UNITED KINGDOM
QUALITY ASH
ASSOCIATION

AN OVERVIEW ON UK ASH PRODUCTION, UTILISATION AND BENEFICIATION

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UK Quality Ash Association

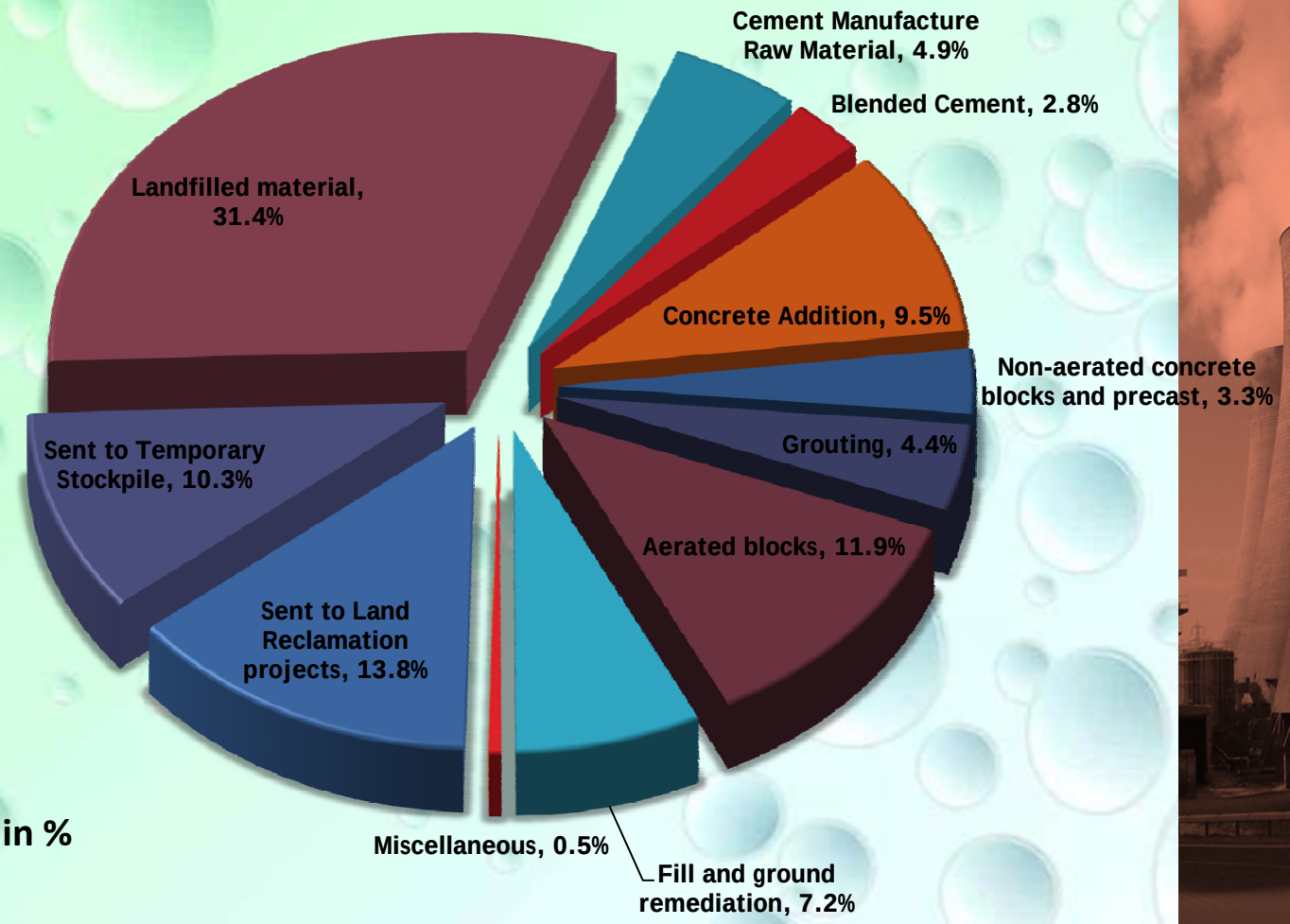
The Coal Research Forum
21st Annual Meeting & Meeting of the Combustion & Environment Divisions

Wednesday 14th APRIL 2010 at E.ON Engineering Ltd, Ratcliffe-on-soar, Nottinghamshire

ASH PRODUCTION IN THE UK

- The UK produces about;
  - 5.3mt of PFA per annum
  - 800,000 tonnes of FBA per annum
  - 1.5mt of gypsum per annum
- This has been consistent for a number of years. However;
  - Large Combustion Plant Directive
    - A number of stations are due to close by 2015
    - 20,000 hours limit – the variation in usage rate is making it difficult to predict when stations will actually close
    - Availability of gas and price increasing uncertaintity of the future for coal fired generation (Carbon Capture?)

Utilisation of PFA for 2008



PFA production in %

OTHER MATERIALS WHICH ARE IMPORTANT TO OTHER INDUSTRIES

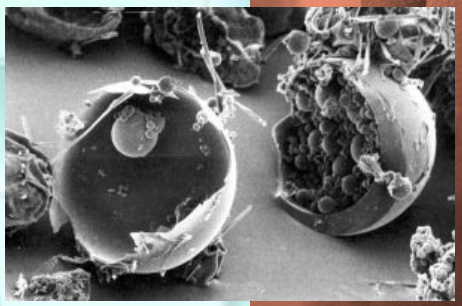
- FBA is important to block making and in short supply;
  - There is no other cheap source of lightweight aggregate material available in the UK
    - Incinerator Bottom Ash was tried and found to be unstable
    - Imported pumice had a significant price rise due to one quarry being closed in Greece
- Gypsum is important in plasterboard production;
  - Purer gypsum than natural material
  - Reduced cost to both environment and producer
    - No mining required and associated handling
  - Will supply exceed demand as more FGD fitted?

OTHER MATERIALS

Other Coal Fired Power Station Materials	Tonnes	% of Total produced
Cenospheres	2,317	100%
Gypsum produced	1,593,190	
Gypsum sold	1,593,190	100%
Stockpiled gypsum	0	0%
FBA production	827,877	
FBA utilisation	800,610	96.7%
Stockpiled FBA	55,347	6.7%
Total production of all coal fired power station products	7,803,007	
Dry storage capacity	38,800	
EN450 storage capacity	34,050	
Stockpile PFA available	21,948,104	

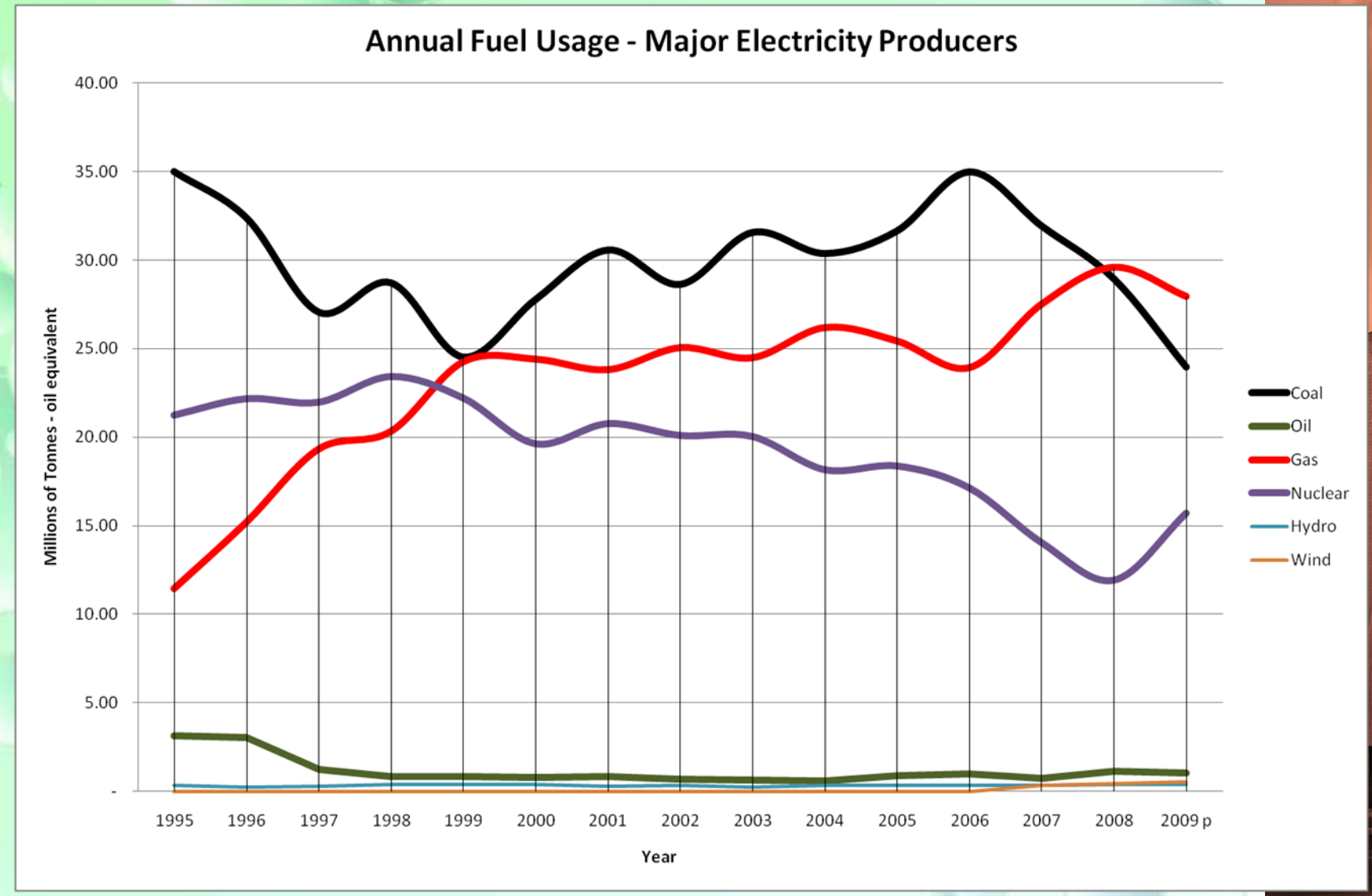
OTHER MATERIALS – CONT...

- Cenospheres;
  - High value product;
    - But little lagooning in UK, so less available now
    - Patches of cenospheres in old lagoons now all used
    - Imports from Russia and China supply most of demand
- Issues with lack of storage capacity;
  - Peak construction demand in summer
  - Peak electricity demand in winter
  - Low LOI ash (<7.0%) in short supply during summer – even during the recession
  - Double shifting & lack of base loading reducing quality ash availability

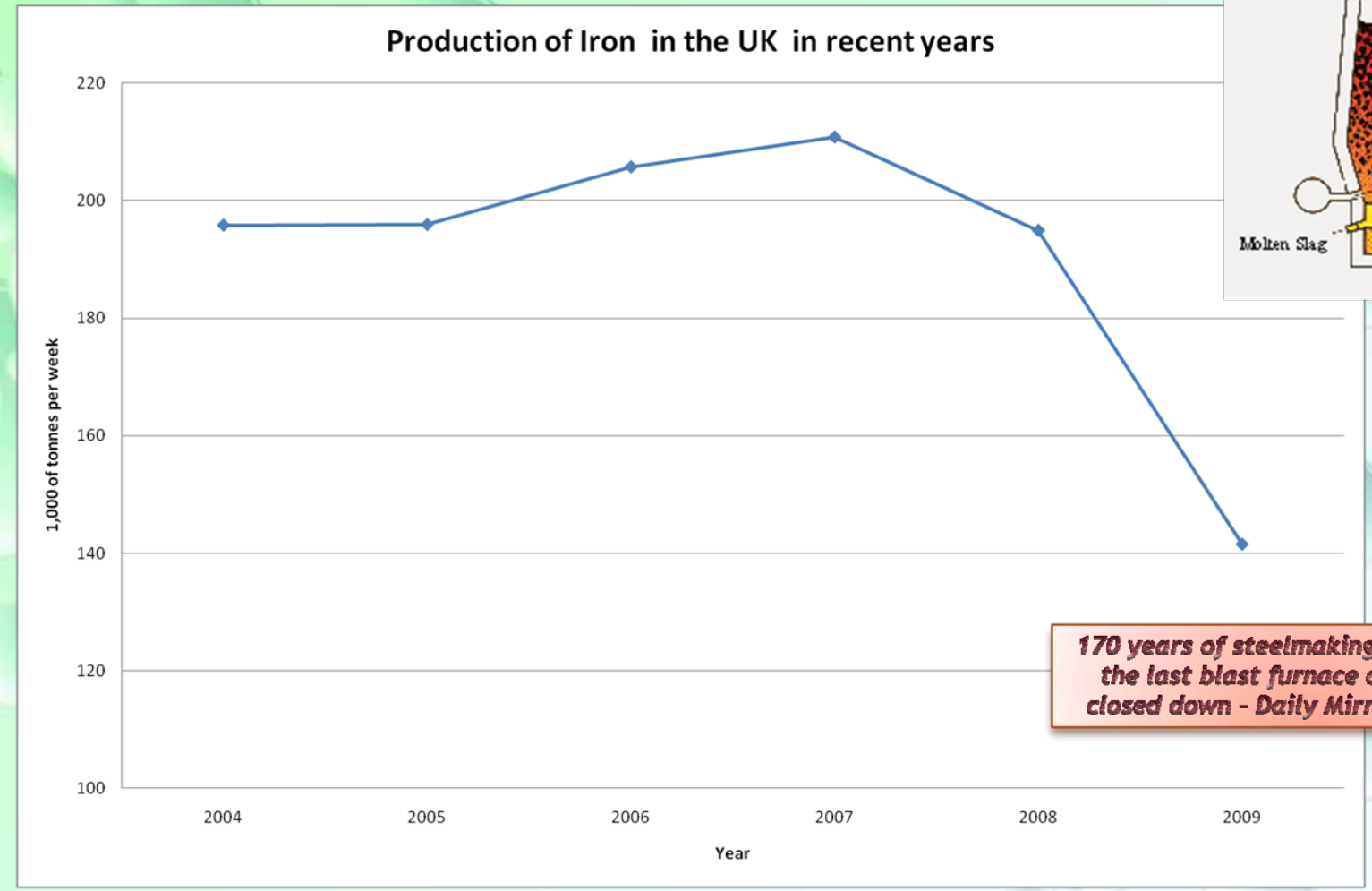


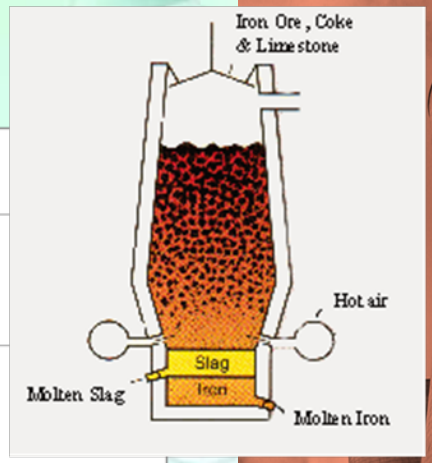
ISSUES DURING 2008 & 2009

- Aircrete block makers;
  - Difficulties in finding suitable quality ash
  - Chemistry and consistency important for quality control of blocks
    - Double shifting, etc lead to deteriorating quality during 2009 – some producers ran out of suitable ash!
- Demise of Ground Granulated Blastfurnace Slag in UK;
  - The recession reduced iron production, so less GGBS made
  - Price of GGBS rose to the same as CEM I
  - Increased demand for PFA for use in cement and concrete
  - Teeside furnaces closed February 2010


Annual Fuel Usage - Major Electricity Producers
Millions of Tonnes - oil equivalent
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
-
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009 p
Year
Coal
Oil
Gas
Nuclear
Hydro
Wind

GGBS IS THE MAIN ALTERNATIVE TO PFA IN CONCRETE

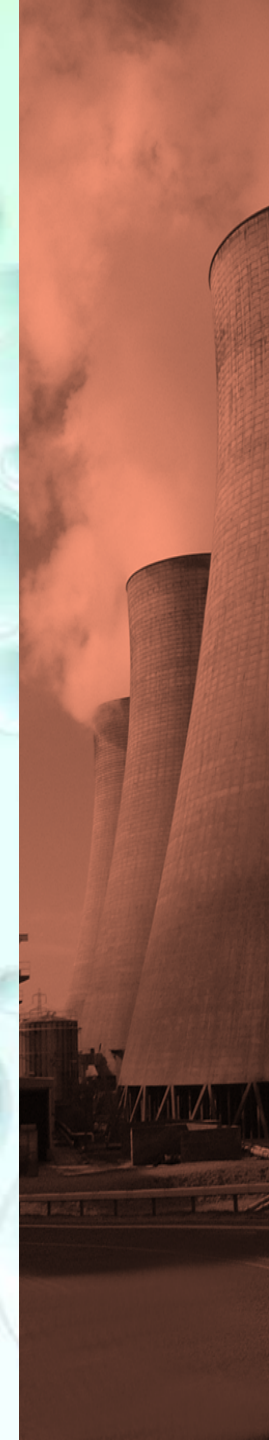


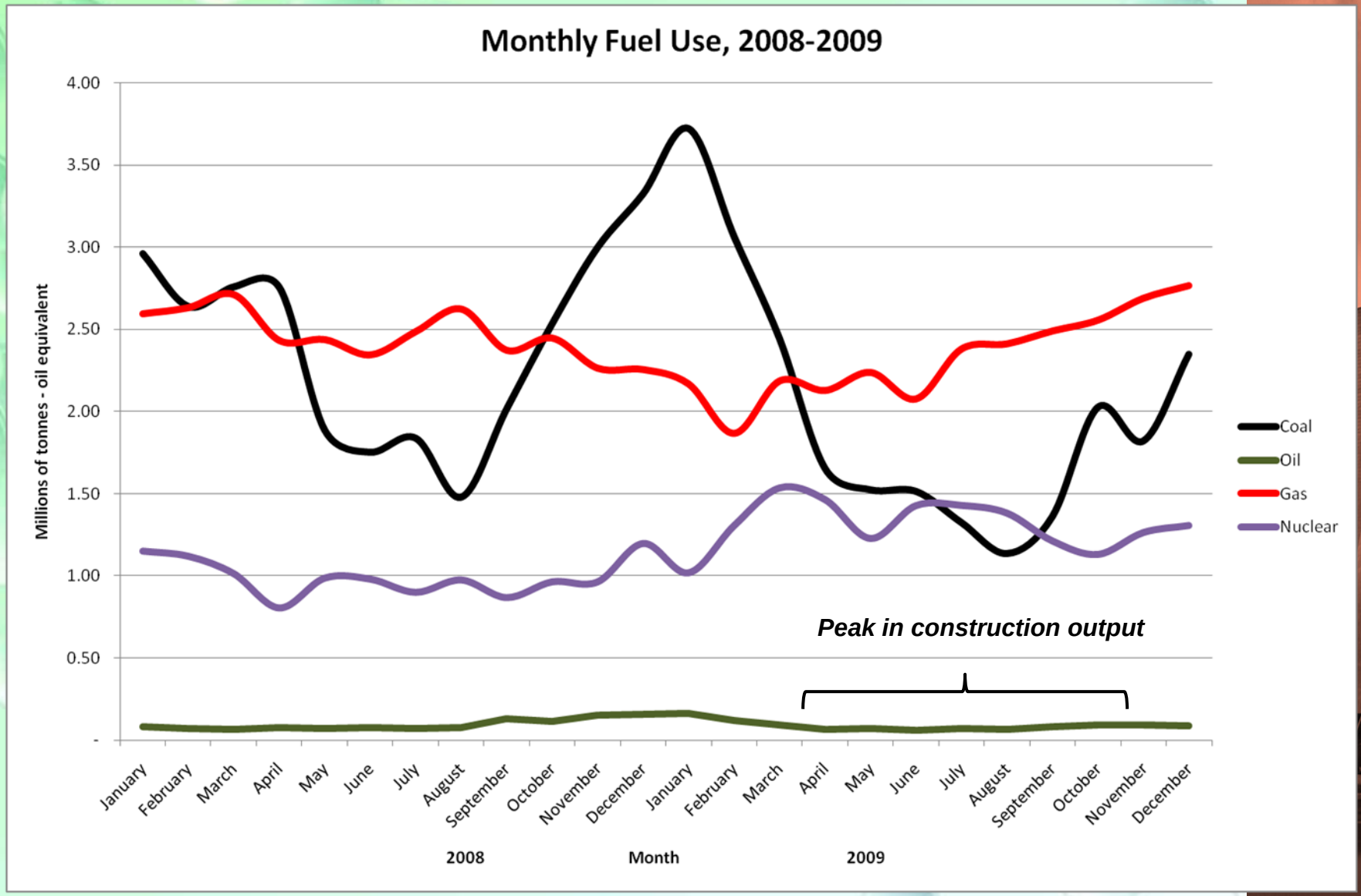


170 years of steelmaking ends in fury as the last blast furnace on Teesside is closed down - Daily Mirror - 22/2/2010

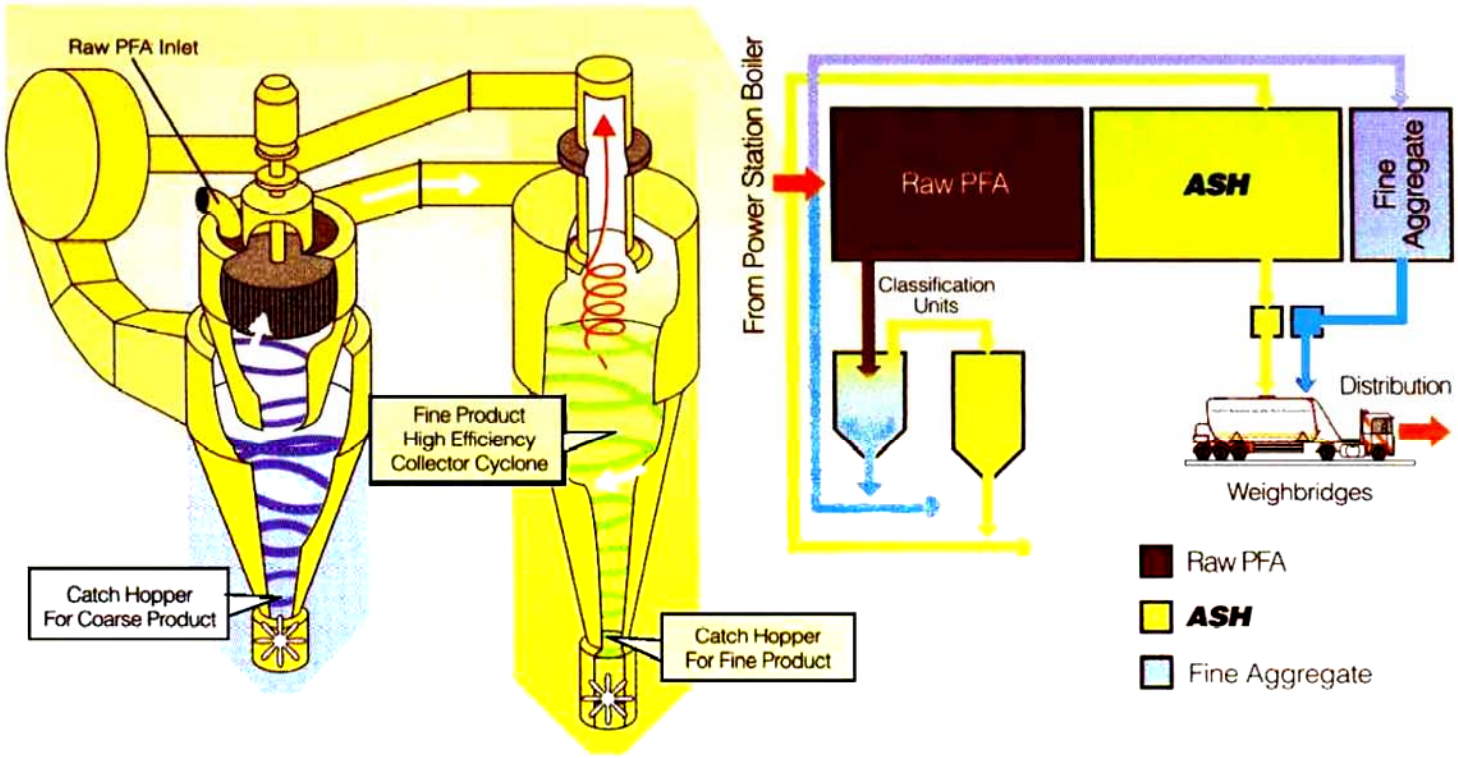
ISSUES IN 2008 & 2009

- Increased demand for <7.0% LOI PFA in 2009
  - Due to lack of GGBS
  - Reduced coal fired generation;
    - Double shifting and less base load generation increased LOI of available material!
  - Demand outstripped supply – even during a recession
    - Concrete and cement industries had 25% downturn in production!
    - Many precast factories closed/mothballed, etc.
  - Many concrete producers prefer classified ash
    - Throughput of classifiers is quite low, the result is at times low LOI ash is diverted to less critical applications, e.g. Fill, grout, etc.



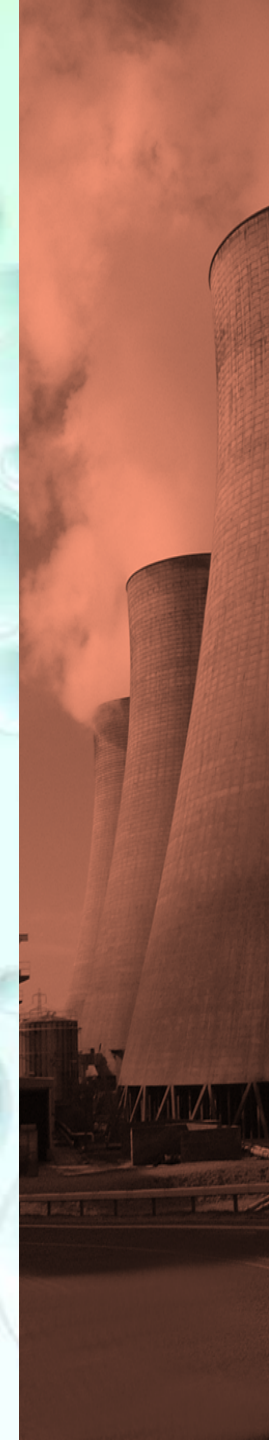

Monthly Fuel Use, 2008-2009
Millions of tonnes - oil equivalent
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
-
Coal
Oil
Gas
Nuclear
Peak in construction output
January
February
March
April
May
June
July
August
September
October
November
December
January
February
March
April
May
June
July
August
September
October
November
December
2008
Month
2009

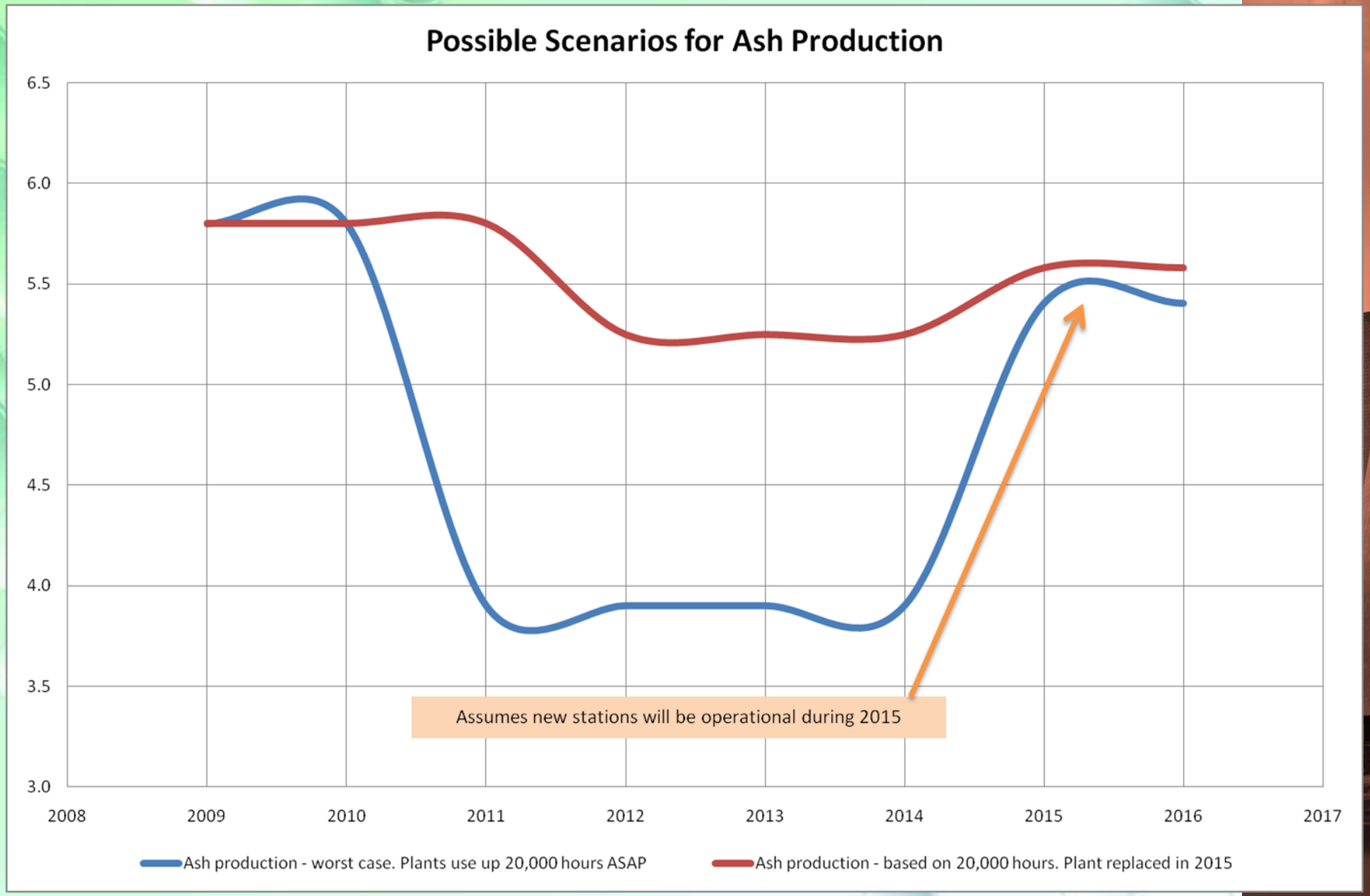
FLY ASH MAY BE CLASSIFIED - BS EN450-1: CAT. S - AIR SWEPT CLASSIFIERS



FUTURE SCENARIOS

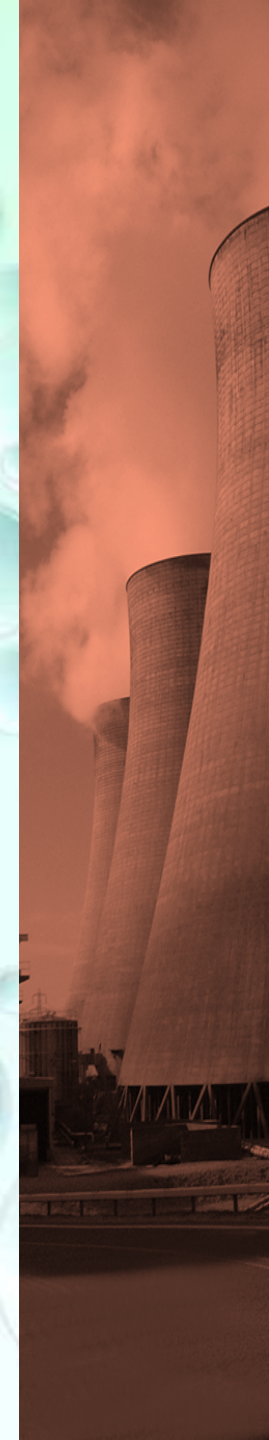
- Less coal fired generation
  - No company is building new, more efficient stations with SCR, etc.
- Older stations struggling to produce low LOI ash
  - This is unlikely to get any better with time!
- Ammonium injection required by 2015 to reduce NO_x emissions;
  - Excess ammonia could end up in the PFA
  - Requires careful control of furnace,
  - Or processing with ammonia removal systems!




Possible Scenarios for Ash Production
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Assumes new stations will be operational during 2015
Ash production - worst case. Plants use up 20,000 hours ASAP
Ash production - based on 20,000 hours. Plant replaced in 2015

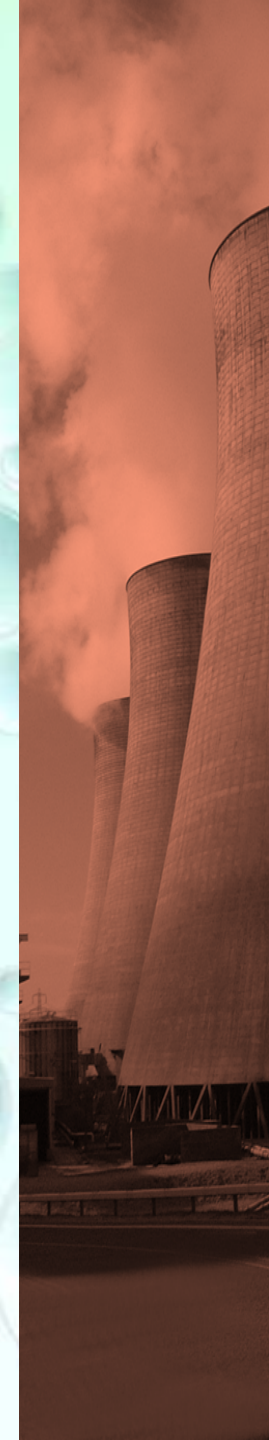
POSSIBLE SOLUTIONS?

- The limit of LOI in cement and concrete standards is 7.0%
  - Could higher levels be permitted in some concretes?
  - Could Category C ash (EN450-1) be assigned suitability for use in UK?
  - **This will take years to achieve!!**
- Alternatives are;
  - More processing,
  - More dry storage or,
  - Wet storage with driers to recover ash at peak demand!
- More later on this…

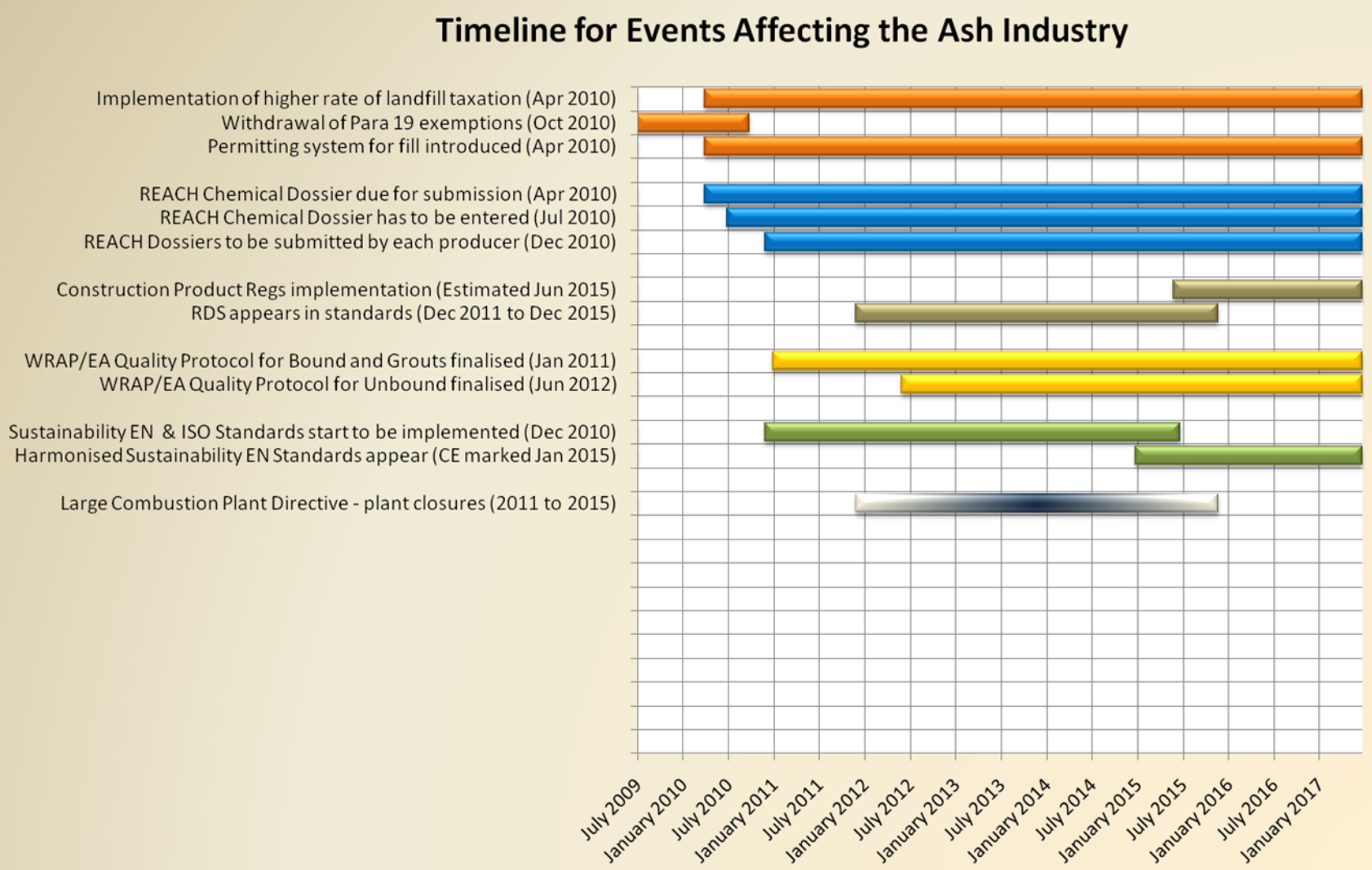


REGULATORY ISSUES…

- PFA and FBA will not get an easy ride;
  - Quality Protocol – defines when ash ceases to be a waste
    - PFA must be supplied to recognised standards – the death of 'Run of Station'
    - Environment Agency will review the system every 2 years
  - Regulated Dangerous Substances – requirements will be in product standards by 2011 onwards
    - These are likely to be the same requirements as in the Quality Protocol
  - REACH
    - Being a product not a waste, means has to comply with REACH

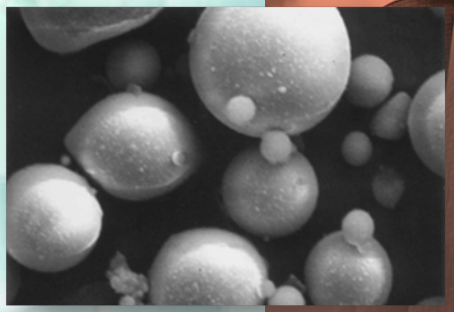


TIMELINE OF FUTURE EVENTS

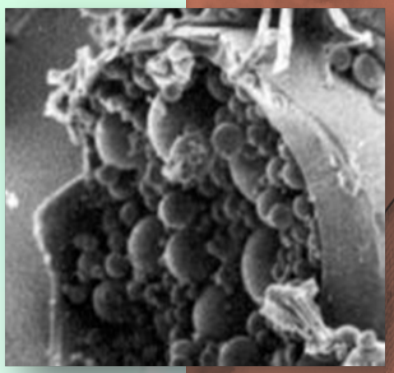


MORE REGULATORY ISSUES…

- Construction Product Regulations;
  - Likely to be implemented ~June 2015 (or later)
    - Supply to recognised standard will be legal requirement if such a standard exists
    - CE Marking becomes compulsory
- Sustainable Construction standards;
  - These are being worked at currently
    - A series of standards to assess environment impacts and sustainability issues will become increasingly used
    - These will start to become ‘harmonised’ in 2015
    - Pressure on materials suppliers to comply with Quality Management and Sustainability schemes



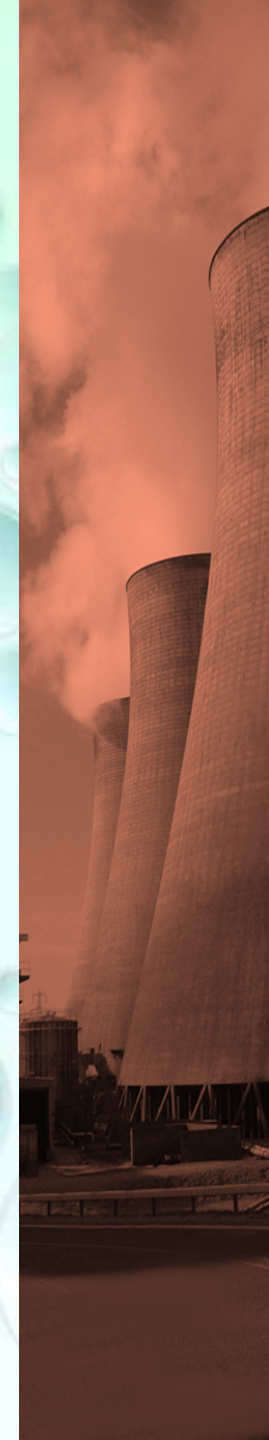
SUM OF THE ISSUES FOR THE INDUSTRY TO ADDRESS…



- Lower LOI PFA is required;
  - If cement, concrete and aircrete block industries are to continue to be supplied
- Ammonia slip;
  - This issue needs to be addressed;
    - Either process the ash to remove the ammonia or control SCR and injection very carefully
- Must inform customers of future scenarios for PFA and FBA availability;
  - They need to be aware so they can make contingency plans.

OTHER DEVELOPMENTS IN FLY ASH…

- Carbon reduction plants;
  - These remove excess carbon from the fly ash
  - LOI as low as 1.5% not uncommon
  - Some previously unusable ashes may become available
  - These ashes may be surprisingly reactive
  - Colour may or may not be lighter with carbon reduction plants
  - Most plants are electrostatic STI units
    - One has ammonium reduction system
- One water based ash processing system operational is operational in the UK;
  - Rocktron (NB: this is a patented process)



CARBON REDUCTION IS HERE …

Sustainable Success

ScotAsh's ash recycling and blending plant is designed not only to recycle ash from the Longannet Power Station, helping to avoid disposal costs, but also to reduce the dependency of the construction industry on raw primary materials. A major investment programme has recently been completed, and Claire Hunt visited the plant on the occasion of its official opening by Lewis Macdonald, MSP.

An £8 million investment programme has been commissioned to upgrade ScotAsh's ash recycling and blending plant at ScottishPower's Longannet Power Station, in Fife, Scotland. ScotAsh, originally established in July 1999, is a 50/50 joint venture between Lafarge Cement UK and ScottishPower. The company produces pulverised fuel ash (PFA) and PFA blended products by recycling ash pumped directly from the power stations. This year, approximately 650 000 tpa of ash will be recycled, with products being delivered by road, sea and rail to contruction, marine, oil, and waste stabilisation industries worldwide.

Some of the PFA produced is transported by bulk tanker to Lafarge's nearby Dunbar cement plant for use as a raw material in cement manufacture. In addition, Portland cement produced at Dunbar is supplied to ScotAsh for blending with PFA to produce the company's range of Trojan blended cements and general purpose grouts.

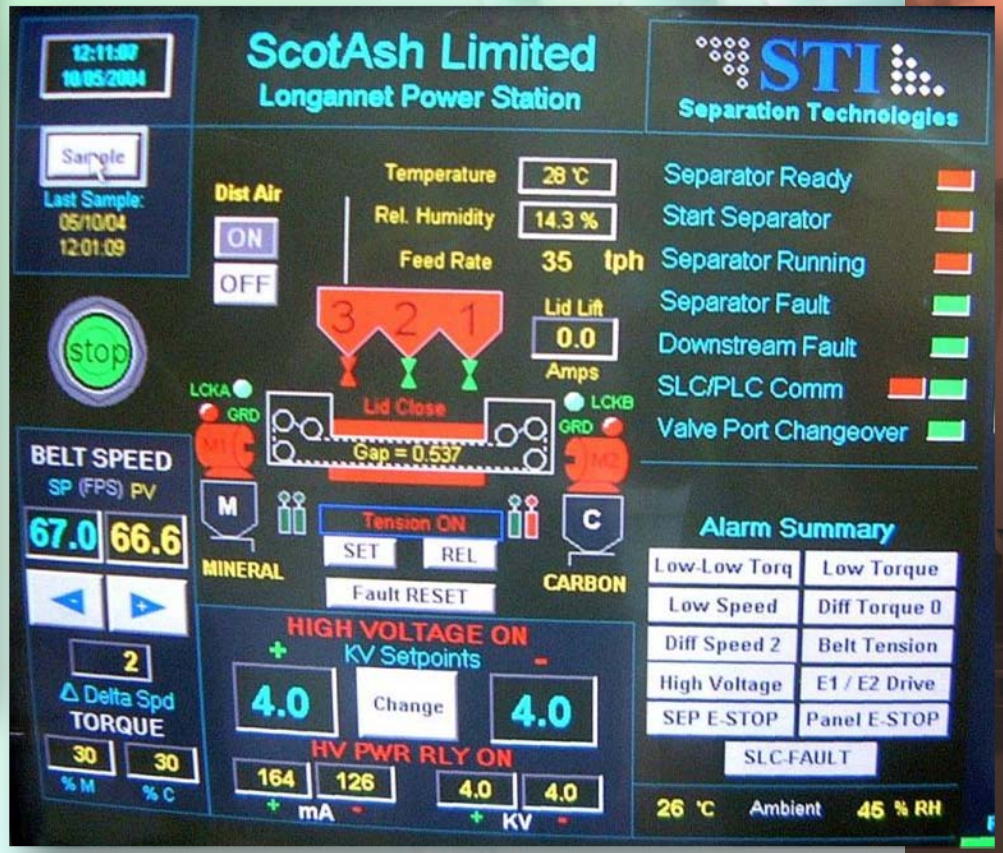
Sustainability

Longannet is the second largest coal-fired power station in the UK, and has an installed capacity of four 600 MW units. On average, more than 800 000 tpa of ash are produced from Longannet and its sister power station, Cockenzie in East Lothian. Before the development of the ScotAsh facilities, the majority of this ash had to be pumped to lagoons, where it dried out, creating new stretches of foreshore.

Apart from the benefits derived from avoiding the need for disposal and costly disposal tariffs, the recycled ash can be used as a raw material in place of shale or clay in cement manufacture, to displace primary raw materials in the contruction industry, as a concrete

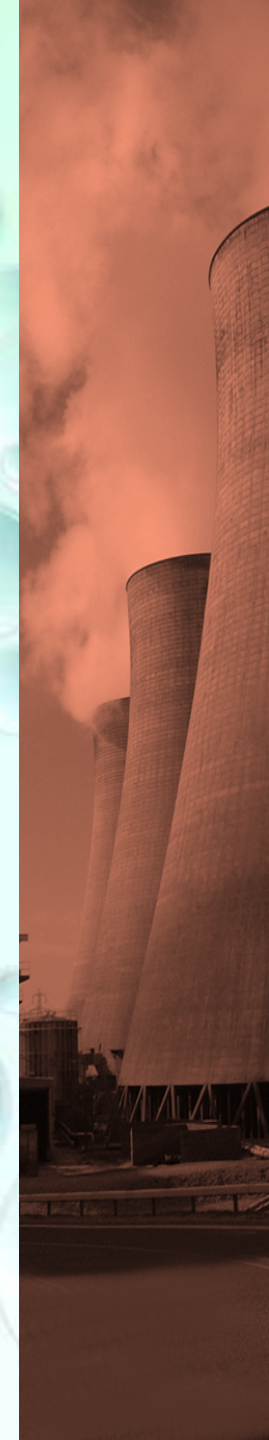
Longannet Power Station

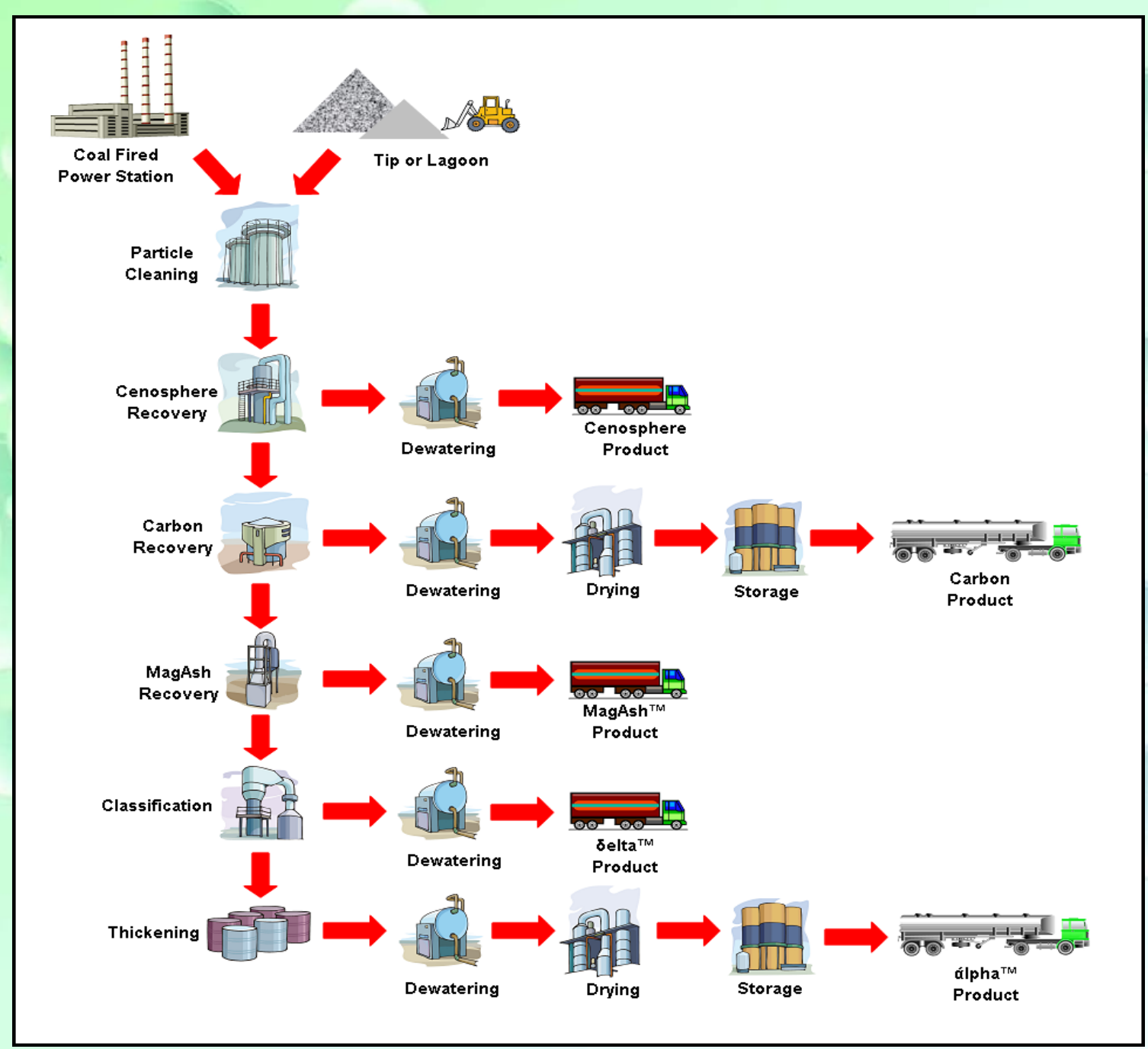
Reprinted from WORLD CEMENT August 2003



ROCKTRON – WET PROCESSING

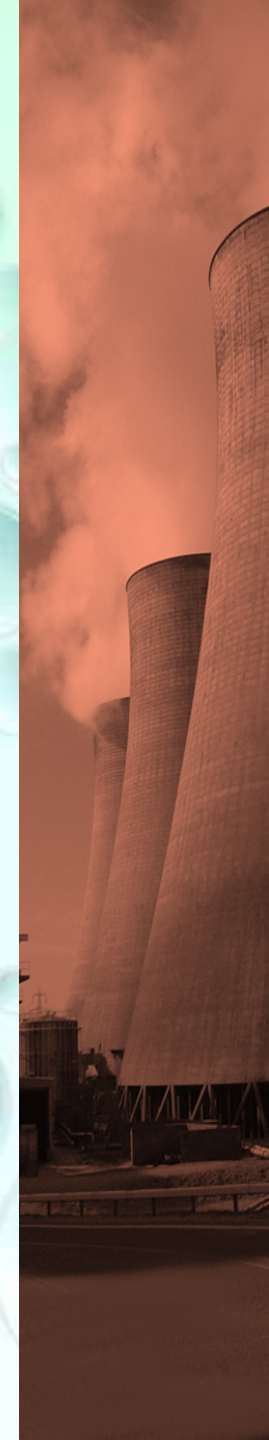
- System can use stockpile ash;
  - No dependence on station being operational
  - Older ash found easier to process;
    - Is this a co-combustion or low NOx burner issue?
  - Readily available throughout the year
- PFA can be processed in a number of valuable products;
  - Fine ash, magnetite, cenospheres, low LOI, etc
  - The drawback is drying the material post processing;
    - Energy and cost of drying increases material cost
    - But dry ash normally only for used in concrete



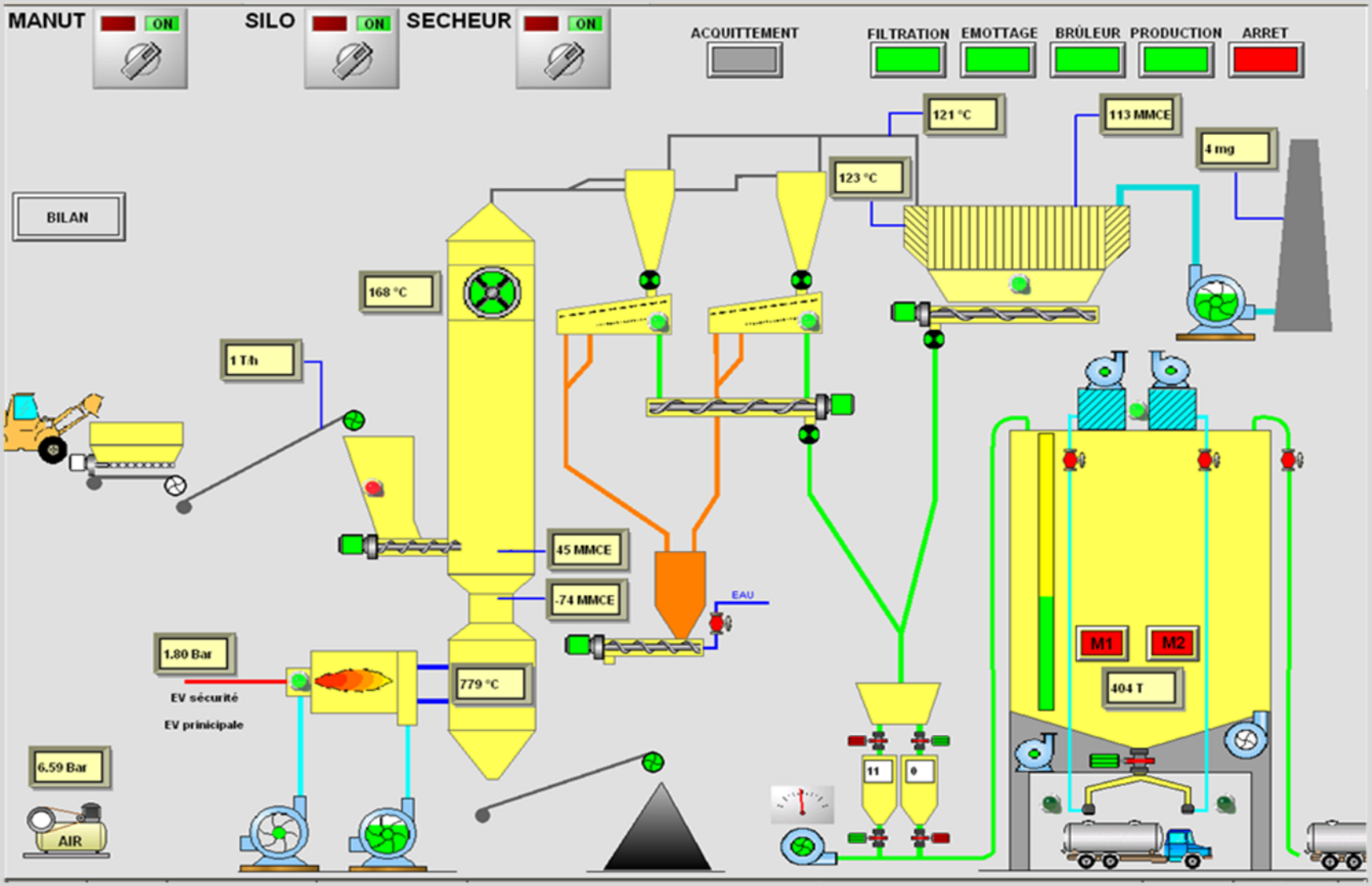

Coal Fired Power Station
Tip or Lagoon
Particle Cleaning
Cenosphere Recovery
Dewatering
Cenosphere Product
Carbon Recovery
Dewatering
Drying
Storage
Carbon Product
MagAsh Recovery
Dewatering
MagAsh™ Product
Classification
Dewatering
δelta™ Product
Thickening
Dewatering
Drying
Storage
άlpha™ Product

OTHER SOLUTIONS…

- Winter storage of ash;
  - Increase the storage of low LOI ash in the winter for use the following summer;
    - Dry storage is expensive.
    - German power stations have silos of up to 100,000 tonnes!
  - Store conditioned ash then dry it;
    - Perhaps classify it as well
  - Central multi company storage facility in southern UK?
    - Use economies of scale to reduce costs
    - Make sure the ash in in the right location
    - Handling and drying will increase costs – will wither industry pay for this higher cost?

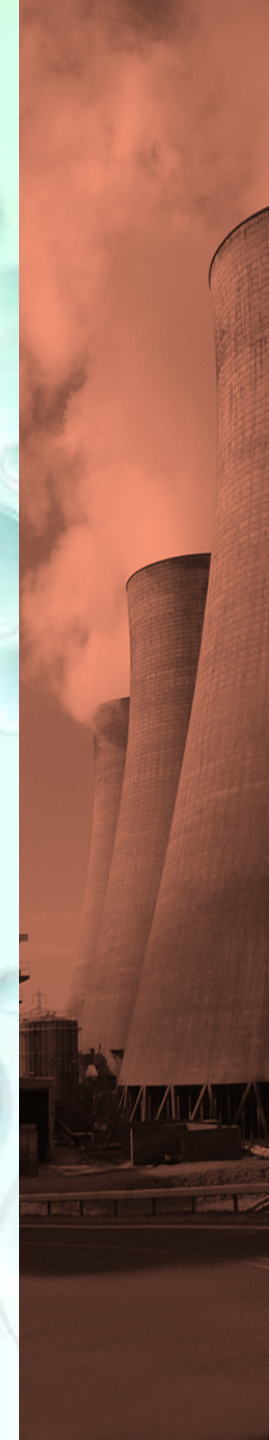


DRYING ASH IS COMPLEX!



CONCLUSIONS…

- Difficult times ahead for the ash industry;
  - Reduced production
  - Quality issues
  - Increased regulatory burden
  - Supply and demand aspects
  - Capitalisation required for the solutions to work
- Future for UKQAA;
  - Continue to work at solving some of these problems
  - Get a realistic message across to the producers and users



FOR MORE INFORMATION ABOUT PFA/FLY ASH OR THE UKQAA CONTACT US …

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