WHITE PAPER

FROM EFFICIENCY TO IMPACT

TURNING THERMAL ENERGY INTO DECARBONISATION MOMENTUM

IN FOCUS: **FOOD & DRINK MANUFACTURING**

OPTIMISE TO DECARBONISE

spirax sarco

THE UNTAPPED POTENTIAL

INTRODUCTION

Across manufacturing from brewing and dairy processing to food production, heat drives the physical and chemical processes that turn materials into finished products. In industrial terms, heat is the movement of thermal energy; the energy stored within systems and transferred to where it's needed for production. Yet despite its central role, it remains one of the least optimised and least visible aspects of most energy strategies.

> **MOMENTUM TURNS INCREMENTAL GAINS INTO INDUSTRIAL CHANGE**

Over the past decade, efficiency progress has focused largely on reducing electricity consumption and sourcing 100% renewable power, with more than 100 UK-based companies including Diageo, GSK and Nestlé UK & Ireland joining the RE100 initiative (The Climate Group & CDP, RE100 Progress Report, 2024). While this has driven major progress in Scope 2 emissions reduction, direct fuel use and process heat; the dominant sources of Scope 1 emissions have received far less attention, despite representing the largest remaining decarbonisation gap in industry. Addressing process heat and direct fuel use is inherently more complex; site-specific, capital-intensive and often constrained by limited, always-on visibility into thermal performance (IEA, The Future of Heat in Industry, 2022; Carbon Trust, Industrial Energy Efficiency Case Studies, 2023; SBTi, Guidance for Near-Term Targets in Industry, 2023).

Globally, thermal energy use accounts for more than half of total industrial energy consumption and in some sectors, up to 70% of total process demand (IEA, The Future of Heat in Industry, 2022). How organisations generate, manage and recover this energy therefore represents one of the largest untapped opportunities to cut carbon, strengthen competitiveness and reduce operating costs.

Thermal energy efficiency is not a maintenance task, it is a strategic lever for accelerating progress toward net zero. It shifts the conversation beyond routine cost control, reframing efficiency as a driver of long-term resilience, competitiveness and decarbonisation. By optimising how heat is produced, distributed and recovered, organisations can deliver immediate reductions in Scope 1 emissions, improve energy performance and reduce operating costs, while preparing their systems for the integration of renewable and low-carbon heat sources. In an energy landscape where electricity prices remain three to four times higher than gas (DESNZ, UK Industrial Energy Prices, 2024), improving thermal efficiency also helps manufacturers manage cost volatility and grid constraints, which continue to limit the pace of full electrification.

Efficiency at this level does more than cut carbon, it builds strategic agility. Every kilowatt-hour saved today strengthens an organisation's capacity to invest in tomorrow's solutions, from electrification to renewable-heat integration. In this way, thermal efficiency becomes the foundation, not the footnote of industrial decarbonisation.

DECARBONISING HEAT

THE MISSING LINK IN NET-ZERO STRATEGIES?

01

Many organisations across the UK and Ireland have made significant progress in renewable electricity and carbon offsetting.

More than 100 UK-based companies including Diageo, GSK and Nestlé UK & Ireland have joined the RE100 initiative, committing to 100% renewable electricity across their operations (The Climate Group, 2024). At the same time, investment in certified carbon-offset projects under frameworks such as Gold Standard and Verified Carbon Standard (VCS) continues to grow, with the UK's voluntary carbon market exceeding £1.5 billion in 2023 (Ecosystem Marketplace, 2023).

However, this progress sits within a more complex energy landscape, where decarbonising heat, maintaining energy security and managing cost pressures remain significant challenges for organisations across the UK and Ireland. Electricity remains significantly more expensive than natural gas; a price gap known as the spark gap meaning that for many manufacturers, running electric equipment can cost three times more than using gas-fired systems (Ofgem, 2024). Combined with grid-capacity constraints and connection delays, full electrification of heat and process systems remains economically and operationally challenging for most industrial users (National Grid ESO, 2024; EirGrid, 2023).

As a result, while organisations have successfully decarbonised their purchased electricity (Scope 2), the next step lies in tackling direct (Scope 1) emissions from fuel combustion and thermal processes; areas where energy efficiency, waste-heat recovery and hybrid thermal energy systems combining multiple heat sources such as gas and electric to balance reliability, cost and carbon reduction potential can deliver faster, lower-cost decarbonisation gains. This imbalance, rapid progress in electricity decarbonisation but slower movement on heat explains why industrial heat is now emerging as the missing link in credible net-zero strategies. So far, the journey to net zero has focused on what's most visible: electricity, renewables and offsets. But beneath the surface of every factory floor, another challenge remains; heat.

In manufacturing, pharmaceuticals and food production, thermal energy drives the process itself and the majority of emissions. Unlike electricity, which can be sourced renewably from the grid, industrial heat is typically generated on-site through the combustion of natural gas or other fossil fuels. According to the International Energy Agency (IEA), industrial heat production accounts for around one-third of global CO_2 emissions. Nearly twice that of electricity generation (IEA, Tracking Clean Energy Progress, 2023). That's why addressing thermal systems is not optional; it's central to credible decarbonisation.

Addressing industrial heat isn't simply about cutting waste, it's about unlocking momentum. Thermal energy efficiency delivers immediate, measurable carbon reductions while strengthening cost control and resilience. By optimising how heat is generated, distributed and recovered, manufacturers can reduce emissions today and create the flexibility to integrate low-carbon technologies tomorrow.

In doing so, efficiency becomes far more than a technical improvement; it becomes the engine of progress, accelerating decarbonisation across every stage of production.

TURNING EFFICIENCY INTO DECARBONISATION MOMENTUM

If industrial heat is the hidden half of the energy challenge, efficiency is the catalyst that makes it visible and actionable.

02

Optimising steam and process heat is not a stopgap measure but a strategic enabler that converts ambition into measurable carbon reduction. Efficiency at this level means more than upgrading equipment. It's about understanding how every part of a thermal system from the boilers to condensate return interacts and where energy is lost through combustion inefficiency, insulation gaps, steam and condensate leaks, pressure mismanagement or wasted heat recovery potential. By addressing these inefficiencies, manufacturers can unlock rapid carbon and cost savings while laying the groundwork for deeper transformation.

Efficiency delivers progress on multiple fronts:

- **Cuts Scope 1 emissions from fuel combustion; the largest source of direct industrial CO_2**
- **Lowers operational costs in a volatile energy market, with achievable payback periods of less than two years**
- **Strengthens resilience by reducing dependence on fossil fuels and exposure to price shocks**
- **Creates flexibility for the future; efficient systems can evolve more easily, whether through electrification, renewable integration or alternative fuel sources**

In short, improving thermal performance is the fastest route to industrial decarbonisation today and the foundation for every low-carbon investment that follows. Each efficiency gain compounds the next, turning small steps into sustained momentum toward net zero.

FROM MOMENTUM TO IMPACT

SCALING EFFICIENCY ACROSS SITES

Once momentum is established at site level, the next step is to replicate and scale success across entire operations. For multi-site manufacturers, this means turning isolated energy projects into a cohesive decarbonisation programme. One that measures impact, shares best practice and sustains progress over time

03

Real change happens when efficiency moves beyond individual projects and becomes a systemic approach embedded across multiple facilities, regions and business units.

The most successful manufacturers treat decarbonisation not as a series of technical upgrades but as an enterprise-level strategy, linking energy performance, sustainability goals and operational excellence. In practice, this shift from momentum to impact depends on three things: visibility, consistency and collaboration.

1

Visibility:
Turning Data into Decarbonisation Insight

To manage what matters, it must first be measured.

Connected monitoring tools and digital energy management platforms now give manufacturers always on visibility into how heat is generated, distributed and recovered across processes and plants. By monitoring and analysing key parameters such as steam flow, condensate return and energy use across the network, manufacturers can benchmark performance, identify hidden inefficiencies and quantify carbon savings all whilst building a robust foundation for smarter, more sustainable steam management. Digitisation transforms efficiency from a one-off initiative into a cycle of continuous optimisation and verification. Connected dashboards and analytics enable teams to:

+ Quantify CO2 reductions and fuel savings
+ Validate payback periods and ROI
+ Report verified progress toward Scope 1 and Scope 2 targets

According to the IEA's Energy Efficiency 2023 Report, implementing digital energy-management systems can reduce industrial fuel consumption by up to 15 % when scaled across sites. Visibility turns data into direction transforming efficiency into measurable decarbonisation momentum.

03

2

Consistency:
Embedding Best Practice at Scale

Many manufacturers begin with a single pilot site but lasting impact comes when results are replicated across networks. Standardising best practice in steam and thermal energy optimisation, condensate recovery and maintenance protocols ensures every facility benefits from proven efficiency strategies. Establishing cross-site frameworks and replicable roadmaps allows teams to share knowledge and scale improvements efficiently. By defining common Key Performance Indicators (KPIs), engineering standards and reporting structures, organisations can drive improvement without reinventing the process at each location.

For example, food and beverage producers implementing standardised steam-optimisation programmes have achieved average energy savings of 10–20 % across multiple plants within two years (Carbon Trust, Industrial Energy Efficiency Case Studies, 2023).

Consistency converts isolated efficiency gains into enterprise-wide performance improvement.

3

Collaboration:
Partnering for Long-Term Value

No organisation decarbonises alone.

Delivering change at scale requires collaboration across operations, sustainability, procurement and technology partners who understand both process efficiency and commercial realities. This is where Spirax Sarco's Optimise to Decarbonise approach supports industry leaders combining deep expertise in steam and thermal systems with data-driven insight and long-term partnership.

Together, we help organisations:

+ **Identify and prioritise high-impact decarbonisation projects across sites**
+ **Implement scalable, measurable solutions tailored to local conditions**
+ **Establish continuous monitoring and performance reporting to sustain savings over time**

When efficiency becomes embedded across multiple facilities, decarbonisation stops being a project. It becomes part of how the organisation operates. Collaboration turns efficiency from operational success into strategic value.

FROM LOCAL RESULTS TO GLOBAL PROGRESS

Scaling efficiency across sites transforms decarbonisation from a collection of local wins into a coordinated driver of competitive advantage. It delivers measurable CO_2 reductions, lower operational costs and a culture of continuous improvement that endures.

In a world where every tonne of CO_2 counts, thermal energy optimisation remains one of the few levers that can deliver immediate impact today while preparing businesses for the energy systems of tomorrow.

EFFICIENCY ISN'T JUST MOMENTUM; IT'S MEASURABLE PROGRESS AT SCALE.

THE ROLE OF PARTNERSHIP

FROM ENERGY SAVINGS TO SUSTAINABLE GROWTH

Delivering lasting decarbonisation impact requires more than technology, it demands partnership.

04

As industries move from pilot projects to enterprise-wide transformation, collaboration becomes the critical ingredient that connects engineering excellence with strategic sustainability outcomes.

At Spirax Sarco, our Optimise to Decarbonise approach is built on this principle:

COMBINING TECHNICAL EXPERTISE WITH LONG-TERM COLLABORATION TO HELP MANUFACTURERS ACHIEVE THEIR CARBON, COST AND COMPETITIVENESS GOALS SIMULTANEOUSLY.

CO-CREATING DECARBONISATION ROADMAPS

Every business has a unique journey to net zero shaped by its processes, products and energy profile. That's why our work begins with co-creating Decarbonisation Roadmaps tailored to each organisation's operational realities and corporate sustainability objectives. Through detailed site assessments and system modelling, we identify where thermal energy optimisation can deliver the highest return on investment from steam trap management and condensate recovery to heat recovery systems. Each roadmap quantifies CO_2 reduction potential, payback period and long-term efficiency gains, providing a clear business case for action. For example, across the food and beverage sector, Spirax Sarco partners have achieved 10–25% reductions in energy use and corresponding Scope 1 emission savings, often within 18 months of implementation.

04

BUILDING STRATEGIC ALIGNMENT ACROSS FUNCTIONS

Sustained decarbonisation doesn't happen in silos.

True progress occurs when engineering, operations and sustainability teams share a common vision, supported by a trusted technical partner.
Spirax Sarco works with key stakeholders from plant managers and energy engineers to sustainability directors to align technical improvements with broader ESG and business performance goals. This integrated approach ensures that every optimisation project delivers measurable outcomes across cost, carbon, compliance and competitiveness.

> **ENERGY EFFICIENCY IS THE BRIDGE BETWEEN OPERATIONAL PERFORMANCE AND SUSTAINABILITY IMPACT AND THAT BRIDGE IS BUILT THROUGH COLLABORATION.**

10-25%

REDUCTIONS IN SCOPE 1 EMISSIONS WITHIN 18 MONTHS OF IMPLEMENTATION

PROVING IMPACT AND SUSTAINING PROGRESS

Partnership doesn't end at implementation. It continues through measurement, reporting and refinement. Our dashboards and reporting tools provide clients with always on visibility into performance metrics, demonstrating tangible progress toward corporate net-zero targets.

Regular reviews, data validation and performance benchmarking help maintain momentum, ensuring efficiency gains are locked in and continually enhanced. In doing so, we help clients turn one-time energy savings into ongoing, reportable sustainability value. By connecting data, people and process, Spirax Sarco helps leading manufacturers transform energy optimisation into measurable business impact across sites, sectors and continents.

ENABLING PEER-TO-PEER LEARNING AND ADVOCACY

Decarbonisation is accelerating fastest where industries collaborate and share insight. Through executive roundtables, thought leadership programmes and the Decarbonisation Leaders Network, Spirax Sarco facilitates knowledge exchange between global manufacturers committed to sustainable growth.

These forums enable clients to showcase their progress, discuss barriers and inspire collective action reinforcing that industrial decarbonisation is not just a technical challenge but a shared responsibility.

FROM PARTNERSHIP TO PROGRESS

The path to industrial net zero isn't a straight line but with the right partnerships, it's a measurable one. By combining thermal energy expertise, data-driven insight and long-term collaboration, Spirax Sarco helps organisations move beyond incremental improvements toward transformational change.

Together, we're not just optimising systems, we're enabling sustainable industry.

PROOF IN ACTION

Progress toward industrial net zero is being written in real factories, every day.

05

Across the food, beverage sector, Spirax Sarco is partnering with global leaders to demonstrate how thermal energy optimisation translates directly into carbon reduction, cost savings and resilience.

FINDING THE RIGHT 'WHEY' FOR CHEESE PRODUCER

Our engineers work directly with customers to understand their operations, identify opportunities for improvement and develop practical solutions that create measurable value. By combining close customer relationships with deep application expertise, we help organisations improve performance, efficiency and sustainability.

"Walking the Plant" is one of the most important ways in which our direct sales engineers can add value to our customers by identifying potential problems and finding solutions. For Saputo, a bulk cheese and whey producer, a visit from direct sales engineer Travis Berry helped identify important efficiency and sustainability improvements, which have led to annual savings of around US$700,000.

At its dairy plant in California, Saputo has three clean-in-place kitchen areas each producing condensate from heat exchangers which was going to waste, losing valuable heat. Spirax Sarco designed a solution to recover and return the condensate to the steam generating boiler, improving efficiency and sustainability.

The new condensate recovery system has delivered quantified energy, water and CO_2 savings since its installation, as well as reducing safety risks and the amount of boiler chemicals needed to treat the fresh water.

3150 tons
OF $C0_2$ SAVED PER YEAR

$700K
ANNUAL SAVINGS

05

DIGITAL INSIGHTS AND PRE-EMPTIVE ACTION IMPROVE SUSTAINABILITY

Cotopaxi and Spirax Sarco worked together with Kraft Heinz, to design and install our connected energy and sustainability platform, STRATA, at its Shanghai facility.

The digital insights generated by the system, which examined how Kraft Heinz was managing its use of water, air, gas, energy and steam (WAGES) combined with Spirax Sarco's efficiency and sustainability solutions, quickly delivered value.

Through the installation of 23 utility meters the WAGES data was collected and sent to STRATA every minute, generating real time analysis. A number of issues were identified, including significant steam leakage detected during a factory 'shutdown' subsequently addressed by the Spirax Sarco team.

Through monitoring the water meters and using insights generated, the team also identified evaporation and heat loss to the atmosphere from the process cooling towers. To provide a more sustainable and efficient solution, we designed a new heat recovery system, including an industrial heat pump, to capture the heat that would have been lost and re-use it within the factory's production processes.

The way in which Cotopaxi technology and Spirax Sarco know-how have come together is helping Kraft Heinz achieve its Environmental Stewardship Goals, through greater efficiency in steam use, as well as reductions in carbon emissions.

>4,000 tonnes

EQUIVALENT STEAM SAVING POTENTIAL PER YEAR

FROM HIDDEN FAILURE TO IMMEDIATE ACTION

THE PROBLEM

Our customer, an international brewer, with more than 300 installed steam traps, was impacted by significant steam loss and reduced efficiency due to having limited visibility of real-time performance data.

"WITHOUT THE SOFTWARE WE WOULD NOT HAVE IDENTIFIED THE FAILURE FOR A VERY LONG TIME."

CUSTOMER ENERGY MANAGER

THE SOLUTION

Typically, a steam trap survey would be undertaken annually, meaning that any failures in the system could stay undetected for up to many full years. The STS EcoBolt Steam Trap Monitoring Service addresses this issue. As part of a trial, STS installed monitors on four steam traps within the main brewing process.

By connecting these monitors to our digital platform dashboard, the customer and our sales engineers were able to monitor performance, energy consumption and detect failures in their critical operations.

THE IMPACT

The results were immediate, with the dashboard identifying a steam trap having 'failed open'. Without the monitoring in place, the customer would have been unaware that they were losing money, which over the period of one year could have cost as much as £3,200 with 13.2 tonnes of CO_2 being emitted as a result of thermal energy being wasted because of the failed steam trap. With EcoBolt in place, the time from trap failure to replacement was just 23 days. A later survey identified around 15% of the customer's steam traps had failed, demonstrating the significant value potential from digital monitoring for our customers' economics, as well as for our planet.

05

INDUSTRY GROUP	WATER SAVINGS (M^3/YEAR)	CO_2 SAVINGS (TON / YEAR)	ENERGY SAVINGS (GJ / YEAR)
Chemicals	3,690,246	678,493	9,426,098
FOOD & BEVERAGE	**24,047,415**	**4,340,261**	**58,843,642**
Healthcare	7,111,659	1,337,359	17,976,478
Oil & Gas	3,552,955	628,236	8,843,117
Other	43,605,514	8,016,238	110,387,502
TOTAL	82,007,789	15,000,588	205,476,837

In Food & Beverage, steam is critical but it's also one of the biggest hidden cost and carbon drivers. By optimising steam and thermal systems, Spirax Sarco has helped Food & Beverage manufacturers save 24 million cubic metres of water, 4.3 million tonnes of CO_2, and nearly 59 million GJ of energy annually — almost one-third of our total sustainability impact across all industries.

That translates directly into lower fuel bills, reduced emissions, improved process reliability, and faster progress toward ESG goals.

FROM INSIGHT TO INDUSTRY IMPACT

These examples illustrate that thermal energy optimisation delivers tangible results in the here and now. By focusing on data, engineering excellence and collaboration, Spirax Sarco's partners are cutting thousands of tonnes of CO_2 each year while improving productivity and cost control.

THIS IS DECARBONISATION IN ACTION. WHERE EFFICIENCY MEETS IMPACT.

LOOKING AHEAD

THE FUTURE OF INDUSTRIAL HEAT DECARBONISATION

The road to industrial net zero is not defined by a single technology but by a sequence of intelligent decisions starting with efficiency and building toward low-carbon transformation.

06

The next decade will see unprecedented change in how manufacturers generate and manage heat. Hybrid thermal systems, electrification of process heat and renewable fuels will all play a role in reshaping industrial energy landscapes. But each of these solutions relies on one critical foundation: efficient, optimised thermal systems capable of adapting to new energy inputs.

Without efficiency first, electrification and fuel switching simply move inefficiency from one energy source to another. That's why the most successful industrial decarbonisation strategies will blend efficiency, innovation and collaboration combining near-term emission reductions with long-term system transformation.

EFFICIENCY AS THE FOUNDATION FOR LOW-CARBON HEAT

As electrification and renewable heat technologies evolve, manufacturers who have already optimised their thermal systems will move faster, at lower cost and with greater confidence. Optimised systems:

- **Require less capital to convert to renewable or electric heat**
  By reducing overall energy demand and improving system efficiency, less capacity is needed when transitioning to low-carbon heat sources or renewable steam generation. This means smaller equipment, lower infrastructure costs and faster payback when electrification or renewable integration becomes viable.
- **Deliver lower operational costs, even as energy prices fluctuate**
  Efficient thermal systems minimise fuel waste and recover more usable heat from existing processes, reducing exposure to volatile gas and electricity prices. In an environment where energy markets remain unpredictable, optimised systems provide a stable, predictable cost base.
- **Provide verifiable data to demonstrate progress against corporate climate targets**
  Connected monitoring and measurement tools generate transparent, auditable performance data. This allows organisations to quantify Scope 1 emission reductions, validate ROI and report verified progress against sustainability frameworks such as the Science Based Targets initiative (SBTi) or CDP disclosures.

In this way, optimisation becomes both the proof and the platform for progress, strengthening operational resilience, accelerating decarbonisation and enabling every step that follows on the journey to net zero.

06

THE ROLE OF DIGITALISATION AND DATA

Digital transformation will further accelerate this shift.

Smart sensors, connected steam systems and actionable analytics now allow always on tracking and trending of energy flows and carbon performance across global operations. This visibility enables manufacturers to:

Quantify carbon savings site by site
Real-time performance data provides clear insight into how each system and site contributes to overall decarbonisation targets. This makes it possible to measure verified Scope 1 reductions, benchmark performance and prioritise investment where the largest carbon and cost savings can be achieved.

Predict performance issues before they cause losses
With connected sensors and analytics, manufacturers can move from reactive maintenance fixing issues after they occur to condition-based performance management, where decisions are driven by always-on operational data. By continuously monitoring key parameters such as temperature, pressure and asset performance, these systems detect early signs of wear, leakage or inefficiency long before they cause disruption. This shift is critical for three reasons.

First, it prevents unplanned downtime, ensuring production continuity in energy-intensive processes where even brief outages can be costly. **Second**, it reduces energy and steam losses, directly lowering fuel use and Scope 1 emissions making system management an active contributor to decarbonisation. **Third**, it extends equipment life and reliability, reducing the need for premature replacements and avoiding the embodied carbon associated with new assets.

In essence, condition-based monitoring transforms maintenance from a reactive cost centre into a strategic tool for energy efficiency, reliability and carbon reduction. By pairing digital visibility with proactive action, manufacturers can protect performance today while building a foundation for more resilient, sustainable operations tomorrow.

Drive continuous optimisation through insight and performance analytics
As data accumulates across systems and sites, analytics can identify emerging efficiency patterns and performance trends. Over time, this creates a proactive alert network that detects deviations, highlights optimisation opportunities and supports smarter energy management across operations — all calibrated to each facility's specific systems, thresholds and operating conditions. By combining digital insight with deep engineering expertise, organisations can achieve a new level of precision and control in how they manage energy, reduce emissions and sustain long-term decarbonisation progress.

COLLABORATING FOR A SUSTAINABLE INDUSTRIAL FUTURE

No single organisation can decarbonise industry alone.

The challenge is too complex and the opportunity too great for isolated action. That's why the future of industrial heat will be built through partnerships between manufacturers, strategic thermal energy partners like Spirax Sarco and policymakers working toward a shared vision of sustainable industry.

At Spirax Sarco, we believe that collaboration is the catalyst for progress. Through our approach, we continue to work alongside global manufacturers to help them reduce emissions, increase efficiency and prepare for a low-carbon future.

CONCLUSION

FROM EFFICIENCY TO ENDURING IMPACT

The transition to net zero is not a race to the finish line. It's a journey of constant optimisation, innovation and partnership.

Industrial heat may once have been seen as a hidden challenge but today it stands as one of the greatest opportunities for meaningful climate action. By focusing on efficiency first, industries can accelerate decarbonisation, strengthen resilience and unlock sustainable growth for decades to come.

The future of industrial decarbonisation begins with optimising what we already have and building from there.

OPTIMISE TO DECARBONISE

Empowering global industry to cut carbon, reduce cost and build a sustainable energy future.

LEARN MORE ABOUT OUR APPROACH

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Spirax Sarco is a global leader in steam and thermal energy management, helping manufacturers around the world reduce energy use, cut carbon emissions and accelerate their path to net zero through intelligent, efficient and sustainable thermal solutions.

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