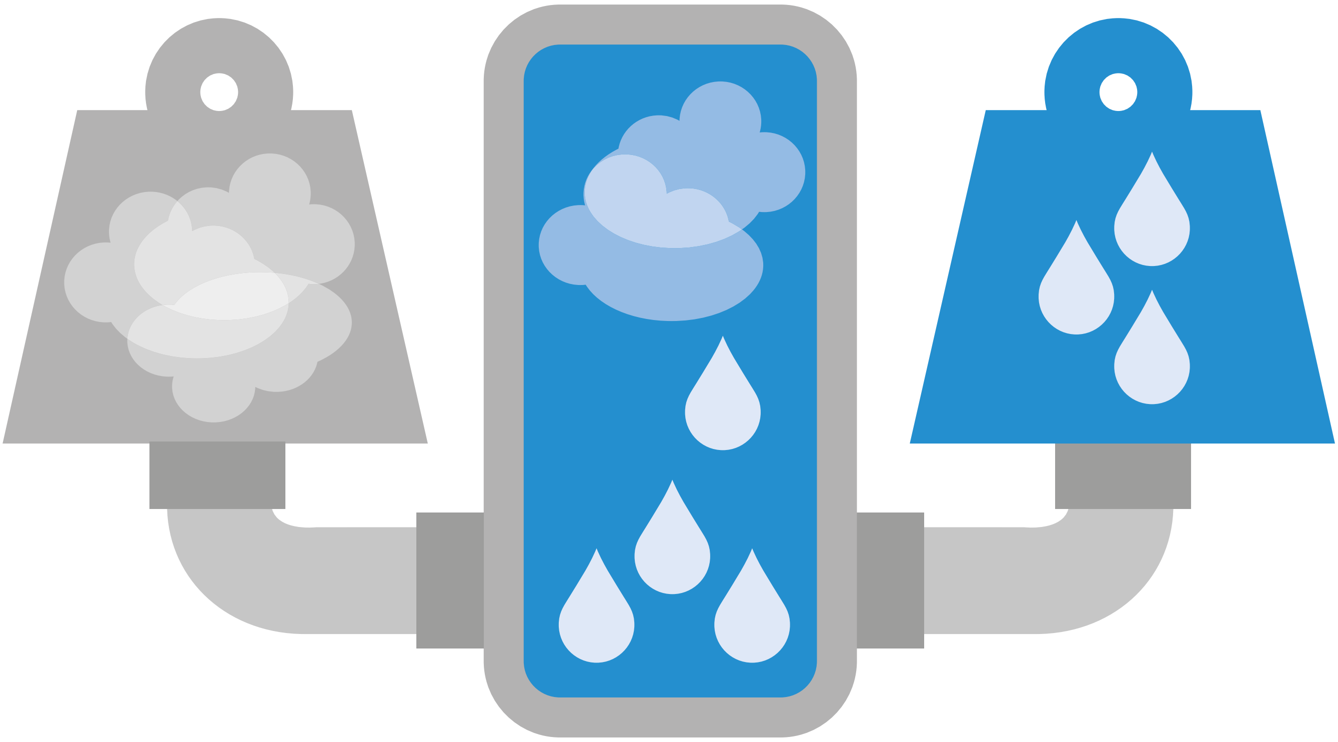


White Paper

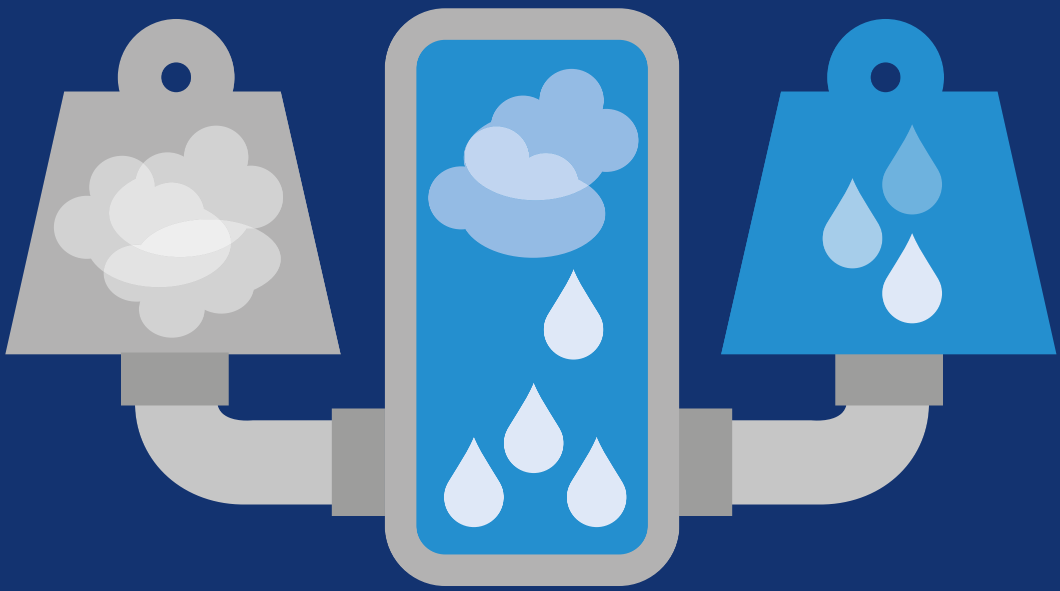
# The unsung hero of boilerhouse efficiency

How condensate recovery can be a real game-changer in energy and facilities management

First for Steam Solutions

EXPERTISE | SOLUTIONS | SUSTAINABILITY

spirax sarco



*First for Steam Solutions*

EXPERTISE | SOLUTIONS | SUSTAINABILITY

# Introduction: What's this guide all about?

It's no longer enough to strike a good deal on energy supplies, or achieve high levels of productivity: now we are expected to do both, and at the same time comply with a complex web of regulation. Striking the right balance between these, of course, can make that crucial, tangible contribution to your company's revenue flow. Industry is changing, technologies are shifting, and with it the way that many sectors and organisations function. In an increasingly complicated economic and industrial landscape, those of us working in energy and facilities management are facing new and ever-increasing challenges. Given that many of us are dealing with ageing equipment, at a time when economic uncertainties can make it difficult to justify investment in anything new, these challenges are very significant and can be tough for us to deal with.

Wouldn't it be helpful therefore, to find a way to extend the life cycle of equipment, while simultaneously making our businesses more productive, driving down costs, complying with regulatory targets and improving our companies' environmental and public profile?

The good news is that truly efficient condensate recovery can help us to achieve all of these things, and at a far lower cost than we would imagine. In this white paper, we will find out how and why good condensate management can make a real difference to your steam system operations, and to your company's financial and managerial results. Ready?

**Chris Coleman**
**Boilerhouse National Specialist**

"LET'S GET STARTED!"

# Summary of reasons for condensate recovery:

- Water charges are reduced
- Effluent charges and possible cooling costs are reduced
- Fuel costs are reduced
- More steam can be produced from the boiler
- Boiler blowdown is reduced and less energy is lost from the boiler
- Chemical treatment of raw make-up water is reduced.

> TO PUT IT REALLY SIMPLY, CONDENSATE IS THE HOT WATER THAT FORMS WHEN STEAM PASSES FROM THE VAPOUR TO A LIQUID STATE.

# What is condensate and why does it need to be managed?

When water first enters the boiler and is transformed into steam, this transformation is achieved by the action of the latent heat. The latent heat is the form of energy that changes the water from a liquid state to a gaseous state. The feedwater absorbs the latent heat, which turns it into steam. In many industrial steam applications, the steam moves through the system, where it transfers a proportion of its latent heat into whatever it is heating. In releasing that latent heat it then turns back into a liquid – or as we know it, condensate.

As we all know, condensate is hot, making it a valuable resource in terms of energy. Any loss of the latent heat within the steam system does not cause a temperature drop. So, when the steam turns back to the liquid state (or condensate) we will not see a temperature drop, because the sensible heat remains.

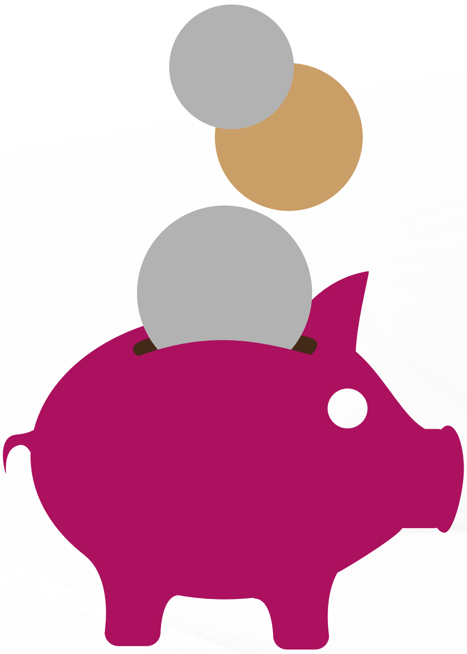
The condensate generated by the steam heating system will normally have about 25% of the energy that the steam had, and contains virtually no dissolved solids. Recovering and re-using as much of the condensate as possible can have huge advantages for you in terms of financial savings.

> IF THE CONDENSATE IS MERELY DISCHARGED FROM THE SYSTEM AND DISPOSED OF, THAT VALUABLE ENERGY RESOURCE IS THROWN AWAY WITH IT AND THAT IS AN ENTIRELY, EASILY AVOIDABLE WASTE THAT FEW OF US CAN AFFORD.

# Where does condensate go?

If condensate is drained away rather than reused, it can trigger water and effluent management costs which can be significant for many of us. Draining condensate can make it harder for us to comply with the regulatory standards around environmental effluent. In many countries, including the UK, condensate often has to be cooled before it can be drained which again may cost us extra. Put simply, we're throwing money away.

Since water and energy, both alone and in combination, are valuable resources, it simply doesn't make financial or managerial sense to tip them down the drain. So, how else can we put that energy and water to good use? This is what you do…



# The uses of condensate

" BETTER STILL, GOOD CONDENSATE MANAGEMENT IS COST-EFFECTIVE AND GENERALLY STRAIGHT-FORWARD TO ACHIEVE, AS WE SHALL SEE. "

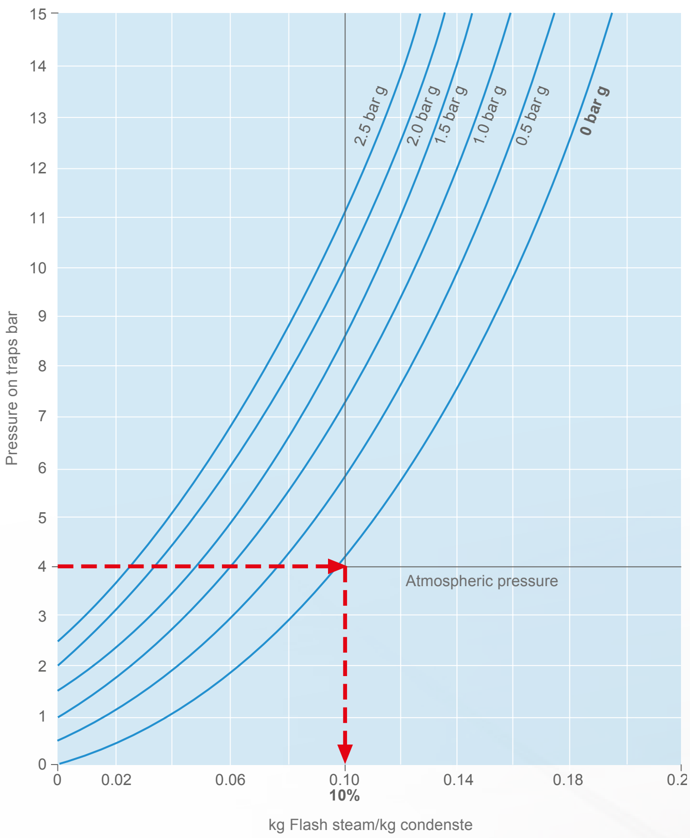
## Boiler feedwater

If condensate is not used as feedwater, the boiler must be continually topped up with cold water, which is costly in terms of both water and energy. Cold feedwater must be heated. In contrast, condensate is already hot, so not only does it reduce the need for (and cost of) fresh water and treatment chemicals, it also requires much less energy than cold make-up water does to be ready for use. Indeed, re-using condensate in this way can reduce boiler fuel costs by 10–20%.

Or, to look at things differently, every 6°C boost in the temperature of the feedwater knocks 1% off a typical boiler's energy usage. Reducing boiler fuel demand has other benefits, too. It can bring down emissions of carbon dioxide, nitrogen oxides and sulphur oxides, which makes the entire process more environmentally friendly.

spirax sarco

> ON TOP OF THE COST SAVINGS, YOU CAN PACK QUITE A PUNCH IN ENVIRONMENTAL BENEFITS TOO.

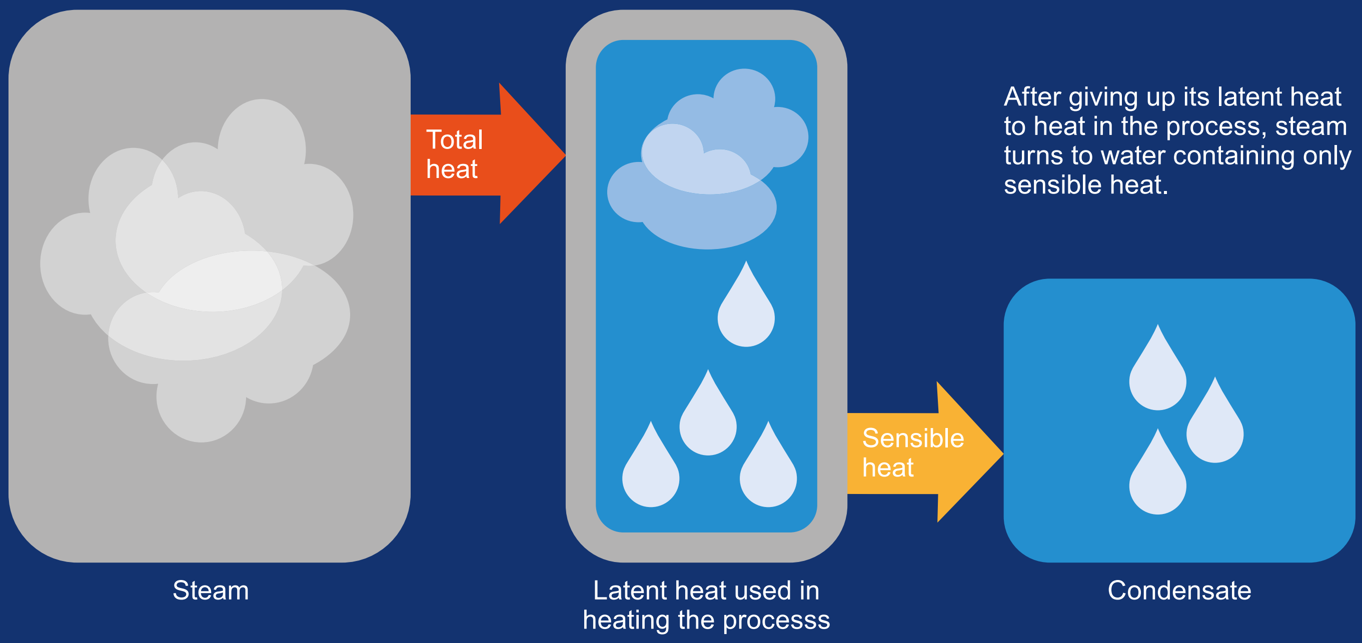



## Flash steam recovery

Flash steam can be harvested and re-used. This is formed when high pressure condensate is exposed to a large pressure drop, often created during the blowdown process. A flash vessel is just one method that can be used to recover energy by separating flash steam from condensate. As condensate enters the flash vessel, flash steam is produced and can be piped from the top of the vessel to the feedtank through the deaerator.

We can fit float traps to the outlet of the flash vessel where residual blowdown water will be drained. The water will still be hot at this point and is allowed to pass into the plated heat exchanger where it gives up its heat to the circulating cold make-up water. In other words, if we use the hot water from the flash vessel, heat energy is recovered.

The use of both a flash vessel and plated heat exchanger pack will allow you to recover up to 80% of the energy from the rejected Total Dissolved Solids (TDS) water, which can also result in fuel savings, a reduction in carbon dioxide emissions, and the elimination of unsightly plumes of steam. So, on top of the cost savings, you can pack quite a punch in environmental benefits too.




# The costs and benefits of recovering condensate

The higher the temperature of recovered condensate, the more it can contribute to the efficiency of your operation, so it's important to remove condensate promptly (before it can lose much sensible heat) and in as great a volume as possible. A good, efficient system should generate a recovery rate of around 80% - a good rate of return, in anybody's terms.

Of course, your situation is unique, and only a technical and financial assessment can determine the payback profile of your particular condensate recovery system.

> "RECOVER UP TO 80% OF THE ENERGY REJECTED FROM TDS WATER."

- ✔ Fuel savings
- ✔ Reduced $CO^2$
- ✔ Eliminate unsightly plumes of steam

# Worked example:

**The following worked example shows the potential savings of condensate recovery at a real UK site:**

Steam supply: Two 454 kg/h boilers delivering up to 908 kg/h of steam
Condensate recovery potential: 400 kg/h (a conservative estimate)

### Fuel savings:

The rate of energy saved by re-using condensate at

95°C, replacing cold feedwater at 10°C (based on a specific heat capacity of water of 4.186 kJ/kg) = (400 x 4.186 x (95-10))/3600(seconds) = 39.53 kW

Assuming 75% boiler efficiency, generating 39.53 kW

would require gas equivalent to 52.71 kW.

Hours of operation = 24 hours x 5.5 days/week x 50

weeks = 6,600 hours

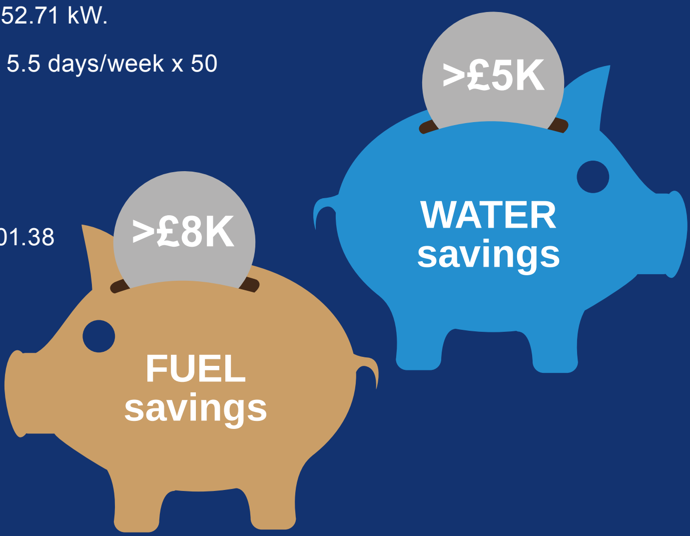
Gas price = 2.3 p/kWh

Cost of gas saved per year =
(52.71 x 6600 x 2.3)/100 = £8,001.38

### Water savings:

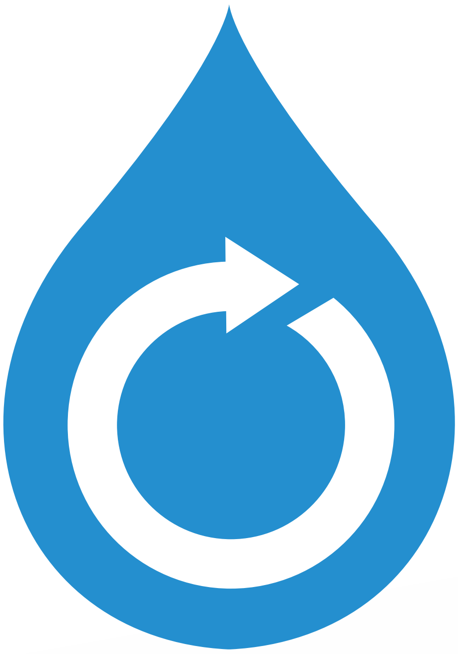
Water and effluent costs = £2.00 per m3

Annual water cost savings =
(400 x 6600)/1000 = 2640 kg x £2.00 =
£5,280.00




TOTAL COST SAVINGS: **£13,281.38** PER YEAR
(Not including boiler blowdown and additional savings in water treatment chemicals.)

# What about contamination?



If we reuse condensate, how many of us worry about putting contaminates directly into the boiler? This is a genuine concern. Condensate can pick up contaminates, and contaminated feedwater can cause problems such as corrosion and carryover.

**There are two very effective ways you can overcome this challenge.**

1. The first is to fit conductivity or turbidity meters to an existing condensate return system to detect contamination. Whenever it is detected, the contaminated condensate is automatically dumped before it reaches the boiler. This solution can be fine-tuned according to the nature of the operation.

2. Another approach is to recycle only the heat energy from contaminated condensate. This is done using heat exchangers, which ensure the heat is captured before the contaminated liquid is disposed of.

> “IF WE REUSE CONDENSATE, HOW MANY OF US WORRY ABOUT PUTTING CONTAMINATES DIRECTLY INTO THE BOILER?”

# How is condensate recovered?

So, we've talked about the benefits of condensate, but how is it recovered? Here's a simple step-by-step process.

**Step 1**

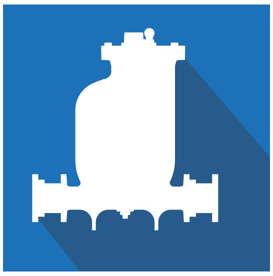
## Steam traps are used to remove condensate from the steam system

Steam traps are perhaps the most important part of this process. Their job is to remove condensate and incondensable gases from the system at the appropriate time while leaving in place the steam that is central to the heating activity. Condensate and incondensable gases must be removed efficiently, since they can cause corrosion, poor heat transfer and other problems if they are left in the system. A good first step in any condensation recovery plan is a steam trap survey which will identify areas for improvement/upgrade, and estimate potential financial gains.

### *Steam trap surveys*

*A steam trap survey will help to keep a system running smoothly and will almost certainly reveal impressive savings through reduced fuel consumption, fuel emissions, water, and effluent charges. For example, an analysis of 50 Spirax Sarco steam trap surveys revealed potential annual energy savings of £28,400 per survey on average. The average payback time on each survey, including the cost of replacement products and their installation, is around two months when all upgrade work is completed.*

**Step 2**



## Pumps return condensate to the boiler feedtank

Ideally, condensate will run away from steam traps via gravity but where this is impossible the condensate must be lifted to a higher level. Sometimes, pumps are needed to achieve this. Depending on your unique operating environment, there are several types used, often in combination. These include: electrical condensate pumps, mechanical condensate pumps, and automatic pump traps.

**Step 3**

## Feedtank heating and deaeration

In the feedtank, condensate is mixed with other feedwater to heat it. The most efficient way to heat and deaerate is using a deaerator head, which mixes returned condensate, flash steam and cold makeup water as they are fed into the feedwater tank.

While this outlines the basic process, there are other points to bear in mind.

**Step 4**

## Flash steam can also be recovered

Flash steam is released from hot condensate when the pressure of that condensate drops, for example when it is being discharged from the main steam system. Using a flash steam system is one of the most energy efficient ways of extracting heat from condensate before it goes back into the feedwater tank.

**Step 5**

## Pressurised low-loss condensate recovery can boost benefits

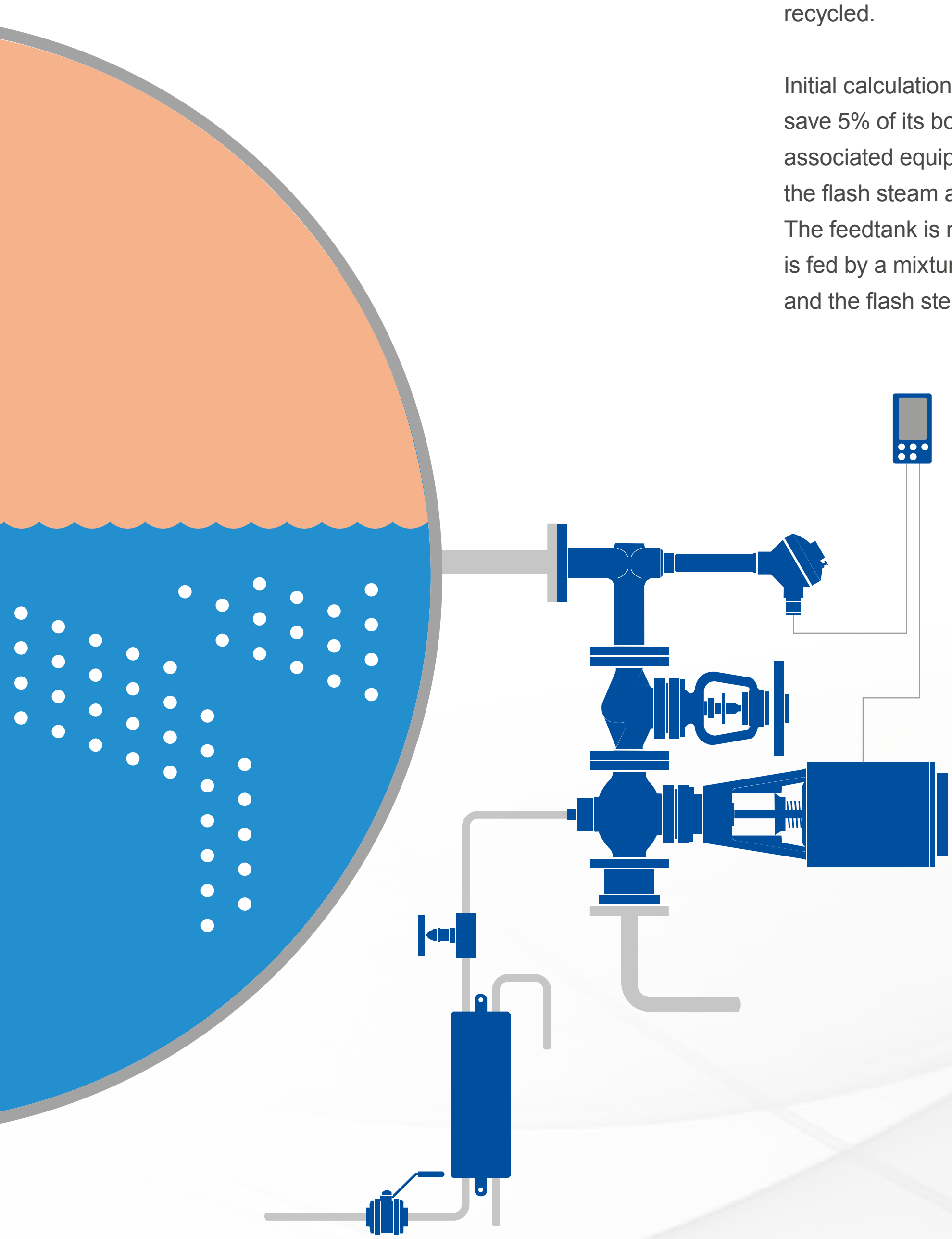
I know from extensive experience in the field that huge savings in annual fuel and water costs, ranging from £17,000 for a small system, to £160,000 for larger systems, are possible, along with significant savings in carbon dioxide emissions. Payback times for such systems have been very short, sometimes less than a year.

# Case Study

## Food production

A British bakery has knocked almost 6.5% off the combined cost of energy and water to its boiler, thanks to the installation of a flash steam recovery system. The system, commissioned by Spirax Sarco, recovers the flash steam generated by TDS blowdown from the main boiler at the company's site in Bicester. Previously, this flash steam was being discharged, rather than recycled.

Initial calculations predicted that the British bakery would save 5% of its boiler costs by installing a new flash vessel and associated equipment that would enable the company to recover the flash steam and return it to the boiler feedtank.
The feedtank is maintained at 85°C by injecting live steam, and is fed by a mixture of returning condensate, cold make-up water and the flash steam recovered from the TDS blowdown water.



# Conclusion: Unlock the next level of steam efficiency

All of us, whether you're an energy manager, plant supervisor or maintenance manager at any level, are now facing more challenges than ever. Chief among these are the needs to manage costs, maximise productivity, extend equipment lifecycles without unacceptable loss of equipment performance, and generally contribute to the revenue flow. On top of this, technologies are shifting and there's an ever-increasing body of regulation to comply with, covering areas from health and safety to environmental protection.

These challenges aren't going to go away anytime soon. So, it makes sense for all of us to take every possible step to save money and make sure your plant or energy centre is adding real value to your business. It's only by doing this that businesses can become cleaner, more efficient, and more profitable. Condensate recovery is one process that absolutely lends itself to this approach, and will generate substantial savings and operational advantages to all of us who use steam systems.

Of course, there has to be a degree of strategy and logic involved, but that's why we've built up the expertise to help you determine what your specific system, set up and performance will be. It's a creative exercise, so keep that in mind if you get bogged down in technicalities. This might seem like a huge undertaking, especially when resources are limited, but as we've outlined, there are plenty of economical ways to not only get started with condensate recovery, but to continue the momentum in the years to come.

**Chris Coleman**
**National Boilerhouse Specialist**

spiraxsarco.com

## Operating Companies

### EMEA

Belgium
Czech Republic
Denmark
Egypt
Finland
* **France**
Germany
* **Italy**
East Africa
Middle East
Norway
Netherlands
Poland
Portugal
Russia
South Africa
Spain
Sweden
Switzerland
Turkey
* **UK**

### Americas

* **Argentina**
* **Brazil**
Canada
Chile
Colombia
* **Mexico**
Peru
* **USA**

### Asia Pacific

Australia
* **China**
Hong Kong
* **India**
Indonesia
Japan
Malaysia
New Zealand
Philippines
Singapore
South Korea
Taiwan
Thailand
Vietnam

* **Manufacturing sites**

## Sales Offices

### EMEA

Austria
Greece
Hungary
Ivory Coast
Jordan
Kazakhstan
Romania
Slovak Republic
Ukraine

### Americas

Costa Rica
Panama

### Asia Pacific

Cambodia
Myanmar

## Distributors

### EMEA

Algeria
Bahrain
Bulgaria
Cameroon
Croatia
Cyprus
Ethiopia
Estonia
Ghana
Iceland
Israel
Kuwait
Latvia
Lebanon
Lithuania
Madagascar
Malawi
Malta
Mauritius
Morocco
Namibia
Nigeria
Oman
Qatar
Saudi Arabia
Slovenia
Sudan

### Americas

Bolivia
Dominican Republic
Ecuador
El Salvador
Guatemala
Honduras
Jamaica
Netherland Antilles
Nicaragua
Paraguay
Trinidad and Tobago
Uruguay

### Asia Pacific

Bangladesh
Fiji
Pakistan

Spirax-Sarco Limited, Charlton House, Cheltenham,
Gloucestershire, GL53 8ER, UK
T +44 (0)1242 521361
F +44 (0)1242 573342
E uk.enquiries@uk.spiraxsarco.com

Spirax-Sarco ensures that it is fully compliant with all United Nations, European Union and U.S. sanctions in relation to the supply of its products and services.
In relation to the manufacture of our products, we ensure we do not use conflict minerals.

© Copyright 2017 Spirax Sarco is a registered trademark of Spirax-Sarco Limited.
Some products, services or solutions may not be available in certain markets.