

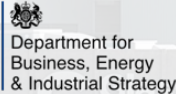


# Assessing the potential of Hydrogen Fuel for the Foundation Industries

## Hydrogen Supply Chain Showcase

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UK Research and Innovation



INDUSTRIAL STRATEGY



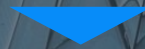
LIVERPOOL CITY REGION  
COMBINED AUTHORITY

METROMAYOR  
LIVERPOOL CITY REGION

STRATEGIC INVESTMENT FUND

THE GLOBAL CENTRE OF  
EXCELLENCE FOR GLASS  
IN R&D, INNOVATION AND TRAINING

# Who We Are



We were built by the glass industry, for the global glass industry to create the Global Centre of Excellence in St Helens, UK to make glass the low carbon material of choice.



Non-Profit, Membership Organisation



Research and Technology Organisation

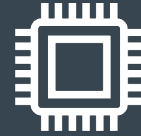


Leading the global shift to sustainable manufacture

## Our Mission ▶



Support organizations  
Sustainability Journey



Demonstrate disruptive  
technologies



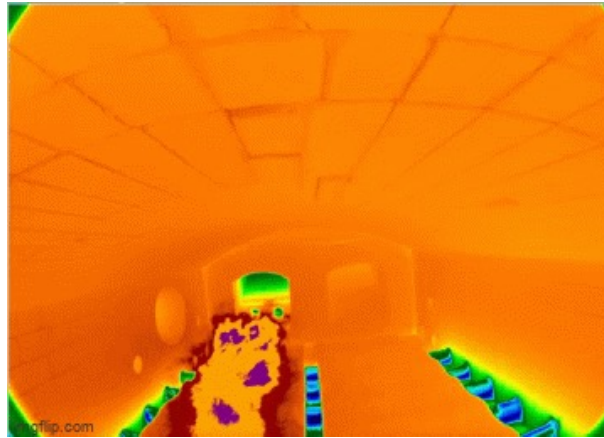
Generate new impactful ideas  
felt through the supply chain to  
the consumer

## ◀ Our Vision

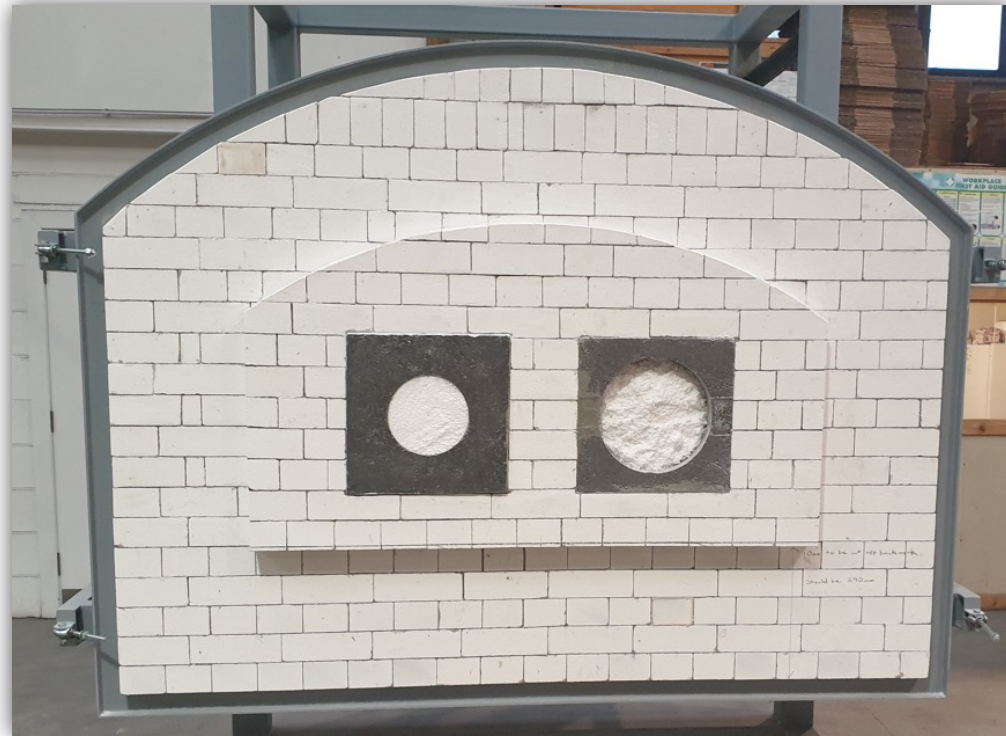
A sustainable future, enabled by glass.

# Combustion Research Facility

- 350kW multi-fuel combustion test bed (CTB): Scalable replica of an end-fired regenerative glass furnace
  - Natural Gas,
  - Hydrogen,
  - Liquid Biofuels,
  - Fuel Blends (any natural gas/hydrogen, any gaseous+liquid fuel blends)
- Interchangeable back wall to set up different test configurations for a variety of experimental programs including glass, ceramics and steel with and without hearth thermal load
- Heating of furnace from cold or with electric preheater at desired temperature setpoint (up to 1050°C)
- Fully instrumented furnace



# CTB with Steel/Ceramics Backwall





## Case 1: Hydrogen Trials in CTB, Glass

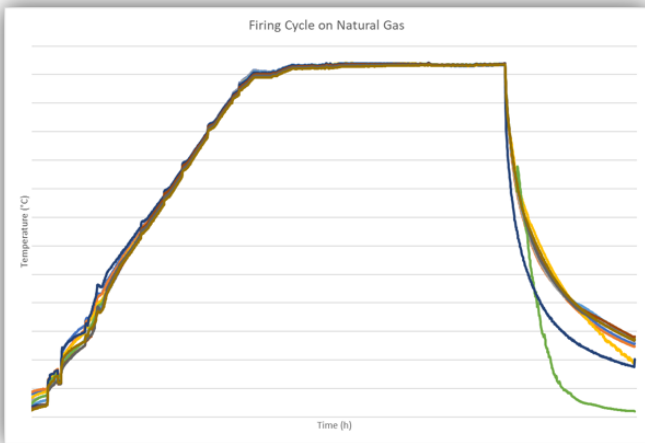
- Underport burners with preheated air configuration (original)
- Glass simulations using various liquid and gaseous fuels
- No product in furnace
- Thermal load simulated by water-cooled pins
- Peak operating temperature  $>1500^{\circ}\text{C}$

# Case 2: Hydrogen Trials in CTB, Ceramics

- CTB with steel backwall configuration
- Different ceramic kiln scenarios
- Natural gas and 100% hydrogen starting from cold (ambient) temperature
- Firing cycle profiles agreed by consortium partners for different product types
- Temperature ranges vary depending on product



# Case 3: Hydrogen Trials in CTB, Steel



- Industrial Hydrogen Accelerator Project - HYDESS
- CTB with steel backwall configuration
- Firing cycles agreed within consortium steel partners
  - Re-heat cycle
  - Degas cycle
  - Special cycle for particular steel product
- Natural gas, hydrogen and blends starting from cold (ambient) temperature
- Strength analysis – No detrimental effect on material properties comparing baseline gas with hydrogen/blends



H<sub>2</sub> flame with cold background



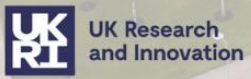
H<sub>2</sub> flame with hot background





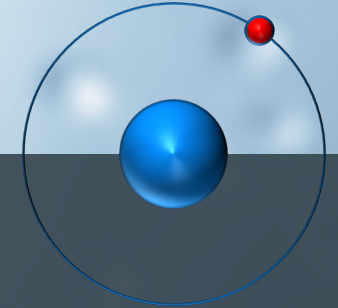
# Pilot Facility: St Helens, UK

- 30t/day glass R&D capability
- Hosting CTB and ceramic/steel kiln
- Designed as a platform to assess new technologies:
  - Carbon Capture
  - Waste heat recovery
  - New furnace/burner designs
  - Assessment of new refractory materials
- Benchmark low-carbon fuels:
  - Natural Gas
  - Hydrogen
  - Electric
  - Bio-fuels
- **Open-Access**
- **Due to be commissioned: Early 2024**



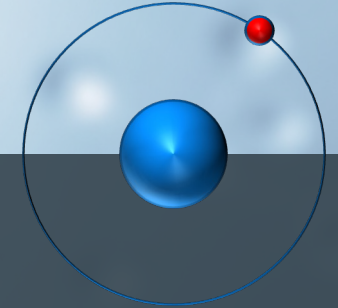
ST HELENS  
BOROUGH COUNCIL





# Key Advantages of Hydrogen as a Fuel

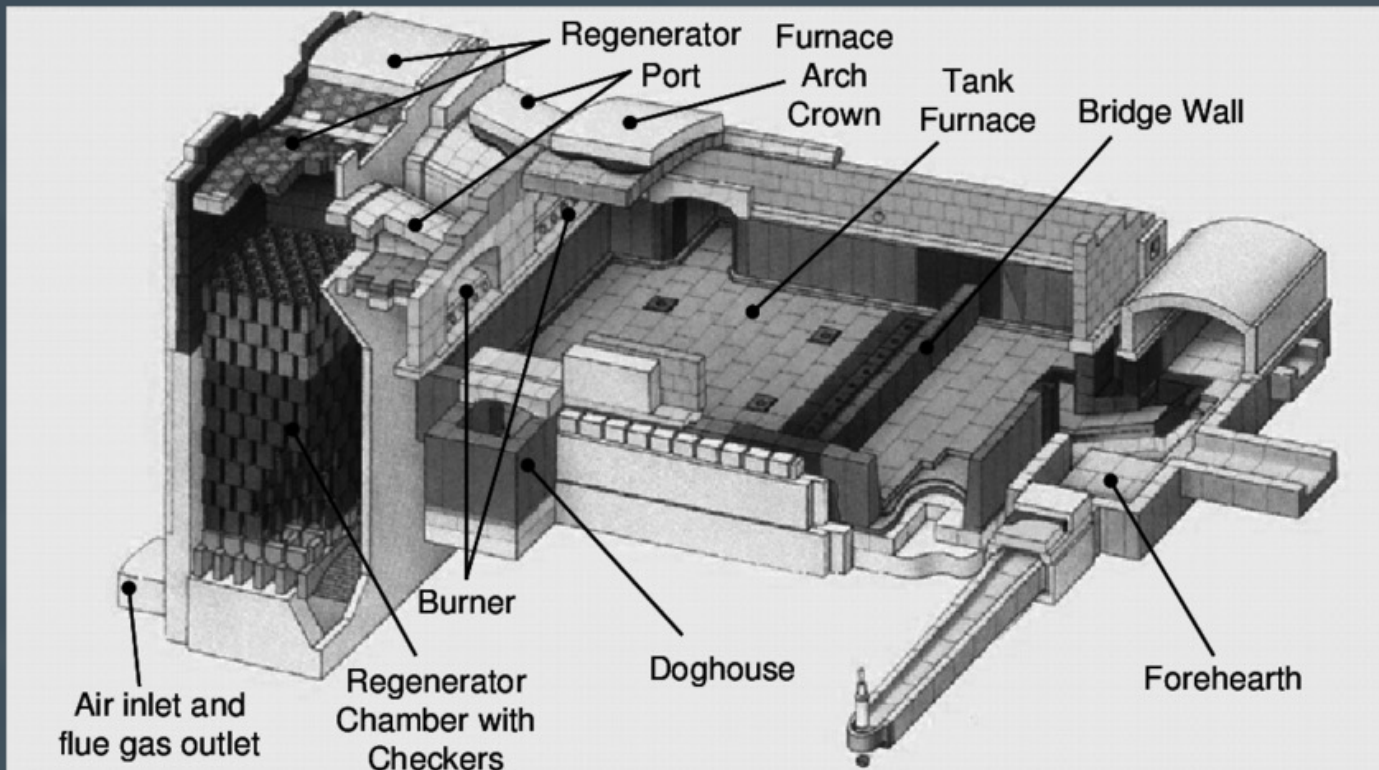
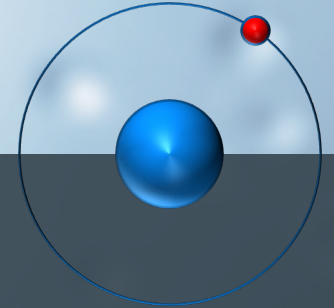
- Abundant and inexhaustible
- Environmentally friendly – non-toxic substance, which is rare for a fuel source
- It is renewable
- Ideal for use in remote areas
- Low-carbon hydrogen is a versatile clean-burning fuel
- Flexible energy source to support net zero-carbon energy strategies world-wide
- Hydrogen is a high-density source of energy with great energy efficiency – better than most fossil fuels
- Hydrogen has the highest energy content of any common fuel by weight
- Wide range of application – heat, transport, power, industry
- A new market is emerging – countries are developing their own hydrogen strategies



# Key Challenges of Hydrogen as a Fuel

- Flammability and the fear of hydrogen: A myth to overcome
- Clean production is still a challenge
- Cost of production – blue vs green hydrogen
- Infrastructure required for site delivery/production
  - Hydrogen embrittlement
  - Safe distribution network and transport
  - Current network upgrades required
  - Production on site as an alternative using renewable energy
- Environmental impact: NOx control
- Meeting the demand from customers

# Key Challenges of Hydrogen on Materials



- Refractories
  - Crown
  - Refractory pockets
  - Exhaust
  - Regenerators
- Gas delivery system
  - Pipework
  - Burners
  - Control equipment

Image: Regenerative Furnace Schematics. Courtesy of "The Potential of Thermophotovoltaic Heat Recovery for the Glass Industry", DOI: [10.1063/1.1539368](https://doi.org/10.1063/1.1539368)

An architectural rendering of a modern, multi-story glass building. The building features a prominent glass facade and a large entrance area. In the foreground, there is a parking lot with several cars and a white van. A sign on the building reads "Glass Futures". The sky is overcast with dark clouds. The overall scene is dimly lit, suggesting dusk or dawn.

# Thank You!

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