The Heat You Cannot Use

On Grief, Dissipation, and Wasted Potential

Cade Kaminski · Sam Wolpert · March 12, 2026

Economic Analysis Spreadsheet

McNeil Center
Entrepreneurship & Innovation

Ball Challenge S26

Innov8x

Industry Challenge

HEATING DEMAND

Gas Boiler → Process Heat

4,626 kW

COOLING LOAD

Compressors + Equipment → Tower

3,999 kW → rejected to atmosphere

Nearly equal thermal flows running in parallel --> purchased energy is being thrown away

<2hr Startup	1–4 Line Turndown	Fluid Isolation	Existing Equip Stays

Solution: Recover Purchased Energy

CURRENT STATE

PROPOSED

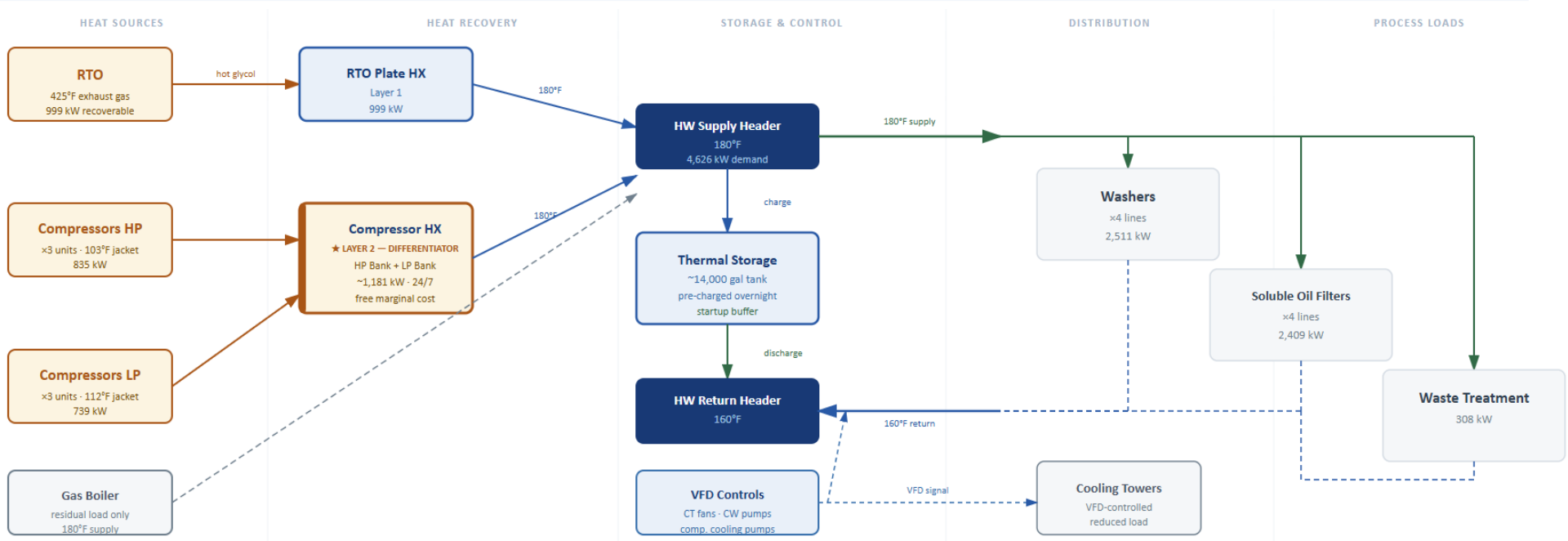
2,180 kW

Waste heat available for recovery
(RTO 999 kW + Compressors 1,181 kW)

47%

Of total heating demand covered
by recovered waste heat (4-line scenario)

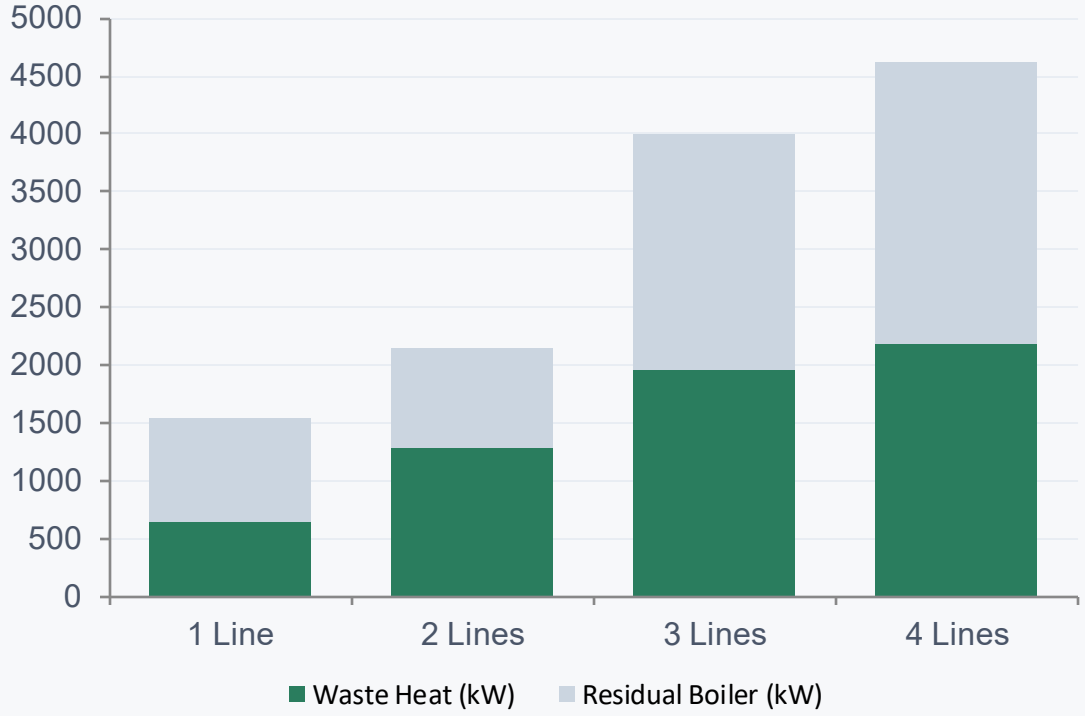
How the System Works



Solution: 5-Layer Waste Heat Cascade

1	Phase 1A	**RTO Heat Recovery**	999 kW
2	Phase 1B	**Compressor Jacket HX**	1,181 kW
3	Phase 1C	**Thermal Storage Buffer**	<2hr startup
4	Phase 1D	**VFD Controls Upgrade**	30–50% pump savings
5	Phase 2	**Heat Pump**	COP 4.5, 100→140°F

Performance Across All Scenarios



42% Coverage (1 Line)

59% Coverage (2 Lines)

48% Coverage (3 Lines)

47% Coverage (4 Lines)

Cost Analysis

Economic Analysis Spreadsheet -->

$850K	$134K/yr	6.3 yr	$1.75M
Phase 1 CAPEX	Net Annual Savings	Simple Payback	10-Year NPV (8%)

CAPEX BREAKDOWN

Phase	Description	Cost
1A	RTO HX Integration	$200K
1B	Compressor Jacket HX	$120K
1C	Thermal Storage Tank	$350K
1D	VFD Controls Upgrade	$180K

3,870

tCO_2/yr Scope 1 Reduction

$0 Carbon Price Required

Positive ROI with no carbon pricing assumption

Risks & Opportunities

RISKS	OPPORTUNITIES
! Glycol–water fluid isolation adds heat exchanger complexity	✓ Energy Trust of Oregon incentives available
! Startup sequencing requires controls integration	✓ Scalable to other Ball manufacturing facilities
! Compressor HX retrofit needs scheduled downtime	✓ Phase 2 heat pump adds full electrification path

Mitigation: Phased rollout de-risks each layer. Layer 4 VFDs have <2yr standalone payback — lowest risk first.

Implementation Timeline

Phase 1A RTO HX	Phase 1B Compressor HX	Phase 1C Storage Tank	Phase 1D VFD Upgrade
Months 1–3	Months 2–5	Months 4–8	Months 6–9

Phase 2: Heat Pump · Year 2+ · ~$131K · Conditional on electricity rates & Phase 1 performance

KEY MILESTONES

Month 3	RTO heat online — 999 kW recovered
Month 6	Compressor HX + storage commissioned
Month 9	Full system operational — all 5 layers active
Month 12	Performance verification & Phase 2 decision

Conclusion

Novelty

Recovers compressor energy already being purchased — no new energy required

High Impact

3,870 tCO_2/yr Scope 1 reduction at 47% coverage

Implementable

$850K investment, 6.3yr payback, positive ROI at $0 carbon price

Approve Phase 1 Engineering Study — $850K Capital Request

Deploy at Corvallis → Verify performance → Scale across Ball fleet

Questions?