

Briefing: Drax Power Station Emissions – Coal-to-Biomass conversion increases levels of dangerous small particles

Biofuelwatch, July 2017

SUMMARY

- Data obtained through a Freedom of Information request shows that Drax Power Station's emissions of particulates (PM₁₀) have increased by 135% since the conversion of 3 of 6 units to burn biomass (wood pellets) instead of coal.
- Levels of PM₁₀ are significantly correlated with volume of biomass burnt over the past 9 years.
- The volume of PM₁₀ now emitted yearly by Drax is equivalent to that from adding 3 million extra diesel cars on the roads.
- PM₁₀ are an especially dangerous form of air pollution linked to a wide range of health problems including cancer, heart disease and neurological problems. However, they are poorly monitored nationwide and legal limits in England and Wales are 2.5 times the limit recommended by the World Health Organisation.
- The nearest PM₁₀ monitoring station is 9 miles from Drax. Due to prevailing winds, Drax's 'plume zone' extends North-East of the power station. PM₁₀ has not been monitored within this area since 2012, and then at a distance of 20 miles from Drax.
- Burning wood for energy in the UK is rapidly rising, and medical professionals are warning of a looming health crisis from increased particulate pollution. New wood-burning power stations are set to go online, but domestic wood-burning is the biggest single contributor.
- We call for far more extensive and rigorous monitoring of particulates, particularly in settlements close to biomass power stations, and an end to subsidies for burning wood for energy on health grounds.
- Fossil fuel burning also damages public health: Europe's coal-fired power stations caused 22,900 premature deaths across the continent via their emissions to air. We need an urgent phase-out of coal-fired power stations in the UK, but without the proposed loophole that power stations may burn biomass instead.

INTRODUCTION

Drax Power Station in North Yorkshire is one of the biggest burners of coal in the UK, burning nearly 3 million tonnes last year, and since its well publicised conversion of three of its six generating units to run on wood pellets, it is the biggest biomass power station in the world. In 2016, Drax burnt over 6.5 million tonnes of wood pellets [1], made from 13.2 million tonnes of wood¹.

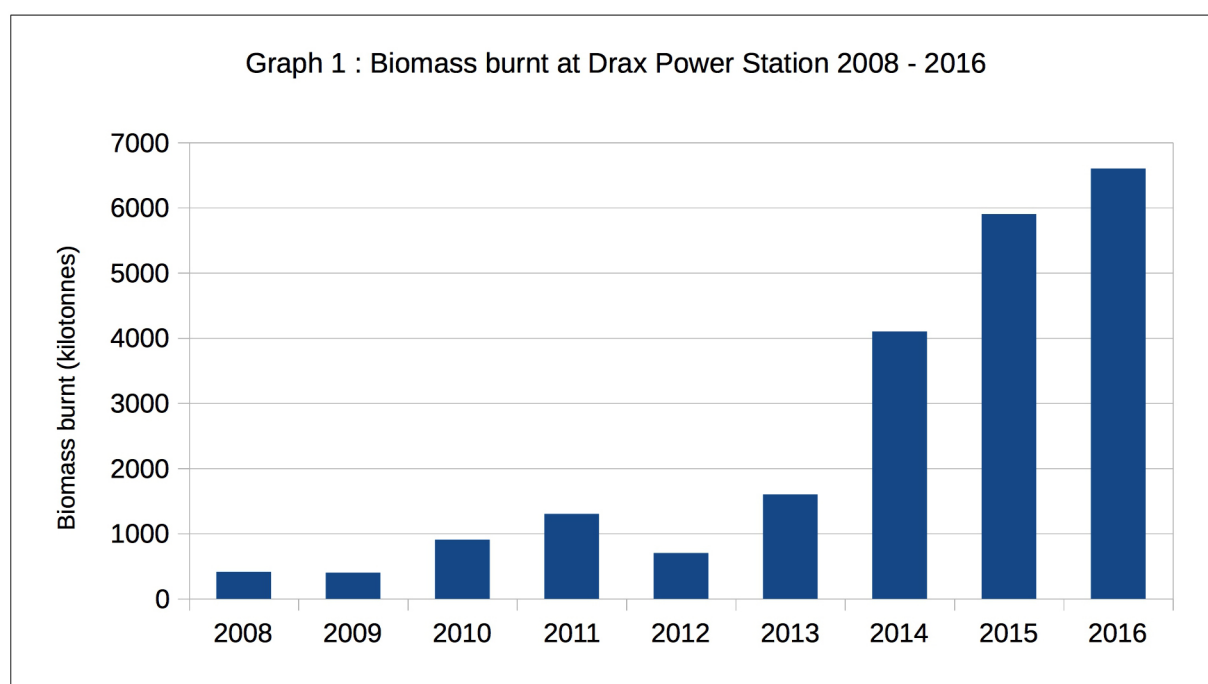
Previously, Biofuelwatch has focussed on the environmental cost of Drax, to forests, biodiversity and the climate. However, this investigation reveals that Drax's biomass conversion has another cost, and that is to the health of local residents and workers via increased pollution of particulates.

EMISSIONS DATA

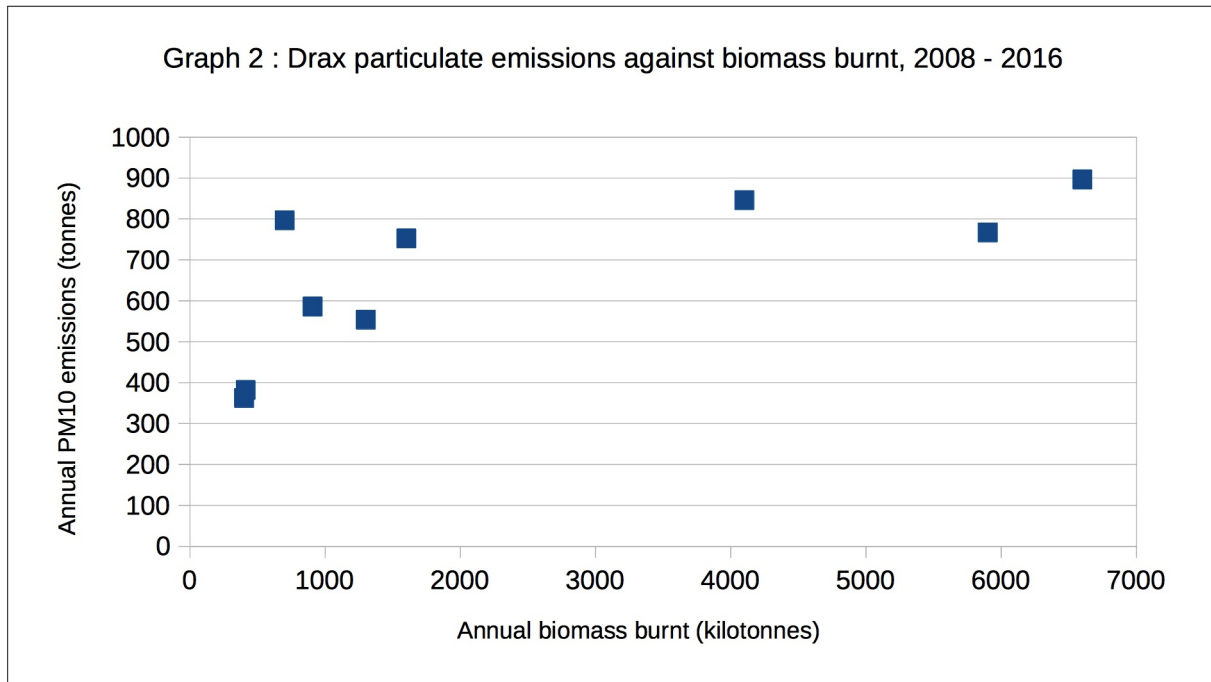
Through a Freedom of Information (FOI) request to the Environment Agency, Biofuelwatch have discovered that since Drax converted to running half its generating capacity burning wood pellets, its emissions of PM₁₀ have increased by over 100%, from 382 tonnes a year in 2008 to 897 tonnes a year in 2016 (see table 1 below).

Year	Biomass burnt (tonnes)	PM10 emissions (tonnes)
2008	412000	382
2009	400000	362.4
2010	907000	586
2011	1300000	554
2012	700000	797
2013	1600000	752.3
2014	4100000	846
2015	5900000	767.09
2016	6600000	896.5

Table 1: Drax's particulate emissions, 2008 – 2016, from an FOI submitted to the Environment Agency in May 2017. Biomass figures are obtained from Drax's annual reports. Although Drax only began converting its units to burn biomass in 2012, prior to this biomass was burnt via 'co-firing' with coal.



1. NB – each tonne of dry wood pellets requires approximately 2 tonnes of “green wood” to make (freshly cut wood which has not been dried out).



Statistical analysis of this data shows that PM_{10} levels are significantly correlated with levels of biomass burning (Spearman's rank correlation coefficient, $R_s=0.7833$ $p<0.10$).

This increase in particulate emissions is major: we calculate that in 2016, Drax's particulate emissions were equivalent to that of adding **3 million extra diesel cars on the roads**.²

PARTICULATE AIR POLLUTION

"Particulate matter" or "particulates" is a term used to describe a mixture of tiny solid and liquid particles dispersed in air, invisible to the naked eye. They are produced from a wide range of activities; not only combustion in power plants, but also domestic and commercial combustion, agriculture, road transport and by industrial processes and manufacturing. There are three main size categories: PM_{10} , with a diameter of less than 10 micrometres; $PM_{2.5}$ with a diameter less than 2.5 micrometres; and ultrafine particles less than 0.1 micrometre in diameter. PM_{10} thus includes $PM_{2.5}$ and ultrafine particles.

Particulates are an especially dangerous form of air pollution. The smaller the particle, the deeper it can penetrate into the lungs and particles of $PM_{2.5}$ and below can even enter the bloodstream and travel to other organs, causing inflammation, DNA and tissue damage and restriction of blood vessels [24]. These effects in turn can lead to a broad range of respiratory and cardiovascular health problems, including cancers, heart disease and stroke [4]. The World Health Organisation (WHO) states that there is no 'safe' level of exposure to particulates, as adverse health impacts have been demonstrated at very low atmospheric concentrations, and following both short-term and long-term exposures [5].

Particulate pollution has a heavy cost. The European Environment Agency calculate that in 2016, across 41 European countries, $PM_{2.5}$ exposure caused 467,000 premature deaths. Air pollution from ozone (O_3), nitrogen dioxide (NO_2) and $PM_{2.5}$ combined caused 555,000 deaths, making $PM_{2.5}$ by far the deadliest common form of air pollution [25]. In the UK, 37,930 premature deaths were attributed to $PM_{2.5}$ pollution [25], compared to 11,940 from NO_2 and 710 from O_3 .

2. In 2014, the most recent year for which data is available, diesel cars released 3.14 kilotonnes (kt) of PM_{10} s [2]. In 2014, the number of diesel cars on the roads was 10.7 million [3]. Therefore, in 2016, Drax released the equivalent of 28% of all particulate emissions from diesel cars in 2014 – or rather, equivalent emissions to 3 million extra diesel cars on the roads.

Unfortunately there is no legal obligation in England and Wales to monitor PM_{2.5}, and instead PM₁₀ is monitored. However, as the PM₁₀ fraction includes particles of 2.5µm and below, we can estimate PM_{2.5} concentrations, although these estimates are only indicative. We believe that the majority of Drax's particulate emissions will be PM_{2.5} as most of the particulates from biomass combustion are in this finer range [5][31].³

WHO guideline levels for PM₁₀ are 20µg/m³ (annual average) and no more than 50µg/m³ in 24 hours. The UK legal level is double this (40 µg/m³ annual average), and allows for 35 days a year where levels may exceed 50µg/m³ [6].

The UK's air quality is dangerously poor. The UK's air pollution has been declared a public health emergency by MPs and condemned by the UN [7,8], with 40 million people living in areas with illegal air pollution [9]. The Royal College of Physicians estimated that air pollution causes 40,000 early deaths each year [10]. The UK has repeatedly breached legal limits for nitrogen dioxide (NO₂), and the high court and the supreme court have both ruled against the Government's inaction on air pollution in the past two years [11].

Air pollution is inadequately monitored nationwide, with a confusing tangle of legislation. Much of the responsibility of air quality monitoring is placed upon local governments which, with increasingly restricted budgets, often cannot carry out adequate monitoring. The area local to Drax is a prime example of this.

AIR POLLUTION AROUND DRAX

The Department for the Environment, Food and Rural Affairs (DEFRA) carries out nationwide air quality monitoring in addition to local councils, but the closest stations are in York, Hull and Doncaster. There isn't a single station in the so-called "Megawatt Valley", the area south and west of Selby which, until recently, had three fully operational power stations (Drax, Eggborough and Ferrybridge) [27].

Drax Power Station is located in Selby District Council. Our investigation has found that in this area, there are no automatic monitoring stations, which would monitor PM₁₀, only NO₂ diffusion tubes [26]. Automatic monitoring stations are a relatively expensive technology which can continuously monitor a range of pollutants, and give more accurate and reliable readings than the low-tech and low-cost diffusion tubes [30]. The tubes showed illegally high NO₂ levels at four sites in Selby in 2016, forcing the council to declare an "Air Quality Management Area" in the town centre [14].

In 2008, the Council noted that "it was likely that the provisional air quality objectives for PM₁₀ would be exceeded at some locations with relevant public exposure, however, we have no statutory imperative to investigate" [14]. The council has not monitored PM₁₀ levels for any of its subsequent air quality status reports. The only PM₁₀ monitoring undertaken in recent years was a 2010 report on nearby Kellingley Colliery (9 miles West of Drax), which reported an annual concentration of 26µg/m³ - far above the WHO's guidelines but within the legal Air Quality Objective for England and Wales [15].

However, Drax's pollution plume predominantly covers the area North-East of the station, due to prevailing South-Westerly winds. This area falls under the jurisdiction of the East Riding of Yorkshire

3. The WHO notes that: "the combustion of wood and other biomass fuels can be an important source of particulate air pollution, the resulting combustion particles being largely in the fine (PM_{2.5}) mode." [31], a review of particulate emissions factors from many different types of biomass, found that "among the particle size ranges analyzed in this review work, fine particles (PM_{2.5}) had higher emission factors than the other size ranges."

council, who closed down their three automatic monitoring stations in December 2012 due to budget cuts, replacing them with a network of diffusion tubes which only monitor NO₂ [13]. These found in 2015 that there had been exceedances of the 40µg/m³ legal limit for NO₂ at four locations.

Two of the old automatic monitoring stations were located in the town of Beverley, approximately 23 miles North-East of Drax, and one in Preston, around 32 miles East of Drax. At both Beverley and Preston, levels of PM₁₀ pollution were above WHO guidelines, but within legal limits from 2009-2012 [13]. No monitoring of PM₁₀ was carried out at all in 2013 or 2014. There has been no report on air quality since 2015.

York City Council does monitor PM₁₀, but all its sites are in urban environments, and located at a distance of at least 15 miles, and North, of Drax [16].

The fact that there has been no monitoring of PM₁₀ within 20 miles of Drax in its plume area since 2012, before the conversion to biomass was begun, and particulates have only ever been monitored within 9 miles of Drax, is worrying to say the least. It's all the more worrying given the recent more than doubling of PM₁₀ emissions from the power station.

DRAX'S IMPACTS ON LOCAL HEALTH

It's hard to estimate exactly what impact Drax's air pollution has on the local population. In 2016, a coalition of European NGOs, including WWF and Sandbag, produced a report on the health impact of Europe's coal-fired power stations, using emissions data from 2013 [28]. They found that, due to emissions of NO₂, ground level ozone and PM_{2.5}, that these power stations were responsible for 22,900 premature deaths across the continent. PM_{2.5} was responsible for 83% of the total, approximately 19,000 deaths.

The report also looked into the health impact of individual power stations: Drax was the fourth highest polluter, and so the fourth most deadly in 2013, responsible for 590 premature deaths. It would be interesting to see whether this estimate has risen given the recent increase in PM₁₀ emissions.



However, it may have decreased. The report notes that a large proportion of the PM_{2.5} were 'secondary particulates' which are formed by the reaction between sulphur dioxide and nitrogen oxides released from coal power plants [28]. Drax's emissions of NO_x and SO₂ have decreased in recent years (see table 2 below). We believe NO_x emissions have lowered due to the fitting of 'selective non-catalytic reduction' equipment (a requirement by the EU 2016 Industrial Emissions Directive). SO₂ emissions have probably decreased because biomass has a lower sulphur content than coal.

Year	NOx emissions (tonnes)	SO2 emissions (tonnes)
2014*	35900	24700
2015*	31400	18600
2016†	14670.7	8252.8

Table 2: Emissions of nitrogen oxides and sulphur dioxide from Drax Power Station, 2014-2016

* From the European Pollutant Release and Transfer Register, accessible from <http://prtr.ec.europa.eu/#/home>

† From the Freedom of Information request submitted to the EA

WOOD-BURNING: A LOOMING HEALTH CRISIS?

Drax's 767 tonnes of PM₁₀ in 2015 accounted for 0.5% of the nationwide total of 145,000 tonnes [19]. Industry (energy production, manufacturing and other processes) were together the single largest contributor, accounting for around 35% of the total. However, they were closely followed by residential, commercial and agricultural combustion, accounting for 33%. Road transport made up 14%, and was the third largest contributor.

Domestic wood-burning stoves have come increasingly under fire as they were found to be responsible for 50% of a recent London pollution spike [20] and doctors are warning of the health impacts of increased wood-burning in the UK, particularly due to PM_{2.5}. Dr Dorothy Robinson, a senior statistician writing in the British Medical Journal, writes

“Revised figures show domestic wood burning to be the UK's largest single source of PM_{2.5} emissions, 2.4 times greater than all PM_{2.5} emissions from traffic. The new information (33% of PM_{2.5} emissions in 2013-2014 from domestic wood burning, twice the previous estimate of 17%) highlights the extremely misguided nature of current policies.

...The disproportionate amount of PM_{2.5} pollution from domestic wood burning continues to escape attention. Few people who install wood stoves are likely to understand that a single log-burning stove permitted in smokeless zones emits more PM_{2.5} per year than 1,000 petrol cars and has estimated health costs in urban areas of thousands of pounds per year.” [22]

Log fires have a cultural significance and are often a source of wellbeing to residents, and in some rural locations burning sustainably sourced biomass may be the best option for the climate and the local ecology. However, wood burning in urban areas should be more carefully regulated, especially in urban areas (the United Nations Environment Programme recommends phasing out log-burning stoves in developed countries to mitigate climate change and protect health [32]).

In order to stand a reasonable (66%) chance of keeping global warming below 2°C, as is required by the Paris Agreement, there must be a managed but rapid phase-out of fossil fuel burning from the energy system, with their complete removal by 2050 [33]. In addition, as shown by the 'Dark Cloud' report, the emissions from Europe's coal-fired power stations are causing 23,000 people to die early, and cause health impacts costing between 32 and 62 billion Euros every year. For these reasons, we strongly support the Government's proposal to phase-out coal-fired power stations by 2025, and urge them to set an earlier date for the phase out.

However, we must not replace one problem with another. Biomass power may have lower emissions of nitrogen oxides and sulphur dioxide than coal, but it is by no means a 'clean' fuel, as the greatly increased particulate emissions from Drax indicate. In fact, tonne for tonne, biomass may have a worse impact on public health due to these particulates, although more research and modelling must be done.

Currently, biomass electricity is actively encouraged by the UK Government via subsidies, and received £800 million of bill-payers' money in 2015. Burning wood to generate electricity is on the increase; from 0.4 million tonnes in 2010 to almost 15 million tonnes in 2015 [23], and two new large biomass power plants are set to go online at Lynemouth and Teeside in 2018 with the capacity to burn 3 million tonnes of wood apiece. In addition, the current proposal for the phase-out of coal-fired generation includes an option to allow the stations to remain open if they co-fire or convert to biomass [39].

This is a very worrying trend. If a large proportion of fossil fuel burning in our energy system is to be replaced by biomass burning, this would have disastrous impacts on public health due to increased particulate emissions. This is on top of the disastrous impacts on climate, biodiversity and forests that Biofuelwatch has previously reported [see 35 and 36].



We call for:

- An end to subsidies to fossil fuel generators (in 2018/19 coal, gas and diesel generators will receive a subsidy of £730 million [40]);
- An end to tax breaks for offshore oil and gas (which have been £2.3 billion in the past three years [37]) and to exploration for new oil and gas reserves;
- An end to subsidies for biomass electricity (grandfathered “Renewable Obligation Certificates” and the new “Contracts for Difference”), which amounted to £800 million from electricity bills in 2015 [38]);
- An urgent coal phase-out without biomass loopholes.

We also believe it's imperative that the air pollution crisis in this country is ended. We support the call by ClientEarth for a new Clean Air Act, which would:

- Adopt new legal limits for pollutants so that they are in line with WHO objectives, and adopt a new guideline level specifically for PM_{2.5};
- Retain current EU laws after Brexit, and consolidate the various different national, EU and international laws into one coherent body of legislation;
- Require national, local and city authorities to collect adequate information on air pollution – including data from a minimum number of air quality monitoring stations – and proactively provide the public with that information, including through smog warnings during high pollution episodes;
- Require national, local and city authorities to take measures to reduce exposure to air pollution – particularly for vulnerable groups such as children, older people and those suffering from pre-existing health conditions. (These could include Clean Air Zones with charges or bans on vehicles, especially diesel vehicles, and restrictions on domestic wood-burning.)

A number of other measures have been proposed [see 29].

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