SECOND INTERNATIONAL
SLAG VALORISATION SYMPOSIUM
THE TRANSITION TO SUSTAINABLE MATERIALS MANAGEMENT

# Novel approaches to the valorisation of ashes using aggregation by carbonation

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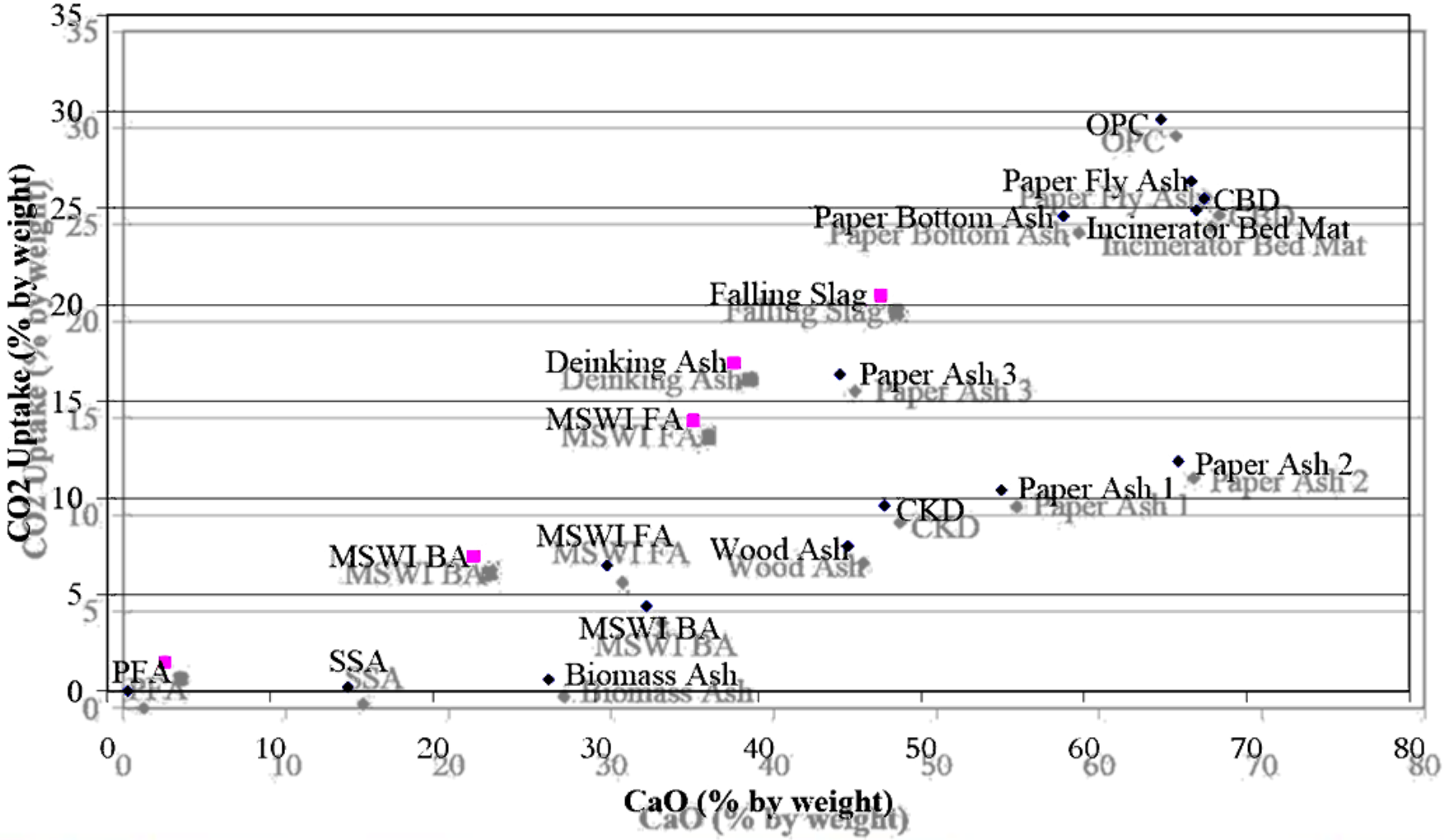
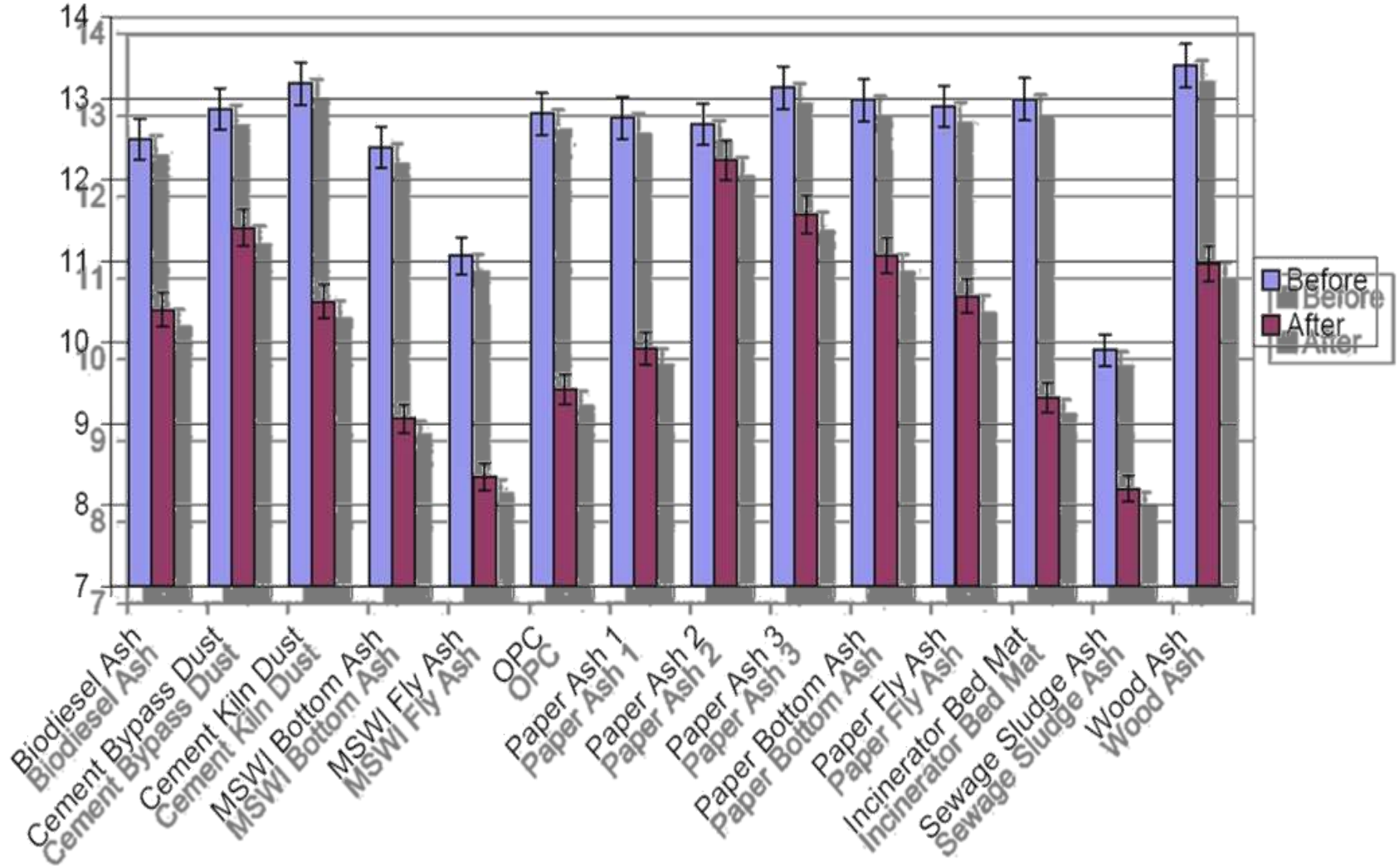
# Structure of presentation

- Background to current work
- Capture of $CO_2$ from North Farm Landfill, Kent
- Commercial-scale aggregate production at Brandon, Suffolk
- Results
- Summary

# Evaluation of 'carbonatable' wastes (ca 2001):



# Change in pH upon carbonation



# Treatment of diverse waste streams

Steel Wastewater Sludge

Quarry Fines

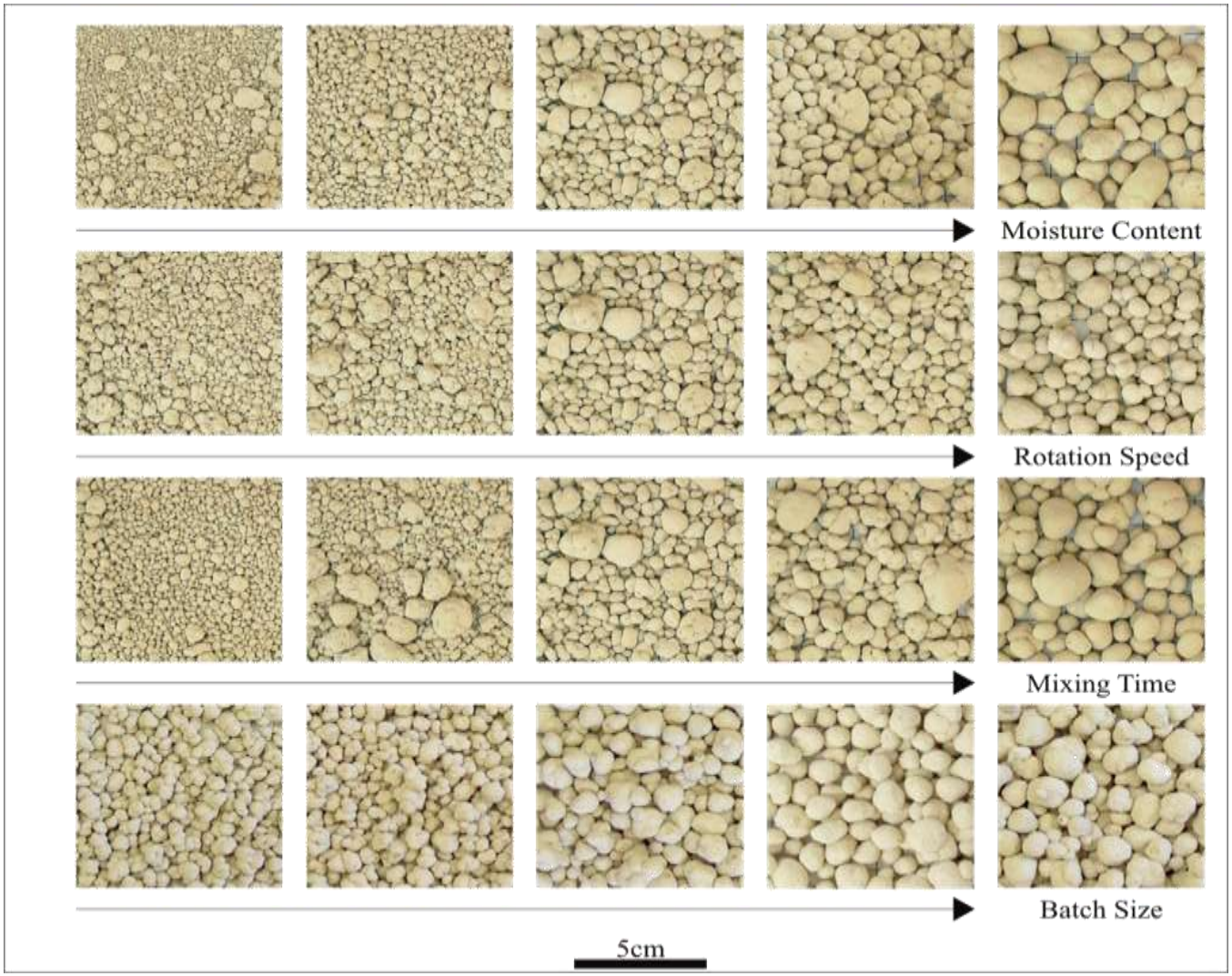
Bauxite

Paper Ash

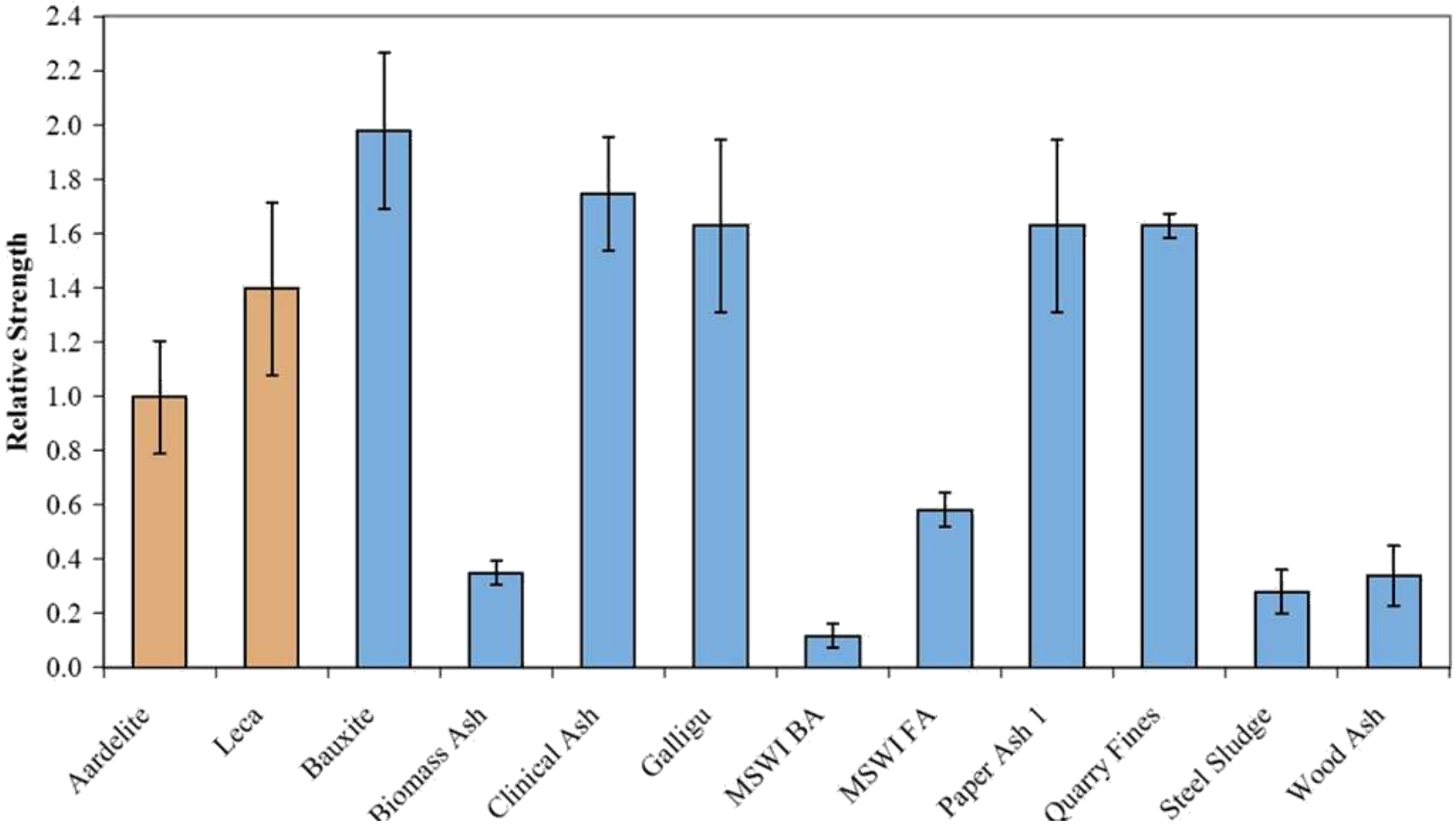
Wood Ash

Metal Dust

# Processing variables for aggregation



# Relative strength of carbonated aggregates (Aardelite = 1)



# Summary results from laboratory work

- Established that a wide range of wastes can be treated
- Waste management solutions based upon carbonation appear viable, but rely upon an individual approach [its just not always that easy]
- Treatment by carbonation appears to be cost-effective
- Significant know-how and IP was generated and validated in the laboratory
- Need to demonstrate process at larger-scale and pilot production of aggregates

# Carbon capture from source

- Using 'bottled' $CO_2$ is expensive and point source emissions are a potentially valuable resource
- Demonstration of capture required with direct incorporation into aggregate production process
- With support from the Environment Agency and Kent County Council, a methanogenic landfill (owned by KCC) was identified for use
- A pilot-scale combined $CO_2$ capture and aggregate production plant was established using local waste streams

# Landfill project outline

- Identify a landfill site in SE England, capture gas and obtain local wastes suitable for treatment by carbonation
- Construct a pilot-scale facility at the chosen site, divert landfill gas and use as the source of carbon for production of engineering material
- Produce 40 tonnes of carbonated product , test and apply to section of landfill in demonstration of this novel approach
- Evaluate efficacy (carbon capture/ indicative costs etc.) for future full-scale application

# The project partnership

- **Kent County Council**

  Landfill owner looking for new approach to managing re-engineering of closed landfills, and with an interest in carbon reduction

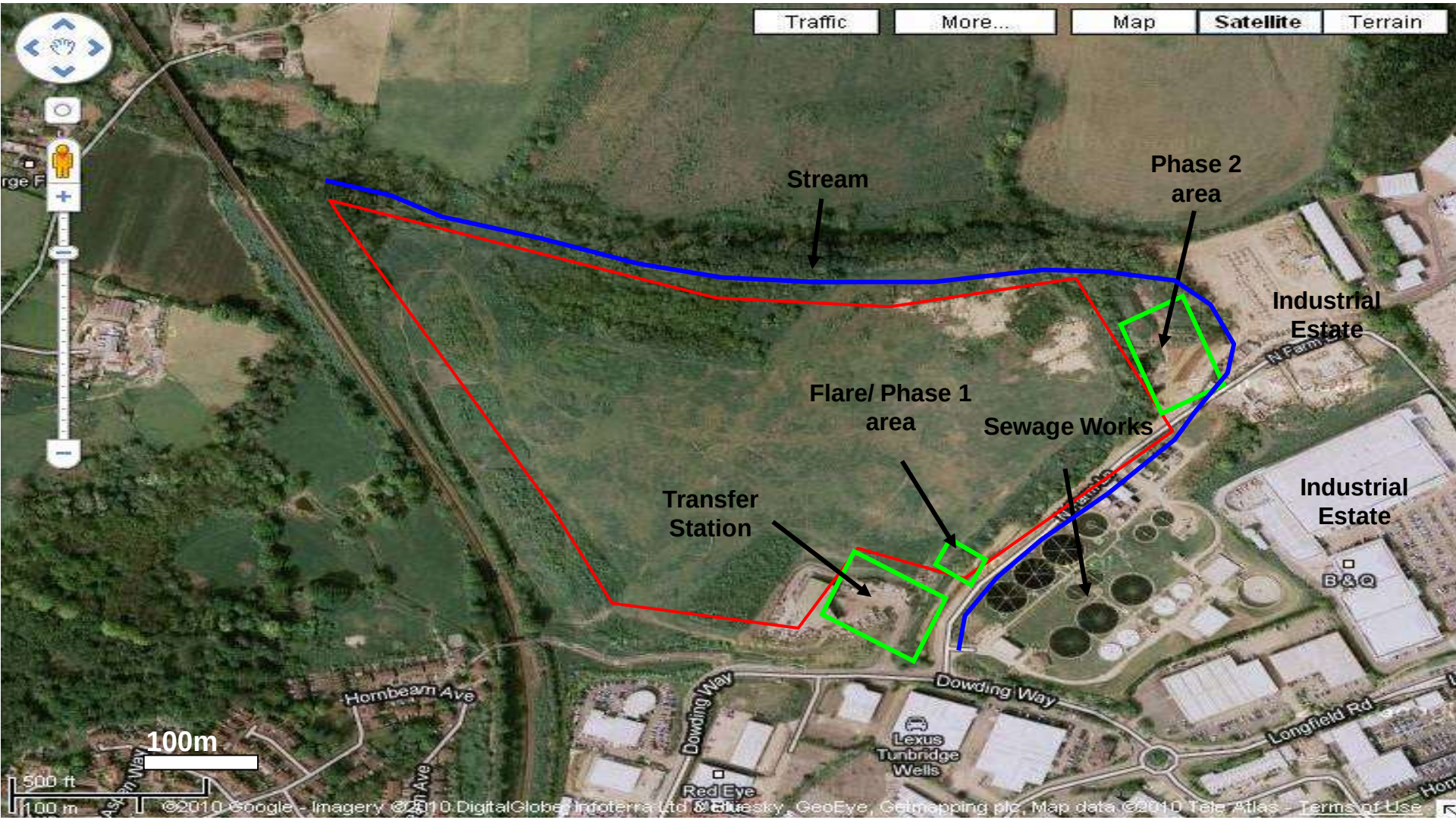
- **Environment Agency**

  Regulatory body, with interest in enabling reclamation of waste, and promotion of sustainable approach to landfill management

- **Carbon8**

  Developing new technology, commissioned by KCC to pilot the capture of carbon from landfill gas and produce engineering media

# North Farm Landfill site, Tunbridge Wells, Kent



# Approach adopted

- 10 wastes were sourced locally and treated in 25Kg kilogram batches (laboratory), and analysed for compliance with the waste regulations
- Construction of a full-scale temporary treatment plant to manufacture 10 tonne production runs of the best materials selected from the initial scale-up trials (i.e. 2.5 tonne batches)
- Opening the site for demonstrations to local authorities, industry and waste producers
- Use of the treated material to restore a small section of the landfill for continued monitoring (to by a done by civil/landfill engineering contractor)

# Ash processing


*a) Untreated ash,*
*b) Finely granulated ash,*
*c) Coarsely granulated ash*

# Landfill flare capture point

# Gas interception and optimised ‘boiler’

# North farm landfill site

# North Farm pilot-scale facility

# Aggregate production

# Bagged product

# Summary of North Farm trial

- Continuous production of aggregate possible at 2T/hr
- $CO_2$ uptake varied between 2 and 10% w/w (dry)
- Ca. 1T carbon 'captured' in 27T of product
- Products could be 'tailored' for use in geotechnical or cement-based products
- Field application at North Farm landfill to an evaluate geotechnical performance not yet completed (3rd party contractor)

# Commercial scale production of aggregate using APCr

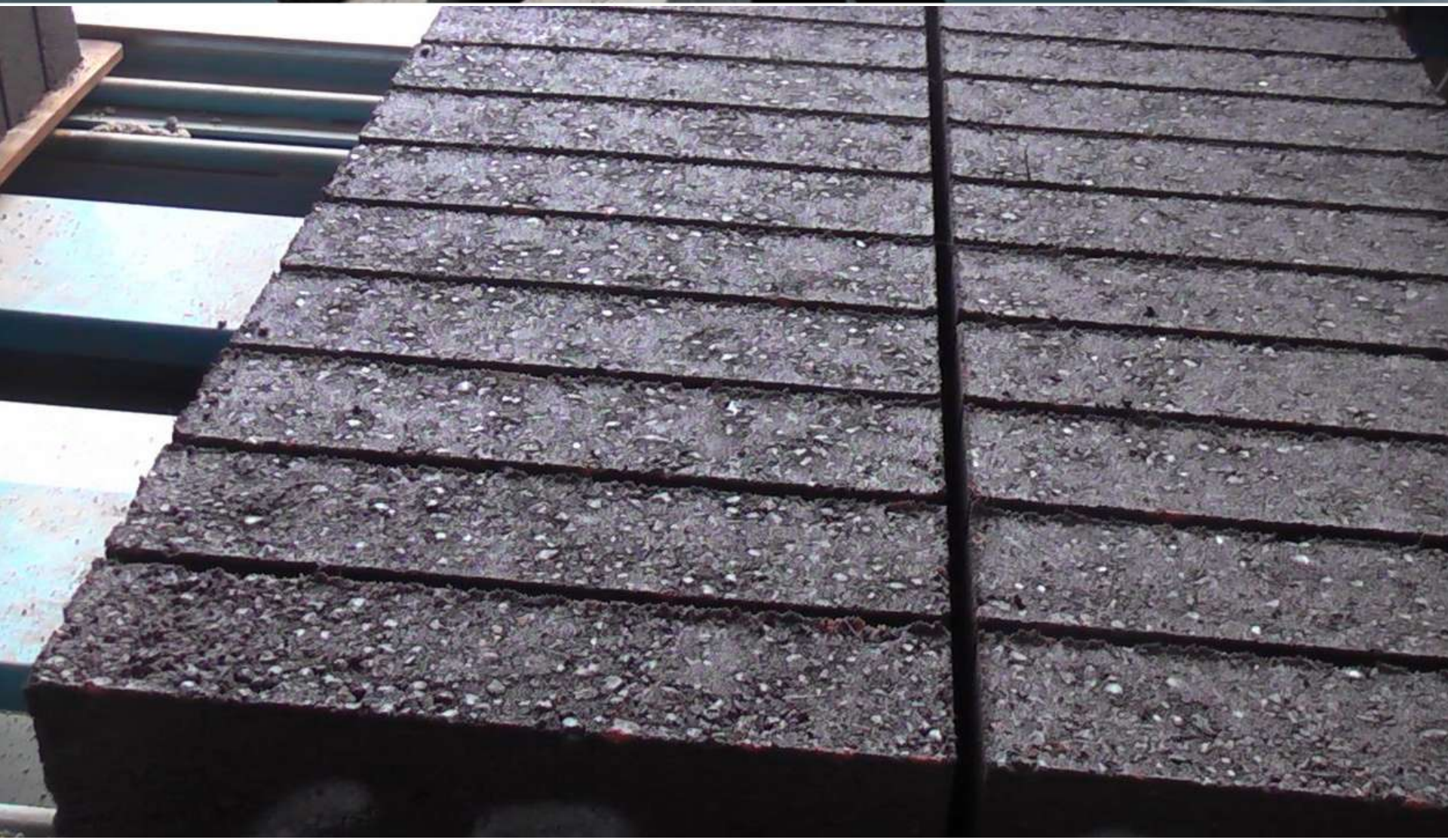
- Currently, around 3 Mt of municipal solid waste is incinerated each year in England
- This produces just over 1 Mt of ashes/yr
- Of these ashes, roughly 20% are Air Pollution Control residues (APCr)
- 88% of APCr are sent to landfill (ca. 185,000 t/yr).
- APCr contain lime, carbon, heavy metals, chlorine, dioxins and soluble salts
- APCr can capture up to 20% $CO_2$ by weight

# Commercial plant set-up

# Aggregate stock-pile and blocks

# Tile production 1

# Tile production 2



# Tile production 3

# Global summary

- Aggregates produced by carbonation cementation
- Significant know-how and IP was generated and validated
- $CO_2$ captured from a point source and successfully incorporated into aggregate production at pilot-scale
- Commercial scale production of aggregates successful, and 30T batches supplied for block production
- 200T stockpile generated, being tested for fitness for purpose by independent organisation
- Block trials with 2 commercial companies successful

# Where next?

- End of waste certification anticipated shortly
- R2 equity-based funding completed
- Commercial scale implementation at 26kT/pa in 2011
- Independent certification anticipated shortly
- Technology exploitation outside UK
- Work on-going with steel residues
- Potential for adoption by steel industry

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