

**UNITED NATIONS ENVIRONMENT PROGRAMME  
INTERNATIONAL INSTITUTE OF REFRIGERATION  
EUROPEAN ENERGY CENTRE  
CENTRO STUDI GALILEO**



**15th EUROPEAN CONFERENCE  
THE LATEST TECHNOLOGY  
IN AIR CONDITIONING AND REFRIGERATION INDUSTRY.  
7<sup>th</sup>-8<sup>th</sup> June 2013  
Politecnico of Milano - Italy**



**Latest Technology in Refrigeration and Air Conditioning  
Under the Auspices of the PRESIDENCY  
XV EUROPEAN CONFERENCE**



**OF THE COUNCIL OF MINISTERS  
MILANO 7<sup>th</sup>-8<sup>th</sup> JUNE 2013**



# **NATURAL REFRIGERANTS**

## **HEAT PUMPS**

**LINE UP OF NATURAL FIVE : NH<sub>3</sub> – CO<sub>2</sub> – HC – WATER – AIR**

**HOT WATER PRODUCTION NH<sub>3</sub> HEAT PUMP**

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# LINE UP OF NATURAL FIVE

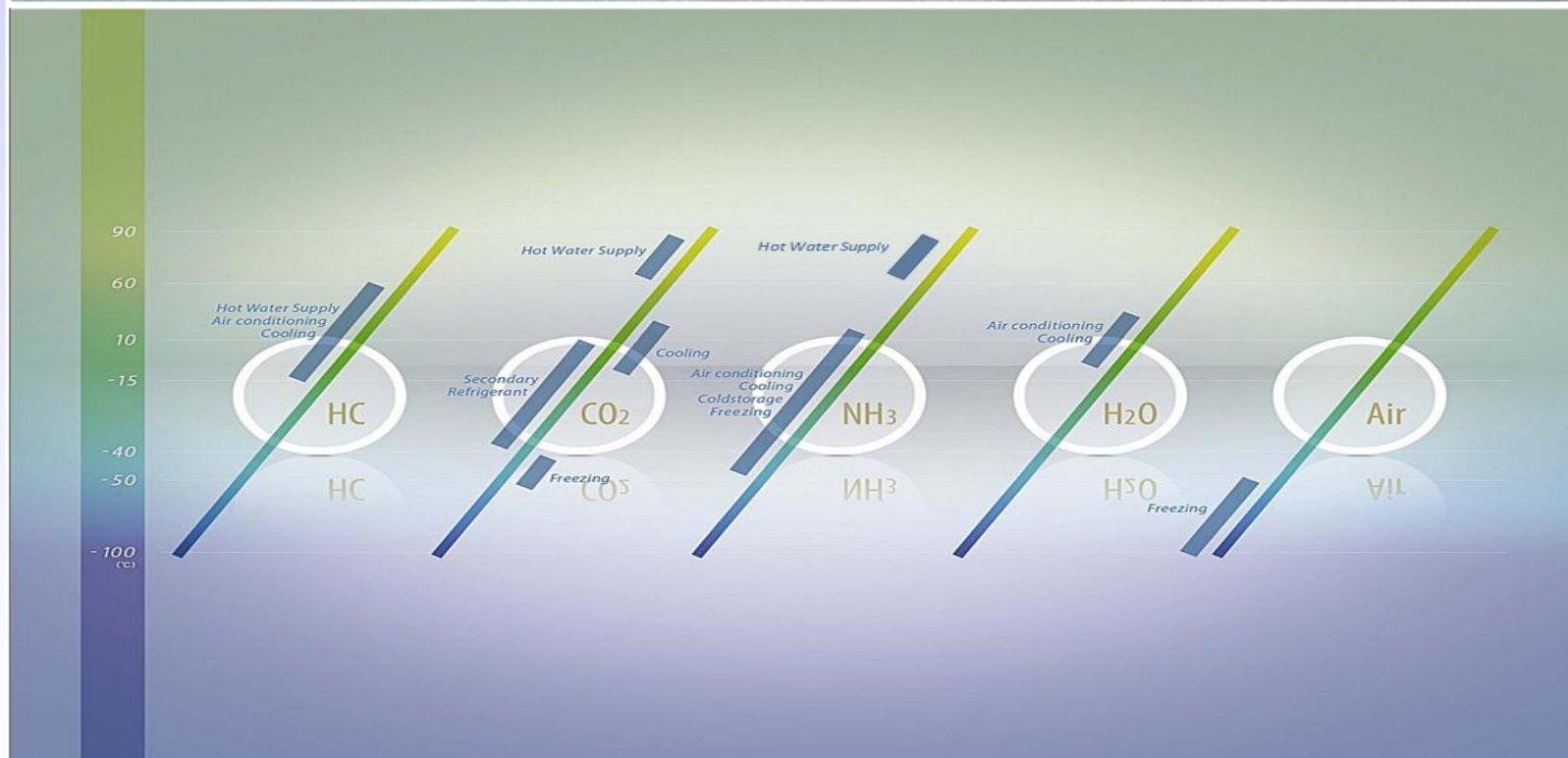
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**NATURAL  
FIVE**  
HC  
CO<sub>2</sub>  
NH<sub>3</sub>  
H<sub>2</sub>O  
Air  
Natural  
Refrigerant

Five Environmentally Friendly Natural Working Fluids  
For Freezing, Air conditioning, Heating & Hot Water Supplying

To Help Protect the Earth from Global Warming...

Mayekawa is focusing its efforts on technological research and development  
to simultaneously achieve "Energy Saving" and "Chemical Refrigerant Free".



# "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 Heating	Utility hot water			
60°C			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					
-60°C			Cryogenics		Cryogenics
-100°C					
Notes	<ul style="list-style-type: none"> <li>Conventional system</li> <li>National Projects</li> </ul>	<ul style="list-style-type: none"> <li>HeatCO<sub>2</sub>m</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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# FIELD CASE

## HOT WATER PRODUCTION NH<sub>3</sub> HEAT PUMP

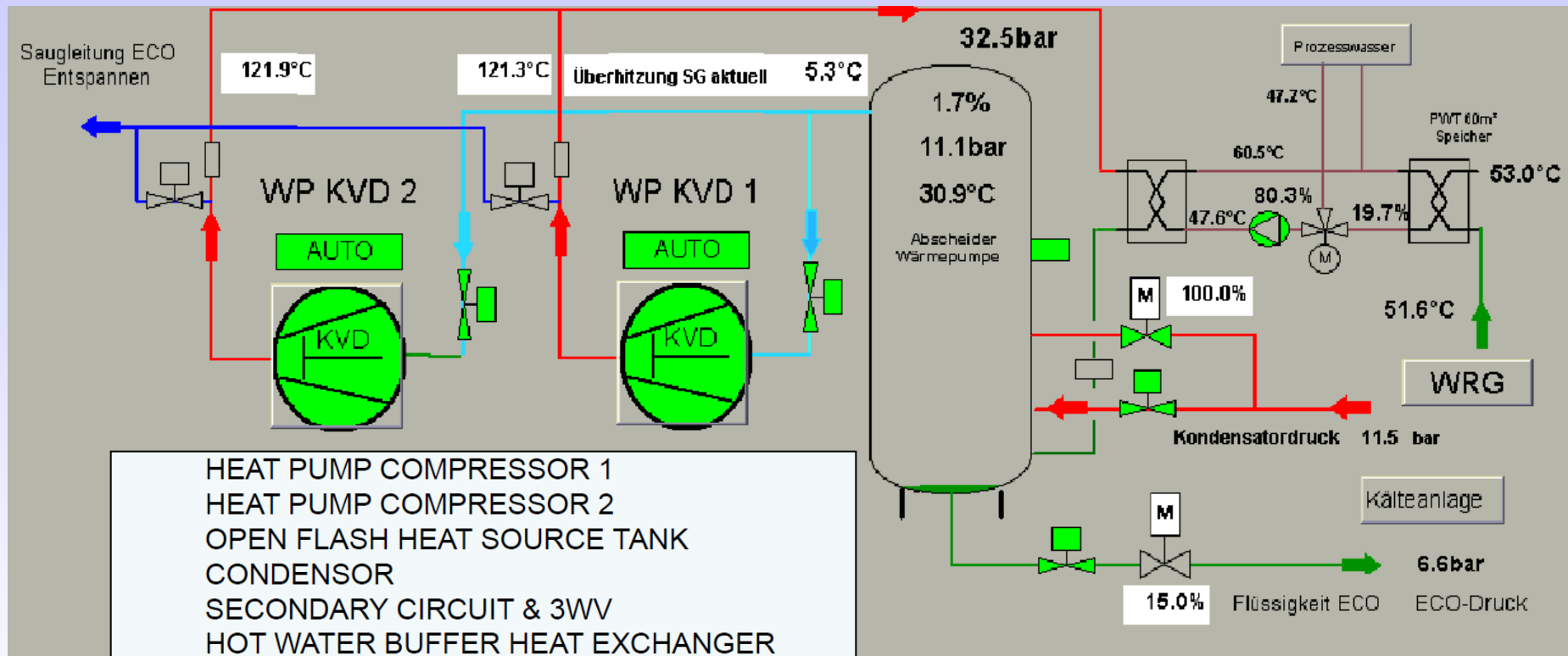
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## REQUIREMENT

NEED	Produce hot water up to 60°C by NH3 heat pump
CAPACITY	<p>Hot water consumption : 160 m<sup>3</sup>/day</p> <p>Period : 5 days/week, 18 to 20hrs/day</p> <p>buffer tanks available :</p> <p>60m<sup>3</sup>(hot water)/20m<sup>3</sup>(energy-boiler vessels)</p> <p>Heat capacity=max.750kW</p>
MEDIUM	<p>Refrigerant : NH<sub>3</sub></p> <ul style="list-style-type: none"> <li>- Natural refrigerant (ODP=0 &amp; GWP=0)</li> <li>- Condensing temperature 65°C (28,5 barg)</li> </ul> <p>Secondary medium : glycol-water</p> <ul style="list-style-type: none"> <li>- between NH<sub>3</sub> &amp; process</li> </ul>
HEAT SOURCE	<p>Condensor circuit of the central refrigeration plant</p> <ul style="list-style-type: none"> <li>- HP evaporating temperature 25°C (9,0 barg)</li> </ul>



## PRINCIPLE SCHEME



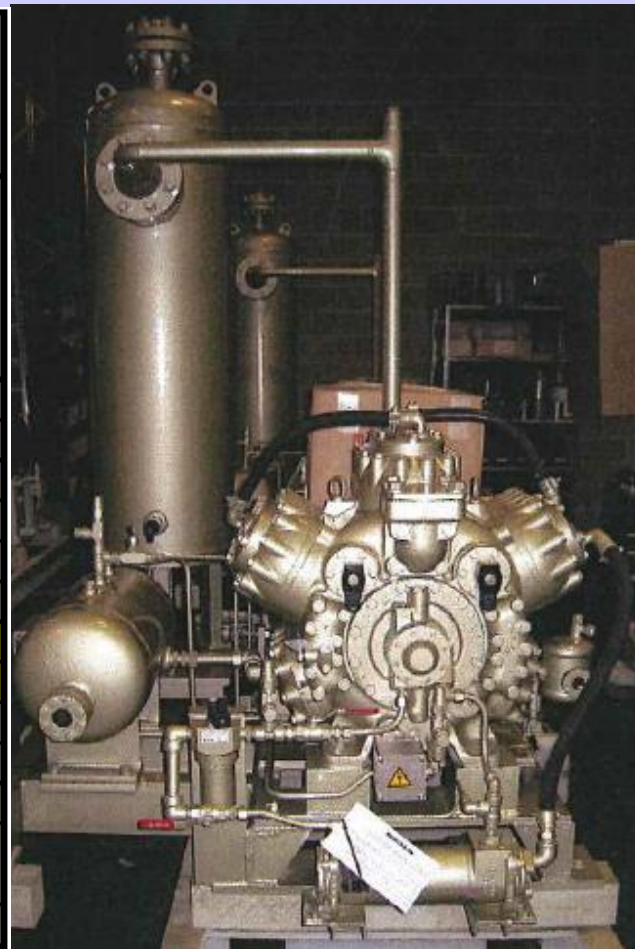
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# Design data

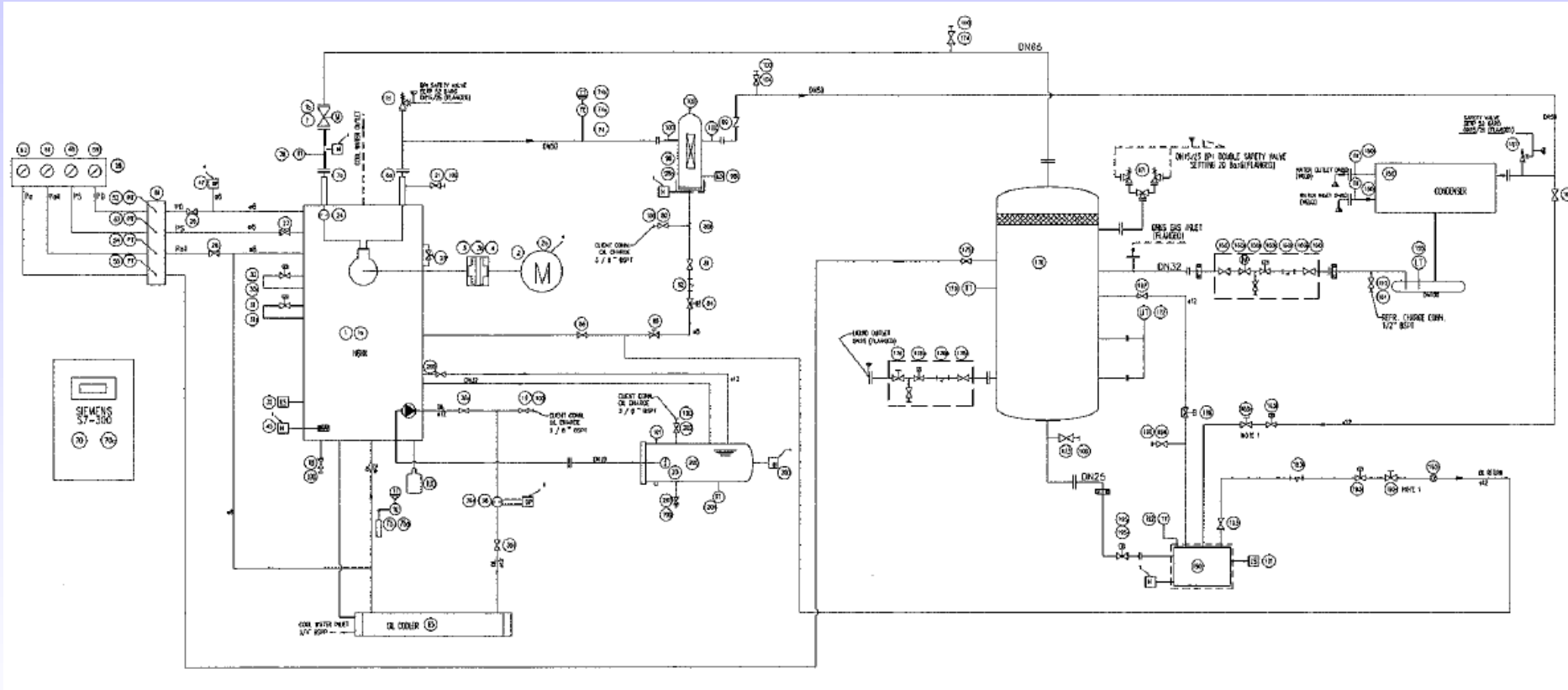
## EQUIPMENT

MODEL		N6HK	
QTY		2	
SITE LOCATION		GERMANY STORKOW	
COUNTRY			
TOWN			
REFRIGERANT		NH3	
TE	°C	25	
TC	°C	65	
PS	barg	9	
PD	barg	28,5	
RPM	rpm	970	1450
QC	kW	262	393
BKW	kW	44	69
COP-H		5.9	5.7
OPERATING HOURS		25/04/2013	
KVD1	hrs	9900	
KVD2	hrs	9562	



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# UNIT PID



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## UNIT LAYOUT



Installation date :  
October 2010

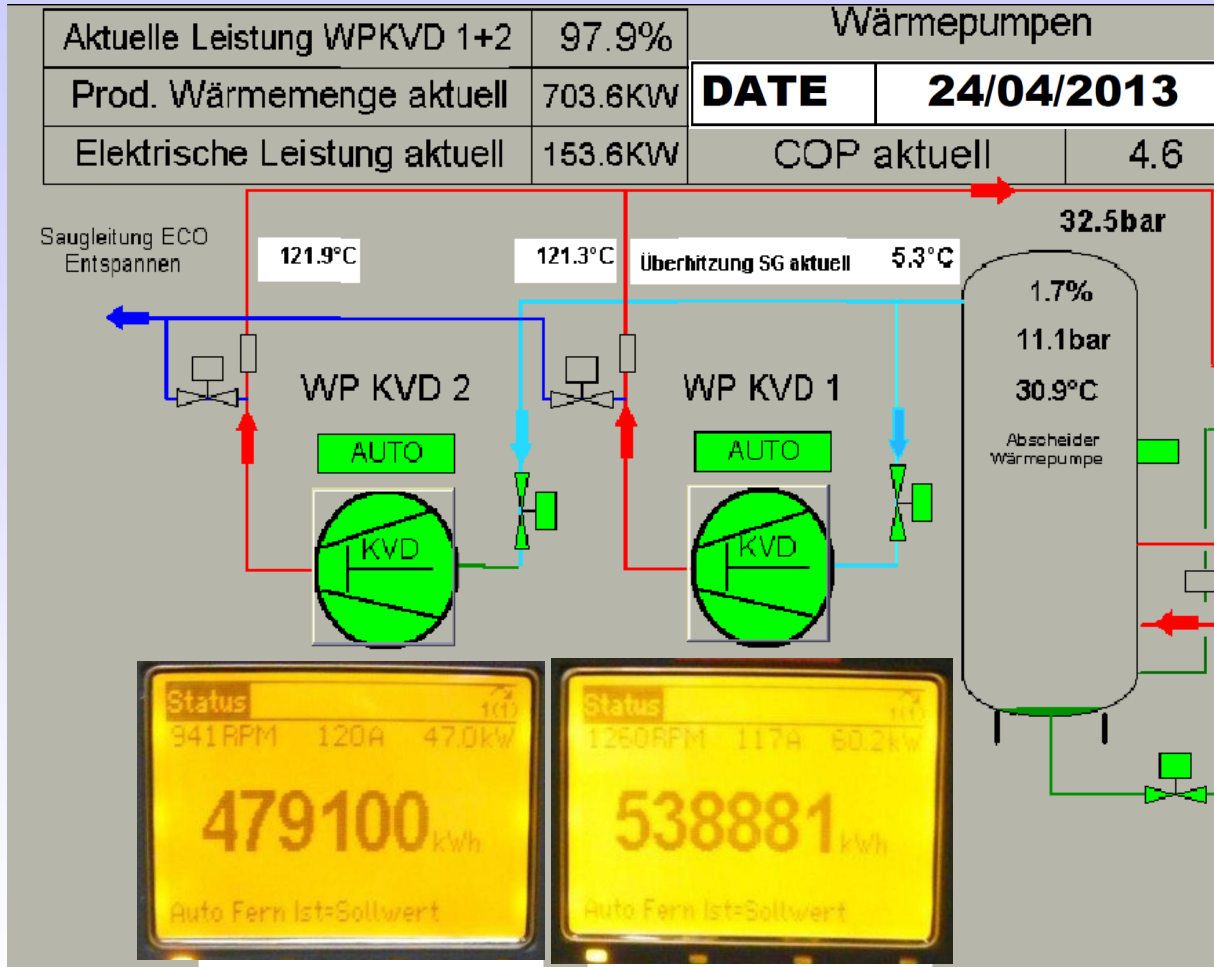
Operating hours per year  
 $\pm 10.600$  hrs

Calculation detail :  
POWER DRIVE  
Efficiency =  
97~98%

DRIVE MOTOR  
SEVA 280M 90kW  
 $\cos\varphi = 0,87/0,75$   
efficiency =  
93,7/93,2  
(100%/50% load)

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## OPERATION STATUS



### Operating hours

KVD1 9900 hrs  
KVD2 9562 hrs  
Σ 19462 hrs

### Power consumption

C1 538881 kWh  
C2 479100 kWh  
Total 1017981 kWh

### Heating production

Total 4928342 kWh

Total COPh : 4,8

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## OPERATION SAVINGS

COSTS		GAS BOILER	HEAT PUMP
plant heating capacity	kW	4928342	4928342
total running hours status	hrs		19462
load ratio (average)	%	75	75
efficiency	%	85	
required energy	kWh	7730732	1017981
energy quantity			
o gas	liter	773073	
o electricity	kWh		1017981
COP-heating		0.64	4,84
energy cost			
o gas	€/kWh	0,04	
o electricity	€/kWh		0,15
o total energy cost	€	309229	152697
energy saving	€		156532
	%		50
installation cost	€		300000
operating hours per year	hrs		10600
energy saving per year	€		85381
return of investment	years		3,5

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# CONCLUSION :

## ANNUAL SAVINGS :

OPERATION 85.381 €  
CONDENSOR-WATER 2.244 mW  
(2,5m3+ treatment)  
NATURAL WASTE HEAT  
CONDENSOR

RETURN OF INVESTMENT 3.5 YRS

HIGHER EFFICIENCY THAN COMPARABLE  
TECHNOLOGIES

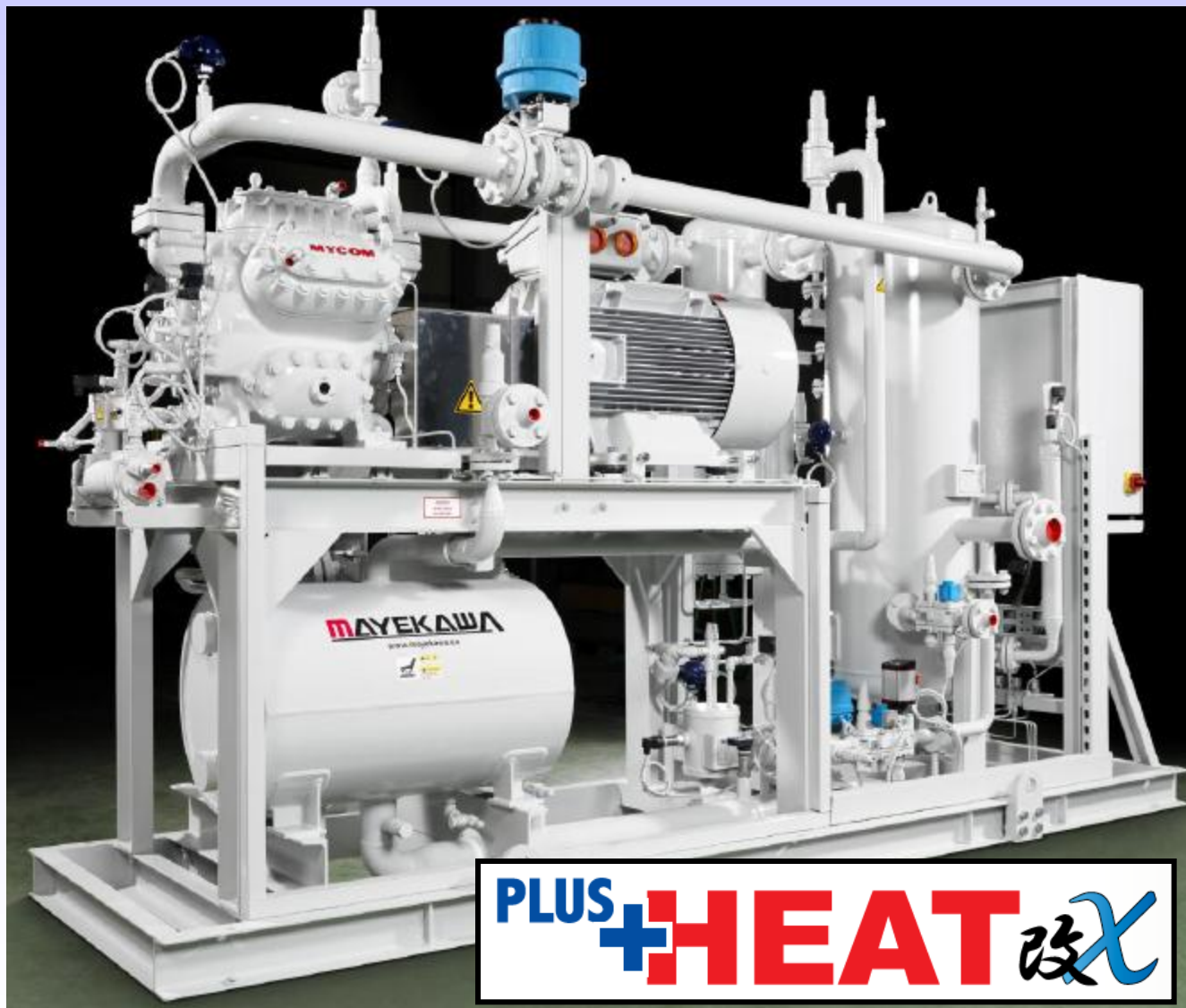
LONG LIFE TIME (>25 YEARS)

MAINTENANCE LOW-COST

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# MAYEKAWA NEW STANDARD HIGH STAGE HEAT PUMP

**MAYEKAWA**  
**MYCOM**





# HOT WATER PRODUCTION AMMONIA HEAT PUMP

## THANKS FOR YOUR ATTENTION !

SPECIAL THANKS TO :  
Kältetechnik Dresden + Bremen  
Alfhausen-Germany  
[www.dresen-kaelte.de](http://www.dresen-kaelte.de)

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# MAYEKAWA MYCOM

**WORLDWIDE**  
• 35 countries / 122 offices  
• 8 production plants



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