Lake States TAPPI Energy Forum

Heat Recovery – When to Apply Air to Air, When to Consider Other Heat Sinks

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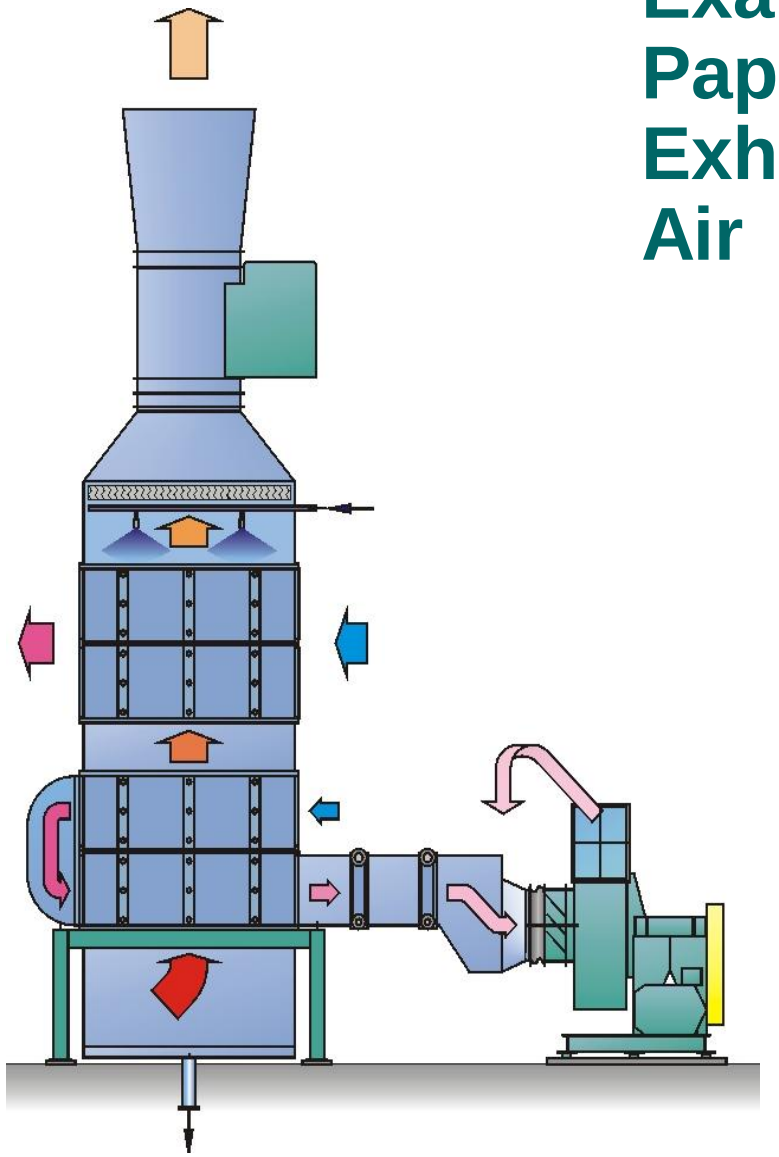
metso paper

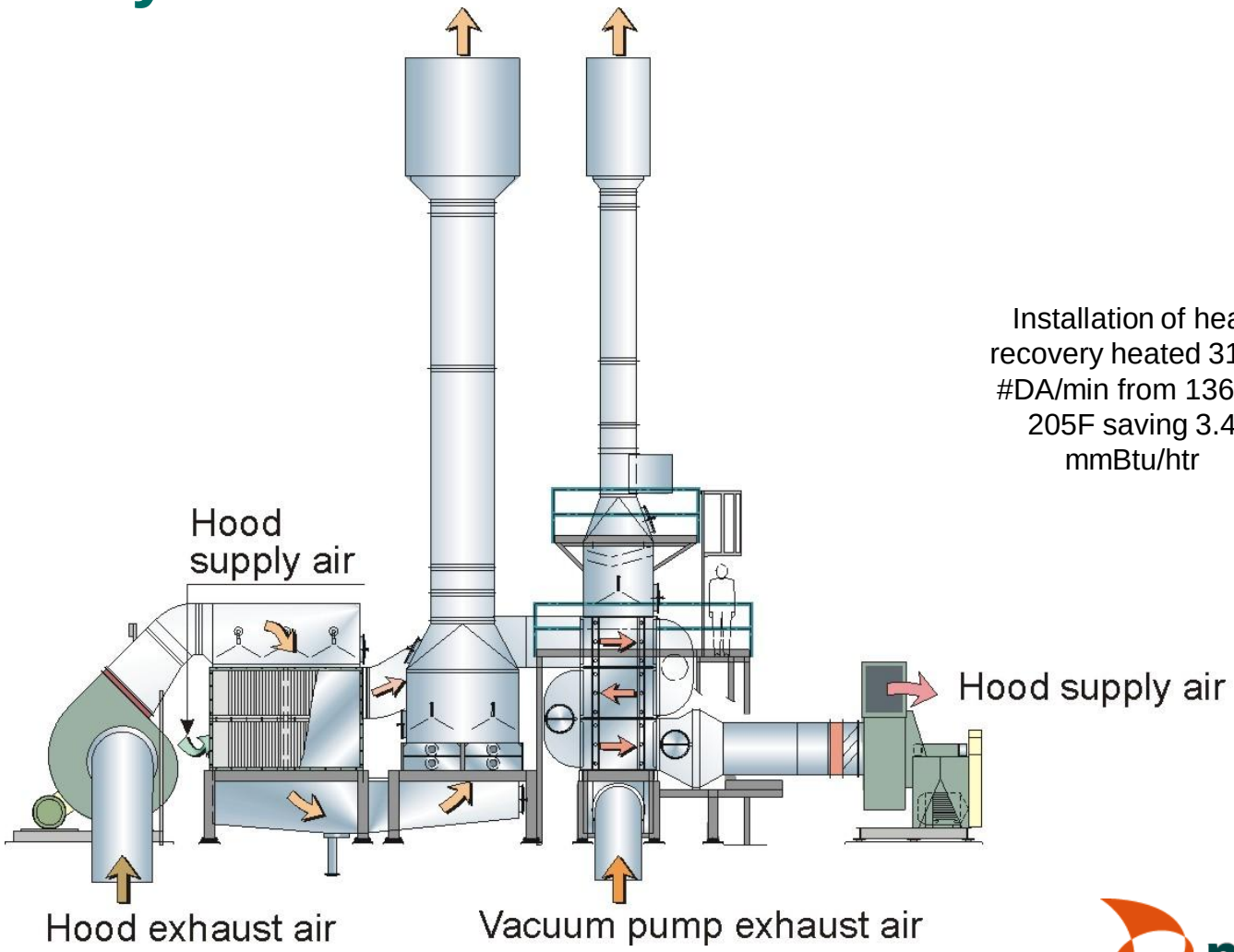
Air to Air Heat recovery

- Air to air heat recovery is very effective when:
  - Waste air stream and fresh airstream are in close proximity
  - Waste air stream is high temperature
  - Waste air stream has significant sensible heat
  - Heated airstream requires heating year-round
- Examples:
  - Utilize paper machine hood exhaust to preheat hood makeup air
  - Utilize paper machine vacuum blower exhaust to preheat hood makeup air
  - Utilize Yankee exhaust to preheat combustion and makeup air
  - Utilize Coater air dryer exhaust to preheat combustion and makeup air

Example 1:
Paper Machine
Exhaust to Heat PV Air

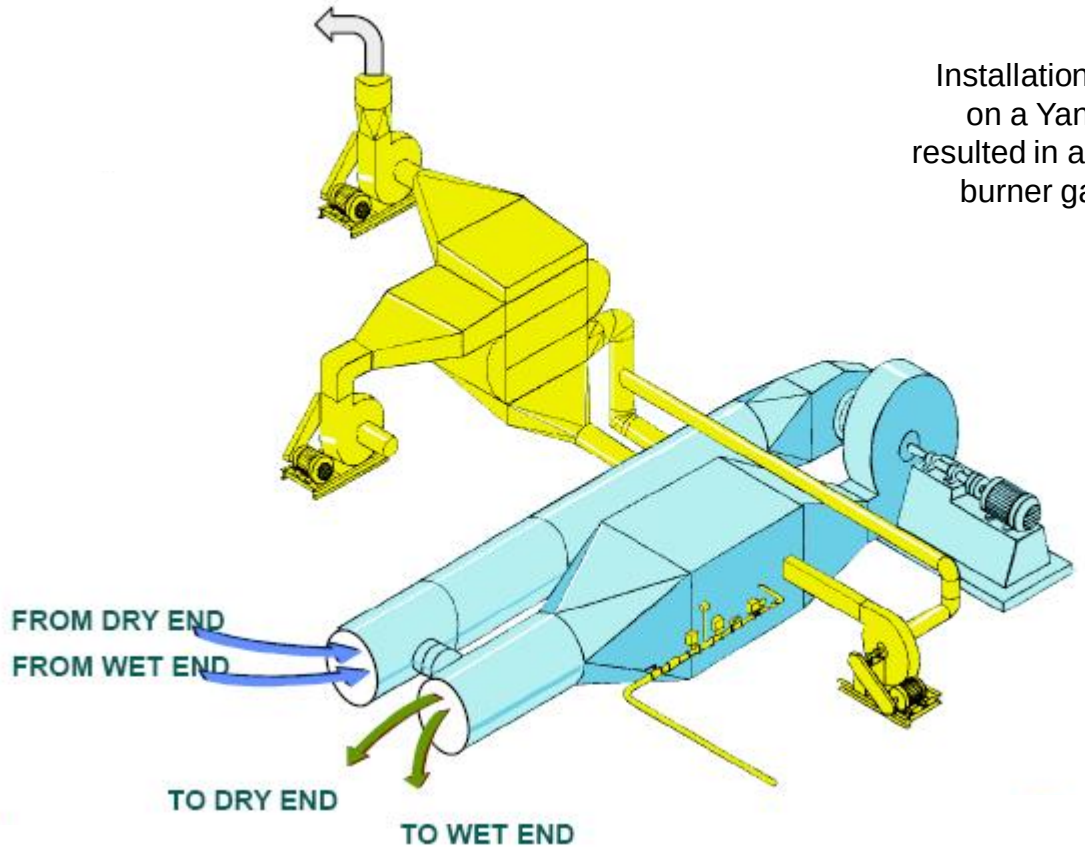


Example 2: Vacuum Blower Exhaust Air Heat Recovery



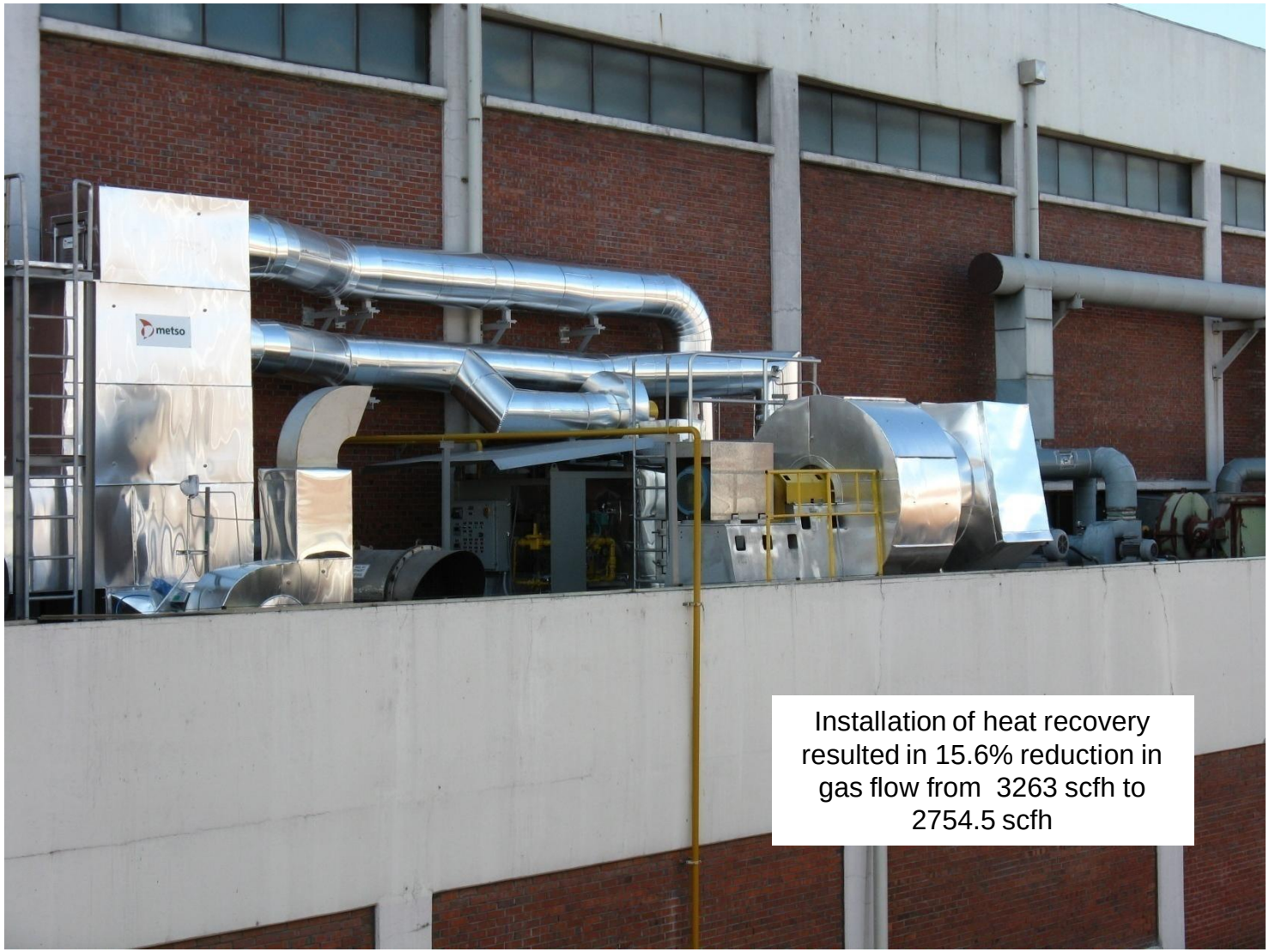
Installation of heat recovery heated 3168 #DA/min from 136 to 205F saving 3.4 mmBtu/htr

Example 3: Yankee Exhaust to Combustion & Makeup Air



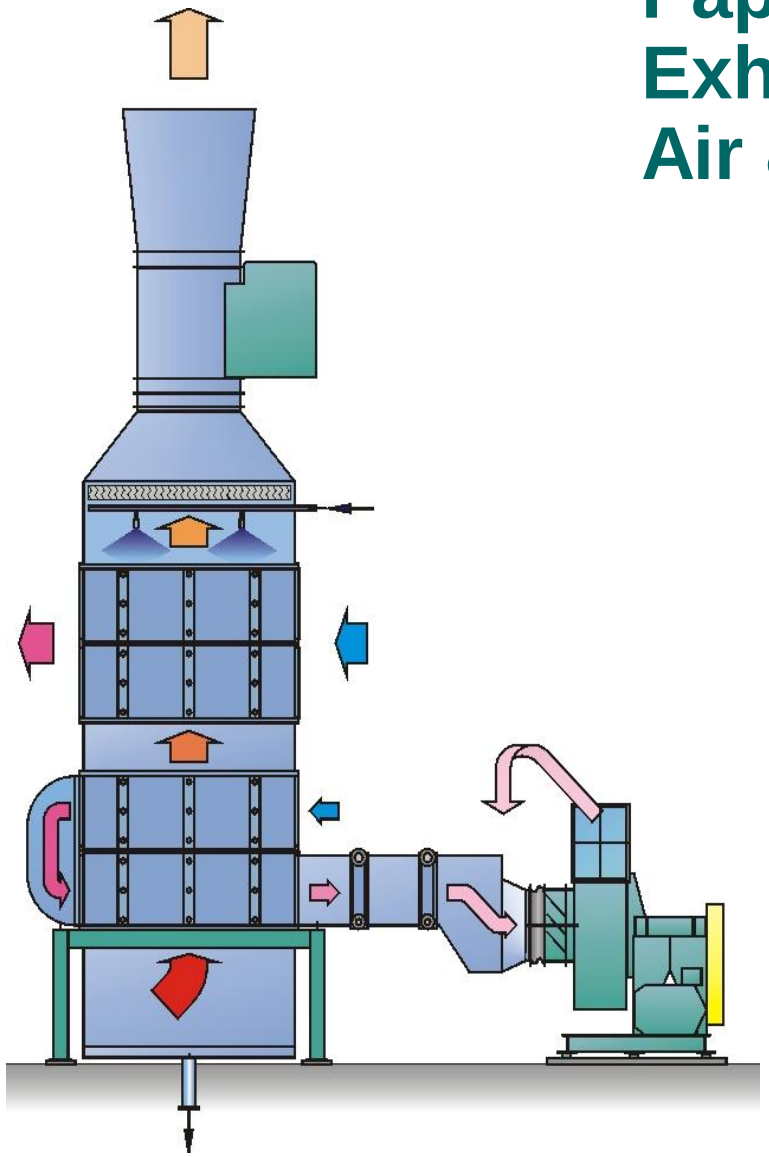
Installation of heat recovery on a Yankee air system resulted in an 18% reduction in burner gas consumption

Example 4: Air Dryer Exhaust to Combustion & Makeup Air



Installation of heat recovery resulted in 15.6% reduction in gas flow from 3263 scfh to 2754.5 scfh

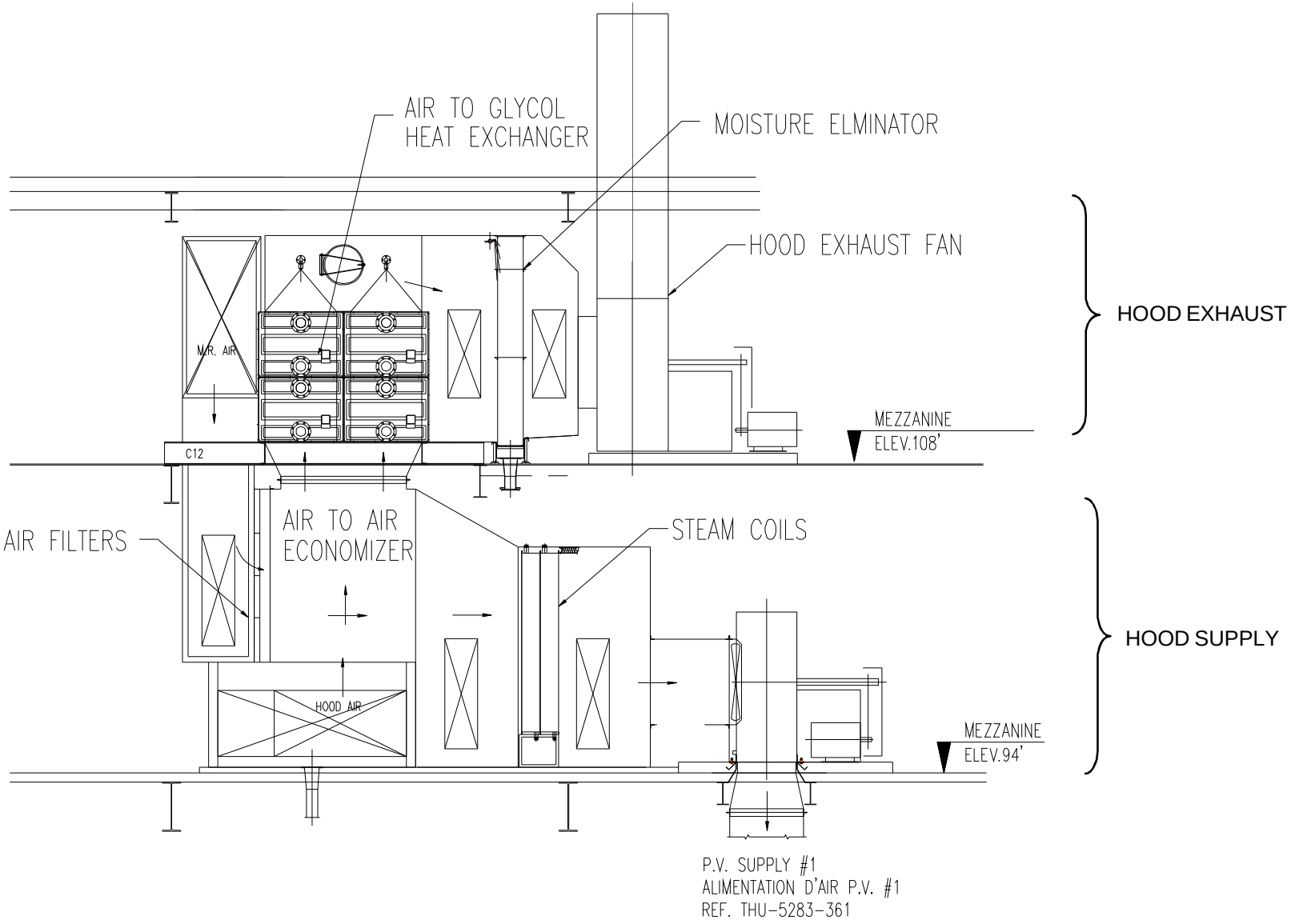
Paper Machine Exhaust to Heat PV Air & Outside Air



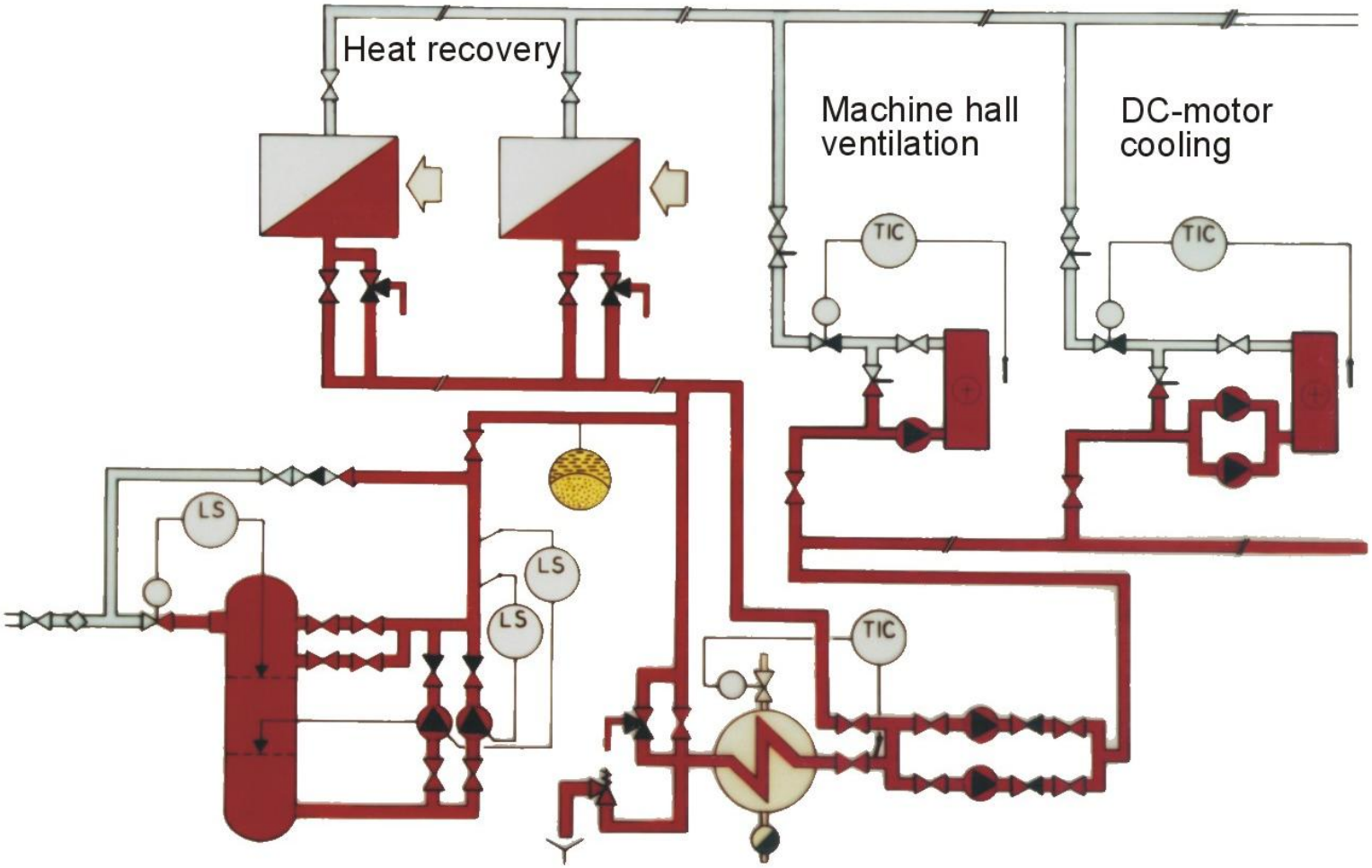
Pros
- Simple system .

Cons
-Requires large ducts on mezzanine
- Costly to distribute air
- Plates tend to ice up in very cold climates
- Difficult to control temperature

Rebuild Air - Air to Air - Glycol

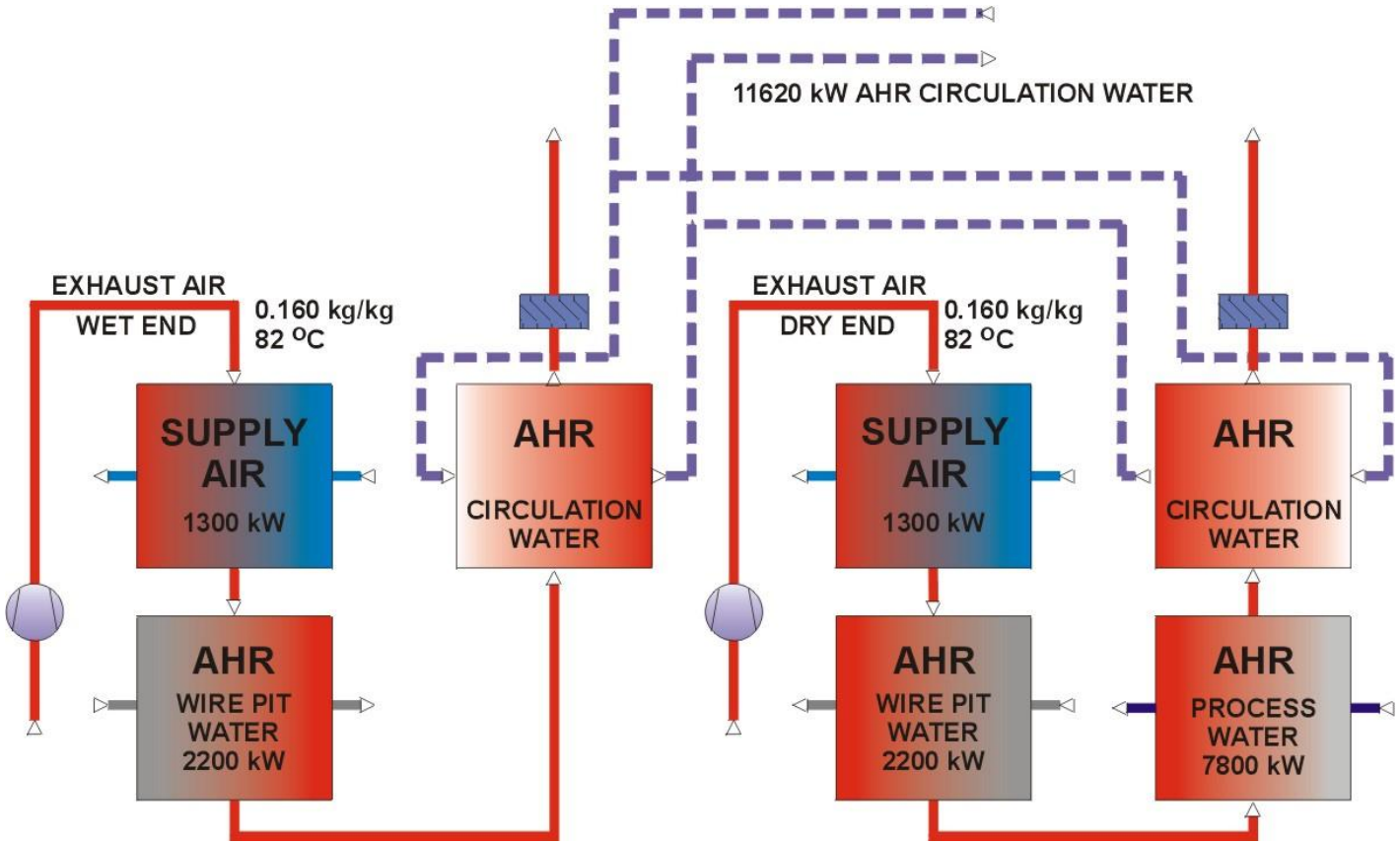


Glycol Heat Recovery Schematic

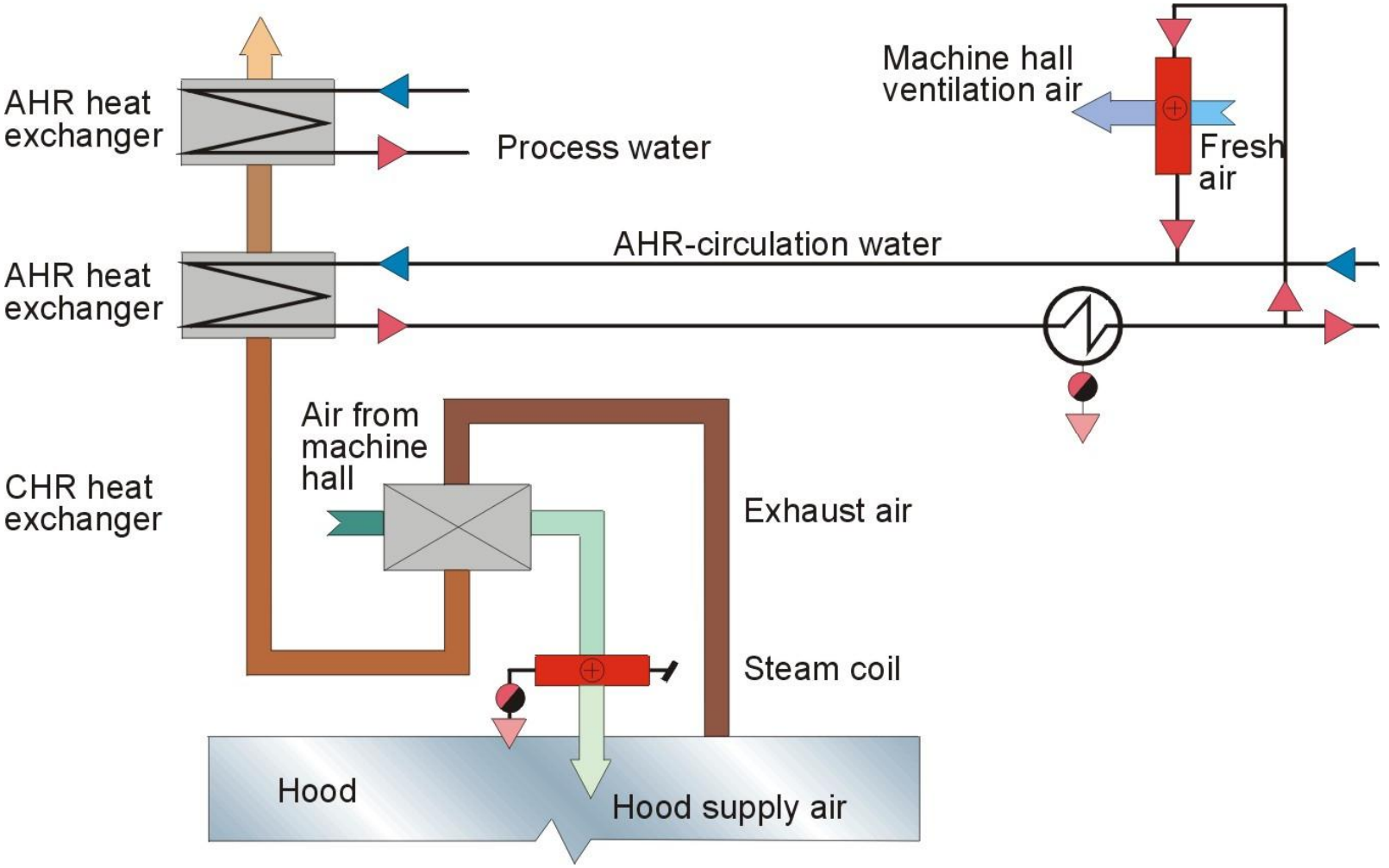


Heat Recovery to Wire Pit Water

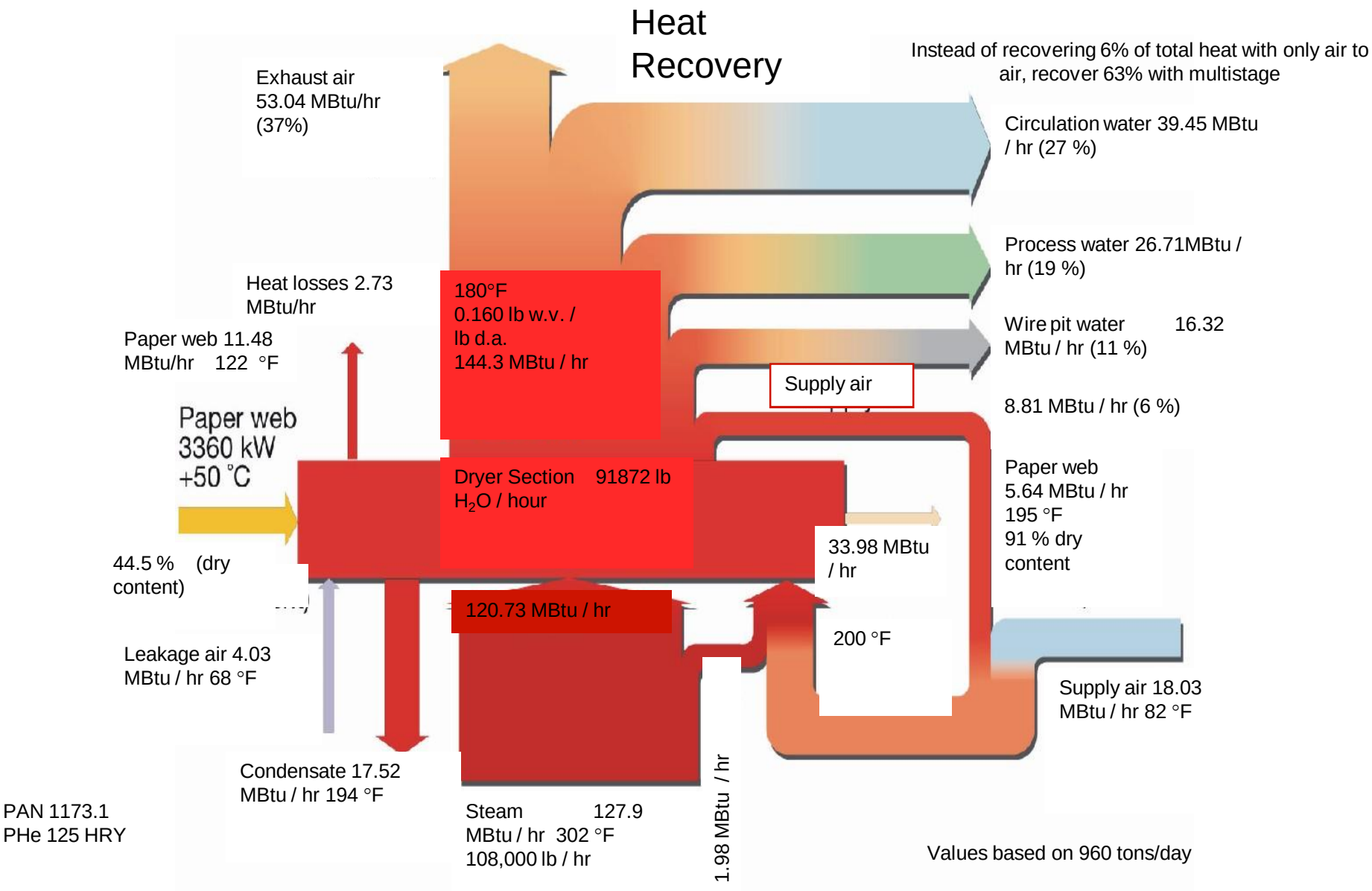
(Example Newsprint Paper Machine, Production 980 t / 24h)



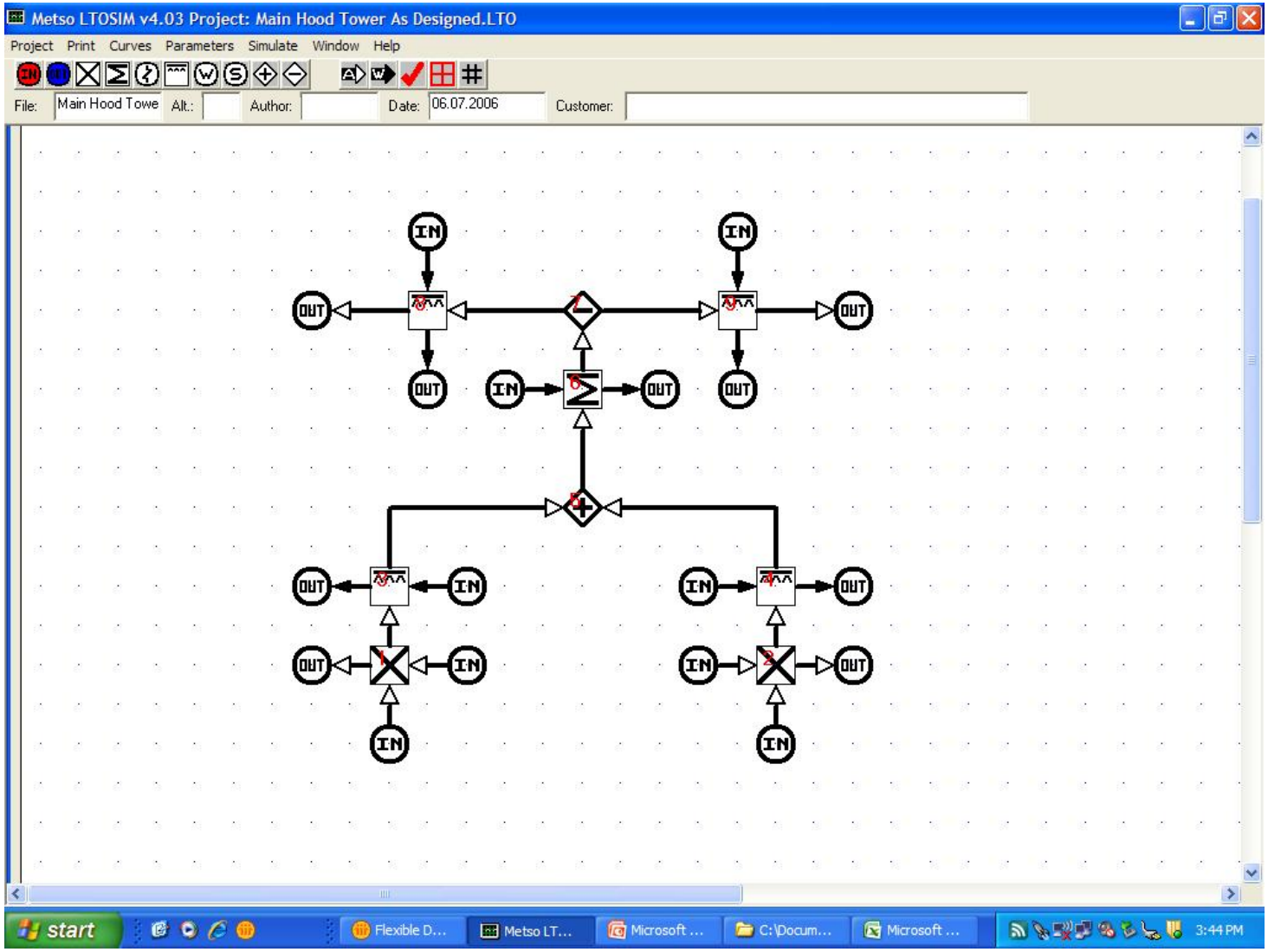
MultiStage Heat Recovery System



Sankey Diagram for a Newsprint Machine



Heat Recovery Simulation Software



Central WI

960TPD PM

Heat Recovery Potential from Hood Exhaust to MUA

Month	Op. Days/ Month	Avg O/A Temp	Supply Temp	Degrees Heated*	Heat Recovered (Btu) Makeup Air Heating Req'd (BTU)	Makeup Air Heating Avialable (BTU)	Gas Savings with Heat Recovery (BTU)	EXCESS Heat Recovery
Jul	29	67.2	70	0	0	27457200000	0	27457200000
Aug	30	65.1	70	0	0	28404000000	0	28404000000
Sept	29	55.9	70	0	0	27457200000	0	27457200000
Oct	30	44.4	70	25.6	13934592000	28404000000	13934592000	14469408000
Nov	29	29.8	70	40.2	21152275200	27457200000	21152275200	6304924800
Dec	28	16.3	70	53.7	27281318400	26510400000	26510400000	-770918400
Jan	30	10.6	70	59.4	32332608000	28404000000	28404000000	-3928608000
Feb	27	16.1	70	53.9	26404963200	25563600000	25563600000	-841363200
Mar	30	27.1	70	42.9	23351328000	28404000000	23351328000	5052672000
Apr	30	40.9	70	29.1	15839712000	28404000000	15839712000	12564288000
May	30	54	70	0	0	28404000000	0	28404000000
Jun	28	62.5	70	0	0	26510400000	0	26510400000
	350				1.60297E+11			

154,755,907,200 Totals (btu/year)

97%

18423322.29

Energy Cost (gas) per million Btu	$8.00	
Electrical Energy Cost ($/HP/yr)	$450	
SCFM of heated make-up air	700000	
Heat Recovery Capacity	13150000	BTUH/tower
Number of towers	3	
Total Heat Recovery Potential	39450000	BTUH
Total annual (gas) savings	$1,238,047 /yr	
Total Elect. Increase	($55,014) /yr	
Total Annual Savings	$1,183,034	

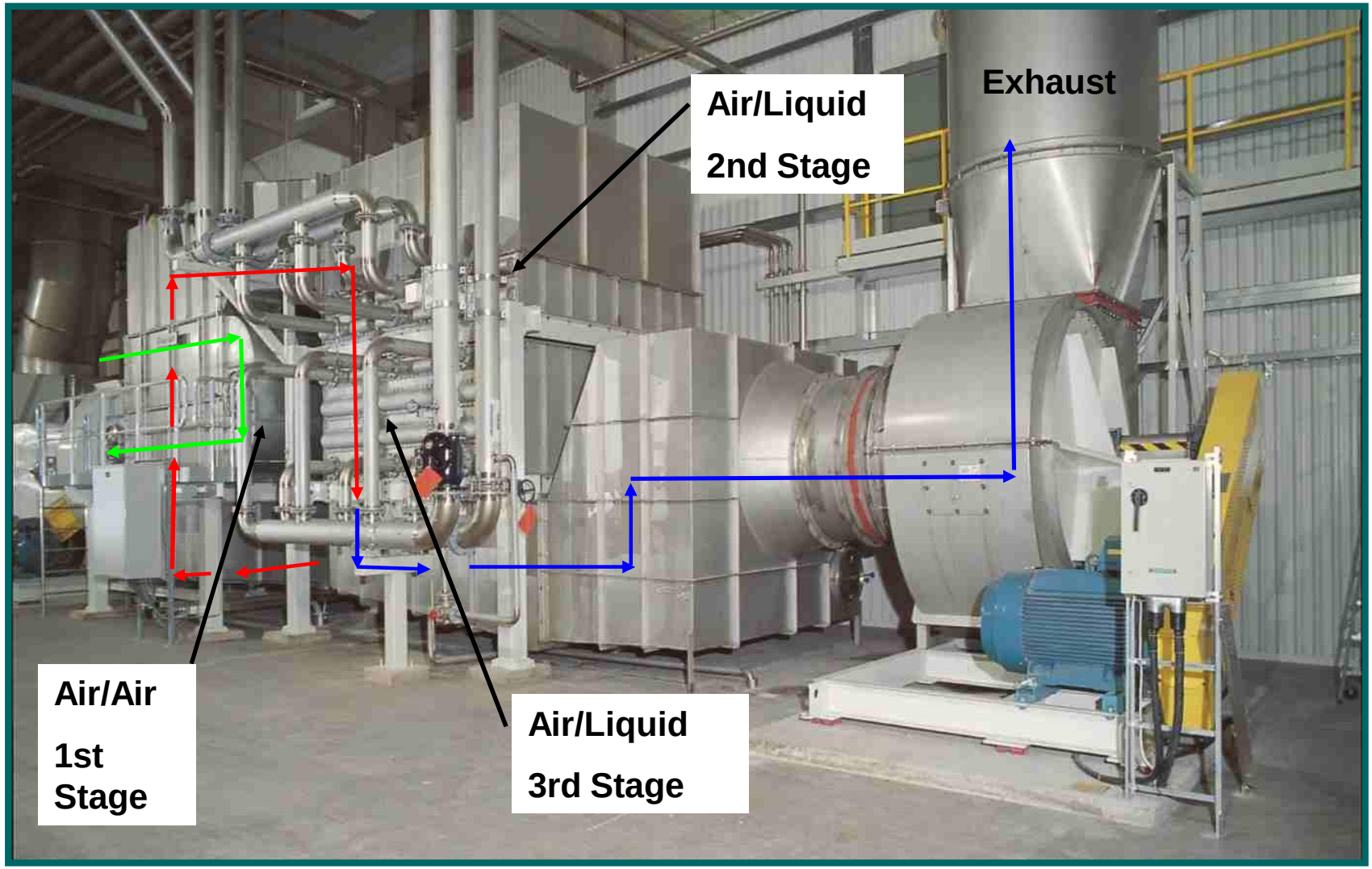
Electrical Energy Costs

Exh Fan HP Increase/fan		10
# of Exh Fans		3
Total Fan HP Increase		30
Op. days /yr	350	
Op cost		$12,981
AMU Fan HP Iincrease (total)		5
# of AMU's	6	
Op. days /yr	350	
Op cost		$2,163
Pump HP Iincrease (Total)		150
# of Pumps	1	
Op. days /yr	215	$0.00
Op cost		$39,870
Total Elect Op Cost		$55,014

Value of Heat Recovery

Stage	Peak Heat Recovery (mmBtu/hr)	Seasonal	Value at $8/mmBtu, 350 operating days/yr
Air to Air (PV Pre-heat)	8.81	No	$592,000
Air to White Water	16.32	No	$1,096,000
Air to Glycol	39.45	Yes	$1,183,000
Air to Makeup Water	26.7	No, but seasonal inlet temperature variation	$1,794,000
TOTAL			$4,665,000

Typical 3 Stage Heat Recovery System



Summary

- Air to air heat recovery is a viable means of saving energy
  - There are, however limitations
- Evaluation of other potential heat sinks will result in significantly increased savings opportunities several times that available using only air to air
- The best approach is a multistage design
- Multistage design is optimized using the latest computer software