Coal and Biomass –Synergies and Opportunities

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Coal and Biomass –Synergies and Opportunities

Biomass development

The science and technology underlying biomass combustion

The future development potential

The use of coal - history

Environmental issues predominant

Large Combustion Plant Directive

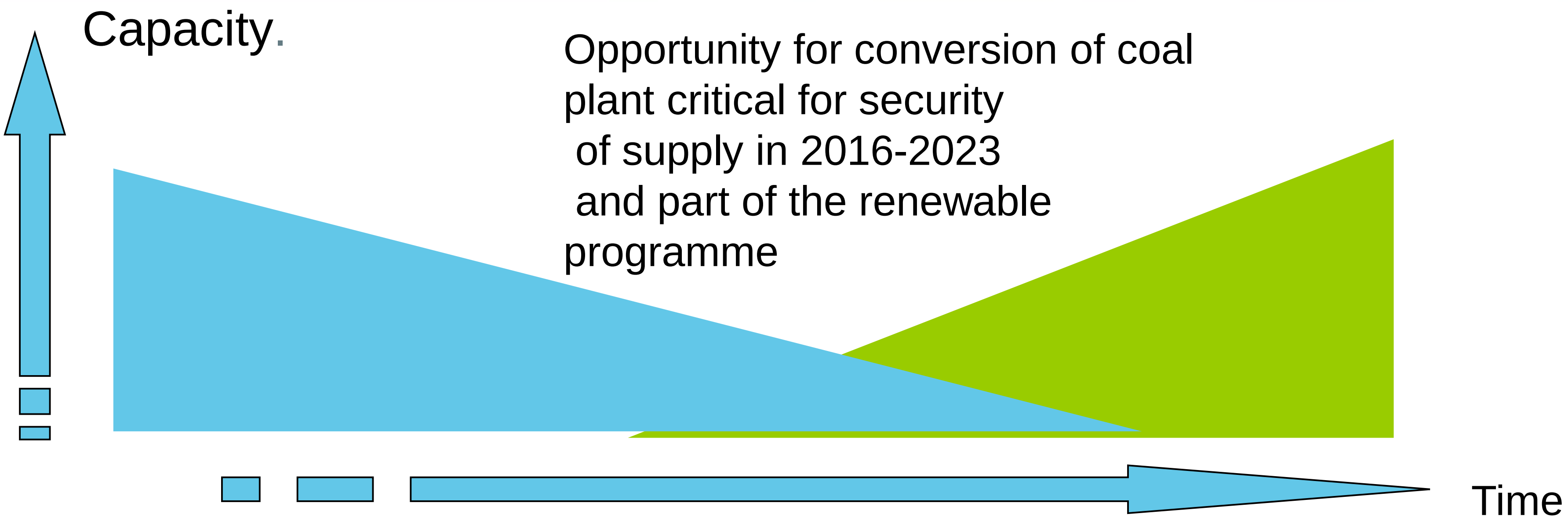
Industrial Emissions Directive

SO_2 and NO_x

- Acidification and eutrophication
- Flue gas Desulphurisation
- Selective (Non) Catalytic Reduction

Particulate – health effects

The use of coal- current



Existing ‘old’ coal plant, running at lower load

New capacity, very low environmental impact plant (renewables, nuclear, biomass and fossil with CCS),

Benefits of biomass

Conversion/co-firing of coal plant

Economic compared to any other renewable

Renewable energy – UK compliance by 2020

High degree of carbon saving – directly replacing coal

Existing plant – maintenance of capacity, speed of conversion

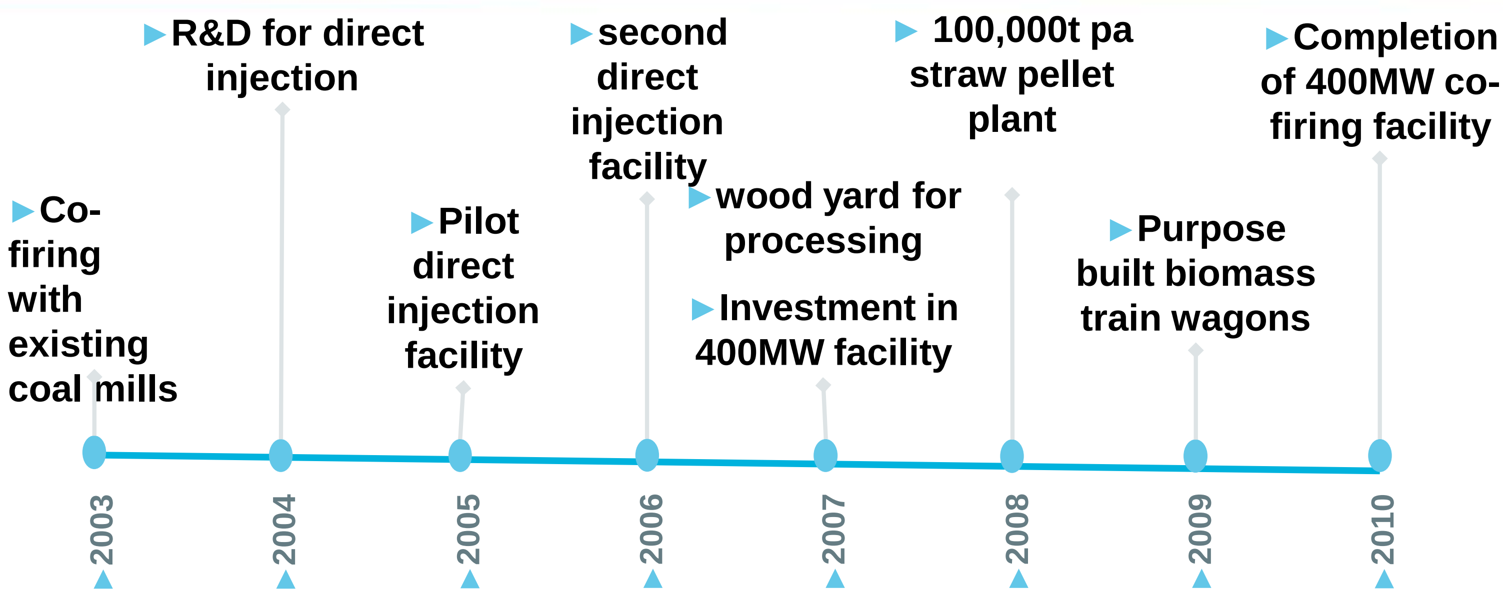
Existing transmission- no need to socialise additional line costs

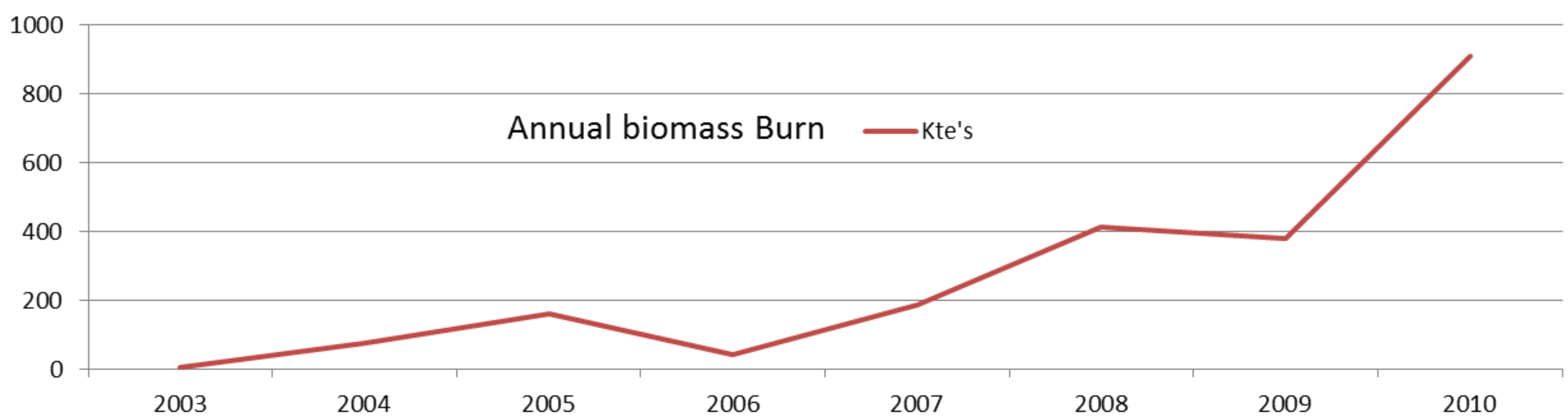
Only renewable to operate independent of weather/season/time of day

High ramp rates allowing load following

Easier station compliance with Industrial Emissions Directive (IED) in 2016

Biomass at Drax -- Evolution – R&D phase

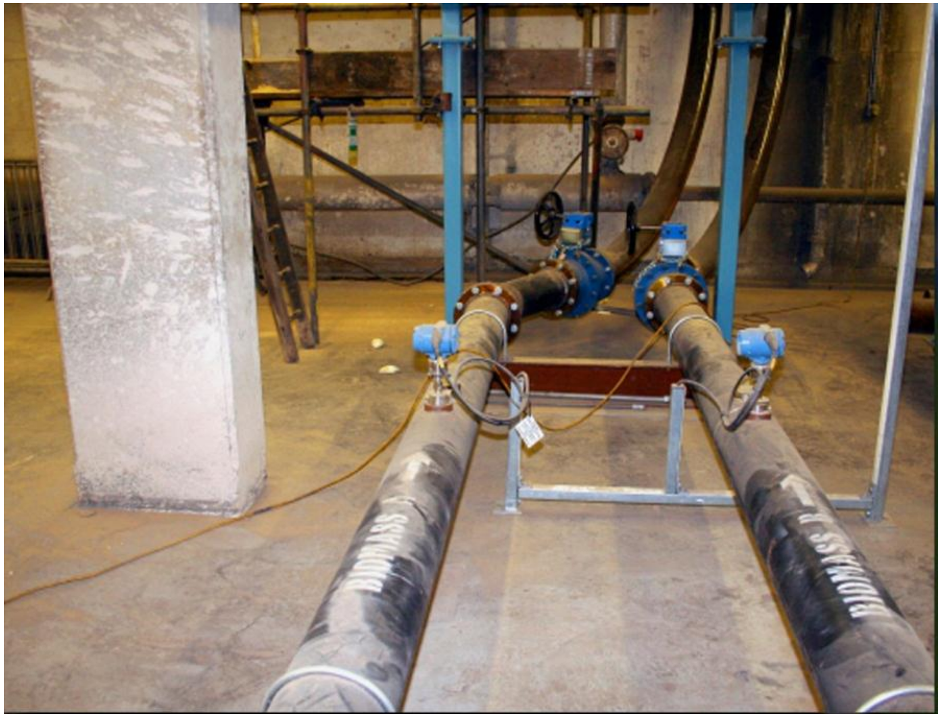




First steps




Pilot DI (Direct injection)



Need to bypass coal mills
Present the fuel to the boiler as powder
In house – 20T/hr direct injection system

R&D

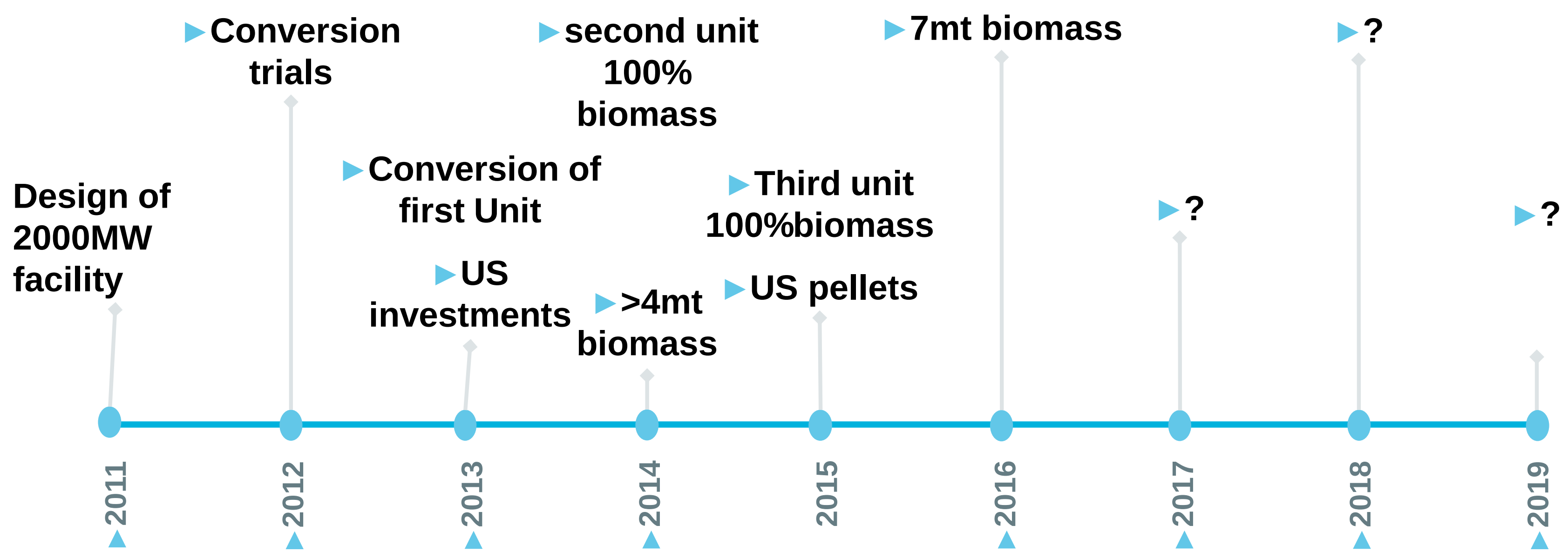
Pelletising

400 MW R&D

20 t/hr pilot facility success leads to 1.5t pa facility with road and rail receipt and 24,500t storage

R&D issues around safety, storage handling, transport, sampling

Biomass at Drax - Evolution - Implementation phase



Drax is transforming from one of the largest carbon emitters in Europe to the largest green power station in the world

Step change in scale of operation means

- Synergies with coal reduce
- Technological risks increase
- Biomass supply chain issues important

Supply chain

2013 - Drax US subsidiary starts building two 450,000 t pa pellet plant in SE USA and associated port at Baton Rouge
2014 - Commissioning and 2015 first deliveries
Further plant under consideration

Supply chain

Investment in train sets
- increasing volume per train
- maintaining fuel in dry condition

Investment in port storage at UK

Technical Challenges

Moving from Biomass to coal is not just a fuel switch

- Biomass is low density and must be kept dry
  - Transport & storage must be designed accordingly
- Eliminate airborne dust at every opportunity
  - Fuel Specification
  - Modified conveyor transfer points / rail receipt facilities
  - Use separate systems to remove & handle dust
  - Isolate where possible - fully enclosed belts / pneumatic systems
- Bulk storage needs careful management
  - Target zero retained material / Monitor & control temperatures & Gases
  - Ability inert and to ‘box-in’ storage (keep air out)
- Fire systems require innovative solutions
  - Utilise proven detection technology / Use sprinkler & deluge systems only in the right places
  - Gas inerting - a better way to manage silo fires than water deluge

Dust Management

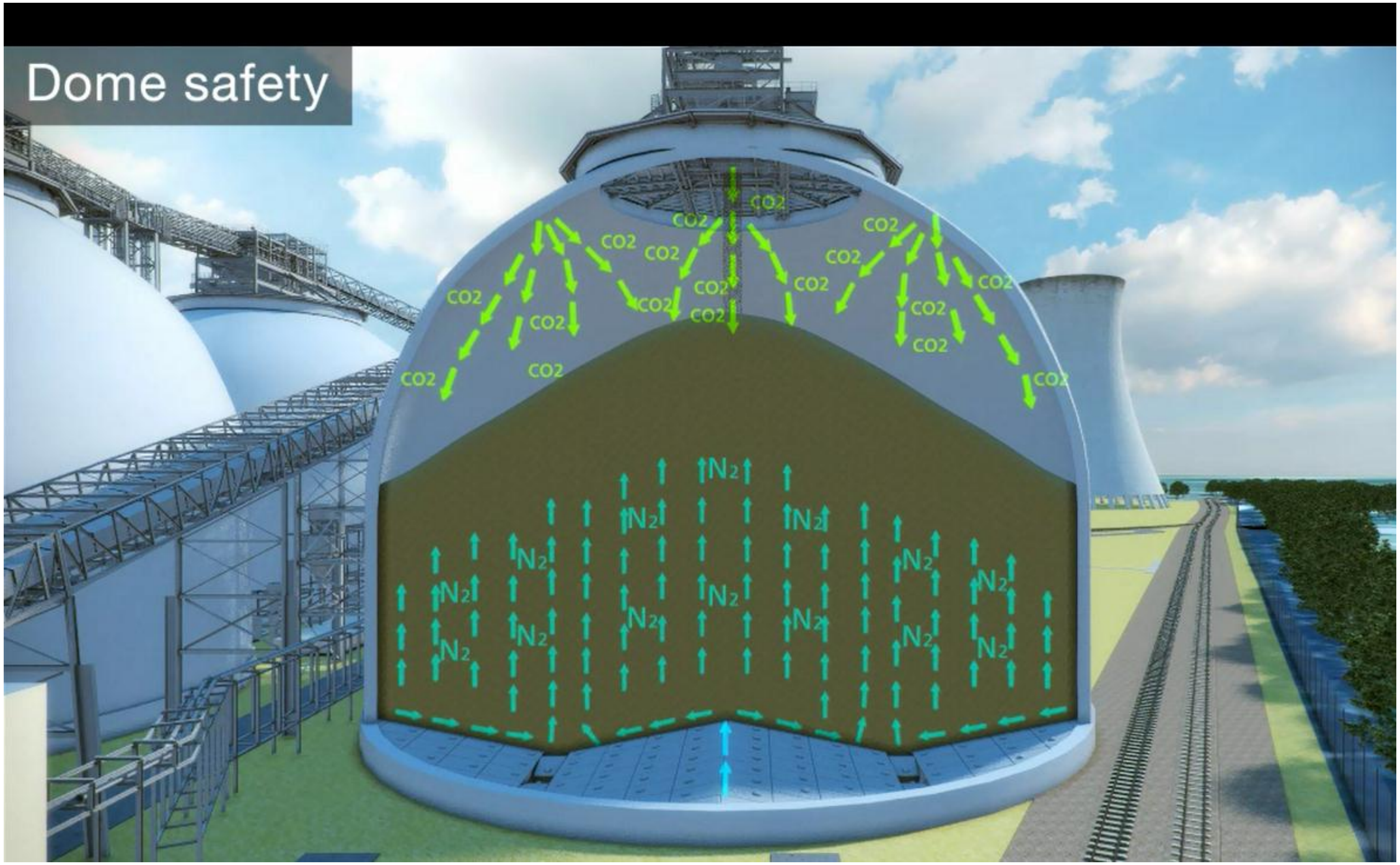
Safety paramount

- Main problem is managing pellet breakup prior to milling
- Design focused on preventing dust production and release to atmosphere
- Dust collected separately throughout system

Storage Domes

Current approach 4 *75,000t domes.

Dome Safety



Technical Challenges

- Heat integration must be understood and modified for safe / efficient operations
  - No heat required for drying biomass / High temperatures create clear fire risk
- Milling Equipment - friable coal versus soft/resilient biomass
  - Coal mills require modification or complete change out
  - Residence time / temperature
- Speed of combustion critical in pulverised coal units – incomplete combustion a major concern
  - Particle size fuel specification
  - Boiler residence time
  - Likely to be critical limiting factor in unit output capacity
- Flame Stability
  - Low NOx coal burners unsuitable for biomass

Biomass combustion

- In a (coal or) biomass unit
  - Waste solids slag and foul the boiler
  - Waste acids corrode boiler surfaces

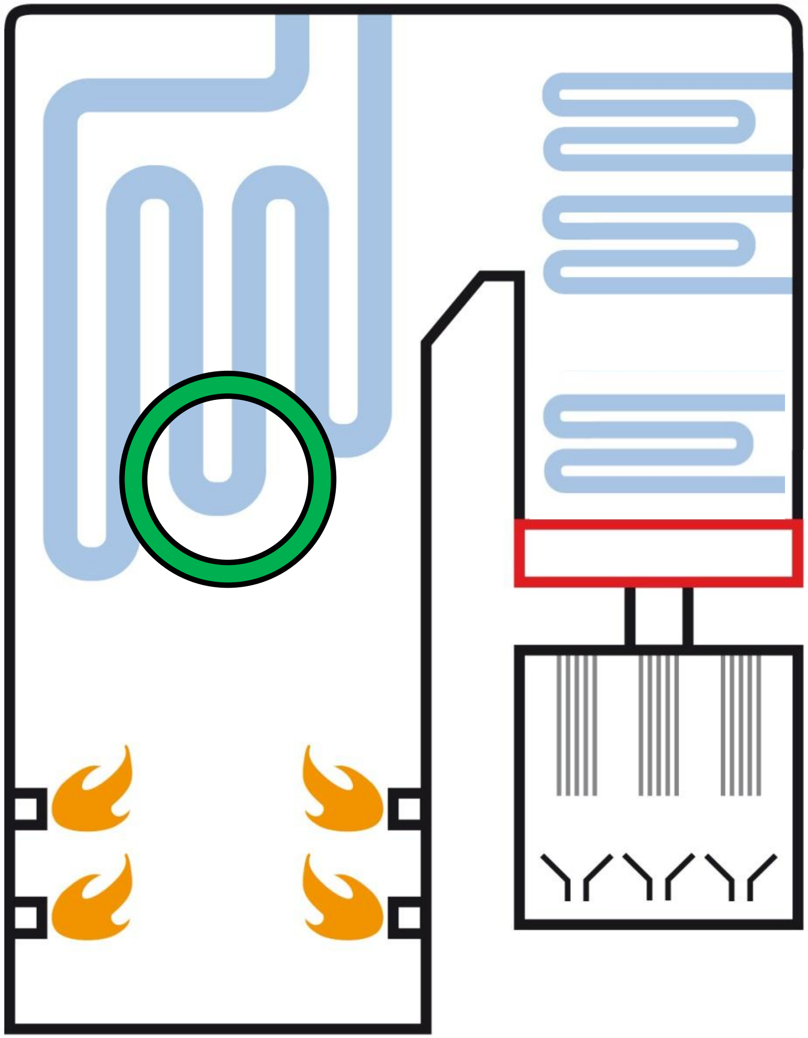
As the fraction of biomass in the fuel increases

- Less ash to absorb sticky biomass deposits such as KCl
- Sulphur/chlorine ratio becomes more important
- Positive and negative effects!
- Much less ash
- SCR catalysts poisoned
- FGD not required

Fuel chemistry management is key to ‘fouling / corrosion management’ & reliable operations

- Establish clear fuel specifications
- Ability to blend delivered fuels / use mitigant addition
- Need systems to blend or reject depending on chemistry
- No clear rigorous classification methodology.
- Need continual monitoring of corrosion, new areas of fouling, possibly ending up with new engineering solutions etc– ‘learning by doing’

Pendant tube slag



Sustainability at Drax

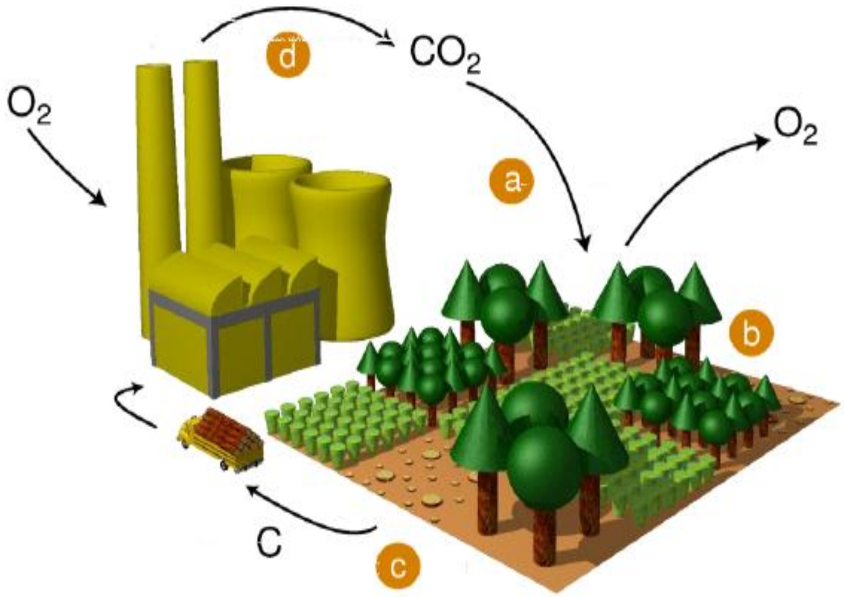
Sustainability underpins everything we do

1. Industry leading sustainability policy
   - Implemented in 2008
2. Only burn biomass from sustainable sources
   - Delivers major carbon savings
   - Reject all illegal or non-sustainable biomass
   - Extensive third party auditing
3. Strongly support introduction of robust mandatory sustainability criteria.
4. Criteria around carbon stock developing.

Drax Sustainability Policy Objectives

- **Contributing to a significant reduction in carbon emissions**
- **Maintaining forest productivity**
- **Not contributing to deforestation**
- **Not using prime agricultural land**
- **Not converting high carbon stock land into use for bioenergy**
- **Using good environmental practices**
- **Not using biomass from highly bio-diverse areas**
- **Not 'land-grabbing'**
- **Not displacing indigenous populations**
- **Contributing to local social well-being**

Carbon neutrality



Overall carbon neutral

- Zero change in C-stock? Yes... if the forest grows at the same rate as the power plant uses wood.
- But note that no forest is used simply for bioenergy!
- No time lag between combustion and regrowth if use sustainable forestry practices

Transitional technology?

Has biomass power a long life or transitional?

UK Government view

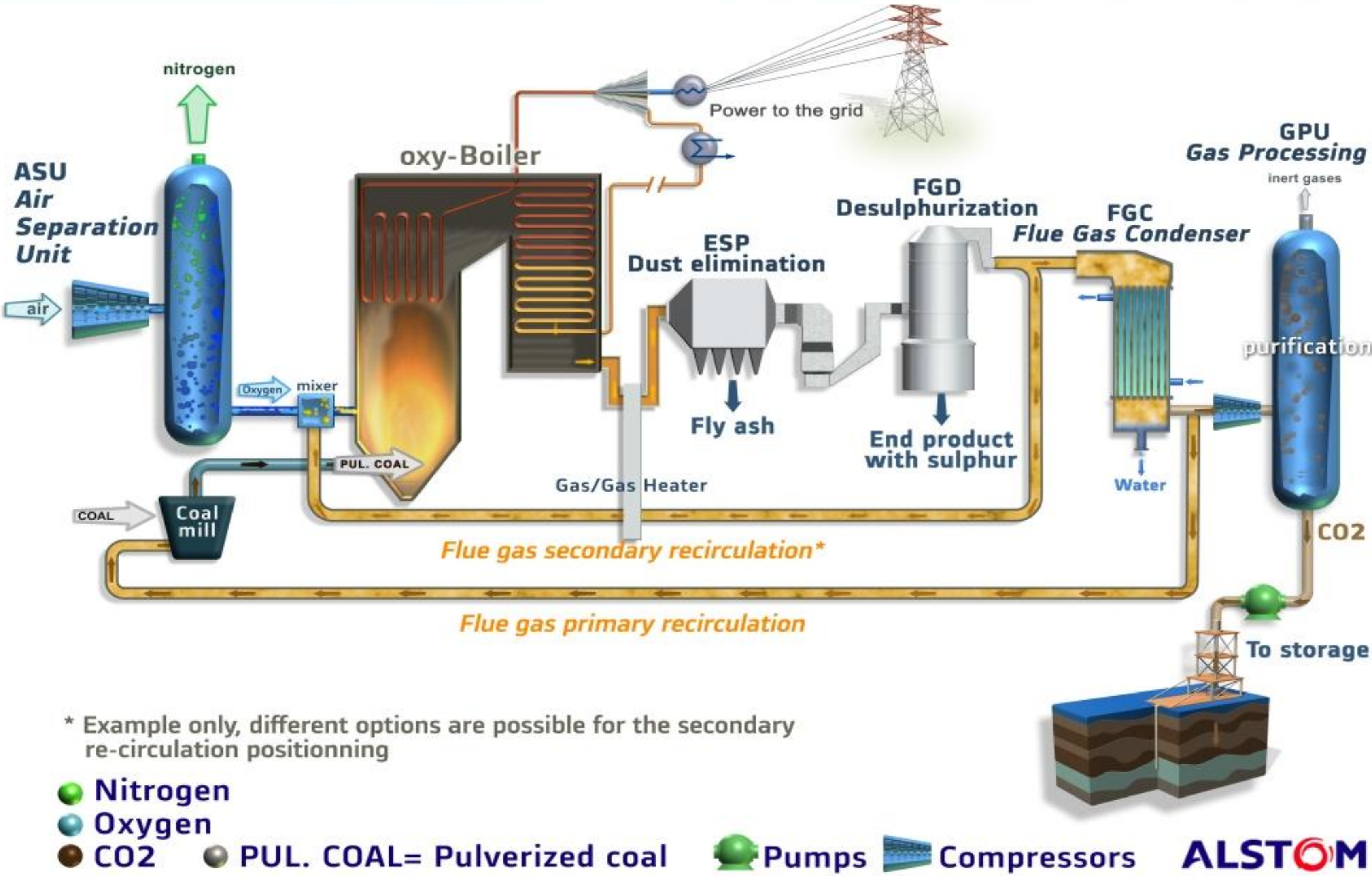
- converted coal plant near end of life
- dedicated biomass plant expensive
- subsidy ends in 2027
- is power the best use of a limited resource?
- should biomass be prioritised for 2nd gen biofuels?
- concerns around impact of high volume use of wood

However

- 2050 targets unachievable without biomass/CCS?

Carbon capture – White Rose Project

Oxy-Fuel



nitrogen
Power to the grid
ASU
Air
Separation
Unit
air
oxy-Boiler
GPU
Gas Processing Unit
inert gases
FGD
Desulphurization
FGC
Flue Gas Condenser
ESP
Dust elimination
purification
Oxygen
mixer
Fly ash
End product
with sulphur
PUL. COAL
Gas/Gas Heater
Water
COAL
Coal
mill
CO2
Flue gas secondary recirculation*
Flue gas primary recirculation
To storage
* Example only, different options are possible for the secondary
re-circulation positionning
Nitrogen
Oxygen
CO2
PUL. COAL= Pulverized coal
Pumps
Compressors
ALSTOM

Summary

Biomass is an abundant low-carbon resource

Conversion of coal plant has economic and environmental benefits

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Plans to procure and burn up to 8Mt per year at Drax

At high levels of biomass use, technologies diverge from coal

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Supply chain critical

Supply chain embryonic- needing considerable investment

Technology transitional

CCS option