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Presented by Jan Boone, MAYEKAWA

MARKET TREND

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NATURAL REFRIGERANT	APPLICATION	TYPE	COOLING/HEATING OUTPUT				QUANTITIES	NOTES
			RANGE		TEMPERATURE		TREND	
			kW	kW	°C	°C	%	
NH3	COMPRESSION HEAT PUMP	PISTON	200	600	50	80	25	
		SCREW	500	2000	50	80	150	
CO2	COMPRESSION SUBCRITICAL	PISTON		1000	-52	-30	150	
		SCREW		3000	-52	-30	150	
	COMPRESSION TRANSCRITICAL HEAT PUMP	PISTON		90	90	100		ECO-CUTE (P&K) (MJ : 300 pcs)
	PUMP SECONDARY BRINE	SCREW		90 800		-30 -30	10	NEWTON3000 (P&K) (MJ : 350 pcs)
HC	COMPRESSION SUBCRITICAL	PISTON SCREW		2000	-40	-20	10	process/chemical
WATER	ADSORPTION DESORPTION	ADREF	100	300	15	20		ADREF (P&K) (MJ : +50pcs)
AIR	COMPRESSION TRANSCRITICAL	TURBINE		30	-120	-80		PASCAL AIR (MJ : 10 pcs)

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FIELD CASES :

NATURAL REFRIGERANTS
In Different Industrial
HEAT PUMP plants in Norway

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FIELD CASE

TECHNOLOGY AREA – ENERGY STATION – COOLING & HEATING

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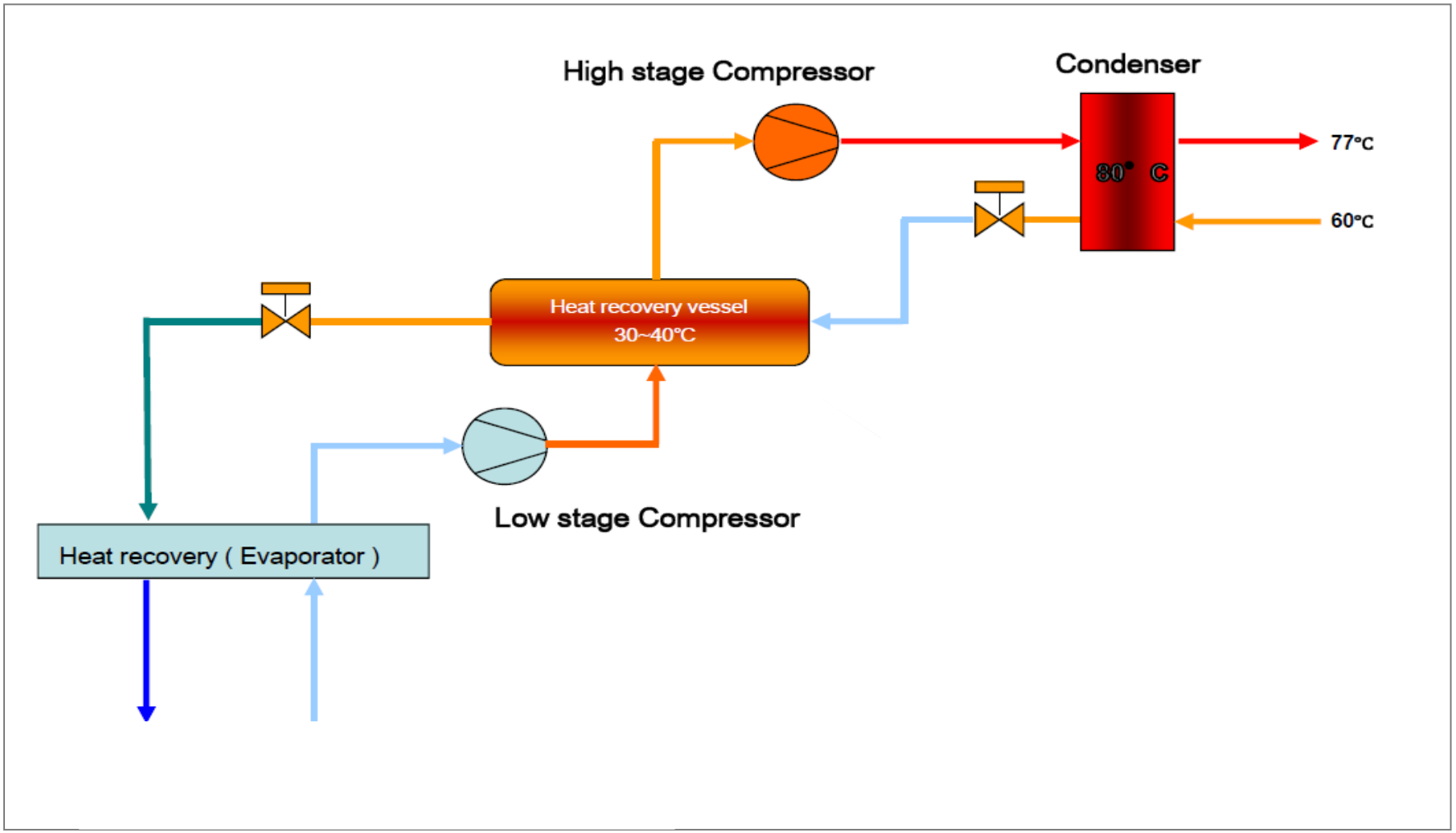
INTRODUCTION

Starting point, need?	**The contractor THERMA INDUSTRI has received the request from his customer to install 2 hot water heat pumps, each 1350kW for 77°C.**
Heat output ? **2700 kW** **77°C**	**The plant is an energy station of a technology area.** **The cooling is used to produce ice-water for :** **Office cooling** **Cooling for data center** **The heating is used to produce hot water of maximum 82°C for :** **District heating**
Heat Source ? **30°C to 40°C**	**Requirements ?** **Heat source :** **1) Heat rejection from the cooling plant needed for office- and process cooling** **Minimum load : 600 kW** **Maximum load : 5000 kW** **2) Sewage water in case insufficient cooling plant heat rejection available.**
Restrictions ?	

->INTRODUCTION

Why natural refrigerants +80°C	For the temperature of 80°C NH_3 is the most suitable refrigerant
Which choice & why	NH_3 (TC=+80°C & PD=39,6barg) as natural refrigerant to obtain 77°C hot water. 50bar compressor available NH_3 is standard application for Therma Industri.
Timeframe	The project started in 2008. Installation done in 2009.


High stage Compressor
Condenser
77°C
80° C
60°C
Heat recovery vessel
30~40°C
Low stage Compressor
Heat recovery (Evaporator)


ATTENTION
31 4:18PM

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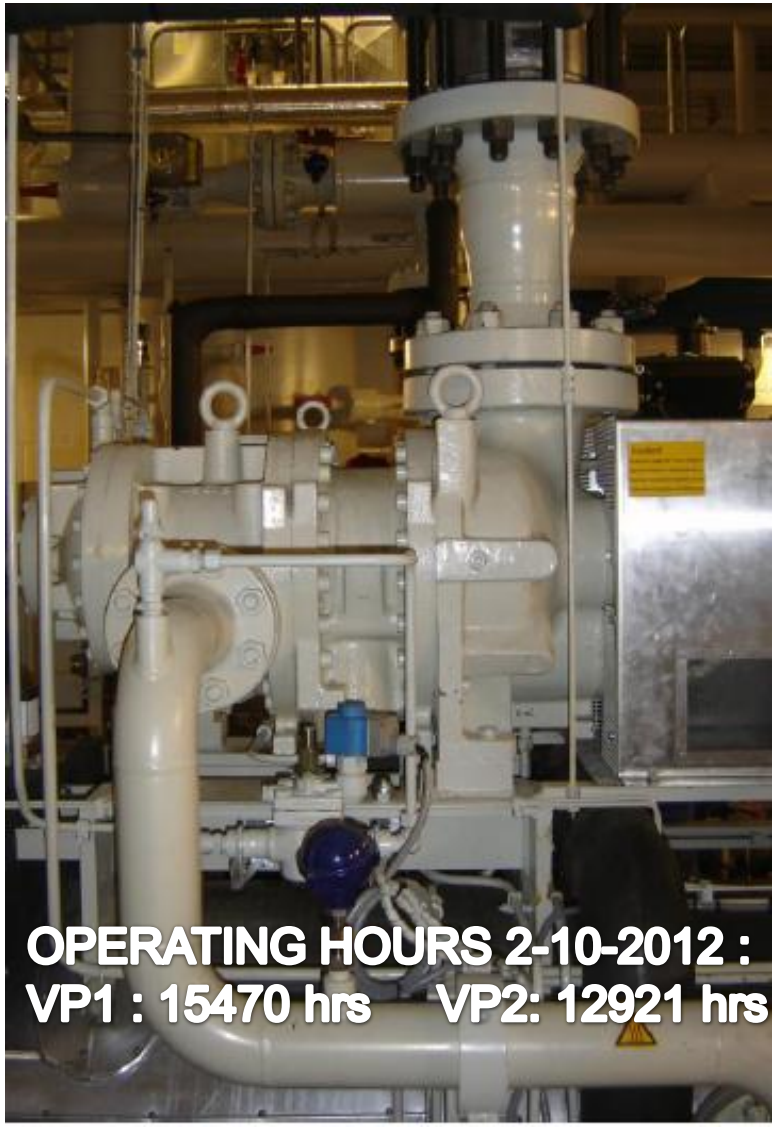
IDENTIFICATION		
COMPRESSOR MODEL	SERIAL NUMBER	UNIT
N160GHS-V	8161006	VP1
N160GHS-V	8161005	VP2
MAIN DRIVE MOTOR	315kW	
QUANTITY	2	

PER MACHINE		HEAT INPUT	POWER INPUT	HEAT OUTPUT	
T	°C	30		77	
	kW	RT	BKW	QC	COP-h
RPM	3550	820	266	1086	4,1
	1800	361	136	497	3,7
T	°C	40		77	
	kW	RT	BKW	QC	COP-h
RPM	3550	1103	263	1366	5,2
	1800	471	134	605	4,5

T	°C	temperature	(heat input : NH3, heat output : hot water)
RT	kW	heat source capacity	
BKW	kW	absorbed motor power at shaft	
QC	kW	heat output capcity	
COP-h		coefficient of heating performance	
RPM	rpm	shaft revolution per minute	



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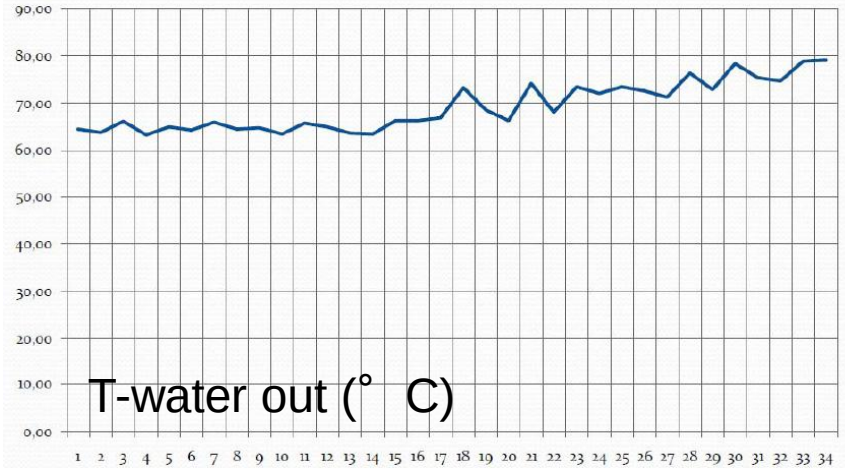
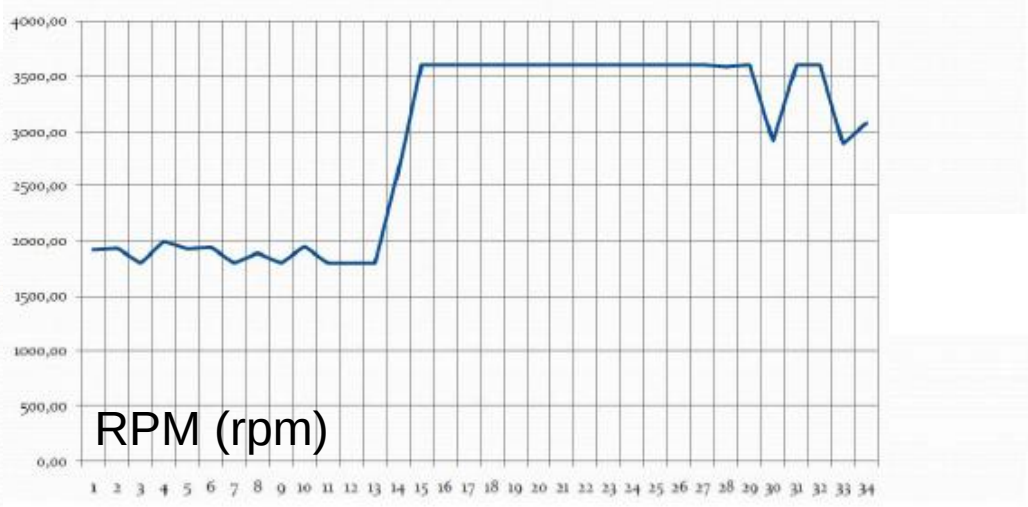
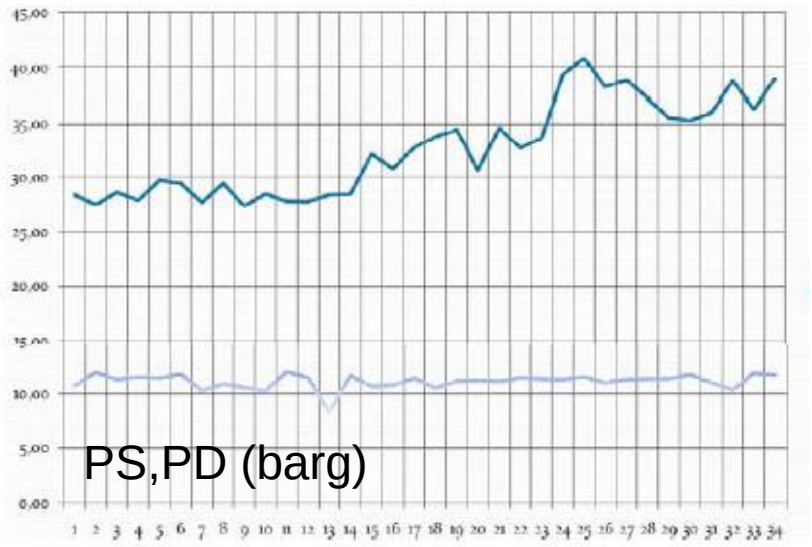
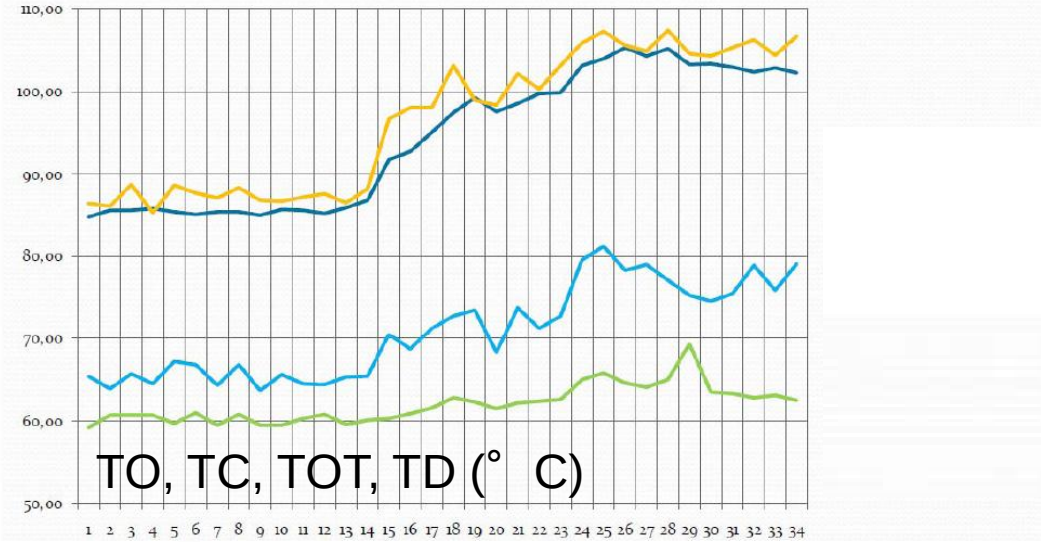
ATMO EU sphere
Solutions for Europe
natural refrigerants

LOGGING DATA









EFFICIENCY ANALYSIS

Difference planned & actual results if occured?	
If yes, why were there differences?	The plant produced approx. 10 GWh of energy in 2010, which increased to 13 GWh in 2011. The design COP-h is in the range of 3.7 to 5.2 depending on the plant load. The yearly overall COP-h was above 3 for the first 3 years of operation. Compared to classic boiler: saving of 72% input energy !
How is the process of measuring efficiency?	The equipment is operating following load programs which must be covered by the heating plant, which was fullfilled. The machines are equipped with frequency convertor for speed control at part-load operation in order to keep the best COP-h

HEAT SOURCE / HEAT OUTPUT / COP-heating overview

TE °C	TM °C	TC °C	RT kW	QTY	QC kW	BKWhp kW	HEAT SOURCE data center kW	HEAT SOURCE sewage water kW	extra compressor N200VL-L rt kW	extra compressor N200VL-L bkw kW	COP-final BKWt kW	COP-final cop-total QC/BKWt
4	40	80	2206	2	2732	526	600	1606	1360	246	772	3,5

CONCLUSION

NATURAL REFRIGERANTS SOLUTIONS FOR EUROPE :

THIS PROVEN FIELD EXAMPLE SHOWS THAT THE SUCCESS OF THE NEW TECHNOLOGY IS MUCH DEPENDING ON THE QUALITY OF THE PREPARATIONS DONE ON BEFOREHAND FOLLOWED BY THE INSTALLATION AND COMMISIONING WITH OPTIMAL FINE TUNING, FROM COOPERATION BETWEEN ALL PARTIES INVOLVED :

MANUFACTURER : MAYEKAWA JAPAN/ MAYEKAWA EUROPE
CONTRACTOR : THERMA INDUSTRI.

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natural refrigerants

THANKS FOR YOUR ATTENTION !

& much appreciated thanks to the Contractor of the fieldcases :

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