



**eSynergy**  
Recycling

## **EXPERTS IN RECYCLING**

*Using technologies that safely  
preserve our environment*

**End-of-Life Fridge Recycling  
Domestic**



# Domestic End-of-Life Fridge Recycling

**AS AN INDUSTRY LEADER, ESYNERGY OFFERS A BATRRT COMPLIANT TREATMENT PROCESS AND A COMPETITIVE PRICING STRUCTURE.**

## **Regulation of Fridge Recycling**

The Waste Electrical and Electronic Equipment (WEEE) Regulations require WEEE to be recycled to prescribed recovery targets to avoid landfilling of precious metals and other resources. This required various types of crushing, milling etc. of WEEE to liberate these fractions. During the process, blowing agents used to expand the insulation foam in refrigeration equipment can potentially be released into the atmosphere.

## **CFCs**

In the stratosphere, the CFC molecules released from refrigeration equipment during disposal break down by the action of solar ultraviolet radiation and release their constituent chlorine atoms. Once released, chlorine can go on to essentially steal, by catalytic reaction, an oxygen

atom from an ozone molecule (O<sub>3</sub>), thus removing it by decomposition. The Chlorine Monoxide molecule which is formed can then go on to shed this oxygen atom, reforming the chlorine atom which can then go on to repeat the process.

Stratospheric ozone shields living organisms on Earth from the harmful effects of the Sun's ultraviolet radiation. Even a relatively small decrease in the stratospheric ozone concentration can result in an increased incidence of skin cancer and genetic damage in many organisms. CFCs have a lifetime in the atmosphere of about 20 to 100 years, and consequently one free chlorine atom from a CFC molecule can do a lot of damage, destroying ozone molecules for decades.



**FULLY BATRRT AND IED  
COMPLIANT RECYCLING PROCESSES**

## HFCs

HFCs do not contain chlorine, therefore pose no risk as catalysts for ozone decomposition. However, once released into the atmosphere they are extremely effective at insulating the Earth from the loss of infrared radiation, leading to global warming, which requires no further explanation.

The Fluorinated Greenhouse Gases Regulations 2009 implement the EU F Gas Regulation and its supplementary Commission Regulations in Great Britain (Northern Ireland has its own regulations). The Environmental Protection (Controls on Ozone-Depleting Substances) Regulations 2011 and the Ozone-Depleting Substances (Qualifications) Regulations 2009 implement the EU ODS Regulation.

## HCs (Pentane)

The UK Environment Agency and Health and Safety Executive are acutely concerned that pentane releases are appropriately monitored and properly controlled. 2013 saw the effective inclusion of pentane-blown foams into the loss-monitoring regimes of Ozone Depleting Substances (ODS) treatment plants. These measures were implemented via the Environment Agency's report 'Flammability of Fridge Insulation Foam Produced with a Hydrocarbon Blowing Agent'.

The requirement was necessary to avoid fire and explosion in third party shredding systems. This was due to the misleading classification of baled insulated panels as non-hazardous, which led to

them being processed through shredding systems which are not 'intrinsically safe' i.e. they do not include inert gas suppression and monitoring.

DEFRA's WEEE BATRRT (Best Available Treatment Recovery and Recycling Technique) guidance states that **'appliances containing hydrocarbons must be processed in intrinsically safe equipment'**.

The DEFRA BATRRT document requires recyclers to implement the standards of recovery contained in the 2002 'Guidance on the Recovery and Disposal of Controlled Substances Contained in Refrigerators and Freezers' document. This document specifies the methods for the recovery of ODS, high GWP and hydrocarbon blowing agents.

## Activated Carbon Adsorption

eSynergy currently uses this technique to abate solvent pentane emissions from its pre-shredding process used for large commercial refrigeration equipment.

## Cryogenic Condensation

This is considered the most appropriate method for the recovery of blowing agents for several reasons. The liquid nitrogen vaporised in the cryogenic process is reused to 'inert' the shredder process to protect against the release of hydrocarbons. The only products produced in the process are recovered blowing agents and water. These gases can be efficiently co-processed through a thermal process, breaking down the CFC and HFC molecules with little production of oxides.

**COLLECTION OPTIONS AVAILABLE  
FOR ALL VOLUME REQUIREMENTS**



## OZONE DEPLETING SUBSTANCE RECOVERY

## ESYNERGY FRIDGE RECYCLING PROCESS

### Specialist Treatment Processes

Operators and producers are at risk of prosecution under sections 33 – 34 of the Environmental Protection Act 1990 if they continue to bale pentane-blown foam carcasses and consign them for further processing, in the knowledge that they will be dealt with as non-hazardous metal product that may be processed by conventional shredding.

Co-processing through conventional small-scale fridge recycling plants also presents significant risk as pentane blowing agents increase in the waste stream. Conventional fridge recycling plants were designed decades ago to deal with inert gases and are entirely encapsulated to enable the recovery of polluting solvents (CFCs/HFCs); this presents a risk that the shredding chamber will develop an explosive atmosphere during the processing of material containing pentane. Many efforts have been made to monitor lower explosion levels and inert the internal atmosphere using gaseous nitrogen. However, fires are still common.

The eSynergy fridge plant is fed using a unique loading system designed to elevate entire panels or commercial fridge carcasses into an inerted feed hopper before passing into the shredding

chamber. The system is hydraulically powered and represents the first practical solution to the encapsulated recycling of building/cold room panels and commercial refrigeration equipment containing hazardous substances.

All shredding of insulation foam takes place within an inert environment via streams of gaseous nitrogen from the cryo-condensation plant and the vaporisers supplied by BOC. Inertisation is increased on demand, depending on the oxygen level present in the shredding chamber, monitored at points of potential ignition. Automatic shutdown occurs when oxygen levels exceed set limits or 25% of the lower explosion limit is reached. Pentane emissions must be prevented or reduced by way of appropriate abatement; eSynergy uses an activated carbon technology to filter pentane from exhaust emissions.

eSynergy is the first UK operator to be permitted for the destruction of refrigeration equipment and composite insulated panels under the newly implemented provisions of the Industrial Emissions Directive.

## FLAMMABLE HYDROCARBON SAFE PROCESSING

## Disposal of Residues

The principle residue recovered during the shredding process is the recovered blown PUR or PIR Foam.

The most economic route is to turn this residue into a resource at the facility. eSynergy use a pyrolysis process which converts the foam to gases with a high calorific value by thermal conversion. 'Pyro' is Greek for 'heat' and 'lysis' is Latin for 'change'. It means 'change by heat'.

The material is fed into a large 5m x 500mm tube where it is sealed from the ingress of oxygen and the tube heated to a high temperature, around 700-800C. It cannot burn or oxidise as there is **no oxygen or other halogen or reagent** available. Instead it simply breaks down to a gas. The gas is injected in to a separate chamber where it is oxidised and combusted. The energy released at this stage is used in part to heat the tube (achieving a state of self-fuelling).

Not only is it possible to get near to zero landfill, but costs can be significantly lower than with a conventional facility that shreds waste and has to export the hazardous residues for processing elsewhere.



## **Our Recycling Mission**

*To deliver safe, clean and environmentally responsible waste treatment technology and recycling services for difficult hazardous wastes*

### **Experts**

Experts in recycling, we are committed to the protection of our environment, driven by a desire to preserve through innovation. We take great pride in our people and our innovative technologies. Continual improvement of all our recycling processes and our employee training is at the core of our corporate ethos.

### **Commitment and Responsibility**

Our commitment to provide the best possible service to our customers has led us to the development of innovative technologies that ensure the highest quality of service at the best available price on the market.

We are working tirelessly to deliver a reliable and safe service by cultivating a healthy and safe working and living environment for our employees and the public. Our devotion to providing outstanding services to our customers inspires us to constantly and continuously perfect our routines; improve our practices and take responsibility for our work from beginning to end.


### **Innovation**

eSynergy Recycling provides solutions for some of the most difficult hazardous wastes by using cutting-edge technologies. Proving synergies and pushing the growth of the circular economy is the key to the realisation of many government targets for collection, treatment and recycling of these wastes. eSynergy Recycling is the only UK recycler with the capability to thermally convert non-recyclable residues on site, converting them into heat and power.

### **eSynergy Recycling Difference**

eSynergy combines the large scale shredding and material separation of a metals fragging facility with the high temperature thermal and cryogenic technologies of a specialist hazardous waste treatment plant, to provide a safe, compliant and environmentally friendly solution for difficult high volume waste streams that contain hazardous substances such as construction panels or commercial refrigeration equipment containing CFCs (Chlorofluorocarbons) and flammable hydrocarbons (pentane).

**Our unique economies of scale allow us to provide our services at exceptionally low cost, and, using our fleet of dedicated specialist vehicles, we are able to offer the most competitive and convenient service on the market.**



*As a leading solutions provider we must continually assess the newest emerging technologies, both mechanical and thermal, to ensure that our clients are receiving the very highest recovery standards for their waste.*

**Sean Allinson-Bulman**  
Chief Executive

*Pyrolysis provides an economic and effective energy recovery process for a wide range of materials, recovering up to 80% of the energy value of the waste fuel as usable heat and power, and operates to the highest environmental standards.*

**Professor John Sharpe**

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