THE AIR THAT WE BREATHE IN – HOW IT AFFECTS US

Professor Dr Reza Ziarati BSc (Eng), PhD (Eng), Cert Ed, CMechE, CElecE, CMarEng, CEng, FIMechE, FIET, FIMarEST

Chairman - Centre for Factories of the Future
General Coordinator - MarEdu Partnership
Vice-Chancellor - BAU UK
General Coordinator - MariFuture
Senior Partner - Berkeley House

- Telephone: +44 (0) 1926 802000
- Tel/Fax: +44 (0) 2476 470060
- Websites: www.c4ff.co.uk; www.marifuture.org; www.maredu.co.uk;
- www.berkeley-house.co.uk; www.bahcesehir.ac.uk; www.inspire-group.org
-
- E-mail: reza.ziarati@c4ff.co.uk

Introduction

Coventry City Council was instructed on March 26th 2019 to implement a Class D charging Clean Air Zone (CAZ) to curb the air pollution levels in the city. The council's alternative measures that included traffic limitation on a few roads were rejected by DEFRAs ministers who believed Coventry would not be able to handle the nitrogen dioxide levels that were set to surpass the EU's limits (Ogden 2019). The CAZ in Coventry will charge the drivers of every vehicle if high emission standards are not achieved. DEFRA have instructed the Coventry City Council to implement the CAZ as soon as possible in order to comply with the NO2 levels by 2023 (Ogden 2019).

March 2019 Government Direction has been superseded by the Direction issued by the Minister in February 2020. This removes any requirement for the City Council to implement a CAZ, and instead instructs the Council to implement an alternative package of measures.

Research was carried out in 2016 in local authorities or on the outskirts of the West Midlands Combined Authority (WMCA) and it was found that the number of times the DAQI rating of at least 4 (moderate to very high air pollution levels) occurred 40 times; that is higher than a vast number of other regions in the UK, with most of the other combined authorities only recording 20 incidents (Ives and Shorthouse, 2018).

Recommended Actions and Health Advice

Air Pollution Banding	Value	Accompanying health messages for at-risk individuals*	Accompanying health messages for the general population
Low	1-3	**Enjoy** your usual outdoor activities.	**Enjoy** your usual outdoor activities.
Moderate	4-6	Adults and children with lung problems, and adults with heart problems, **who experience symptoms**, should **consider reducing** strenuous physical activity, particularly outdoors.	**Enjoy** your usual outdoor activities.
High	7-9	Adults and children with lung problems, and adults with heart problems, should **reduce** strenuous physical exertion, particularly outdoors, and particularly if they experience symptoms. People with asthma may find they need to use their reliever inhaler more often. Older people should also **reduce** physical exertion.	Anyone experiencing discomfort such as sore eyes, cough or sore throat should **consider reducing** activity, particularly outdoors.
Very High	10	Adults and children with lung problems, adults with heart problems, and older people, should **avoid** strenuous physical activity. People with asthma may find they need to use their reliever inhaler more often.	**Reduce** physical exertion, particularly outdoors, especially if you experience symptoms such as cough or sore throat.

Ziarati (2020) shows a detailed extract published by the Public Health England in 2014 on the levels of anthropogenic (as a result of human activity) PM2.5 concentrations. As seen, Coventry registered an average concentration of 11.1µg/m3 which is 12.1% higher than the national average and is one of the highest in the region (Ives and Shorthouse, 2018). It further reports that the mortality rate of individuals under the age of 75 stemming from preventable cardiovascular diseases occurring as a result of the adverse effects of air pollution from 2014-2016, with Coventry having 400 deaths which is one of the highest in the West Midlands region.

According to the Royal College of Physicians (RCP) and the Royal College of Paediatrics and Child Health (RCPCH) (2016), there are approximately 40,000 deaths occurring annually in the UK that attributed to being exposed to outside air pollution. Ziarati (2020) displays a detailed account by the Committee on the Medical Effects of Air Pollution (COMEAP) on mortality as a result of exposure to PM2.5 in the UK, with the number of associated deaths being 28,861 (RCP 2016) with Coventry being one of the highest contributor. He presents also a report the European Commission which analysed the effect of air pollution on the health of the public in the EU as a whole and the UK separately; this is shown in the table below.

O_3 effects	Units	EU	UK
Mortality	Premature deaths	23,507	1,371
Respiratory hospital admissions	Cases	19,117	1,368
Cardiovascular hospital admissions	Cases	86,279	2,678
Minor restricted activity days	Days	108,845,140	6,662,683
$PM_{2.5}$ effects			
Mortality	Life-years lost	4,030,653*	327,769*
Mortality	Premature deaths	379,420*	30,018*
Infant mortality	Premature deaths	777	70
Chronic bronchitis	Cases	316,685	25,582
Bronchitis in children aged 6–12	Cases	1,068,990	102,386
Respiratory hospital admissions	Cases	142,243	11,652
Cardiac hospital admissions	Cases	108,989	4,523
Restricted activity days	Days	436,351,761	40,809,466
Asthma symptom days in children	Days	11,290,673	1,171,559
Lost working days	Days	121,378,612	6,097,215

Health Impacts caused by Air Pollutants in the EU and UK

The above table gives in-depth details of the adverse effects caused by $PM_{2.5}$ (and Ozone (O_3) in 2010. The UK contributes to 5.8% of the number of premature deaths associated with Ozone in the EU while for $PM_{2.5}$ the UK contributes to 7.9% of premature deaths in the EU (RCP 2016).

The above focused on $PM_{2.5}$ which is most serious of the PMs.However, use of electric cars which are on average heavier have increased PM as small as 0.1 µ. The following is extracted from Ziarati (2020) report.

Particulate matter affects the respiratory system because once inhaled, the sizes of the particles end up in different places. PM_{10} can travel to one's airways, $PM_{2.5}$ can go deep into the lungs and reach the breathing sacs and $PM_{0.1}$ can cross into the bloodstream; this is very dangerous as these particles can carry toxic chemicals. Prolonged exposure to particulate matter can lead to lung cancer and heart disease (British Lung Foundation, 2017). It causes nose and throat irritation, can lead to irregular heartbeat and leads to a higher number of 18 people suffering from heart conditions and lung conditions such as asthma and bronchitis being admitted to hospitals (Spare The Air, 2020) (British Lung Foundation, 2017).

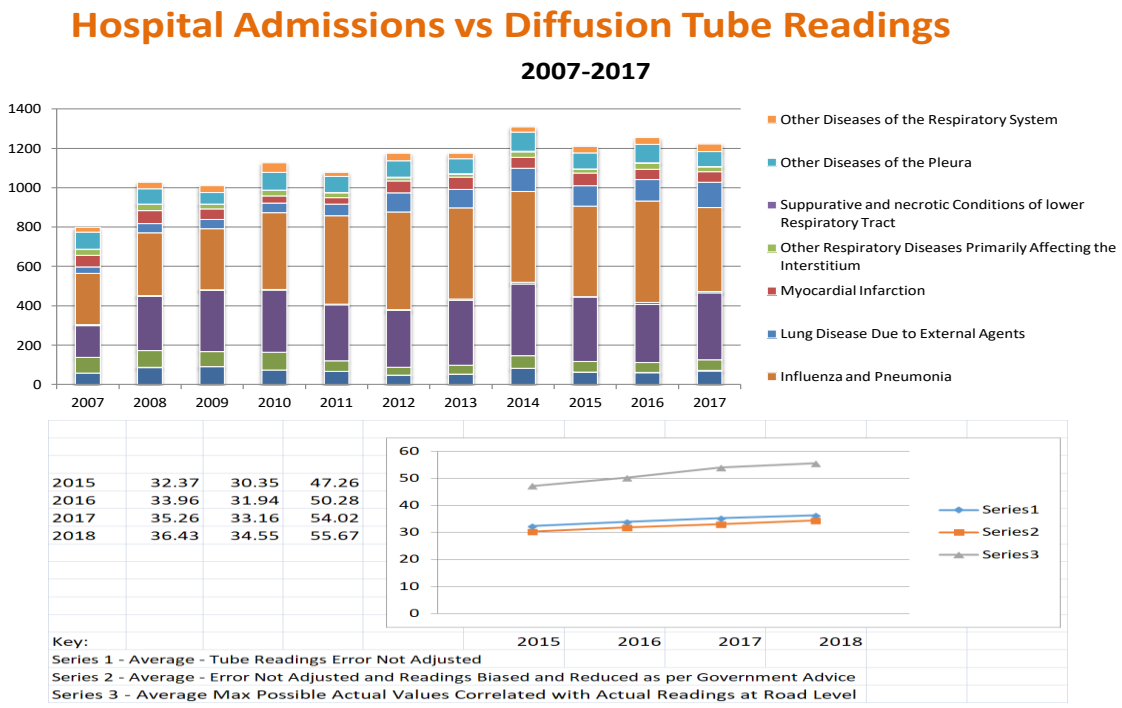
In a series of tests during the lockdown (see graphs below) the PM2.5 concentration reached a level of 36.321 µg/m_3 and the PM10 concentration reached to a level of 53 µg/m_3 while the highest Nitrogen Dioxide (NO_2) concentration was 65.98125 µg/m_3. These high values were taken during the lockdown period and were expected to be a lot lower. Furtherore, the measurements are not known to be the pollutant hot spots. For these reasons, the readings should be a cause for concerned by the City's residents.

The presence of high levels of NO_2 causes irritation and inflammation of one's airways which could lead to asthma or Chronic Obstructive Pulmonary Disease (COPD) and causes symptoms such as coughing and breathing difficulties. The largest demographic affected by this are children and the elderly as they are more likely to develop respiratory infection (British Lung Foundation, 2017).

Ziarati (2020) also states that there are other pollutants that need to be taken into account when a major development is being proposed. Ozone, eh states, causes irritation of airways in the lungs for both healthy people and others suffering from lung conditions. High levels of this gas cause breathing discomfort, reduce one's lung capacity, triggering asthma related symptoms as well as leading to a greater risk of pneumonia and bronchitis. It also causes an increase in tiredness, reduces resistance to infections and weakens athletic performance (British Lung Foundation, 2017) (Spare The Air, 2020). He also warned us against Sulphur Dioxide (SO2), which its presence in the air can lead to irritation of the lining of the nose, throat and lungs. It causes tightness of the chest; it narrows as well as inflames the airways in the lungs 22 leading to coughing and mucus. One of the resulting symptoms includes pain while deep breathing. It makes people susceptible to chest infections and worsens people suffering from COPD and asthma (National Park Service, 2018) (British Lung Foundation, 2017).

The Air quality plan proposed by Coventry while has many good features is not an air quality plan as it has not references to pollutants and the only pollutant it focuses on is that of NO_2 which are reduced substantially from measuring source that provide to at least under measure by 25%.

The graphs below are based on a reliable source (Ziarati (2019)) clearly shows level of NO_2 is increasing and that there is correlation between NO_2 emissions and admission to the hospital in Coventry for respiratory illnesses.



The appendix shows the latest results reported in Ziarati (2020).

Conclusion

The tests conducted during the lockdown clearly showed that the $PM_{2.5}$ concentration reached a level of 36.321 μg/m3 and the PM10 concentration reached to a level of 53 μg/m3 while the highest Nitrogen Dioxide (NO_2) concentration was 65.98125 μg/m3. These high values were taken during the lockdown period and were expected to be a lot lower 6 than the targets set. With regard to target set for the $PM_{2.5}$, this is expected to be reduced by a further 15% hence there should be a major issue as to how the levels are to be further reduced. Furthermore, the sites where the measurements were taken are not known to be the main pollutant hotspots. For these reasons, the readings should be a cause for concern, for the Government, the Council and the City's residents. The readings taken have been reported to have been reduced by some 20%, so the above reading should in fact be increased by this amount/percentage.

Coventry does not report on main pollutants such as $PM_{2.5}$. It relies on inaccurate NO_2 measured values which have then been subsequently and unjustifiably reduced using bias and distance adjustment factors that cannot be academically condoned. With no disrespect to those responsible for drawing up the Air Quality Plan, as stated in the CW-AQPC (Ziarati et al, 2020) report, there are a number of issues that Coventry has to take into consideration. The most important consideration should be a comprehensive, accurate and reliable measurement of all key pollutants over a reasonable period of time in any area where a development is being proposed; and that development should only go ahead if the levels of all key pollutants are well below that of the targets set. It should also be a requirement that any development would not adversely impact the level of the key toxins/pollutants.

All results here are checked against DEFRA readings that are more accurate than Coventry's inaccurate and inappropriate NO_2 readings. It fair to say that Monitoring for NO_2 should be carried out with a continuous analyser such as chemiluminescence analyser, open path DOAS analyser or other MCERTS approved instrument, passive diffusion tubes or a combination of the two (DEFRA 2009). A chemiluminescence analyser works using works on the principle of chemiluminescence 23 which gives an accurate measure of NO_2. It is important to have a diffusion tube which is inexpensive next to a accurate device so that other diffusion tube across teh City can be calibrated against. Diffusion tubes absorb NO_2 from air within a period of four weeks. They are usually sited on lampposts and data is collected and taken to laboratories for analysis. "Precision" and "bias'', are used to describe the performance of diffusion tubes. The precision can be described as the ability of a measurement to be consistently reproduced (Garshi 2018). Bias represents the overall tendency of the diffusion tubes to depart from the true value. it is possible to adjust the results to account for bias, it is not possible to correct for poor precision (DEFRA 2009) hence the reason for recommending calibration. DEFRA has developed a spreadsheet for local authorities to calculate the precision of their tubes but this has not been systematically applied. The issues regarding reducing the readings due to distance from the road is nonsensical as the level pollution as demonstrated by one of the graphs above is greater nearer the road rather than 3 metre away on a lamp post.

Appendixes

For Appendixes see below

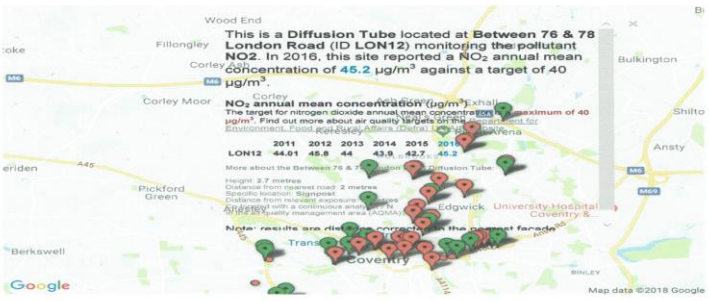
The choice is ours!

The choice is stark! Carrying on with what we are doing and destroying the world or taking drastic actions and leaving a better world for our next generations

Why Air Quality People Chamber? And Why an Independent Local Office for Measuring pollutants

Graph of Coventry Hot Spots 2015

Map of the location of the diffusion tubes around Coventry



AQ Mesh monitors

We are currently trialling two AQ Mesh monitors at one location in the city. These are small, battery operated units that measure nitrogen dioxide. We are investigating procuring more of these monitors in order to monitor at more locations in the future.

Pollution data

Further information on air quality monitoring in Coventry and the West Midlands, including pollutant levels and monitoring results.

« *Previous* Air quality in Coventry *Next* » Reviewing and assessing air quality in Coventry

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Graph of Coventry Hot Spots 2016

Map of the location of the diffusion tubes around Coventry

This is a Diffusion Tube located at Outside 190 Sir Henry Parkes Road (ID SHP3) monitoring the pollutant NO2. In 2016, this site reported a NO_2 annual mean concentration of 34.9 µg/m³ against a target of 40 µg/m³.

NO_2 annual mean concentration (µg/m³)

	2011	2012	2013	2014	2015	2016
SHP3					31.3	34.9

Hearsall Golf Club

War Memorial Park

Google

Map data ©2018 Google

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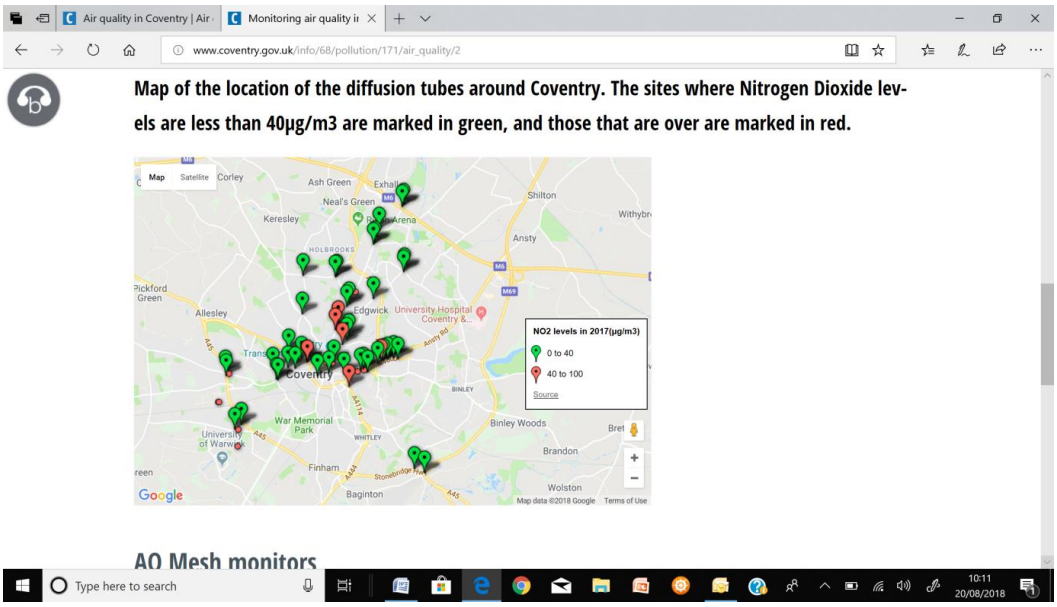
Using Adjustment Factors In 2017



Air quality in Coventry | Air

Monitoring air quality ir

www.coventry.gov.uk/info/68/pollution/171/air_quality/2

Map of the location of the diffusion tubes around Coventry. The sites where Nitrogen Dioxide levels are less than 40µg/m3 are marked in green, and those that are over are marked in red.

Map Satellite

Corley

Ash Green

Neal's Green

Keresley

Shilton

Ansty

HOLBROOKS

Pickford Green

Allesley

Edgwick

University Hospital Coventry &...

Coventry

BINLEY

War Memorial Park

WHITLEY

Binley Woods

Brandon

Finham

Baginton

Wolston

NO2 levels in 2017(µg/m3)

0 to 40

40 to 100

Source

Google

Map data ©2018 Google Terms of Use

AQ Mesh monitors

Type here to search

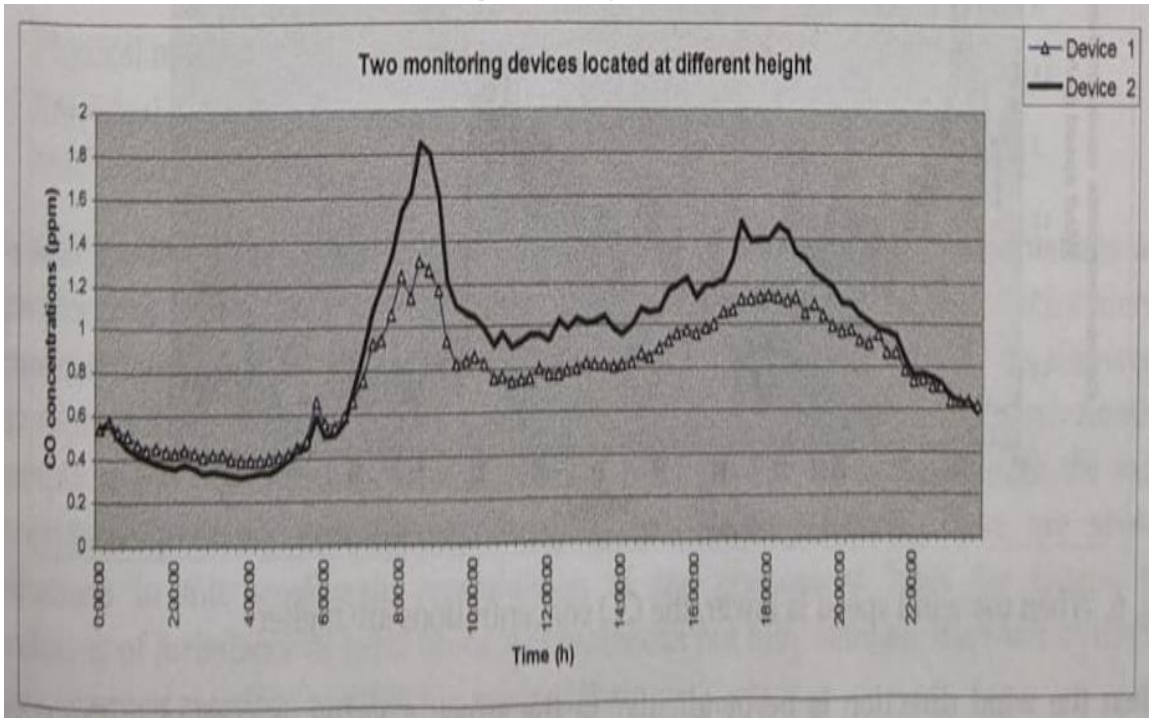
10:11

20/08/2018

Why 2017 Figures Improved?
A Travesty of Facts

Site Refere	Address	Specific Locatic	Siting Category	Easting	Northing	Tube to receptor	Distance from tube to road	Distance from road	Height	Bias Adjusted (0.87) and Annualis ed [1]	Distance corrected to nearest exposure	RZ Corrections
CC01*/1N	Holyhead R	Lamp Post	Roadside	432105	279578	4.1	3.1	7.2	2.8	36.8	33.9	56.40
HR1	Holyhead R	Downpipe	Façade	432683	279240	0	5.8	5.8	2.7	**52.8**	**52.77**	80.87
HR2c	104 Holyhe	Downpipe	Façade	432525	279345	0	6.1	6.1	2.1	26.9	26.93	41.27
HR1c	73 Holyhea	Lampost	Roadside	432712	279227	4.2	1.8	6	2.5	**79.2**	**63.9**	121.38
BH1a	Walsgrave	Lampost T1FE/	Roadside	434987	279209	2.9	2.93	5.83	2.67	37.6	35.0	57.62
BH2a	Walsgrave	Window	Façade	435125.972	279286.384	0	3.9	3.9	2.8	**43.5**	**43.52**	66.67
BH4	Walsgrave	Sign	Roadside	435331.002	279358.004	2.2	1.3	3.5	1.8	**45.3**		69.43
												0.00
BH13	196/198 W	Downpipe	Façade	435507.842	279387.046	0	5.2	5.2	2.5	34.1	34.07	52.26
BH14	238 Walsgr	Lamp post 238	Roadside	435657.77	279356.774	8	1.6	9.6	2.5	37.5	30.3	57.47
BH15i	Walsgrave	Lamp post	Roadside	435184	279298	3.5	1	4.5	2.3	**40.9**	34.4	62.68
												0.00
FS1	Fairfax Stre	Lamp Post	Roadside	433569	279233.999	3.9	1	4.9	3	**45.9**	39.3	70.34
												0.00
QV1	Lampost ou	Lamp post L15i	Roadside	433029	278798	2.12	1.95	4.07	2.57	38.7	35.1	59.31
GF1	Greyfriars T	Downpipe	Façade	433407	278882	0	0.47	0.47	2.59	25.5	25.53	39.08
GS1	Outside Go	Downpipe	Façade	433899	278845	0	9.8	9.8	2.8	35.3	35.30	54.10
LON12	Between 7!	Signpost	Roadside	434073	278459	2	2	4	2.72	**48.8**	**44.3**	74.79
												0.00
SE1	Spon End, S	Downpipe	Roadside	432083.701	279042.164	2.6	0.1	2.7	2	35.4	30.0	54.25
SE3	97 Spon En	Downpipe	Façade	432302.698	279027.648	0	2.3	2.3	3.1	36.6	36.62	56.09
QAV01	Queensland	Lamp post	Roadside	431595	278990.999	5.2	0.1	5.3	2.5	**41.9**	28.8	64.21
QAV12	Queensland	downpipe	Façade	431703.653	278680.098	0	4.3	4.3	2	31.1	31.12	47.66
QAV13	Hearsall La	downpipe	Façade	431762.894	278657.464	0	4.9	4.9	2.5	37.3	37.34	57.16
ngford Road												0.00
R5	Foleshill Rc	Downpipe	Façade	433716.001	280502.996	0	3.7	3.7	2.8	**40.1**	**40.13**	61.46
R6	Foleshill Rc	Signpost	Roadside	433609	280246	2.2	2.05	4.25	2.72	**50.7**	**45.7**	77.70
R8	Foleshill Rc	Downpipe	Façade	433992.004	281008.002	0	4.3	4.3	2.75	37.3	37.26	57.16
R9	Foleshill Rc	Lamp Post	Roadside	434059	281105	1.83	3.07	4.9	2.65	36.9	34.9	56.55
LR1	23 Longfor	Downpipe	Façade	434836.002	283030.003	0	5.6	5.6	2	37.8	37.80	57.93
LR2	24 Longfor	Downpipe	Façade	434879.997	283076.999	0	4.2	4.2	2	37.2	37.17	57.01
LR3	Longford R	Downpipe	Façade	435015.892	283515.014	0	8.5	8.5	1.5	38.7	38.71	59.31
												0.00
BRN2	Burnaby Rc	Downpipe	Façade	433604.997	281964.998	0	5.5	5.5	2.75	36.0	35.98	55.17
BRN5	41 Holbroo	Downpipe	Façade	433639.7	281995.91	0	6.7	6.7	2	32.6	32.57	49.96
BA1	Beake Aver	Downpipe	Façade	432526	280806	0	7.5	7.5	3	33.8	33.75	51.80
BA1c	299 Beake	Downpipe	Façade	432544.08	282004.7	0	10.45	10.45	2.04	25.2	25.15	38.62
												0.00
SS1	Stoney Star	Downpipe	Façade	434061.848	280082.127	0	3.7	3.7	2.5	34.3	34.25	52.57
SS2	Stoney Star	Downpipe	Façade	433993.999	279968.999	0	4.5	4.5	2.5	32.6	31.27	49.96
SS3	R/O 21 Torc	astle Close (fa	Façade	434842.004	281271.996	0	4.5	4.5	2.5	36.1	36.09	55.33
SS5	Lampost L2	Lampost	Roadside	433852	279814	1.8	2	3.8	2.51	**45.8**	**42.7**	70.19
												0.00
												0.00
BELL1	16 Hall Gre	Downpipe	Façade	435849	282211	0	5.7	5.7	2.5	38.2	38.15	58.54
BELL2	314 Bell Gr	Downpipe	Façade	435826	282158	0	2.9	2.9	2.7	35.2	35.20	53.95
FGS2	Select & Sa	Downpipe	Façade	434450	279001	0	2.4	2.4	2.7	32.7	32.67	50.11
FGS3A		Downpipe	Façade	434521	279024	0	5.5	5.5	2.5	33.8	33.78	51.80
GR1	217 Gulson	Downpipe	Façade	434679	278920	0	4.5	4.5	2.5	33.5	33.45	51.34
Grange2		Telegraph Pole	Roadside	435765	284246	1.44	0.3	1.74	2.4	35.7	32.50	54.71
SHP1	257 Sir Her	Downpipe	Façade	430447.4	277080.3	0	9.93	9.93	2.37	/	<25%	
SHP2	262 Sir Her	Downpipe	Façade	430364.1	277059.6	0	12.47	12.47	2.3	28.6	28.58	43.83
SHP3	Outside 19	Lampost L28 P	Roadside	430566.84	277231.21	4.16	4.6	8.76	2.4	34.0	31.20	52.11
BL1	Corner Bro	Lampost	Roadside	430043.77	278890.3	9.6	1.5	11.1	2.55	31.6	26.40	48.43
DH1	Outside 58	Lampost L148F	Roadside	430076.25	278789.4	12.67	3.17	15.84	2.45	29.9	25.60	45.82
												0.00
STL1	End of Stor	Lampost L6KGF	Roadside	436203.494	275841.291	9	12	21	2.45	35.2	31.20	53.95
LON8	On no. 703	Downpipe	Façade	436551.238	275703.36	0	17.9	17.9	2.45	30.0	29.97	45.98
												0.00
Grange3	161/163 Gi	Telegraph Pole	Roadside	435791	284285	1.44	0.3	1.74	2.43	35.4	32.2	54.25

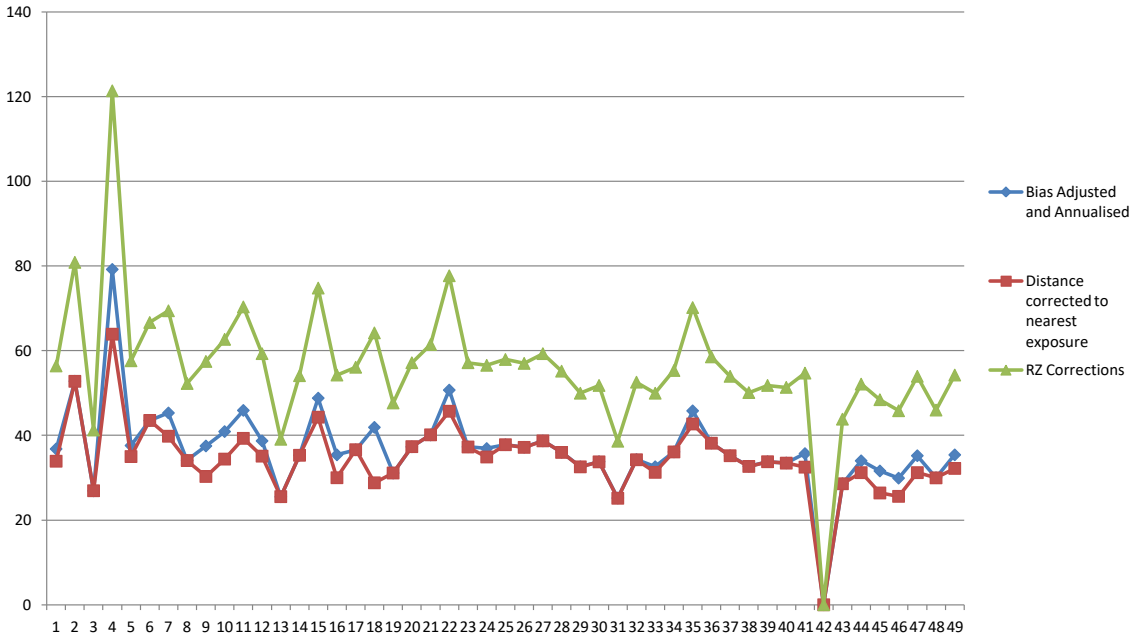
Device 2 is closer to the street and recorded higher pollution level



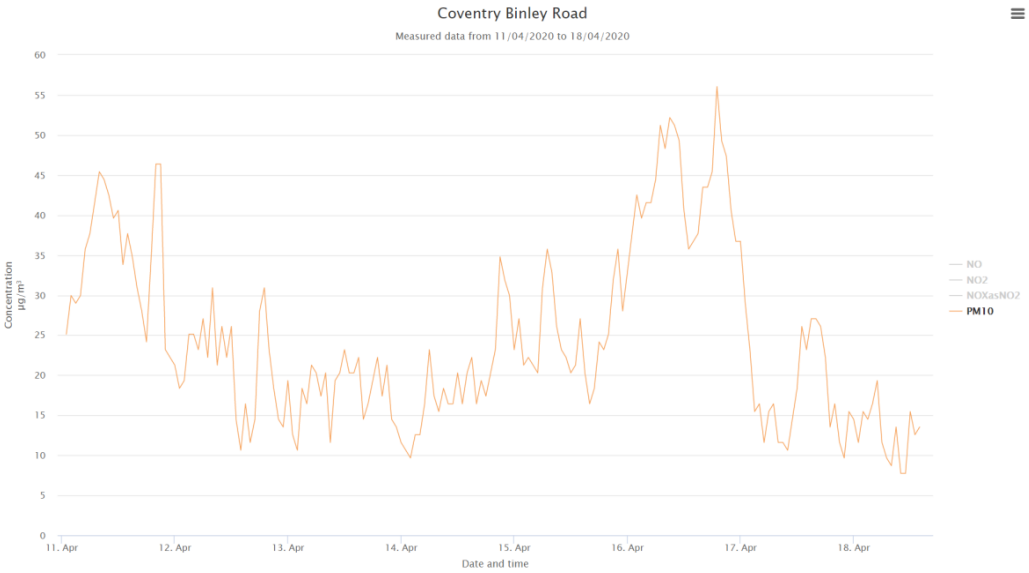
ACTUAL DIFFUSION TUBE READINGS – COVENTRY 2017

BIAS ADJUSTED VS DISTANCE CORRECTED VS RZ CORRECTED

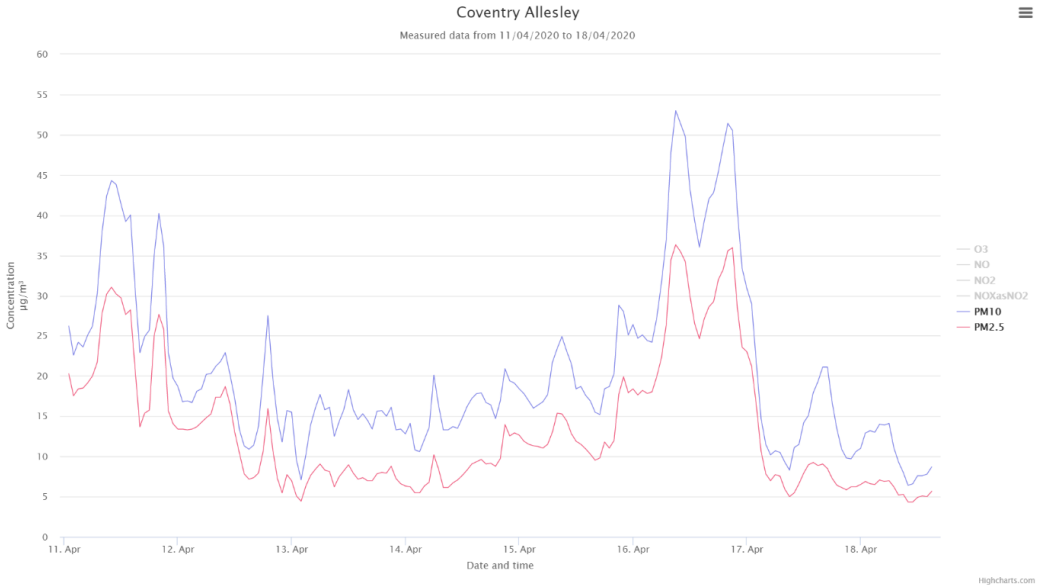
NB: RZ FIGURES ARE BASED ON ACTUAL MEASUREMENT AT ROAD LEVELS



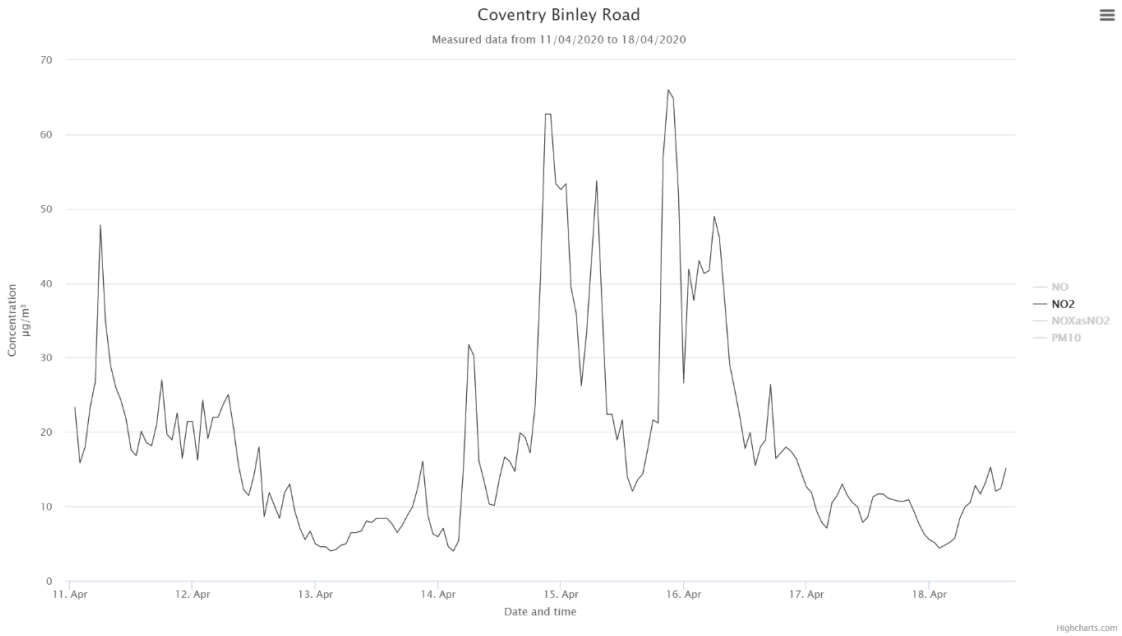
Recent Results



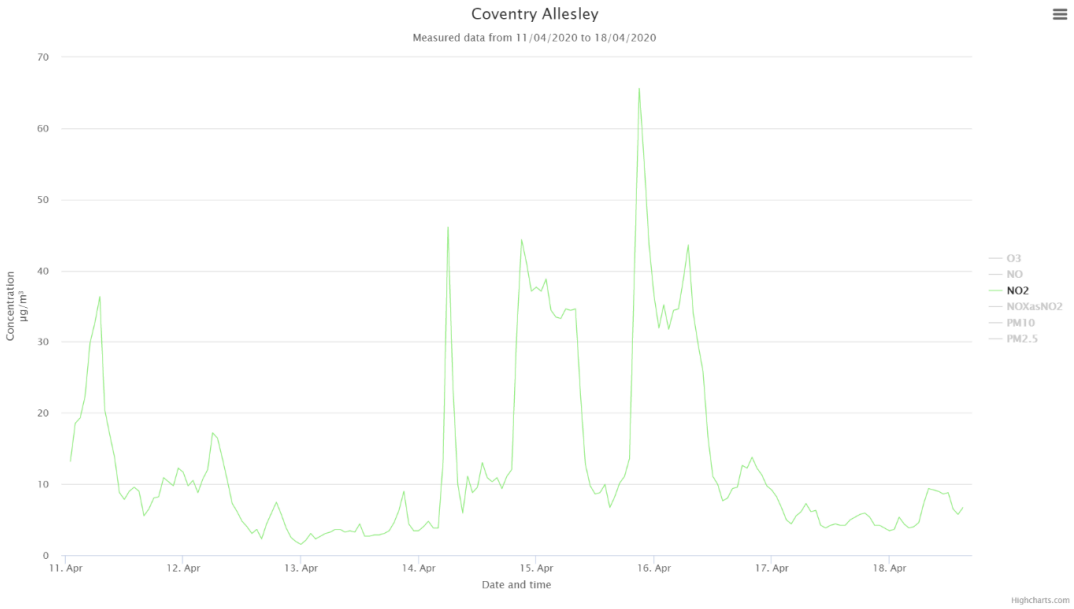
Recent Results



Recent Results



Recent Results



Summary of Results

- The results in above slides are examples of worsening air quality in cities such as Coventry
- It is clear that there has been a steady increase of some 8% NOX (and 10% other pollutants) in Coventry every year since the measurement started.
- The results for 2017 shows a reduction but this is not true as the readings have been intentionally reduced and in fact they should have shown an increase (see above). The method used to reduce figures arbitrarily and illogically is shown in table presented above.
- There is a correlation between level of pollutants and admission to local hospitals as shown in slides above.
- The latest results (April 2020) clearly shows that even during the lockdown with much less traffic the level of all pollutants were well above the Government's own max targets (see levels on 15th and 16th April for instance). The level of the most serious pollutants viz., PM2.5 was well above the targets (55%) set on 15th and 16th April 2020.
- Based on results a local office is recommended to monitor level of pollution as part of a serious attempt in helping to tackle air pollution which should be enshrined as a main objective of future infrastructure plans in the in any forthcoming local or national Government review

Professor Dr Reza Ziarati – Chair of CW-AQPC