Convert Waste Heat to Useful Heat

High Temperature Heat Pump solution

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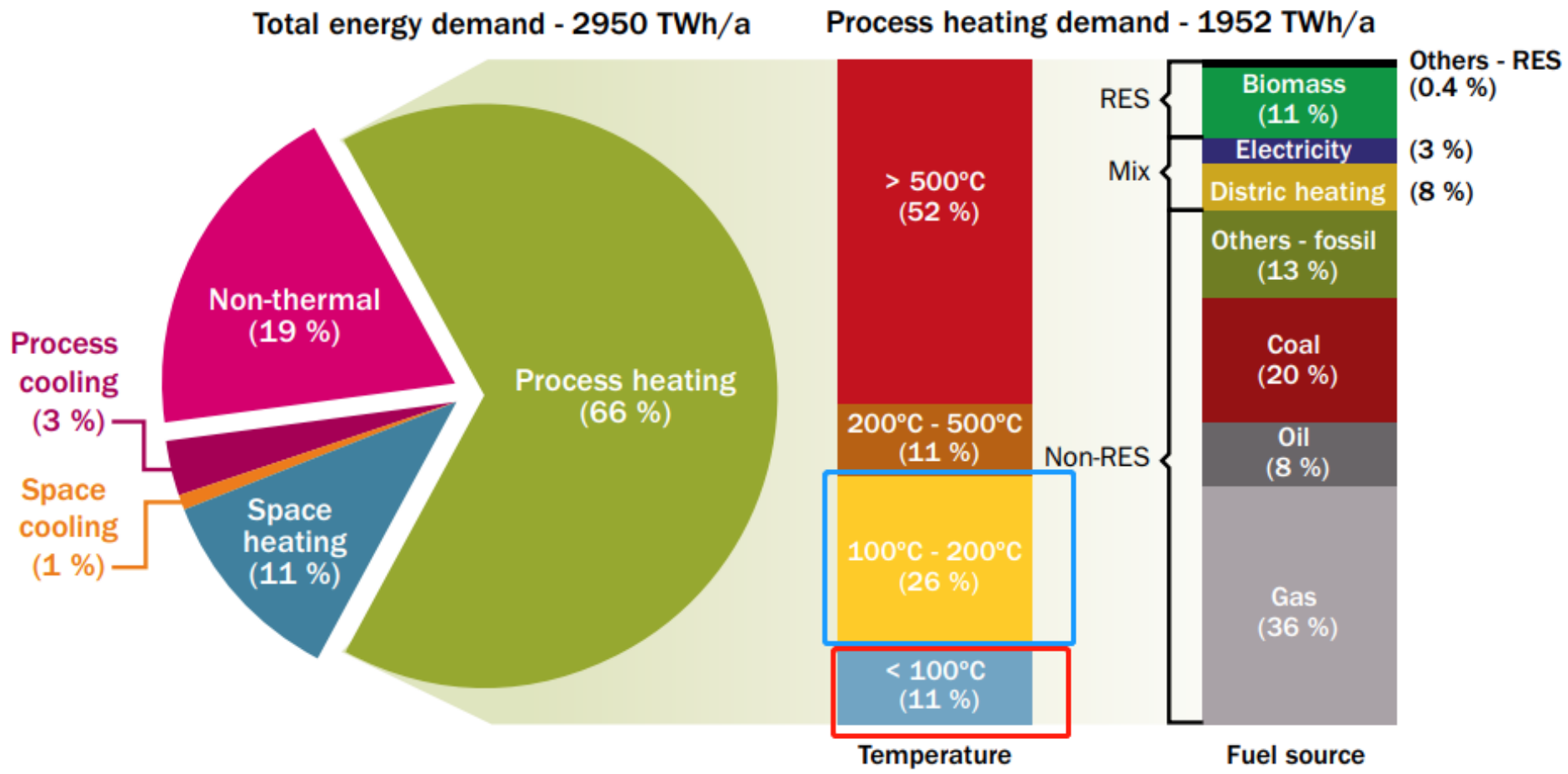
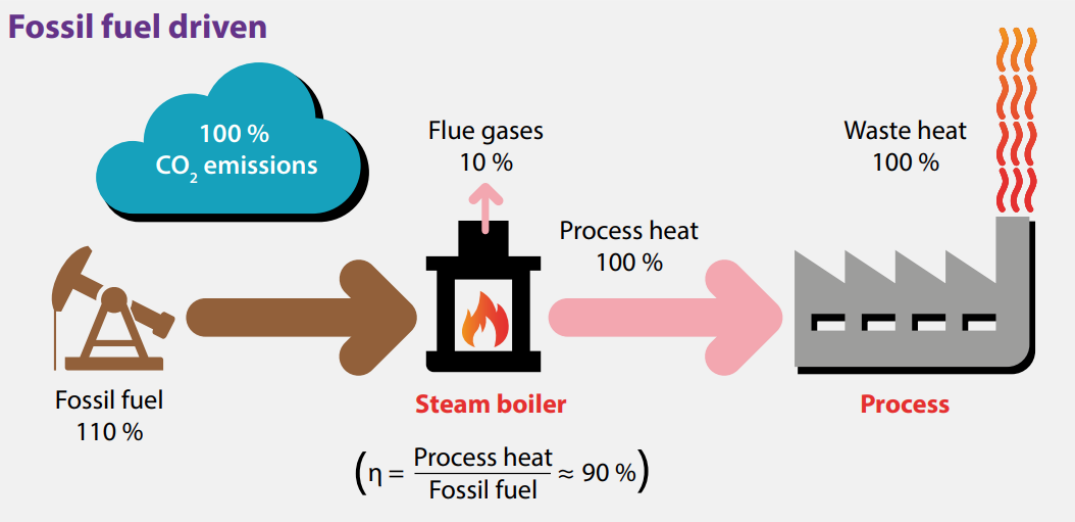
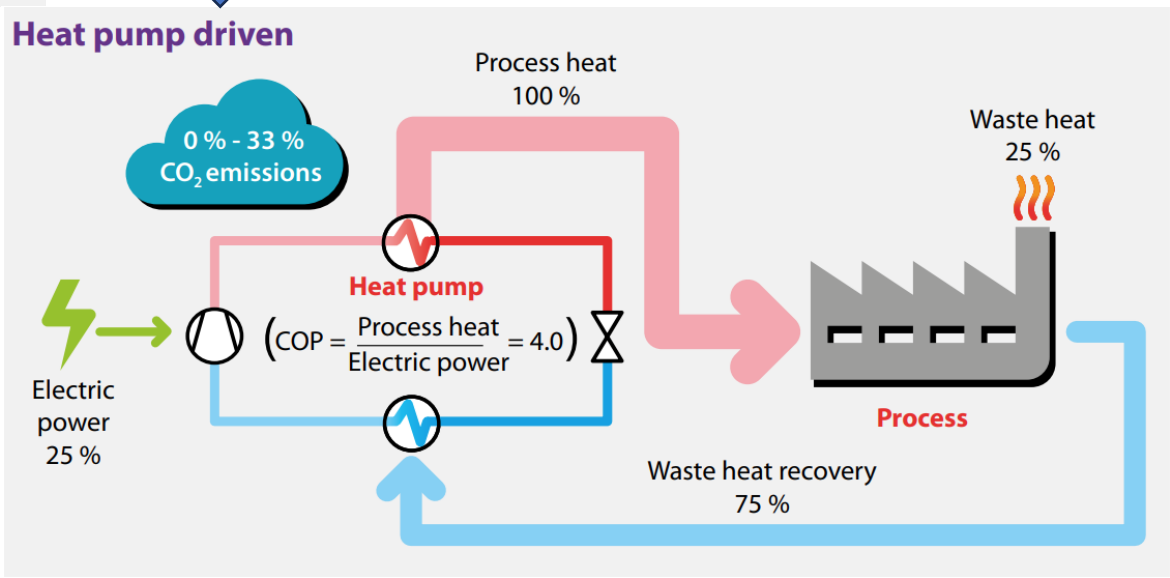


- **About 37% of the industrial process heat is lower than 200℃**
- **The current industrial process heat demand is primarily (78%) covered by fossil**

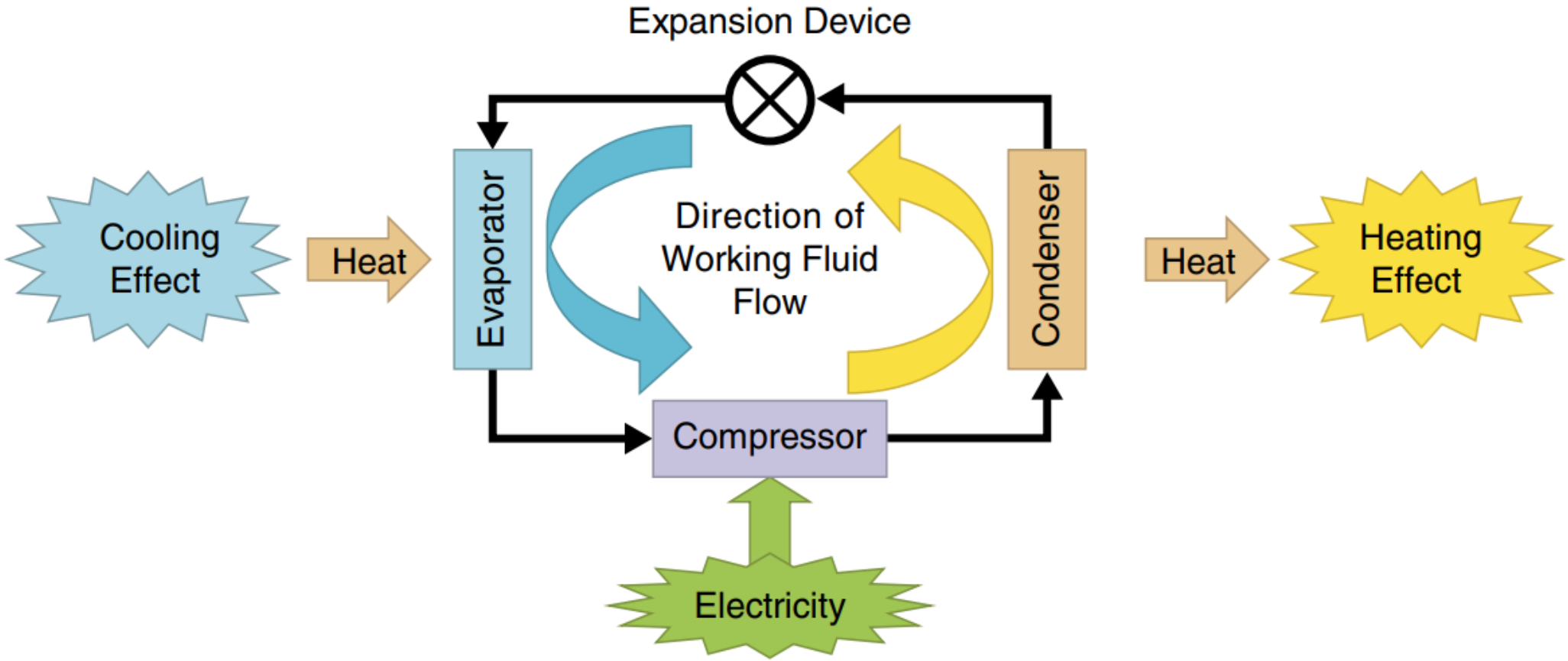
It is the time to Change



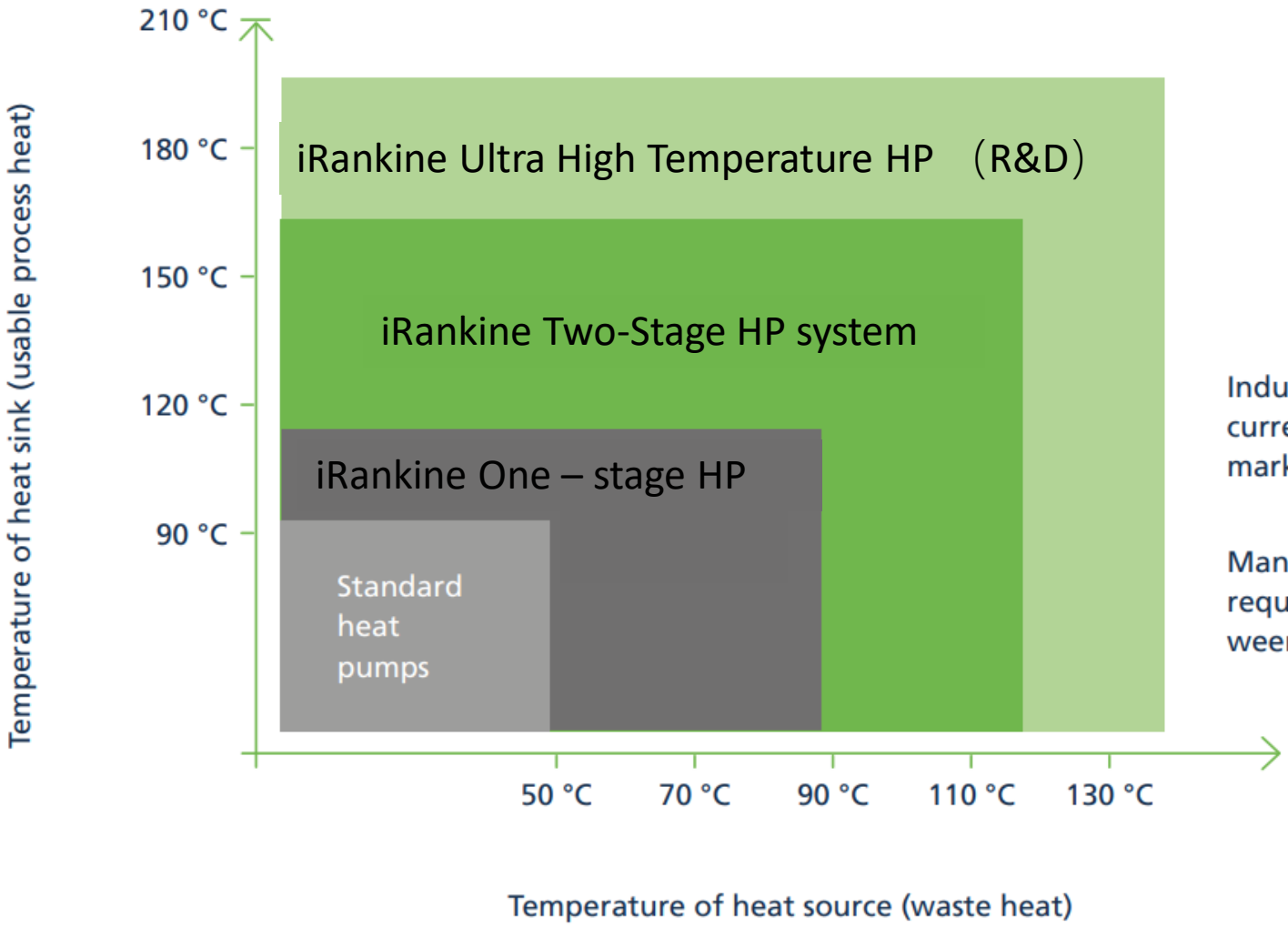
Industrial Heat Pump (HP)



Principle of Closed-cycle Mechanical Heat Pump



What iRankine can supply



Industrial heat pumps currently available on the market reach about 90 °C.

Many industrial applications require temperatures between 100 °C and 200 °C.

General Data Sheet of Industrial HP Products Series

Heat Production	kW	167.5	449.3	691	898.6	1155.2	1382
Compressor	Adjust range	25 ~ 100%			1.5 ~100%		
	Qty	1			2		
	Working fluid	R245fa					
Evaporator	Type	Tube-Shell					
	water flow rate m^3/h	20.6	55.9	86.1	111.8	143.9	172.3
	Pressure drop kPa	< 100					
	Dia. of pipe DN	80	125	150	150	200	200
Condenser	Type	Tube-Shell					
	water flow rate m^3/h	30	80.4	123.6	160.7	206.6	247.2
	Pressure drop kPa	< 100					
	Dia. of pipe DN	80	125	150	150	200	200
Dimensions	L mm	3350	3820	3820	4960	4980	4980
	W mm	1490	1675	1675	1700	1900	1900
	H mm	1900	2300	2400	2450	2450	2450
Weight	kg	2450	2750	3260	5270	6300	7150

Performance Estimate Table

Power consumption of heat pump to produce 1 ton of steam (kW/ton of steam)																
Steam temperature/℃		100	105	110	115	120	125	130	135	140	145	150	155	160	165	170
Steam pressure/bar.A		1	1.2	1.4	1.7	2	2.3	2.7	3.1	3.6	4.2	4.8	5.4	6.2	7	7.9
Inlet water temperature/℃	Outlet water temperature/℃	One-Stage				Two-stage										
90	80	103	117	135	154	179	177	192	207	227	243	259	286	303	335	353
85	75	116	132	151	175	201	190	205	220	242	258	274	302	319	356	374
80	70	130	148	170	196	226	204	219	234	258	274	290	321	338	377	395
75	65	145	166	191	220	255	219	234	249	276	292	308	342	359	401	419
70	60	163	187	215	248	285	237	252	267	297	313	329	366	383	429	447
65	55	184	211	239	276	318	258	273	288	321	337	353	390	407	457	475
60	50	204	234	270	311	357	278	293	308	344	360	376	421	438	492	510
55	45	232	265	304	345	384	306	321	336	375	391	407	455	472	526	544
50	40	262	290	347	392	434	336	351	366	400	416	432	498	515	573	591

COP of HP per 1 ton steam

Steam temperature/℃		100	105	110	115	120	125	130	135	140	145	150	155	160	165	170
Steam pressure/bar.A		1	1.2	1.4	1.7	2	2.3	2.7	3.1	3.6	4.2	4.8	5.4	6.2	7	7.9
Inlet water temperature/℃	Outlet water temperature/℃															
90	80	6.65	5.87	5.11	4.49	3.87	3.93	3.63	3.38	3.09	2.89	2.72	2.47	2.33	2.12	2.01
85	75	5.91	5.21	4.57	3.95	3.45	3.66	3.40	3.18	2.90	2.73	2.57	2.34	2.22	1.99	1.90
80	70	5.27	4.64	4.06	3.53	3.07	3.41	3.18	2.99	2.72	2.57	2.43	2.20	2.09	1.88	1.80
75	65	4.72	4.14	3.61	3.14	2.72	3.18	2.98	2.81	2.54	2.41	2.29	2.06	1.97	1.77	1.70
70	60	4.20	3.68	3.21	2.79	2.43	2.93	2.77	2.62	2.36	2.25	2.14	1.93	1.85	1.65	1.59
65	55	3.72	3.26	2.88	2.51	2.18	2.70	2.55	2.43	2.18	2.09	2.00	1.81	1.74	1.55	1.50
60	50	3.36	2.94	2.55	2.22	1.94	2.50	2.38	2.27	2.04	1.95	1.87	1.68	1.62	1.44	1.39
55	45	2.95	2.59	2.27	2.00	1.81	2.27	2.17	2.08	1.87	1.80	1.73	1.55	1.50	1.35	1.31
50	40	2.61	2.37	1.99	1.76	1.60	2.07	1.99	1.91	1.75	1.69	1.63	1.42	1.37	1.24	1.20

Success Case in resin manufactory

Stage one （closed loop HP）

Date	2023-03-13		
Water inlet temp.	66.1℃	Steam temp.	109.1 ℃
Water outlet temp.	54.3℃	Steam Pressure	1.37 BarA
Feeding water temp at heatsink	64.4℃	Steam Flowrate	1091.3 kg/h
Current A	419.3 A		

Stage two （open loop steam compressing）

Date	2023-03-13		
Steam in temp.	107.5℃	Steam in Press.	1.3 BarA
Steam out temp.	130.3℃	Steam out Press.	2.68 BarA
Feeding water temp at heatsink	64.4℃	Steam Flowrate	1091.3 kg/h
Current A	157.6 A		