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Delivery and establishment of the first UK commercial scale plant to deliver ultra clean syngas

Paul Winstanley CEng. MSOE. MIPlantE. Project Manager

Agenda

- What is the ETI
- Background
- Waste Gasification Project
- Summary
- Lessons learnt
- ETI knowledge

What is the 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

bp

CATERPILLAR®

EDF ENERGY

Rolls-Royce

Department for Business, Energy & Industrial Strategy

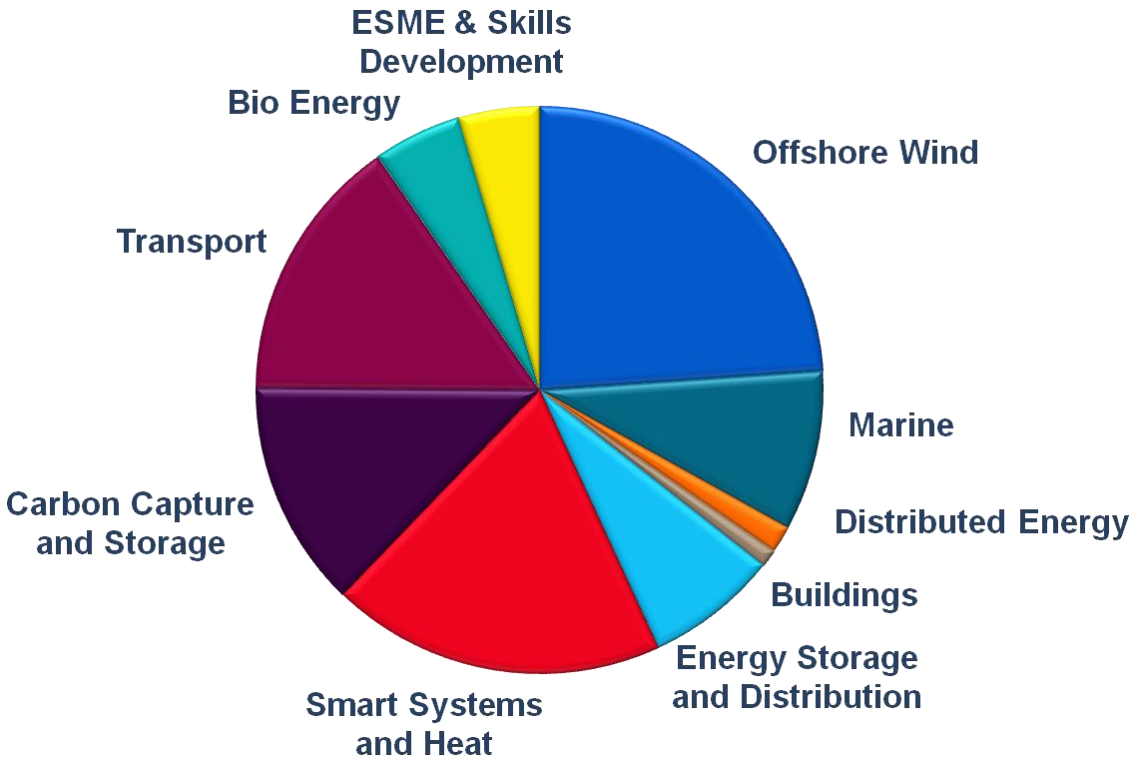
EPSRC Pioneering research and skills

Innovate UK Technology Strategy Board

ETI programme associate

HITACHI Inspire the Next

ETI invests in projects at three levels



Nine Technology Programme areas

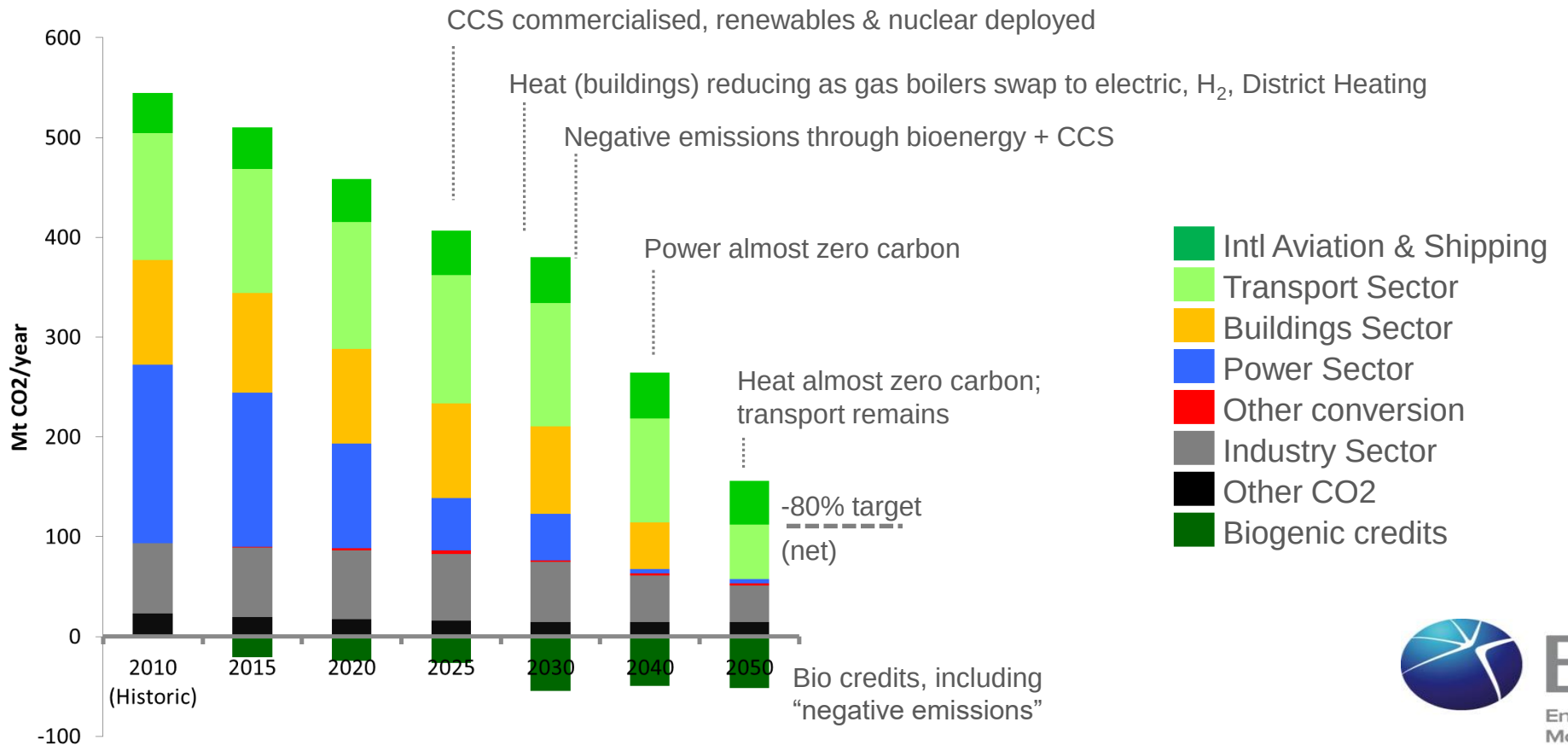
Delivering...

- New knowledge
- Technology development
- Technology demonstration
- Reduced risk

ESME
Energy System Modelling Environment

A route to meeting - 80% CO_2 for the UK

Power now, heat next, transport gradual – cost optimal



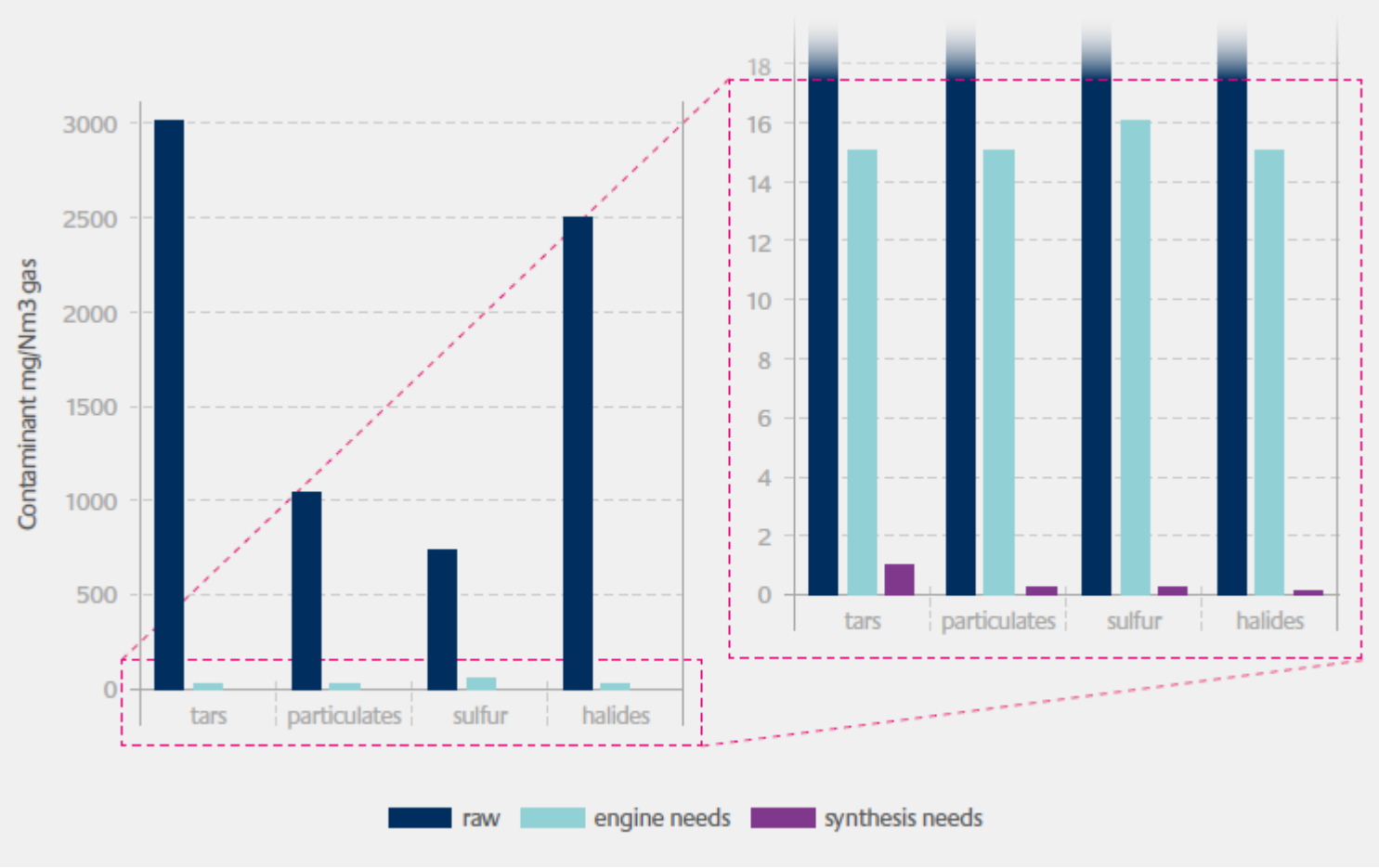
ESME Energy System Modelling Environment

Chart data from base case v4.3

Benefits of gasification can only be realised if the raw syngas is cleaned up

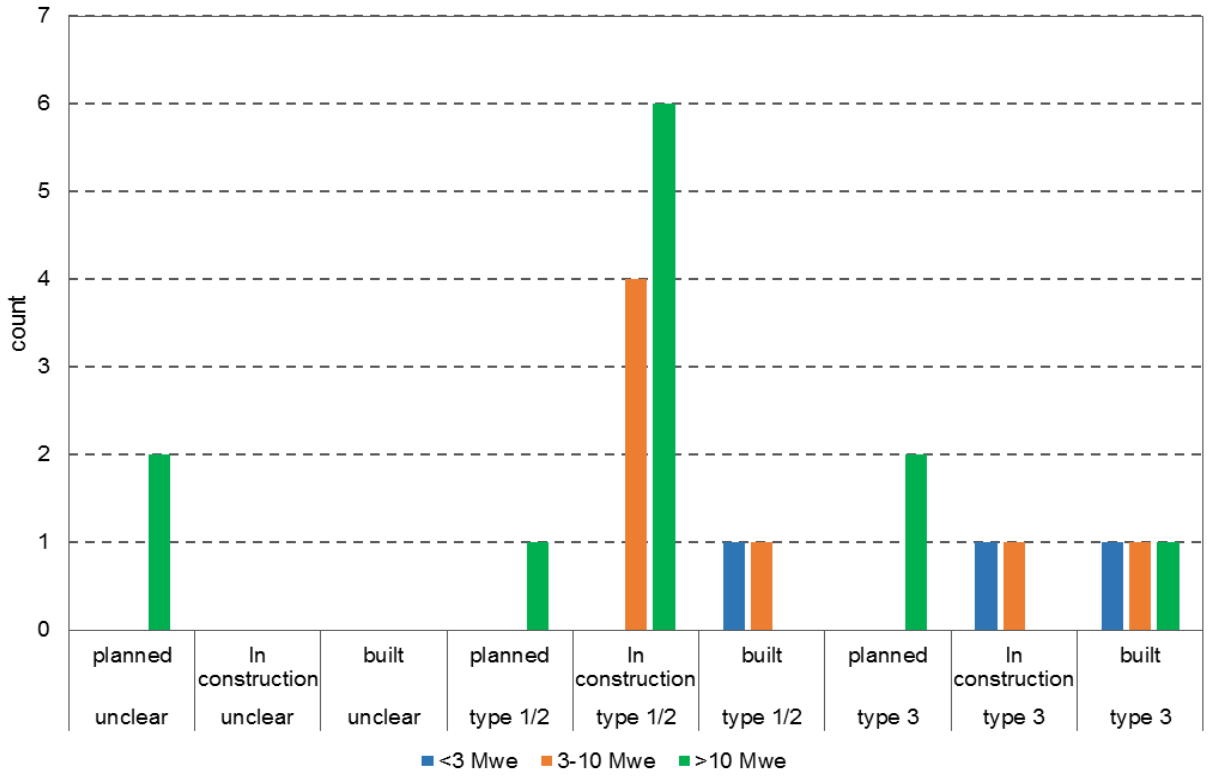
- Power
  - Small scales (5-10MWe) at higher efficiencies because we can use engines
    - less benefit at >20MWe (as steam becomes efficient)
    - Reduced local impact
    - Easier to use waste heat
    - Reputation (ref. ETI social science research)
- Fuels and chemicals
  - Raw syngas unacceptable – must be ultra-clean
  - Variety of vectors including for HDV and aviation
- Learning through power and fuels

Syngas clean-up is challenging



ETI project and current gasification landscape in UK

- Type 1
  - No gas cleaning
- Type 2
  - Gas cleaning but no tar removal
  - Improved steam boiler efficiency & reliability
- Type 3
  - Gas cleaning & tar removal
  - Allows syngas use in engines, gas turbines, chemical synthesis



ETI analysis highlights gasification as a prominent, scenario resilient technology

Appraise (2009-11) → Select (2012-13) → Define (2014-16) → Execute (2017 +)

EFW project

BVCM
Bioenergy Value Chain Model
Optimising Bioenergy

WG Phase 1

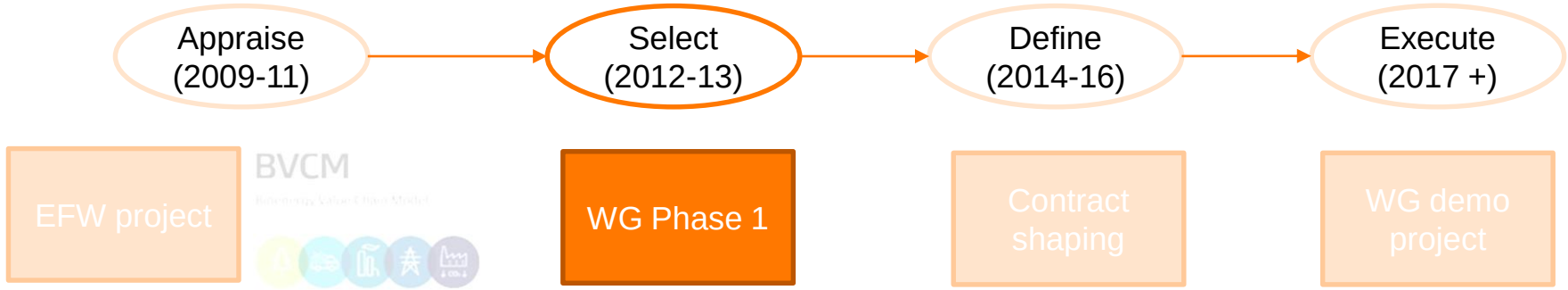
Contract shaping

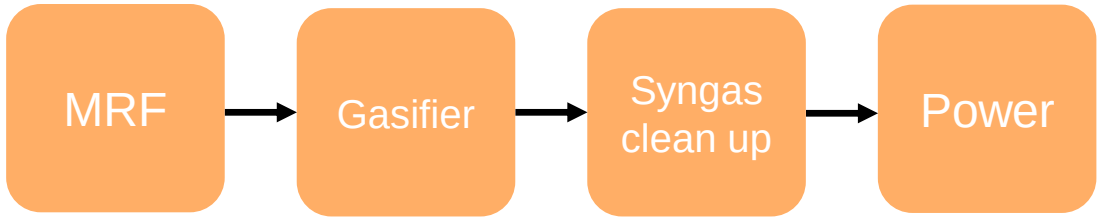
WG demo project

flexible efficient affordable scalable

Small scale (town) **waste gasification with syngas clean up** is a potentially important technology with near term deployment opportunities

Phase 1 waste gasification project

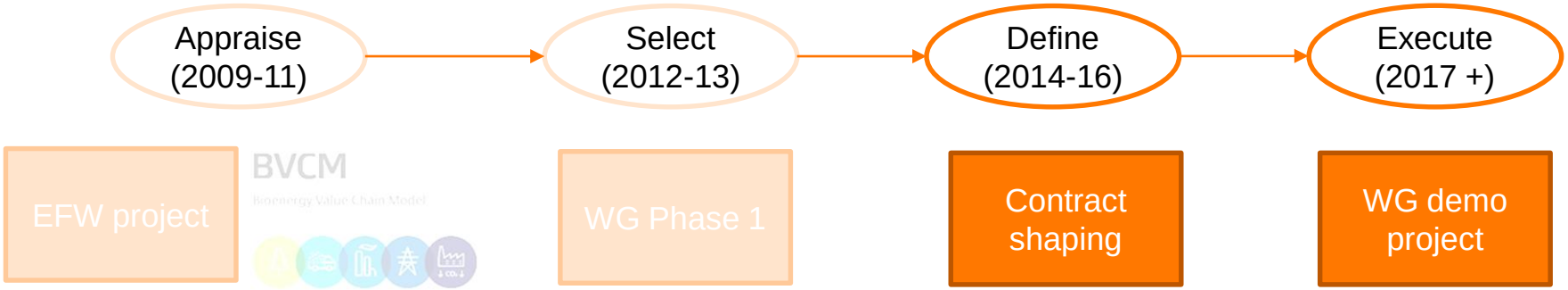




Competition – 3 designs

- FEED study and Business Plan
- Has to demonstrate high efficiency (net >25%) and availability (>80%)

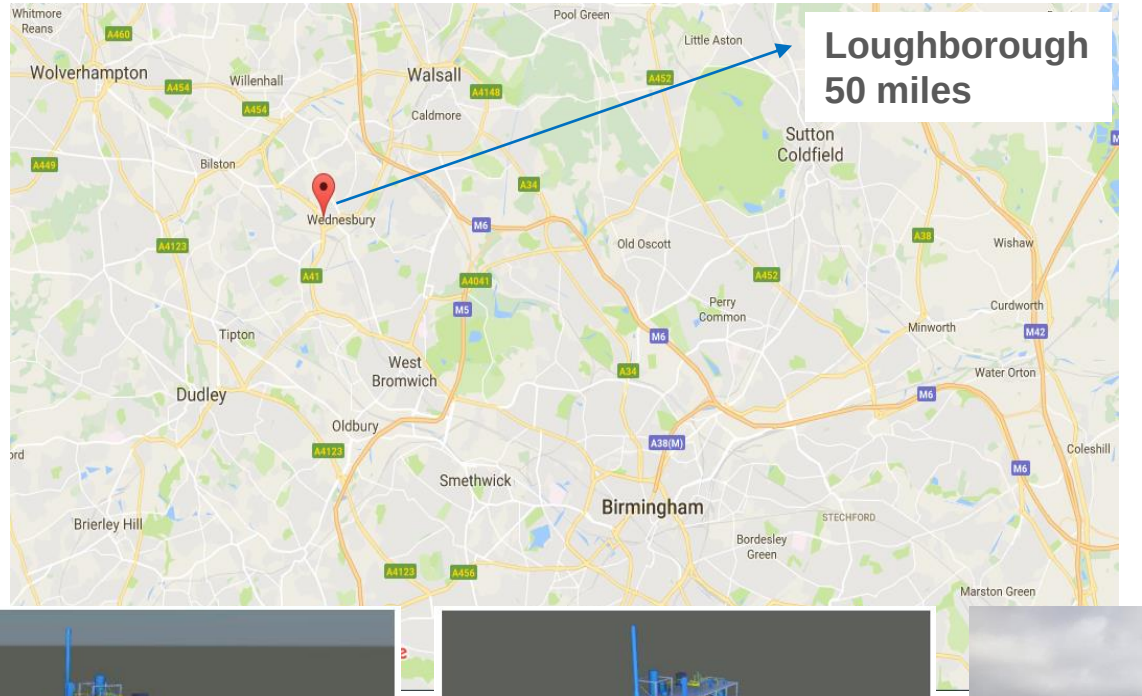
Phase 2 waste gasification project - demonstrator

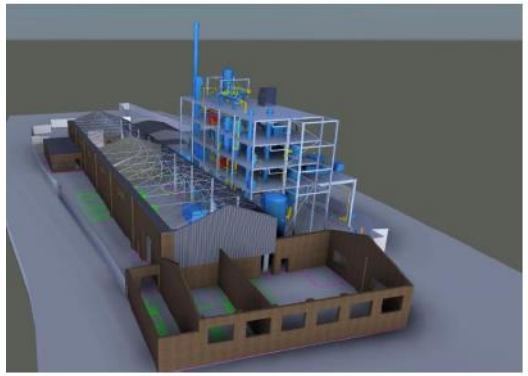


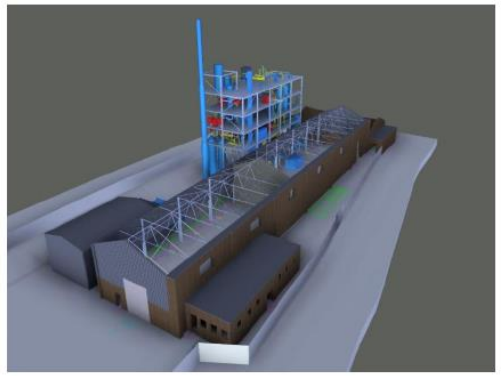
- Commissioned construction of a 1.5 MWe demonstration project
- Feedstock – mix of C&I and MSW
- Fluimax pressurised fluidised bed gasifier with a high temperature treatment to produce a high quality, hydrogen rich syngas
- Power generation via a specially adapted syngas engine
- Will incorporate unique syngas testing facility
- Commissioning March 2019 – followed by feedstock testing

Advanced Waste Gasification

ETI's 1.5 MWe waste gasification project, Wednesbury

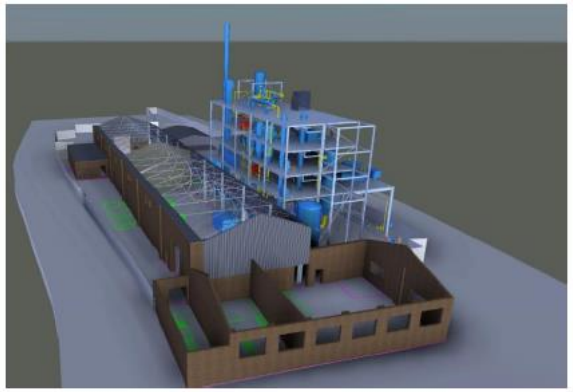


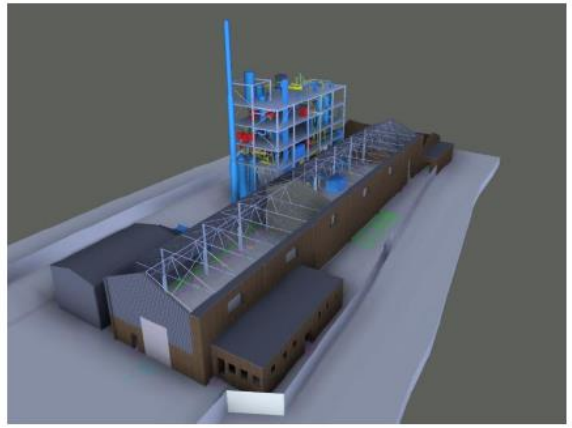




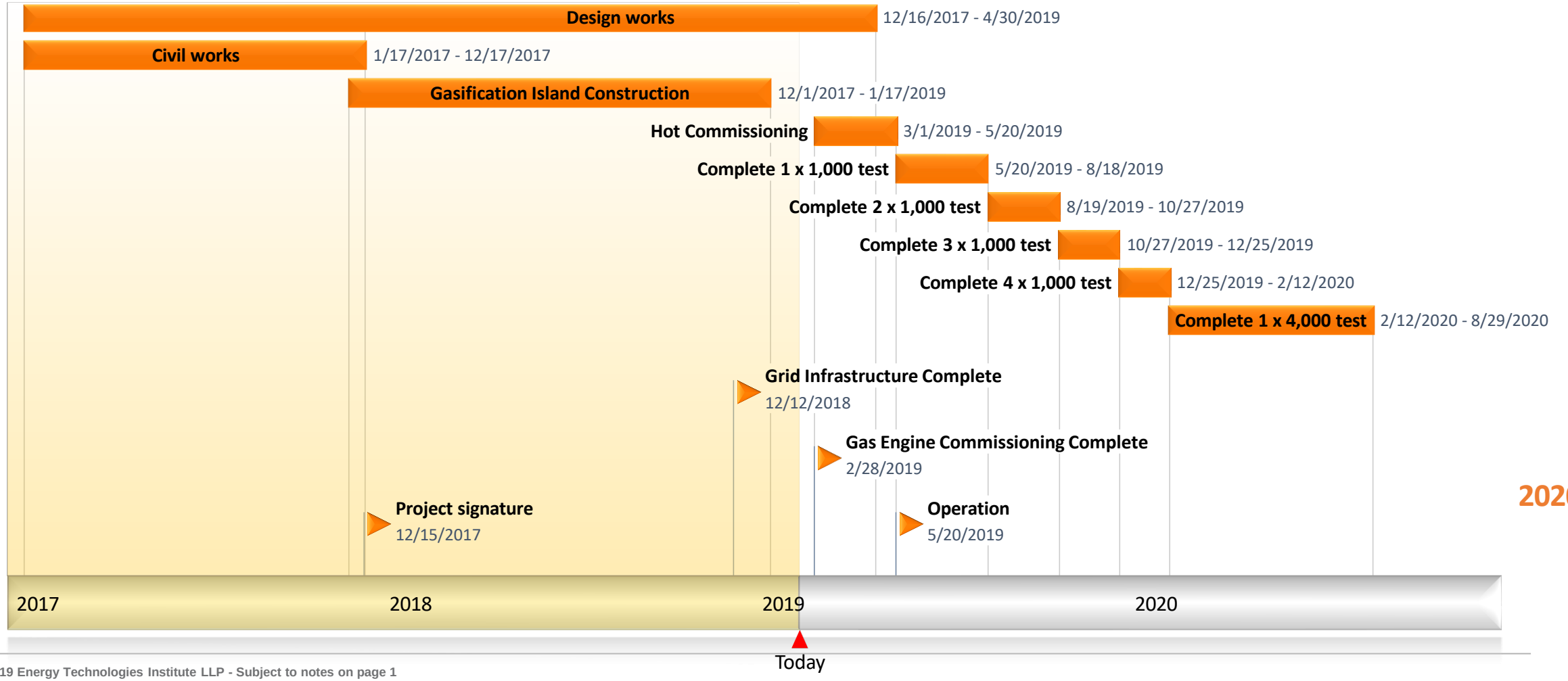
ETI progress in gasification

- ETI, bioenergy and gasification
- Most important UK resources and resilience
- Why is ultra-clean syngas important?
- ETI project progress and key lessons learnt





Project key dates



2020

Summary

- ETI, bioenergy and gasification
  - Both fundamentally important to achieving UK decarbonisation targets
- Most important UK resources and resilience
  - Wastes + others, both imported and indigenous
  - Variety drives technology choices
- Why is ultra-clean syngas important?
  - Only way that the benefits of gasification can be realised
- ETI project progress and key lessons learnt
  - Commissioning in mid 2018
  - Insights paper: http://www.eti.co.uk/insights/

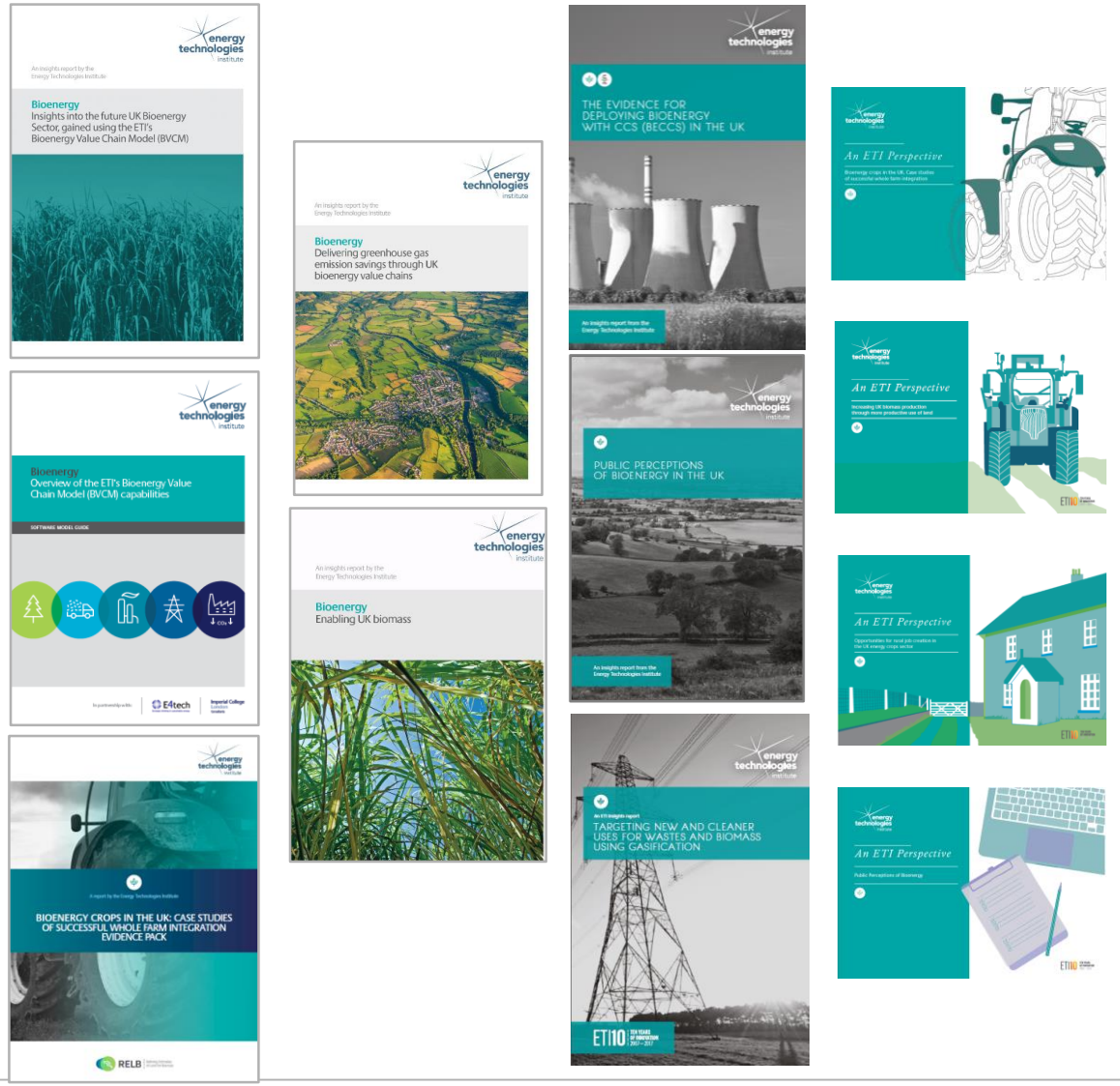
Some key lessons learned to date

- Gasification offers a number of benefits in the UK setting
  - Flexible in feedstock and outputs - resilience
  - Comparable/better efficiencies compared with other technologies, especially at smaller scales
- Gasification of wastes and use of syngas in an engine is technically feasible
  - ETI's targets are achievable
- Potential to be cost competitive with other sources of renewable power
  - scope to reduce costs as experience is gained (especially procurement costs).
- To build confidence in financing and delivering, UK policies should be designed as an integrated programme of stages
  - Support needed beyond FOAK
- Careful and considered approach to scale up is needed
- HSE management needs to be well led – Chartered IOSH level
- Structured / staged approach to Project Management – challenge to bring in different types of Project Management at the RIGHT stage(s)
- Financing / legal – need careful and ongoing management

ETI knowledge

ETI Publications:
http://www.eti.co.uk/library

ETI Knowledge Zone:
http://www.eti.co.uk/programmes/bioenergy



Registered Office
Energy Technologies Institute
Charnwood Building
Holywell Park
Loughborough
LE11 3AQ

For all general enquiries telephone the ETI on 01509 202020

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