USE IT OR LOSE IT

INDUSTRIAL WASTE HEAT OR NUCLEAR POWER HEAT TRANSPORTED BY TANKERS TO CITY DISTRICT HEATING SYSTEM

Attachment ● February 19, 2021

APPENDICES

TEAM MEMBERS:

Tom Sommardal

Truls Evensen

Satish Kumar

Tapio Kivilehto

Nikolai Solovjov

Appendix 1: LIST OF STAKEHOLDERS

Interested Party	Int / Ext	Reason for Inclusion
Energy Suppliers	External	Providers of waste hot water/CHP, Neste, Fortum and other sources
Ports	External	Providers of access to the port for transportation
Equipment providers	External	Heat Pumps suppliers and equipment suppliers
Banks and Financial institutions	External	Provides financial support and concerned with the financial health of the company
Ships Providers	External	Ship providers for the transport of hot water
Fuel Suppliers	External	Fuel and energy suppliers
Certification Body	External	Audit for compliance, issue certifications
Direct Customer	External	Purchase our products and services, Helen.
Employee / Staff /Operators	Internal	Directly responsible for the manufacture of products, delivery of service
Insurers	External	Provides insurance coverage
Local Community	External	Impacted by our activities in the region, Helsinki City and other cities.
Regulatory Bodies	External	Mandate regulatory requirements
Staffing Agencies	External	Provide candidates for hiring - conduct initial vetting of candidates
Supplier	External	Provides our raw materials and critical support services
Top Management	Internal	Has direct responsibility for the management of the company
Unions	External	Employees interests, social labour laws

P S : Helen role will be defined at the project start.

Appendix 2: Implementation of schedule risk analysis and mitigation plan.

High:9 Medium:6 Low:3

Register of Implementation Schedule Risks					
Risk Element	**Potential contributing factors**	**Impact**	**Likelihood**	**Impact Vs Likelihood**	**Potential mitigating actions**
Energy Suppliers	● Not able secure contract with the suppliers ● Poor definition of the scope and objectives of Projects in the business case resulting in the omission of cost during project costing	High	Low	27	● Well established energy suppliers are identified, Klilpilahti and Loviisa, ● Initial discussion about the feasibility of implementation is done with the suppliers and Schedule timelines are established in line with the HEC goal ● Robust procedures for assessing the business potential and investment needs, Scope defined and established. ● A flexibly designed contract adaptable to future changes
Tax Policies	●Heat pump electricity not being classified under electricity class 2 tax	High	Low	27	●Alternative energy sources (without heat pumps)are considered for implementation of the solution. ● Initiate lobbying to have favourable tax laws for using heat pumps in district heating.
Water Tankers/ Heat Pump Ships	●Contract Management-Agreement on vessel purchase or hiring not managed	High	Low	27	● Second-hand Cargo vessels market is well researched and documented it is easy to procure/hire the needed vessels for the operations. The solution provider(Use it or Lose it) has the experience of over three decades in ship management.
Equipment Suppliers	●Not able to adhere to the minimum quality standards of the contract ●Inappropriate business partners	High	Low	27	●Multiple reputed suppliers identified who have a good track record of supplying equipment (mainly heat pumps) ● A flexibly designed contract adaptable to future changes
Infrastructure	●Shore power availability ● Non-availability of the key for heat pumps to operate	High	Low	27	● Produce electricity with the ships own generators ● Operate the heat pump ships at anchorage outside the harbour

Appendix 3: Risk analysis of Reliability and Security of Supply and Mitigation plan.

High:9 Medium:6 Low:3					
Risk Register of Reliability and Availability					
Risk Element	**Potential contributing factors**	**Impact**	**Likelihood**	**Impact Vs Likelihood**	**Potential mitigating actions**
Contractual-Financial	● Poorly negotiated contracts leading huge losses in case of disputes ● The contract has not taken care of Future Demand and relative prices hike ● Financial exposure to the institution due to wrong assessment of business potential, Infrastructure not built on time ● Poor knowledge of Intellectual Property legislation (including Patents & copyright) ● Large scale changes in services adversely affect service quality and profitability ● Not able to adhere to the minimum quality standards of the contract ● Electricity Price Fluctuations	High	Low	27	● Adopt Early supplier involvement (ESI), leads to better selection of suppliers and service providers. ● Well established energy suppliers are identified, Klilpilahti and Loviisa, ● Establish a detailed plan of how and what infrastructure needs to build with the suppliers and Schedule timelines are established in line with the HEC goal ● Robust procedures for assessing the business potential and investment needs, Scope defined and established. ● thorough review of IPR by a competent team, Sound legal and financial advice ● A flexibly designed contract adaptable to future changes ● Regular reviews of projects. ● Robust back up plan to run the ships on LNG/LBG
Social	●Social groups protesting against the company for not abiding local rules ●Targetted activities by Advocacy groups ●Poor relations with local/regional authorities and business community ● Business operations affected by targetted criminal activities ● Perception by the consumer of workers that we exploit employees leading to protests, boycotts and Lawsuits ● Operations affected by Fundamentalists and Guerilla movements/Terrorism	High	Low	27	● Transparency policies adopted in designing the contract. ●Robust procedures (international standards) are followed in implementing for secured operations. ● Detailed open communication plan to inform all the stakeholders involved. (including the unions) ● Design project procedures to abide by social labour laws and regulations and a work contract structured to keep the key personals involved to keep them away from strikes. ● Lobbying to classify this as critical service, to eliminate the key personal going on strike, the agreement reached beforehand with the unions involved.
Compliance	●Failure to comply with legislation - Regulatory Framework ● Poor awareness of legal obligations under a variety of Acts and Regulations. ●Business disruption due to trade restrictions (Political opposition) ● Service delivery affected by Govt Proposals	High	Low	27	●Thorough review of regulatory requirements by a competent team, Sound legal and financial advice ● Transparency policies adopted in designing the contract ● A flexibly designed contract adaptable to future changes ● Regular reviews of projects.Design project procedures to abide by social labour laws and regulations
Environment	●Severe weather Conditions ●Change in Waterways ●Fire on Board, particularly on the heat pump ship ●Oil Spill.	High	Low	27	● A detailed survey of waterways and maps present, operated by experienced professionals ● Multiple sources of the heat source and operated in a safe environment, chances of severe weather conditions are rare, Equipment/ships used are all weatherproof (Class 1 ice breakers) Safety. ● Finlands NESA is identified as the initial provider of vessels needed

List of Figures:

[1] https://www.helen.fi/helen-oy/vastuullisuus/ajankohtaista/avoindata

List of Tables:

List of References:

1) *Ice Class, Wikipedia [online] Available from https://en.wikipedia.org/wiki/Ice_class [Accessed on 16th March 2020]*

2) Norsepower, Available from https://www.norsepower.com/ [Accessed on 16th March 2020]

3) Bergroth, N,[2010] Carbon-free nuclear district heating for the Helsinki area? [online], Available from https://www.powerengineeringint.com/world-regions/europe/carbon-free-nuclear-district-heating-for-the-helsinki-area/# [Accessed on 16th March 2020]

4) *Bergroth,N,[2010] Carbon-free nuclear district heating for the Helsinki area? [online], Available from https://www.powerengineeringint.com/world-regions/europe/carbon-free-nuclear-district-heating-for-the-helsinki-area/# [Accessed on 16th March 2020]*

5) World Nuclear organization, Cooling Nuclear Plant]s [2019], Available from https://www.world-nuclear.org/information-library/current-and-future-generation/cooling-power-plants.aspx, [Accessed on 23rd, March 2020]

6) Sähkön ja eräiden polttoaineiden verotaulukot - vero.fi, Accessed on 22nd Jan 2021.

7) Energy Taxation, Available from heating-system-in-helsinki.pdf (Accessed on 12th Jan 2021)

8) https://www.helen.fi/helen-oy/vastuullisuus/ajankohtaista/avoindata

Calculations and Workings:

1.6 Loading of the Energy

Heat capacity of Water

1 ton of hot water (75°C temperature difference) can contain 0.0875 MWh energy.

E = (4.2 kJ/kg°C)x((115 °C) - (40°C))x(1000 liter)x(1 kg/liter)
= 315000 kJ = (315000 kWs) x(1/3600 h/s)
= 87.5 kWh = 0.0875 MWh

1 ton of hot water with 55°C or 65°C temperature difference could contain 0,0642 MWh respective 0,0758 MWh energy.

Based on Wärtsiläs engines and information											
	Energy needed	Power	Generator efficiency			gas					
	kj/kWh	kw		kJ/h	LHV (kJ/m3)	m3/h	NG density (kg/m3)	kg/h	LNG density (kg/m3)	LNG m3/h	kgLNG/kWh
20V31	7500	11800	0.96	92187500	39000	2363.782	0.7	1654.65	420	3.94	0.1402244
6L34DF	7530	3000	0.96	23531250	39000	603.3654	0.7	422.36	420	1.01	0.1407853
4x20V31		47200						6618.59			
Output		45111						6325.68			
HEAT PUMP											
Output MW		Input MW	Electric tax II	tax/produced MWh		LNG	LBG	**LNG**	**LBG**	**Purchased electricity**	
Heating	COP	needed power	€/MWh	€/MWh	fuel cons	Cost/h	Cost/h	€/MWh	€/MWh	€/MWh	
			0.63		ton/h	€/h	€/h				
203	4.5	45.11		0.1400	6.326	2194.1	4359.8	**10.8**	**21.5**	**13.5**	
								Emission kg CO2/MWh produced heat			
								LNG	**LBG**	**Purchased electricity**	
								kg/MWh	Kg/MWh	Kg/MWh	
								85.7	**0**	**6.7**	

Fuel and Emission Calculations:

LNG/LBG PRICE AND CALORIFIC VALUES					Emission		
	GJ/kg	MWh	€/MWh	€	t/TJ	TJ/t	Ton CO2
LNG 1 ton	49.3	13.7	25	342.4	55.8	0.049	**2.75094**
LBG 1 ton	49.3	13.7	50	684.7	0	0	0

PURCHASED ELECTRICITY		Emission
	€/MWh	
Electricity	40	kg CO2/MWh
Transport	20	**30**
Price delivered	60	

Voyage Calculations: Sköldvik/Kilpilahti

SHIP NAME:	MT HELEN	DATE:	21/01/2021

SPEED (nautical miles)		ROTATION		DISTANCE/miles	
BALLAST	10	Commencing	Helsinki	**BALLAST**	56
LADEN	10	Load port	Sköldvik	**LADEN**	56
		Load port			
		Discharge Port	Helsinki		
		Discharge Port			
				TOTAL MILES	**112**

CARGO DESCRIPTION				
Energy/ton	**Temp diff**	**QUANTITY units/mts/cbm**	**LOADING DAYS**	**DISCHARGING DAYS**
0.05825	50	46000	0.5	0.5
0.0642	55			
0.0758	65			

FUEL CONSUMPTION			
	LOADED	**BALLAST**	**PORT and/or ANCHOR**
LBG (mts)			
LNG (mts)	10	10	3

VOYAGE CALCULATION				
	DISTANCE	**DAYS**	**IFO/mts**	**LNG/mts**
BALLAST	56	0.23	0.00	1.87
LADEN	56	0.23	0.00	1.87
L/D PORTS		1.00	0.00	3.00
Weather Days		0.00	0.00	0.00
TOTAL	**112**	**1.47**	**0.00**	**6.73**

COST	Price/mts	TOTAL COST	Transported Energy (MWh)		kg CO2/MWh
LBG	684	0	**2679.5**	**MWh dT50**	**6.9**
LNG	342	2,303	**2953.2**	**MWh dT55**	**6.3**
			3486.8	**MWh dT65**	**5.3**
Load Ports D/A	Sköldvik	7,000	**Transport Cost/MWh**		
	0		**13.5**	**Eur/MWh dt50**	
Discharging Ports D/A	Helsinki	1,346	**12.3**	**Eur/MWh dt55**	
	Port+pilot	8,000	**10.4**	**Eur/MWh dt65**	
OTHER COSTS					
GENERAL TOTAL		18,649			
	T/C EXPENSE	**12,715**			

Daily T/C Rate	12,000		Lumpsum	36,249

Voyage Calculations LBG: Sköldvik/Kilpilahti

SHIP NAME:	MT HELEN	DATE:	21/01/2021

SPEED (nautical miles)		ROTATION		DISTANCE/miles	
BALLAST	10	Commencing	Helsinki	BALLAST	56
LADEN	10	Load port	Sköldvik	LADEN	56
		Load port			
		Discharge Port	Helsinki		
		Discharge Port			
				TOTAL MILES	112

CARGO DESCRIPTION				
		QUANTITY	LOADING	DISCHARGING
Energy/ton	Temp diff	units/mts/cbm	DAYS	DAYS
0.05825	50	46000	0.5	0.5
0.0642	55			
0.0758	65			

FUEL CONSUMPTION			
	LOADED	BALLAST	PORT and/or ANCHOR
LBG (mts)	10	10	3
LNG (mts)	0	0	0

VOYAGE CALCULATION				
	DISTANCE	DAYS	IFO/mts	LNG/mts
BALLAST	56	0.23	2.33	0.00
LADEN	56	0.23	2.33	0.00
L/D PORTS		1.00	3.00	0.00
Weather Days		0.00	0.00	0.00
TOTAL	112	1.47	7.67	0.00

COST	Price/mts	TOTAL COST	Transported Energy (MWh)		kg CO2/MWh
LBG	684	5,244	2679.5	MWh dT50	0.0
LNG	342	0	2953.2	MWh dT55	0.0
			3486.8	MWh dT65	0.0
Load Ports D/A	Sköldvik	7,000	Transport Cost/MWh		
	0		14.6	Eur/MWh dt50	
Discharging Ports D/A	Helsinki	1,346	13.3	Eur/MWh dt55	
	Port+pilot	8,000	11.2	Eur/MWh dt65	
OTHER COSTS					
GENERAL TOTAL		21,590			
	T/C EXPENSE	14,720			

Daily T/C Rate	12,000	Lumpsum	39,190

Voyage Calculations Loviisa

SHIP NAME:	Helen	DATE:	21/01/2021

SPEED (nautical miles)		ROTATION		DISTANCE/miles	
BALLAST	10	Commencing	Helsinki	**BALLAST**	72
LADEN	10	Load port	Loviisa	**LADEN**	72
		Load port			
		Discharge Port	Helsinki		
		Discharge Port			
				TOTAL MILES	**144**

CARGO DESCRIPTION				
Energy/ton	**Temp diff**	**QUANTITY units/mts/cbm**	**LOADING DAYS**	**DISCHARGING DAYS**
0.05825	50	46000	0.5	0.5
0.0758	65			
0.0875	75			

FUEL CONSUMPTION			
	LOADED	**BALLAST**	**PORT and/or ANCHOR**
IFO			
LNG	10	10	3

VOYAGE CALCULATION				
	DISTANCE	**DAYS**	**IFO/mts**	**MGO/mts**
BALLAST	72	0.30	0.00	2.40
LADEN	72	0.30	0.00	2.40
L/D PORTS		1.00	0.00	3.00
Weather Days		0.00	0.00	0.00
TOTAL	**144**	**1.60**	**0.00**	**7.80**

COST	**Price/mts**	**TOTAL COST**	Transported Energy (MWh)		**kg CO2/MWh**
LBG	684	0	**2679.5**	**MWh dT50**	**8.0**
LNG	342	2,668	**3486.8**	**MWh dT65**	**6.2**
			4025	**MWh dT75**	**5.3**
Load Ports D/A	Loviisa	0	**Transport Cost/MWh**		
	0		**11.6**	**Eur/MWh dt50**	
Discharging Ports D/A	Helsinki	1,346	**9.0**	**Eur/MWh dt65**	
	Port+pilot	8,000	**7.8**	**Eur/MWh dt75**	
OTHER COSTS					
GENERAL TOTAL		12,014			
	T/C EXPENSE	**7,509**			

Daily T/C Rate	**12,000**		**Lumpsum**	**31,214**

Voyage Calculations LBG Loviisa

SHIP NAME:	Helen	DATE:	21/01/2021

SPEED (nautical miles)		ROTATION		DISTANCE/miles	
BALLAST	10	Commencing	Helsinki	BALLAST	72
LADEN	10	Load port	Loviisa	LADEN	72
		Load port			
		Discharge Port	Helsinki		
		Discharge Port			
				TOTAL MILES	144

CARGO DESCRIPTION				
Energy/ton	Temp diff	QUANTITY units/mts/cbm	LOADING DAYS	DISCHARGING DAYS
0.05825	50	46000	0.5	0.5
0.0758	65			
0.0875	75			

FUEL CONSUMPTION			
	LOADED	BALLAST	PORT and/or ANCHOR
LBG	10	10	3
LNG	0	0	0

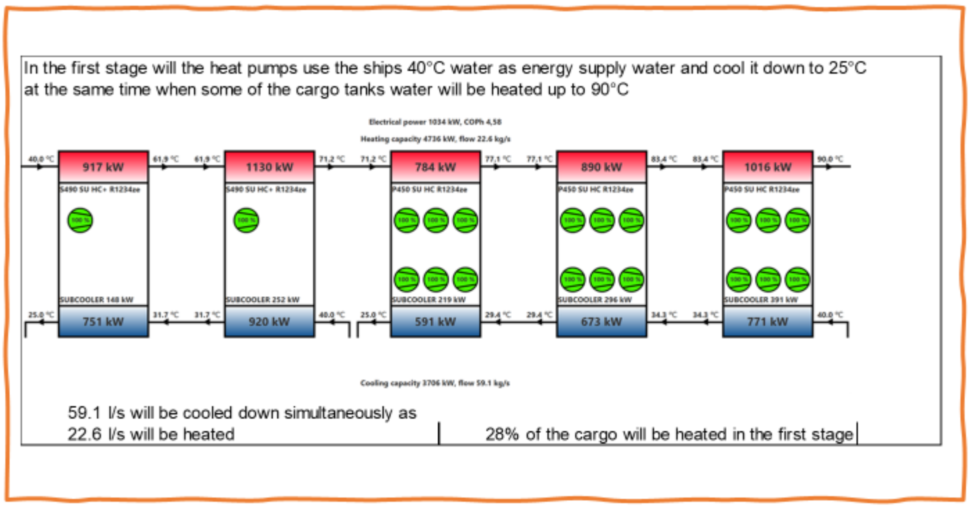
VOYAGE CALCULATION				
	DISTANCE	DAYS	LBG/mts	LNG/mts
BALLAST	72	0.30	3.00	0.00
LADEN	72	0.30	3.00	0.00
L/D PORTS		1.00	3.00	0.00
Weather Days		0.00	0.00	0.00
TOTAL	144	1.60	9.00	0.00

COST	Price/mts	TOTAL COST	Transported Energy (MWh)		kg CO2/MWh
LBG	684	6,156	2679.5	MWh dT50	0.0
LNG	342	0	3486.8	MWh dT65	0.0
			4025	MWh dT75	0.0
Load Ports D/A	Loviisa	0	Transport Cost/MWh		
	0		13.0	Eur/MWh dt50	
Discharging Ports D/A	Helsinki	1,346	10.0	Eur/MWh dt65	
	Port+pilot	8,000	8.6	Eur/MWh dt75	
OTHER COSTS					
GENERAL TOTAL		15,502			
	T/C EXPENSE	9,689			

Daily T/C Rate	12,000	Lumpsum	34,702

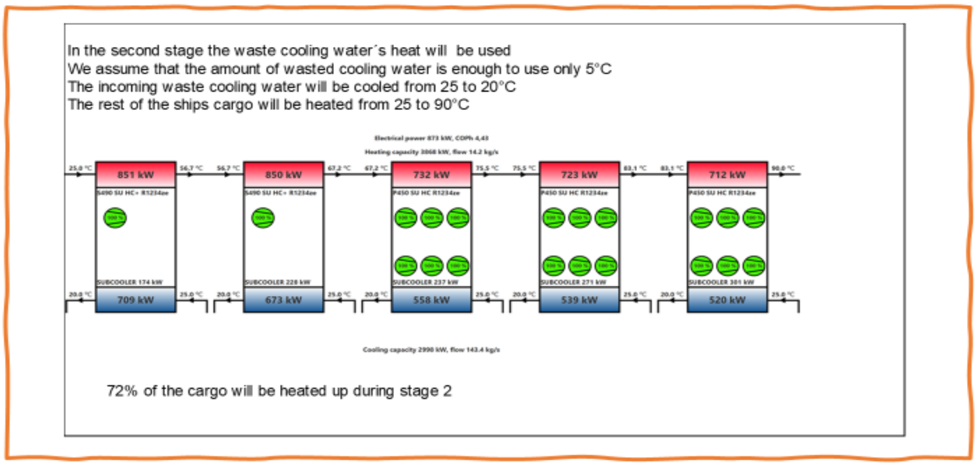
Double-acting heat pump working principle:

Stage 1:



Use it or Lose it

Stage 2:



Use it or Lose it

	Efficient	COP		
Stage 1	4736	4.58		
Stage 2	3868	4.43		
Average	4111	4.47		
			200	MW heating power
Amount of Modules to get 200 MW heating power is				49
Budget price for these 49 modules:			~20 M€	