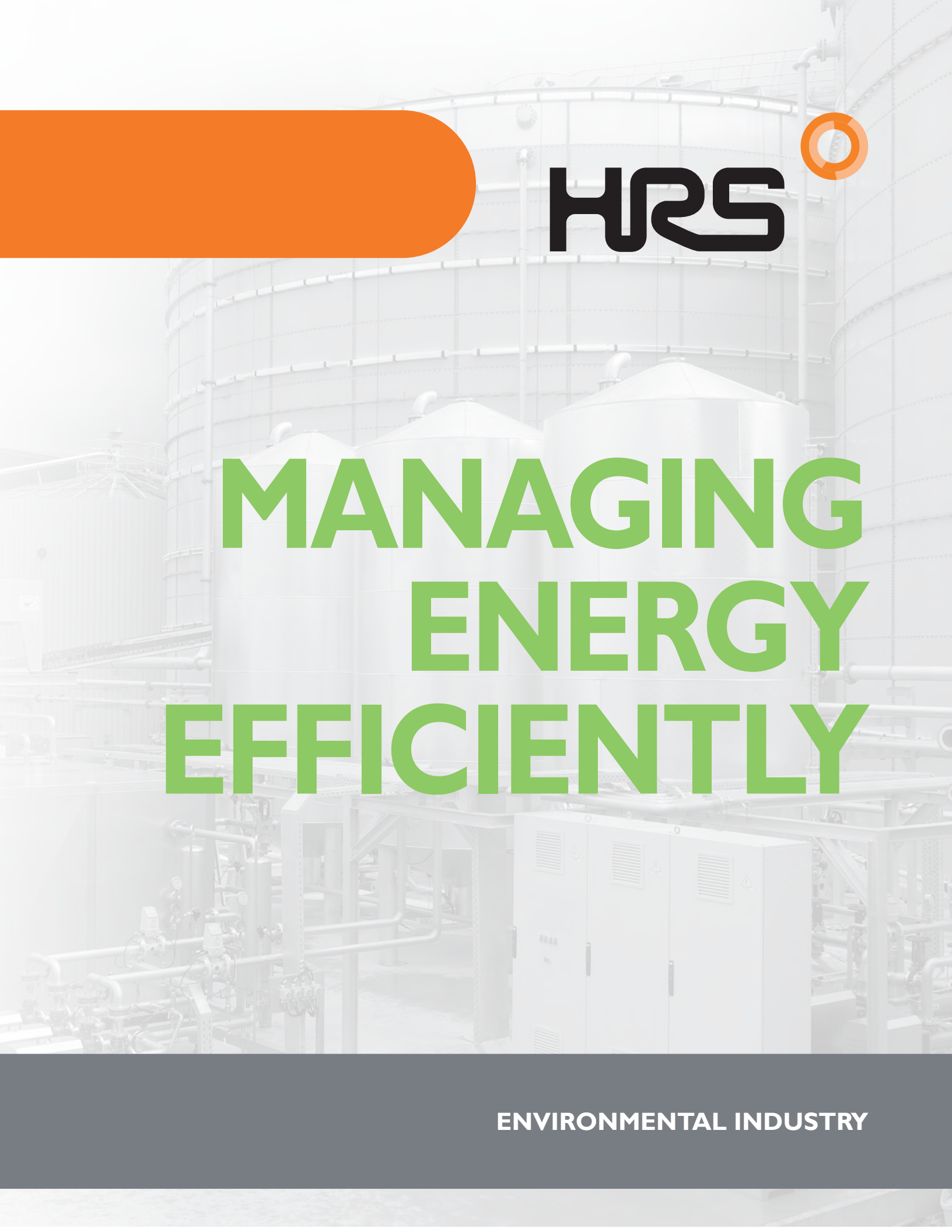


MANAGING ENERGY EFFICIENTLY

ENVIRONMENTAL INDUSTRY

We have a duty to protect the environment and human health from the effects of waste management and disposal.

Operators are growing increasingly aware of the environmental impact of their activities. Strict environmental regulations demand companies to source means of reducing the generation of residues and work towards converting waste streams into energy or added value products. As a result, **companies are looking to adopt a sustainable and cost effective approach to the management of such waste,** in order to comply with regulations, **while maintaining a strategic position ahead of their competitors.**

HRS Heat Exchangers operates at the forefront of thermal technology, offering innovative and effective heat transfer products worldwide **with a focus on managing energy efficiently.**

With approaching 40 years' experience **specializing in the design and manufacture of an extensive range of turnkey systems and components incorporating our corrugated tube and scraped surface heat exchangers technology,** in compliance with the Global Standards.

HRS has a global network of offices: UK, Spain, USA, Malaysia, Australia, India, Russia and Mexico; with manufacturing plants in the UK, India and Spain.

Our patented and proven heat transfer technologies, combined with our knowledge make it possible to offer best in class solutions for the following **environmental applications:**

- **Wastewater**
- **Sludge**
- **Manures**
- **Digestate**

- **Waste streams from:**
  - **Agriculture**
  - **Food**
  - **Pharmaceutical**
  - **Other industries**

PRODUCT RANGE

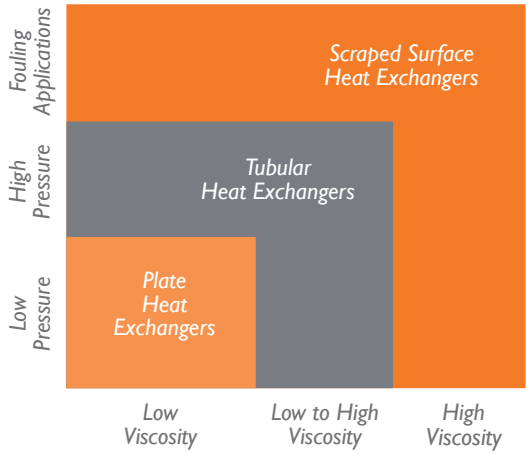
- **Heat Exchangers:**
  - Corrugated tube
  - Scraped surface
- **Thermal Processing Systems:**
  - Evaporation/Concentration of waste streams
  - Pasteurization of sludge

- **Solutions for Renewable Energy Applications:**
  - **Biogas:**
    Digestate Concentration (DCS)
    Pasteurization (DPS)
  - **Biogas Dehumidification System**
  - **Bioethanol**
  - **Biodiesel**

CORRUGATED TUBE HEAT EXCHANGERS

High level of efficiency for the environmental industry

Using HRS' corrugated tube technology, both **heat transfer and efficiency are increased** over standard smooth and dimple tube heat exchangers. In addition, potential product **fouling is minimized.** This makes it possible for HRS to provide **more compact and economical** heat exchanger solutions.



AS Series **Viscous Effluents**

A heat exchanger with three or four concentric tubes where the product flows through an annular space heated or cooled from the outside and inside. Very efficient for viscous fluids that are difficult to treat in other geometries.

DTI Series **Sludge/Digestate**

A tube in tube heat exchanger for processing sludge with large particles. The large diameter of the inner tube allows sludge to be processed without blockages. Promotes high heat transfer and easy to clean. A true counterpart for digester heating and sludge heat treatment.

DTR Series **Sludge/Digestate**

Based on the DTI Series, but with an adapted design for direct energy recovery (product vs product) for sludge with low viscosity. The inner tube is removable making it possible to inspect both product and service side.

K Series **Wastewater**

A multitube heat exchanger for low viscosity fluids and small particles. Ideal for energy recovery applications with wastewater. The corrugated inner tubes achieve high heat transfer, whilst providing a good resistance to fouling with ease of cleaning.

G Series **Gases**

Based on the K Series, this heat exchanger has a special design for working with gases.
The larger inner tubes offer more economic designs with a reduced pressure drop on the gas side.
Ideal for heat recovery from exhaust/flue gases.

SCRAPED SURFACE HEAT EXCHANGERS

Environmental processing with reduced downtime

Our scraped surface heat exchangers are self-cleaning, keeping heat transfer high at all times.

For difficult heat transfer applications, with high viscosities and where fouling can become a problem, **the preferred option is a scraped surface heat exchanger.** Scraped surface heat exchangers keep heat transfer high and the heat transfer surface is constantly cleaned.

HRS offers two technologies for scraped surface heat transfer with patented solutions designed for specific needs: HRS Unicus Series which reciprocates and HRS R Series which rotates.

HRS Unicus Series: The solution for effluent evaporation and applications with fouling risk

The HRS Unicus Series is a multitube heat exchanger, each inner tube has a scraper bar that moves back and forth in the direction of the tube's axis.

The heat transfer surface is constantly scraped and heat transfer remains high. Unicus models are available with areas up to 1,938 ft^2.

The HRS Unicus is the **ideal solution for applications such as effluent evaporation, where fouling or low heat transfer is a problem.**

HRS R Series

The HRS R Series is a compact scraped surface heat exchanger **designed for extreme viscosities and applications with limited space for installation**.

Each inner tube contains a scraping axis with helical blade that spins at high velocity. The high velocity keeps heat transfer very high and the helical blade moves the product forward, reducing pressure drop. When run in reverse product from the unit is recovered. Fouling is eliminated constantly, assuring a clean heat transfer area.

The HRS R Series can be used in **environmental and industrial applications.**

THERMAL PROCESSING SYSTEMS

Thermal processing systems for the environmental industry

Evaporation **is an efficient way of reducing the volume of effluents**. Our evaporation systems raise effluents to its boiling point; water is evaporated and condensed, thus obtaining a concentrated end product and water. **Forced recirculation**: a pump sends the product through the evaporator at high velocity. This process ensures heat transfer remains high and the negative effects of fouling are limited.

Where possible we aim to integrate our evaporation systems with waste heat sources to achieve an effective sustainable process.

HRS applies two heat transfer technologies within its evaporation systems:

3 effect DCS installed at Willen Biogas

Corrugated Tube Evaporation Systems

Using the HRS K Series as an evaporator module for the evaporation of low viscosity effluents with reduced particle size. **High heat transfer and good resistance against fouling.**

Applications: Wastewater, brines and effluents with organic solids in low concentration and effluents with low to medium viscosities.

2 effect DCS installed at SSE Barkip

Scraped Surface Evaporation Systems

Using the HRS **Unicus Series as an evaporator module for high fouling fluids with elevated viscosities**. When concentrating to a high dry solid percentage the risk of fouling and high viscosity (low heat transfer) become apparent. For these applications, the **Unicus is ideal due to its self-cleaning scraper action.**

Applications: Effluents with high fouling risk and organic solids with high dry matter concentration.

SOLUTIONS FOR RENEWABLE ENERGY APPLICATIONS

BIOGAS

Digestate Management

HRS offers pasteurization and concentration technology for the efficient management of digestate:

- **Digestate Pasteurization System (DPS):**
  Continuous three tank pasteurization of digestate with minimum energy investment.
- **Digestate Concentration System (DCS):**
  A system that can reduce the volume of digestate to 20%, or less, of its original volume.

HRS 3 Tank Digestate Pasteurization System (DPS) with heat regeneration

Solutions are tailored for each biogas plant. **The DPS or DCS can be individually selected or combined,** depending on several factors such as: suitable thermal energy, digestate use, waste volume, etc.

Our digestate management solutions offer the following advantages:

- Digestate is efficiently pasteurized to ensure it can be used safely for fertilization.
- Digestate volume is significantly reduced, lowering the cost of transporting digestate off-site.
- Waste heat sources, such as heat from the CHP installation can be used as the energy source for both DPS and DCS processes.
- DPS and DCS (or a combination of both) can convert digestate from a stream of waste to a value added product.

Digester Heating

Our DTI heat exchangers offer reliable solutions and advantages for heating digesters:

- High heat transfer
- Long running times
- No product blockage
- Easy to clean

HRS DTI Series for Digester Heating

CHP Exhaust Gas Heat Recovery

The HRS G Series is an ideal heat exchanger for cooling CHP exhaust gas. The corrugated tubes can work with smaller heat transfer areas than traditional smooth tube heat exchangers. Our G Series units can be integrated and used to deliver thermal energy from the CHP units to our DPS and DCS systems.

Exhaust Gas Cooler

BIOGAS DEHUMIDIFICATION SYSTEMS

The HRS BDS Series is an efficient solution to cool and dehumidify biogas for combustion with two standard options. The system condenses up to 90% of the water contained in the gas, which is continuously separated before the lean biogas is ready for use. This is a necessary process for all bio-energy plants that use biogas as fuel in CHP engines.

A heat recovery step can be included as a standard option thus reducing energy costs up to 20%.

The BDS comes complete with controls in a packaged 'plug and play' skid.

BIOETHANOL

The corrugated tube HRS K Series and HRS Unicus Scraped Surface Series have proven their success for bioethanol applications:

- Heating/cooling and condensation (HRS K Series)
- Energy recovery (HRS K Series)
- Corn oil extraction (HRS Unicus Series)

HRS Unicus installed in a Corn Oil extraction application where there is a high risk of fouling

HRS K Series Methanol Condenser

BIODIESEL

Thanks to its corrugated tubes promoting higher heat transfer, the HRS K Series works very efficiently for biodiesel applications:

- Heating/cooling of oils and biodiesel
- Direct heat recovery (product vs product)
- Methanol condensing

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