



ctec
energy



Advanced Recycling Technology

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CTEC Energy

**Next Generation
Waste, Energy & Sustainability**



**National Performance
Advisory Group**

21st March 2024

Our Partners & Suppliers

We are proud to collaborate with a diverse network of trusted and world-leading partners and suppliers who share our commitment to excellence and sustainability. Together, we leverage expertise and resources to deliver innovative solutions that meet the evolving needs of our customers.

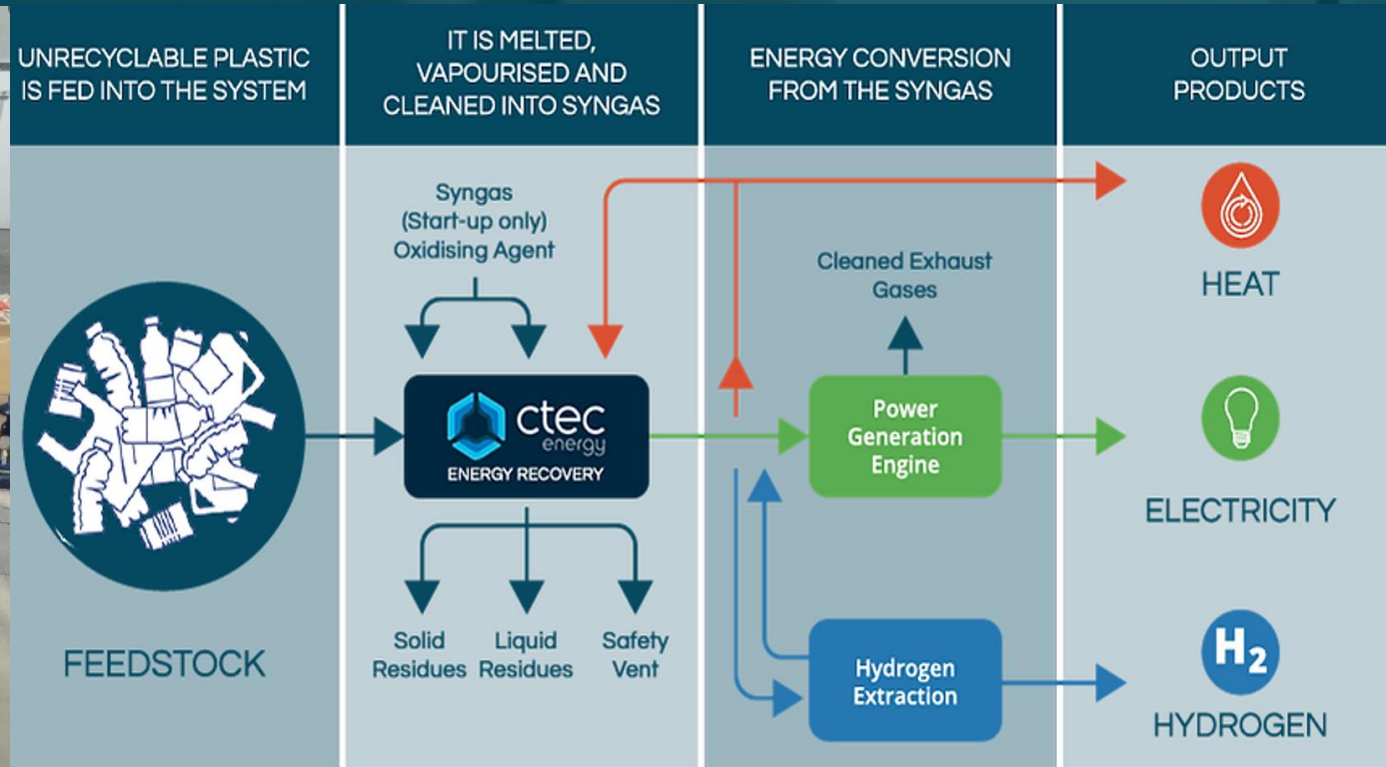




What do we offer?

From single site waste producers, such as hospitals and ports, to new commercial and residential developments, CTEC prides itself on its flexibility to cater for our customers waste-management needs. Discover what CTEC can do for you.

A Cleaner Energy Future



**CTEC's 3rd Generation plant
in operation under R&D for
the past 5 years.**

**Clean Thermodynamic Energy
Conversion Ltd**

CTEC Energy

less than

10%

of petroleum in the world
is turned into plastic

Every year

400

million

tons of plastic waste is
generated worldwide

Worldwide, only

9%

of plastic waste is recycled

Advanced Recycling of Plastic

- **Not all plastics** or plastic products are **recyclable**, necessitating an alternative approach.
- Existing recycling methods offer **minimal benefits**, often providing a feel-good factor **without substantial impact**. Not all plastics meet acceptable recycling parameters.
- Instead of solely mechanically recycling plastic, consider transforming it into syngas, boasting **50%** of the energy density of natural gases.
- While a fraction of petroleum becomes plastic, recycling it via mechanical separation, classification, cleaning, transportation, and reprocessing can be a **false economy**. Plastics could serve as a valuable energy source, offering double the value compared to gasoline.
- Recycled plastic production costs surpass those of virgin plastic, rendering mechanical plastic recycling **economically unviable**.
- The recycling process, spanning collection, sorting, processing, and transport, demands more time, labour, and equipment, yielding **lower-quality** and **less efficient outputs** than manufacturing virgin plastic resin from fossil fuels.
- **Advanced Recycling** to build synthetic fuels for transportation, **enhanced use of waste plastic**.

Enhanced **Waste-
to-Energy**
conversion

3x

less CO₂ emissions
compared to a typical
incineration plant

25-30%

less greenhouse gases
than incineration per
generated MW

The Benefits

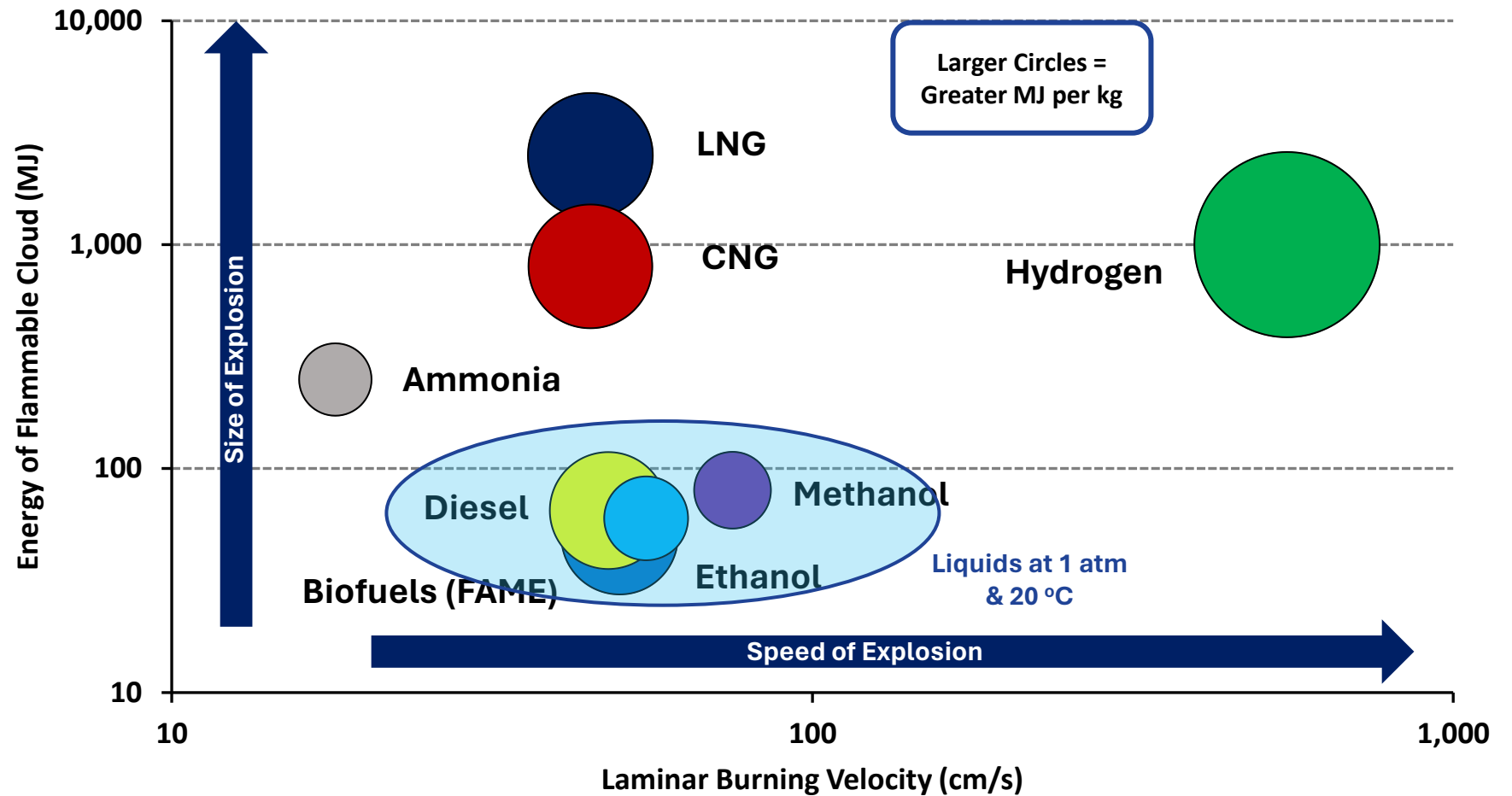
- Plastic gasification yields syngas with up to **45%** H₂ concentration, offering environmental benefits and a **lower carbon footprint** compared to coal, oil, and natural gas.
- Gasification operates effectively on a **small scale**, providing **flexibility** to enhance the value of plastics of different compositions or mixtures, or when mixed with another feedstock.
- Effective energy management utilises existing carbon and hydrogen, **reducing reliance on fossil fuels, methanol** being a synthetic fuel or attractive carrier of Hydrogen.
- By preventing hard-to-recycle or non-recyclable materials from reaching landfills and decreasing the export of plastic waste, gasification promotes **environmental sustainability**.
- Gasification boasts **ultra-low emissions**, facilitating the destruction of **PFAS** (forever plastic) and **F-Gases, Anesthetic gases** with **off-grid capability**.

Syngas Hydrogen e-methanol

To provide solutions for the big challenges of our time, we are building synthetic fuels with our technology partners.

Using CTEC Hydrogen e-methanol is produced from renewable sources such as recycled carbon dioxide, biomass, plastic waste, or sewage sludge.

Fuel Safety Analysis of Hydrogen Carriers



The NHS produced
>156,000
tonnes
of waste in 2022/23

The estimated carbon
impact of this waste is
>100,000
tonnes
of CO₂e per year

A more
sustainable
option is needed

Medical Waste – The Burning Issue

The healthcare sector has seen a steady increase in the volume of waste generated in recent years, largely attributed to ongoing population growth and the outbreak of the COVID-19 pandemic. How it chooses to manage the disposal of this waste in a world that is progressively prioritising sustainable practices has garnered significant attention.

- **Incineration** has long been the go-to solution for disposing of clinical waste, but its **shortcomings** have become increasingly apparent:
 - release of **toxic pollutants** and **greenhouse gases**.
 - **failure** to maximise on the **waste energy content**.
- The need for **more sustainable, environmentally friendly** solutions that not only mitigate the adverse impacts of waste disposal but also harness its latent energy potential has never been more pressing.

What do we offer?



Waste Management Solutions



Electricity



Thermal Energy



Lower CO₂ Emissions¹



Cost Savings

Our vision is to pioneer clean energy and waste management solutions worldwide, aimed at significantly reducing CO₂ emissions and fostering a more environmentally sustainable planet via **Advanced recycling.**

- Our gasification systems offer a comprehensive **waste management solution** for a variety of feedstocks.
- Our advanced gasification technology converts these waste materials into valuable **thermal** and **electrical energy** – turning a problem into an asset.
- We offer our customers:
 - **on-site energy production** allowing for considerable **cost savings** and removing their reliance on the grid.
 - **surplus energy storage** capability for use during peak demand periods or for resale to the grid.
 - **emission reduction** strategies to minimise pollutants released into the environment.

¹ Compared to incineration



What is gasification?

Our gasification technology serves as the cornerstone of our systems, driving efficient and sustainable conversion of waste into valuable energy resources. But what is it?



Enhanced **Waste-to-Energy**
conversion

25-30%

less greenhouse gases
than incineration per
generated MW

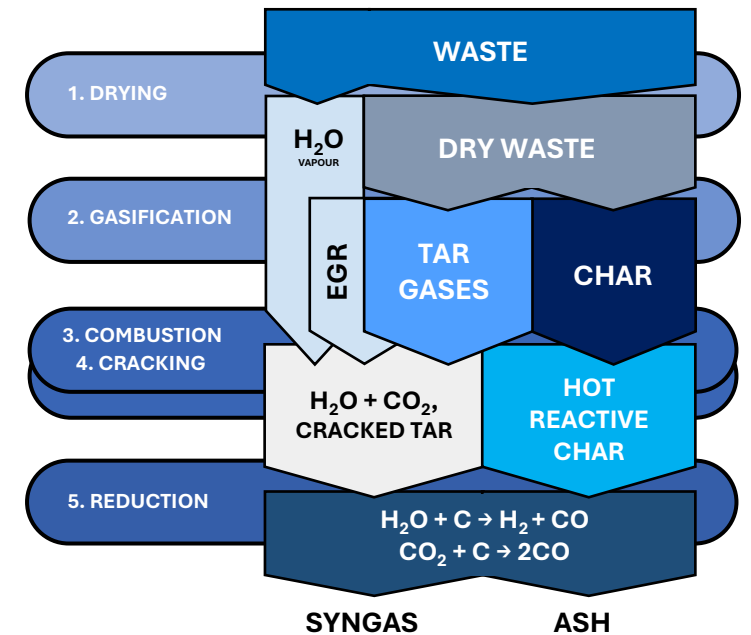
**Dioxin &
Furan**

emissions low due to O₂-
deficient environment

Gasification

Gasification is a thermochemical process that converts carbon-containing materials, through controlled heating and precise O₂ and/or steam doses, into a gaseous mixture known as synthetic gas (syngas), predominantly comprising CO, H₂ and CH₄.

- Gasification is a highly intricate process, characterised by a series of chemical reactions that demand **precise control**.
- CTEC ensures **optimal conditions** to produce the most **energy-dense syngas**, unlocking the full potential of waste materials.
- Utilising significantly **higher temperatures** than conventional incineration methods, the CTEC system achieves **superior waste-to-energy** conversion while **cutting emission levels**.





Our system

At CTEC, we take pride in our range of systems, each built upon innovative and patented technologies. Let's explore these systems and the cutting-edge technology that drives them.

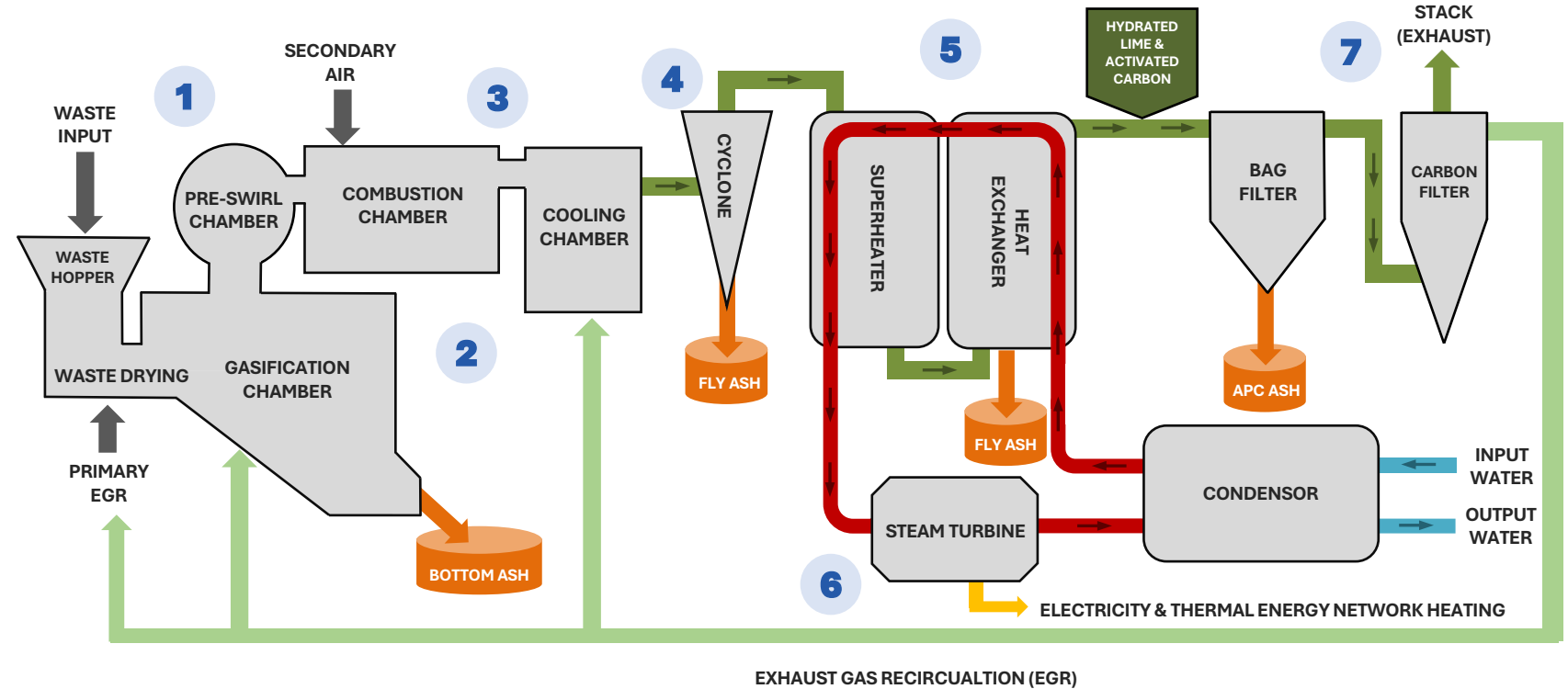


The CTEC System

Drawing upon over a decade of innovation and refinement, CTEC has developed a range of systems, all rooted in its patented waste-to-energy gasification system configuration.

Our system is comprised of seven key areas:

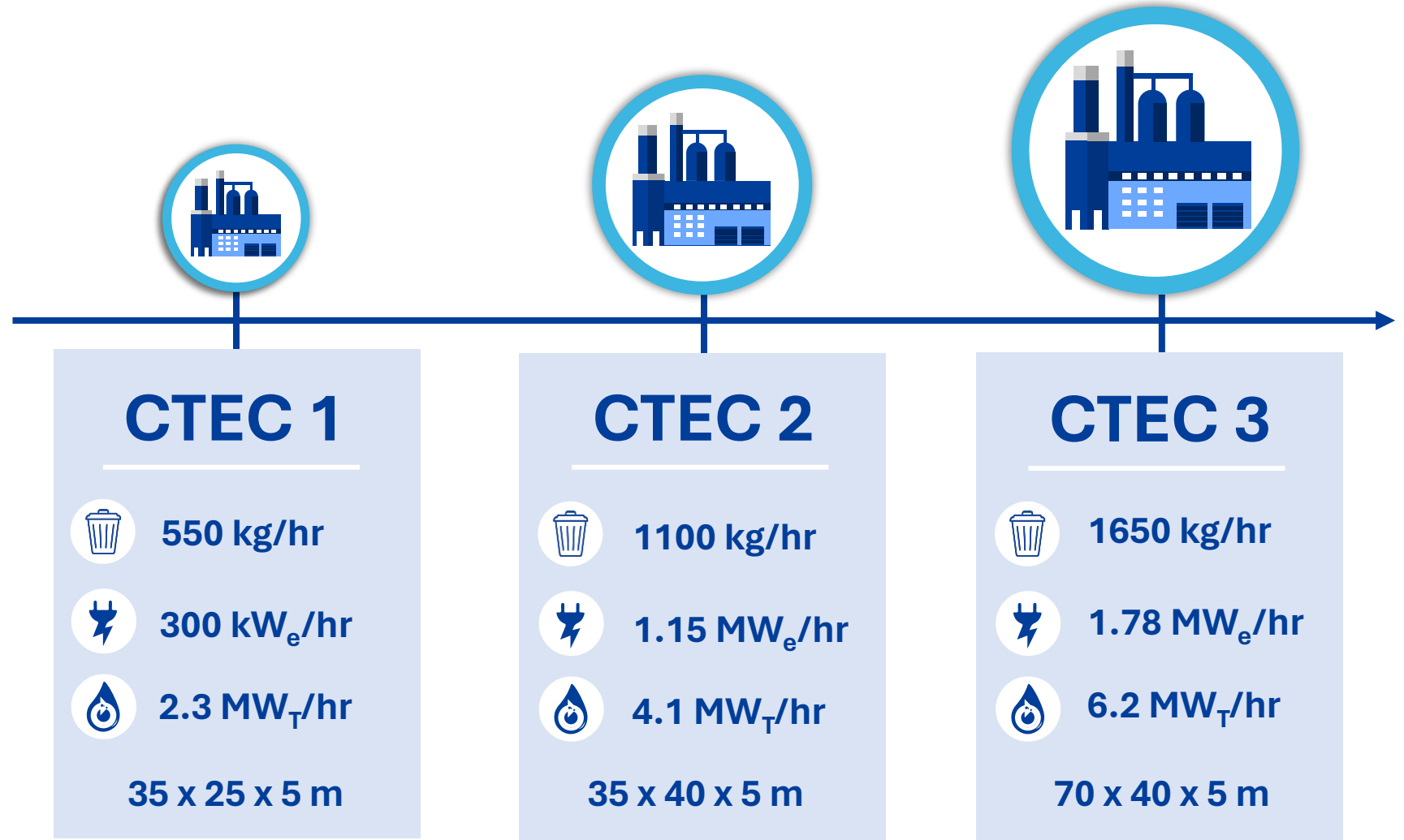
- 1 Waste Processing & Loading
- 2 Waste Gasification Chamber
- 3 Syngas Combustion Chamber
- 4 Post-Combustion Gas Treatment
- 5 Superheater & Heat Exchanger
- 6 Turbine & Steam Circuit
- 7 Air Pollution Control



The CTEC Range

CTEC's current lineup comprises three systems varying in waste input capacity and subsequent energetic output¹, catering to a diverse range of operational needs.

The CTEC systems are completely modular, designed to be installed on-site, close to sources of waste.



¹The energetic outputs are based on waste with an average calorific value of 5,400 kcal/kg

Emission Control

 Lower CO₂ Emissions¹

 PFAS & PCB Removal

 Reduced NO_x & SO₂ Emissions¹

 Minimal Furan & Dioxin Emissions

 Particulate & Odour Control

At CTEC we are committed to ensuring our emissions remain as low as possible to minimise our impact on the atmosphere, as a result we integrate various features into our system design and operational conditions to uphold this commitment.

- Our waste-to-energy systems are carefully designed to minimise a number of harmful pollutants including:
 - carbon dioxide (CO₂)
 - sulphur dioxide (SO₂)
 - nitrogen oxides (NO_x)
 - furans & dioxins
 - per- and polyfluoroalkyl substances (PFAS)
- Our systems guarantee **efficient emission control**, safeguarding both **public health** and the **environment**.

3x

less CO₂ emissions compared to a typical incineration plant

Ultra Low Emissions

compared to EU limits

¹ Compared to incineration



Additional technology

CTEC is continuously exploring new ways of augmenting its pre-existing technology, which is why we offer several additional modules aimed at ensuring our customers get the most out of their waste-management solutions.

>99.9%

pure high-grade H₂

> 320
tonnes

of H₂ per annum*

Technology partnership with
Air Liquide

a world leader in H₂
recovery

* By a CTEC 3 with syngas H₂ content of 39% v/v

H₂ Extraction

In addition to our standard systems, CTEC is able to facilitate the seamless integration of advanced gas-recovery technologies, enabling the efficient extraction of H₂ from syngas.

- As a **clean** and **versatile** fuel, H₂ offers itself as a **renewable** and **efficient** alternative to traditional sources.
- The high-purity H₂ is suitable for an array of applications, including:
 - **fuel cells**
 - **chemical synthesis into e-methanol**
 - powering clean **transportation**
 - the manufacturing of **electronics**
 - **analytical techniques** in laboratories



Fuel Cells



Chemical
Synthesis



Transport



Electronics



Analytical
Techniques



Scalable



Off-Grid Capability

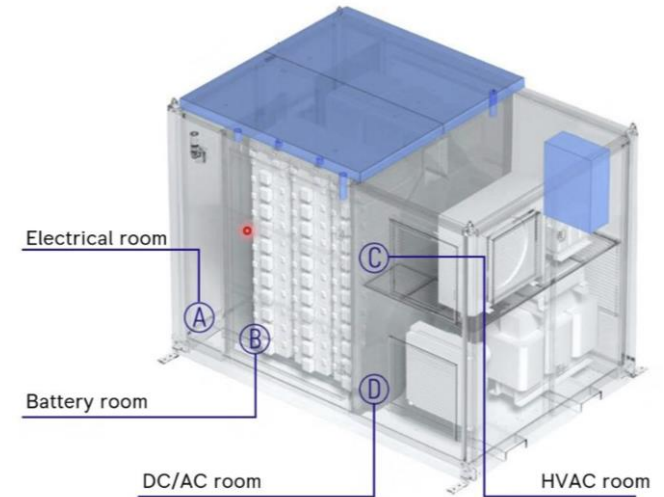


Flexible

Battery Storage

Through partnership with Rolls-Royce, we can offer the integration of battery storage options for our gasification systems.

- Integrating energy storage options into CTEC's systems offers our customers **several benefits**:
 - use stored electricity during **peak demand** or for **resale** back to the grid, the latter providing a potential **revenue stream**.
 - peak load shaving**, optimising energy usage, **reducing costs** and alleviating strain on the grid.
 - off-grid functionality** for CTEC systems, supporting autonomous grid formation without auxiliary power.
- These battery storage options are **scalable** and **flexible**, easily accommodating various capacity needs and applications.



Rolls-Royce's mtu EnergyPack QS - 312-624 kWh capacity

NHS

What can we offer the NHS?

CTEC can offer NHS hospitals the ability to meet tomorrow's Sustainability Agenda today while delivering significant operational savings.

The NHS is the largest single user of energy in the UK Public Sector.

In England alone, the NHS consumed 11,240 GWh of energy last year, costing over £1.2 billion, up 53% from the previous year.

CTEC can help make the NHS considerable annual savings on overhead. Let's look at the case for a CTEC 1 unit in an NHS hospital.

The hospital generates

4,488 Tonne
of waste annually

In a CTEC 1, this waste can produce up to

2.5 GWh of electricity **18.8 GWh** of heat energy

This will result in potential gross savings¹ of

£590K in electricity **£1.2m** in heating **£2.3m** in gate fees

£3.9m in total ¹

¹ Assuming tariffs of £0.24 /kW_e, £0.06 /kW_t & £477 /tonne. Does not include operating costs.

The advantages of the CTEC systems are plentiful.

Our units can offer hospitals small scale, highly efficient and low emission waste-to-energy facilities, uniquely suited to reducing the carbon footprint of the NHS.



Efficient, on-site waste management solution



Electrical energy with surplus storage and peak load shaving capabilities.



Superheated steam, saturated steam, hot water or air conditioning, depending on requirements.



Ultra Low Emissions including CO₂, SO₂, & PFAS.



Considerable cost savings and potential revenue streams.



Potential unit payback of 2 years.

How to reach us



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