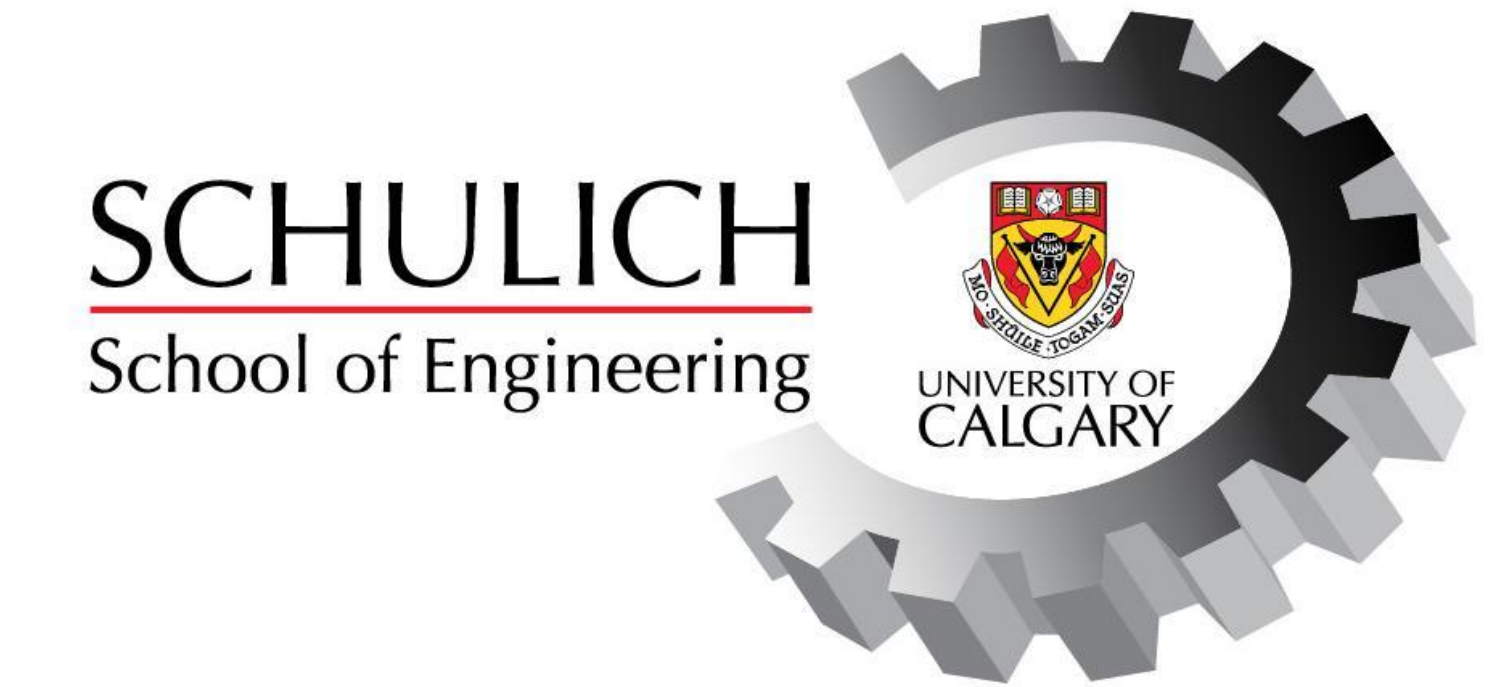


Waste Heat Recovery at Suncor East Tank Farm

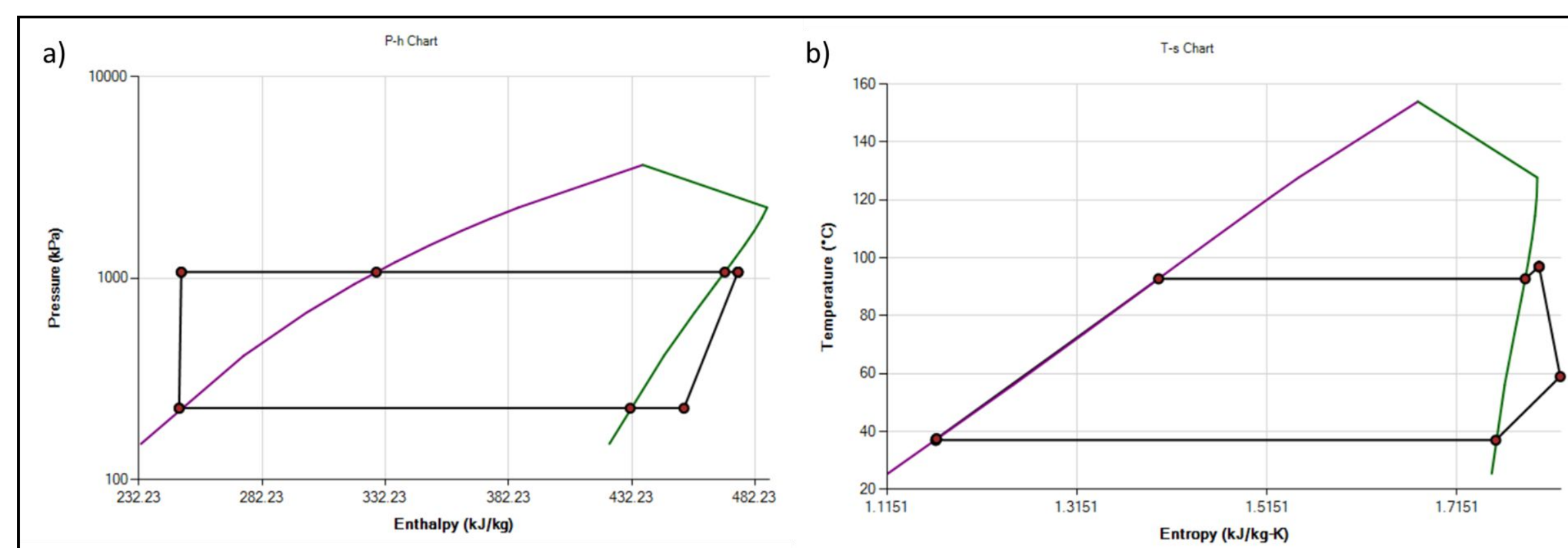
BigBrain, Inc.

Josh Garden, Devin Whyte, Eric Godin, Jackson Penner, & Ricardo Herrera Duran
Schulich School of Engineering, University of Calgary



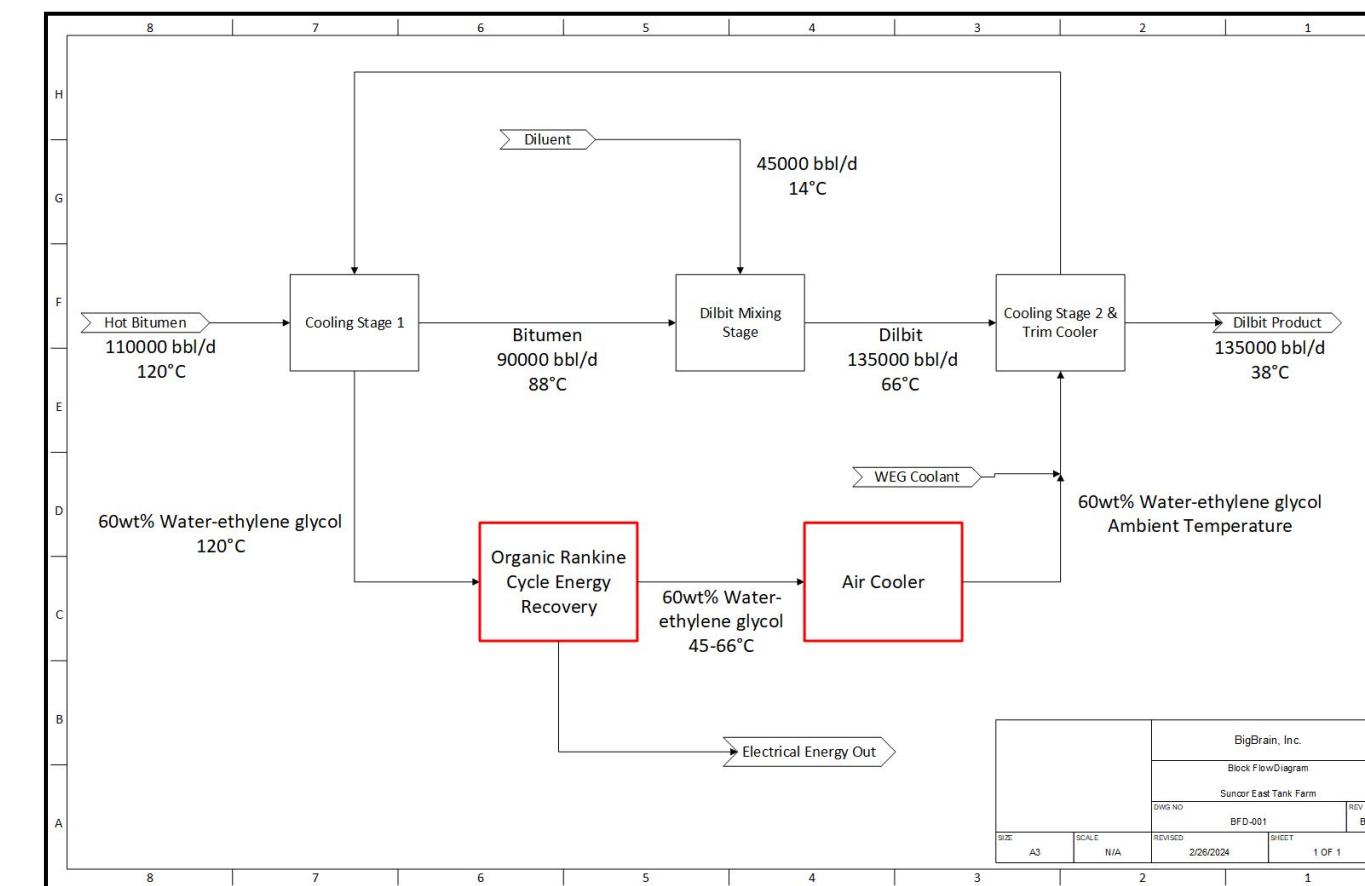
Abstract

BigBrain, Inc. presents a robust waste heat recovery solution that can withstand the high temperature fluctuations of Northern Alberta. This allows Suncor to significantly diminish its carbon footprint while striving towards GHG emission initiatives (**10Mt reduction in GHG emissions by 2030**)¹. Big Brain, Inc. has designed an Organic Rankine Cycle (ORC) waste heat recovery system using working fluid mixture of 70:30 isopentane and R-245fa. ORC system demonstrates energy savings of 700kW while reducing CO₂ emissions by 3.6 kilotonnes of CO₂ per year.



Introduction

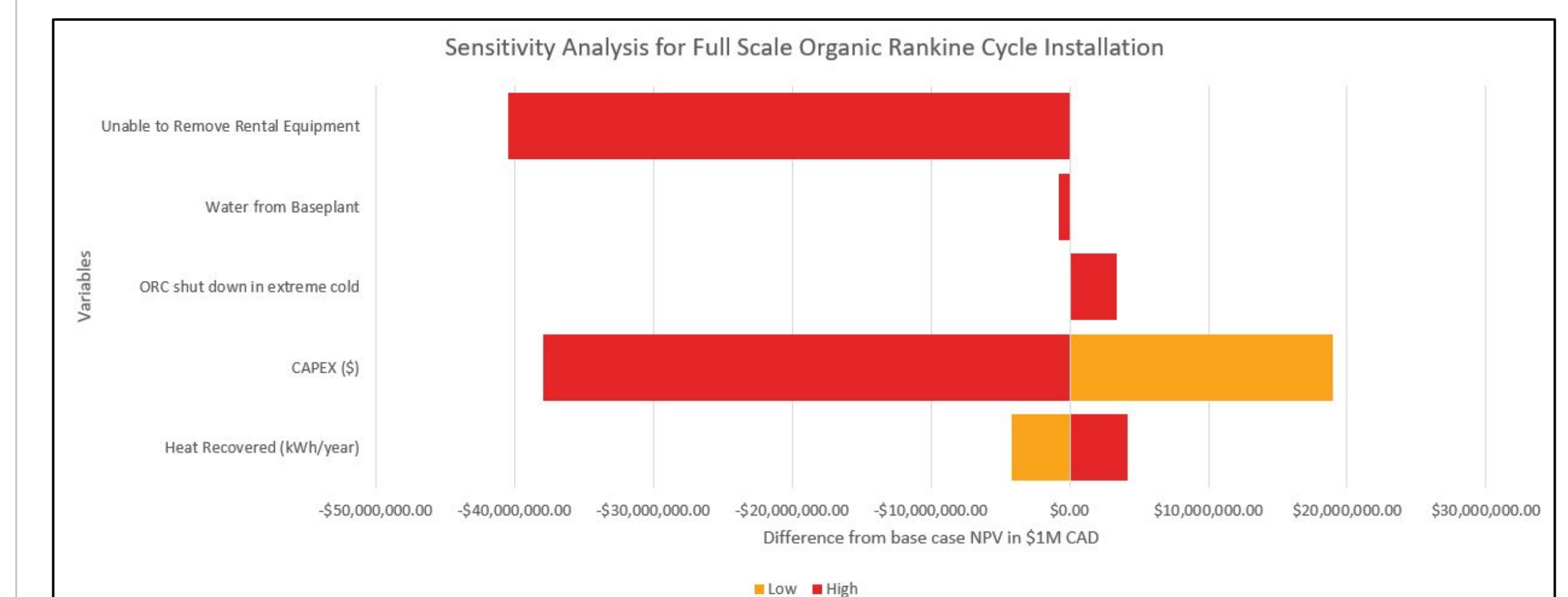
Location and Process: Suncor East Tank Farm (ETF) is a dilbit mixing and cooling facility designed to process 125 kbpd bitumen from SAGD operations
Design Issue: Vapor pressure exceedance in dilbit mixing, large OPEX from Aggreko chiller rental, excess GHG emissions.
Solution: Integration of an ORC waste heat recovery system. Ensures the cooling of the ETF dilbit below 38°C (removing the possibility for true vapor pressure exceedances) and substantially reduce emissions by converting waste heat to electrical power to run dilbit air coolers



Results

Economic evaluation of the ORC implemented into Suncor's ETF involved assumptions of a 20 year life span. A corporate tax rate of 30% was selected and an escalation percentage of 3% was applied to both the direct and indirect operating costs and energy savings per kWh.

- TCI of \$40,800,500.00
- NPV of \$19,400,000.00
- IRR of 21.24%
- Discounted Payback Period of 4 years

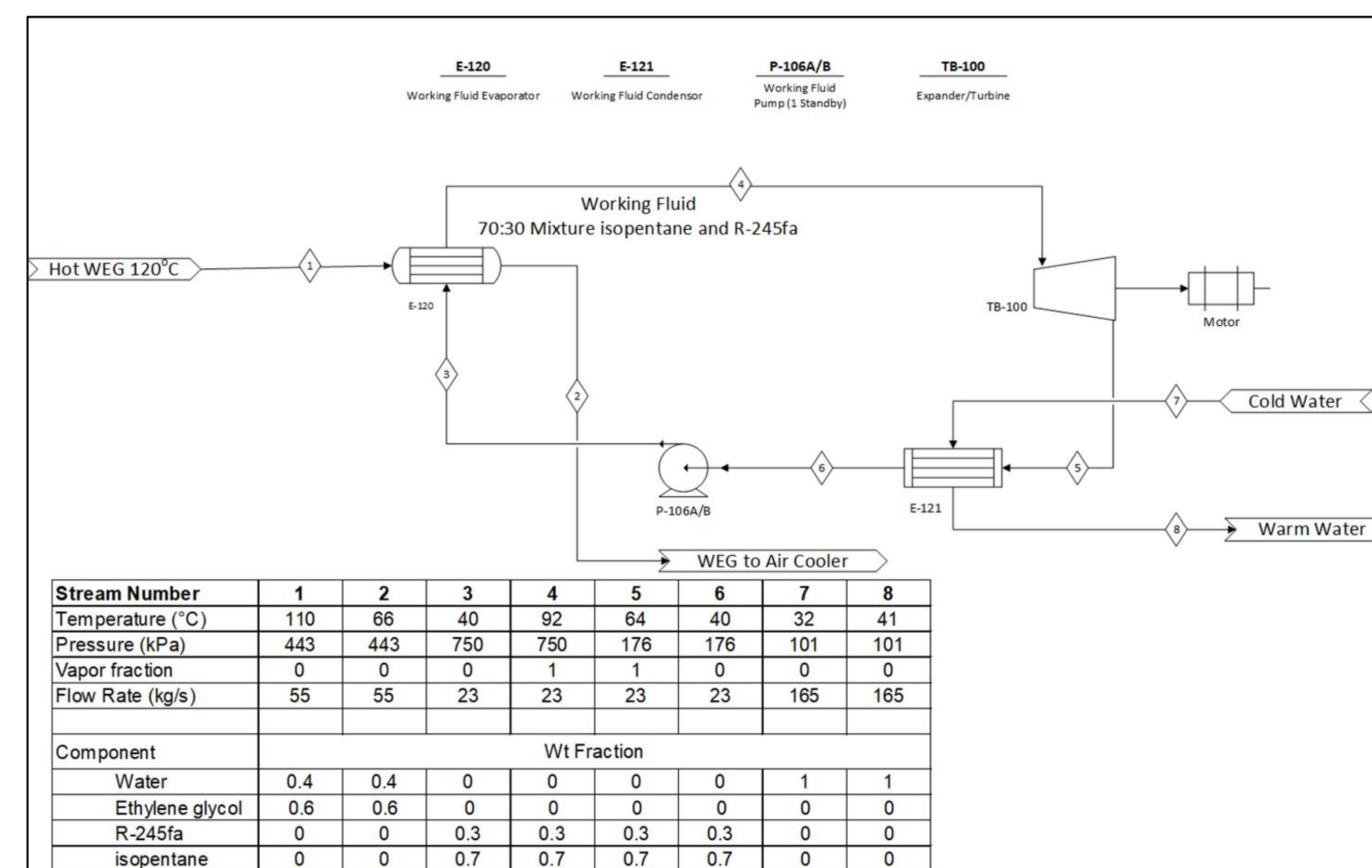


Discussion

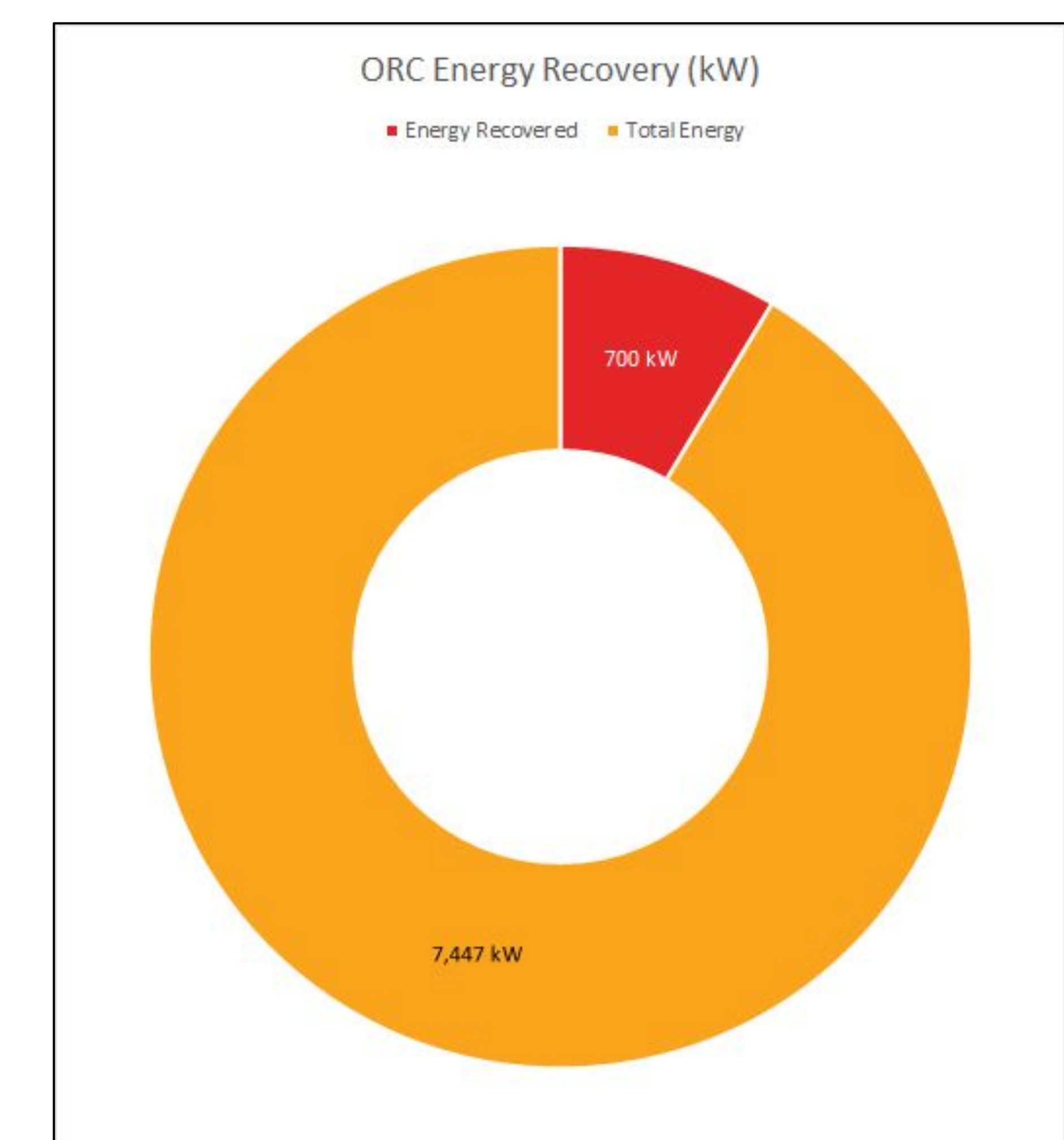
- ORC design largely limited by large size of Condenser
- Use of Water-cooled ORC condenser substantially reduces energy requirements
- Use of 70:30 mixture of isopentane and R-245fa as working fluid provides ideal balance between performance, safety, and environmental
- Contributes positively to Suncor's goal of 10Mt reduction in GHG emissions by 2030.
- Economics greatly improve with respect total life cycle timeline of project.
- Redesigned air coolers allow removal of previously rented equipment.

Conclusions

- ORC recovers up to **700 kW of usable power**.
- ORC design provides **21.24% rate of return** with payback period of 4 years.
- ORC generates **savings of over \$1.4 million per year** and reduces emissions by **3.6 kilotonnes of CO₂ per year**.



Our ORC demonstrates a **9.4% heat recovery efficiency, generating 700kW of usable power** which will be used to offset **GHG emissions**.



References

1. Climate Strategy: Reducing Emissions in our Base Business, Suncor Energy Inc, 2023.
<https://www.suncor.com/en-ca/climate/climate-strategy/reducing-emissions-in-our-base-business>

CONTACT INFORMATION:

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