CO2 Reduction
‘Charge Carbon’
COAL to ECOKE

Process Impact
Environmental Impact

Ed Heath-Whyte MIEMA, MIET, MIMMM, CEnv
Head of Environment and Sustainability LSUK

#CutToTheFuture
• No solution to reach net zero without addressing the largest industrial emitter of CO2 – steel. Major financial challenge requiring innovation and investment

• LIBERTY aims to transform steel manufacturing into product and technology leader through GREENSTEEL strategy

• GREENSTEEL recycles and upcycle the growing amount of scrap steel, using electric arc furnaces powered by renewable energy

• High grade steel and alloys feed downstream operations for demanding sectors such as defence, aerospace and energy

• LIBERTY developing integrated GREENSTEEL approach across Australia, UK Europe and the US. Industry-leading ambition to be carbon neutral by 2030.
• **ecoke is a sustainable new raw material** that can replace anthracite, the main source of charge carbon in electric steelmaking

• LIBERTY Steel UK (LSUK) e coke utrials in 2022 showed ability to **reduce EAF crude steel’s direct carbon emissions by up to 30%**

• From mid-January LSUK to start steel production utilising **100% e coke**

• As well as environmental benefits, offers opportunity to **lower energy costs, reduce carbon credits and create substantial savings**

• Pioneering product that opens up **significant opportunities across LIBERTY’s global business and steel industry worldwide**
PROCESS IMPACT

‘Charge Carbon’ COAL to ECOKE®
Furnace Monitoring

- Off-gas temperatures remained normal
- Oxygen control and melt carbon more stable
- Energy Consumption slight increase.

Product Monitoring

- Trials to narrow strip via Large Bloom with no change in product cleanliness or properties
- Trials to Engineering Bar via Small Bloom no change in product cleanliness or properties
• **Trials of e coke 100 took place during 2023** that included EAF operational changes

• The expectation was that **e coke 100 would negatively impact KPIs**

• Results confirmed **expectations and melt analysis was good**

• However full cost per ton of using e coke 100 **compared to Anthracite when the UK ETS charges are included were very positive.**

<table>
<thead>
<tr>
<th>Costs included:-</th>
<th>Anthracite</th>
<th>eCoke 100</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power On Mins</td>
<td>87</td>
<td>95</td>
<td>-8</td>
</tr>
<tr>
<td>New Kwh/t</td>
<td>461</td>
<td>485</td>
<td>-23</td>
</tr>
<tr>
<td>Tap Temp</td>
<td>1687</td>
<td>1658</td>
<td>29</td>
</tr>
<tr>
<td>Oxygen Per Ton</td>
<td>15</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Gas Per Ton</td>
<td>1.46</td>
<td>1.95</td>
<td>-0.49</td>
</tr>
</tbody>
</table>

**Change in Power On Mins:**
- Anthracite: 87
- eCoke 100: 95
- Change: -8

**Change in New Kwh/t:**
- Anthracite: 461
- eCoke 100: 485
- Change: -23

**Change in Tap Temp:**
- Anthracite: 1687
- eCoke 100: 1658
- Change: 29
Economic Case for e coke®

- e coke costs more per tonne than Anthracite
- e coke is Biomass and is not subject to UKETS
- Slight increases in ‘other’ costs (Electricity)

\[
\text{Coal/Coke £} + \text{UKETS Allowance ££} = \text{£££}
\]

\[
\text{E coke £££} + (\text{No ETS Allowance costs}) = \text{££££}
\]
• ecoke100 has enabled Liberty Speciality Steels to **reduce their carbon footprint immediately** while **maintaining focus on high quality steels.**

• Our advance in Greensteel manufacture is **not without compromise in the current market** as key performance metrics were affected.

• Electric steel makers have the ability to be **truly Green if we think differently** and accept that our future measures will not be the same as the past.
ENVIRONMENTAL IMPACT
‘Charge Carbon’ COAL to ECOKE®
Using ecode® as EAF Charge Carbon

- As part of the Rotherham Steel and Bar CN30 Roadmap Carbon additions to the EAF’s were identified as a significant source of CO2.

- CPL Industries had a product called ecode®30 that IS a 30% Biomass / 70% Anthracite mix. And ecode®100 that IS 100% Biomass.

- ecode® is a briquette and is delivered in 1 tonne FIBC’s so was a direct replacement for the Anthracite.

<table>
<thead>
<tr>
<th>CO2 Source in EAF Steelmaking</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire/Injection Carbon</td>
<td>3.5</td>
</tr>
<tr>
<td>PET Coke</td>
<td>3.3</td>
</tr>
<tr>
<td>Anthracite Charge Carbon</td>
<td>29.5</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>50.7</td>
</tr>
<tr>
<td>Cast Steel / Scrap Balance</td>
<td>4.2</td>
</tr>
<tr>
<td>Electrodes</td>
<td>7.7</td>
</tr>
<tr>
<td>Alloy Additions</td>
<td>0.3</td>
</tr>
<tr>
<td>Primary Alloys</td>
<td>0.8</td>
</tr>
</tbody>
</table>
A ‘Change in Operation’ Application had to be made to the Environment Agency, this was to change the ‘Raw Materials used in Steelmaking’ table in the Environmental Permit.

Information provided:

• Reason for new Raw material
• Dates of Trial Period
• Description of the Raw material
• Delivery and Storage of the material
• Details of how the use of the raw material meets any relevant Best Available Technique (BAT).
• Details of how the raw material may affect emission limits
Environmental Emissions from ecode®

Air Emissions Monitoring Evidence

- No Change in Dust Emissions
- No Change in Dioxin and Furan Emissions

- No Change in VOC Emissions
- No Change in PCB Emissions
Environmental Emissions from ecoke®

![Graph of VOC mg/m³ with data points from 2010 to 2023.]

![Graph of PCB ng/m³ with data points from 2004 to 2023.]

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• **Water** – No Impact

• **Ground**
  • Stored in an Fabric Intermediate Bulk Container (FIBC) in a concrete pen.

• **Waste**
  • No impact on waste, Wooden pallets will be reused.

• **Environmental Permit conditions checked and NO IMPACT from the use of eCoke**

APPROVAL FOR USE FROM ENVIRONMENT AGENCY
ACP Rotherham Steelmaking & Raw Materials

- Scott Jackson
- Paul Senior
- Leon Barker
- Gareth Griffiths
- Kevin Woodger
- Matt Szczepkowski
- Lee Bradshaw
- Andy Fereday
- Asmanh Khan

Environment and Sustainability Department

- Ed Heath-Whyte
- Jake Canfield-Hagyard
Thank You!

For Further information contact:

Edward Heath-Whyte
Head of Environment and Sustainability
Liberty Steel UK
ed.heath-whyte@libertysteelgroup.com

Scott Jackson
ACP Works Manager
Liberty Speciality Steel
Scott.Jackson@libertysteelgroup.com