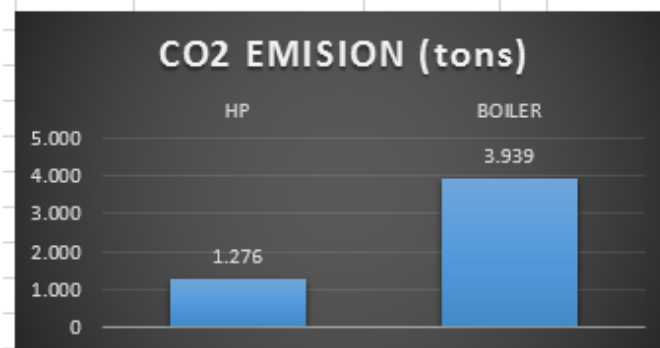
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OPERATING SAVINGS		HEAT PUMP	GAS BOILER	SAVING	
					%
Performance COPh		7,85	0,90 *		
Hot water (year)	mW	20.028	22.253		
Energy consumption (year)	MWh	2.551	22.253	19.702	89
Energy prices	euro/MWh	68	29		
Energy costs	euro	173.468	645.347	471.879	73
CO2 emissions	tons	1.276	3.939	2.663	68



\* incl.20% losses on heat pump

# SUMMARY

# SAVINGS / YR

HEAT SOURCE	HOT WATER T°	OUTPUT INPUT ENERGY MWh/yr	ENERGY MWhr %	ENERGY € %	CO2 tons %
HIGH T°	85	20.028	19.702	471.879	2.663
ALCOHOL		2.551			
75°C		7,85	89	73	68





This project at CP Kelco is an excellent  
Example of cooperation between :

Production industry and  
Energy supply companies

Achieving both Environmental and  
Economical benefits



Special thankword to  
SVEDAN INDUSTRI KOELEANLAEG A-S  
MR.SOREN GRAM ([sg@svedan.com](mailto:sg@svedan.com))

RESOURCES

MR.CHRISTIAN JENSEN (VIEGAND MAAGOE, DK)  
UTILISATION OF WASTE HEAT IN INDUSTRY,  
HEAT PUMP FORUM 2019, EHPA, Brussels 15-16/5/2019



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**THANKS FOR  
YOUR ATTENTION**



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### MARKET AVAILABILITY

REPRESENTATIVE SERBIA :

**“KLIMA” doo Smederevo – Serbia**  
Telephone : +381 26/ 618 992  
Website : [www.klima.co.rs](http://www.klima.co.rs)

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