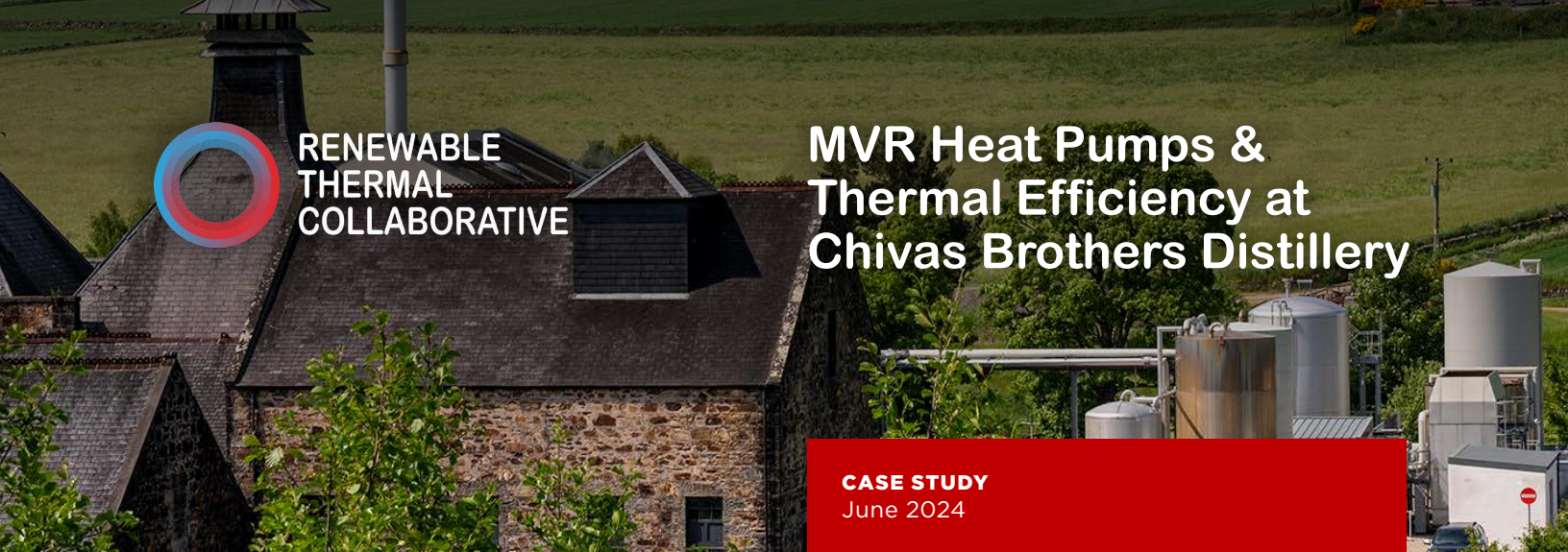




RENEWABLE
THERMAL
COLLABORATIVE

MVR Heat Pumps & Thermal Efficiency at Chivas Brothers Distillery



Glentauchers distillery in Speyside, Scotland

CASE STUDY

June 2024

LOCATION

Speyside, Scotland

INDUSTRY TYPE

Food and beverage

FACILITY TYPE

Whisky distillery

TEMPERATURE LIFT

From 81°C to 106°C

TECHNOLOGY DEPLOYED

Heat pump — Mechanical Vapor Recompression (MVR)

EMISSIONS IMPACT

Avoids 4,320 metric tons of CO₂ emissions annually

Project Overview

Chivas Brothers, the Scotch whisky business of Pernod Ricard, adopted Mechanical Vapor Recompression (MVR) technology from Piller Blowers & Compressors GmbH (PILLER) as part of a heat recovery system at its Glentauchers malt whisky distillery in Speyside, Scotland. This project contributes to Chivas Brothers' goal of achieving carbon neutral whisky distillation by the end of 2026 and demonstrates an effective application of heat pump technology in the distillation process.

The heat pump system at the Glentauchers distillery is comprised of two main components: a vertical condenser and an MVR set of three PILLER VapoFans. The system allows the distillery to boil stills using thermal energy recovered from the alcohol evaporation process, which would otherwise dissipate through cooling towers. Heat recovery with MVR technology greatly increases the distillery's efficiency, reducing energy use by 48% and carbon emissions by 53%.

Following the success of this project, Chivas Brothers invested more than £60 million to install MVR heat pumps at all of its applicable distilleries, a move projected to reduce the company's total annual onsite emissions by 38%.

“Heat recovery forms a critical part of our commitment to achieve carbon neutral distillation by the end of 2026. This technology has the potential to transform our industry and accelerate its progress to net zero. Understandably, this technology won't be right for every distillery, but we encourage our peers to explore whether it has the potential to reduce their own carbon output.”

— Jean-Etienne Gourgues

Chairman and CEO, Chivas Brothers



Copper stills at the Glentauchers distillery

Project Origination

Chivas Brothers produces malt whisky through batch distillation using copper stills. The stills are filled with alcohol-containing feed, and in the traditional process, fossil fuel-powered boilers provide steam to the reboilers to heat the still and evaporate the alcohol. This alcohol evaporation process is very energy intensive, and without heat recovery technology, most of the thermal energy is lost via cooling towers after condensing the alcohol.

At the outset of the project, Chivas Brothers already used heat recovery technology at all 12 of its malt distilleries, including a combination of hot water condensers and Thermal Vapor Recompression (TVR). These systems decreased the need for external energy from oil-fired boilers but could recover only 60% of the condenser heat at best. Chivas Brothers sought to increase the heat recovery rate to reduce energy usage and emissions and identified MVR as the best technology available to achieve this objective.

Before installing MVR at all eligible distilleries, Chivas Brothers decided to conduct a pilot project at the Glentauchers distillery in Speyside, Scotland. The Glentauchers distillery produces four million liters of alcohol per year, with three wash stills and three spirit stills. Before this project, the Glentauchers distillery used 27 megajoules per liter of alcohol (MJ/LA), 97.5% of which was heat.

System Design & Installation

The MVR equipment consists of a vertical condenser and three PILLER VapoFans connected in series. The condenser produces low-pressure steam by recovering the latent heat of vapors from the wash still. The PILLER VapoFans, powered by renewable electricity, compress the low-pressure steam to boost the temperature by approximately 25°C and deliver steam to the still's reboiler. The heat recovery system is the primary heat source for the distillation process, displacing an oil-fired boiler.

Chivas Brothers commissioned the Glentauchers project in two stages. The first stage, beginning in May 2021, piloted the use of MVR technology to



MVR equipment, including three PILLER VapoFans

capture heat from one of the distillery's three wash stills. Chivas Brothers received a grant from the [Scottish Industrial Energy Transformation Fund](#) to partially fund the pilot installation.

After results from the pilot demonstrated the technology's ability to capture close to 100% of the condenser's latent heat, Chivas Brothers designed and approved the second stage of the heat recovery project. In December 2022, Chivas Brothers applied the MVR technology to the site's two other wash stills, installed TVR on two spirit stills, and maintained hot water recovery on one spirit still. PILLER used data from the pilot stage to improve the fan design for the second stage, boosting the system's average coefficient of performance (COP) from 10 to 12. COP is the ratio of the thermal energy delivered by a heat pump to the electricity it consumes.

Key Outcomes

By significantly increasing the distillery's heat recovery rate, the project reduced total energy consumption by 48%, from 27 to 14 MJ/LA. This translates to a 53% reduction in carbon emissions, from 8,290 to 3,970 metric tons of CO₂ per year.

These energy savings were a direct result of the MVR technology's high efficiency. The entire heat recovery system has an average COP of 12, meaning that for every one megawatt (MW) of heat that it delivers to the distillation process, it uses only 90 kilowatts (kW) of electrical energy. The efficiency of the MVR system derives from PILLER's VapoFans, which turn the still's waste heat into a usable resource with minimal energy loss.

PILLER's MVR technology is also highly responsive and flexible, which is important for a batched process like whisky distillation. Because it operates by using the heat produced by the alcohol evaporation process itself, the MVR system increases in efficiency as a batch progresses, beginning at a COP of nine and ending near 20 after a few hours. The VapoFans' two-minute ramp-down time minimizes energy loss between batches.

“The heat pump system adapts to the constantly changing process conditions during distillation and provides the required compression at each stage of the process.”

- Gregor Schumm

Head of Process Engineering at PILLER¹

The efficiency gains and energy savings from this project advanced Chivas Brothers toward its goal of carbon neutral distillation by the end of 2026. As part of its fiscal year 2023 financial results, Chivas Brothers announced an investment of £60 million over the next three years to install MVR heat pump systems across all of its applicable distilleries. This effort will save 30,000 metric tons of CO₂ emissions annually, a 38% total reduction.

Lessons Learned

- **Pilot projects prove the case.** Chivas Brothers successfully piloted MVR technology at the Glentauchers distillery before installing additional MVR heat pumps at Glentauchers and other sites. The pilot project helped Chivas Brothers and PILLER realize the importance of proper condensate removal and improve the fan design to increase the average COP from 10 to 12 for the second phase of installations.
- **Customization maximizes heat recovery.** Instead of installing MVR on all six of the distillery's stills, Chivas Brothers selected a combination of MVR, TVR, and hot water condensers to maximize the heat recovery rate. This configuration enabled Chivas Brothers to minimize the capital cost of the project and maximize the efficiency of the heat recovery system.
- **Heat recovery and electrification significantly reduce costs and emissions.** The highly efficient MVR system reduces energy usage and emissions relative to fossil fuel-powered steam boilers. By reducing the total energy required for distillation, the heat recovery system also reduces costs.

¹ Piller Blowers & Compressors GmbH, [“Case Study - PILLER MVR Technology in the Distillation Process at Chivas Brothers,”](#) January 2024.

Next Steps for Interested Buyers

Buyers interested in learning more about renewable thermal should:

- Check out Chivas Brothers' [open source case study and basis of design](#) and PILLER's [case study](#) on the Glentauchers distillery project.
- Read more [case studies](#) from the RTC to learn how energy users and solutions providers are deploying renewable thermal solutions.
- Find a list of solutions providers through the [RTC Partner Locator](#).
- Use the [RTC Heat Pump Decision Support Tools](#) to identify, evaluate, and act on opportunities to deploy industrial heat pumps.
- Join the RTC to participate in Working Group meetings, learn from other renewable thermal users, and connect with solutions providers. Contact the RTC's Membership Director, Perry Hodgkins Jones, at perry@dgardiner.com to learn more.
- See more information on the applications and market potential of renewable thermal solutions in the [Renewable Thermal Vision Report](#).



The Renewable Thermal Collaborative (RTC) is the global coalition for companies, institutions, and governments committed to scaling up renewable heating and cooling at their facilities. Learn more about our work at www.renewablethermal.org.

© Renewable Thermal Collaborative

JUNE 2024