



UTILIZATION OF THERMAL ENERGY TO INCREASE SYSTEM EFFICIENCY

FLORØ 18-19 SEPTEMBER 2019

MMC FIRST PROCESS IS A NORWEGIAN COMPANY.

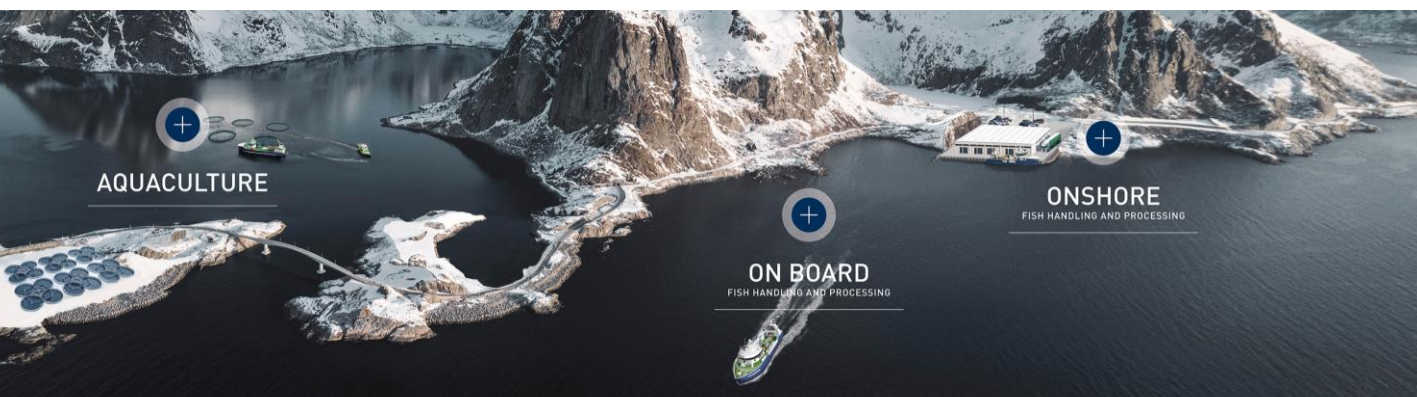
We are totally transforming the seafood industry by offering complete and sustainable system solutions for the handling, processing and cooling of fish to the seafood industry onshore and offshore - worldwide.





VISION

Our vision is to transform the world's seafood industry so it can manage nature's marine resources in a more sustainable and environment-friendly manner, and thereby create added value for businesses and society at large.



THE COMPANY

The most complete supplier of total system solutions for handling of seafood to the fishery and aquaculture industries at sea and on shore

Unmatched competence and range of technology within fish handling, processing and refrigeration

Based in Norway with 160 employees in Fosnavåg, Ålesund and Haugesund

3 in 1 => Power in One – a Complete Gamechanger



New building in Aalesund ready 26th of September 2019

2200m2 workshop. 2100m2 office and administration



View from my office





SYSTEM SOLUTIONS BY INDUSTRY

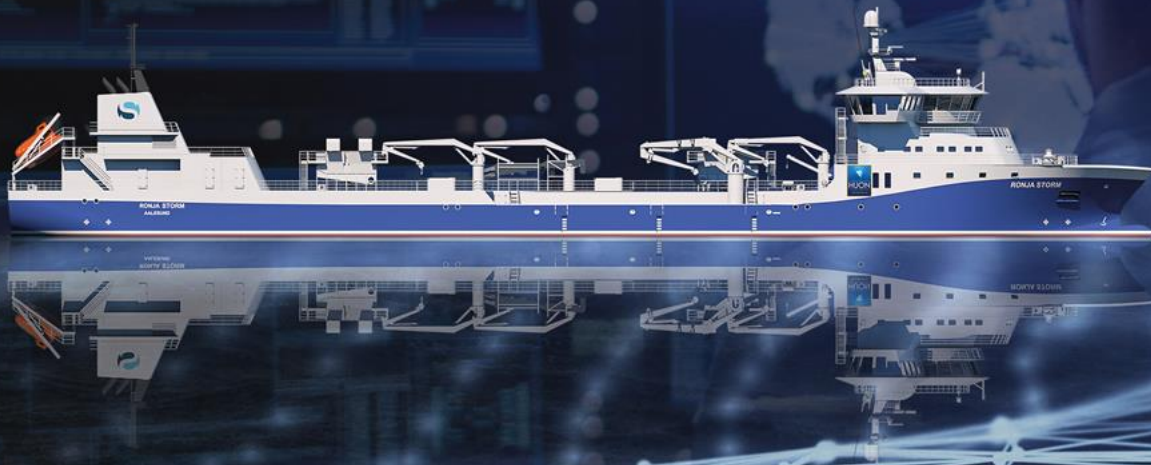

AQUACULTURE


ON BOARD
FISH HANDLING AND PROCESSING

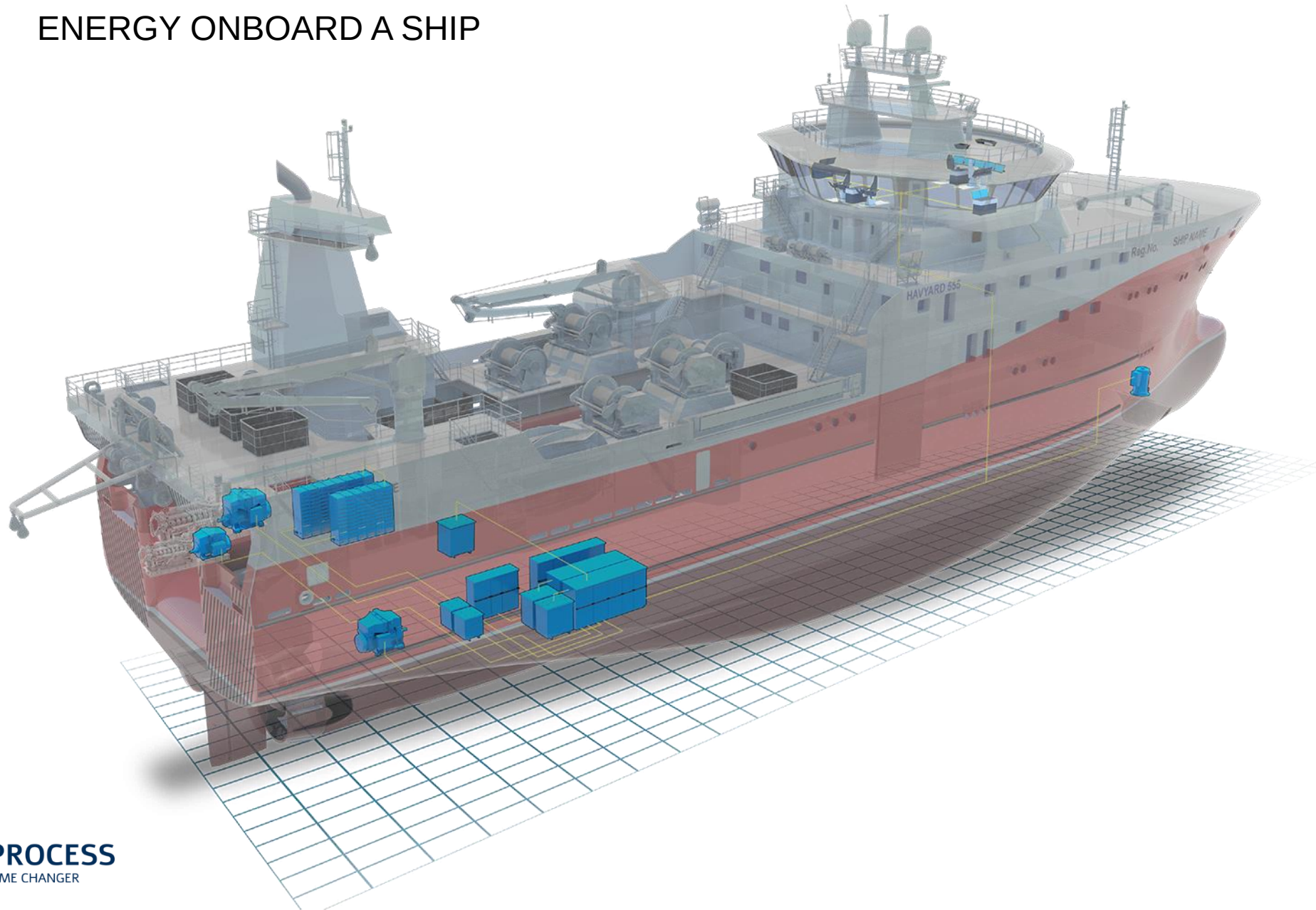

ONSHORE
FISH HANDLING AND PROCESSING

TECHNOLOGY COMPLETE SYSTEM SOLUTIONS

- Logistics & Handling
- Processing
- Refrigeration
- **Energy Optimization**
- Water Treatment
- Automation & Control



ENERGY ONBOARD A SHIP



HYDROGEN FUEL CELL

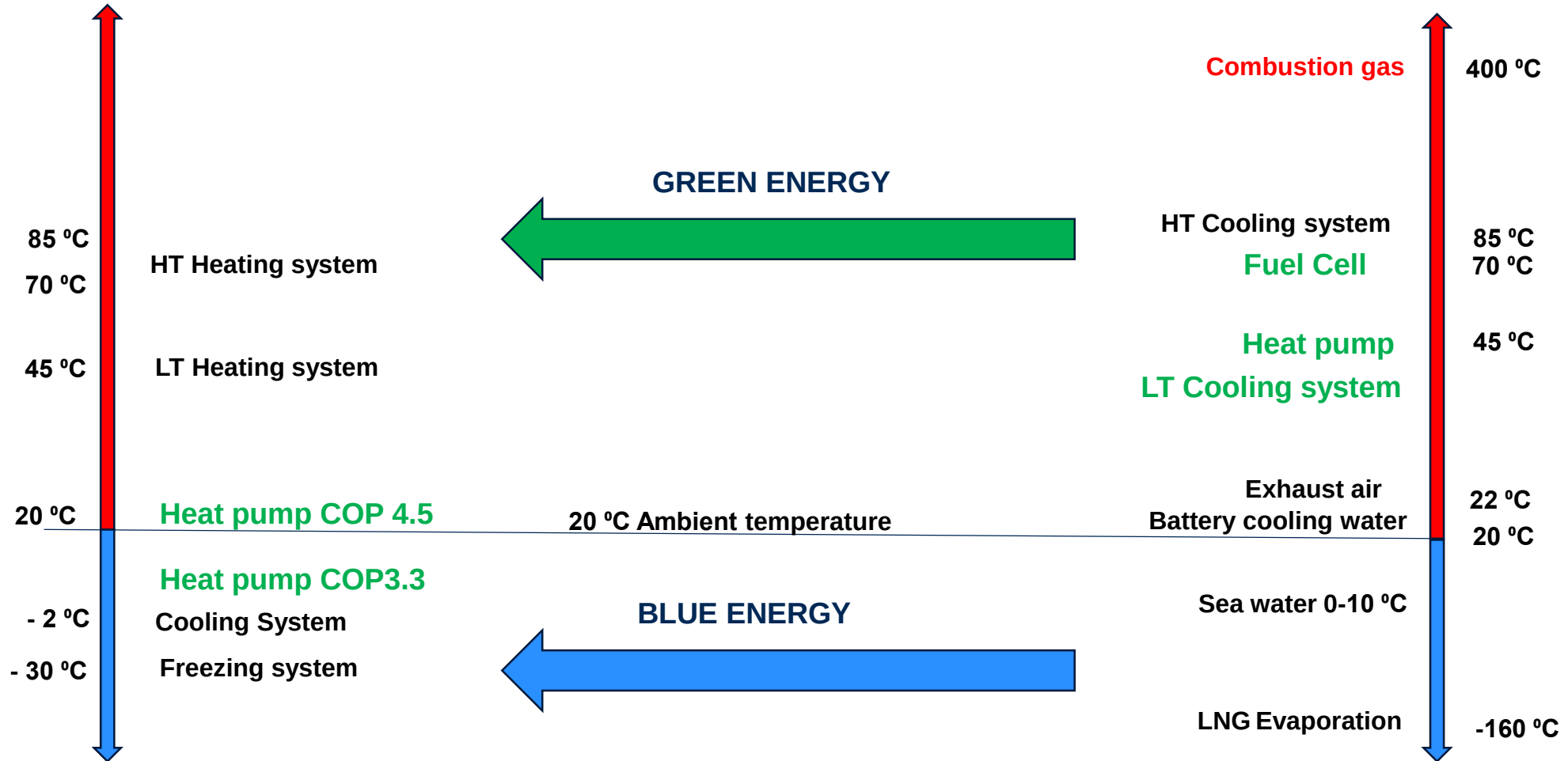
- Efficiency:
 - Electricity 50-60%
 - Waste energy 40-50% @ temperature 70-80 gr.C
- How can we utilize this waste energy on ships ?????



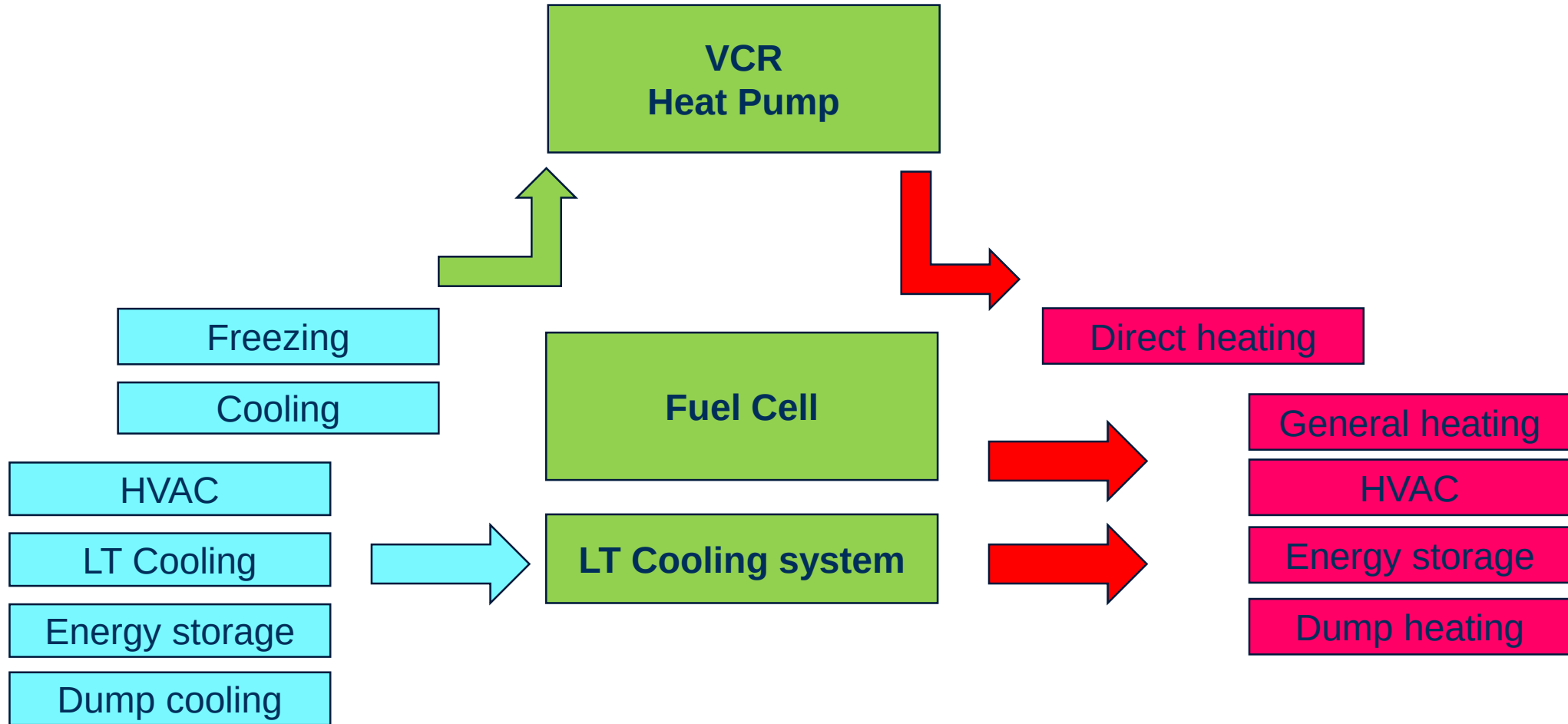
THERMAL ENERGY ON SHIPS

ENERGY CONSUMERS

ENERGY GENERATORS



THERMAL ENERGY SYSTEM



HOW MUCH WASTE ENERGY CAN BE RECOVERED??

- Depends on:
 - - Operational profile, type of ship, sailing route, speed etc.
 - - Ambient temperature in air and sea during a year
 - - Energy generator and configuration
 - - Energy consumers and configuration
 - - Energy storage facilities
 - - Crew awarnes on energy use

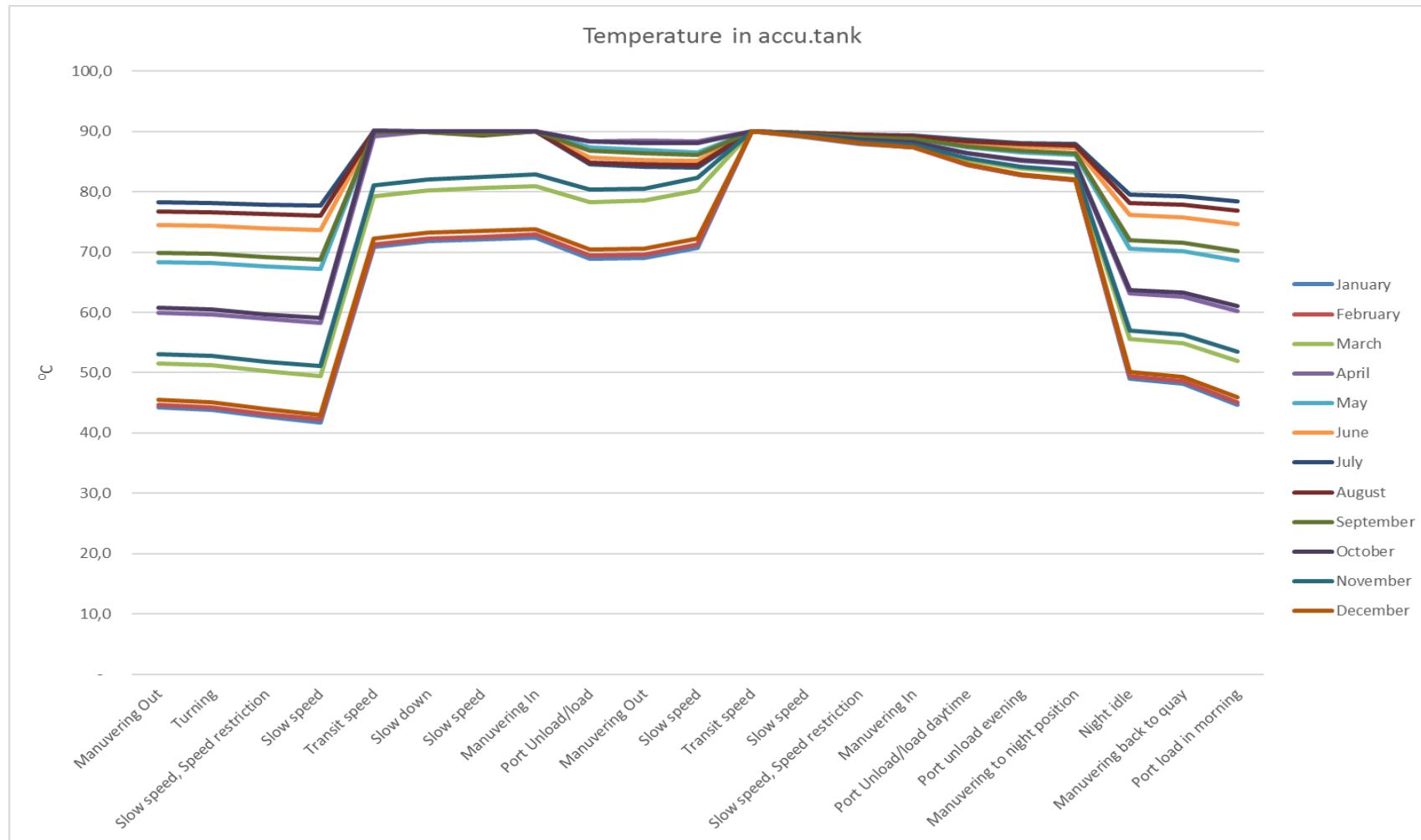




ENERGY SAVINGS – OPERATIONAL PROFILE

Total Savings kWh, Color Hybrid, 2xSandefjord-Strømstad													
	January	February	March	April	May	June	July	August	September	Oktober	November	Desember	Total
Energy from Battery	350 129	316 246	350 129	338 835	350 129	338 835	350 129	350 129	338 835	350 129	338 835	350 129	4 122 486
Energy from Climeon	10 529	10 427	25 641	40 205	55 641	62 070	68 635	64 919	52 569	39 203	25 341	12 455	467 633
Reduced Energy by for Apsorbtion Cooling	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy from Diesel engines	1 590 662	1 435 810	1 575 550	1 509 335	1 545 550	1 487 470	1 532 556	1 536 273	1 496 971	1 561 989	1 524 199	1 588 737	18 385 103
Energy in propulsion loss	51 124	46 176	51 124	49 475	51 124	49 475	51 124	51 124	49 475	51 124	49 475	51 124	601 940
Propulsion Energy kWh	1 900 197	1 716 307	1 900 197	1 838 900	1 900 197	1 838 900	1 900 197	1 900 197	1 838 900	1 900 197	1 838 900	1 900 197	22 373 283
Heating effect shore power	-	-	-	-	-	-	-	-	-	-	-	-	-
Utilized Energy from HT system for HVAC heating	837 543	749 656	712 896	542 656	398 583	265 486	193 996	226 379	356 145	546 426	663 841	817 297	6 310 904
Utilized Energy from LT system for HVAC pre-heating	163 859	146 212	132 145	92 630	59 255	31 790	16 404	22 980	50 953	92 376	121 488	158 574	1 088 666
LT cooling energy balance (Waste energy to sea)	104 967	94 625	101 944	95 812	96 879	92 648	95 168	95 745	94 102	99 589	98 550	104 582	1 174 610
Total savings	1 011 932	906 295	870 681	675 490	513 479	359 346	279 035	314 278	459 667	678 005	810 670	988 326	7 867 204
Additional savings Absorption chiller						62 070	68 635	64 919	52 569				248 192
Sea Water Temperature		°C											
Outside Air temperature		°C											
Ambient Design temperature		°C											
Inside air temperature	20	°C											
dT Air temperature		°C											
% load for heating													
Max load LT pre-heating HVAC	994	kW											
Max load HT heating HVAC	650	kW											
Misc heating fixed		kW											
Misc heating temp dependent		kW											
Specific heat capacity water/glycol 30%	3994	J/kgK											
Max. Temperature in Accu. Tank		°C											
Min. Temperature in Accu. Tank		°C											
System Volume	350	m3											
Propulsion loss	3 %												

THERMAL ENERGY STORAGE - OPERATIONAL PROFILE



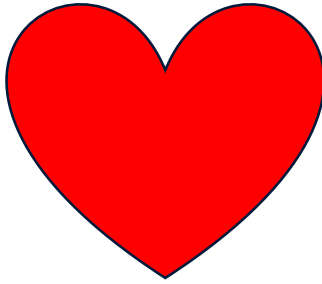
ENERGY SAVINGS – OPERATIONAL PROFILE AUGUST

			2x Sandefjord - Strømstad										2x Strømstad - Sandefjord										Night time											
	Capacity		Manuvering Out	Turning	Slow speed, Speed restriction	Slow speed	Transit speed	Slow down	Slow speed	Manuvering In	Port Unload/load	Manuvering Out	Slow speed	Transit speed	Slow speed	Slow speed, Speed restriction	Manuvering In	Port Unload/load daytime	Port unload evening	Manuvering to night position	Night idle	Manuvering back to quay	Port load in morning	Hour pr. day	No.of days	kWh/day								
Waste Energy Management System, Color Hybrid																												TOTAL						
Operating time		min.	8	8	20	16	212	12	12	12	100	6	20	226	16	20	12	50	30	15	570	15	60	24	31			744	hour					
Engine 1 (RR B33:45 L8)	4800	kW					3 321	2 171	1 226	1 365	316																							
Engine 2 (RR B33:45 L6)	3600	kW										1 186	2 319	2 834																				
Engine 3 (RR B33:45 L6)	3600	kW										1 186	2 319	2 834																				
Engine 4 (RR B33:45 L8)	4800	kW					3 321	2 171	1 226	1 365	316																							
Effect from Battery		kW	2 524	3 142	2 524	4 378									4 378	2 524	2 730	750	750	1 803	350	1 803	750											
Energy from Battery		kWh	336	419	841	1 167	-	-	-	-	-	-	-	-	1 167	841	546	625	375	451	3 325	451	750				11 294	350 129	kWh					
Absorption Cooling effect	900	kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
Reduced Effect by Absorption Cooling			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
Reduced Energy by for Absorption Cooling		kWh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
Absorption Cooling COP electrical			3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0					
Absorption Cooling, efficiency		%	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %	81,0 %					
Effect from Climeon	300	kW	-	-	-	-	207	241	226	-	118	255	255	255	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
Energy from Climeon		kWh	-	-	-	-	732	48	45	-	196	26	85	962	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
Climeon efficiency		%	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %	9,8 %					
Effect from Diesel engines		kW					6 642	4 343	2 452	2 730	632	2 371	4 637	5 667																				
Energy from Diesel engines		kWh					23 469	869	490	546	1 054	237	1 546	21 346														49 557	1 536 273	kWh				
Diesel Engine load %		%					69,2 %	45,2 %	25,5 %	28,4 %	6,6 %	32,9 %	64,4 %	78,7 %																				
Effect loss in propulsion		kW	74	92	74	128	200	134	78	80	-	77	143	173	128	74	80	-	-	53	-	53	-											
Energy in propulsion loss		kWh	10	12	25	34	705	27	16	16	-	8	48	650	34	25	16	-	-	13	-	13	-				1 649	51 124	kWh					
Propulsion loss %		%	3,0 %	3,0 %	3,0 %	3,0 %	3,0 %	3,0 %	3,0 %	3,0 %		3,0 %	3,0 %	3,0 %	3,0 %	3,0 %	3,0 %			3,0 %		3,0 %												
Propulsion effect kW		kW	2 450	3 050	2 450	4 250	6 650	4 450	2 600	2 650	750	2 550	4 750	5 750	4 250	2 450	2 650	750	750	1 750	350	1 750	750											
Propulsion Energy kWh		kWh	327	407	817	1 133	23 497	890	520	530	1 250	255	1 583	21 658	1 133	817	530	625	375	438	3 325	438	750				61 297	1 900 197	kWh					
	0																																	
Heat effect available in HT heat recovery system		kW					3 985	2 693	1 471	1 638	360	1 446	2 782	3 514																				
Heat energy available in HT heat recovery system		kWh					14 082	539	294	328	601	145	927	13 235														30 149	934 631	kWh				
Recovered effect from Exh.gas + HT system		%					60,0 %	62,0 %	60,0 %	60,0 %	57,0 %	61,0 %	60,0 %	62,0 %																				
Heating effect Recovered Engine 1 (- = preheating)		kW	-20	-20	-20	-20	1 993	1 346	736	819	180	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20					
Heating effect Recovered Engine 2 (- = preheating)		kW	-20	-20	-20	-20	-20	-20	-20	-20	-20	723	1 391	1 757	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20					
Heating effect Recovered Engine 3 (- = preheating)		kW	-20	-20	-20	-20	-20	-20	-20	-20	-20	723	1 391	1 757	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20					
Heating effect Recovered Engine 4 (- = preheating)		kW	-20	-20	-20	-20	1 993	1 346	736	819	180	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20					
Heating effect shore power		kW																																
	0																																	
Available HT Effect for misc. Consumers kW		kW	-80	-80	-80	-80	3 945	2 653	1 431	1 598	320	1 406	2 742	3 474	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80					
Available HT Energy for misc. Consumers kWh		kWh	-11	-11	-27	-21	13 940	531	286	320	534	141	914	13 084	-21	-27	-16	-67	-40	-20	-760	-20	-80				28 629	887 511	kWh					
	0																																	
HT heating effect for HVAC		kW	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57					
Additional HT heating effect for HVAC (if LT is not sufficient)		kW	-86	-86	-86	-86	-79	-79	-83	-82	-86	-83	-79	-79	-86	-86	-86	-87	-87	-87	-87	-87	-87	-87	-87	-87	-87	-87	-87					
Misc heating fixed		kW	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150					
Misc heating outside temp. dependent		kW	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13					
Utilized Effect from HT system for HVAC heating		kW	-306	-306	-306	-306	-299	-299	-303	-302	-306	-303	-299	-299	-306	-306	-306	-307	-307	-307	-307	-307	-307	-307	-307	-307	-307	-307	-307					
Utilized Energy from HT system for HVAC heating		kWh	41	41	102	82	1 058	60	61	60	510	30	100	1 128	82	102	61	256	153	77	2 916	77	307				6 396	-198 275	kWh					
Utilized for Absorption Cooling	1111	kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
Utilized for power generation Climeon	2600	kW	-	-	-	-	-2 110	-2 450	-2 300	-1 200	-2 600	-2 600	-2 600	-2 600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					

ENERGY SAVINGS – OPERATIONAL PROFILE AUGUST

Additional heating effect (kW) to/from system volume (approx. 350m3)		kW	-386	-386	-386	-386	1 536	-97	-1 171	1 296	-1 186	-1 496	-157	574	-386	-386	-386	-387	-387	-387	-387	-387					
Energy to/from system volume kWh		kWh	-52	-52	-129	-103	5 427	-19	-234	259	-1 976	-150	-52	2 163	-103	-129	-77	-322	-193	-97	-3 676	-97	-387			2	kWh
Corrected Energy to/from system volume kWh		kWh	-52	-52	-129	-103	5 416	-19	-234	254	-1 976	-150	-52	2 178	-103	-129	-77	-322	-193	-97	-3 676	-97	-387			-	kWh
Energy level in system volume, 350m3, (90-30 deg.C)	83 874	kWh	78 741	78 689	78 561	78 458	83 885	83 855	83 620	83 879	81 898	81 748	81 696	83 874	83 771	83 642	83 565	83 243	83 049	82 952	79 276	79 179	78 792				
Corrected energy level in system volume		kWh	78 741	78 689	78 561	78 458	83 874	83 855	83 620	83 874	81 898	81 748	81 696	83 874	83 771	83 642	83 565	83 243	83 049	82 952	79 276	79 179	78 792				
Temperature rise/drop in system volume (accu.tank)		kWh	-0,1	-0,1	-0,3	-0,3	14,0	-0,0	-0,6	0,7	-5,1	-0,4	-0,1	5,6	-0,3	-0,3	-0,2	-0,8	-0,5	-0,2	-9,5	-0,2	-1,0				
Actual temperature in system volume (accu.tank)		kWh	76,8	76,6	76,3	76,1	90,0	90,0	89,3	90,0	84,9	84,5	84,4	90,0	89,7	89,4	89,2	88,4	87,9	87,6	78,2	77,9	76,9				
Corrected temperature in system volume (accu.tank)			76,8	76,6	76,3	76,1	90,0	90,0	89,3	90,0	84,9	84,5	84,4	90,0	89,7	89,4	89,2	88,4	87,9	87,6	78,2	77,9	76,9				
0																											
LT Effect from propulsion loss (5%)		kW	74	92	74	128	200	134	78	80	-	77	143	173	128	74	80	-	-	53	-	53	-				
LT Effect from LT Engine Cooling system (20%)		kW	-	-	-	-	1 328	869	490	546	126	474	927	1 133	-	-	-	-	-	-	-	-	-				
Total available LT Effect from LT Cooling system		kW	74	92	74	128	1 528	1 002	568	625	126	551	1 070	1 306	128	74	80	-	-	53	-	53	-				
Utilized Effect from LT system for HVAC pre-heating		kW	74	92	74	128	994	994	568	625	126	551	994	994	128	74	80	-	-	53	-	53	-				
Utilized Energy from LT system for HVAC pre-heating		kWh	1	1	2	3	307	17	10	11	18	5	29	328	3	2	1	-	-	1	-	1	-		741	22 980	kWh
LT cooling effect balance		kW	-	-	-	-	534	8	-	-	-	-	76	312	-	-	-	-	-	-	-	-	-				
LT cooling energy balance (Waste energy to sea)		kWh	-	-	-	-	1 887	2	-	-	-	-	25	1 175	-	-	-	-	-	-	-	-	-		3 089	95 745	kWh
Sea Water Temperature	18,4	°C																									
Outside Air temperature	16,5	°C																									
Ambient Design temperature	-20	°C																									
Inside air temperature	20	°C																									
dT Air temperature	3,5	°C																									
% load for heating	9 %																										
Max load LT pre-heating HVAC	994	kW																									
Max load HT heating HVAC	650	kW																									
Misc heating fixed	150	kW																									
Misc heating temp dependent	150	kW																									
Specific heat capacity water/glycol 30%	3994	J/kgK																									
Max. Temperature in Accu. Tank	90	°C																									
Min. Temperature in Accu. Tank	80	°C																									
System Volume	350	m3																									
Propulsion loss	3 %																										

I BELIEVE IN HYDROGEN AS AN ENERGY CARRIER



Thank you for your attension!

A COMPLETE
GAME
CHANGER