Improving Glycol Chilling Efficiency at Ruhstaller Farm Brewery

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ABT 212: A Path to Zero Net Energy
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Background: Ruhstaller Farms is a brewery and taproom founded in 2020 in Dixon, CA. ***~90% of their energy*** powers a propylene glycol chilling loop that cools beer in brewing, fermentation, crashing, and maturation before packaging.

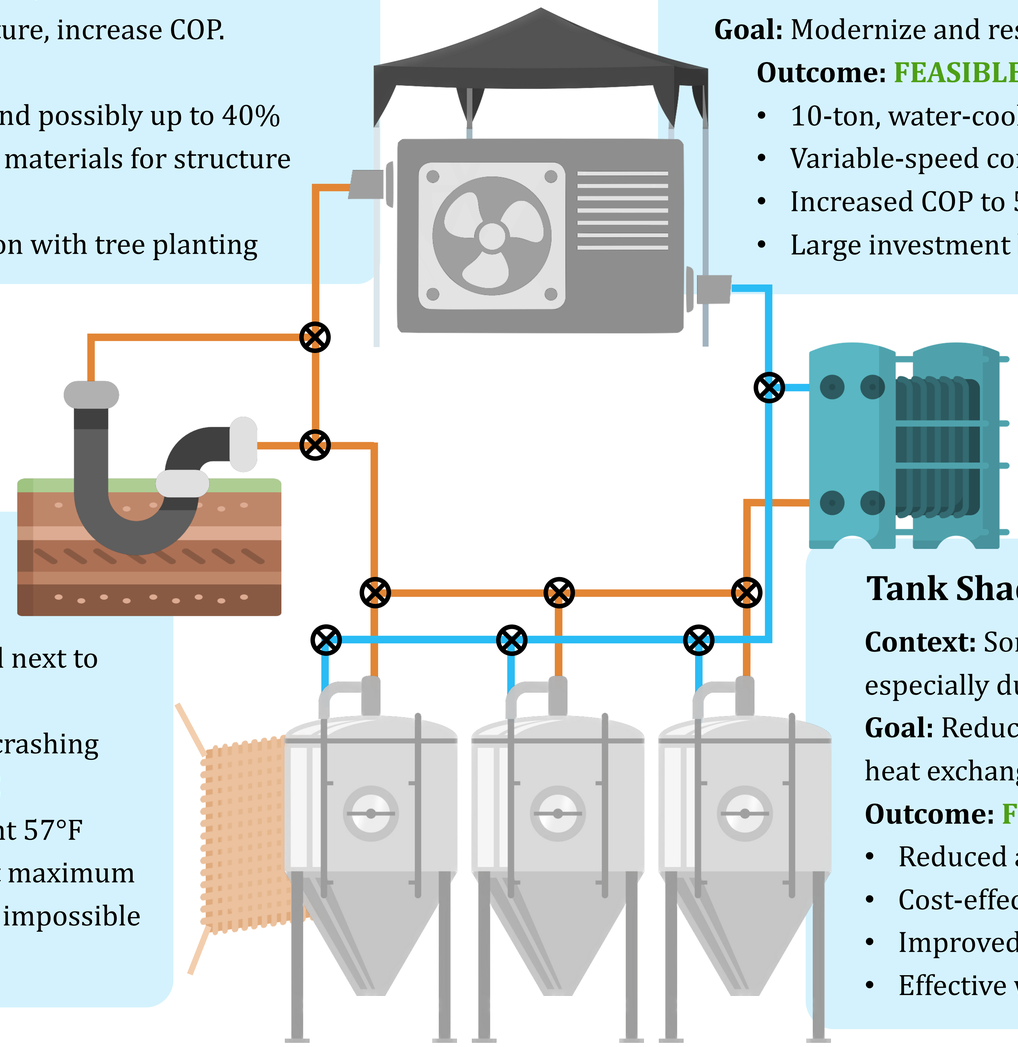
Goal: Assess ***four intervention methods*** and calculate projected ***energy*** savings, ***cost*** savings, and ***simple payback.***

Proposed Solutions

Chiller Shading: *Low Intervention*

Context: Chiller in direct sun, hot ambient intake air.
Goal: Reduce air temperature, increase COP.
Outcome: FEASIBLE

- Increased COP by 1%, and possibly up to 40%
- Cost-effective, available materials for structure
- Improved ergonomics
- Potential natural solution with tree planting



Chiller Replacement: *Medium Intervention*

Context: Second-hand chiller, possibly suboptimal
Goal: Modernize and resize chiller, increase COP.
Outcome: FEASIBLE

- 10-ton, water-cooled model
- Variable-speed compressor
- Increased COP to 5 *(from 3.3)*
- Large investment but fast payback

Ground-Source HX: *High Intervention*

Context: Unused 100’ well next to fermentation tanks
Goal: Remove heat when crashing
Outcome: NOT FEASIBLE

- Groundwater at constant 57°F
- Glycol reaches ~55°F at maximum
- Effective heat exchange impossible
- Beer QA → limited use

Tank Shading: *Low Intervention*

Context: Some tanks in direct sun, especially during afternoon
Goal: Reduce surface temperature and heat exchange.
Outcome: FEASIBLE

- Reduced average temperature by 2°F
- Cost-effective, site-consistent materials
- Improved ergonomics
- Effective when hot → demand-response

Results

Interventions

	Baseline	Tank shade	Chiller shade	Chiller swap	GSHX
Cooling [kBTU]	94,673	93,983	94,673	94,673	*Infeasible*
El. power [kW]	12.5	12.4	12.4	8.3	
El. use [kWh/mo]	8384	8323	8301	5562	
El. cost [$/mo]	$1,593	$1,581	$1,577	$1,057	
El. savings [$/mo]	--	**$12**	**$16**	**$536**	
Intervention cost [$]	--	$259	$173	$21,340	
Simple payback [mo]	--	**22.3**	**10.9**	**39.8**	

- **New chiller saves most energy and money**, but most risky investment
  - **Uncertain of COP** in real field conditions
  - Current chiller has service life
- Shading interventions don’t save much, but are nearly **risk-free investments**
- Thermodynamic model can be utilized for **experimentation** and future modeling
  - e.g., %ABV and temperature setpoints

Future Work

- **Rate plan** suggested by PG&E may save ~$2000
- **Demand-response** by brewing earlier or later Refine measurements, equations, and assumptions in model
- Make **Excel modeling tool** user-friendly and share to Ruhstaller for future use
- **Detailed design** of interventions
  - Contact chiller company for quote
  - Assess on-site materials

Acknowledgements and References

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[1] El Sherbini, A. I., and G. P. Maheshwari. 2010. “Impact of Shading Air-Cooled Condensers on the Efficiency of Air-Conditioning Systems.” *Energy and Buildings* 42(10): 1948–51. [2] Fred M. Scheer. 2014. “Thermal Process Engineering for Brewers; Basics in Theory and Practice.” [3] Olajire, Abass A. 2020. “The Brewing Industry and Environmental Challenges.” *Journal of Cleaner Production* 256: 102817. [4] Pacific Gas and Electric and Ruhstaller Farm. 2023. “Green Button Data for Ruhstaller Farm; Chiller and Pump Circuit.” [5] Parker, Danny S, SF Barkaszi, and Jeffrey K Sonne. 1996. “Measured Impacts of Air Conditioner Condenser Shading.” Images: VectorStock, ClipArtMax, CDN-icons-PNG.flaticon.com, Freepik and BioRender