

RWE npower's approach to clean coal technologies

Dr Trudy Beeley

Fuel & Combustion Engineer

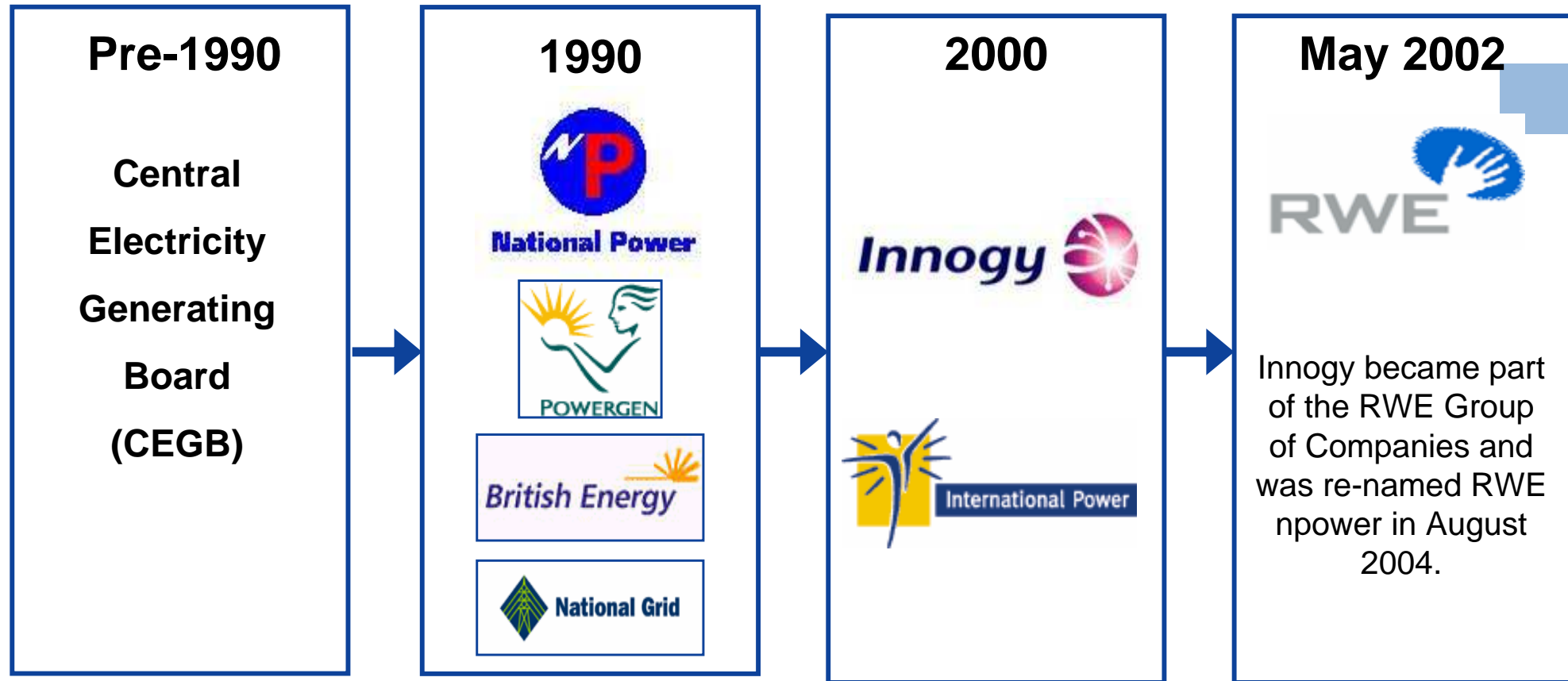
Engineering, RWE npower

RWE Power International

External Brand for RWE npower (UK) and RWE Power (Germany)
{formerly Rheinbraun Engineering} for the provision of services on:

- Asset Development
- Decommissioning
- Environmental Management
- Exploration and Mineral Deposit Evaluation
- Gas Turbine Services
- Information Systems
- Learning and Development
- Mining
- Mining Maintenance
- Mining Equipment Engineering
- Operations and Maintenance
- Plant Performance
- Plant Rehabilitation
- Power Station Maintenance
- Risk Assessment Processes

Where do we come from?



Clean Coal Technology

- Two main drivers:
 - LCPD
 - CO₂ reduction

EU's Large Combustion Plant Directive LCPD

Reduction of emissions of NO_x, SO_x and dust

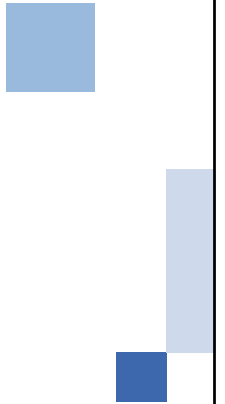
RWE npower's experience

- Converting its own plant to comply most “effectively”
 - Environmental emissions
 - Commercially
 - Securely (reliable plant)

And most importantly

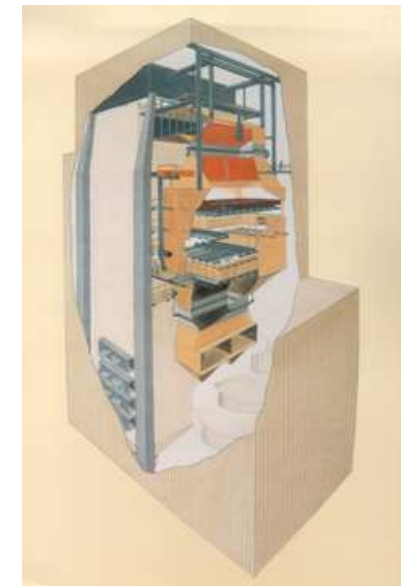
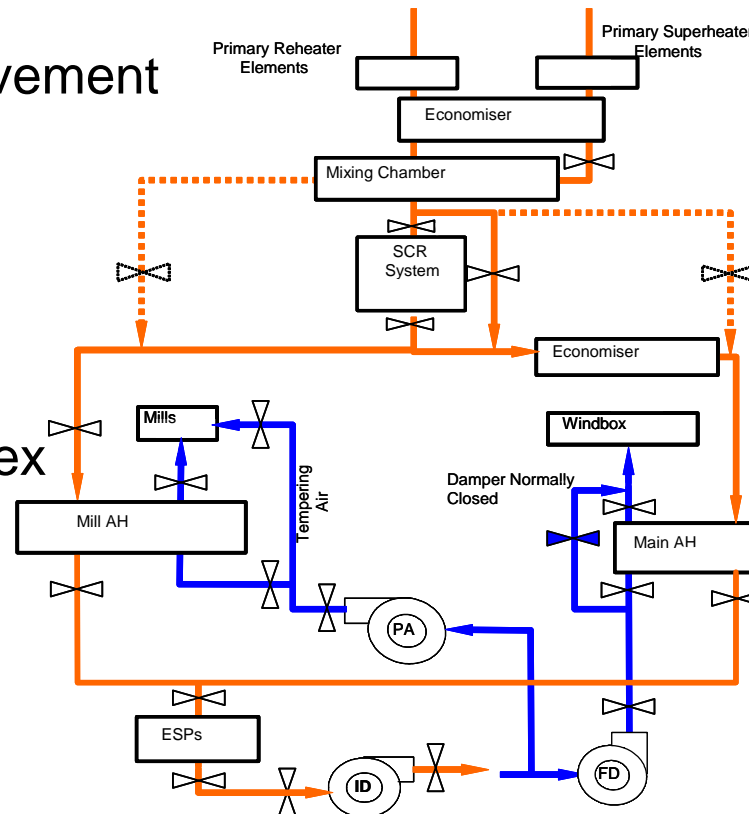
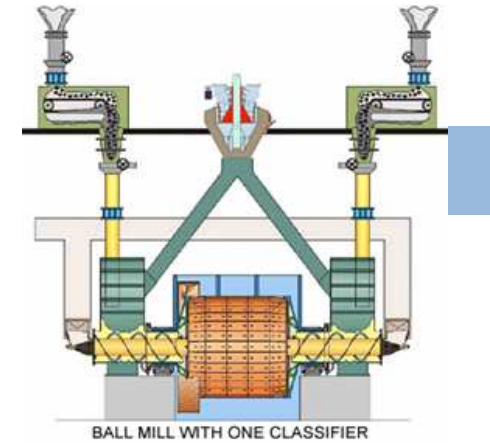
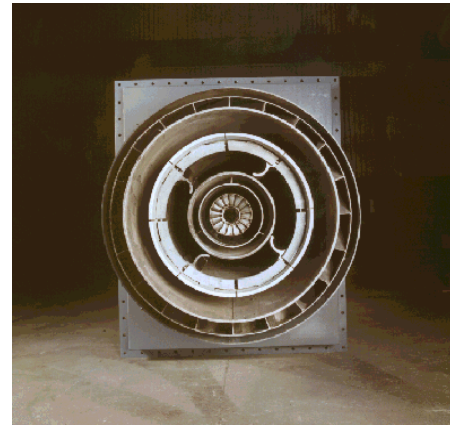
 - Safely

- Providing advice to third parties on how to meet their emission challenges

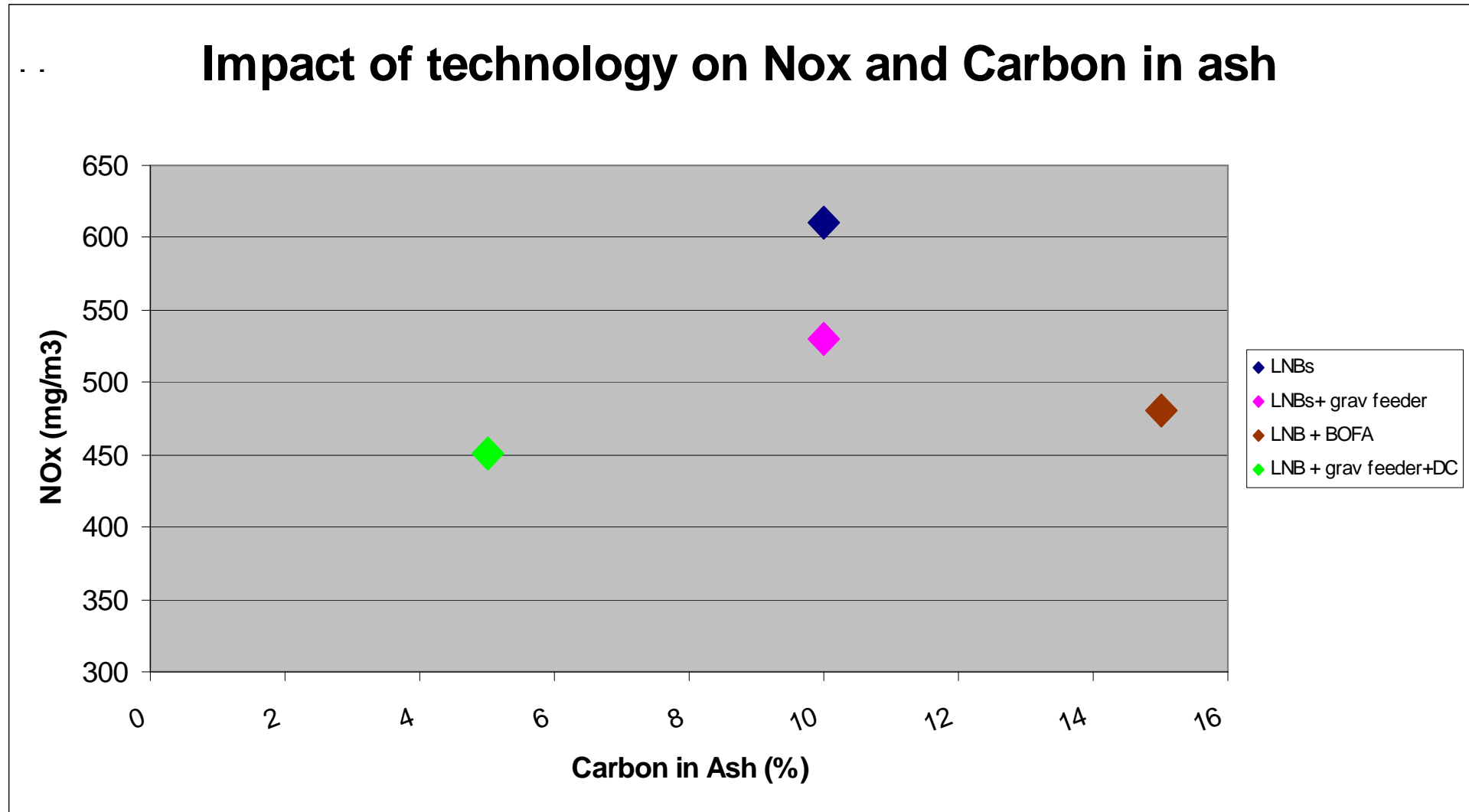


NOx reduction

- Combustion (Primary means)
 - Low NOx burners
 - Over-fire air
 - Combustion improvement
- Secondary measures
 - SCR
- Influence of fuel: complex

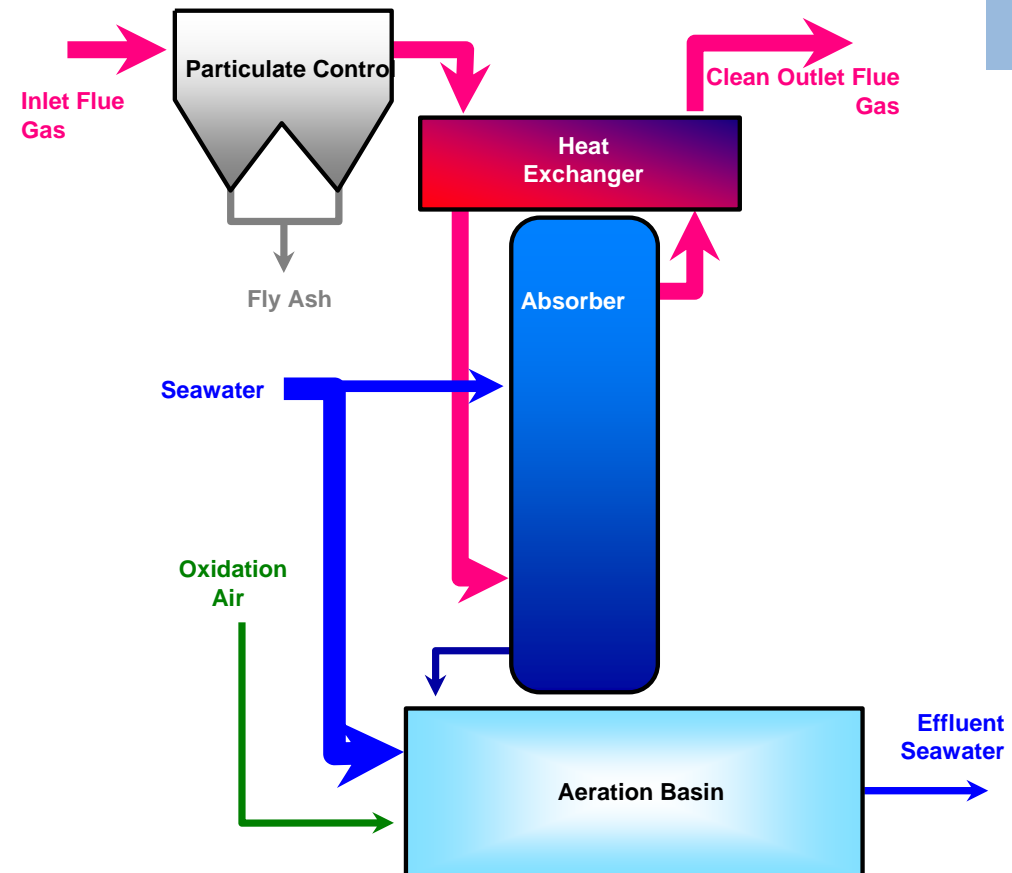


NOx compliance technology selection



SOx reduction

- Primary means
 - Ultra-low sulphur coal
 - Indonesian sub-bituminous coal
- Secondary means
 - FGD
 - Sea water process
 - Limestone – gypsum
- Influence of fuel: simple



Dust Emissions

- ESPs

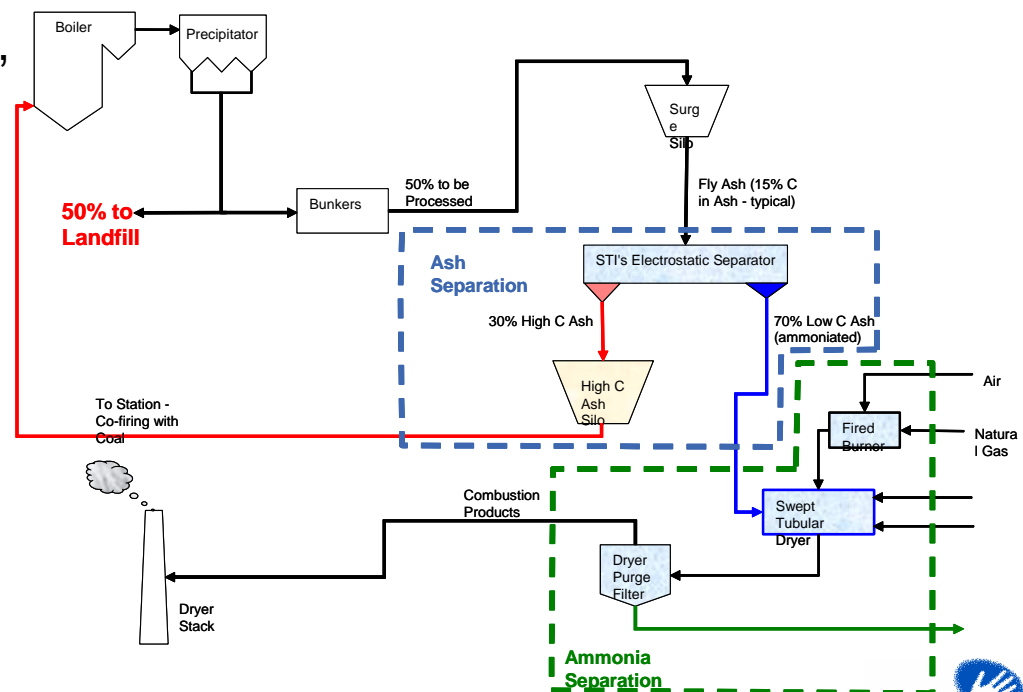
- Influence of combustion
- Influence of boiler & air ingress
- Influence of ESP technology, condition & control



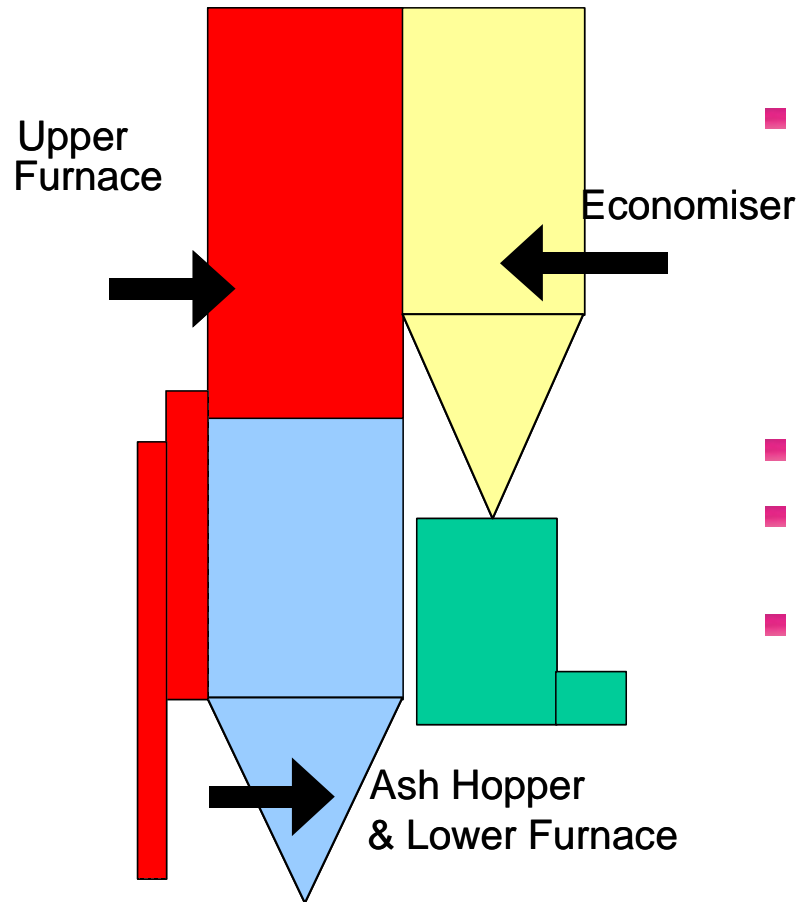
- Bag-filters

- Influence of fuel: complex

- Ash disposal issue



Air Ingress Survey



■ Issue: Boiler casing integrity deteriorates with flexible operation allowing increased air in-leakage

■ Concern: Air ingress causes operational problems:

- poor combustion
- increased likelihood of excessive dust emission
- altered heat release patterns and consequent component overheating

■ Problem: Leakage is very difficult to find

■ Solution: B&CT developed air ingress survey

■ Method:

1. A series of tests varying furnace operating pressure
2. Spreadsheet based analysis identifies:
 - quality and location
 - cost to power station

CO₂ reduction



CO₂ Reduction

- Lower carbon fuels
 - Natural gas (CH ratio of 0.25, cf coal 1.0)
 - Biomass (considered to be zero carbon)
- Higher efficiency plant
 - Supercritical boilers
 - High efficiency gas turbines
- Gasification and oxyfuel combustion
- CO₂ scrubbing

Biomass

■ Solid Biomass

- Coal replacement

■ Liquid Biomass

- Coal station HFO light up replacement
- Littlebrook Power Station Palm Oil trials

Solid Biomass



Woodchip – coarse



Woodchip – fine



Wood pellets

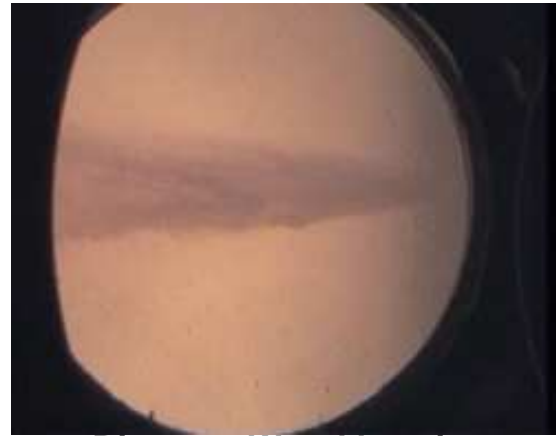


Miscanthus growing



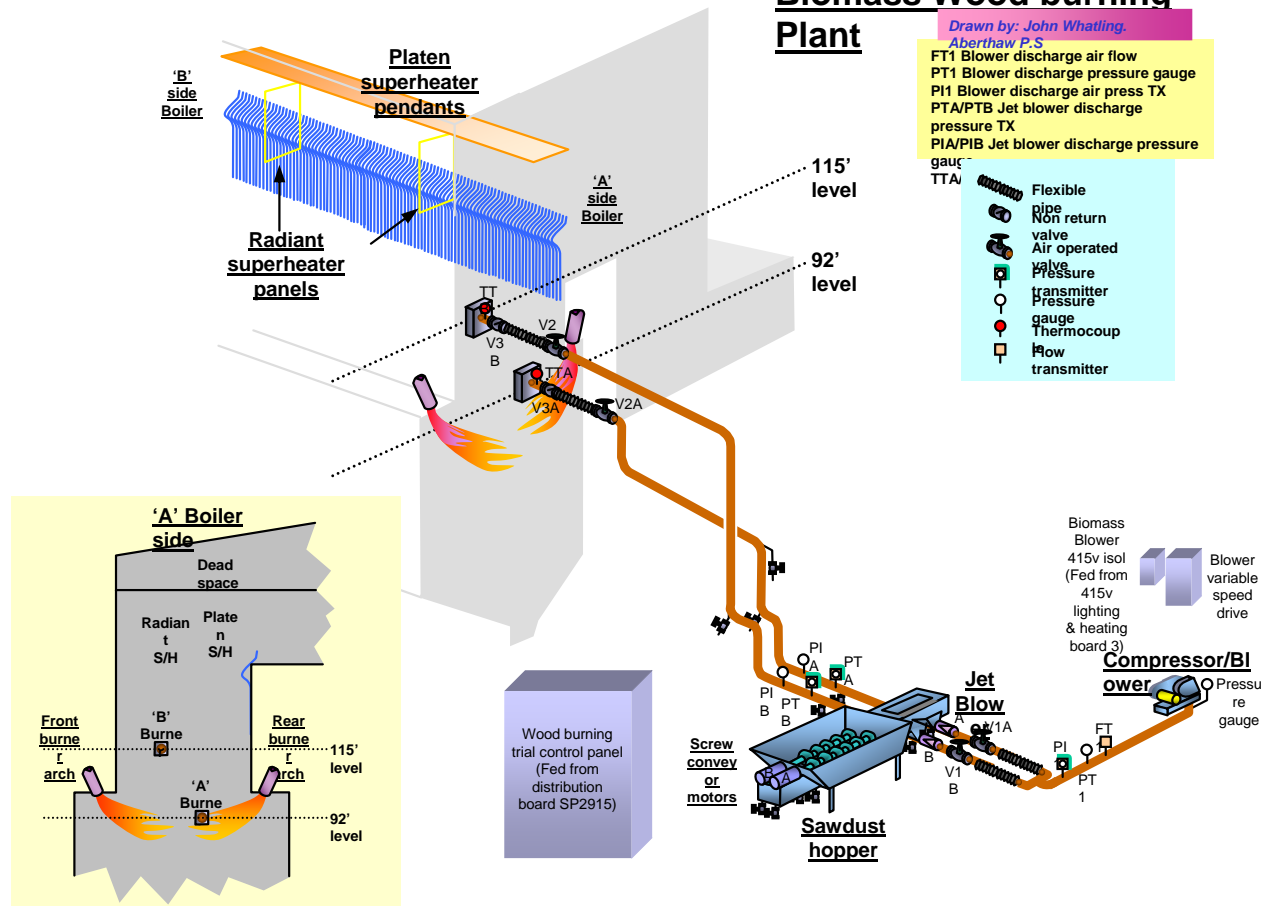
PKE “fuel”

Direct Injection of Biomass



Biomass Wood burning Plant

Drawn by: John Whadling.
 Aberthaw P.S.
 FT1 Blower discharge air flow
 PT1 Blower discharge pressure gauge
 PI1 Blower discharge air press TX
 PTA/PTB Jet blower discharge pressure TX
 PIA/PIB Jet blower discharge pressure gauge
 TTA



Liquid Biofuels

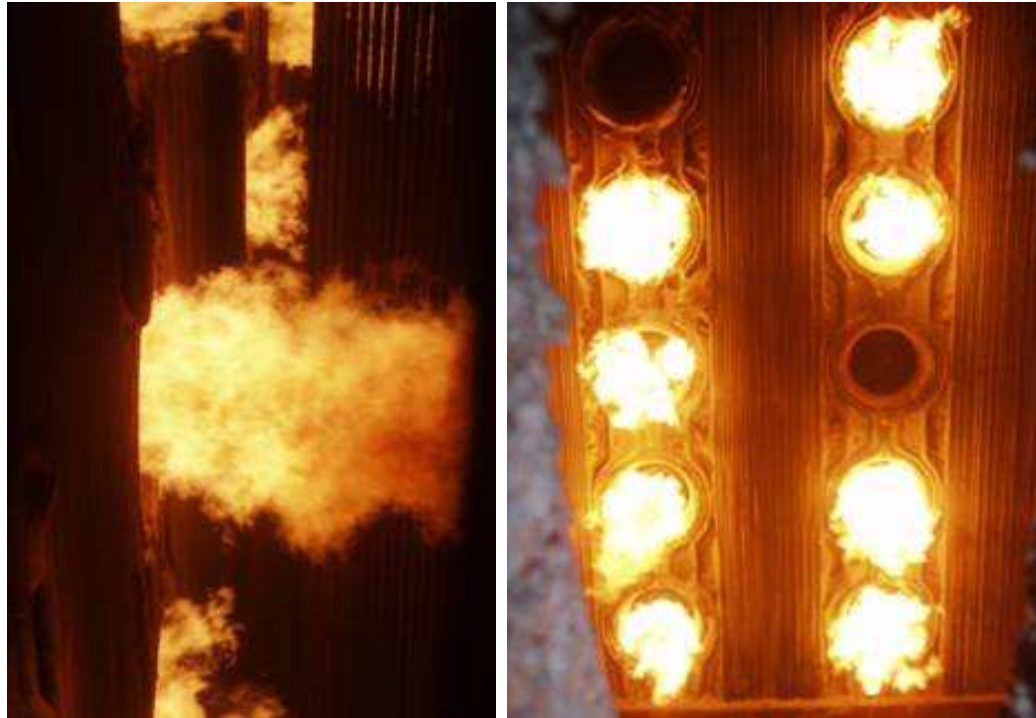
- HFO replacement
 - Tallow – WID, ended firing in 2005
 - Palm oil – similar characteristics to tallow
- Distillate replacement
 - Bio-diesel



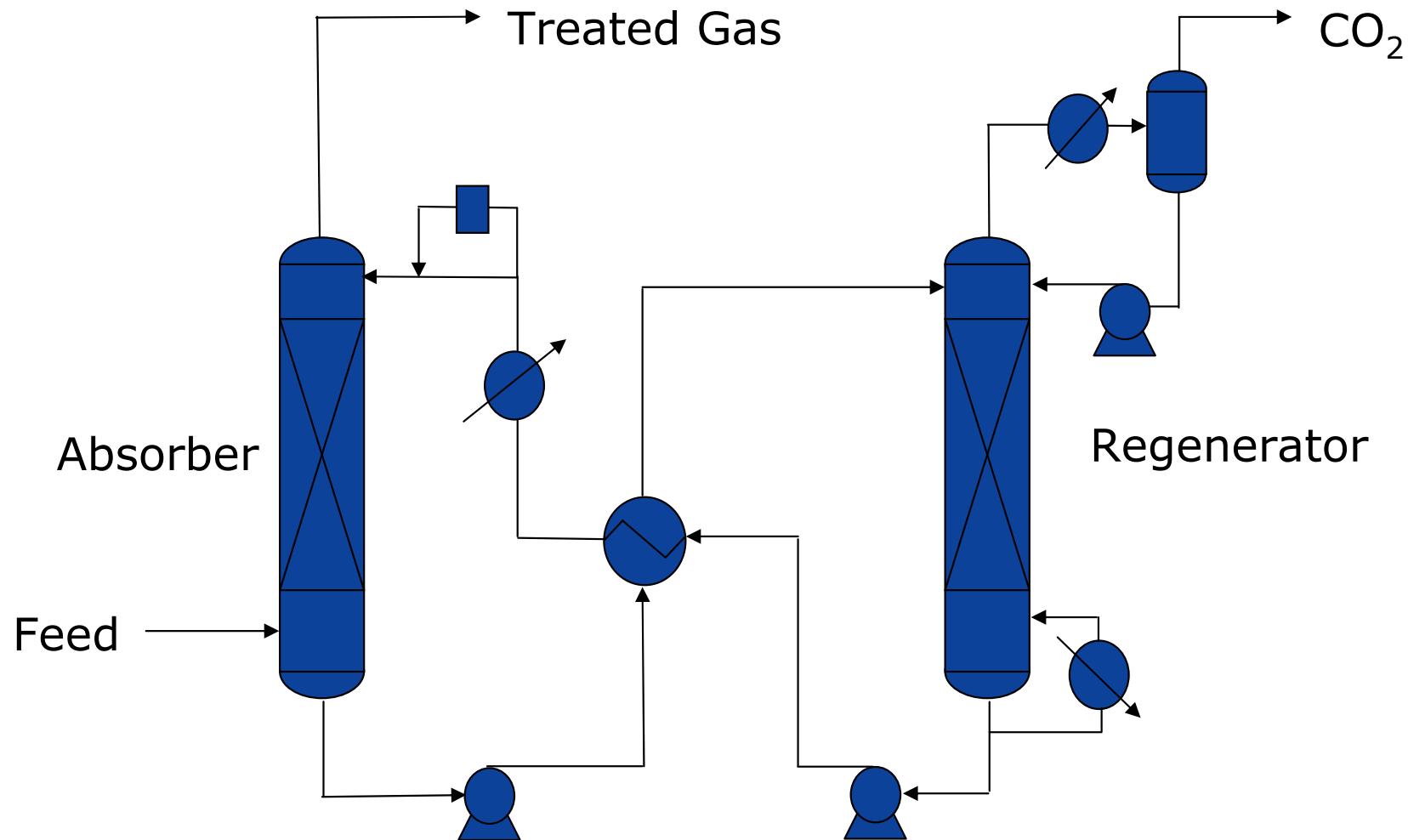
Tallow flame

Liquid Fuel Assessment

- Paper assessment
- CTF tests
- Single burner trial
- Plant Mod Procedure
- Full boiler tests
- EA Authorisation
- Commercial burn



Amine Scrubbing of CO₂



Industrial CO₂ Capture

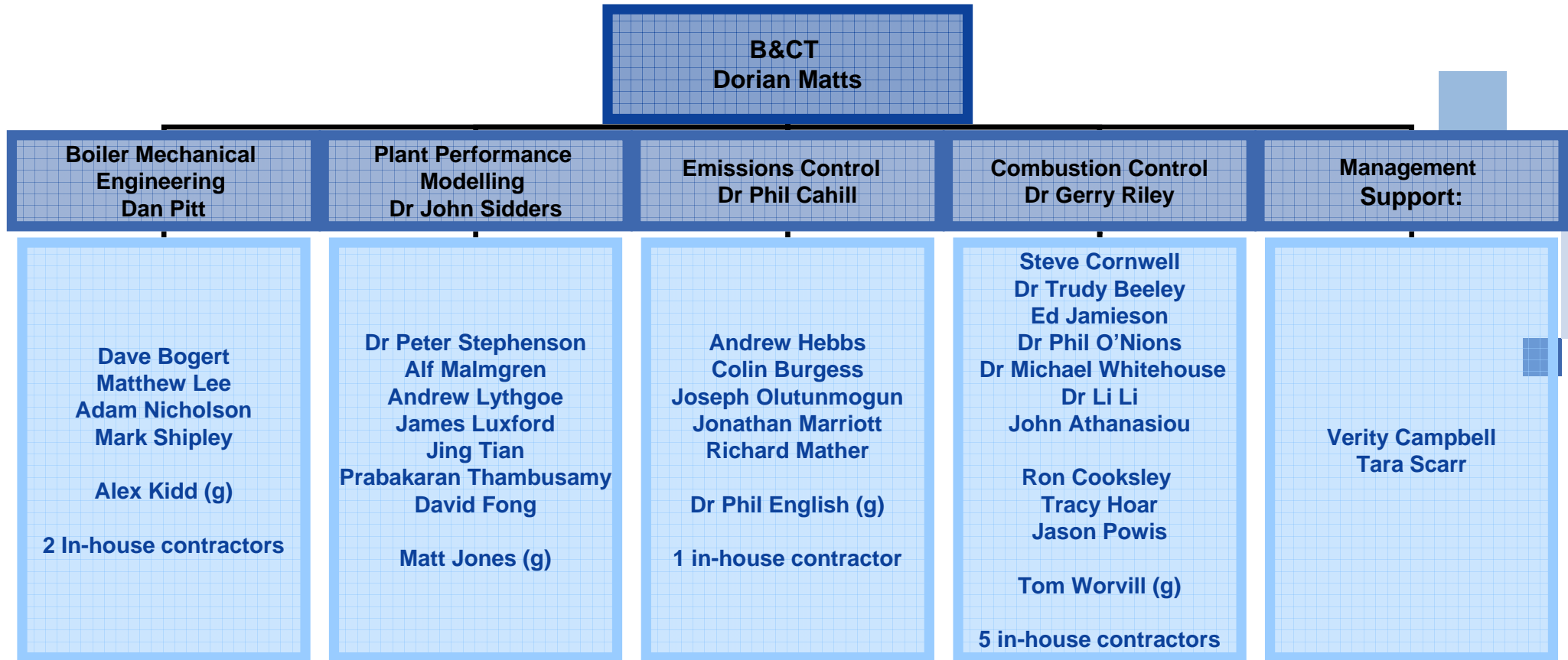
Poland - 4200kg/h (0.8% of 800MW unit)



RWE npower competence

Emission Control Related

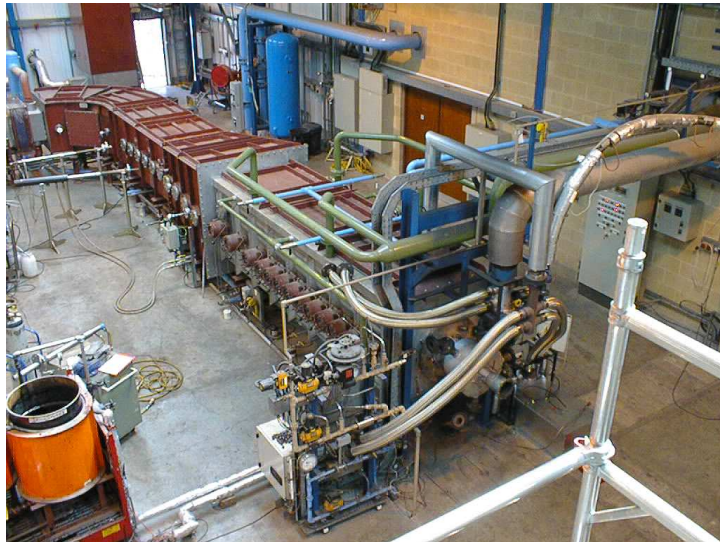
The People



Over 500 man-years of power station related technical experience

Test Facilities, Labs & Site Testing

■ Combustion Test Facility (Didcot A)



Burnt:
From anthracite
through high volatile
coals to lignite
From Orimulsion to
Cows!



■ DTF & Laboratories

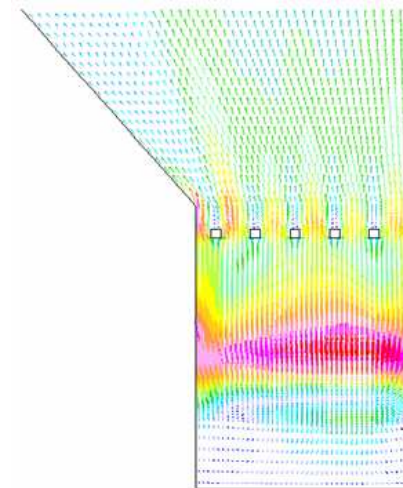


- Drop Tube Furnace
 - Basic parameter characterisation
- Fuel Characterisation Lab
 - specialist tests
 - Mill Fire Test
 - TGA
 - etc.
 - Analysis Database



Fuel Assessment Models

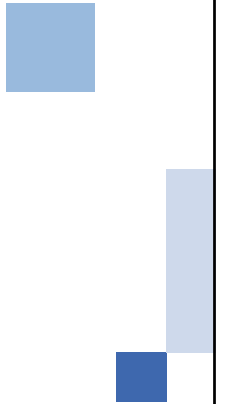
- Newburn
 - Predicts implications of fuel specification on add-on costs of generation
- FURDEC, Gatecycle, CFD
 - model impact of fuel conversion process on plant in detail
- Fuels Database
 - Over 1500 world coal specifications
 - Over 300 coal assessments
 - About 90 coals trialled on stations
- Coal Matrices
 - Captures fuel specification ranges and verified add-on costs for “trialled” coals for stations and fuel traders
 - Includes biomass



Fuel & Combustion Supporting R&D

- UK Government & EU part funded:
 - DTI NOx & DTI Burnout Projects Lead
 - DTI Biomass & DTI Ash Re-firing Projects Lead
 - DTI amine scrubbing & oxy-fuel projects
 - Various ECSC projects:
 - bunker monitors
 - intelligent flame eyes
 - slagging & fouling
 - biomass

- Currently - £10M worth of F&C R&D supported



RWE Power International Customers for Emission Control Projects

- Europe
 - EDF
 - ESB
 - ENEL
 - EoP
 - EDP
 - Union Fenosa (Serbia)
 - Elbistan EUAS (Turkey)
 - Kostolac (Serbia) EAR
 - RAE (Greece)
- UK
 - Alcan
 - Drax Power
 - British Energy
 - AES
 - Uskmouth
- Rest of the World:
 - PSEG (US)
 - International Power: Hub (Pakistan)
 - International Power: Hazelwood (Australia)
 - Castle Peak (Hong Kong)
 - Vales Point (Delta, Australia)