Air quality and health impacts of Aberthaw power station

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Cover image: Aberthaw power station. Image © Ben Salter/Flickr

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Executive summary

The 1,500MW Aberthaw coal-fired power plant in southern Wales is among the largest point sources of air pollution in the UK. In 2013 it had the 3rd highest emissions of nitrogen oxides of any industrial installation throughout the EU. Of the 12-highest nitrogen oxides polluters in the EU, Aberthaw is by some margin the greatest polluter relative to the electricity generated[1].

Hundreds of people's lives are ended prematurely as a result of pollution from Aberthaw power station every year. This pollution also causes tens of thousands of days of lost productivity through sick leave, and hundreds of thousands of days of illness every year. The annual societal cost of the premature deaths resulting from Aberthaw's NO_2 pollution is £226.4 million in total, and £37.9 million in Wales alone.

The pollution is responsible for causing asthma symptoms in children, bronchitis in children, chronic bronchitis in adults, hundreds of hospital admissions every year, and low birth weight in babies.

Over the 45 years since it started operating, pollution from this one power station alone is likely to have caused the premature deaths of more than 3,000 people in Wales, and 18,000 across a wider area.

Governments and environmental regulators appear to be failing to comply with requirements of European legislation through failing to even monitor spikes in emissions from Aberthaw power station, let alone act on them.

The electricity produced by Aberthaw power station could be substituted by renewable sources, creating substantially more employment for Wales.

Given the particularly heavy pollutant load associated with this power station both in absolute terms and per unit of electricity generated, the serious health impact of this pollution and the massive quantities of greenhouse gases emitted, we call for the full and permanent closure of Aberthaw power station.

1 **Air Pollution and Climate Secretariat Acid News June 2014, p23**

Introduction

Public health in the UK is heavily affected by air pollution, with the Royal College of Physicians attributing 40,000 premature deaths in 2016 to this cause[2]. Reducing emissions from large industrial sources, such as coal-fired power plants is one of the interventions with highest effectiveness and feasibility of implementation in addressing the very significant negative health impacts of air pollution.

We analysed the impacts of the emissions from Aberthaw power station on air quality and health[3]. The health impacts of the modelled air pollutant exposure resulting from the emissions were assessed following World Health Organization recommendations.

The emissions elevate the levels of sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and particulates over the entire southern UK, with the worst impacts in the coastal parts of Glamorgan and Gwent due to prevalent wind patterns.

Air pollution is harmful to everyone[4]. Exposure to these pollutants increases the risk of diseases such as stroke, lung cancer, heart and respiratory diseases in adults, as well as respiratory symptoms in children[5]. This leads to premature deaths from these causes. SO_2, NOx and dust emissions contribute to toxic particle exposure.

The estimated health impacts due to NO_2 exposure are 400 premature deaths per year[6], principally in the UK. The emissions from the power plant are estimated to be responsible for 195,000 days of illness per year, including 35,000 days of sick leave.

In other words, on an average day, 530 people are ill due to the harmful health impacts of the pollution. The health impacts include an estimated 3,400 cases of asthma symptoms in children, 260 cases of bronchitis in children, 60 cases of chronic bronchitis in adults and 290 hospital admissions per year. The estimated number of babies born with a low birth weight due to the pollution is 20.

On average, there are 67 equivalent attributable deaths annually in Wales as a result of pollution from Aberthaw power station. We also suffer 15 cases of bronchitis and 200 cases of asthma in children, 4 new cases of chronic bronchitis in adults and 39 hospital admissions annually. The toll of sickness adds up to 11,200 days, with 1,700 days lost from work each year.

To put this in perspective, 105 people were killed on the roads of Wales in 2015[7]. While the Welsh Government has a Road Safety Framework for Wales[8] that aims to reduce “almost entirely avoidable” casualties, no such strategy exists for the entirely avoidable casualties resulting from Aberthaw power station.

2 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016
3 See appendix 1 for the methodology
4 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016
5 WWF Europe’s Dark Cloud, July 2016
6 The relationship between pollution and modelled health impacts applies to long-term chronic impacts, with loss of life (premature death) measured in years or decades
7 Welsh Government Statistical Services: “What were the top 10 causes of fatal or serious road accidents in Wales during 2015?”, June 2016
8 Welsh Government Road Safety Framework for Wales, July 2013

The towns and cities most affected by pollution from Aberthaw power station include:

- Barry (Wales' fifth-biggest conurbation) – 24-hour maximum NO_2 of 55 µg/m^3
- Maesteg, Cardiff and Llantwit Major – 24-hour maximum NO_2 above 30 µg/m^3
- Llantrisant, Bridgend, Pontypridd and Porthcawl – 24-hour maximum NO_2 above 20 µg/m^3
- Newport – 24-hour maximum NO_2 above 15 µg/m^3
- Bristol and Swansea – 24-hour maximum NO_2 above 10 µg/m^3
- Poole, Gloucester, Cheltenham and Bournemouth – 24-hour maximum NO_2 above 5 µg/m^3

The cost to society of emissions from Aberthaw power station is at least £950 million every year[9].

The operators of Aberthaw power station have declared that the plant will be run below capacity from March 2017. However no further detail has been provided on these plans. Given the particularly heavy pollutant load associated with this power station both in absolute terms and per unit of electricity generated, the massive quantities of greenhouse gases emitted and the serious health impact of the pollution, we call for the full and permanent closure of Aberthaw power station.

9 Friends of the Earth Cymru, Aberthaw power station, February 2016

Impacts of pollution from Aberthaw power station on air quality – NO_2

On an annual basis, much of southern Britain is affected to some degree by air pollution from Aberthaw power station ***(Figure 1)***. Unsurprisingly, the largest air quality impacts take place on the coast in the vicinity of the power plant, with a notably increased load in the east due to prevailing wind patterns ***(Figures 2 and 4)***. Barry, Cardiff and Penarth are the most affected towns for NO_2 health impacts.

However, the pollution negatively affects air quality on a huge geographical scale, with impacts as far afield as the Republic of Ireland, Scotland and France ***(Figure 3)***.

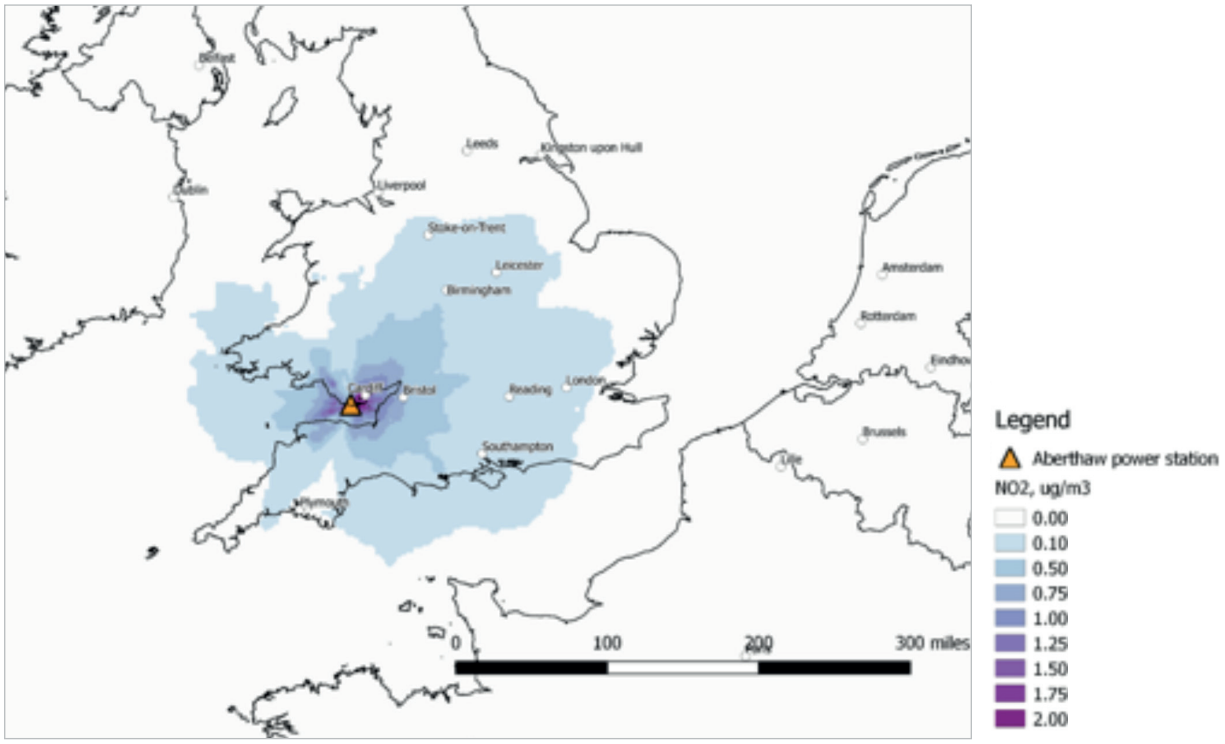


Figure 1 *Modelled annual average NO_2 concentration attributable to emissions from Aberthaw power station ($\mu g/m^3$)*

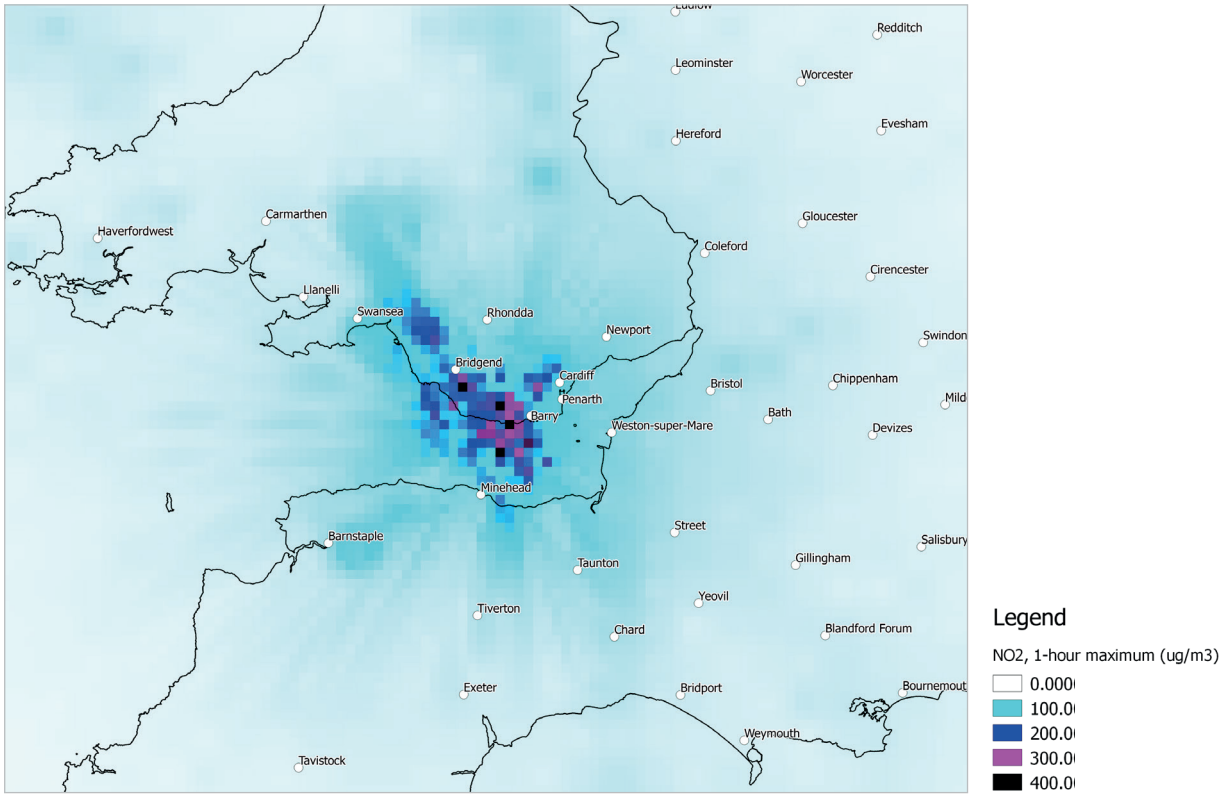


Figure 2 Modelled annual average NO_2 concentration attributable to emissions from Aberthaw power station ($\mu g/m^3$)

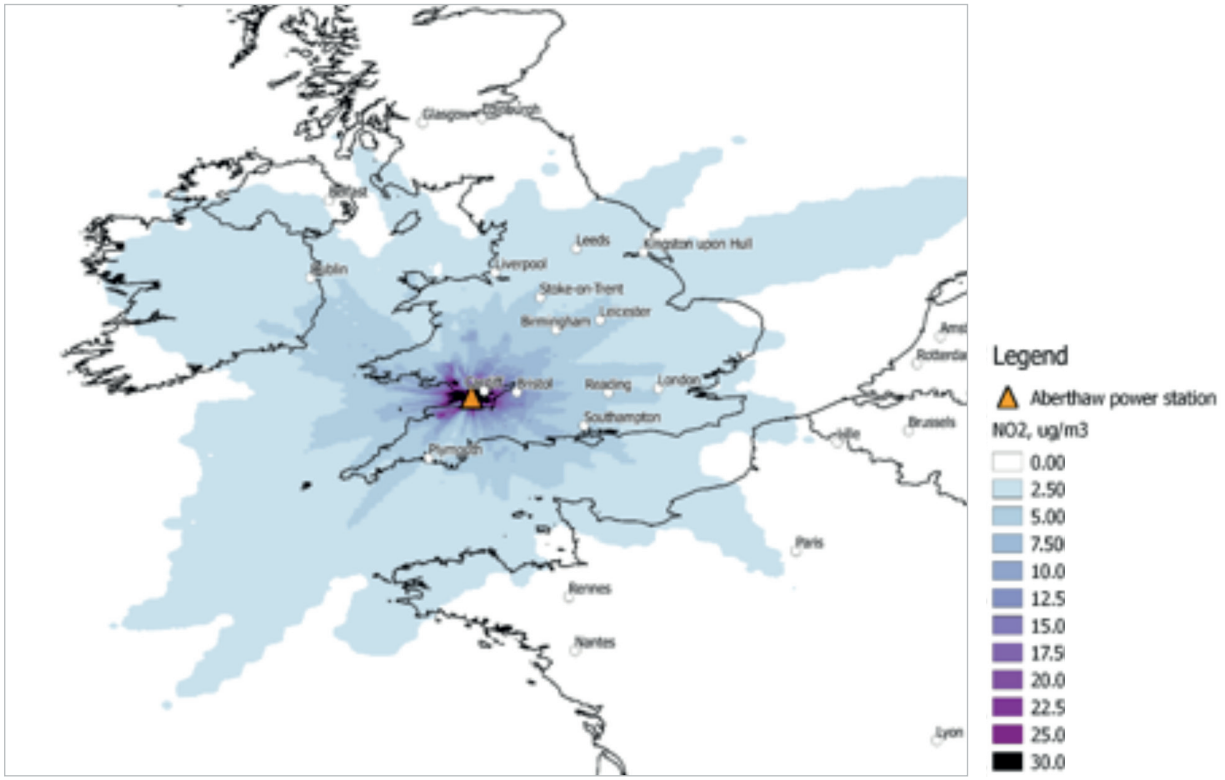


Figure 3 *Modelled 24-hour maximum NO_2 concentration attributable to emissions from Aberthaw power station ($\mu g/m^3$)*

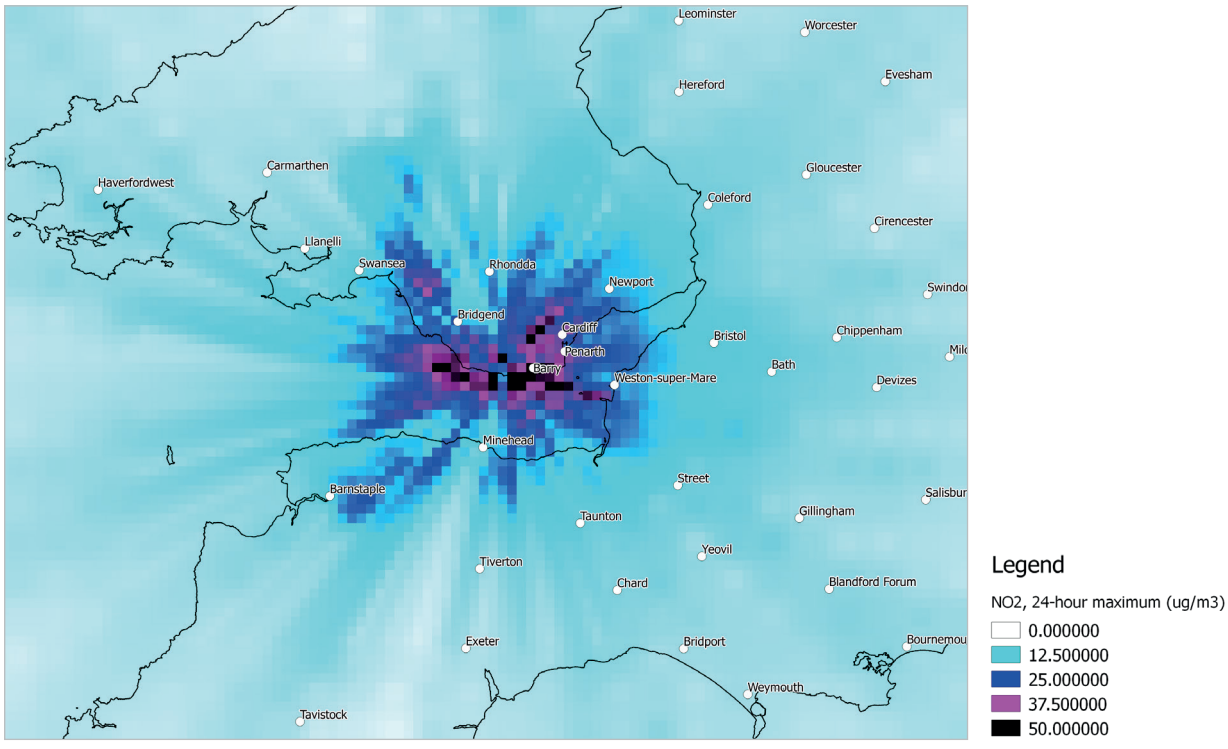


Figure 4 *Modelled 24-hour maximum NO_2 concentration attributable to emissions from Aberthaw power station ($\mu g/m^3$)*

In the worst-affected locations, the emissions from Aberthaw power station can increase daily average NO_2 levels by more than 30µg/m^3, which is 100% above annual average levels[10].

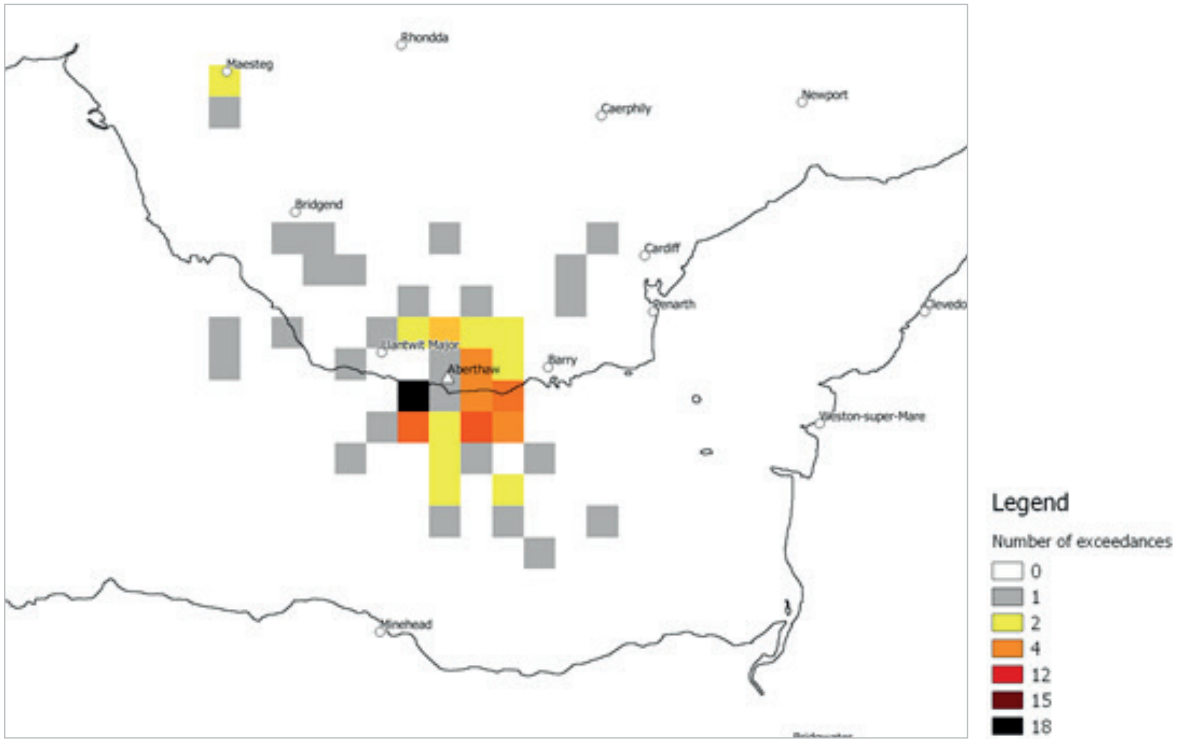


Figure 5 Modelled number of exceedences of the 1-hour maximum NO_2 limit of 200 µg/m^3 caused solely by emissions from Aberthaw power station

Aberthaw causes large numbers of exceedences of 1-hour air quality standards. A maximum of 18 exceedences are permitted in any one calendar year. This figure is reached on the coast west of Aberthaw, with 12 exceedences at Rhoose and large numbers of areas subject to pollution spikes on an annual basis.

The towns most affected by the NO_2 pollution from Aberthaw power station are set out in ***Figures 6 and 7***. The most severe impact is felt locally across coastal southern Wales. However, large conurbations across southern England, including Exeter, Swindon and Bournemouth, all receive significant doses of NO_2 from Aberthaw. Bristol receives pollution equivalent to that suffered by the people of Swansea.

10 Average PM2.5 levels in the region ranged between 10-15µg/m3, and NO2 levels between 15-36µg/m3 in 2013 based on data reported by UK government into the EEA AirBase.

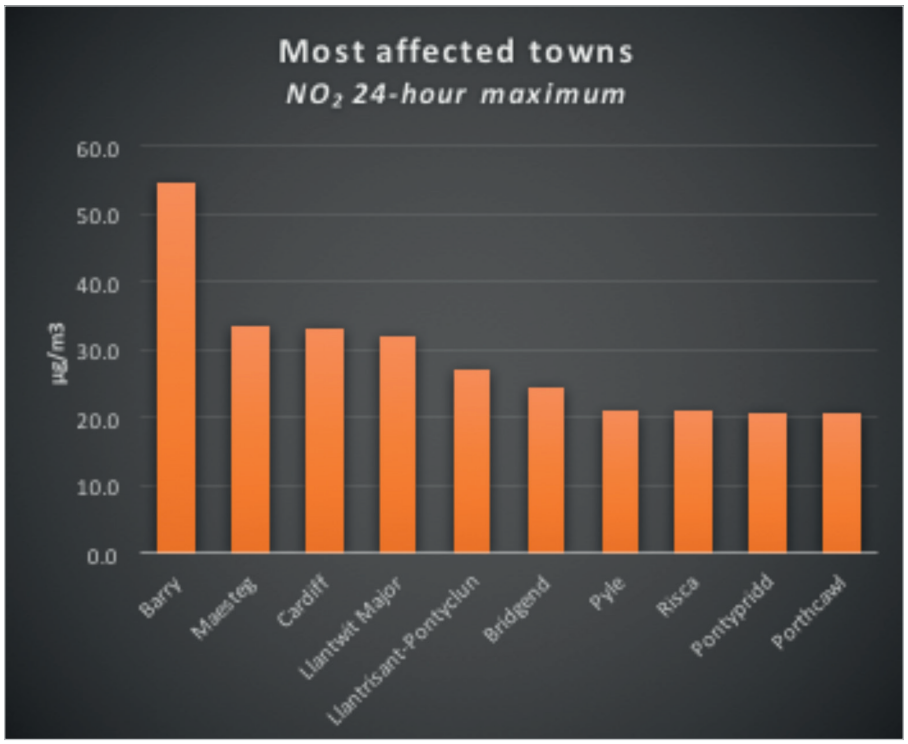


Figure 6 *Towns most affected by NO_2 pollution from Aberthaw power station (24-hour maximum values)*

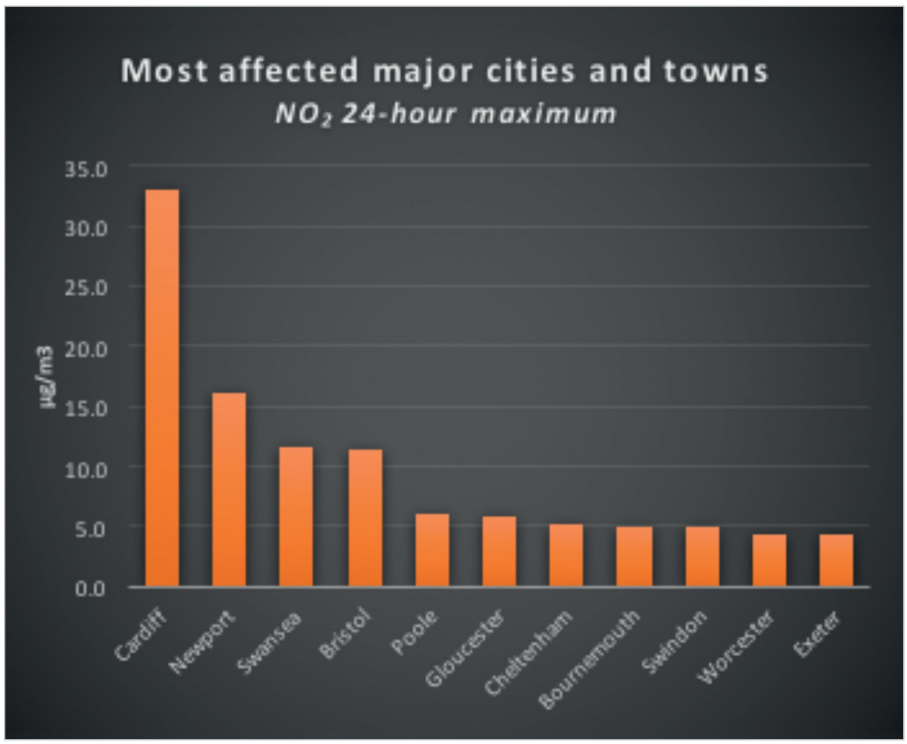


Figure 7 *Cities most affected by NO_2 pollution from Aberthaw power station (24-hour maximum values)*

Impacts of pollution from Aberthaw power station on air quality – PM2.5

PM2.5 health impacts take place primarily when atmospheric conditions are favourable for the formation of particles from SO_2 and NOx emissions. Newport, Clevedon and Nailsea are the most affected locations for PM2.5 and PM10 health impacts ***(Figure 8).***

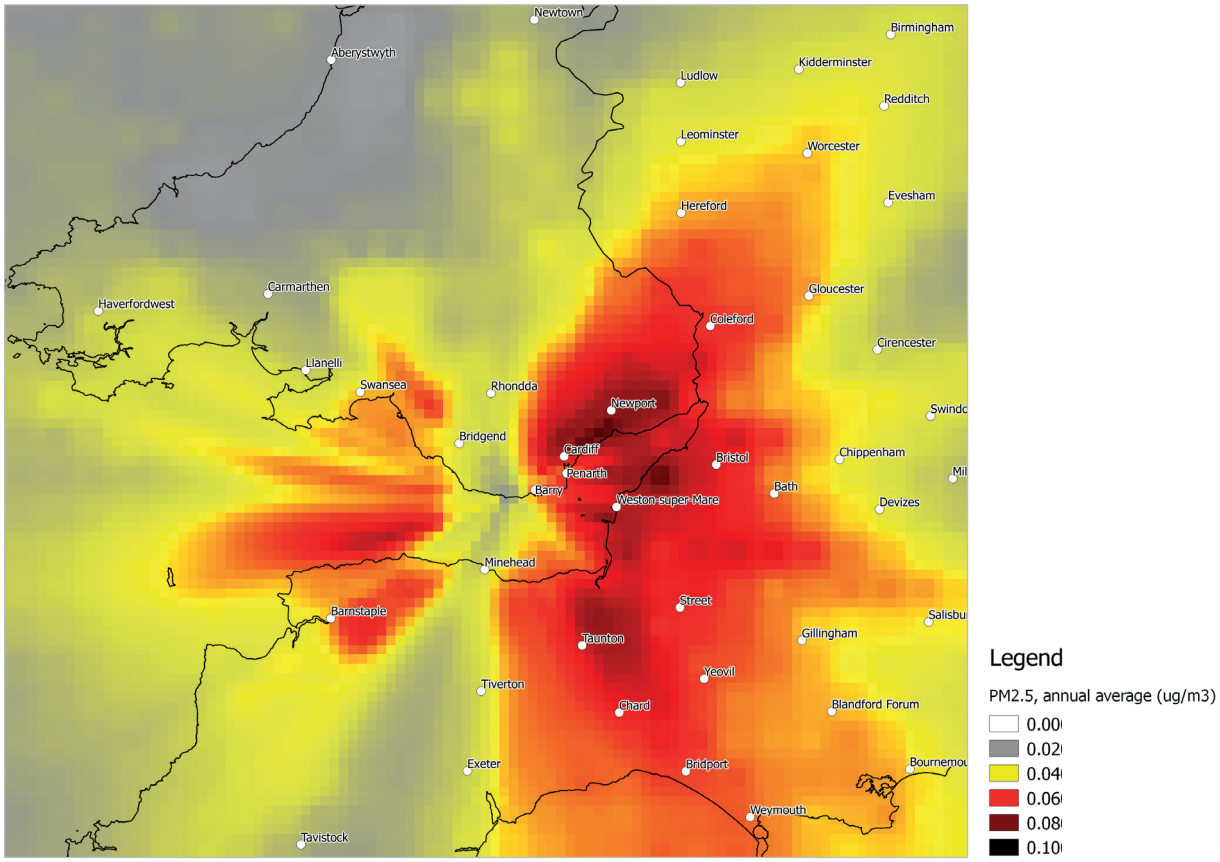


Figure 8 Modelled annual average PM2.5 concentration attributable to emissions from Aberthaw power station (µg/m³)

Modelled elevations of PM2.5 pollution from Aberthaw power station are felt even further afield than those of its NO_2 pollution, reaching France, Belgium, the Netherlands and parts of Germany, and into the Atlantic west of Ireland ***(Figure 9)***.

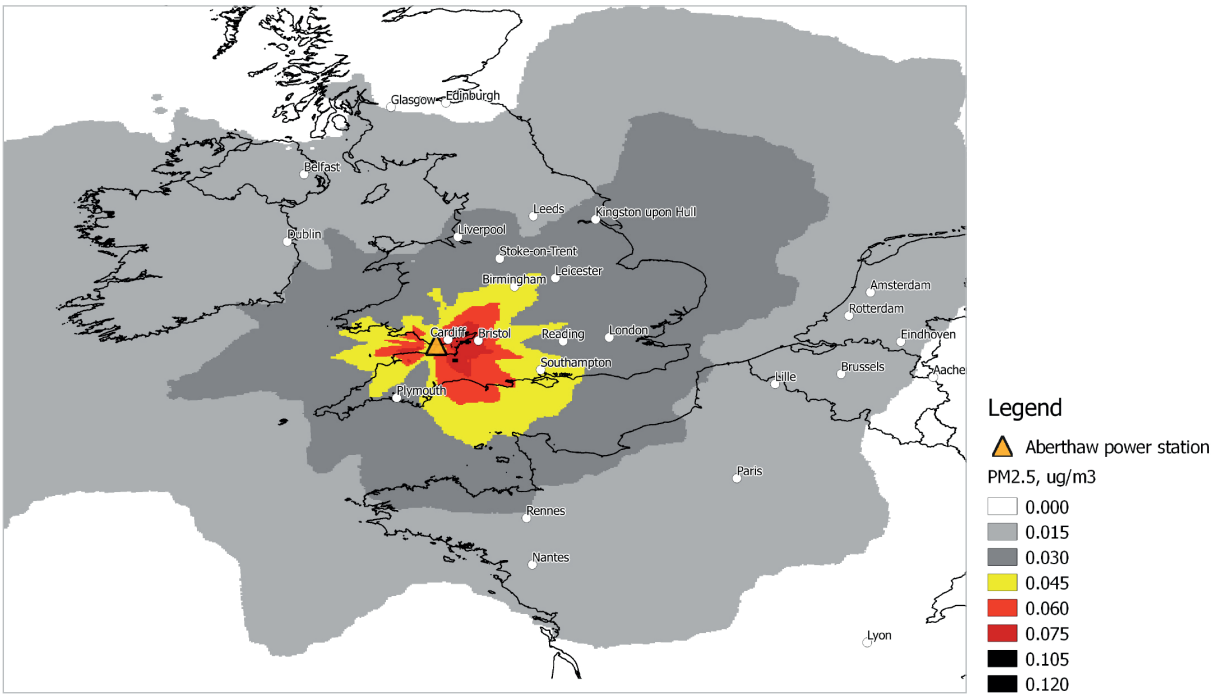


Figure 9 *Modelled annual average PM2.5 concentrations attributable to emissions from Aberthaw power station (µg/m³)*

On a daily basis, levels of PM2.5 elevated by 0.9 µg/m³ or more are found as far as the Republic of Ireland, Northern Ireland, France, and into the North Sea and Atlantic Ocean *(Figure 10)*.

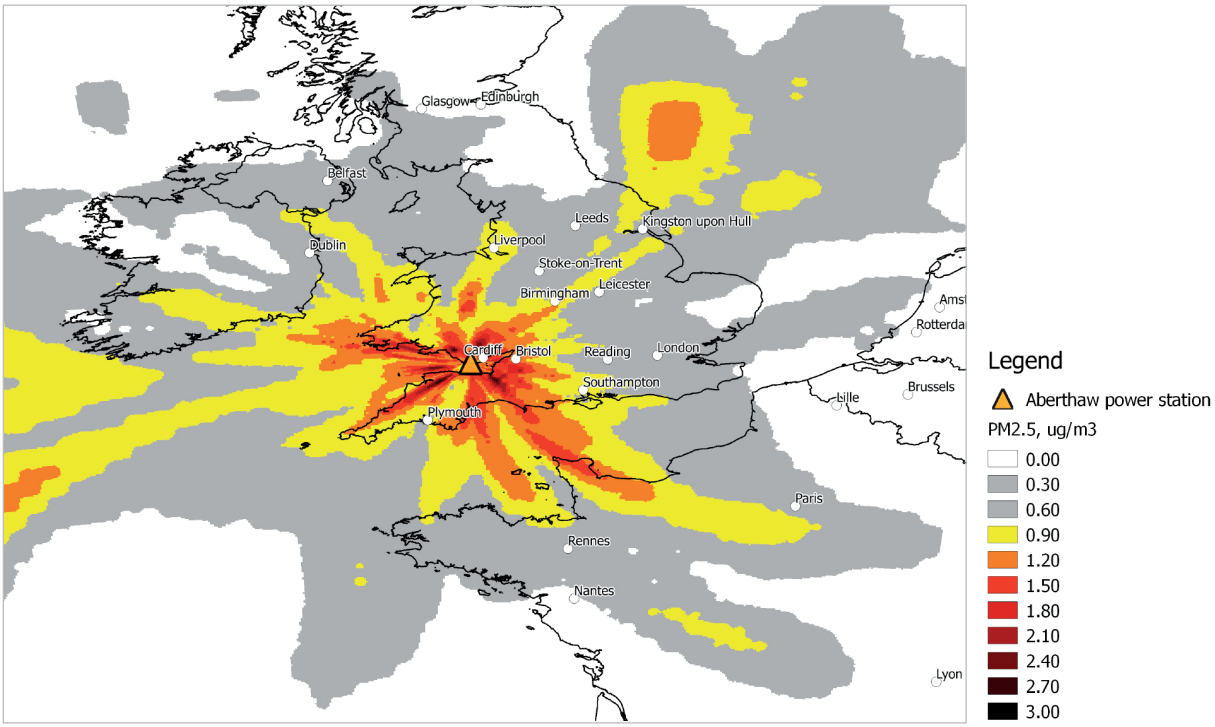


Figure 10 *Modelled 24-hour maximum PM2.5 concentration attributable to emissions from Aberthaw power station (µg/m³)*

Health impacts of air pollution

Early exposure to air pollution can damage the lungs, and increase the risk of lung infections that may be fatal[11]. It is known to have an effect on heart health in adult life[12].

Factors that exert an adverse influence on human development, including air pollution, can have a far greater influence during pregnancy and early childhood than at other times[13]. Once the physical development of organ systems, such as the lungs, is harmed, they may not have the capacity to recover. This means that organ damage that occurs as a result of harm in early life, including before birth, will be present for the rest of that individual's life[14].

DNA in developing foetuses is susceptible to changes arising from exposure to air pollution. Even seemingly trivial interference during critical periods of foetus development can irrevocably harm organs and tissues or change their developmental trajectory so that their function is permanently impaired[15].

There is compelling evidence in children and adults that air pollution exposure is associated with new-onset asthma[16]. There is also evidence that air pollution may exacerbate the effects of respiratory infections in young children[17]. Acute exposure to high levels of air pollution results in increased respiratory symptoms in children, and increased visits to emergency departments with respiratory illnesses[18].

Exposure to air pollution has health effects at every stage of life, from before birth into old age. The damage is sometimes gradual, and may not become apparent for many years. Long-term exposure to air pollution may speed up the decline of lung function through adulthood and into older age. There is a strong link between air pollution and cardiovascular disease. There is also good evidence that outdoor air pollution causes lung cancer[19].

In addition, air pollution has a greater impact on poorer people because they are[20]:

- More likely to live in polluted areas
- Exposed to higher levels of air pollution
- More vulnerable to health problems caused by air pollution

Air pollution is extremely costly to society: it forces people to miss work and school, causes pain and suffering, increases healthcare costs, and causes tens of thousands of early deaths every year[21].

11 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016, p34
12 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016, p34
13 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016, pp38-39
14 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016, pp38-39
15 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016, p39
16 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016, p42
17 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016, p42
18 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016, p43
19 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016, p50
20 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016, p66
21 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016, p77

Health impacts of NO2 pollution

Exposure to NO_2 is associated with increased hospital admissions, decreased lung function, increased susceptibility to respiratory infections and allergens[22], asthma prevalence and incidence, cancer incidence, adverse birth outcomes, and mortality[23]. Short-term exposure can reduce the oxygen saturation of the blood and lead to dizziness[24] and it is believed to cause respiratory morbidity[25].

Long-term exposure is associated with damage to the respiratory system and cardiovascular systems, including premature death[26]. There are particular, significant, associations between long-term exposure to NO_2 and lung function in children, including respiratory infections in early childhood[27]. Symptoms of bronchitis in asthmatic children increase in association with long-term exposure to NO_2[28].

The UK Government estimates that the effects of NO_2 on mortality are equivalent to 23,500 deaths annually in the UK[29].

The hourly limit value for NO_2 is 200 µg/m^3 which may be exceeded on no more than 18 occasions per year[30]. The pollution from Aberthaw appears to result in significant breaches of the hourly limit value of 200 µg/m^3 across almost parts of the Vale of Glamorgan and into Bridgend and Cardiff *(see Figure 5)*, although it is not certain that these exceedences number more than 18 at any individual site.

But this finding is at odds with the Air Quality Plan for the south Wales area, which claims there are no exceedences of the 200 µg/m^3 limit[31]. Air quality monitoring is only conducted for the purposes of hourly exceedences adjacent to the road network. The Welsh Government, Natural Resources Wales and affected local authorities appear to be failing to comply with requirements of European legislation through failing to even monitor spikes in emissions from Aberthaw power station, let alone act on them. The same is true for the Air Quality plan for the Cardiff urban area[32].

22 Defra Air pollution in the UK 2014, September 2015, p11
23 Committee on the Medical Effects of Air Pollutants, Statement on the evidence for the effects of nitrogen dioxide on health, March 2015, p1
24 WWF Europe's Dark Cloud, July 2016
25 Committee on the Medical Effects of Air Pollutants, Statement on the evidence for the effects of nitrogen dioxide on health, March 2015, p3
26 WWF Europe's Dark Cloud, July 2016
27 Committee on the Medical Effects of Air Pollutants, Statement on the evidence for the effects of nitrogen dioxide on health, March 2015, p5
28 WHO Ambient (outdoor) air quality and health, March 2014
29 Defra Draft plans to improve air quality in the UK, September 2015, p5
30 Defra National air quality objectives and European Directive limit and target values for the protection of human health
31 Defra Air quality plan for the achievement of EU air quality limit value for nitrogen dioxide (NO2) in south Wales (UK0041), December 2015, p9
32 Defra Air quality plan for the achievement of EU air quality limit value for nitrogen dioxide (NO2) in Cardiff Urban Area (UK0026), December 2015, p8

The annual limit value for NO_2 is 40 µg/m^3. Population weighted mean exposure to NO_2 is 12.5 µg/m^3 in Wales[33]. However, exposure will be somewhat higher in Welsh towns and cities - average background levels of NO_2 in urban areas of the UK is around 25 µg/m^3[34]. If we assume that background levels of NO_2 in Cardiff and Barry is around 20 µg/m^3, the average annual elevation of NO_2 as a result of Aberthaw power station's operations (around 2 µg/m^3) is about 10% of the total annual load.

We might therefore expect a 10% reduction in this pollutant to have a similar reduction in health impacts in these areas (alongside reductions to a more modest degree across much of southern Wales).

33 Defra Valuing impacts on air quality, September 2015, p8
34 Defra Draft plans to improve air quality in the UK, September 2015, p49. This figure was not updated in the 2014 report Defra Air pollution in the UK 2014, September 2015, p44

Health impacts of PM2.5 pollution

PM2.5 penetrates deeply into the human respiratory system. These fine particles have a high likelihood of passing from the alveoli into the blood and can thus reach different organs of the body. Physiological changes induced by PM include tissue damage from free radicals (oxidative stress) and inflammation, plaque formation in arteries (atherogenesis) as well as narrowing of blood vessels (vasoconstriction) and even permanent damage to cell DNA. These changes have strong knock-on effects, eventually leading to serious chronic diseases such as heart attacks, strokes and cancer[35]. There is understood to be no safe threshold below which no adverse effects would be anticipated[36].

There is consistent evidence that exposure to particulates during pregnancy increases the risk of low birth weight[37]. Infants living in areas with high levels of particulate air pollution are at increased risk of death during the first year of life, particularly from respiratory illnesses[38].

The biggest impact of particulate air pollution on public health is understood to be from long-term exposure to PM2.5, which increases the mortality risk, particularly from cardiovascular causes[39] (although increased risk also occurs without lengthy exposure to such pollution[40]) and lung cancer[41]. Aberthaw power station has been pumping out pollution that forms vast quantities of PM2.5 for more than 40 years.

Exposure to high concentrations of PM2.5 (e.g. during short-term pollution episodes) can also exacerbate lung and heart conditions, significantly affecting quality of life, and increase deaths and hospital admissions. Less severe effects of short-term particle exposure also occur during pollution episodes, including worsening of asthma symptoms and even a general feeling of being unwell leading to a lower level of activity[42]. This is why the 24-hour maximum values of PM2.5 are of particular note.

More than 28,000 people in Wales have chronic phlegm (a proxy for chronic bronchitis) resulting from particulate pollution[43]. A reduction of 1 μg/m^3 in PM10 (which is known to be less damaging to health than PM2.5) across the zone affected to this degree by Aberthaw power station would reduce this figure by around 1,500[44].

35 WWF Europe's Dark Cloud, July 2016
36 Defra Public health: Sources and effects of PM2.5
37 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016, p41
38 Royal College of Physicians The Lifelong Impact of Air Pollution, February 2016, p42
39 Department of Health Cardiovascular disease and air pollution, February 2006, p3
40 Department of Health Cardiovascular disease and air pollution, February 2006, p202
41 Air Quality Expert Group Fine particulate matter (PM2.5) in the United Kingdom, 2012, p12
42 Air Quality Expert Group Fine particulate matter (PM2.5) in the United Kingdom, 2012, p12
43 Committee on the Medical Effects of Air Pollutants Long-term exposure to air pollution and chronic bronchitis, July 2016, xii
44 Committee on the Medical Effects of Air Pollutants Long-term exposure to air pollution and chronic bronchitis, July 2016, xii
Slightly less than half of the population of Wales is affected to this degree

Children, the elderly and those with predisposed respiratory and cardiovascular disease, are more susceptible to the health impacts from air pollution[45]. However, coronary artery disease is common and often not detected prior to an acute episode of illness, for example, a heart attack[46]. Experts have indicated that young adults (16+) may be just as susceptible to cardiovascular impacts of PM2.5 as elderly people[47].

The annual limit value for PM2.5 is 25 µg/m^3[48].

The annual average background levels of PM2.5 in southern Wales is around 14 µg/m^3[49]. We are little reassured by RWE's commitment to operate Aberthaw during winter months only, from April 2017[50]. The PM2.5 load is seasonal, with much greater loads in winter than summer. The Air Quality Expert Group states:
"*It is clear that wintertime concentrations will make the greatest contribution to the annual mean; it may thus be more effective to target measures at those sources contributing to the elevated wintertime concentrations*"[51].

However, the substantially lower load of PM2.5 in summer also means that Aberthaw's contribution to the summer load has, for the past 40 years, been highly significant. Background July and August concentrations of 8-9 µg/m^3 mean that Aberthaw's contribution to the coastal PM2.5 pollution load in southern Wales during these months is considerably greater than 10%[52].

Concentrations of PM2.5 alongside busy roads are 1-2 µg/m^3 above background levels[53]. Cardiff and Newport – some of the worst-impacted towns by Aberthaw's particulate pollution, with a combined population approaching half a million people[54], or one-sixth of the population of Wales – have an annual average PM2.5 impact of >1 µg/m^3. The health impact for people living there of Aberthaw's particulate pollution is the equivalent of the entire population of these cities living within a few metres of busy roads[55].

Or, to put it another way, closing Aberthaw power station would – for this one pollutant alone – be the health equivalent of removing every single vehicle off every road in Cardiff and Newport for residents of those cities[56].

The indicative annual mean PM2.5 concentration limit for Wales is 21 µg/m^3[57]. So for areas of the southern Wales coast, Aberthaw's pollution represents 5% of the permissible annual pollution load.

45 Defra Public health: Sources and effects of PM2.5
46 Department of Health Cardiovascular disease and air pollution, February 2006, p202
47 Department of Health Cardiovascular disease and air pollution, February 2006, p202
48 European Commission Air quality standards
49 Air Quality Expert Group Fine particulate matter (PM2.5) in the United Kingdom, 2012, p47
50 BBC, Aberthaw power station to downgrade operations, 25 April 2016
51 Air Quality Expert Group Fine particulate matter (PM2.5) in the United Kingdom, 2012, p50
52 Air Quality Expert Group Fine particulate matter (PM2.5) in the United Kingdom, 2012, p50
53 Air Quality Expert Group Fine particulate matter (PM2.5) in the United Kingdom, 2012, p56
54 Wikipedia List of localities in Wales by population
55 Air Quality Expert Group Fine particulate matter (PM2.5) in the United Kingdom, 2012, p78
56 Air Quality Expert Group Mitigation of United Kingdom PM2.5 concentrations, 2013, p37
57 Air Quality Expert Group Fine particulate matter (PM2.5) in the United Kingdom, 2012, p67

Health impacts of air pollution from Aberthaw power station

A significant part of the total population exposure to pollution and of the resulting health impacts takes place due to long-range transport of the pollution all across Wales and England, and even overseas to France, Benelux and Ireland. Of the modelled NO_2 exposure, 17% takes place in Wales, 67% in the rest of the UK and 18% abroad. Similarly, 6% of the modelled PM2.5 exposure takes place in Wales, 60% in the rest of the UK, and 34% abroad.

We should not be surprised that Aberthaw power station is a polluter of European scale. After all, of 14,326 industrial installations on the European database of facilities causing the highest damage costs to health and the environment, Aberthaw power station ranks number 70[58].

Aggregate damage (€ M)

Rank	Installation	Location	Member State	Activity	Low estimate	High estimate
70	**NWE npower plc, Aberthaw Power Station**	**Barry**	**United Kingdom**	**Thermal power stations and other combustion installations**	**874**	**2823**

The health impacts resulting from Aberthaw power station's pollution were assessed using a methodology set out in Appendix 2.

Projected annual health impacts attributable to emissions from Aberthaw power station, cases per year

Health impact	**Unit**	**Best estimate**	**Confidence interval (95%)**
premature deaths, NO_2	cases	400	(230-570)
bronchitis in children, PM10	cases	260	(-70-580)
asthma symptoms in children, PM10 and NO_2	cases	3,400	(700-6,200)
chronic bronchitis in adults, PM10	new cases	63	(22-99)
hospital admissions, PM2.5 and NO_2	cases	290	(140-440)
restricted activity days, PM2.5	days	195,000	(175,000-219,000)
work days lost, PM2.5	working days	35,000	(30,000-40,000)
low birth weight births, PM2.5	cases	17	(5-30)

58 European Environment Agency Industrial facilities causing the highest damage costs to health and the environment, November 2014

Projected annual health impacts in Wales attributable to emissions from Aberthaw power station, cases per year

Health impact	Unit	Best estimate	Confidence interval (95%)
premature deaths, NO_2	cases	67	(38-96)
bronchitis in children, PM10	cases	15	(-4-33)
asthma symptoms in children, PM10 and NO_2	cases	200	(40-370)
chronic bronchitis in adults, PM10	new cases	4	(1-6)
hospital admissions, PM2.5 and NO_2	cases	39	(22-55)
restricted activity days, PM2.5	days	11,200	(10,000-12,600)
work days lost, PM2.5	working days	1,700	(1,500-2,000)
low birth weight births, PM2.5	cases	1	(0-2)

The annual societal cost of the deaths resulting from Aberthaw's NO_2 pollution is £226.4 million in total, and £37.9 million in Wales alone[59]. Assuming that half of these deaths are from respiratory diseases, pollution from Aberthaw power station is a causative factor in 0.75% of the respiratory deaths in Wales[60].

To put this in perspective, 105 people were killed on the roads of Wales in 2015[61]. While the Welsh Government has a Road Safety Framework for Wales[62] that aims to reduce "almost entirely avoidable" casualties, no such strategy exists for the entirely avoidable premature deaths resulting from pollution from Aberthaw power station.

Over the 45 years since it started operating, pollution from Aberthaw power station is likely to have caused the premature deaths of more than 3,000 people in Wales, and 18,000 across a wider area.

Asthma symptoms develop in 0.3% of the children in Wales with the condition[63] as a result of pollution from Aberthaw power station.

59 Using central assumptions from Defra Valuing impacts on air quality, September 2015.
60 4,444 deaths from respiratory conditions in Wales in 2014. Welsh Government Respiratory Annual Report 2015, p8
61 Welsh Government Statistical Services: "What were the top 10 causes of fatal or serious road accidents in Wales during 2015?", June 2016
62 Welsh Government Road Safety Framework for Wales, July 2013
63 200 of 59,000. Welsh Government Respiratory Annual Report 2015, p1

Despite the toll of sickness and mortality associated with air pollution from Aberthaw power station, it is not once listed in the three plans for the achievement of EU air quality limit value for NO_2 that are principally affected, that is, South Wales[64], Cardiff urban area[65] and Swansea urban area[66].

Nor is Aberthaw power station mentioned in the Welsh Government Respiratory Annual Report 2015[67], despite it being a notable contributor to respiratory deaths and sickness in Wales.

Finally, climate change will have real health impacts on people in Wales. Aberthaw power station is a collosal emitter of the chief climate-changing gas, carbon dioxide[68], contributing 16% of Wales' emissions in 2014[69].

64 Defra Air quality plan for the achievement of EU air quality limit value for nitrogen dioxide (NO2) in south Wales (UK0041), December 2015
65 Defra Air quality plan for the achievement of EU air quality limit value for nitrogen dioxide (NO2) in Cardiff Urban Area (UK0026), December 2015
66 Defra Air quality plan for the achievement of EU air quality limit value for nitrogen dioxide (NO2) in Swansea Urban Area (UK0027), December 2015
67 Welsh Government Respiratory Annual Report 2015
68 Aberthaw emitted just over 6 million tonnes of carbon dioxide in 2014 (Dave Jones, pers. comm.)
69 National Atmospheric Emissions Inventory Greenhouse gas inventories for England, Scotland, Wales and Northern Irleand: 1990-2014, xv

Aberthaw vs Renewables

We estimate that Aberthaw power station generated 7,104 GWh of electricity in 2014[70]. In that year, 3,409 GWh of renewable electricity was generated in Wales[71]. So in order to replace the electricity generated by Aberthaw from renewables, we would need to double the renewable electricity generation from Wales.

To put it another way, we would need to double our renewable electricity generation per unit of economic activity (GVA) – which would place Wales at a similar proportion of renewables/ GVA to Scotland. So by emulating Scottish ambition on renewables, Wales could supplant Aberthaw's polluting electricity with zero-emissions equivalent, creating 1,500 jobs and delivering £104 million GVA[72].

But even if the forthcoming decision of the European Court of Justice[73] does not result in its permanent closure, Aberthaw power station is going to reduce its operating hours substantially from April 2017[74]. Advice from the Climate Change Commission aligns with the direction of travel from the UK Government that coal-fired electricity generation shall cease in the UK by the early to mid 2020s.

So the question needs to be asked – why do we tolerate a power station that prematurely ends the lives of hundreds and makes thousands of people sick at a cost to health and the environment of hundreds of millions of pounds[75], when its contribution to electricity generation could be made good within a few years from non-polluting renewables?

70 Since Aberthaw was the only coal-fired power station generating over 9 months of 2014, and its generating capacity is very much greater than Uskmouth B, we assume 95% of the 2014 coal-derived generation to have come from Aberthaw power station (7,104 GWh). DECC DUKES special feature – sub national electricity figures, December 2015
71 DECC Dukes special feature – sub-national renewable electricity, September 2015
72 Assuming similar job creation across the board as derives from onshore wind, and 1.8 GW of new capacity
73 Friends of the Earth Cymru Aberthaw pollution case: UK defence "untenable", June 2016
74 BBC, Aberthaw power station to downgrade operations, 25 April 2016
75 Friends of the Earth Cymru, Aberthaw power station, February 2016, p15

Conclusions and recommendations

Extensive research into air pollution of the nature emitted by Aberthaw power station led the Committee on the Medical Effects of Air Pollutants to conclude that a precautionary approach should be adopted in planning and policy development[76]. It is this precautionary approach that should now be adopted by the Welsh Government, the UK Government and Natural Resources Wales. Every pressure should be applied to RWE to cease its operations at Aberthaw power station with immediate effect.

The Welsh Government does not appear to be responding to the very real harm being caused to the health of the people of Wales as a result of the pollution from Aberthaw power station. This is despite the Welsh Government's statement:
"*Controlling air pollution in Wales is a high priority for the Welsh Government. The driver is not only compliance with European legislation, but a commitment to protect human health and the environment*"[77].

We can find no reference to Aberthaw power station in the Welsh Government's three Air Quality (NO_2) plans for southern Wales, nor in the Respiratory Annual Report.

On average, pollution from Aberthaw is responsible for curtailing the lives of 67 people in Wales every year. This is equivalent to 64% of the death toll on Welsh roads – yet there is no special strategy for securing the accelerated final closure of the plant.

At a wider scale, the estimated health impacts due to NO_2 exposure are 400 premature deaths per year. The emissions from the power plant are estimated to be responsible for 195,000 days of illness per year, including 35,000 days of sick leave. In other words, on an average day, 530 people are ill due to the harmful health impacts of the pollution.

Aberthaw power station has been generating for 45 years. It is an old power station that belongs in a different era. The fact that its pollution has been causing respiratory sickness and prematurely ending the lives of thousands upon thousands of people in Wales and beyond for decades has eluded scrutiny.

The time for proper public scrutiny is now upon us. The Welsh and UK Governments must do everything in their power to ensure that Aberthaw power station ceases operating. For good.

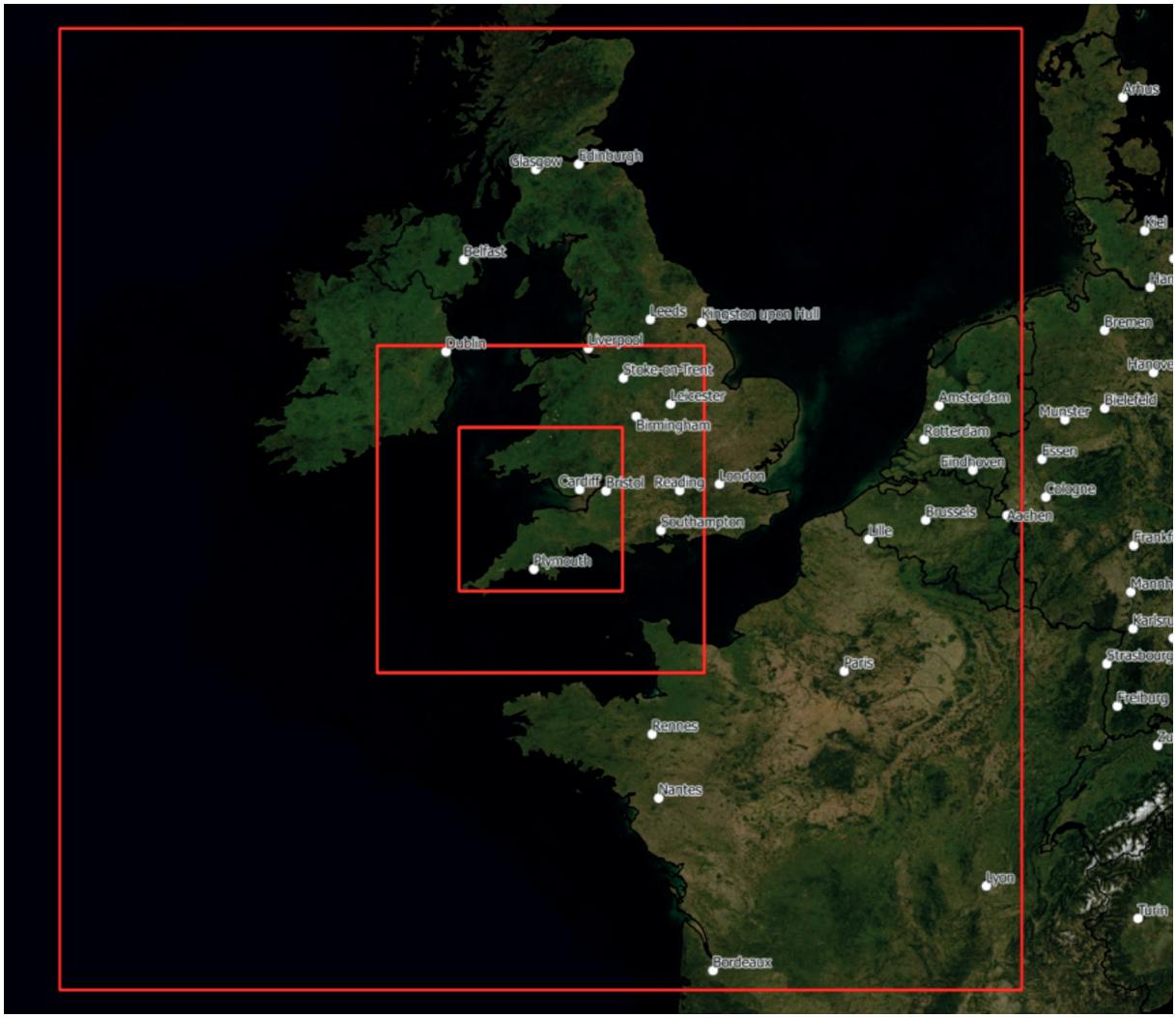
76 Department of Health Cardiovascular disease and air pollution, February 2006, p4
77 Defra Draft plans to improve air quality in the UK, September 2015, p19

Appendix 1 – air pollution methodology

We used the **CALPUFF** air pollution modeling system recommended by the Environmental Protection Agency of the USA for assessing long range transport of pollutants and their impacts.

Importantly, the CALPUFF modeling system is capable of simulating the chemical transformation of SO_2 and NOx emissions into secondary PM2.5 pollution in the atmosphere, a very important impact pathway that is usually neglected in Environmental Impact Assessments and regulatory processes.

The impacts were modelled over a 1500km x 1500km domain covering UK and parts of the neighboring countries, with the immediate vicinity of the plant covered at higher spatial resolution.



TAPM and Calpuff nested modeling domains (in red)

The modelling results are best available estimates, not precise readings.

Properties of Aberthaw power station used in the modelling

Latitude	51.392
Longitude	-3.404
SO_2 (tonnes/annum)	5,860
NOx (tonnes/annum)	31,500
PM10 (tonnes/annum)	432
PM2.5 (tonnes/annum)	192
Stack height (m)	153
Stack diameter (m)	6.9
Gas temperature (^oC)	60
Gas velocity (m/s)	20

Information sourced from:
- http://www.hadek.com/sites/default/files/CICIND-Paper-Aberthaw-Power-Station-Prepares-for-FGD-Operation.pdf
- https://tools.wmflabs.org/geohack/geohack.php?pagename=List_of_tallest_structures_in_the_United_Kingdom&params=51_23_34.32_N_3_24_16.64_W_type:landmark&title=Aberthaw+Power+Station+Chimney
- https://www.gov.uk/government/statistics/so2-nox-return-2014#history

44% of PM10 was assumed to be PM2.5, in line with the U.S. EPA AP-42 default value for electrostatic precipitators. Reported annual emissions were converted into average emission rates, which were then applied throughout the year. These emission and stack data were used as the basis of modeling the plant's air quality impacts using the CALMET-CALPUFF modeling system.

Atmospheric dispersion modeling for the case studies was carried out using version 7 (June 2015) of the CALPUFF modeling system. CALPUFF is an advanced non-steady-state meteorological and air quality modeling system adopted by the U.S. Environmental Protection Agency (USEPA) in its Guideline on Air Quality Models as the preferred model for assessing long range transport of pollutants and their impacts.

The TAPM modeling system, developed by Australia's national science agency CSIRO, was used to generate the hourly three-dimensional weather fields required by CALPUFF. TAPM uses as its inputs global weather data provided for the modeling system by CSIRO. TAPM outputs were converted into formats accepted by CALPUFF's meteorological preprocessor, CALMET, using the CALTAPM utility, and the meteorological data were then prepared for CALPUFF execution using CALMET. CALMET generates a set of time-varying micrometeorological parameters (hourly 3-dimensional temperature fields, and hourly gridded stability class, surface friction velocity, mixing height, Monin-Obukhov length, convective velocity scale, air density, short-wave solar radiation, surface relative humidity and temperature, precipitation code, and precipitation rate) for input to CALPUFF.

Terrain height and land-use data were also prepared using the TAPM system and global datasets made available by CSIRO. A set of concentric nested grids with a 50x50 grid size and 30km, 10km and 5km horizontal resolutions and 35 vertical levels, centered on the Craiova region, was used for the TAPM simulations.

A full calendar year CALPUFF simulation was carried out for 2013. The ISORROPIA II chemistry module of the CALPUFF model requires data on background concentrations of species affecting secondary inorganic aerosol formation. Hourly ozone concentrations for calendar year 2013 from 10 different stations in UK and neighboring countries were imported into the model. Appropriate measured values could not be obtained for ammonia and H_2O_2 concentrations, so monthly average values were retrieved from the EMEP MSC-W model outputs for 2013 made available by the Norwegian Meteorological Agency[78].

The CALPUFF results were reprocessed using the POSTUTIL utility to repartition different nitrogen species (NO, NO_2, NO_3 and HNO_3) based on background ammonia concentrations.

78 Open Source EMEP/MSC-W model, rv4.8 (October 2015). https://wiki.met.no/emep/page1/emepmscw_opensource

Appendix 2 – health impacts methodology

Health impacts resulting from the increase in NO_2, PM2.5 and PM10 concentrations caused by the power plant were evaluated by assessing the resulting population exposure, based on high-resolution gridded population data for 2010 from NASA SEDAC[79], and then applying the updated WHO recommendations for health impact assessment of air pollution in Europe[80]. Required data for current incidence of different health conditions was obtained from WHO databases[81] and from Holland 2014[82]. Low birth weight births were assessed based on the findings of Dadvand et al 2013[83] on the relationship between low birth weight and PM2.5 pollution, with required baseline incidence rates obtained from World Bank World Development Indicators.

The following risk ratios (for 10ug/m^3 increase in pollutant concentrations) recommended by World Health Organization (except low birth weigth from Dadvand et al 2013[84]) were used as the basis of concentration-response relationships.

Effect	Pollutant	RR: central	RR: low	RR: high
bronchitis in children, PM10	PM10	1.08	0.98	1.19
asthma symptoms in asthmatic children, PM10	PM10	1.028	1.006	1.051
incidence of chronic bronchitis in adults, PM10	PM10	1.117	1.04	1.189
long-term mortality, all causes, PM25	PM25	1.062	1.04	1.083
cardiovascular hospital admissions, PM25	PM25	1.0091	1.0017	1.0166
respiratory hospital admissions, PM25	PM25	1.019	0.9982	1.0402
restricted activity days, PM25	PM25	1.047	1.042	1.053
work days lost, PM25	PM25	1.046	1.039	1.053
bronchitic symptoms in asthmatic children, NO_2	NO_2	1.021	0.99	1.06
respiratory hospital admissions, NO_2	NO_2	1.018	1.0115	1.0245
long term mortality, all causes, NO_2	NO_2	1.055	1.031	1.08
respiratory hospital admissions, NO_2	NO_2	1.0015	0.9992	1.0038
low birth weight births, PM25	PM25	1.10	1.03	1.18

Long-term mortality due to PM2.5 exposure was not included in the reported total health impacts because of the possibility of the impacts overlapping with NO_2 highlighted by WHO.

79 http://sedac.ciesin.columbia.edu/data/set/gpw-v3-population-count-future-estimates
80 http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/activities/health-aspects-of-air-pollution-and-review-of-eu-policies-the-revihaap-and-hrapie-projects
81 WHO mortality database, http://data.euro.who.int/hfamdb/; European hospital morbidity database (http://www.euro.who.int/en/what-wedo/data-and-evidence/databases/european-hospital-morbiditydatabase-hmdb2); European Health for All database (HFA-DB) (http://data.euro.who.int/hfadb/)
82 Holland, M. 2014: Implementation of the HRAPIE Recommendations for European Air Pollution CBA work. EMRC.
83 Dadvand P et al. 2013: Maternal Exposure to Particulate Air Pollution and Term Birth Weight: A Multi-Country Evaluation of Effect and Heterogeneity. Environ Health Perspect 121:367–373. http://dx.doi.org/10.1289/ehp.1205575
84 Dadvand P et al. 2013: Maternal Exposure to Particulate Air Pollution and Term Birth Weight: A Multi-Country Evaluation of Effect and Heterogeneity. Environ Health Perspect 121:367–373. http://dx.doi.org/10.1289/ehp.1205575

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