



[www.eti.co.uk](http://www.eti.co.uk)

# Waste gasification with syngas clean up – reaching commercial demonstration and future prospects in the wider bioenergy sector

Paul Winstanley *CEng. MSOE*

**ETI10** | TEN YEARS  
OF INNOVATION  
2007 – 2017

©2017 Energy Technologies Institute LLP

The information in this document is the property of Energy Technologies Institute LLP and may not be copied or communicated to a third party, or used for any purpose other than that for which it is supplied without the express written consent of Energy Technologies Institute LLP.  
This information is given in good faith based upon the latest information available to Energy Technologies Institute LLP, no warranty or representation is given concerning such information, which must not be taken as establishing any contractual or other commitment binding upon Energy Technologies Institute LLP or any of its subsidiary or associated companies.



## Agenda

- Who are ETI
- Why is Bioenergy Important
- Why Waste as a feedstock
- Why Gasification
- What is the ETI doing to enable commercialisation of gasification



# The Energy Technologies Institute (ETI)

- The ETI is a public-private partnership between global energy and engineering companies and the UK Government.
- Targeted development, demonstration and de-risking of new technologies for affordable and secure energy
- Shared risk

## ETI members

---



**CATERPILLAR®**



**Rolls-Royce**



  
Department for  
Business, Energy  
& Industrial Strategy

**EPSRC**  
Pioneering research  
and skills

**Innovate UK**

## ETI programme associate

---

**HITACHI**  
Inspire the Next



# Bioenergy

A key lever – particularly with CCS

Requires sustainable supplies – imports and indigenous

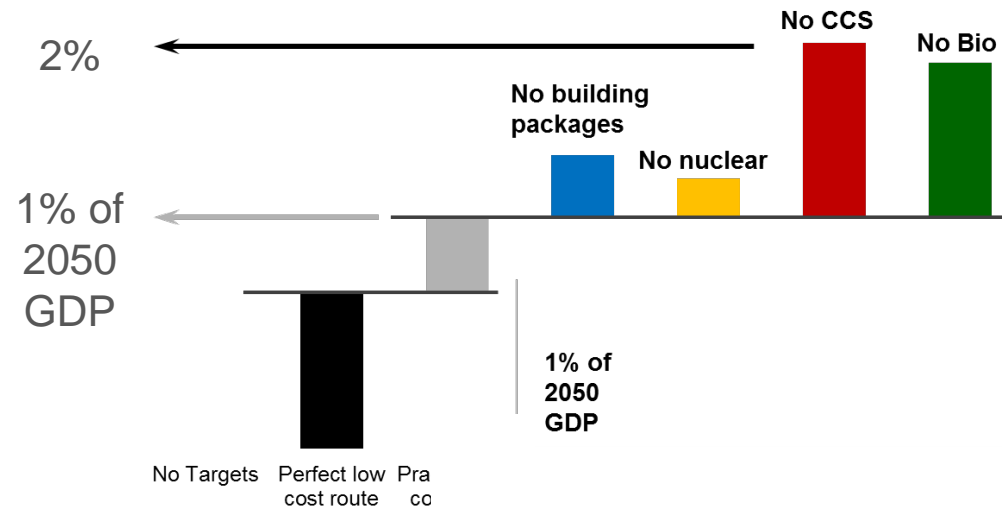


- Could support a range of conversion and utilisation routes - flexibility
  - Hydrogen
  - SNG
  - Heat
  - Bioeconomy
- Major potential for creating ‘negative emissions’ via CCS
- ETI investing in soil science, logistics and value chain models
- Informing decisions
  - “what do we grow ?”
  - “where do we grow it ?”
  - “how do we use it ?”



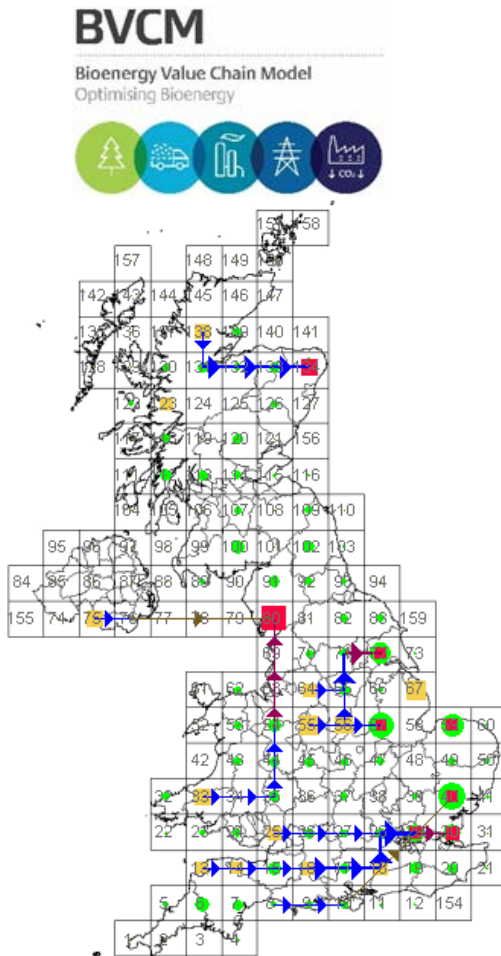
## Additional cost of delivering 2050 -80% CO<sub>2</sub> energy system (NPV £bn 2010-2050) if a technology is excluded from the portfolio

- Hugely valuable low carbon energy source
  - Storable
  - Flexible
    - Heat, power, fuels, chemicals, materials
- With CCS, can deliver negative emissions
  - Lowest cost 2050 low carbon energy system.





## Why is ETI interested in gasification?



- Key insights from BVCM modelling
  - Gasification
    - key bioenergy enabler
    - resilient
  - The sector will need a combination of feedstocks



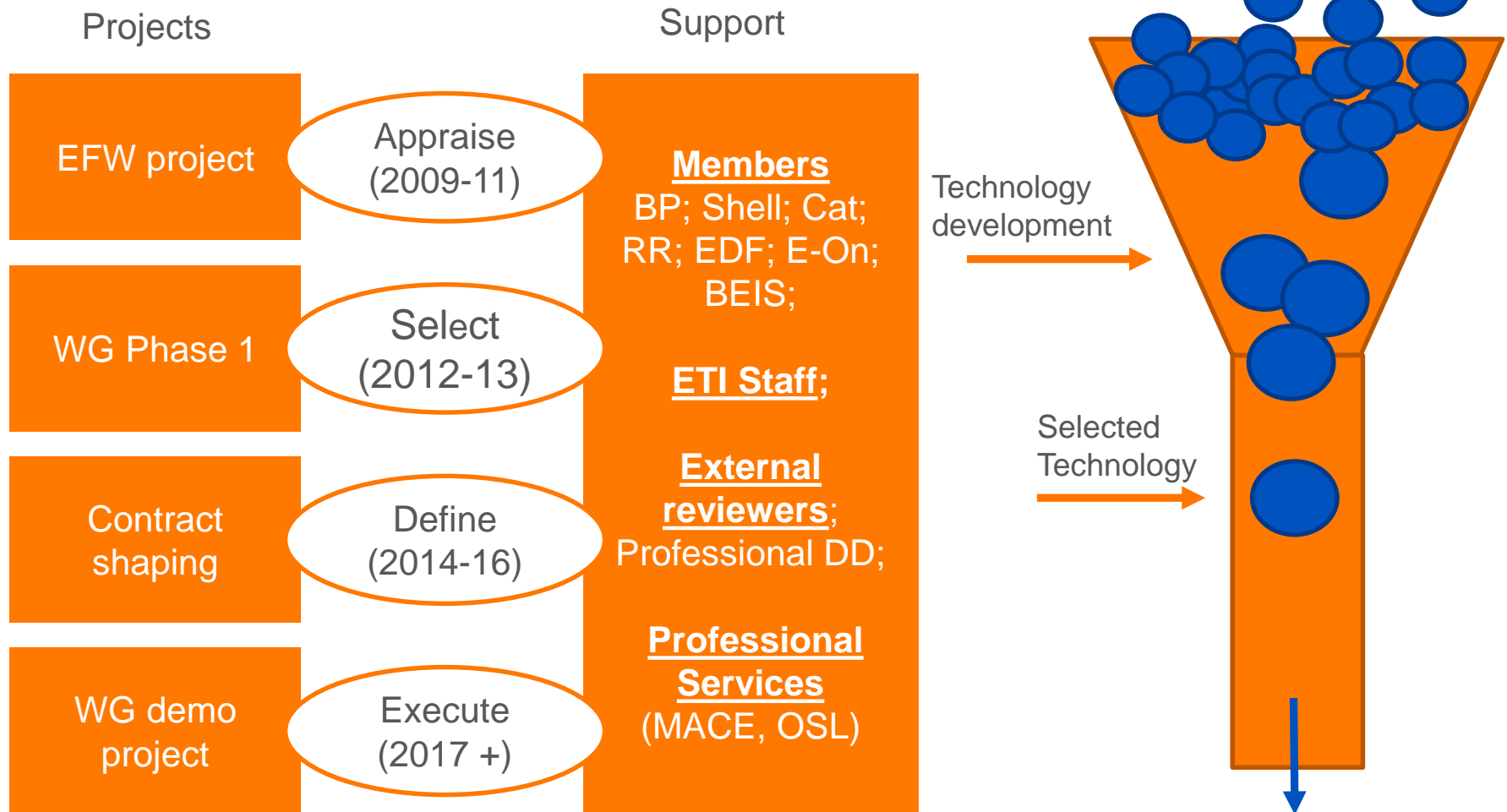
## Biomass – many sources, each with different benefits and concerns

- Wastes
- Energy crops
- Agricultural residues
- Forest derived – long rotation forestry (LRF)
- Sugars, oils starches





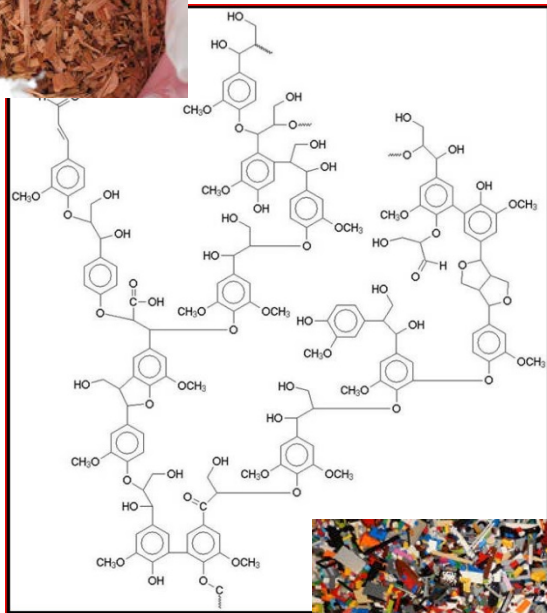
# Waste Gasification with Syngas Clean-up







Gasification converts the energy held within a difficult to use solid fuel into an easier to use gas. To best use the gasifier product gas we must clean it

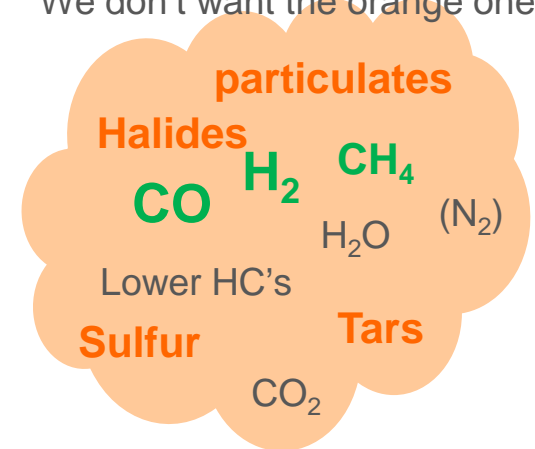


Gasification



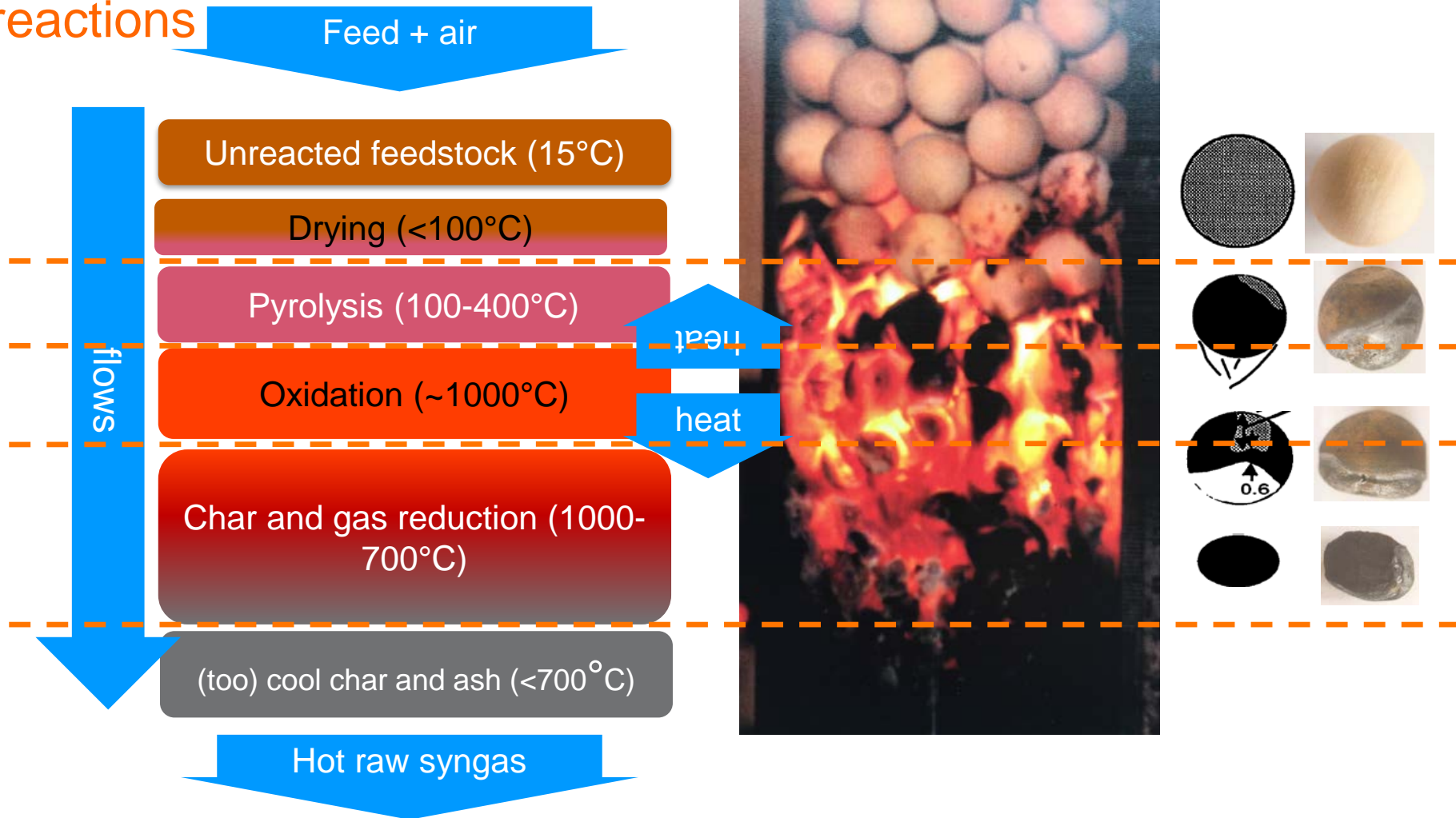
In general

- We want the green ones
- We can live with the grey ones
- We don't want the orange ones





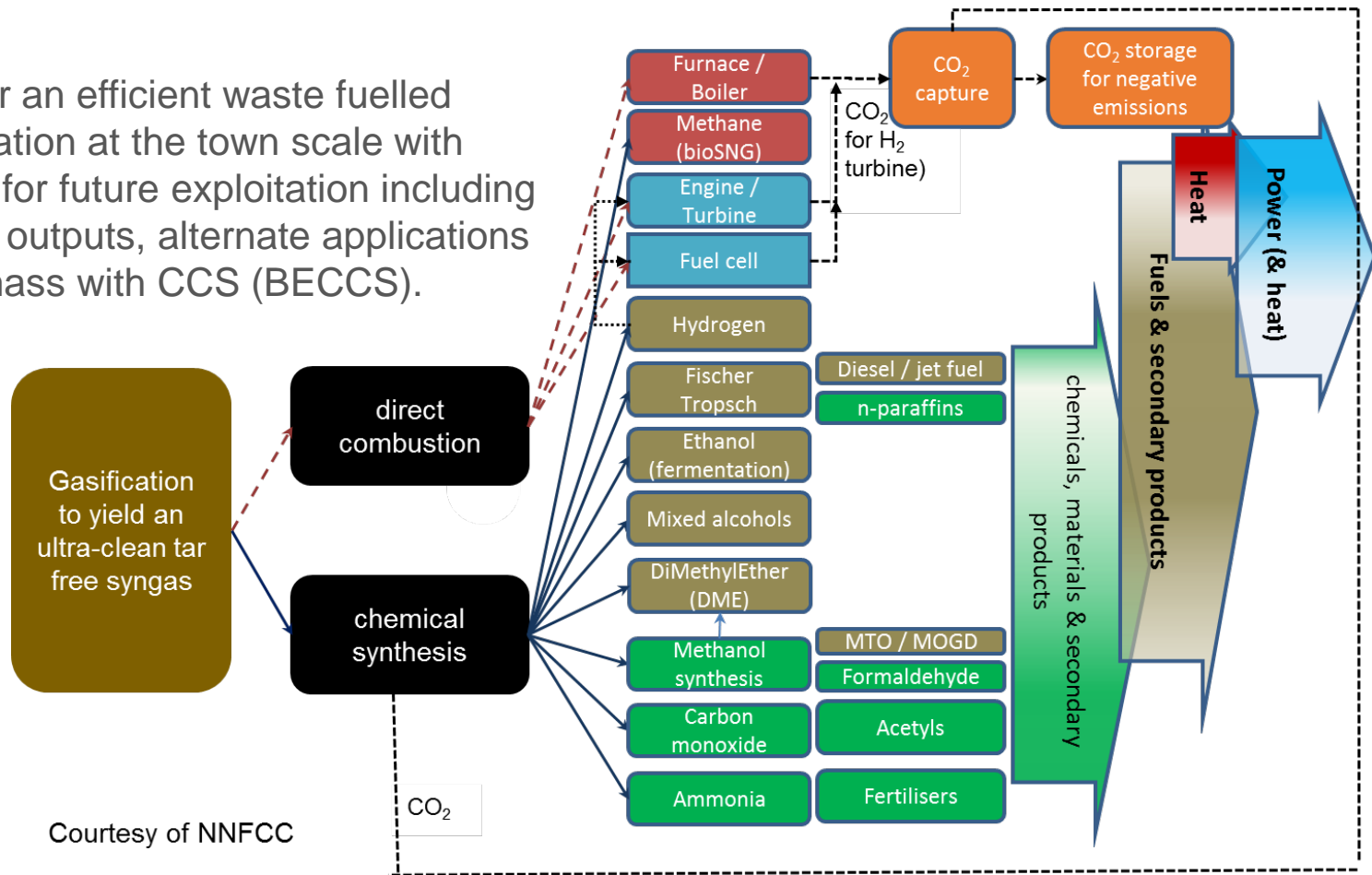
# Balance “heat making” reactions against “heat using” gasification reactions





# Gasification provides flexibility – provided there is clean syngas

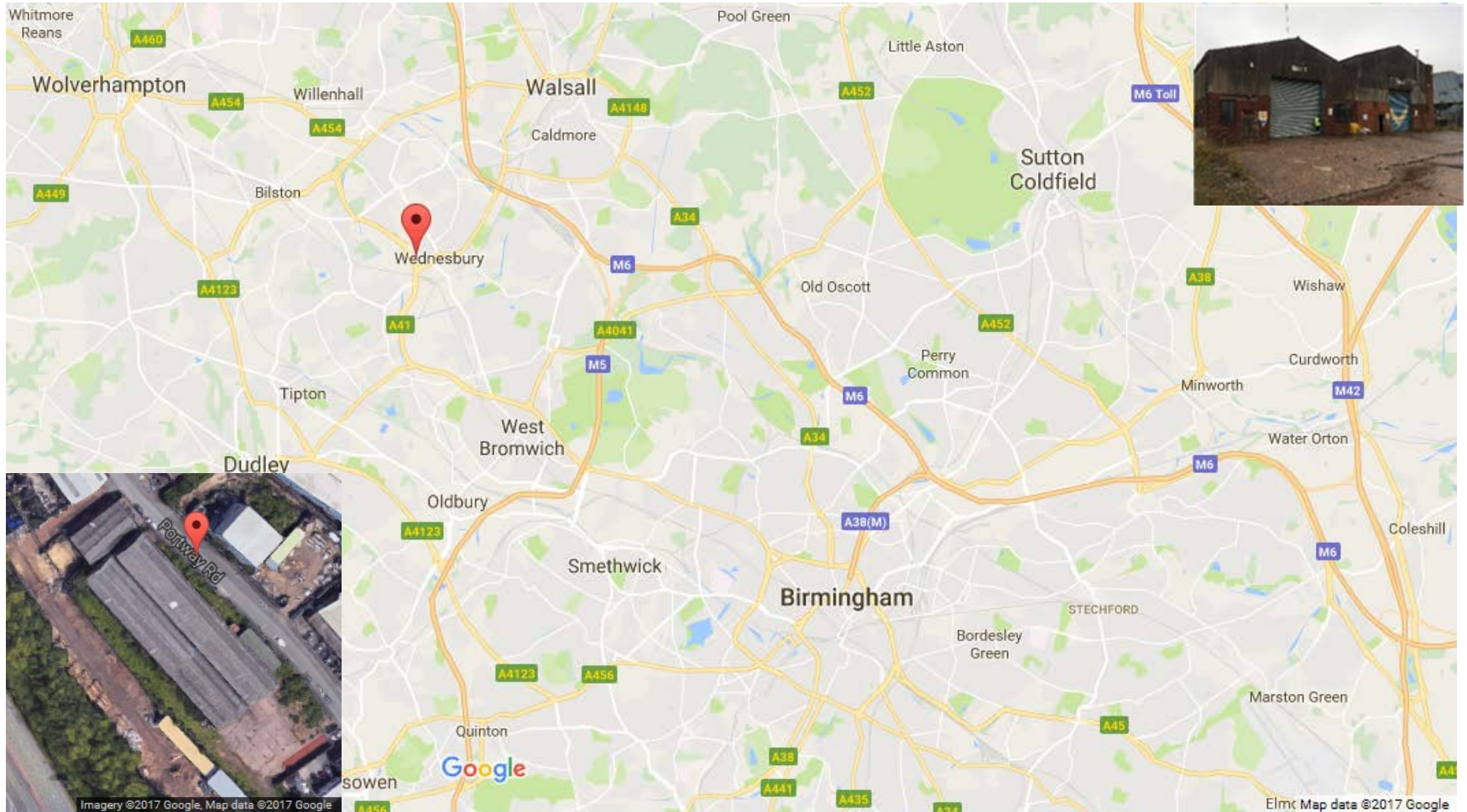
To deliver an efficient waste fuelled power station at the town scale with potential for future exploitation including alternate outputs, alternate applications and biomass with CCS (BECCS).



Courtesy of NNFC

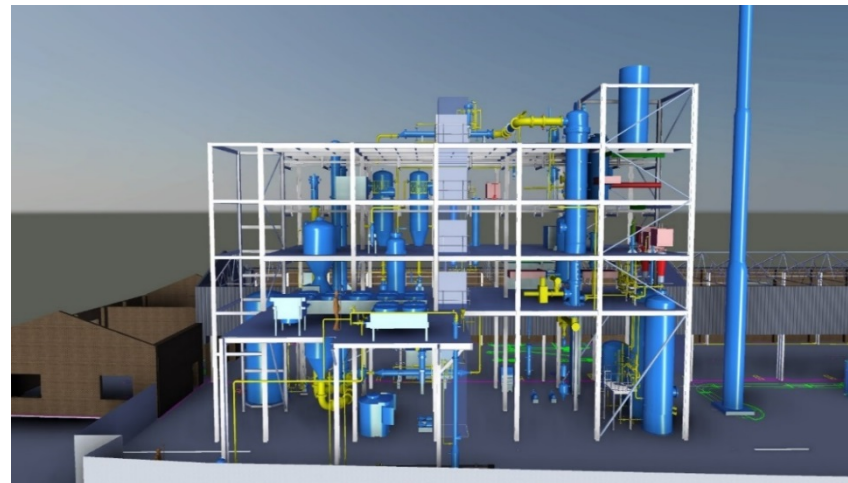
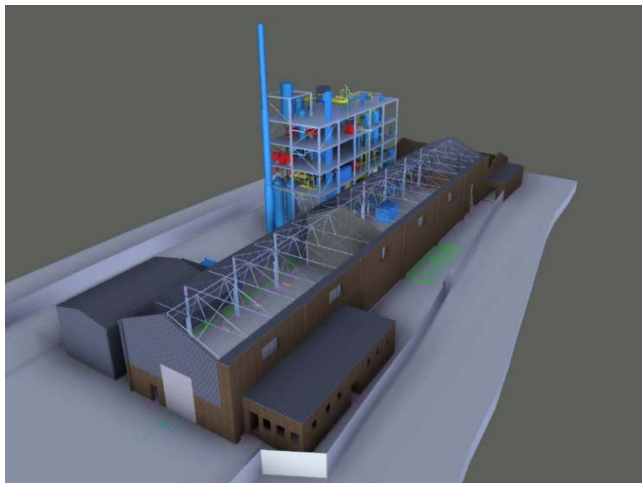
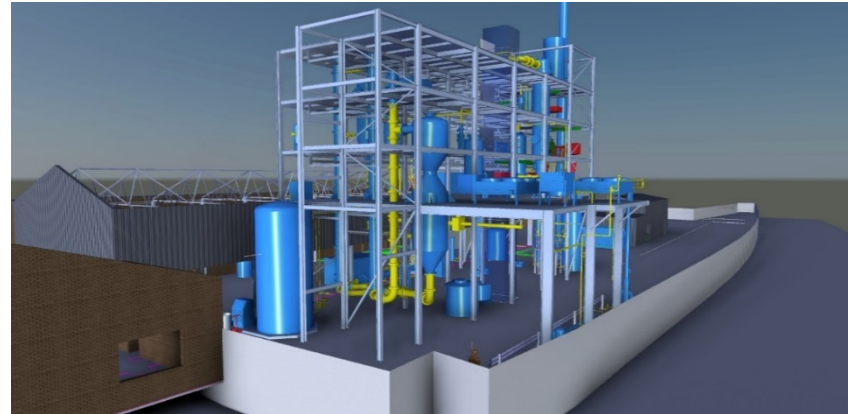


# Commercial Demonstration Site





# Commercial Demonstration Plant





# What's next...



Registered Office  
Energy Technologies Institute  
Holywell Building  
Holywell Park  
Loughborough  
LE11 3UZ



For all general enquiries  
telephone the ETI on  
01509 202020



For more information  
about the ETI visit  
[www.eti.co.uk](http://www.eti.co.uk)



For the latest ETI news  
and announcements  
email [info@eti.co.uk](mailto:info@eti.co.uk)



The ETI can also be  
followed on Twitter  
[@the\\_ETI](https://twitter.com/the_ETI)