HERU

Technology

The HERU Technology

"I believe engineering and innovation will be the solution to our global resource and pollution problems.

I am proud to be leading an incredible team of innovators who are working to bring this game-changing technology to market.

We have some of the best engineers in formula one racing, aerospace engineering, and technology manufacturing looking at this invention to ensure the technology is both easy for the user, and better for our environment than the current system".

Nik Spencer

Brunel University London | BAXI | WYCHAVON DISTRICT COUNCIL good services, good value | worcestershire county council | RUGBY BOROUGH COUNCIL | mtc Manufacturing Technology Centre

What is the HERU?

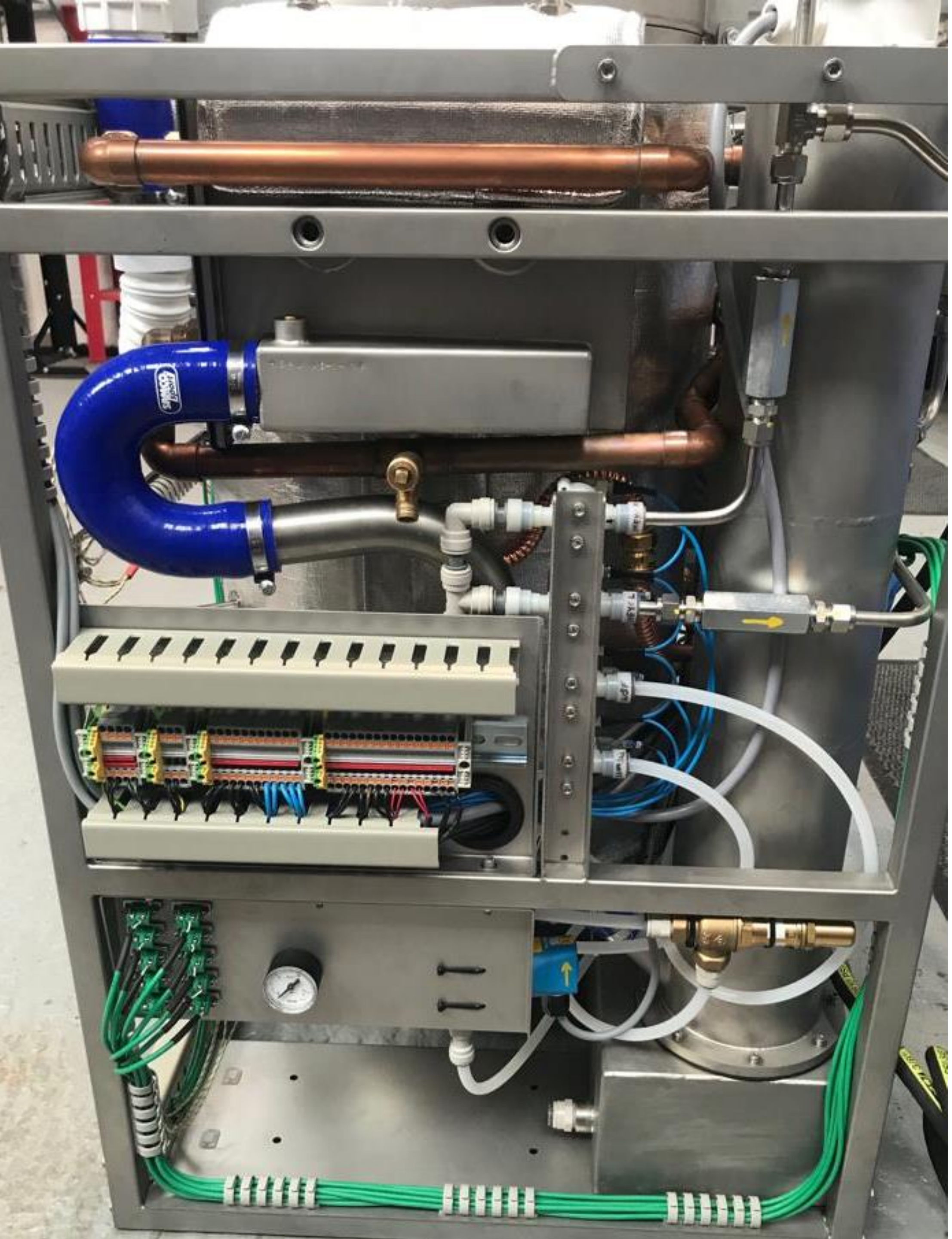
Globally patented technology that could put an end to fuel poverty, while providing a significant reduction in carbon and substantial savings for local government.

The genius aspect of the HERU technology, is utilising a well-known industrial heat treatment technique known as pyrolysis, but doing it at very low temperatures (up to 300°C).

Pyrolysis is a thermochemical decomposition process, which converts substances in the absence of oxygen into oil, synthesised gas (syngas) and char, with the temperature affecting the ratio and chemical composition of outputs. The breakthrough engineered and patented by the team and Brunel University London, is the development of heat pipe technology making the pyrolysis chamber the most effective ever developed.

The HERU is a highly efficient energy production system with outputs that have been thoroughly tested as being clean and safe to release to air and sewer.

THE HERU PUTS THE DECISION-MAKING POWER OF RESOURCE MANAGEMENT INTO YOUR HANDS, GIVING YOU THE CHOICE TO REDUCE YOUR ENERGY BILLS AND STOP WASTE ARISING



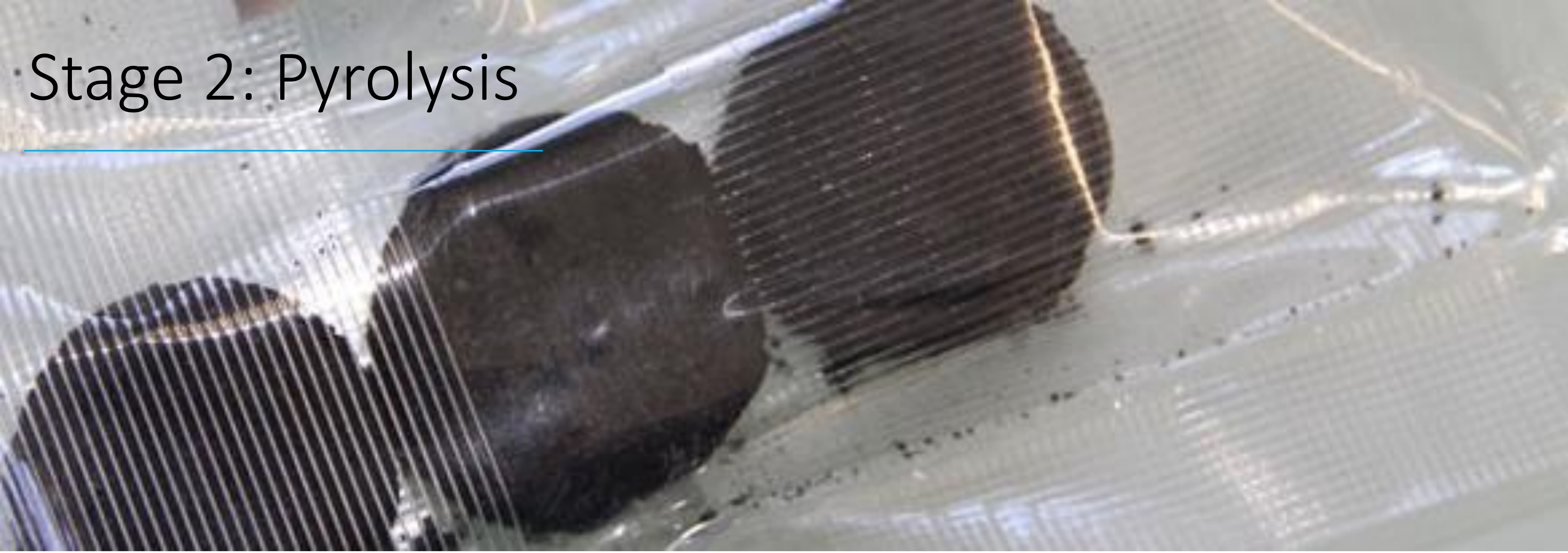
How it works

Stage 1: Drying

The chamber heats up to around 100°C, which dries out the material (a typical mix usually contains 47% moisture) by boiling off any moisture as steam.

This steam is packed with energy so passes over heat exchangers enabling this heat to be transferred to water making it hot. The condensed steam is then flushed to sewer.

Stage 2: Pyrolysis



The dried matter is then heated up to 300°C, decomposing it in the absence of oxygen. This releases an oily vapour containing oil and syngas. The tiny amount of oil condenses on the heat exchanger and is washed off every 15 minutes with water jets and detergent and flushed to sewer. As the process operates under low temperatures, the process doesn’t break the hydrocarbons found in the oil, making the tiny amount of oil produced safe to flush to the sewer. The small amount of syngas is then cleaned using our patented water screen filtration system, compressed and stored ready for combustion in the home boiler as and when required. An inert, valuable, high calorific char glowing at around 300°C remains in the chamber.

Stage 3: Combustion

Air is introduced to initiate combustion of the char creating an exothermic reaction that releases the heat energy stored in this material. The exhaust gases pass over the heat exchanger to recover this energy, before being cleaned via the water screen filtration system and then compressed and stored ready for combustion in the boiler as and when required. A small amount of ash is leftover at the end of the process, which is also flushed to sewer accounting for about 1-3% of the original material mass.

The heat collected by the heat exchanger, mostly during stages 1 and 3 (which release the most energy via steam or syngas) is used to pre-heat water for the boiler, storing it in a tank, which the boiler uses for domestic use in the home.

The HERU's cleaned, compressed syngas, generated during stage 2, is used as a gas fuel in the normal home boiler, via the air inlet valve, meaning the boiler needs less natural gas or oil to operate making it a fully hybrid boiler.

Heat Pipe Technology

The benefit of the patented heat pipes, developed by the team and Brunel University, are that they enable an even heat distribution throughout the chamber. This reduces the energy required to heat the chamber and provides better control of the pyrolysis process, the latter being critical for variable feedstocks.

Heat pipes enjoy the following characteristics:

- Thermal conductivity that is many orders of magnitude higher than copper (also known as thermal super conductors)
- Passive operation – no moving part or pumping energy requirements to transfer heat from the hot source to the heat sink
- It can be used to construct pyrolysis reactors that function at constant wall temperatures
- Scalable systems from micro to macro size systems
- Prolonged lifetime for the system

Usability

Designed to be a simple as using a washing machine.

1) Lift the lid
2) Add the resource
3) Close and lock the lid
4) Ensure the detergent is topped up
5) Switch it on the touch screen control panel
6) Leave it to run

The HERU team knew that the end user must be able to operate the machine easily, and that it could be powered as simply as any domestic appliance.

Inputs

Using low temperature pyrolysis, the HERU converts many materials found in the home, such as:

1. Paper and card
2. Packaging
3. Plastics
4. Garden clippings
5. Uneaten food

Process this to inert char that is consumed safely by the machine to generate heat for domestic heating applications. On average this mix of material contains 47% moisture, which produces on average 2.5 times the amount of energy used to run the HERU.

The HERU does not process metals and glass, as these require much hotter temperatures to impact their structures. If an object containing mixed metal and plastic were inserted, the plastic would be converted to syngas/ oil and char and the metal would simply remain in the unit. Any remaining metal and glass can simply be removed at the end and sent for recycling.

Outputs

Pyrolysis oil - this accounts for 5% to 20% of the initial weight of the inputs. Fourier-transform infrared spectroscopy (FTIR) and XRF chemical analysis techniques have been used to check the components of the resulting oils and have revealed a non-toxic, mainly water composition. The oils gather on the heat exchanger and are washed off every 15 minutes with water and detergent, before being discharged to sewer. The detergent breaks down any fat, oils and grease (FOG) preventing this causing an issue in the sewer distribution network.

Syngas – this accounts for 10% to 20% of the initial weight of the inputs and is released mostly during the pyrolysis stage, but also during combustion. It is mainly comprised of carbon monoxide (CO), methane (CH_4) and carbon dioxide (CO_2), but also contains trace amounts of micro-pollutants including volatile organic compounds (VOC's), nitrous oxides (NOX) and sulphur dioxides (SOX). The raw gas is washed in our patented water screen filtration system, which removes the majority of these micro-pollutants, which are subsequently flushed to sewer. The syngas is then compressed and stored for use as and when required. The act of combusting the gas at 1,900°C, via the air inlet valve of the home boiler, enables the energy stored in this material to be released to power the boiler. This chemical reaction also changes the composition of the gases enabling them to be safely released to air via the boiler exhaust. This exhaust is colourless and odourless and falls well within the parameters of a normal boiler exhaust gas composition.

Water – 35% to 45% of the inputs is ultimately water, which leaves the chamber as steam and is condensed on the heat exchangers, the energy is recovered and the water goes into the sewerage systems.

Char – this accounts for 49% to 52% of the inputs. This is the main fuel source of the HERU. The material has a good calorific value and therefore provides a lot of heat energy when burnt. X-ray fluorescence (XRF) and X-Ray Diffraction (XRD) chemical analysis have both revealed non-toxic components, which make it safe to handle.

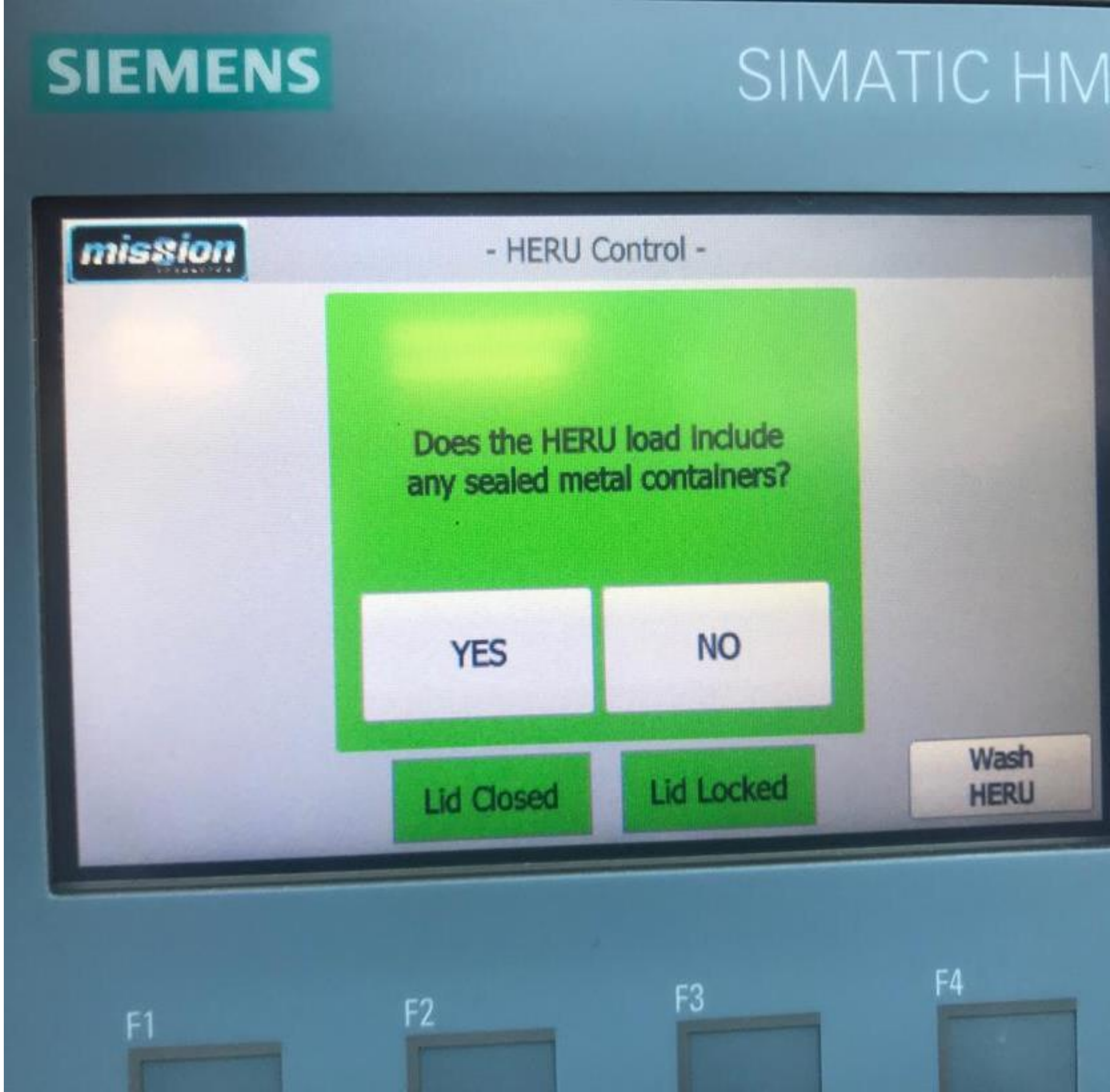
Ash – this accounts for 1-3% of the initial weight of the inputs. The ash results from complete combustion of the char in HERU. The chemical analysis of the ash shows it is non-toxic and of inert composition. This is also washed to sewer.

Safety

As safe to use as an oven.

1) Operates in pyrolysis in similar temperature to a domestic oven and in combustion at a lower temperature than a domestic boiler
2) Safety mechanisms to ensure the lid can not be lifted whilst it is running or hot
3) Reminder prompts to ensure the user has added restricted items, such as sealed food cans
4) Vigorously tested to ensure it can handle anything that is placed in there by mistake (such as an aerosol can)
5) The HERU has been inspected by PUWER assessors

There are household items that are not designed to go into the HERU as they provide no benefit or may produce harmful emissions. This includes for example batteries, chemicals, pharmaceuticals or metals and glass (see below). Items such as these should be recycled or disposed of appropriately.



Emissions Outputs

A sewer discharge - which mostly contains water (about 48 litres per cycle, compared to a washing machine which uses around 50 litres per cycle) as well as pyrolysis oil, particulates and very tiny amounts of micro-pollutants from the water screen filtration system. It also contains inert ash and detergent. The detergent helps break down any fats, oils and grease from the oil, whilst the inert ash helps balance the pH, particularly in sewerage network. This emission has been tested as being safe to discharge to sewer.

An air emission – the air emission is expelled via the household boiler exhaust. It arises from pyrolysis and combustion and has been processed by both the patented water filtration system and boiler. It has been thoroughly tested as being safe for release to air without posing risk of harm to human health or the environment and falls within the parameters of a normal boiler exhaust gas composition. It is both colourless and odourless.

Carbon

If you make the decision to dispose of everyday materials, either to the recycling or residual waste bin, these materials become waste and enter the waste supply chain. The current waste supply chain is very carbon intensive. This applies to transportation of waste by heavy goods vehicles, as well as the infrastructure and techniques required to process waste and recyclables. Although many techniques nowadays get value from waste, such as incineration, which recovers energy from the waste, many losses occur along the way. For example, 75% of the energy is lost through the generation and distribution of electricity produced by an energy from waste incinerator .

Most low-grade recyclable materials are sent abroad and processed into new products. This is a carbon-intensive practice, as every tonne of material is shipped aboard, transported to a carbon-heavy processing plant before completing the cycle. It is still way better than landfill, but not a perfect solution.

Alongside this, the average home in a mild climate uses between 5,000kWh and 30,000kWh of energy per year for heating. According to the National Grid, about 83% of homes use gas to provide this heat. Only 45% of this gas supply comes from UK production with 38% originating from European/ Russian pipelines and 17% from liquefied natural gas (LNG) tankers. This is a natural and finite resource. In 2017 the UK government reported that approximately 11% of homes in England live in ‘fuel poverty’, meaning they cannot afford to keep their homes adequately heated.

By converting everyday materials into energy, avoiding the creation of waste, means the useful outputs (heat energy) are used where they are needed most. This is a highly efficient process. Nothing is lost in transportation or requires processing in carbon-intensive infrastructure. This massively reduces the amount of carbon generated.

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We would love to show you the HERU.

If you are interested in learning more, please get in touch.

HERU