



International Collaboration for sustainable Glass Manufacturing

With Aston Fuller, General Manager and
Masimba Toperesu, R&D Projects Lead

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

AGENDA

- 01 **Introduction**
- 02 **Overview of Glass Futures**
- 03 **Overview of new £60m Innovation centre**
- 04 **Opportunities for international collaborations**
- 05 **Summary**

India-UK Collaboration Opportunities

Energy for Growth Dialogue 2017 - Inaugural meeting April 2017 in New Delhi

UKRI – Funded India Lab 2 Lab collaboration – 2022

UKRI Visit India Mission - March 2023

India visit UK Mission - May 2023

UK - India Round 7 FTA Talks – March 2023

- There is expected to be a long and positive relationship for UK-India trade
- Opportunity to ensure that collaboration on technology is also part of the relationship
- How do we ensure GLASS is part of this relationship discussion?



Glass As An Enabler



Construction

Pharmaceuticals

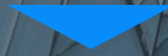
Defence and aerospace

Food and Drink

Optics and telecommunications

Power generation

Who We Are



We were built by the glass industry, for the glass industry to create the Global Centre of Excellence for glass R&D, innovation and training



Non-Profit, Membership
Organisation



Research and
Technology Organisation

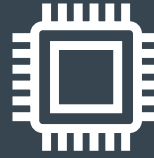


Leading the global shift to
sustainable manufacture

Our Mission▶



Support organizations
Sustainability Journey



Demonstrate disruptive
technologies



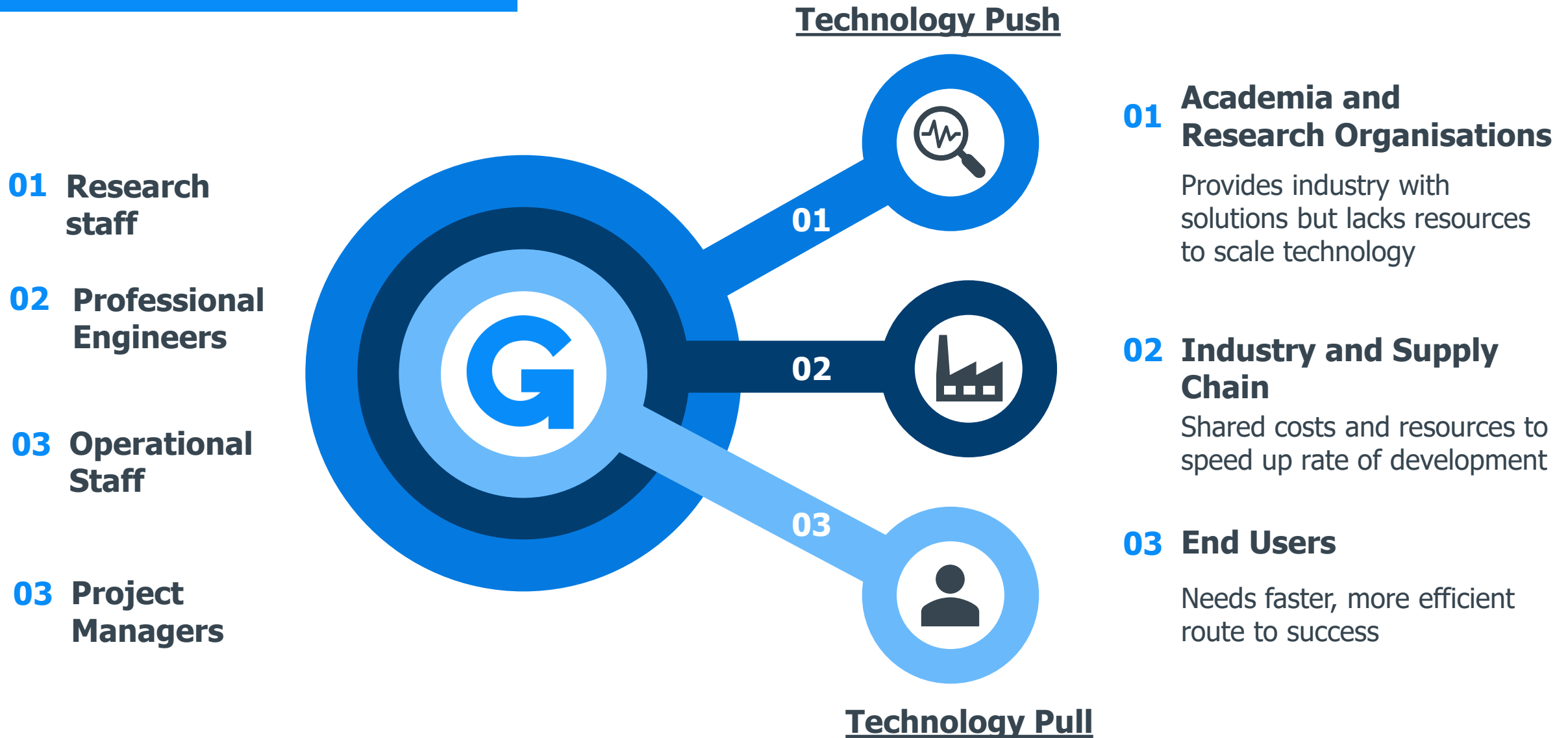
Generate new impactful ideas
felt through the supply chain to
the consumer

◀Our Vision

A sustainable future, enabled by glass.



Collaborating To Accelerate Global Change



Funding Partners

Totalling 5bn Rs

Network Space

Landowner and developer, also securing £12m private sector/institutional investment towards construction costs with a freehold and lease sale

UKRI

£21m through Transforming Foundation Industry (TFI) Challenge fund for fit out and commissioning of R&D facility



UK Government

£7.1m Industrial Fuel Switching contract secured kick started work in 2020



St Helen's Borough Council

Supporting pre-development works



Liverpool City Region Combined Authority

£10m towards construction as a regional strategic investment

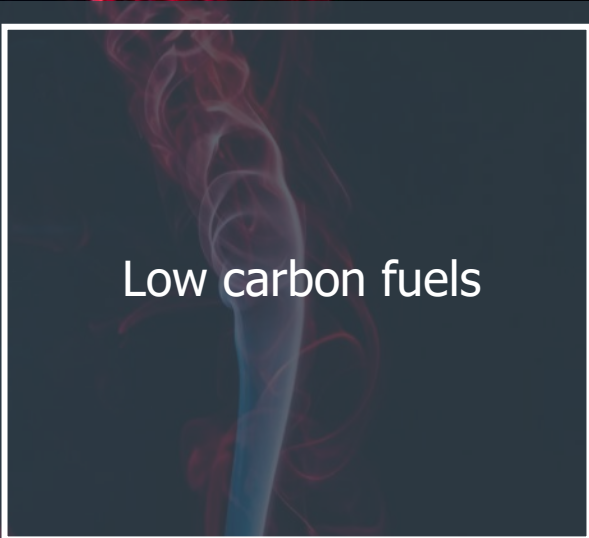


Bridging The Technology Readiness Level (TRL) Gap



**Key Opportunities
to achieve
sustainable Glass
Manufacturing**

*(and for the other Foundation
Industries too!)*



Low carbon fuels



Carbon Capture



Increased recycled
content, and industrial
symbiosis



Waste-heat recovery



Industry 4.0, digital
technologies, sensors
and automation



New Raw materials and
batch compositions

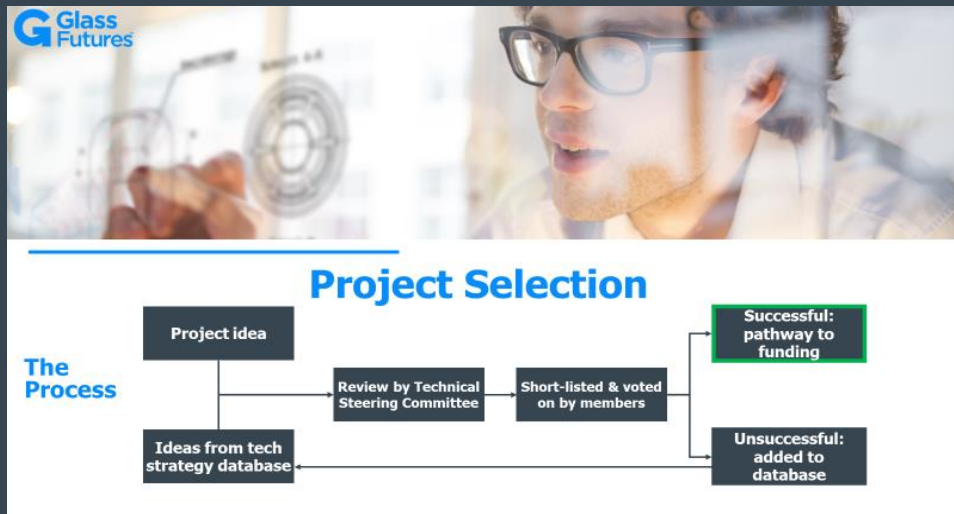


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Tackle Big Problems Collaboratively

Experimenting during production is risky and expensive as margins on glass container manufacturing require maximum plant uptime and production efficiency.

Our **consortium working groups** will accelerate research efforts towards a sustainable future, **to reduce risk and cost** to one individual member.



And Small Problems Privately

GFL is not in the business of supplying glass but supplying glass process experimentation, hence **enabling faster introduction of technologies and processes** that would otherwise take many more years to introduce.

We can help pull together **your own projects** to gain **competitive advantage** in the marketplace.

- Develop new ideas and concepts
- Decrease time to market for new products
- Innovation funding and project management services
- Consultancy and expertise from Glass Futures and our network of leading experts

Knowledge

Our Key Product!





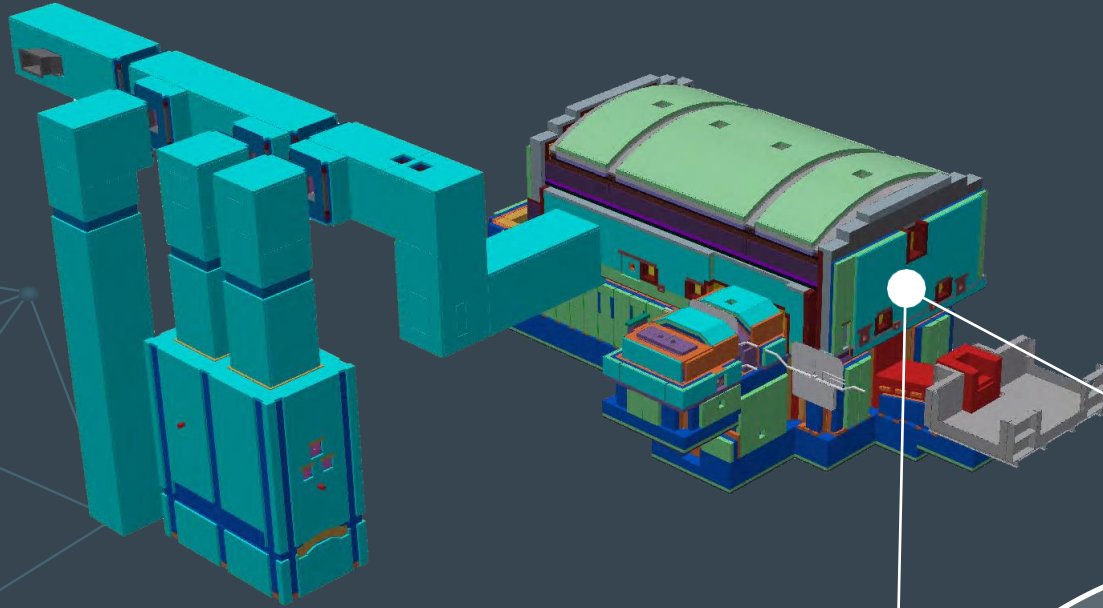
Pilot Facility: St Helens, UK

- 165,000 Sq Ft Industrial facility
- 100,000 Sq Ft Industrial yard
- Open access innovation ecosystem
- 30T/day glass R&D capability
- Industrial scale lab space available
- Circular economy testing of new materials
- Low-carbon fuels:
 - Natural Gas
 - Hydrogen
 - Electric
 - Bio-fuels
- Container, float and fibre manufacturing processes possible
- Warehousing and logistics
 - Digital supply chain proving ground
- Highly skilled jobs and apprenticeships
- Construction complete March 2023









7 Burner locations for
Oxy-Gas/H₂/Oil

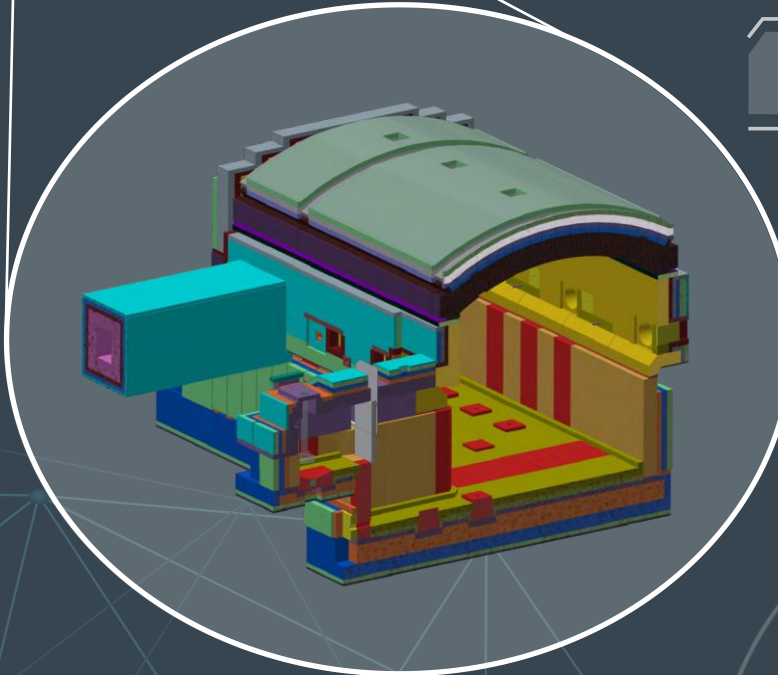
Super boost up to
80% electric melting

2 forehearth and a
melting tank drain

Newly Developed PCS
NEO DCS

Barrier and
Superboost

Rolled Plate and IS
line



Fully automated at
scale batch plant

Batch pattern
adjustment

Full width doghouse
Multiple chargers

Accommodation for
the addition of frit

Full abatement system
CCUS/Heat recovery

Raw Materials and Composition and batch

- ▣ Batch and glass composition development
- ▣ Testing new/alternative raw materials
- ▣ Effect of additives, e.g. surfactants
- ▣ High cullet levels
- ▣ Pelletisation
- ▣ Briquetting
- ▣ Pre-treatment

Batch charging and pattern control

- ▣ Batch pattern and charging optimization
- ▣ Batch physical properties
 - ▣ Moisture content
 - ▣ Particle size (including cullet)
- ▣ Camera development
- ▣ Feeder Design/control

Control/Monitoring/Modelling

- ▣ Camera development
- ▣ IoT/Digitalisation
- ▣ Feedback control
- ▣ Modelling validation
- ▣ Tracer experiments

Fuels and Combustion

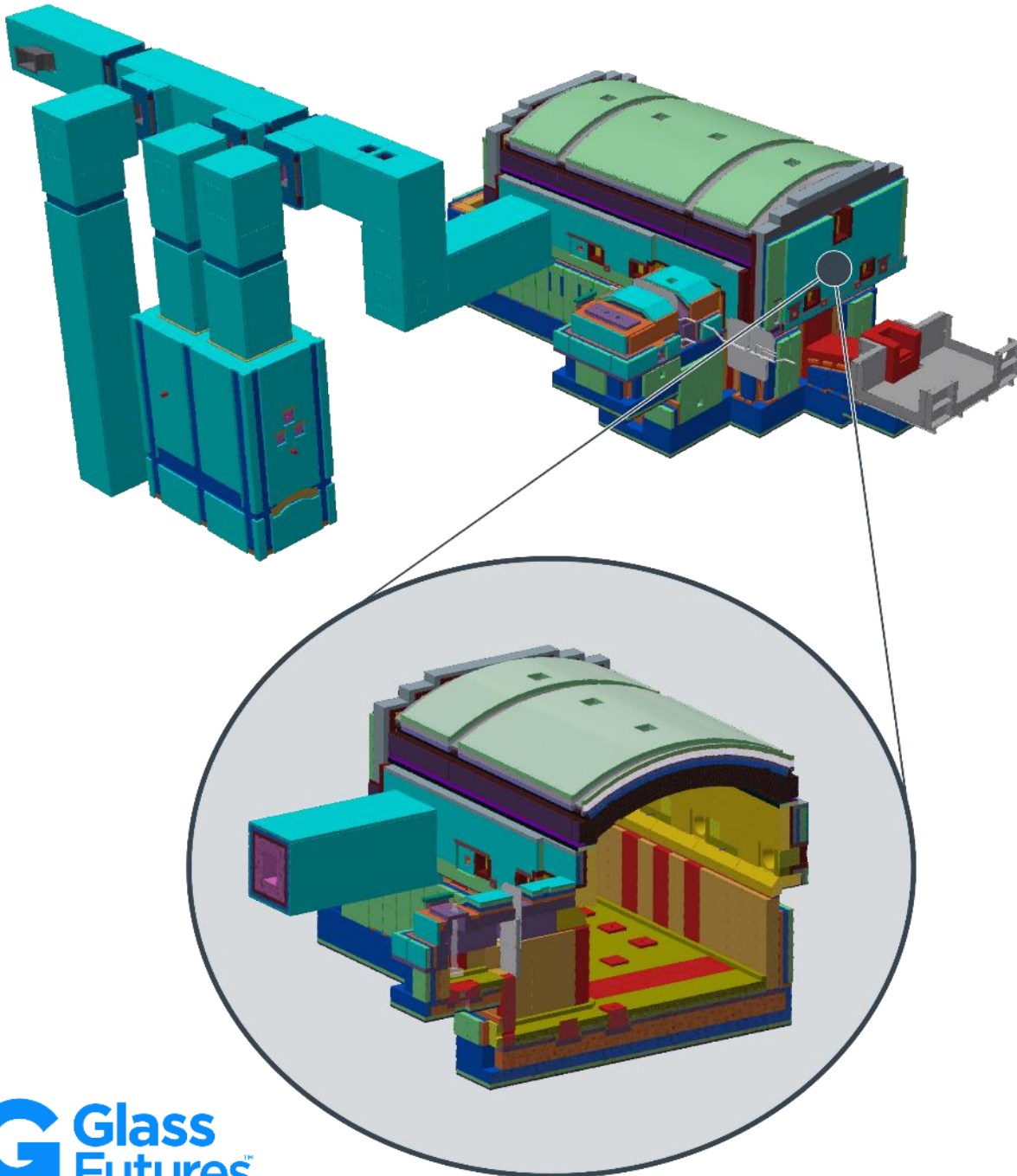
Alternative fuels

- ▣ Oxy-H₂
- ▣ Air-H₂
- ▣ Liquid biofuels
- ▣ Boosting (including superboost)
- ▣ Fuel mixtures
- ▣ Waste Heat Recovery (secondary processes)
- ▣ Burner development and testing

Key Collaborative programmes

- ▣ Key to success is to work together as a big collaborative consortium
- ▣ Also interested in IS machine developments, news coatings and inspection technology – Expect these developments to be smaller groups.
- ▣ Masimba will also talk through the refractory development in a little more detail

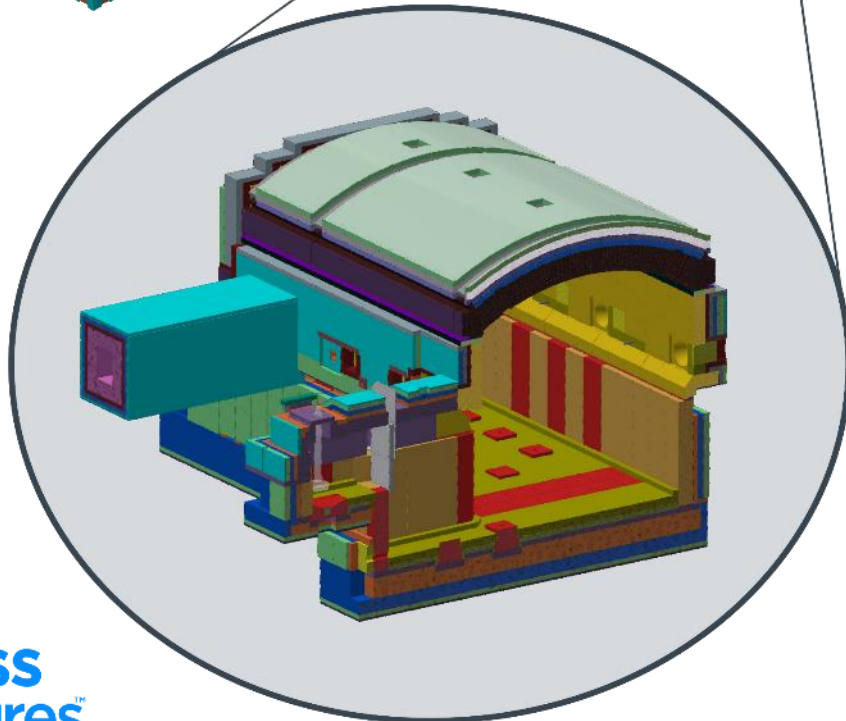
Furnace Features and Capability (Refractory)



- Glass contact test pocket (deep & shallow sections)
 - Stirrers/Bubblers within test pocket drain -
 - Immersed electrodes? Electrode block test site
- Late stage addition composition changes
 - Forehearth section
 - Field trial tests of expendable products
- 3 Crown Sections – Potential of 1 test section to be used for testing.
- Flue gas Refractory Test chamber –
 - Potential for 3 layers of refractories bricks tested in the flue gas flow on the “in” (downward flow) and “out” (upward flow).
 - Up to six layers in total (no drawing yet). Ideal for regenerator type materials but other materials as well.

Training Opportunities & Capabilities

- Provision of a safe controlled opportunity for operational/process training
- Opportunities for Inside Training for Ops/staff
 - Inserting refractory blocks for electrodes in the test pocket hot bath.
 - Refractory repair – hot/cold patch repairs
- Furnace Installation inc. heat-up and cool down
- Glass Technology – classroom and applied together
- Rolled Plate and IS machine operator training and development
- PhD Student and University student placement opportunities



A data rich environment!



One single site wide Control system for Data



Key Systems

Building works complete and handed over in April 2023

All major fit-out works through 2023

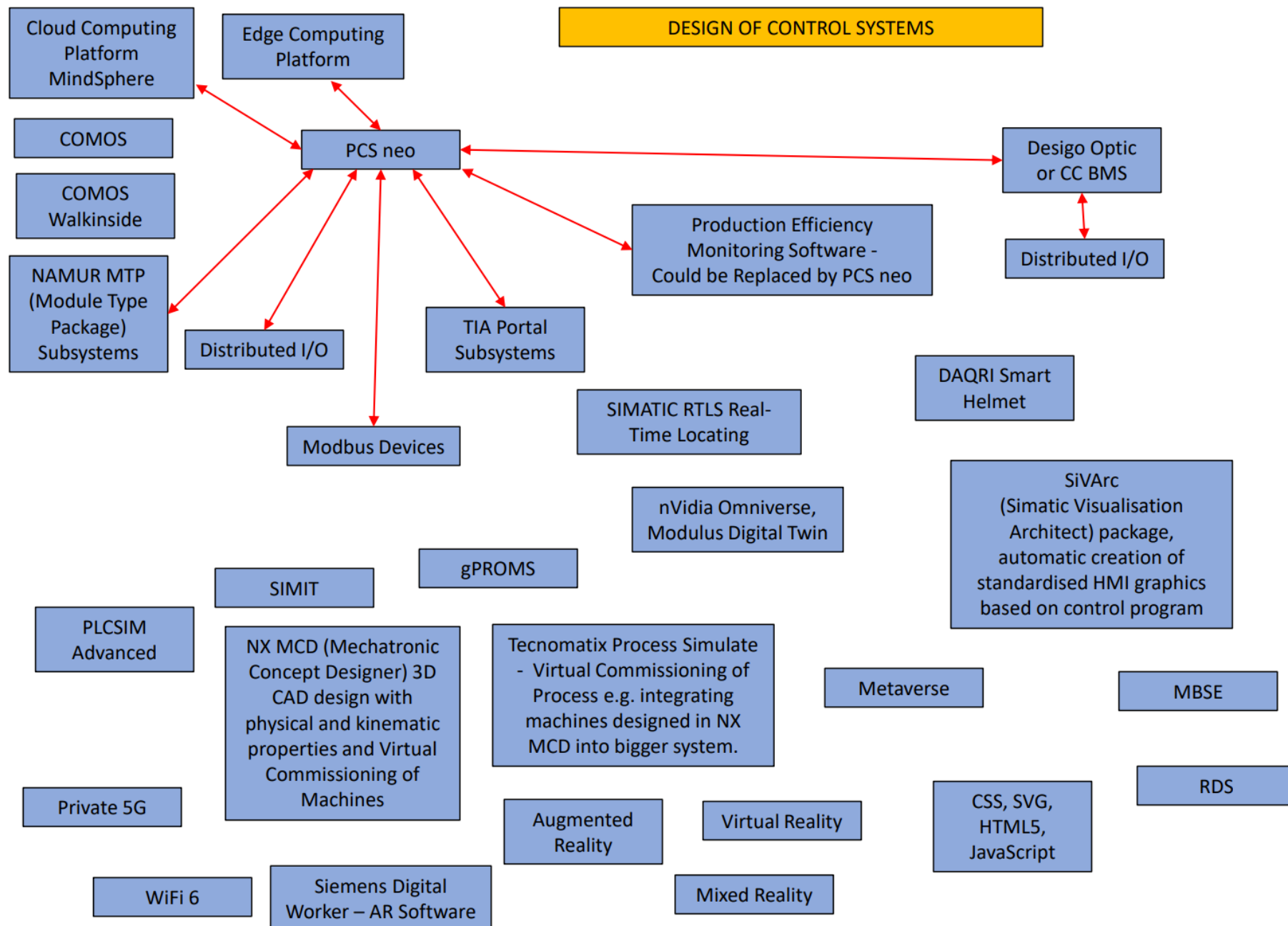
Plant start up in early 2024

Eme provided Batch plant

Custom Furnace designed by Stara Glass

2 x R&D manufacturing lines

GGP Works
Hand Over B & K
GGP Steelwork Packages
GGP Builders works
GGP Civils works
Control Systems Infrastructure
Utilities
Distribution of Utilities
Electrical Systems
Water
Compressed Air & Vacuum
Natural Gas
Hydrogen
Oxygen
Diesel & Test Oils
Nitrogen (Not Required Phase 1)
Other Gases (Not required Phase 1)
Batch Plant & Cullet Return
Batch Plant
GFL Works
EME's Work Plan - Batch Plant
GAME's Work Plan - Batch Plant
Cullet Return
Furnace & Flue Gas
Furnace
Flue Gas
WE & Forehearths
Container Glass Line
Flat Glass Line
Laboratory
Workshops
Storage
Mouldshop
Process Rooms Fit-out
Fire Systems - Process Area
Vehicles
WP3 - Operations Team Recruitment





Adding value to industry with research

Combustion Test Bed

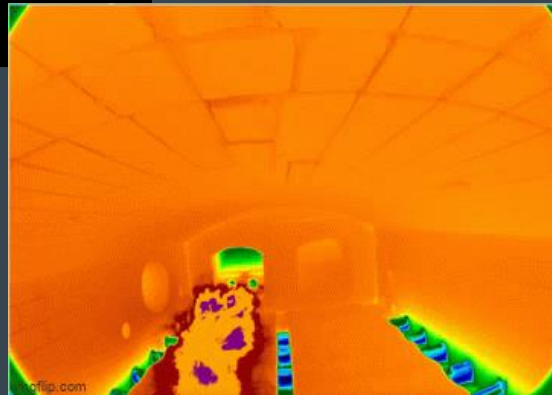
350kW combustion test-rig

Highly instrumented, IR camera

Fuels: Natural Gas, Hydrogen, Biofuels and blends

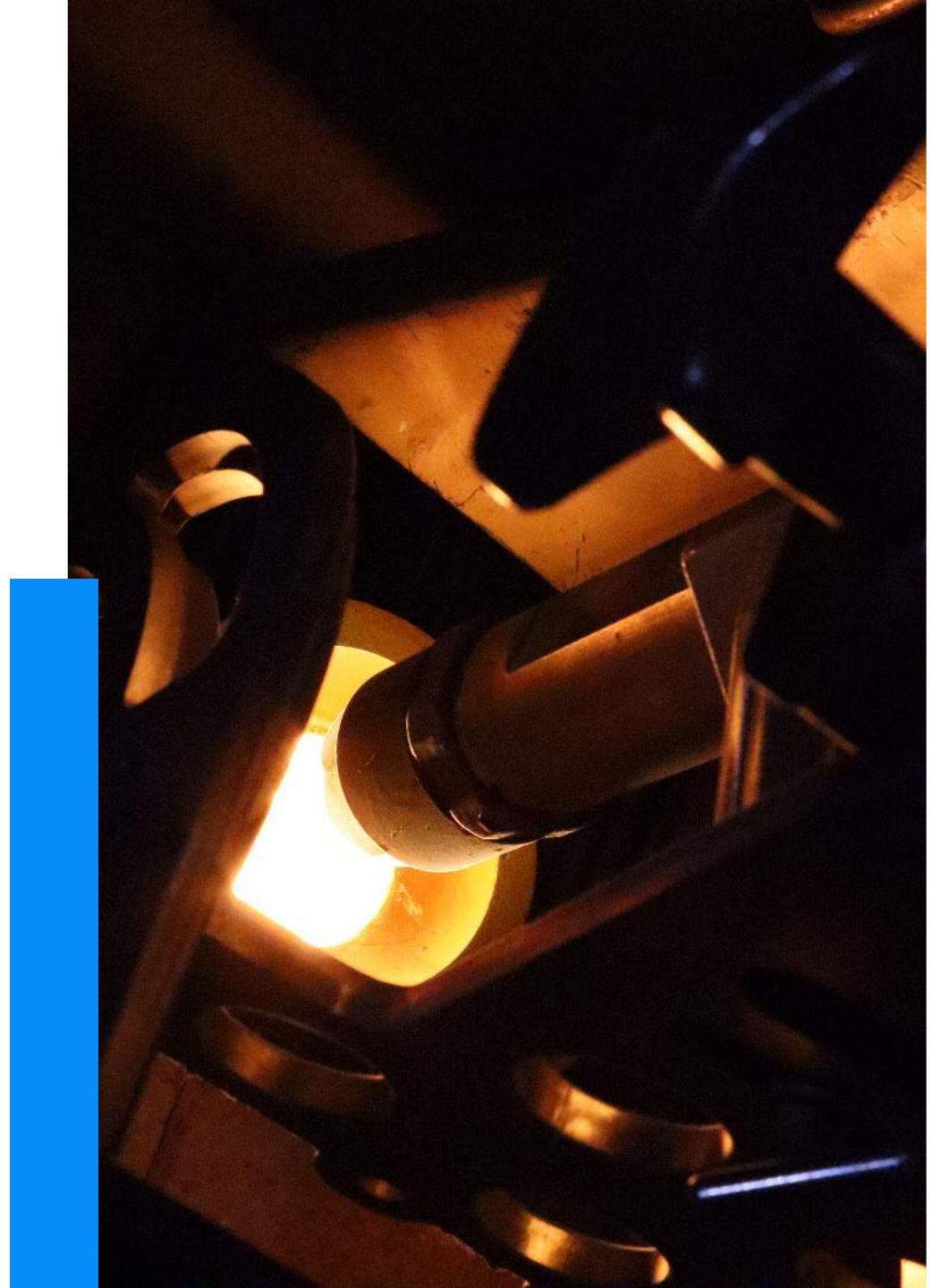
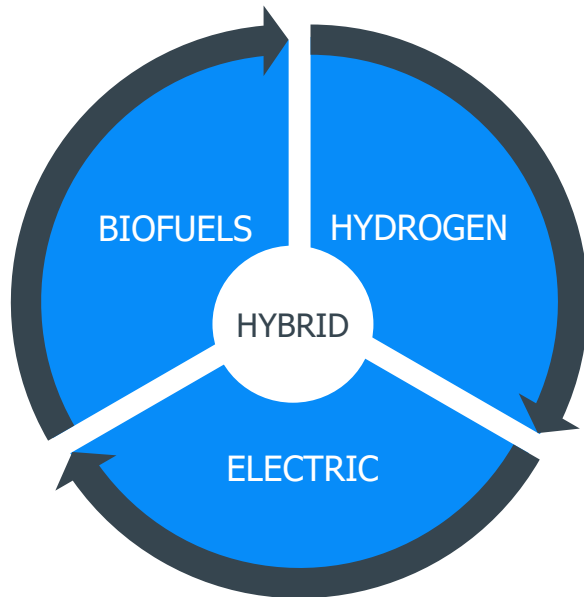
Air preheat: 0°C - 1000°C

Ability to fire from ambient temperatures



Low carbon fuels for industrial furnaces

- More than £22 million funding to date across five projects
- Partners from industry, supply-chain and academia, brands, across the glass, steel and ceramics sectors



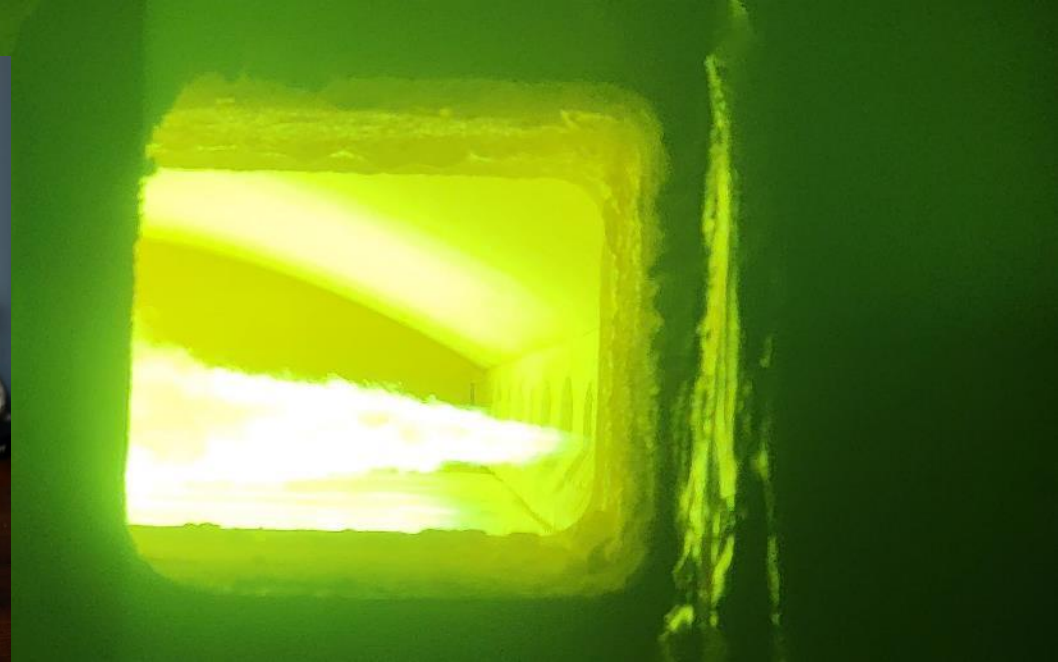
Industrial Biofuel Trials

■ Encirc, Derrylin, January 2021:

- 400T/day container furnace
- 3 weeks continuous operation without issues
- 4 million low-carbon bottles produced

■ NSG Pilkington, St Helens. February 2022:

- 850T/day float furnace
- 165,000 sq ft (3 x football pitches) of the lowest carbon float glass ever made (80% reduction in embedded CO₂)



Carbon Capture Utilisation and Storage (CCUS)

- CCUS technologies extract the CO₂ gases from the furnace exhaust
- Processing emissions from glass furnaces is challenging giving the complex nature of the gases (e.g. contain sulphates, NOx, heavy metals, acids)
- Several different CCUS technologies have been developed
- Glass Futures have reviewed the most promising CCUS technologies that could be used within the glass sector
- A C-Capture CCUS unit is due to be installed on the Pilot line in Jan 2024



Outcome

- Carbon Capture does have potential to remove CO₂ emissions from glass furnaces
- The technology is still in the early stages of development and likely to be 2030 before commercially viable for the glass sector
- The economics will be challenging to justify
- Need to have a plan as to what to do with the CO₂ captured

Cross-sector collaborations

- Ceramics sector – Lots of testing with H2 complete
- Steel/metals sector
- Cement sector
- Advanced Chemicals/materials manufacture
- Energy sector



India-UK Collaboration Opportunities

Glass Futures and AIGMF – making positive relationships

More focused Glass visits between countries?

Events hosted together as UK-India Collaborations

UK - India collaborative funding expected UKRI – CSIR

GFL speaking with all UK public sector bodies

Possibility to fund work and support applications for funding

Glass Futures members already in India, Brands, Manufacturers and melters!

Making sure people look AT GLASS – NOT THROUGH IT





Any Questions?

Aston.fuller@glass-futures.org

Masimba.Toperesu@glass-futures.org