

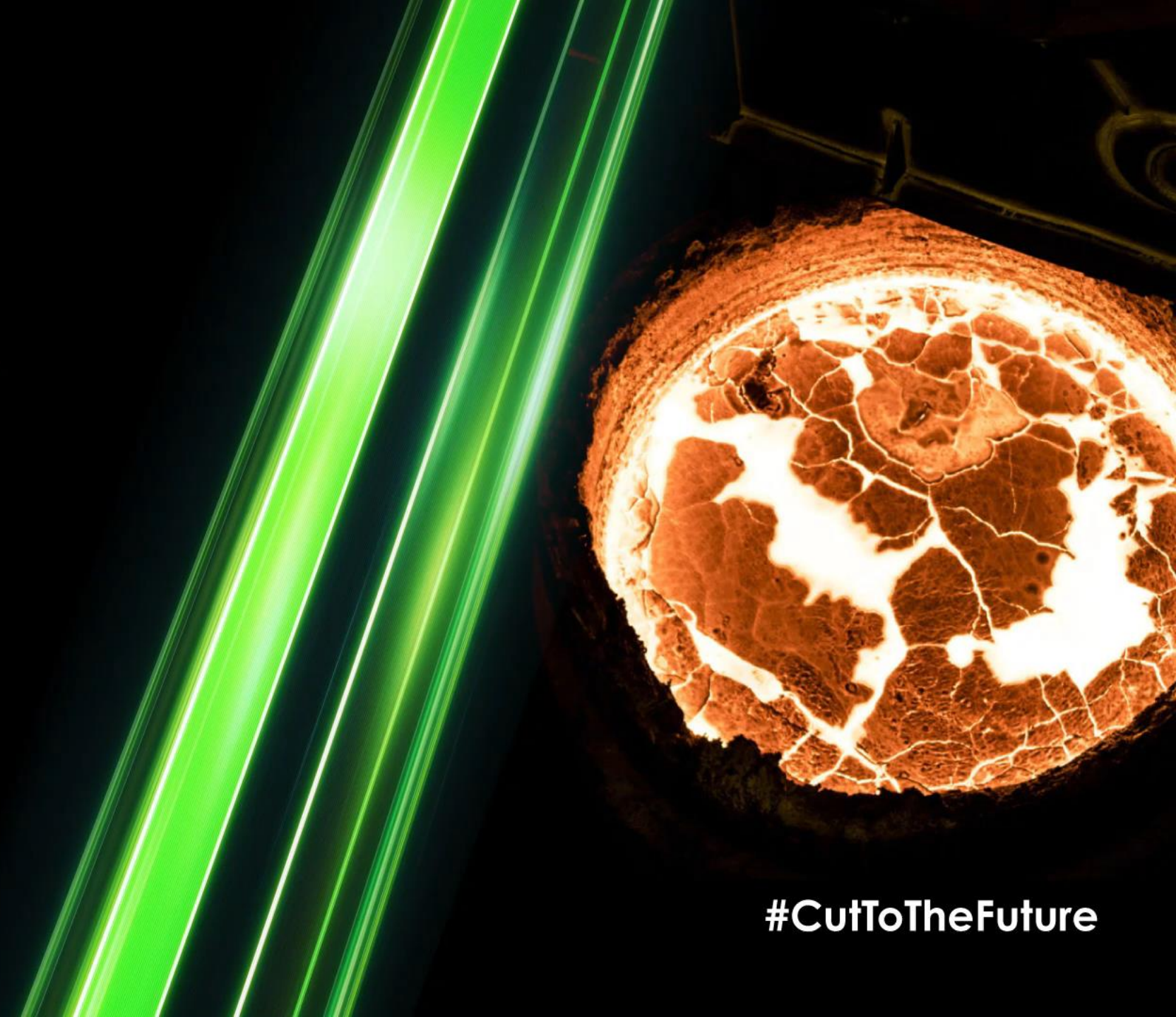


CO2 Reduction 'Charge Carbon' COAL to ECOKE

Process Impact
Environmental Impact

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#CutToTheFuture



GREENSTEEL Strategy



- 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.

Charge Carbon breakthrough

- **ecoke is a sustainable new raw material** that can replace anthracite, the main source of charge carbon in electric steelmaking
- LIBERTY Steel UK (LSUK) ecoke trials in 2022 showed ability to **reduce EAF crude steel's direct carbon emissions by up to 30%**
- From mid-January LUSK to start steel production utilising **100% ecoke**
- 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®



Process Impacts From 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 cleanness or properties
- Trials to Engineering Bar via Small Bloom no change in product cleanness or properties

HI01 (FHI02) - Cast Detail

Cast Id: Q3944M Year Made: 2022 Final Cast Id: Q3944M Round No

Specs & Anal | Baskets | Bubbling | Additions | Temps | Treat | Events | ChmEqu | Narr\Rad | Code

Data | Graph

Dip Time	Unit	Temp (C)	Oxygen (PPM)	Aluminium (%)	Carbon (%)	EMF
20/09/2022 16:34:04	NFN	1599	732.9		0.036	226
20/09/2022 16:37:26	NFN	1629	929.8		0.029	226
20/09/2022 16:48:01	TLD	1581				
20/09/2022 17:33:39	LF2	1582				
20/09/2022 18:00:47	LF2	1583				

HI01 (FHI13) - Cast Detail

Cast Id: Q3944M Year Made: 2022 Final Cast Id: Q3944M Round No

Specs & Anal | Baskets | Bubbling | Additions | Temps | Treat | Events | ChmEqu | Narr\Rad | Code

Electricity

Primary	£12,697.02	70539	Kwh
LF1	£659.34	3663	Kwh
LF2	£2,333.88	12966	Kwh
LF3			Kwh
Total	£2,993.22	16629	Kwh
Total	£15,690.24	87168	Kwh

Process Impacts From ecoke®

- **Trials of ecoke 100 took place during 2023** that included EAF operational changes
- The expectation was that **ecoke 100 would negatively impact KPIs**
- Results confirmed **expectations and melt analysis was good**
- However full cost per ton of using ecoke100 **compared to Anthracite when the UK ETS charges are included were very positive.**

Costs included:-

- Charge carbon
- Gas
- Oxygen
- Electricity
- UK ETS

	Power On Mins	New Kwh/t	Tap Temp	Oxygen Per Ton	Gas Per Ton
Anthracite	87	461	1687	15	1.46
eCoke 100	95	485	1658	5	1.95
Change	-8	-23	29	10	-0.49

Economic Case for ecoke®

- ecoke costs more per tonne than Anthracite
- ecoke is Biomass and is not subject to UKETS
- Slight increases in 'other' costs (Electricity)

Coal/Coke £ + UKETS Allowance ££ = £££

Ecoke £££ + (No ETS Allowance costs) = ££££

ecoke100® a true advance in Greensteel

- e coke100 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 ecoke® 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 ecoke®30 that IS a 30% Biomass / 70% Anthracite mix. And ecoke®100 that IS 100% Biomass.
- ecoke® is a briquette and is delivered in 1 tonne FIBC's so was a direct replacement for the Anthracite.

CO2 Source in EAF Steelmaking	%
Wire/Injection Carbon	3.5
PET Coke	3.3
Anthracite Charge Carbon	29.5
Natural Gas	50.7
Cast Steel / Scrap Balance	4.2
Electrodes	7.7
Alloy Additions	0.3
Primary Alloys	0.8


Approval for Trials of **ecoke**®

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

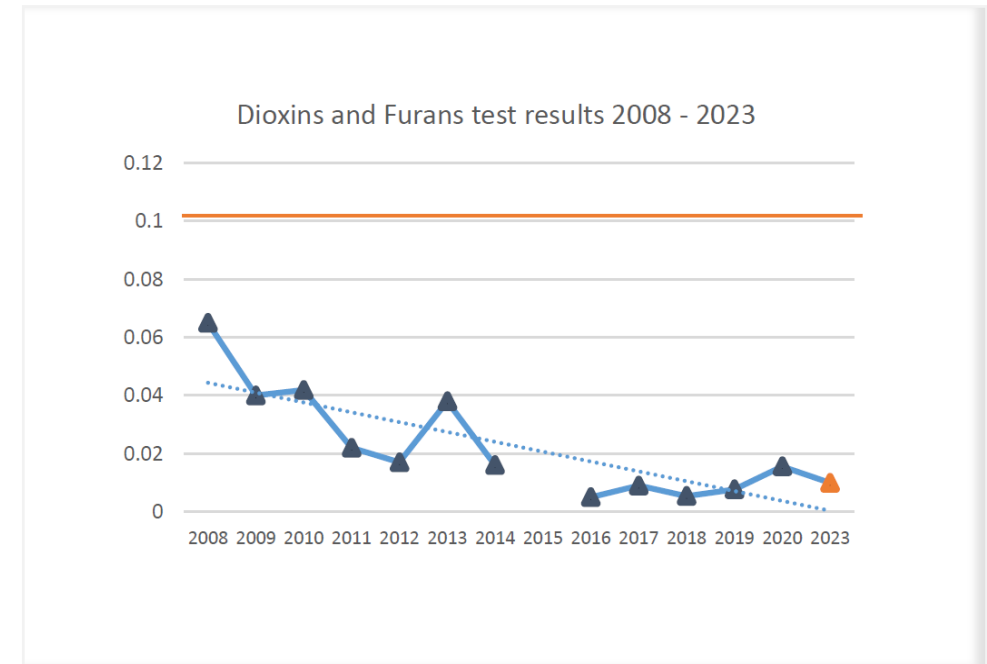
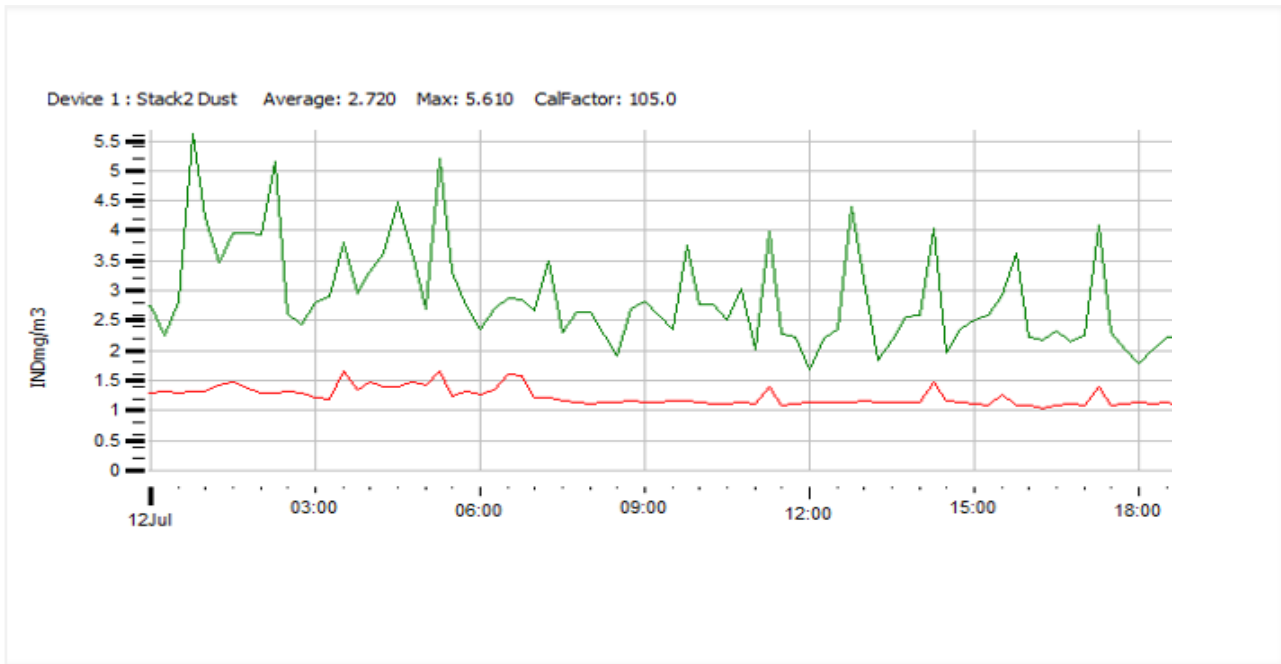
ecoke		
SUSTAINABLE SOLUTIONS FOR INDUSTRY		
ecoke ® Grade:	Grade A	
Production date:	January 2022	
Pillow-shaped briquettes, size (mm)	53x51x28	58x54x32
Fixed C % (db)	78.2	
C % (db)	81.7	
S % (db)	0.84	
N % (db)	1.54	
H % (db)	0.94	
Cl % (db)	0.68	
Moisture % (AR)	12	
Volatiles % (db)	11.6	
Ash % (db)	10.2	
Gross CV (MJ/kg) (db)	29.2	
Gross CV (Kcal/kg) (db)	6976	
Minimum hardness (kgf)	220	220
Minimum sustainable, renewable biomass content %	30	
Bulk density (kg/m3)	750 - 800	
Micum / tumble test values (%)	M40: 90.3	M40: 89.2
	M10: 9.0	M10: 8.9
Elemental Ash Analysis	%	
SiO2	37.41	
Al2O3	14.6	
Fe2O3	6.08	
TiO2	0.58	
Mn3O4	0.14	
CaO	13.22	
MgO	2.86	
Na2O	2.8	
K2O	6.2	
P2O5	0.71	
SO3	15.4	



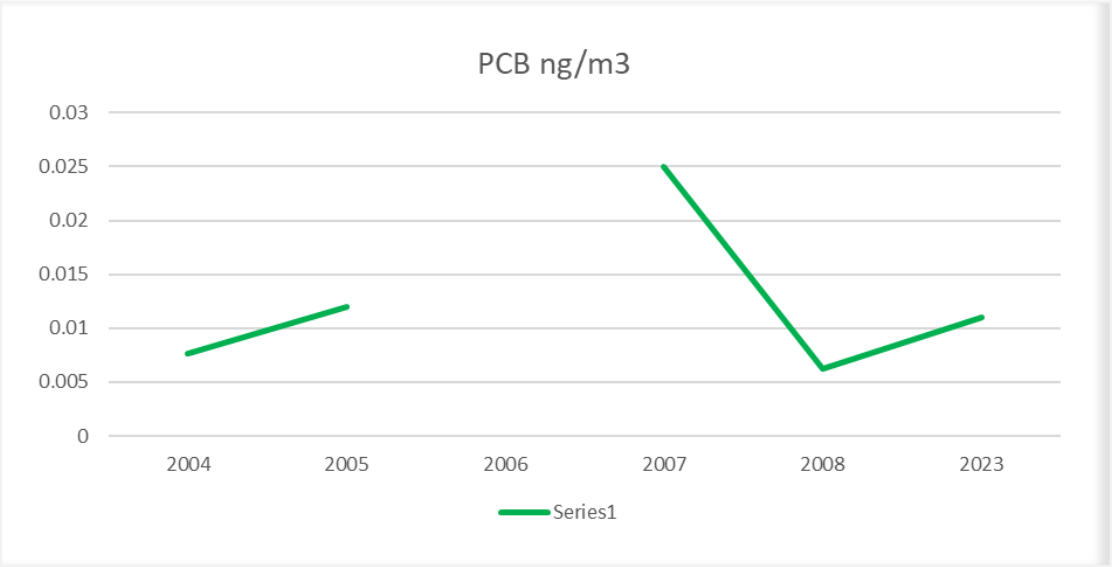
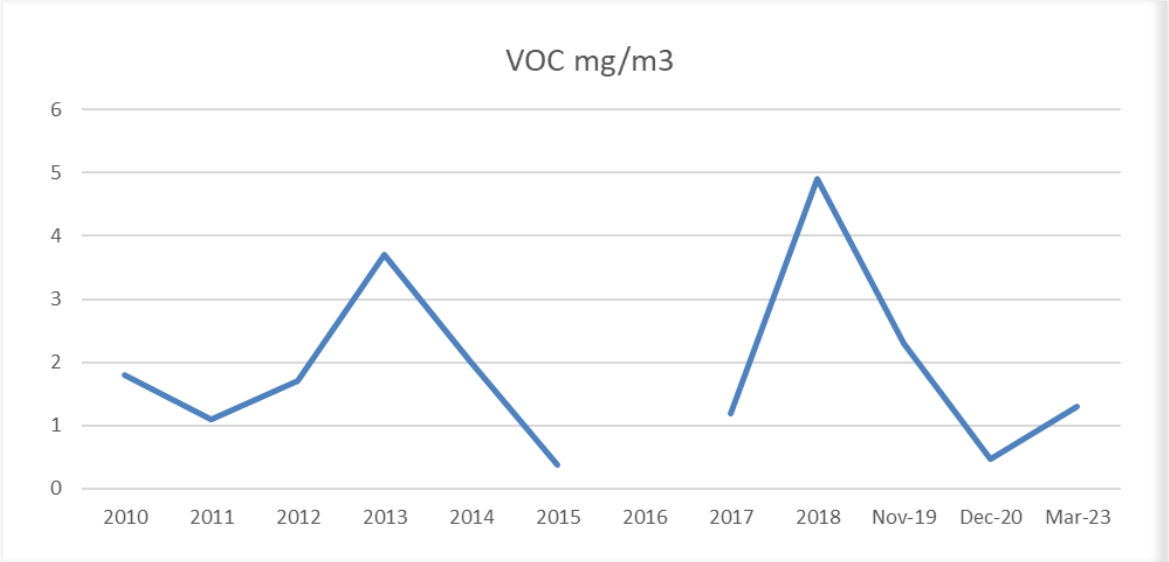
Environmental Emissions from e coke®

Air Emissions Monitoring Evidence

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



Environmental Emissions from e coke®



Environmental Emissions from eCoke®

- **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**



ecoke® Project Team

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 !

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