

= Drax power station =

Drax is a large coal @-@ fired power station in North Yorkshire , England , capable of co @-@ firing biomass and petcoke , and its name comes from the nearby village of Drax . It is situated on the River Ouse between Selby and Goole . Its generating capacity of 3 @, @ 960 megawatts is the highest of any power station in the United Kingdom ( and second @-@ highest in Western Europe , after 4 @, @ 400 MW Neurath Power Station in Germany ) , providing about 7 % of the United Kingdom 's electricity supply .

Opened in 1974 and extended in the mid @-@ 1980s , the station was initially operated by the Central Electricity Generating Board . Since privatisation in 1990 ownership has changed several times , and it is operated by Drax Group plc . Completed in 1986 , it is the newest coal @-@ fired power station in England , flue gas desulphurisation equipment was fitted between 1988 and 1995 ; high and low pressure turbines were replaced between 2007 and 2012 . Because of its large size , the station is the UK 's single largest emitter of carbon dioxide .

The station was c . 2010 co @-@ firing biomass ; in 2012 the company announced plans to convert up to three generating units to solely biomass , burning 7 @. @ 5 million tonnes imported from the United States and Canada .

= = History = =

After the Selby Coalfield was discovered in 1967 the Central Electricity Generating Board built three large power stations to use its coal . These were an expansion of the station at Ferrybridge , a new station at Eggborough , and the station at Drax was constructed on the site of Wood House .

= = = Construction = = =

The station was constructed in three similar phases , each of three generating units . The first phase began in 1973 . Costain constructed the foundations and cable tunnels ; Sir Robert McAlpine laid the roads and built the ancillary buildings ; Mowlem laid the deep foundations ; Alfred McAlpine built the administration and control buildings ; Balfour Beatty undertook general building works ; and James Scott installed cabling . Although the first phase was not completed until 1975 , the station 's first generating set began generating electricity in 1974 .

The second phase began in 1985 . Tarmac Construction undertook the civil engineering works ; Holst Civil Engineers built the chimney ; N.G. Bailey installed cabling ; Reyrolle , English Electric and South Wales Switchgear produced and installed the switchgear ; English Electric manufactured the generator cooling water pumps ; T.W. Broadbent maintained the temporary electrical supplies ; and Sulzer Brothers manufactured the boiler feed pumps . The second phase was completed in 1986 . In both stages the boilers were made by Babcock Power Ltd and the generators by C. A. Parsons and Company . Mitsui Babcock fitted flue @-@ gas desulphurisation ( FGD ) equipment between 1988 and 1995 .

= = = Post @-@ privatisation = = =

On privatisation of the Central Electricity Generating Board in 1990 , the station was transferred from the Central Electricity Generating Board to the privatised generating company National Power , which sold it to the AES Corporation in November 1999 for £ 1 @. @ 87 billion ( US \$ 3 billion ) . AES relinquished ownership in August 2003 , after falling into £ 1 @. @ 3 billion of debt . Independent directors continued the operation to ensure security of supply . In December 2005 , after refinancing , ownership passed to the Drax Group .

Separate acquisition offers from International Power , private equity group Texas Pacific , and a private equity backed bid from Constellation Energy were rejected for undervaluing the company . The company 's valuation subsequently increased to 2005 as a result of rising electricity prices , and on 15 December 2005 Drax Group plc floated its shares on the London Stock Exchange , issuing £

400 million worth of shares , on a valuation of £ 2 @. @ 3 billion .

In 2009 , Drax Group submitted a planning application for the 300 MW biomass Ouse Renewable Energy Plant next to the power station . Government approval was obtained in mid 2011 . In February 2012 the company ceased planning development of the plant , citing logistics costs , and uncertainty concerning government financial support for biomass .

= = = Future = = =

= = = = Carbon capture and storage = = = =

In 2006 Drax Power Limited , in response to a government consultation , stated they were sponsoring development studies into carbon capture and storage ( CCS ) , but noted that it was not then commercially viable , with costs comparable with nuclear or offshore wind power . On 17 June 2009 , Secretary of State for Energy and Climate Change Ed Miliband announced plans to require all UK coal @-@ fired power stations should be fitted with CCS technology by the early 2020s or face closure .

In 2012 a CCS project at Drax was shortlisted for government funding . In 2013 the White Rose CCS project ( formerly the UK OXY CCS project ) was shortlisted for the UK government 's CCS scheme and in late 2013 was awarded a two @-@ year FEED contract ( Front End Engineering Design ) for the CCS project . As of June 2014 , Drax is engaged in a joint venture with Alstom and BOC to build a 626 MW oxygen @-@ fuelled combustion power plant adjacent to the existing Drax site . National Grid would simultaneously construct a pipeline to transport CO2 40 miles ( 64 km ) to the Yorkshire coast for sequestration .

In July 2014 the project was awarded ? 300 million funding from the European Commission .

In September 2015 Drax announced it would not be making any further investments into the CCS scheme after completion of the feasibility study because negative changes to government support for renewable energy had made the project too financially risky , plus drops in the company 's share price due to the same uncertainty had reduced Drax 's ability to raise funds . Front End Engineering Design was expected to continue under Alstom and BOC with the project still being hosted at Drax . In late 2015 the UK Government withdrew its potential financial support for CCS projects - up to £ 1 billion of funding , reversing support promised in the governing party 's 2015 election manifesto . As a result , Leigh Hackett , CEO of Capture Power stated that " [ I ] t is difficult to imagine its continuation in the absence of crucial government support " .

= = Design and specification = =

The main buildings are of steel frame and metal clad construction . The main features are a turbine hall , a boiler house , a chimney and 12 cooling towers . The boiler house is 76 m ( 249 ft ) high , and the turbine hall is 400 m ( 1 @, @ 300 ft ) long . The reinforced concrete chimney stands 259 metres ( 850 ft ) high , with a diameter of 9 @. @ 1 metres ( 30 ft ) , and weighs 44 @, @ 000 tonnes . It consists of three flues , each serving two of the six boilers . When finished , the chimney was the largest industrial chimney in the world , and is still the tallest in the United Kingdom . The twelve 114 metres ( 374 ft ) high natural draft cooling towers stand in two groups of six to the north and south of the station . They are made of reinforced concrete , in the typical hyperboloid design , and each have a base diameter of 92 m ( 302 ft ) . Other facilities include a coal storage area , flue gas desulphurisation plant and gypsum handling facilities .

The station is the second largest coal @-@ fired power station in Europe , after Be?chatów Power Station in Poland . It produces around 24 terawatt @-@ hours ( TWh ) ( 86 @. @ 4 petajoules ) of electricity annually . Although it generates around 1 @, @ 500 @, @ 000 tonnes of ash and 22 @, @ 800 @, @ 000 tonnes of carbon dioxide each year , it is the most carbon @-@ efficient coal @-@ fired power plant in the United Kingdom .

== Ouse jetty ==

The power station also has a jetty on the River Ouse , with a loading capacity of 200 tonnes- historically the jetty was built and used for the construction of the power station in the 1960s / 70s - such as the delivery of equipment . In 2015 a planning application was submitted for the improvement of the jetty 's load capacity to 500 tonnes by White Rose CCS developer Capture Power Limited ( Drax / Alstom / BOC joint venture ) , for the construction of the CCS project .

== Fuel supply ==

The main transport route to the power station for fuel ( originally coal ) is train via a 4 @. @ 5 @-@ mile ( 7 @. @ 2 km ) -long freight @-@ only section of the former Hull and Barnsley Railway , from the Pontefract Line at Hensall Junction . A balloon loop rail layout is used so that wagons of coal do not need to be shunted after being unloaded . Merry @-@ go @-@ round trains are used , so that wagons can be unloaded without the train stopping as it passes through an unloading house . On average , there are 35 deliveries a day , 6 days a week .

The power station also has a jetty ( see § Jetty ) - imports via the jetty ended c.1980 - in 2004 the jetty was trialled for the import of Tall Oil by barge .

== Coal supply ==

The station has a maximum potential consumption of 36 @, @ 000 tonnes of coal a day . In 2011 , it consumed 9 @. @ 1 million tonnes of coal . This coal comes from a mixture of both domestic and international sources , with domestic coal coming from mines in Yorkshire , the Midlands and Scotland , and foreign supplies coming from Australia , Colombia , Poland , Russia and South Africa .

When the station opened , the majority of the coal burned was from local collieries in Yorkshire , including Kellingley Colliery , Prince of Wales , Ackton Hall , Sharlston Colliery , Fryston Colliery , Askern Colliery and Bentley Colliery . Following the miners ' strike in the mid @-@ 1980s , by 2006 , all but Kellingley have closed . ( Kellingley closed at the end of 2015 . ) UK Coal had a five @-@ year contract to supply coal , which ended at the end of 2009 , from Kellingley , Maltby and , until its closure in 2007 , Rossington . Coal was also brought from Harworth Colliery until it was mothballed , and was supplied by Daw Mill in Warwickshire .

The foreign coal is brought via various ports by rail . In c.2007 GB Railfreight won a contract to move coal brought from the Port of Tyne , celebrated by the company naming one of their locomotives Drax Power Station in 2007 . DB Schenker Rail ( UK ) haul coal from the nearby ports of Hull and Immingham , and from Hunterston Terminal on the west coast of Scotland . Freightliner Group move coal imported through Redcar .

In addition to burning coal , the station also co @-@ fires coal with biomass and petroleum coke ( ' petcoke ' ) .

== Biomass ==

== Co @-@ firing ==

The station tested co @-@ firing biomass in the summer of 2004 , and in doing so was the first power station in the UK to be fuelled by wood . The initial trial of 14 @, @ 100 tonnes of willow was locally sourced from nearby Eggborough . Since the trial , the station 's use of biomass has continued . It uses direct injection for firing the biomass , whereby it bypasses the pulverising mills and is either injected directly into the boiler or the fuel line , for greater throughput . In 2009 a target was set for 12 @. @ 5 % of the station 's energy to be sourced from biomass , and the shift to biomass was intended to contribute to the aim of cutting CO2 emissions by 15 % . The station burns

a large range of biomass , mostly wood pellets , sunflower pellets , olive , peanut shell husk and rape meal . The majority comes from overseas . A 100 @, @ 000 tonne pa capacity straw pelletization facility was constructed at Capitol Park , Goole in 2008 , opened 2009 . Construction of specialised biomass handling facilities began in 2009 at the Port of Tyne and at Drax .

== Proposed new build biomass plants ==

In the 2000s Drax Group applied for planning permission to build a new 300 MW power station , fuelled entirely by biomass , to the north of the station ; the Ouse Renewable Energy Plant was expected to burn 1 @, @ 400 @, @ 000 tonnes of biomass each year , saving 1 @, @ 850 @, @ 000 tonnes of CO2 emissions , and expected to create 850 construction jobs and 150 permanent jobs created once opened , through direct and contract employment . Plans were submitted to the Department of Energy and Climate Change in July 2009 for review ; if permission was granted , construction was scheduled begin in late 2010 and to take up to three and a half years . Two other 300 MW biomass plants were planned by Drax at the ports of Hull and Immingham .

In 2012 Drax group abandoned plans for the discrete biomass plant development , due to changes in government subsidies for biomass energy production favouring plant conversion over new build plant . It switched to a project to convert half of the units at its existing plant to biomass firing .

== Full firing with biomass ==

In September 2012 Drax Group announced the conversion to full firing with biomass of three of its six units . The first unit was scheduled to be online by June 2013 , the second unit in 2014 , and the third by 2017 ; initially a biomass supply had been secured for the first unit . The cost was estimated at £ 700 million ( \$ 1 @. @ 13 billion ) , including modifications to fuel mills and boilers and the construction of storage structures and conveyors for the wood pellet fuel . Each unit will consume about 2 @. @ 3 million tonnes of biomass yearly , requiring an estimated annual total of 7 @. @ 5 million tonnes in 2017 . This is equivalent to two @- @ thirds of Europe 's entire energy biomass consumption in 2010 , and requires 1 @, @ 200 @, @ 000 ha ( 4 @, @ 600 sq mi ; 12 @, @ 000 km2 ) of forest to supply on a continuous basis . North America was expected to be the source of the vast majority of the biomass , although some would be domestically sourced willow and elephant grass .

Drax Group 's decision was enabled by a new UK government policy , effective in April 2013 , to award 1 @. @ 0 tradable ROCs ( renewable obligation certificates ) per megawatt of power generation from coal power plants that are fully converted to burn biomass ; CEO Dorothy Thompson stated the company intended to become a predominately biomass @- @ fuelled energy producer . By April 2013 financing for the scheme include £ 190 million through sale of shares , £ 100 million from Prudential / M & G UK Companies Financing Fund , £ 50 million from the UK Green Investment Bank , and £ 75 million Friends Life ( underwritten by HM Treasury ) , as well as a £ 400 million credit facility .

As of 2013 there were plans to install 1 million tonne per year wood pellets pelletizing plants at Morehouse Parish , Louisiana , and Gloster , Mississippi , which would be shipped by road and rail to the port of Baton Rouge , Louisiana then shipped in 50 @, @ 000 @- @ tonne cargo ships to UK . In the financial report for 2013 , Drax announced that an additional 2 million tons pelletisation capacity was being considered , likely to be built in the US .

In 2013 the company signed an agreement with ABP to develop handling facilities at the Port of Hull , Immingham and Grimsby ; construction of automated facilities began in 2013 , creating capacities of 3 and 1 million tonnes per year at the ports of Immingham and Hull respectively , adding to the 1 @. @ 4 million tonne per year Port of Tyne biomass facility built in 2009 . In the same year a new design covered rail wagon with high volumetric capacity for transporting the low density biomass pellets was unveiled for use by Drax in the UK ; 200 wagons of the type were ordered . At Drax pellets would be stored in domes , and transferred by a pneumatic conveyor system before grinding to dust for use .

The Shepherd Building Group was contracted to construct the biomass handling and storage facilities at Drax , with RPS Group as the civil engineer . The design included automated rail to storage handling , screening and storage facilities consisting of four 50 by 63 m ( 164 by 207 ft ) high by wide storage domes with a capacity of 110 @, @ 000 m<sup>3</sup> ( 3 @, @ 900 @, @ 000 cu ft ) . The concrete dome technology was supplied by E & D Company , PLLC ( trading as Engineering System Solutons , ES2 ) and Dome Technology LLC .

By July 2013 one firing unit had been converted , and was reported to be functioning correctly ; by 2013 the conversion of the second and third units was scheduled for 2014 and during or before 2016 respectively . The second unit was converted by May 2014 , initially co @-@ firing an 85 % biomass / coal mix due to limited biomass supply .

In April 2014 Drax was awarded a renewable contract for difference ( CFD ) subsidy for biomass based power generation on another converted coal firing unit , but a third unit , which had been previously marked as eligible for CFD funding was excluded ; Drax Group then legally challenged the decision , initially obtaining a ruling in its favour , which was overturned in the Court of Appeal . In July 2014 the High Court ruled in Drax 's favour .

Biomass conversion at Drax led to it requiring 82 % of UK biomass imports from the USA in 2014 ( 60 % overall of all US wood pellet export ) , a large factor in a 40 % yearly increase in biomass export from that country ; USA sourced imports represented 58 % of Drax 's biomass use in 2014 , with 22 % from Canada .

The Baton Rouge port facility was completed by April 2015 . In mid 2015 Drax reached an agreement with Peel Ports ) to construct a 3million ton per year biomass importation facility at the Port of Liverpool , estimated cost £ 100 million . The rail connected facility was to include 100 @, @ 000 tonnes storage , and be constructed by Graham Construction .

In September 2015 Drax Group and Infinis began a legal action against the UK government due to claimed insufficient notice being given about the withdrawal of a climate related tax exemption ( see Climate Change Levy ) - Drax claimed the change would reduce its earnings by £ 30 million . The claim was rejected by the High Court in February 2016 .

= = = Petcoke = = =

The station started to trial the co @-@ firing of petcoke in one of its boilers in June 2005 , ending in June 2007 , burning 15 % petcoke and 85 % coal . Petcoke was burned to make the electricity more competitive as the price of running the FGD equipment was making the electricity more expensive . The Environment Agency ( EA ) granted permission for the trial in June 2004 , despite the plans being opposed by Friends of the Earth and Selby Council . To meet their concerns , emissions were constantly monitored through the trial , and they were not allowed to burn petcoke without operating the FGD plant to remove the high sulphur content of the emissions . The trial proved that there were no significant negative effects on the environment , and so in late 2007 Drax Group applied to move from trial conditions to commercial burn . The EA granted permission in early 2008 after agreeing with Drax 's findings that the fuel had no significant negative effects on the environment . The station can now burn up to 300 @, @ 000 tonnes of the fuel a year , and stock up to 6 @, @ 000 tonnes on site .

= = Electricity generation = =

Coal is fed into one of 30 coal bunkers , each with a capacity of 1 @, @ 000 tonnes . Each bunker feeds two of the 60 pulverisers , each of which can crush 36 tonnes of coal an hour . The station has six Babcock Power boilers , each weighing 4 @, @ 000 tonnes . The powdered coal from ten pulverisers is blasted into each boiler through burners , which are ignited by propane . In 2003 the original burners were replaced by low nitrogen oxide burners . Each of the six boilers feed steam to a steam turbine set , consisting of one high pressure ( HP ) turbine , one intermediate pressure ( IP ) turbine and three low pressure ( LP ) turbines . The HP turbines generate at 140 megawatts ( MW ) . Exhaust steam from them is fed back to the boiler and reheated , then fed to the 250 MW IP

turbines and finally passes through the 90 MW LP turbines . This gives each generating set a generating capacity of 660 MW : with six generating sets , the station has a total capacity of 3 @, @ 960 MW . Each of the generating units is equipped with the Advanced Plant Management System ( APMS ) , a system developed by RWE npower and Thales , and implemented by Capula .

The station also has six gas turbines providing backup for breakdowns , or shut downs in the National Grid . Their annual output is generally low , generating 75 MW and three of the units have been mothballed and are out of operation , but they could be refurbished . Emissions from these units are released through the station 's second , smaller chimney , to the south of the main stack .

Between 2007 and 2012 the high and low pressure turbines were replaced by Siemens in a £ 100 million programme .

= = = Cooling system = = =

Water is essential to a thermal power station , heated to create steam to turn the steam turbines . Water used in the boilers is taken from two licensed boreholes on site . Once this water has been through the turbines it is cooled by condensers using water taken from the nearby River Ouse . Water is pumped from the river by a pumphouse on the river , north of the station . Once it has been through the condenser , the water is cooled by one of the natural draft cooling towers , with two towers serving each generating set . Once cooled , the water is discharged back into the river .

= = Waste products = =

= = = Flue gas desulphurisation = = =

All six units are served by an independent wet limestone @-@ gypsum flue gas desulphurisation ( FGD ) plant , which was installed between 1988 and 1996 . This diverts gases from the boilers and passes them through a limestone slurry , which removes at least 90 % of the sulphur dioxide ( SO<sub>2</sub> ) . This is equivalent to removing over 250 @, @ 000 tonnes of SO<sub>2</sub> each year . The process requires 10 @, @ 000 tonnes of limestone a week , sourced from Tunstead Quarry in Derbyshire . A byproduct of the process is gypsum , with 15 @, @ 000 tonnes produced each week . This goes to be used in the manufacture of plasterboard . The gypsum is sold exclusively to British Gypsum , and it is transported by rail to their plants at Kirkby Thore ( on the Settle @-@ Carlisle Line ) , East Leake ( on the former Great Central Main Line ) and occasionally to Robertsbridge ( on the Hastings Line ) . DB Schenker transport the gypsum .

= = = Ash use and disposal = = =

Pulverised fuel ash ( PFA ) and furnace bottom ash ( FBA ) are two byproducts from the burning of coal . Each year , the station produces about 1 @, @ 000 @, @ 000 tonnes of PFA and around 220 @, @ 000 tonnes of FBA : all FBA and 85 % of PFA is sold . Under the trade name Drax Ash Products , the ash is sold to the local building industry , where it is used in the manufacture of blocks , cement products , grouting and the laying of roads . The ash is also used in other parts of the country . Between 2005 and 2007 , PFA was used as an infill at four disused salt mines in Northwich in Cheshire . 1 @, @ 100 @, @ 000 tonnes was used in the project , which was to avoid a future risk of subsidence in the town . Ash was delivered by DB Schenker in ten trains a week , each carrying 1 @, @ 100 tonnes . Following a trial in January 2010 , PFA is also transported to Waterford in Ireland by boat . One ship a month will transport 1 @, @ 200 tonnes for the manufacture of construction materials . This will replace 480 lorry journeys annually and is deemed more environmentally friendly .

The unsold PFA is sent by conveyor belt to the Barlow ash mound , which is used for disposal and temporary stockpile . Three conveyors feed the mound , with a total capacity of 750 tonnes an hour . FGD gypsum is disposed of on the mound if it is not of a high enough grade to be sold . The mound

has won a number of awards for its nature conservation work .

= = Environmental effects = =

The environmental effects of coal burning are well documented , the most significant of which is global warming caused by the release of carbon dioxide ( CO<sub>2</sub> ) into the Earth 's atmosphere . Coal is considered to be " easily the most carbon @-@ intensive and polluting form of energy generation available " . In 2007 the station produced 22 @,@ 160 @,@ 000 tonnes of CO<sub>2</sub> , making it the largest single source of CO<sub>2</sub> in the UK . Between 2000 and 2007 , there has been a net increase in carbon dioxide CO<sub>2</sub> of over 3 @,@ 000 @,@ 000 tonnes . The station also has the highest estimated emissions of nitrogen oxides ( NO<sub>x</sub> ) in the European Union .

In 2007 , in a move to try to lower CO<sub>2</sub> emissions , Drax Group signed a £ 100 million contract with Siemens Power Generation to re @-@ blade the steam turbines over four years . This is the largest steam turbine modernisation ever undertaken in the UK , and will increase efficiency . Coupled with the co @-@ firing of biomass , this is part of a target to reduce CO<sub>2</sub> emissions by 15 % by 2011 .

Drax 's annual report for 2013 reported that Drax 's annual emissions were at 20 @,@ 612 @,@ 000 tonnes of CO<sub>2</sub> . This was a slight decrease from 2007 levels due to the burning of biomass . Drax still remains the UK 's largest single source of emissions .

Drax has opted in to the Large Combustion Plant Directive ( LCPD ) and thus is permitted to continue operating beyond 2015 . The use of flue gas desulfurisation ensures that the limits on sulphur dioxide emissions are not exceeded .

= = Protests , industrial action and incidents = =

= = = Climate Camp ( 2006 ) = = =

On 31 August 2006 , over 600 people attended a protest against the high carbon emissions . It was coordinated by the Camp for Climate Action group . At least 3 @,@ 000 police officers from 12 forces were reported to have been drafted in for the duration of the protest , to safeguard electricity supplies and prevent the protesters from shutting the station down . Thirty @-@ nine people were arrested after trying illegally to gain access to the plant .

= = = Train protest ( 2008 ) = = =

At 8 : 00 am on 13 June 2008 , more than 30 climate change campaigners halted an EWS coal train en route to the station by disguising themselves as rail workers by wearing high @-@ visibility clothing and waving red flags . Stopping the train on a bridge across the River Aire , they scaled the wagons with the aid of the bridge 's girders . They then mounted a banner reading " Leave it in the ground " on the side of the wagon and tied the train to the bridge , preventing it moving . They then shovelled more than 20 tonnes of coal on to the railway line . The protest lasted the whole day , until several protesters were removed from the train by police that night . The station 's management said that the protest had no effect on output . The action was coordinated by Camp for Climate Action .

= = = Worker strike ( 2009 ) = = =

On 18 June 2009 , fewer than 200 contractors walked out of or failed to show up in a wildcat strike , showing solidarity with workers at the Lindsey Oil Refinery in Lincolnshire where 51 workers had been laid off while another employer on the site was employing . A spokeswoman said the strike did not affect electricity output .

= = = Biomass fires ( 2011 , 2013 ) = = =

In October 2011 a fire started by spontaneous combustion in a stockpile at the Port of Tyne biomass facility . Another fire occurred at the same facility in a conveyor transfer tower in October 2013 .