Caesar Rodney Institute
Center for Energy & Environment

Public Comments Docket EPA-HQ-OAR-2018-0279

Review of the National Ambient Air Quality Standards for Ozone

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The following comments are submitted in response to EPA Proposed Rule EPA-HQ-OAR-2018-0279, “Review of National Ambient Air Quality Standards for Ozone”.

The Clean Air Act (CAA) gives final authority to the Environmental Protection Agency (EPA) Administrator to decide key issues, such as, establishing the National Ambient Air Quality Standard (NAAQS). The Administrator has announced the EPA will maintain the 2015 Ozone NAAQS of 70 parts per billion (ppb), in conjunction with retaining the indicator (ozone, O3), averaging time (eight hours), and form (annual fourth-highest daily maximum 8-hour average concentration, averaged across three consecutive years). Administrator Wheeler has welcomed public comments that present alternative conclusions.

The discussion below concludes the 2015 decision to lower the NAAQS from 75 ppb to 70 PPB was incorrect. Administrator Wheeler is urged to correct that error by some combination of establishing the NAAQS at 75 ppb, and, or altering the form from the fourth highest day to 7th highest day (98th percentile equivalent) to be compatible with the NAAQS for other Criteria Pollutants. Frequent reference will be made to statements in the EPA Assessment, and page numbers will be sited in parenthesis.

At the outset it is important to understand two key principles sited in the Assessment. **EPA's task is to establish standards that are neither more nor less stringent than necessary** (pg. 15**). The Clean Air Act does not require the Administrator to establish a primary NAAQS at a zero-risk level** (pg. 16). Over the last two years the EPA has announced the successes in Ohio, and Indiana of reaching attainment of the ozone NAAQS, and of the potential for economic progress that can be made without having more stringent air quality permits than needed to maintain healthy air quality. There are 90 million people in 149 counties meeting, or marginally over the current NAAQS. Providing low risk relief to them would allow a stronger focus on the 37 million people in 34 counties who still live with unhealthy ozone levels. The basis for the Administrator's proposed decision, and concerns about the basis are summarized below.

Claim 1: There have been no new scientific studies indicating a significant change in our understanding of the health risks associated with ozone exposure since the last review in 2015 (pg. 11). The primary health risk is respiratory stress after outdoor afternoon physical activity, especially for children with asthma, which can lead to hospitalization, and lost days at work, or school (pg. 10, 45). The largest respiratory effects, and the broadest range of effects noted from controlled human exposure studies were reported following exposures to 80 ppb O3, or higher, with less certain impacts down to 73 PPB (pg. 50, 154). Such studies are due solely to O3 exposures, and are not complicated by the presence of other pollutants or pollutant mixtures (pg. 50).

Counter Claim: There is new science supporting a less stringent NAAQS:

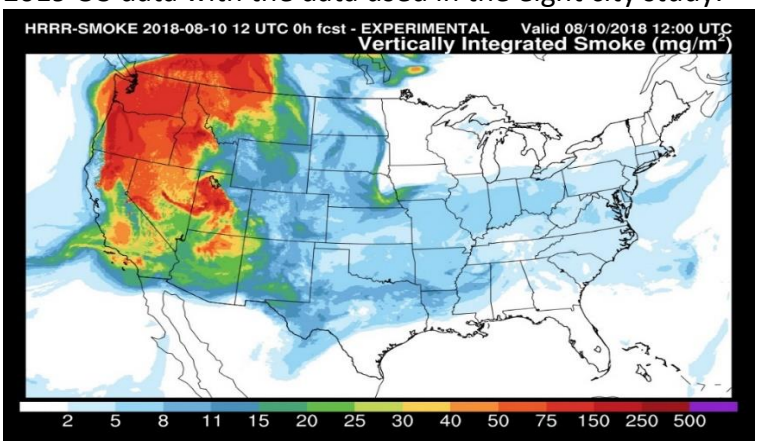
- In 2015 Administrator McCarthy gave especially heavy weight to a single, non-peer reviewed study showing mortality from cardiovascular impacts from ozone exposure. The EPA acknowledges the study has been discredited (pg. 145). In prior reviews there was essentially no mortality risk from O3 exposure. This change in the accepted science virtually eliminating mortality risks, should, by itself, support returning the ozone NAAQS to pre-2015 levels.

- Benchmark studies by the EPA have shown exposure risk for children to one, or two days above 80 PPB with a NAAQS of 75 PPB, have fallen in half since the 2015 review for the single highest exposure days (pg. 159). Even that is a conservative estimate based on out of date 2015-2017 data corrupted by two years of high smoke levels from western wildfires. This also supports stronger consideration of returning to a 75 PPB NAAQS.

Claim 2: The Administrator determined acceptable risk levels based on an eight city study of actual air quality monitoring data combined with atmospheric photochemical modeling, and statistical methods (pg. 94) from 2015 to 2017. Less than 1% of children with asthma are estimated to experience, while breathing at an elevated rate, a daily maximum 7-hour exposure in a single year at or above 73 ppb. Further, the percentage for at least one day with such an exposure at or above 80 ppb is less than 0.1% (Table 2, pg. 113, pg. 154). Those risk levels are met with a 70 ppb NAAQS, but not with 75 ppb (Table 4, pg. 131).

Counter Claim: There are several limitations in the modeling process that suggest the 0.1% exposure to 80 ppb or greater, and 1% exposure to 73 ppb or greater limits could now be met with a 75 ppb NAAQS:

- The EPA recognizes the lack of evidence from controlled human exposure studies at the lower concentrations of greatest interest (e.g., 60, 70 and 80 ppb) for children and for people of any age with asthma present uncertainty (pg. 105). This suggests some latitude in the risk calculation is needed.
- Severe smoke levels from western wildfires spread nationally grossly impacting O3 creation (see map below). For example, in the Philadelphia Non-Attainment Area (NAA) wildfire smoke may have resulted in 4 to 5 days a year of readings significantly above the NAAQS from 2016 to 2018. Exceptional Event petitions were filed, and granted by the EPA for 2016 for Maryland, and New Jersey. The Air Quality Monitoring Station in Philadelphia with the highest O3 readings has seen major improvements in air quality. In the 2015 to 2017 period, used for eight city study 3 year average, the 4th highest day was 78 ppb, with an average of 6 days a year over 75 ppb. By 2019, the single year measurement was 71 ppb, with only two days over 75 ppb, and with the 2020 O3 season almost over, the 4th highest measurement is 70 PPB, with only one day over 75 ppb. There are similar stories across the country. It is recommended the EPA compare 2019 O3 data with the data used in the eight city study.



- Using actual 2019 exposure data from NAA counties with Design Values of 71 to 75 ppb, and actual number of days by county with exposures between 73 to 79 ppb, and actual number of days with exposures of 80 ppb, or higher the actual risk of having a 75 ppb NAAQS can be calculated (see page 10 of this report for details). The risk of exposure of one day between 73 and 79 ppb is 0.41% for children with asthma who spend 4+ hours outdoors in the afternoon compared to a maximum 1% target in the EPA risk analysis. The risk of exposure of one day of 80 ppb, or higher is 0.15% compared to a 0.1% target, however this calculation does not consider likely Exceptional Events. A 75 ppb NAAQS is a reasonable risk.

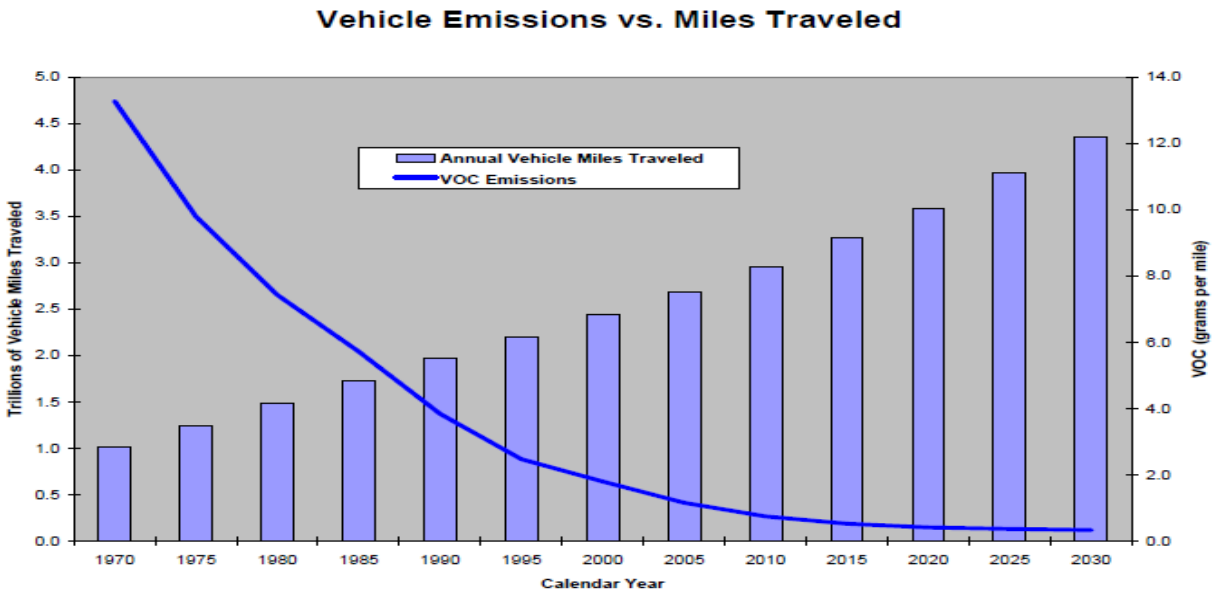
Claim 3: Concentrations of O3 in ambient air that result from natural and non-U.S. anthropogenic sources are collectively referred to as US Background O3 (USB). Findings from modeling analyses performed for the EPA review to investigate patterns of USB ambient conditions in the U.S. are largely consistent with conclusions reached in the 2015 review. The modeling predicts that days with the highest 8-hour concentrations of O3 generally occur in summer and are likely to have substantially greater concentrations due to U.S. anthropogenic sources (pg. 31). The CAA does not require the Administrator to establish a primary NAAQS at background concentration levels (pg. 16). After publication of the 2015 final rule, a number of industry groups, environmental and health organizations, and certain states filed petitions for judicial review in the D.C. Circuit Court of Appeals. The court rejected the argument that the EPA was required to take background O3 concentrations into account when setting the NAAQS, holding that the text of CAA section 109(b) precluded this interpretation because it would mean that if background O3 levels in any part of the country exceeded the level of O3 that is requisite to protect public health, the EPA would be obliged to set the standard at the higher non-protective level (pg. 25).

Counter Claim: The D. C. Circuit, (American Trucking Ass'ns, v. EPA) has clarified the EPA may consider "relative proximity to peak background … concentrations" as a factor in deciding how to revise the NAAQS in the context of considering standard levels within the range of reasonable values supported by the air quality criteria and judgments of the Administrator (pg. 15). There are several developments suggesting USB needs further consideration in setting the NAAQS.

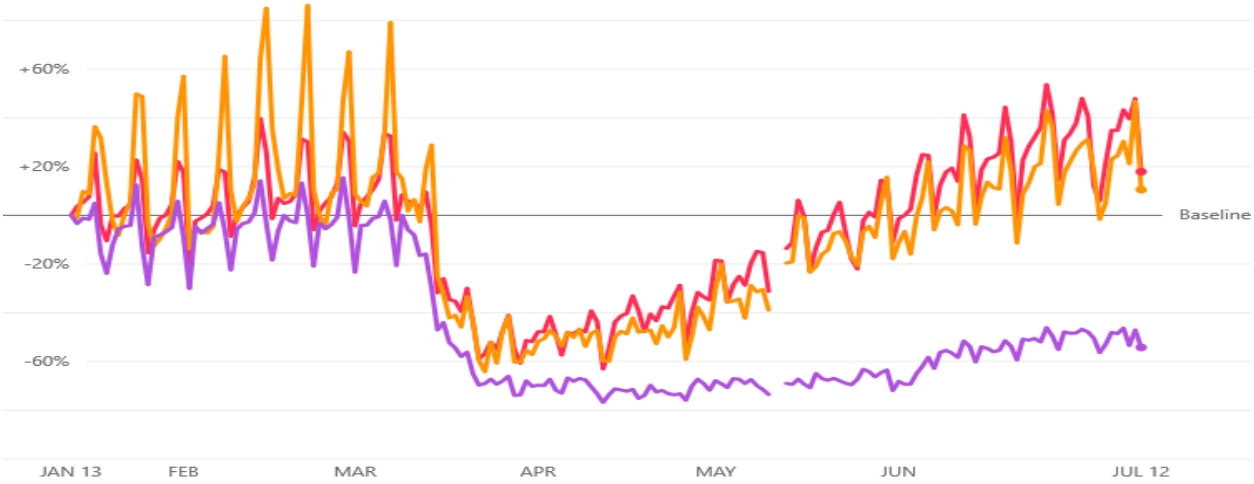
- The D. C. Circuit decision the EPA is not required to take USB into consideration does not mean the opposite is true; that a few counties that cannot meet the NAAQS because of location specific reasons such as topography, weather patterns, and wildfires precludes considering USB concentrations in the rest of the country.
- Hundreds of Air Quality Monitoring Stations where reviewed by the author in twenty-four multi-county Non-Attainment Areas, and twenty-five individual counties (see pages 9 and 10 of this report for more details). Of 183 counties with 125.5 million people reviewed, 119 with 59 million people met the 70 ppb maximum 4th highest day, another 30 counties with 30 million people would meet a 75 ppb 4th highest day maximum. Only 34 counties with 37 million people exceeded a 75 ppb 4th highest day maximum out of 3,143 counties, and county equivalents, or 1% of all counties, with about 12% of the U.S. population are significantly over the current NAAQS (all based on 2010 Census data).

Such low levels of Non-Attainment make it reasonable to give greater consideration of background levels in setting the standard.

- The EPA calculates monthly average ambient levels of O3 by season, and by region to establish a baseline. The average O3 baseline for 15 NAA's during the peak of the COVID-19 lockdowns from 3/22/2020 to 4/20/2020 was only 3 ppb lower in 2020, than the same period in 2019, or about 7% lower (44 ppb vs. 41). See mobility data from Apple showing driving dropped by 40% to 60% over the study period. Power plants, oil refineries, and industry also reduced emissions. Over the same period NO2, a marker for anthropogenic air pollution, dropped 5 ppb, or about 22% (23 ppb vs. 18) (see pages 11 to 13 of this report for more details). Using national trend data from the EPA, NO2 also dropped about 5 ppb, or 12% from 2012 to 2019, and O3 dropped 10 PPB, or 13% over the same time. Why did falling anthropogenic air pollution have one-third the impact in 2020 compared to the earlier period? The most likely reason is we are reaching a point of diminishing returns for lower anthropogenic pollution. Tropospheric O3, forms in the atmosphere when precursor emissions of pollutants, such as nitrogen oxides and volatile organic compounds (VOCs), interact with solar radiation (see page 15 of this report for more information). Precursor emissions result from man-made sources (e.g. motor vehicles, and power plants) and natural sources (e.g. vegetation and wildfires) (pg. 9). NO2 is a necessary catalyst for O3. However, the level on any given day is not so important as NO2 averages about 80% below the NAAQS during the ozone season, and the correlation between NO2 and O3 in the 15 NAA's reviewed by the author was only 0.13 indicating essentially no correlation. So, the most likely driver of O3 levels is the availability of VOCs. About 75% of total VOCs are from natural sources[1]. Anthropogenic emissions have fallen by half since 1990 based on a 2014 EPA VOC inventory, with about two-thirds of the improvement coming from reduced motor vehicle emission. Motor vehicle emission reductions have definitely reached a point of diminishing returns as shown in the EPA provided graph below.



- EPA computer modeling indicates about one-third of the average O3 ambient level in summer months across the U. S. is from anthropogenic sources (14 out of 45 ppb)[2], and about a quarter in the spring (10 out of 42 ppb). However, a detailed study of the Philadelphia NAA showed the difference between the three most rural stations, and the three highest urban stations was only about 3.3 ppb in April, 2020. This suggests USB is being under estimated by a factor of three, and we may be setting the NAAQS too close to the USB level. Returning to a 75 ppb NAAQS, or using the 7th highest day form would be a more reasonable standard.



Apple Mobility data for Philadelphia. https://www.apple.com/covid19/mobility Red = Driving directions, Orange = Walking directions, Purple = Transit directions

- Concerns a 75 ppb NAAQS, or a change in the *n*th day form would back track on the attempt to limit the number of days of high O3 exposure do not consider existing regulatory trends. Existing rules and market trends that are reducing O3 precursors will not change. Motor vehicle tail pipe emission requirements, and the SAFER Rule on miles per gallon requirements will continue to reduce national vehicle fleet emissions as older vehicles leave the fleet. The ACE Rule, and market trends favoring natural gas, and renewable power sources over higher emission coal will continue to reduce emissions from the power sector. As more regions come into NAAQS Attainment, they will still need Maintenance State Implementation Plans to protect against back tracking.

Claim 4: The Administrator decided to keep the *n*th form of the 4th highest day rather than adopting a percentile form because of the differing lengths of the monitoring season for O_3 across the U.S. A percentile-based statistic would not be effective in ensuring the same degree of public health protection across the country. The Administrator recognized the importance of a form that provides stability to ongoing control programs and insulation from the impacts of extreme meteorological events that are conducive to O_3 occurrence (pg. 48).

Counter Claim: While using the 4th highest day takes into account extreme meteorological events, it does not allow for the 3 to 5 days a year of high peak days caused by the extreme number, and size of western wildfires in 3 of the last 4 completed years, with large wildfires again in 2020. Using the 7th highest day for ozone would allow for western wildfire impacts that are expected to continue after decades of neglectful forest management practices in western states. Western states need to develop State Implementation Plans to meet the ozone NAAQS that include improved forest management practices (see page 14 of this report for more wildfire details). That would possibly allow a return to using the 4th highest day form in the next ozone NAAQS review.

- 2019 should be used as the baseline year as 2016 through 2018 air quality monitoring data is seriously corrupted by excessive western wildfire smoke that qualify as Exceptional Events in 3 of the last 4 years. For example, Maryland filed, and was approved by the EPA for 4 days of Exceptional Events dates in 2016; 5/25-26, and 7/21-22. News reports, and warnings from the Delaware's Air Quality Division highlighted 5 days of high ambient ozone levels from western wildfires in 2018; 5/1-2, 7/9-10, and 9/5, and a large number of wildfires were reported in 2017. All nine days in 2016, and 2018 had ambient O3 levels over 80 ppb, the level of greatest concern. Smoke covered most of the country during these times raising ambient ozone levels almost everywhere, and these downwind states had no control over the situation. Using the 7th highest day would provide relief.
- Exceptional Event filing has been scarce as the effort to file is so time consuming. A petition to file an Exceptional Event petition for 2018 to the EPA from Delaware was denied based on the fact that even if the petition were granted, Delaware's northern county is tied as a possible source for ozone elsewhere in the Philadelphia NAA, so the counties NAA status would not change. Switching to a 7th highest day form would eliminate the need for Exceptional Event filing which would save time at the EPA, and the individual states. Alternatively, the EPA has wildfire smoke data and O3 data by location, and could establish Exceptional Events without individual state petitions.
- Both nitrogen dioxide, and fine particle pollution use the 98th percentile in NAAQS, which is equivalent to the 7th highest day, and sets a precedent for doing so for ozone.

Conclusion

There are ample reasons to frame the 2015 decision to reduce the ozone standard from 75 ppb to 70 as a mistake that needs to be remedied, but the EPA is on a path to compound the mistake in 2020. Using relatively smoke free ambient data from 2019 indicates returning to a 75 PPB standard, or using a 7th highest day form to compensate for up to 4, or 5 days a year of continent wide impacts from western wildfires is appropriate. Alternatively, the EPA could establish Exceptional Events from wildfire smoke without waiting for individual state petitions. Over the last two years the EPA has announced the successes in Ohio, and Indiana of reaching attainment of the ozone standard, and of the potential for economic progress that can be made without having more stringent air quality permits than needed to maintain healthy air quality. More recently the EPA reconsidered the boundaries of Wisconsin's Non-Attainment Area, and similar boundary review is needed across the country. There are 90 million people in 149 counties meeting, or marginally over the current standard. Providing relief to them with

low risk of exposure to high levels of ozone would allow a stronger focus on the 37 million people in 34 counties who still live with unhealthy air.

Here is a brief list of why 75 PPB makes more sense:

1) A key study used in 2015 to set the current standard based on potential cardiovascular mortality has been discredited by the EPA review. This removes a key factor supporting the current standard.
2) EPA analysis shows exposure risks of sensitive populations to days over 73 ppb have been cut in half, and even that is a conservative estimate based on out of date 2015-2017 data corrupted by two years of high smoke levels from western wildfires. Actual, relatively smoke free, 2019 ozone data by county shows exposure risk targets adopted in support of the current standard can be met with a 75 ppb NAAQS.
3) Smoke from western wildfires have added 4 to 5 days a year to ozone peak days across the US in 3 of the last 4 years completed years, and requires reassessment of the nth form, and Exceptional Event rules.
4) Using national trend data from the EPA, ambient NO2 dropped about 5 ppb from 2012 to 2019, and ozone dropped 10 ppb. NO2 is a marker for manmade ozone precursors. During the peak of the COVID-19 lockdowns from 3/22/2020 to 4/20/2020, NO2 also dropped 5 ppb compared to 2019, but ozone only fell 3 ppb, one third as much as the 2012 to 2019 period. This suggests we have reached the point of diminishing returns in reducing ozone precursors through regulation of manmade emissions. The current standard is probably set too close to background levels to accommodate normal weather related variations in ambient concentrations. A 75 ppb standard corrects this problem.
5) Court rulings have placed limits on considering natural background levels in setting the standard. A 75 ppb standard leaves only about 1% of U. S. counties exceeding the standard. Such low levels of Non-Attainment make it reasonable to give greater consideration of background levels in setting the standard.

Notes:

1) EPA 2014 emissions inventory, file:///C:/Users/dtste/Downloads/VOC-emissions%20(2).pdf
2) Policy Assessment for the Review of the Ozone National Ambient Air Quality Standards, External Review, U.S. Environmental Protection Agency Office of Air Quality Planning and Standards Health and Environmental Impacts Division, October, 2019, page 2-39 &40
   Drafthttps://yosemite.epa.gov/sab/sabproduct.nsf/264cb1227d55e02c8525740200744 6a4/56F5BB9165D594C78525848C0046BECC/$File/O3-draft_PA-Oct31-2019-ERD.pdf

Additional resources and background

Summary of 2015 ozone NAAQS Non-Attainment Areas 3/22 to 4/20 -PPB

Metro Area	High AQM		Low AQM		O3 Avg.			NO2 Avg.		
	4th High Day	Peak Day	4th High Day	Peak Day	2019	2020	Change	2019	2020	Change
Los Angeles	106	117	64	75						
Individual 76+	98	110								
New York	84	86	62	66	41	41	0%	27	19	-31%
St. Louis	84	88	64	79						
San Joaquin Valley	83	85	69	79	37	36	-5%	22	16	-28%
Houston	80	91	73	80						
Sacramento	79	81	60	76	38	39	2%	13	10	-24%
Denver	78	87	60	66	45	43	-1%	32	28	-11%
Baltimore	77	80	58	61	48	43	-10%	23	17	-26%
Phoenix	76	84	72	82	55	44	-19%	34	21	-35%
San Diego	76	84			49	44	-11%	17	11	-38%
Dallas	76	88	62	71	48	37	-10%	13	11	-17%
Atlanta	75	94	67	76	46	41	-9%	25	22	-11%
Washington, DC	75	76	58	61	48	44	-7%	14	10	-26%
San Antonio	75	78								
Salt Lake City	73	76	64	73	45	43	-4%	26	25	-7%
Individual 71 to 75	75	91								
Cincinnati	72	76	62	73	46	41	-11%	31	27	-19%
Chicago	71	74	60	65	39	34	-12%	34	30	-12%
Cleveland	71	75	55	57	37	39	5%	27	19	-30%
Philadelphia	71	82	59	72	44	40	-8%	23	20	-10%
Detroit	70	73	60	64						
Las Vegas	70	73								
Individual meets 70	70	73								
Milwaukee	68	73	64	71						
Louisville	64	81	63	68						
San Francisco	62	85	53	73						
Average	76	83	62	71	44	41	-8%	23	18	-22%

Population Impacts of Alternative NAAQS-millions

Metro Area	Total Pop.	counties	Over NAAQS Pop.	Counties	Over 75 PPB Pop.	Counties	Over 7th nth Pop.	Counties
Los Angeles	16.6	9	16.6	9	16.6	9	16.6	9
New York	20.2	22	5.1	5	1.9	3	1.9	3
St. Louis	3.8	6	0.3	1	0.3	1	0.3	1
San Joaquin Valley	3.9	8	3.2	7	2.8	6	2.8	6
Houston	5.8	6	5.8	6	5.3	4	5.3	4
Sacramento	2.5	6	1.9	3	0.3	1	0	0
Denver	3.1	8	1.6	4	0.3	1	0.3	1
Baltimore	2.7	6	2.5	4	1.4	3	1.3	2
Phoenix	3.9	3	3.9	3	3.8	2	3.8	2
San Diego	3.1	1	3.1	1	3.1	1	3.1	1
Dallas	6.2	9	5.7	4	0.8	1	0	0
Atlanta	3.7	7	2.1	3	0	0	0	0
Washington, DC	4.2	14	0.9	1	0	0	0	0
San Antonio	1.7	1	1.7	1	0	0	0	0
Salt Lake City	1.6	4	1.3	2	0	0	0	0
Cincinnati	1.9	7	1	2	0	0	0	0
Chicago	8.5	9	5.7	2	0	0	0	0
Cleveland	4.2	7	0.2	1	0	0	0	0
Philadelphia	5.6	16	1.5	1	0	0	0	0
Detroit	4.7	7	0	0	0	0	0	0
Las Vegas	1.9	1	0	0	0	0	0	0
Milwaukee	0.3	3	0	0	0	0	0	0
Louisville	1.1	5	0	0	0	0	0	0
San Francisco	6	9	0	0	0	0	0	0
Individual Counties	8.2	25	2.2	12	0.2	2	0.2	2
Total	125.5	183	66.4	64	36.8	34	35.6	31

<u>Sensitive population and risk factors when ambient O3 levels are over the NAAQS</u>

None of the counties meeting the 70 ppb 4th highest day maximum in 2019 had two or more days in a row over 73 ppb, and only one had a two day period over 80 ppb (Alameda

County, CA). Alameda was downwind on June 10-11, 2019, from the Sand Fire in Yolo County, CA which burned from June 8, to June 17, and the event would be excluded as an Exceptional Event under EPA rules. Only 3 counties meeting a 75 ppb maximum 4th highest day, had periods of two days in a row in excess of 73 ppb, and no multiple day periods above 80 ppb. These three events equal 6 county days total out of a possible 13,870 county days (38 counties X 365 days a year), or 0.04% of the time. For the 70 ppb target exposure, Schelegle et al. (2009) reported, based on O_3 measurements during the six 50-minute exercise periods, that the mean O_3 concentration during the exercise portion of the study protocol was 72 ppb. Based on the measurements for the six exercise periods, the time weighted average concentration across the full 6.6-hour exposure was 73 ppb (pg. 42). The age group for which the prevalence documented by these data is greatest for children aged five to 19 years old, with 9.7% of children aged five to 14 and 9.4% of children aged 15 to 19 years old having asthma (pg. 76). Children under the age of 18 account for 16.7% of the total U.S. population, with 6.2% of the total population being children under 5 years of age. Further, recent CHAD analyses indicate that while 46 – 73% of people do not spend any afternoon time outdoors at moderate or greater exertion, a fraction of the population (i.e., between 5.5 – 6.8% of children) spend more than 4 hours per day outdoors at moderate or greater exertion and may have greater potential to experience exposure events of concern than adults (pg. 137). From this we can calculate the exposure risk for children shown in the table below (based on 2010 Census data used by the EPA, and the actual data in the author's analysis of all NAA counties not meeting a 70 ppb NAAQS, but meeting a 75 ppb NAAQS), and had days over 73 ppb. The total number of children with asthma between the ages of 5 and 18 is 3,099,092 (304,280,000 X 10.5% of population is between 5 and 19 X 9.7% of children between 5 and 19 have asthma = 3,099,092).

Actual Exposure Risk Calculation in 2019

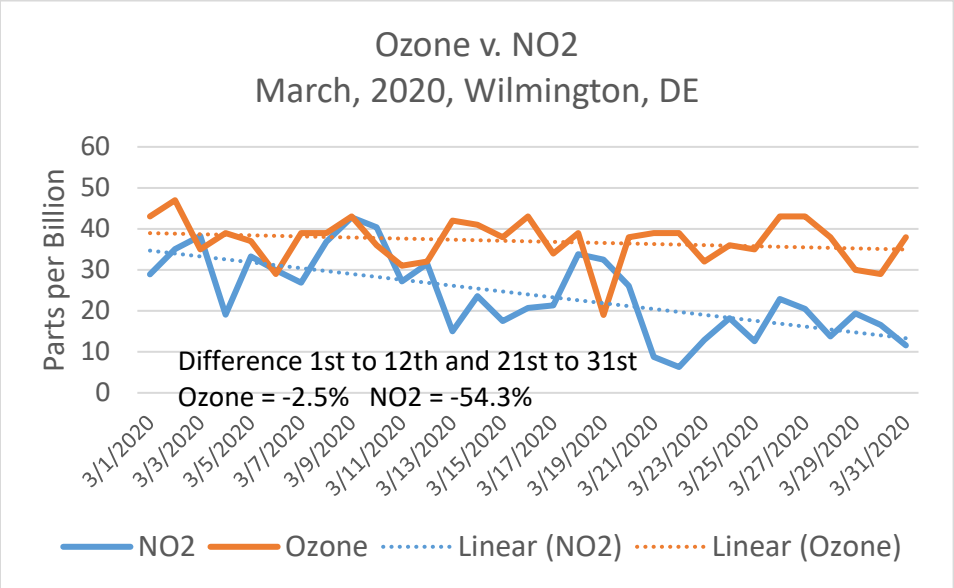
Multiplier	Exposure 73-79 ppb	Exposure 80 ppb+
Total population exposed	18,252,401	6,906,927
Ages 5-19 (10.5% of total)	1,916,502	725,227
Ages 5-19 with asthma (9.7% of children 5 to 19)	185,901	70,347
Ages 5-19 with 4+ hours a day outdoor exposure (6.8% of children 5-19 with asthma)	12,641	4,788
Actual % exposed of 3,099,092 children ages 5-19 with asthma	0.41%	0.15%

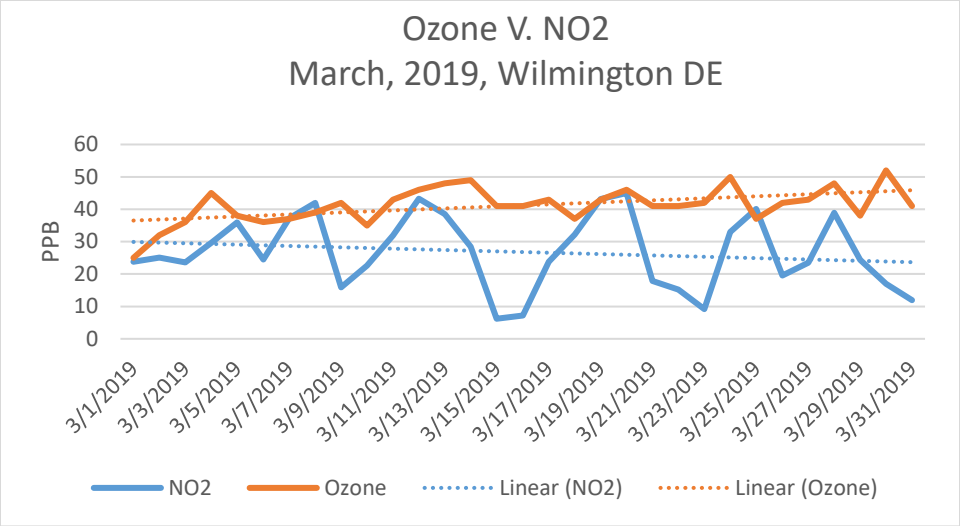
<u>O3 levels impacts NO2 vs. NOX</u>

A comparison of O3, NO2, and NOX levels was made for the Martin Luther King Air Quality Monitoring Station (100032004) in Wilmington, DE. While O3, and NO2 data is

available on the EPA Air Quality Data website, the NOX data, which includes NO2, is available on the Delaware Air Quality Division website. Unfortunately no April, 2020 data is available, so this comparison only covers March, 2020 compared to 2019. On the positive side the first 12 days of March were unaffected by the COVID-19 lockdowns, and the last 12 days were in the deepest part of the lockdown. All three pollutants have seasonal trends with O3 rising about 8% over the month as sunlight and temperatures rise while NO2 falls 23%, and NOX falls 66% as furnaces shut down from winter heating. While NO2 and NOX act as catalyst for O3 creation the daily variations for NO2 and NOX are wide, but O3 stays relatively constant, consequently the correlation with O3 is very low with NO2 at 0.14, and non-NO2 NOX at 0.20 in 2019.

NO2 and NOX levels are good markers for changes in anthropogenic pollution in general including VOC. Comparing the last 12 days of 2020 to 2019 showed NO2 fell 35%, and NOX fell 53% while weather adjusted O3 only fell 5%. The change from the first twelve days of March, 2020, to the last twelve showed NO2 fell 54%, non-NO2 NOX fell 66%, and O3 fell 2.5%. See graphs below to visualize the two years. This supports the conclusion a large drop in manmade emissions during the COVID lockdowns (54%), had essentially no impact on ozone levels, and USB must be playing a larger role than projected by EPA computer modeling. This larger USB impact needs to be considered in determining how stringent to make the 2020 O3 NAAQS.




Ozone V. NO2
March, 2019, Wilmington DE
PPB
60
50
40
30
20
10
0
3/1/2019
3/3/2019
3/5/2019
3/7/2019
3/9/2019
3/11/2019
3/13/2019
3/15/2019
3/17/2019
3/19/2019
3/21/2019
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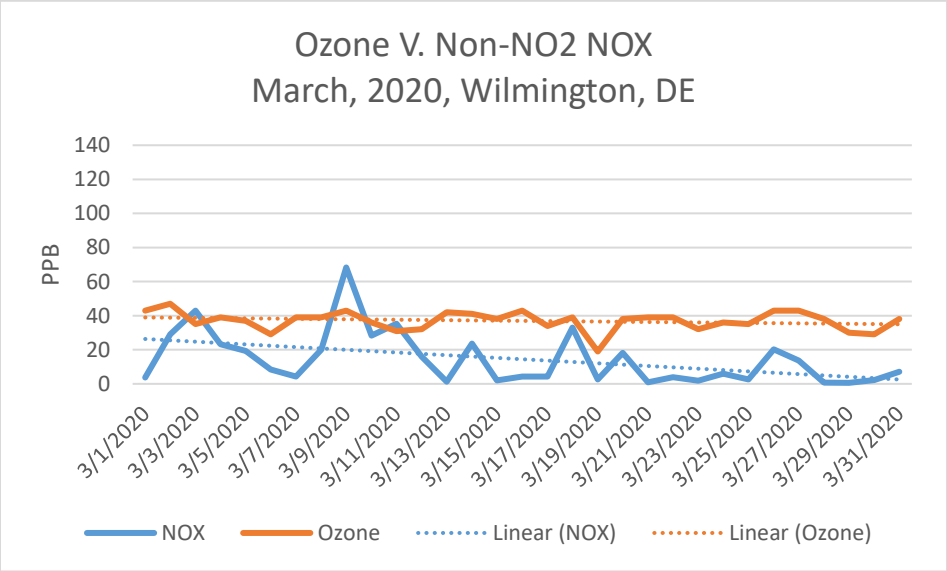
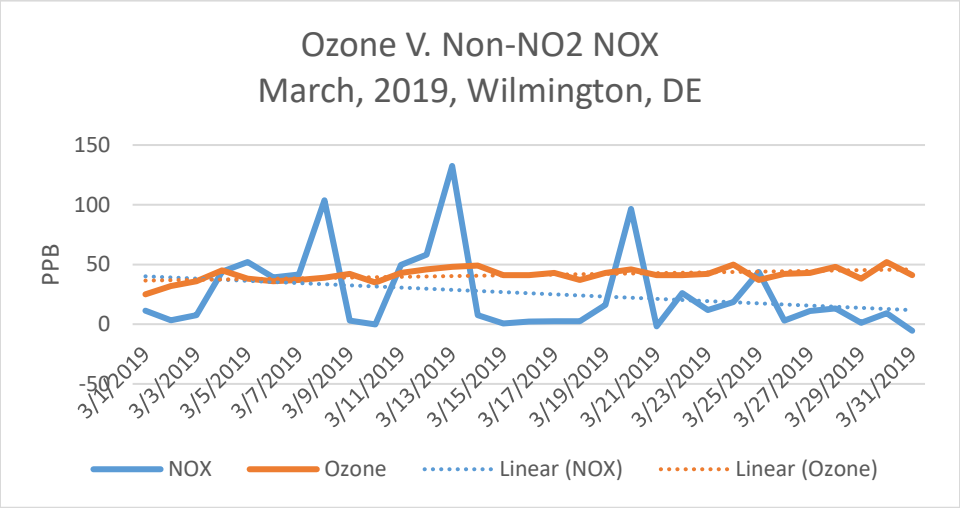
3/29/2019
3/31/2019
NO2
Ozone
Linear (NO2)
Linear (Ozone)


Ozone V. Non-NO2 NOX
March, 2020, Wilmington, DE
PPB
140
120
100
80
60
40
20
0
3/1/2020
3/3/2020
3/5/2020
3/7/2020
3/9/2020
3/11/2020
3/13/2020
3/15/2020
3/17/2020
3/19/2020
3/21/2020
3/23/2020
3/25/2020
3/27/2020
3/29/2020
3/31/2020
NOX
Ozone
Linear (NOX)
Linear (Ozone)


Ozone V. Non-NO2 NOX
March, 2019, Wilmington, DE
PPB
150
100
50
0
-50
3/1/2019
3/3/2019
3/5/2019
3/7/2019
3/9/2019
3/11/2019
3/13/2019
3/15/2019
3/17/2019
3/19/2019
3/21/2019
3/23/2019
3/25/2019
3/27/2019
3/29/2019
3/31/2019
NOX
Ozone
Linear (NOX)
Linear (Ozone)

Summary of changes in historic California forest management practices

The following is partially summarized from an article written by former California Representative, the Honorable Chuck DeVore that was originally published in The Federalist. California's only has about 18" a year of rain that falls mainly in the winter leaving the land very dry by fall when hot, dry winds pick up providing excellent wildfire conditions. Extended droughts are frequent, and are caused by Pacific Ocean current fluctuations in a multi-decadal pattern. Pine Beetle infestations, which have gone on for centuries, accelerate deadwood and fuel accumulation, sometimes killing 90% of trees in an area.

Historic– Native Americans frequently burned pine forests to create grass land to produce more food and game animals.

1840 to 1990 – Growing populations of settlers discourage Native American fire practices "as they threaten structures, and valuable timber. Fire suppression and timber harvesting gradually become more organized. Through 1990, approximately as much timber is harvested as grows naturally every year."

1994 - "Due to concerns over the Northern Spotted Owl population, whose habitat ranges from Northern California to Washington, a federal judge rules that President Clinton's Northwest Forest Plan will stand, dealing a blow to the Western timber industry, from which it never recovers. Forests begin accumulating more fuel than is harvested or burned." Controlled burns are also limited.

2012 – "PG&E, California's largest electric utility, requests a $4.84 billion rate increase for powerline safety upgrades and maintenance. The request is denied as environmental groups fret that the higher energy costs would undermine public support for renewable energy. The decision leads to the deaths of 85 people six years later in a preventable wildfire."

2016-2020 – Drought, seasonal conditions, and continued forest fuel build up lead to massive wildfires spreading smoke throughout the state and the continental U. S. in four out of five years causing 4 to 5 days a year of 80+ ppb ozone levels across the country.

Author's note: It is estimated prehistoric density of Ponderosa Pine forests ranged from 20 to 55 trees per acre. Some areas on the west coast today range from 300 to 900 trees per acre. One estimate from Stanford University suggests controlled burns to remove built up fuel are needed on 20 million acres in California while Cal-Fire only did 18,000 acres in 2018 (ARS TECHNICA, Scott Johnson, 1/21/20, "Why isn't California using more prescribed burns to reduce fire risk?, https://arstechnica.com/science/2020/01/why-isnt-california-using-more-prescribed-burns-to-reduce-fire-risk/).

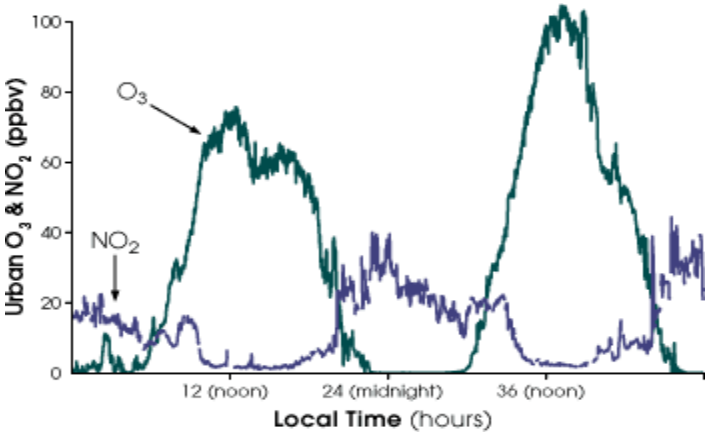
The science of ozone creation

The following is summarized from "Chemistry in the Sunlight", NASA Earth Observatory, http://earthobservatory.nasa.gov/Features/ChemistrySunlight/. There are a number of variables in ozone creation including the amount of sunlight, temperature, wind, humidity, the amount of volatile organic compounds (VOCs), and even ocean breezes as ozone has a longer shelf life over water. The highest ozone days are on hot summer days grouped around the summer solstice, with low wind and moderate humidity, in urban areas with high VOCs. NO_2 is also somewhat sunlight and heat sensitive, and natural VOCs from plant life peak during the growing season. Ground level (tropospheric) ozone is actually produced locally in two general chemical reactions:

- The energy of sunlight splits a nitrogen dioxide (NO_2) molecule into a nitric oxide molecule (NO) and a free oxygen atom (O). The free oxygen atom combines with an oxygen dioxide molecule (O_2) to form ozone (O_3). The reaction reverses fairly quickly as nitric oxide and ozone are very reactive. Coal fired power plants emit a combination of NO_2 and nitric oxide (which quickly reacts to become NO_2) and can be transported by the wind. NO_2 also occurs naturally, and from a variety of manmade sources, primarily motor vehicles.
- A sunlight split NO_2 molecule can also react in a complex way with a wide range of VOC to form ozone which tends to be longer lasting. VOCs can be generated by natural sources, such as from emissions from plants, insects and animals, wildfires, soil, lightning, and volcanoes that account for almost 70 percent of precursor emissions. Emissions from burning fuel in motor vehicles, power plants, and industrial processes add to the natural sources, and are regulated.

In both cases NO_2 is considered a catalyst, the reaction can't occur without it, but the amount of NO_2 is ultimately unchanged over a 24 hour period. Ozone is highly reactive with any physical surface and can cause injury to plants and animals, and especially sensitive people with asthma or COPD. The local nature of ozone is confirmed by Figure 1 below which shows how ozone forms in the day and falls to essentially zero overnight, the reverse of NO_2.

Figure 1. Diurnal Ozone Production



A detailed review by the author in the Philadelphia NAA found correlations between weather elements, and O3 as follows; sunlight 0.57, temperature 0.43, humidity – 0.39, and wind – 0.03. However, it is noted the author discerned no algorithm that comes close to using weather factors to predict actual peak days, and the EPA simply summarizes the situation as the connection is non-linear.