-----Original Message-----
From: Eve Mellor <[redacted]
Sent: 27 July 2023 11:37
To: Aquind Interconnector <aquind@planninginspectorate.gov.uk>
Subject: Reject the AQUIND Interconnecter Project

To whom it may concern,

I am a young person living in Portsmouth and I have recently been given the opportunity to undertake the task of completing an EPQ. I chose the title “What us the worst effect air pollution can have on human health?”, please find a copy of this essay attached. While writing this it came to my attention that air pollution can have substantial and dire effects on human health and that is what I hope you will realise today. My essay and the academic literature referenced within it, which I urge you to read, only touches on a few health conditions and the effects are still overwhelming. The construction of this Interconnecter would create a huge amount of pollution in the city which I and so many others call home. I have given you my science and now I will give you my plea: It cannot reasonably be suggested that the benefits of this project outweigh the harm it would cause. People are going to get hurt. I am making an attempt to appeal to your humanity and remind you that it is not to late to protect the people of Portsmouth. I have faith that you will do the right thing.
Kind regards
Eve Mellor

What is the worst effect air pollution can have on human health?

Air pollution is a problem that greatly affects Earth but it has also been proven to be associated with certain health conditions. This essay aims to assess the whether the conditions of low birth weight, sudden infant death syndrome, psychiatric conditions, coronary heart disease and strokes can be reasonably attributed to exposure to airborne pollutants. The conditions that are deemed to be positively linked with high air pollution levels will then be analysed to comparatively determine the which one of these conditions has the greatest negative effect on society as a whole through effects such as the cost of these conditions to healthcare providing services among other impacts as an attempt to gauge a measure of which condition is 'worst'.

Low Birthweight Discussion:

Some air pollutants that have been associated with low birthweights are SO_2 and TSP (including $PM_{2.5}$ and PM_{10}). These pollutants also interacted with other factors such as anticipated risk causing pregnancies with a higher likelihood of delivering a low birthweight child to be more greatly affected by these higher risk exposure levels than other pregnancies[1]. This evidence suggests that while high exposure to SO_2 and TSP has been proven to be a causal factor in the low birthweight weight of full-term pregnancies when the exposure occurs in the third trimester that there are a range of factors at play. The information used in this study used information regarding birthweights directly from obstetricians giving the data credibility. The conclusion was that on the grounds of both SO_2 and TSP having a statistically significant effect on birthweight that air pollution should be treated as a public health concern.

Another pollutant that has been separately linked to low birthweights $PM_{2.5}$ specifically. High exposures the $PM_{2.5}$ in the periods of 91 to 139 and 249 to 272 were proven to increase the risk of low birth weight in pregnancies[2]. The second window falls in the third trimester which further suggests a link between high exposure to particulate matter and low birthweight. The sample size was 1,300 live births which is large enough to make the results relevant and appropriate to apply to larger populations. Estimates have been made that 3% of cases of low birthweight in the Greater London area can be directly linked to the high exposures to PM $_{2.5}$ which was categorised as $PM_{2.5}$ concentrations of 13.8 $\mu g/m^3$ and

[1] Wang. X et al, May 1997, Association between Air Pollution and Low Birth Weight: A Community-Based Study,https://www.jstor.org/stable/3433580?searchText=The+effect+of+air+pollution+on+low+birth+weight&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3DThe%2Beffect%2Bof%2Bair%2Bpollution%2Bon%2Blow%2Bbirth%2Bweight&ab_segments=0%2FSYC-6744_basic_search%2Ftest-2&refreqid=fastly-default%3A6c65f5fc7ae7a1c5b9c3934f2a15c858&seq=1, 19.6.23

[2] Johnson et al, 16th January 2022, Critical Time Windows for Air Pollution Exposure and Birth Weight in a Multicity Canadian Pregnancy Cohort,

above[3]. $PM_{2.5}$ has also been linked to having greater effects in the pregnancies of Black birthing parents[4].

High concentrations of CO and O_3 have also been linked to an increased risk of low birthweight babies. These pollutants had the most effect when exposures occurred during the third trimester but also had a statistically significant effect when the exposure occurred in the first trimester. CO accounted for the largest rick factor posing an estimated risk of 3.774 of low birthweight and O_3 was estimated to have a risk of 1.116[5]. There remains debate as to whether the effects of CO can be influenced by race as a compounding factor resulting in greater effects on pregnancies with Black birthing parents[4]. This further suggests a link between air pollutant exposure in the third trimester and a low birthweight potentially indicating that this period of the gestation is particularly critical or sensitive to air pollution exposure. This study used the data from 561,569 births of which 1.84% (9820) where classed as having a low birthweight which is widely deemed as a significant sample size and considered the residential history of the birthing parent making it reliable.

It is important to consider that while these sources are reliable the data used in some to classify high and low birthweight cohorts was based on the air pollution in specific areas such as the location of the home but did not consider the air pollution exposure in other areas of the pregnant person's life for example the pollutant concentrations exposure at the place of work. It is also clear that exposure to air pollutants such as SO_2 and TSP especially $PM_{2.5}$ as well as potentially CO exacerbate the effects of other potentially disadvantaging factors such as pregnancies with a higher baseline rick of low birthweight and pregnancies of Black birthing parents effected by factors such as a poorer access to healthcare. Despite these limitations there is a clear link between air pollutant exposure and low birthweight which suggests that low birthweight is a condition that can be said with a considerable degree of validity is a negative impact on human health caused by air pollution.

Sudden Infant Death Syndrome (SIDS) Discussion:

The airborne pollutant CO has been linked to the cause of post-neonatal deaths. The estimated risk of death by all causes in post neonates who experienced high exposure to CO prenatally has been calculated to be 1.20[6]. This study finally concluded that while CO exposure even in low levels has been proven to be linked post-neonatal deaths of all causes

[3] Smith. R.B et al, 10th December 2017, Impact of London's road traffic air and noise pollution on birth weight: retrospective population based on cohort study,https://www.jstor.org/stable/26950844?searchText=The+effect+of+air+pollution+on+low+birth+weight&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3DThe%2Beffect%2Bof%2Bair%2Bpollution%2Bon%2Blow%2Bbirth%2Bweight&ab_segments=0%2FSYC-6744_basic_search%2Ftest-2&refreqid=fastly-default%3A6c65f5fc7ae7a1c5b9c3934f2a15c858&seq=7, 19.6.23

[4] Bell. M.L et al, July 2007, Ambient Air Pollution and Low Birth Weight in Connecticut and Massachusetts, [redacted] 19.6.23

[5] Lee. J et al, September 2007, Effect of Air Pollution on Low Birth weight in Seoul of Korea, 1999-2003, [redacted] 19.6.23

[6] Lee. J et al, September 2007, Time-Series of Air Pollution and Infant Death in Seoul of Korea, 1999-2003, [redacted] 20.6.23

but it cannot be statistically linked to causing SIDS. The study also used data form a large sample group observing 561,569 live births of which 1175 experienced post-neonatal death of all causes, this is a reliable sample size. Of the 1175 deaths only 65 could be directly attributed to SIDS leading to the conclusion that SIDS is not caused by prenatal CO exposure based on the appropriate data.

NO_2 is another pollutant that has been linked to causing SIDS with varying degrees of significance. High NO_2 exposure in as short term as the day before death have been linked to SIDS in a study in Canada. Along with SO_2, NO_2 rises have been calculated to have an association with a 17.72% increase in incidences of SIDS[7]. This study observed data from 12 cities in Canada indicating an appropriate sample size however the levels of each pollutant including NO_2 were only measured every six days which means that while the source is reliable it should be interpreted with caution. Other studies have found a link between high levels of prenatal exposure to NO_2 and higher incidences of non-specific post-neonatal death but found the results to be of no statistical significance and not relevant to the specific condition of SIDS[6]. This suggests that NO_2 could have different effects depending on whether the exposure is antenatal or postnatal.

Another pollutant that has been significantly and insignificantly associated with SIDS is PM_{10}. A study has found that while high levels of PM_{10} where not directly related to infant death, the compounding factors of high PM_{10} exposure and being categorised within the bracket of low socio-economic status led to increased risk of respiratory related death and that respiratory related deaths were found to make up 34.4% of deaths in the data studied[8]. Other studies have acknowledged the presence of a link between high PM_{10} concentrations and high cases of all cause post-neonatal death but consider this data to be of no statistical or contextual significance in literature regarding SIDS[6]. A 2004 study observing air pollution and SIDS came to the conclusion that particulate matter was not linked to the cause of SIDS, even though airborne pollutant concentrations were not measured with ideal frequency this conclusion supports that of other reliable information[7].

The pollutant SO_2 has been linked in a range of levels of casualty to the causation of SIDS. It was also found in Dales et al.2004[7] to have a considerable short-term impact on the risk of SIDS more so than particulate matter (of no specific diameter). The data used to obtain these results was collected over a period of fifteen years (1984-1999) which although dating the study considerably indicates that the conclusion reached is representative of the conditions and links between pollutant concentrations and incidences of SIDS during a sustained period of time. However, another study concluded that $PM_{2.5}$ had a greater impact on the number of cases of SIDS based on the data observed[9]. This is an indication

[7] Dale. R et al, 1st June 2004, Air Pollution and Sudden Infant Death Syndrome, [redacted] 20.6.23

[8] Romieu. I et al, December 2004, Infant Mortality and Air Pollution: Modifying Effect by Social Class, [redacted] 0.6.23

[9] Brunekreef. B, November 1999, Air Pollution Kills Babies…, [redacted]

that further research and analysis of existing data is required in order to gain a deeper understanding of whether or not SO_2 has a negative effect on the frequency of cases of SIDS.

To conclude this section, it must be noted that considerable grounds for debate and further research remain to come to a conclusive decision regarding the casual link between many forms of airborne pollutants. Based on the research, the appropriate judgement is that none of CO, NO_2, $PM_{2.5}$, PM_{10} or SO_2 can truly be considered as factors that definitely and independently effect the risk of SIDS without further research. However, links some greatly significant and others less so were made between the effect of certain pollutants on SIDS and the low socio-economic status families observed[6 and 9]. Although when brought together the data seems to be inconclusive, several of the studies cited here [7 and 9] indicate that their research is consequential to the extent that it warrants a need for further investigation into this area.

Stroke Discussion:

$PM_{2.5}$ is an air pollutant that has been associated with the incidence of strokes. An article highlights a mass systematic review and meta-analysis of 238 studies have shown that an increased short-term exposure to $PM_{2.5}$ led to a higher risk of hospital admission and mortality as a result of stroke[10]. This review of large amount of data suggests a significant and appropriate sample size making the results reliable. However, another article came to a different conclusion that particulate matter (of no specific diameter) along with NO_2 only have marginally, statistically significant effects on the risk of stroke and only in the female and over 70 years old sub-groups having generally negligible results in other areas[11]. This article was also referring to studies on short-term exposure to air pollutants but came to a very different conclusion suggesting that the association between stroke and $PM_{2.5}$ requires more research to come to a definitive conclusion. Both opposing articles were published in the British Medical Journal (BMJ) which is a reputable source. It is also important to consider the impacts of compounding factors such as age and sex with $PM_{2.5}$ on the risk of stroke and still regard air pollutants that only effect certain populations and demographics as a potential threat.

Another form of air pollution that has been studied in relation to its effects on risk of stroke is PM_{10}. Articles have indicated that while PM_{10} does have a statistically significant effect on the incidence of stroke mortality the effect is small and not as influential as other

[redacted] 20.6.23

[10] Shah.A.S.V et al, 5th February 2015, Short-term exposure to air pollution and stroke: systematic review and meta-analysis, [redacted] 0.6.23

[11] Wise. J, 8th June 2015, Researchers find no clear link between air pollution and heart attack or strokes, [redacted] 18.6.23

pollutants from example NO_2 and SO_2[12]. Another makes reference to previous studies suggesting that short term PM_{10} had a notable impact on hospital admissions for ischaemic stroke specifically. The same article reinforces the data suggesting that PM_{10} has a more significant and notable effect on ischaemic strokes also suggesting that it had an effect on people who had experienced at least one incidence of stroke prior to the one observed in the study[13]. This suggests that incidences of stroke effected by short term PM_{10} exposure are less likely to cause mortality.

NO_2 has been positively associated with risk of stroke. This pollutant was also suggested to have a greater impact on strokes in low and middle income countries[10]. The same study estimated that short-term exposure to NO_2 led to an increase of 1.014 relative risk of stroke. This review used data from 6.2 million events of stroke in 28 countries given the sample suitable size and variety to consider the results significant. Similarly to $PM_{2.5}$, NO_2 was recorded as having the greatest impact in female patients and patient over the age of 70 suggesting that it is also a factor that is associate with more risk when occurring in the presence of other contributing factors[11].

SO_2 is the pollutant linked to stroke incidence and mortality with perhaps the most polarising data regarding it's impacts on the risk of stroke. It has been found that SO_2 has an impact on both hospital admission and mortality from stroke on a similar level to that of NO_2 and CO with an estimated relative risk of 1.019[10]. However, another article published in the BMJ suggests that short term SO_2 exposure had little to no effect on the relative risk of stroke or heart attacks and that no statistically significant links were found in any of the demographics observed[11]. Fossil fuel exhaust fume related pollutants of which SO_2 is one have been associated with causing the most effect on incidences of stroke[14]. The appropriate conclusion to be drawn from this data is that SO_2 may have an impact (if small) on the relative risk of stroke hospitalisation and mortality but further research would be required to allow definitive statements to be made with an adequate level confidence and supporting evidence.

In conclusion, certain air pollutants can be more reasonably associated with having a positive associate with incidences of stroke for example particulate matter ($PM_{2.5}$, PM_{10} and particulate matter of no specific diameter) has been more strongly ,yet not unanimously, associated with risk of hospitalisation and mortality as a result of stroke where as there is more research to be conducted in the area of significance to exposure to NO_2 and SO_2 as there is still not a clear conclusion. Based on the data referenced here it is reasonable to say

[12] Qian. Y et al, August 2013, Epidemiological evidence on association between ambient air pollution and stroke mortality, [redacted] 20.6.23

[13] Oudin. A et al, May 2012, Air Pollution and Stroke, [redacted] 20.6.23

[14] Mayor. S, 19th June 2016, Air pollution is a leading risk factor for stroke, global study shows, [redacted] 0.6.23

that some forms of air pollution do have a marginal effect on the risk of stroke especially when linked to other factors.

Psychiatric and Mental Health Conditions Discussion:

One pollutant that has been strongly associated with effecting mental health is NO2. Increased exposure to this pollutant has been linked to increased visits to hospital emergency departments (ED) in young people[15]. This study observed a wide range of patients from 8 to 24 years old who visited the ED meaning the results of this study can be reasonably applied to a large demographic. Another study measuring the use of mental health services came to a similar conclusion that people with higher exposure to NO_2 and had first presented and been recently diagnosed with Psychotic and mood disorder also used mental health services more[16]. This information came for the British Journal of Psychology (BJPscyh) which is well-known, reliable and reputable source. Both of these studies have been conducted and published very recently meaning that the data they present, concluding that NO_2 does affect psychiatric and mental health conditions, is likely to be relevant.

Long-term exposure to $PM_{2.5}$ has been associated with increasing the risk of the onset of depressive symptoms. Several air pollutants in $PM_{2.5}$ have been associated with having effects on the central nervous system and therefore when studied were found to be linked to the causing of a depressed mood in the cohort studied[17]. Another article found when studying the relationship between $PM_{2.5}$ exposure and mental health illnesses the effect of the air pollutants on the people in the high-income bracket was significantly lower than that of the people in the low-income bracket. This same article also made reference to earlier studies showing links between long-term exposure to $PM_{2.5}$ and anxiety as well as long term exposure PM_{10} and an increased risk of suicide[18]. A study of 1,546 people, a significant sample size, found that increased short-term exposure to the pollutants PM2.5 and NO2 led to an increased risk of suicide completion two and three days afterwards respectively and that this effect was also more extreme in spring for $PM_{2.5}$[19].

A third pollutant that has been associated with negative mental health outcomes is O_3. A study reference within a European Journal of Epidemiology article has shown that O_3 can be linked to having an effect on the triggering or suicide. This study was conducted because there have been links made within animal populations between air pollution concentrations

[15] Szyszkowicz. M et al, 12th June 2020, Air Pollution and Emergency Department Visits for Mental Disorders among Youth, [redacted] 21.6.23

[16] Newbury. J.B et al, 19th August 2021, Association between air pollution exposure and mental health service use among individuals with first presentation of psychotic and mood disorders: retrospective cohort study, [redacted] 1.6.23

[17] Buoli. M et al, September 2018, Is there a link between air pollution and mental disorders?, [redacted] 21.6.23

[18] Yang. Z et al, March 2021, Air pollution and mental health: the moderator effect of health behaviours, [redacted] 22.6.23

[19] Bakian. A. V et al, 10th February 2015, Acute air pollution exposure and risk of suicide completion, [redacted] 22.6.23

and effects on gene expression in several organs including the brain[20]. The articles in which this study was referenced also highlighted the trend within the data showing that high exposures to O_3 had the most pronounced results in warmer seasons. This article was published by the company Springer that is widely considered to be a reliable and reputable source; the article was also published relatively recently suggesting that this is representative of the current scientific understanding of the effects of air pollution on suicide risk. High levels of O_3 have also be positively associated with visits of patients aged 8 to 24 to the ED[15].

As previously mentioned, it is considerably challenging to observe quantifiable data regarding the effect of airborne pollutants on mental health, as a result the patients measured in the studies listed above were in many cases those who were experiencing extreme symptoms to the point of needing to visit a hospital ED or attempting or completing death by suicide this may be indicative that the data used is only representative of a relatively small demographic of patients who are either dealing with extreme symptoms and those who are more open to using and have better access to mental health services, EDs and other forms of support. Although the overwhelming majority of the information referenced above all comes to the same conclusion, a study of 70,928 patients concluded that neither $PM_{2.5}$ nor NO_2 had significant effect on the risk of a depressed mood[21]. To draw a conclusion from the potentially limited data available, it is appropriate to say that different air pollutants including NO_2, $PM_{2.5}$ and O_3 can be significantly linked to adverse mental health outcomes.

Coronary Heart Disease (CHD) Discussion:

One pollutant that has been strongly associated with exacerbation of CHD is $PM_{2.5}$. A study has shown that $PM_{2.5}$, particularly that which consists mostly of black carbon, indicates a causal link between long term $PM_{2.5}$ exposure and higher risk of CHD related hospitalisation and mortality in people who at the time of the beginning of the study had not been diagnosed with CHD. In this study 3,104 CHD mortalities were observed making up 0.18% of the population studied suggesting a large and significant sample size[22]. Another study with a similar enfaces on the carbon make-up of the $PM_{2.5}$ came to a concurring conclusion and affirmed that high concentrations of $PM_{2.5}$ led to increased burden associated with CHD hospitalisation and mortality, this study observed 1900 deaths that could be directly attributed to CHD exacerbated by $PM_{2.5}$ which accounted for 10.4% of the total sample size. This study had an even larger sample size and the results suggested a stronger link between $PM_{2.5}$ exposure and CHD related mortality. A third article also found a significant link between this pollutant and CHD based on the results of a study which recorded 7,703 cases

[20] Chen. J. C et al, 3rd November 2017, Air pollution and suicide risk: another adverse effect of air pollution?, [redacted] 21.6.23

[21] Zijlema. W. L et al, March 2016, The association of air pollution and depressed mood in 70,928 individuals from four European cohorts, [redacted] 22.6.23

[22] Qi Gan. W et al, 1st April 2011, Long-Term Exposure to Traffic-Related Air Pollution and the Risk to Coronary Heart Disease Hospitalisation and Mortality, [redacted] 22.6.23

of CHD and 1,475 related deaths and made reference to a previous study showing a link between $PM_{2.5}$ exposure and myocardial infarction[23].

Another airborne pollutant that has been associated, with much more surrounding debate, with exacerbating CHD is NO_2. NO_2 has been linked with increased hospitalisation and mortality as a result of CHD based on the results of a large sample size observed[22]. However, an opposing study found that NO_2 had no effect on CHD hospitalisation and mortality when it was either exposed independently or in conjunction with another pollutant such as $PM_{2.5}$ whereas SO_2 among other pollutants did. This study was conducted over a period of 22 years (1976 to 1998) suggesting that it is representative of a trend over an extended period of time[24]. Another study indicated that NO_2 had little to no impact on the risk of events of CHD in the general sample of patients studied but was influenced to have a greater impact when co-occurring with other risk factors such as sex and age as the risk was increased by NO_2 for people within the sub-groups of female patients and patients over the age of 70[10]. This data highlights a nuance in the effects of NO_2 on risk of CHD.

A pollutant that has been found to have no statistically significant effect on risk of CHD but has an effect on the impact of another pollutant significant enough to make it worth noting is O_3. This was found in a study of 369,469 cases of CHD hospitalisation of which 53,247 were deaths, this large sample size indicates that the results found will be representative of a general trend. When O_3 exposure occurred in conjunction with $PM_{2.5}$ exposure the relative risk of CHD increased from 1.42 ($PM_{2.5}$ exposure alone) to 2.0[24]. The researchers believed that this could be linked to recent finding that increased exposure to the pollutant O_3 increase airway permeability[25]. The data suggesting that O_3 can have no effect on the risk of CHD independently was affirmed by an article in the BMJ highlighting a lack of conclusive evidence and referencing data showing that O_3 had no effect the risk of general CHD, myocardial infarction or strokes in any of the sub-demographics studied.

While it must be said based on the data that a definitive conclusion is yet to be reached regarding the presence and gravity of the effect of NO_2 on CHD, there is a wealth of evidence showing the effect of other airborne pollutants such as $PM_{2.5}$ based on which it is appropriate to reach the conclusion that it does increase the risk of CHD including hospitalisation and mortality. Debate could also be seen to surround the matter of the effects of O_3 on CHD risk as while having no effect independently the effects it has when co-occurring with $PM_{2.5}$ exposure are hugely detrimental. It is appropriate and reasonable to

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[23] Xie. W et al, 26th October 2014, Relationship between fine particulate air pollution and ischaemic heart disease morbidity and mortality, [redacted] 22.6.23

[24] Kessler. R, December 2005, Death by Particles: The Link between Air Pollution and Fatal Coronary Heart Disease in Women, [redacted] 22.6.23

[25] Niu. Y et al, 5th April 2020, Ozone exposure leads to changes in airways permeability, microbiota and metabolome: a randomised, double-blind, crossover trial, [redacted] 22.6.23

conclude that air pollution can be positively associated with CHD even though not all pollutants have a definitive, significant or clear impact.

Effect Comparison Discussion:

One effect that the conditions listed above could cause is cost and burden to healthcare services. Myocardial infarction, associated with CHD, is currently one of the most expensive conditions to treat costing $11.5 billion US dollars globally every year, it is also estimated that the cost of treating all conditions under that umbrella of CHD costs a total of $351 billion US dollars per year and that at the current rate of CHD diagnosis ad costs the cost of treating these conditions will reach $748.7 billion US dollars by 2035 [26]. This also suggested that in regarding time burden, there are approximately 5 million ED visits in the USA for CHD related conditions and in 2016 there were 72 million doctors visits to discuss and treat CHD. Low birthweight is also expensive to treat, it has been estimated that the treatment of a baby of approximately 1,500g at birth was approximately $550,000 US dollars in 2006[27] which when extrapolated across the total number of the low birthweight births would lead to enormous costs globally. It has been found that the individual cost of treating strokes generally can be as high as $59,900 in the US closely followed by $52,735 and $41,950 in Sweden and Spain (measured in US dollars) which would also add up to significant costs considering the current rate of stroke occurrences[28]. Another source suggests that the current cost of treating Strokes is $700 billion US dollars making it more expensive that the estimates for CHD and by 2030 the total cost of stroke is expected the be approximately $1 trillion US dollars[29]. It has been estimated that in 2012 $11.8 billion dollars was spent on the treatment of Serious mental illness including psychotic and mood disorder in England alone which suggests that it also contribute to a considerable for portion of costs especially to the free at the point of treatment healthcare service the NHS which operates in England[30].

Another impact of these conditions is that some can cause death for example a study which observed 7,703 cases of CHD also observed 1,475 deaths[23]. A study has also show that the risk of CHD mortality directly linked to exposure to $PM_{2.5}$, $PM_{2.5\text{-}10}$ and PM_{10} is high in female patients and increases when they are postmenopausal from 1.42 to 1.49, 1.38 to 1.60 and 1.20 to 1.30 relative risk after long term exposure to $PM_{2.5}$, $PM_{2.5\text{-}10}$ and PM_{10}

[26] Weatherspoon. D, 16th July 2020, Heart disease: Facts, Statistics and You, [redacted] 13.1.23

[27] Almond. D et al, May 2010, ESTIMATING MARGINAL RETURNS TO MEDICAL CARE: EVIDENCE FROM AT-RISK NEWBORNS, [redacted] 23.6.23

[28] Strilciuc. S et al, October 2021, The economic burden of stroke: a systematic review of cost of illness studies, [redacted] 23.6.23

[29] World Stroke Organisation, 10th January 2022, How to save $1 trillion, [redacted] 23.6.23

[30] Ride. J et al, 8th November 2019, Healthcare Costs for People with Serious Mental Illness in England: An Analysis of Cost Across Primary Care, Hospital Care and Specialist Mental Healthcare, [redacted] 23.6.23

respectively making these pollutants significant risk factors[24]. In 2020 it was calculated 27.9 in 1,000 babies with a low birth weight died as a result in England and Wales[31]. Strokes generally are estimated to kill 5 million people per year[10] and ischaemic stroke fatalities have been positively associated with high air pollution concentrations however haemorrhagic stroke related mortalities have not[23]. High concentrations of pollutants such as O_3 have also been linked to an increase in completion of suicide[20].

Finally, socio-economic divides are a huge barrier currently plaguing society and experiencing more frequent symptoms or even fatalities linked to the conditions assessed above is just another factor contributing to the widening of this gap which then goes on to effect society in other ways. One example of this is high blood pressure (a condition related to CHD) induced by work related strain generally effects male patients from a low socio-economic background than those from a higher socio-economic background[32]. Regarding the social aspect, Black birthing parents have been found to be more likely to deliver a low birthweight baby as result of CO exposure than their White counter parts[4]. This highlights the influence of race and other socio-economic barriers on air pollutant exposure and the effect of this on low birth weight, it is suggested that this could be linked to poorer access to healthcare among other factors as the study was conducted in the USA. A study which observed incidences of stroke in 28 countries concluded that while the rate of strokes globally is rising, this pattern is seen more vividly in low and middle income countries and that these are also the countries with the greatest observable link between air pollutant concentration and incidences of stroke[10]. Another article on the topic of mental health also made the important point that poor air quality can affect people in many indirect ways as well as direct ways for example if high concentrations of air pollutants pose threat to a person's line of work, they are likely to feel anxiety linked to an increased risk of unemployment and feelings of economic insecurity and that these experiences disproportionately impact people with a low socio-economic status[18]. As well as this a study has found that the people with a lower socio-economic status are the people who are most likely to have their mental health effected by air pollution but are also the people who experience the most exposure[33]. This is potentially indicative of a wider issue within society.

Conclusion:

In conclusion, low birth weights, strokes, poor mental health and increased symptoms of psychiatric conditions and CHD related illness have all been linked to air pollutants. Each of

[31] Census 2021, 17th February 2022, Child an infant mortality in England and Wales: 2020, [redacted] 3.6.23

[32] Landsbergis. P. A et al, June 2003, Lower socioeconomic status among in relation to the association between job strain and blood pressure, [redacted] 23.6.23

[33] O'Neill. M. S, December 2003, Health, Wealth and Air Pollution: Advancing Theory and Methods, [redacted] 23.6.23

the conditions can affect society in different ways for example incidences of stroke cost a significant amount of money to treat whereas incidence of CHD related conditions can high mortality rates particularly in postmenopausal patients[24] and it has been found that low birth weight is directly linked[4] and poor standards of mental health are indirectly linked[18] to low socio-economic status as a result of air pollution considering factors such as the race and income of the patients effected.

Another response why it is hard to rank these conditions and effects in order to establish a worst is because they all intersect. For example, it is widely known that poor general health can lead to suffering and mental health problems and it is therefore very difficult to separate these two experiences. From the socio-economic angle, high costs of care in countries where healthcare is paid for at the point of service can lead to problems, barriers and disadvantages for patients from low socio- economic backgrounds in need of care.

Another factor creating difficulty when accessing which of the conditions it the worst is that how they affect people can vary. An example of how this could be demonstrated is through strokes which can lead to disabilities and it would be impossible and unethical to come to an overarching decision as to whether death or living with this kind of disability is worse as this will depend on that specific patient and will be different for everyone. The ability of friends and family of the patients to cope with these types of challenges will also differ for example some parents of children with a low birthweight will find this distressing although there is direct risk to their own health.

In conclusion there is no scientific way or ethical way to establish the worst effect air pollution can have on human health based on a small collection of health conditions but the science referred to in this essay generally supports the hypothesis that air pollution can cause direct and indirect suffering to the extent that it a threat to the health, safety and well-being of the general public.