State of New Hampshire
2020 Air Quality Update

December 2021

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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State of New Hampshire 2020 Air Quality Update

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Cover photo provided to NHDES by Dr. Jeff Underhill, 2021: Sunset, New Hampshire
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1. Introduction and 2020 Scorecard

Over the past 45 years, significant progress has been made in reducing emissions of air pollutants and improving air quality across the country, including New Hampshire. Much of this is attributed to the adoption of the Clean Air Act (CAA) 50 years ago, in 1970, and its amendments of 1977 and 1990. Improvements in technology, atmospheric science and understanding of pollution-related health effects have led to a cleaner environment and healthier citizens while maintaining economic growth. Despite concerns about pollution control costs, clean air has proven to be consistent with maintaining a strong economy thanks to reductions in lost work/school days, fewer hospital visits and increased tourism.

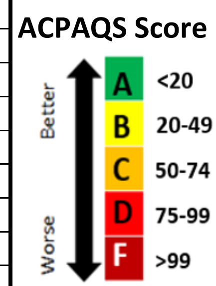
While significant progress has been made, portions of New Hampshire still face air pollution challenges. As the state's population grows and pollution is transported into New Hampshire from other regions, there is an ongoing challenge to maintain our current levels of clean air.

New Hampshire is meeting this challenge as indicated in the 2020 Air Quality Scorecard (Table 1). In 2020, over 90% of days had "Good" air quality for all New Hampshire. The number of "Moderate" days varied by county with most occurring either during winter months in locations where wood burning for residential heating is common, or during summer when ozone (also referred to as smog) is likely to occur. Air quality that is "Unhealthy for Sensitive Groups" (USG) is most likely to occur during the summer in Hillsborough and Rockingham counties and at higher elevations in the state's mountains. In 2020, there were no days in the USG category.

Fortunately, during 2020, there were no reported exceedances of the National Ambient Air Quality Standards (NAAQS) for either ground level ozone or fine particulate matter. Two factors contributed to the lack of exceedances and great air quality during 2020: 1) reduced emissions during the COVID-19 pandemic; and 2) meteorological conditions that supported good air quality. Additional information on air quality ratings and scores are presented in sections 2 and 5.3 of this report. Overall, air quality has improved remarkably since 1970.

Table 1: 2020 Adjusted Criteria Pollutant Air Quality Score (ACPAQS) by County

County	Number of Days in 2020 with Air Quality Rating:				ACPAQS*		
	Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy	2020	2019	2018
Belknap	353	12	0	0	B	A	A
Carroll	353	12	0	0	B	A	A
Cheshire	339	26	0	0	B	A	B
Coos	352	13	0	0	A	A	B
Grafton	354	11	0	0	B	A	A
Hillsborough	337	28	0	0	A	A	B
Merrimack	337	28	0	0	A	A	B
Rockingham	326	39	0	0	B	A	B
Strafford	339	26	0	0	A	A	B
Sullivan	354	11	0	0	B	A	A
High Elevation	331	34	0	0	B	A	B



** Adjusted Criteria Pollutant Air Quality Score (ACPAQS) uses a scale of 0 to 100 (and corresponding letter grades) with 0 representing natural air quality concentrations. Scores increase with more moderate, unhealthy for sensitive groups and unhealthy days.*

The Adjusted Criteria Pollutant Air Quality Score (ACPAQS) presented in Table 1 is calculated by New Hampshire Department of Environmental Service (NHDES) to specifically account for annual human-caused air pollution. It robustly assesses air pollution exposure data by considering hourly and daily measured air pollution concentrations as well as the frequency of days exceeding the thresholds for moderate, USG, and unhealthy Air Quality Index (AQI) classifications (described below in Table 2). The ACPAQS uses a scale that starts at zero, indicating natural background concentrations, and increases with higher ozone and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) concentrations as well as the frequency increases for those higher concentrations. It is worth noting that the ACPAQS considers 24-hour $PM_{2.5}$ concentrations on a rolling clock basis whereas the NAAQS and AQI considers only 24-hour average concentrations occurring from midnight-to-midnight. The NAAQS is discussed further in section 4 and in section 5.3.

2. Air Quality and Air Pollution Health Effects

In order to simplify the understanding of air quality at any given time, the U.S. Environmental Protection Agency (EPA) has developed a multi-pollutant classification system called the Air Quality Index (AQI). When displaying air quality data on their respective websites, EPA and NHDES color code air quality levels based on the AQI, which assists the public in understanding the health-related impacts associated with measured air quality levels. Table 2 describes each of the AQI categories and the color coding shown in this table is the same as that used on the EPA and NHDES websites.

Key Point: Adjusted Criteria Pollutant Air Quality Score (ACPAQS) versus the Air Quality Index (AQI)
The Adjusted Air Quality Score is a NHDES calculated annual ranking of anthropogenic air pollution whereas the Air Quality Index (AQI) is an EPA developed indicator of total air quality at any given time.

Table 2: Air Quality Index Levels of Health Concern

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 – 50	Air quality is considered satisfactory and air pollution poses little or no risk.
Moderate	51 - 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups (USG)	101 - 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 - 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 - 300	Health warnings of emergency conditions. The entire population is more likely to be affected.
Hazardous	301 - 500	Health alert: Everyone may experience more serious health effects.

Source: AirNow.gov

NHDES monitors air pollution emissions throughout the state on a daily basis and issues daily forecasts of air quality on its website[1] using the ratings and colors of the AQI scale to more effectively convey the appropriate health message to the public. When air pollution concentrations are expected to reach USG or higher, NHDES declares an "Air Quality Action Day (AQAD)," urging people to take precautions to protect their health and to take steps to reduce air pollution. Real-time air quality data for New Hampshire can also be viewed on the NHDES website. [2]

The connection between health effects and air pollution exposure is often unrecognized. For example, exposure to air pollution can trigger or exacerbate existing ailments that may be considered unrelated, such as asthma or tightness in the chest when breathing. Repeated exposure to air pollution over time can be the cause of these ailments, yet the connection to air pollution may not be made. Typically, such ailments are treated symptomatically without identifying the actual cause or causes. While air pollution is rarely listed as a cause of death, it may be the underlying cause of a fatal complication to an already compromised individual. Statistically, air pollution in the United States is estimated to cause thousands of premature deaths and millions of other health complications every year. Air quality has improved significantly in recent decades, translating into lives saved and reduced health care costs.

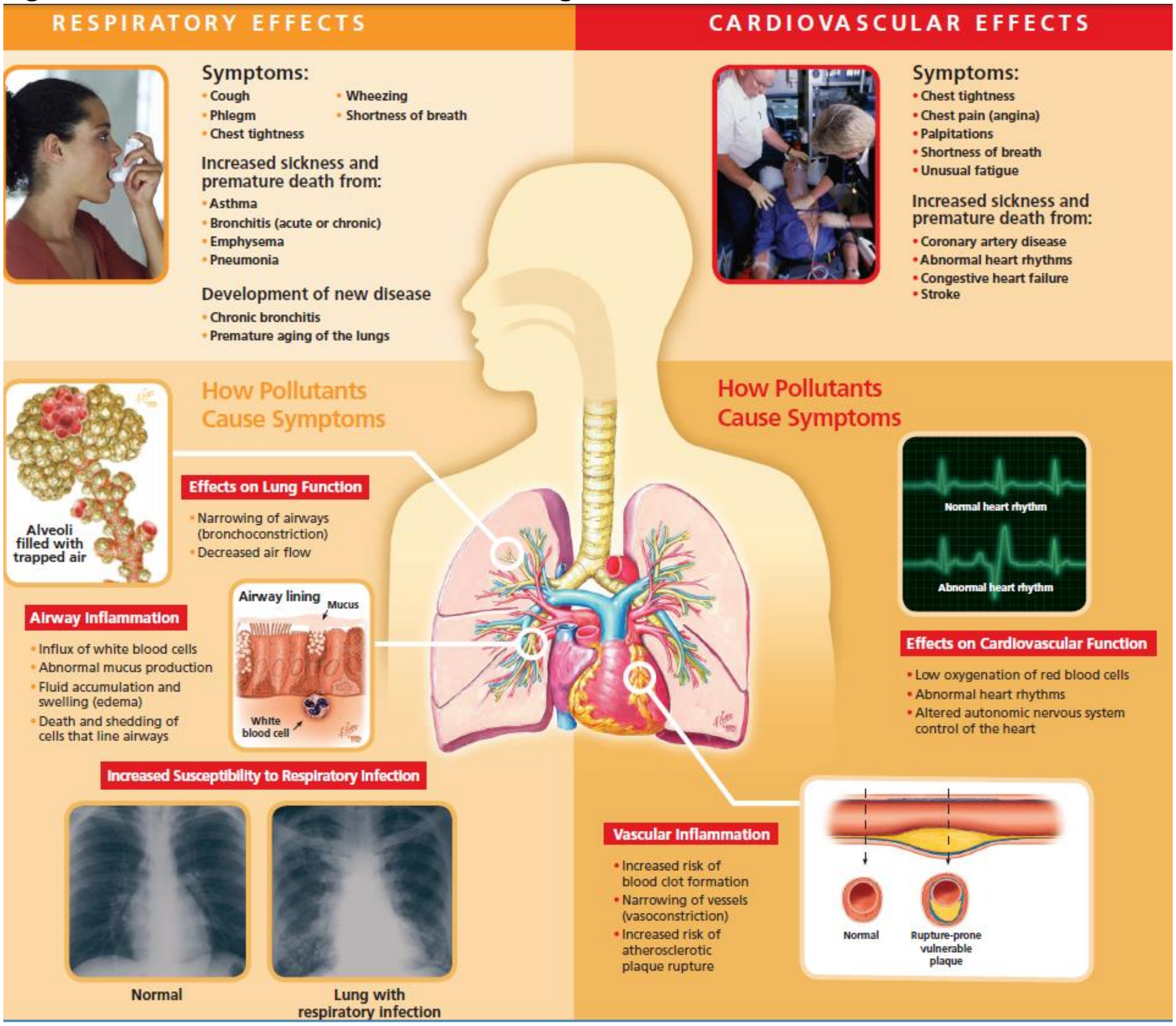
Studies connecting air pollution exposure to health impacts are routinely reviewed prior to setting federal air pollution health standards. Such studies have shown that with decreasing exposure of fine particulate matter (particulate matter less than 2.5 microns, or $PM_{2.5}$), risk of adverse health impacts decrease and life expectancy increases.

[1] NHDES posts daily air pollution forecasts at https://www4.des.state.nh.us/airdata/AirQualityForecast.html

[2] NHDES posts current air pollution levels at https://www4.des.state.nh.us/airdata/

Exposure to ozone and other air pollutants can reduce lung function; aggravate chronic lung diseases such as asthma, emphysema, and bronchitis; and cause or exacerbate other respiratory problems (Figure 1). Persons at highest risk include children, older adults, those with lung disease, and those who are active outdoors. Breathing elevated concentrations of ozone may contribute to premature death in people with heart and lung disease.

Figure 1: Air Pollution Effects on Human Lungs



Source: EPA

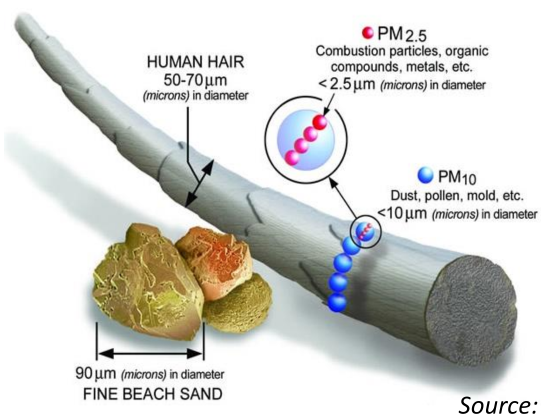
3. Air Pollutants of Primary Concern

Many pollutants contribute to degradation of air quality, but a relatively small number stand out for their potential widespread impacts to public health and the environment in New Hampshire and the US. The pollutants of greatest concern include the "criteria pollutants," airborne toxics such as mercury, and pollutants that cause regional haze.

The six criteria pollutants[3] are:

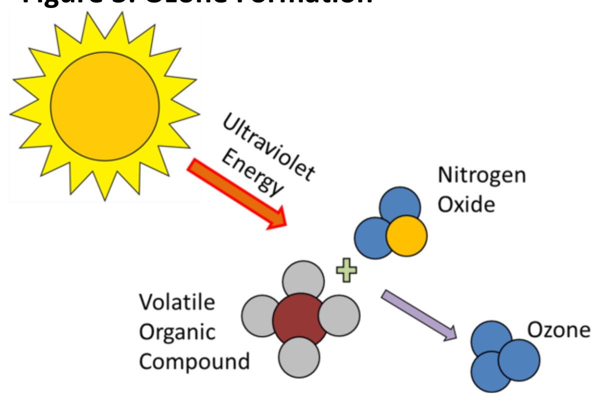
- Carbon monoxide (CO).
- Lead (Pb).
- Nitrogen dioxide (NO_2).
- Particulate matter – Smaller than 10 microns in diameter (PM_{10}) and smaller than 2.5 microns in diameter ($PM_{2.5}$) (Figure 2).
- Ozone (O_3) (Figure 3).
- Sulfur dioxide (SO_2).

Figure 2: Size of $PM_{2.5}$ Particle Pollution



Source: EPA

Figure 3: Ozone Formation



Source: NHDES

In New Hampshire, the most pervasive and widespread air pollutants are $PM_{2.5}$ and ozone. Table 3 describes the different criteria pollutants, some potential sources, and health effects caused by exposure to each.

Air quality in New Hampshire has experienced significant improvements since the 1980s with the biggest improvements occurring with CO, lead, and SO_2. The CAA required a number of air pollution control measures including the installation of catalytic converters in cars, removal of lead from gasoline, and particle scrubbers on certain power plants and industries. Years later additional progress was made in reducing nitrogen oxides, ozone, and $PM_{2.5}$, but progress has been slow due to the widespread nature of the emission sources and the ability of these air pollutants to travel large distances. This made it difficult to trace the high pollution concentrations to specific emission sources or groups of sources. Nevertheless, when several regional and national emission reduction actions were issued, they enabled New Hampshire to make even greater progress towards cleaner air and improved visibility in the state.

[3] Section 108(a) of the CAA requires the establishment of National Ambient Air Quality Standards. The CAA was last amended in 1990.

Table 3: Criteria Pollutants

Pollutant	What is it?	Sources	Health Effects
Carbon Monoxide (CO)	Colorless, odorless gas	Incomplete combustion from mobile sources (cars, trucks, buses, etc.).	Reduced oxygen delivery to body, increased severity of lung ailments.
Lead (Pb)	Metal	Previously an additive to gasoline and paint, still an additive to aviation gasoline.	Damage to nervous system, kidney function, immune system.
Nitrogen Dioxide (NO_2)	Highly reactive gas that is part of a group called nitrogen oxides (NOx).	NOx is emitted from mobile sources (cars, trucks buses, etc.) and stationary sources (power plants, factories, etc.).	Damage to respiratory system.
Ozone (O_3)	A gas composed of three oxygen atoms. “Good” ozone forms a protective layer in the stratosphere and “bad” ozone is formed near the surface in the troposphere.	Ground level ozone is created by chemical reaction of NOx, volatile organic compounds (VOCs) and ultraviolet (UV) light (Figure 2).	Reduced lung function, aggravate lung diseases.
Particulate Matter (PM)	Mixture of solid particles and liquid droplets found in air.	Dust, dirt, soot, smoke. Can be emitted from combustion or formed though secondary chemical reactions.	Particles can travel deep into lungs. Decreased lung function and increased respiratory symptoms.
Sulfur Dioxide (SO_2)	Highly reactive gas that is part of a group called sulfur oxides (SO_x).	Combustion of fossil fuels (primarily coal and oil).	Harmful to respiratory system and aggravates heart disease.

3.1 Particles and Wood Smoke

Concentrations of all six of the criteria air pollutants are considerably lower today in New Hampshire than just a few decades ago. Some pollutants were easier to address and made faster progress than others. As a result, the air pollutant with the greatest health impact in the state in 2020 and beyond is $PM_{2.5}$, much of which comes from wood smoke. Figure 4 highlights some of the health impacts related to wood smoke exposure and illustrates how to burn wood more cleanly in order to reduce the amount of particle pollution.

Wood smoke is very common in New Hampshire because wood is a common source of energy for residential heating. While natural gas is the predominant energy used for residential heating nationwide, it is not commonly found under the rocky New England soils, and what is used in the region is normally shipped or piped-in, and not typically available outside of urban areas. Instead, #2 heating oil and/or wood is the fuel of choice in many of these areas. For New Hampshire, trees are very common throughout the state, making wood an easy heating energy source to obtain. In 2011 when the price of gasoline and fuel oils spiked, many people depended on wood to be the primary source of heat, which was reflected in the rise of $PM_{2.5}$ concentrations during that period.

When someone chooses to heat with wood, wood stoves are the preferred heating device. Pellet stoves and hydronic heaters (also known as outdoor wood boilers) have become more common in recent years, but remain far less common than wood stoves. Newer wood and pellet stoves are much more energy efficient in their heat transfer, than older ones, burning less wood for the same heat, and they emit significantly lower rates of $PM_{2.5}$.

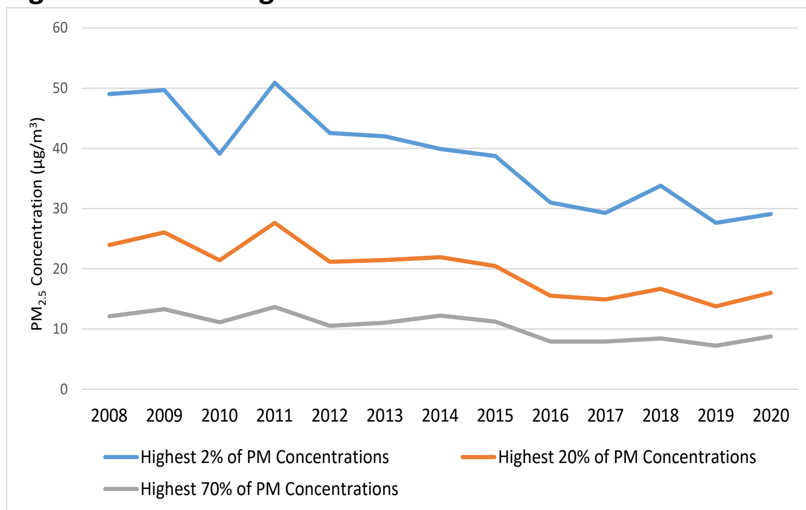
Figure 4: Wood Smoke and Health

Source: EPA

While some people periodically use a standard fireplace for heating, they are disproportionately high-pollution emitting and inefficient at internal heating since much of the heat, including already warmed room air, gets drawn up the chimney. Hydronic heaters can be inefficient burners and high emitters of $PM_{2.5}$, largely because they are often not tended as frequently as indoor wood stoves and are allowed to smolder.

Progress is being made in reducing $PM_{2.5}$ from wood smoke in New Hampshire, largely due to newer EPA certified wood stoves entering the market. NHDES and the American Lung Association conducted wood stove swap-out programs in the state, where a financial incentive would be issued for the installation of a new certified stove, with the removal and destruction of the old one. The user gets more heat with less wood and the neighbors get cleaner air. The City of Keene was the target for the first round of wood stove swap-outs during late 2009 to early 2010 and was able to remove 86 older, high-polluting wood stoves and replace them with new EPA certified wood stoves, cleaner burning pellet stoves, or a natural gas fired heating device. Thanks in part to this effort, Keene's winter-time $PM_{2.5}$ concentrations are now more than 30% cleaner than in 2008 (Figure 5). Subsequent wood stove swap-out programs have further reduced the number of high-emitting wood stoves throughout the state.

Figure 5: Decreasing Wood Smoke in Keene Since 2008



3.2 Beyond the Criteria Air Pollutants

In addition to the six criteria pollutants, another group of concern is toxic air pollutants that can be of localized concern, also known as hazardous air pollutants, which are known or suspected to cause cancer or other serious health concerns. Currently 187 hazardous air pollutants are regulated under the CAA[4]. Examples include benzene, which is found in gasoline; perchloroethylene, which is emitted from some dry cleaning facilities; and methylene chloride, which is used as a solvent and paint stripper by a number of industries. In addition, emerging air pollutants, such as perfluorooctanoic acid (PFOA) and per- and polyfluoroalkyl substances (PFAS) are being studied and regulated where needed.

Greenhouse gas emissions are of global concern because the numerous effects due to shifting temperatures, weather patterns, loss of biological species, and rising sea levels. These changes are measured over decades where slow but steady changes can be clearly identified.

[4] https://www.epa.gov/haps

4. Air Quality Standards

The EPA set air quality standards for the six criteria pollutants known as NAAQS. When air quality levels in an area violate one of these standards, EPA may designate that area as being in “nonattainment” of the standard. In contrast, where air pollution is below the threshold of the standard, the area is considered in “attainment.” The NAAQS consist of two different types: primary and secondary. Primary standards set limits to protect public health for the most vulnerable populations, such as children, older adults, and people with pre-existing heart or lung disease. Secondary standards set limits to protect public welfare, including protection against damage to animals, crops, vegetation, buildings, and visibility in scenic places.

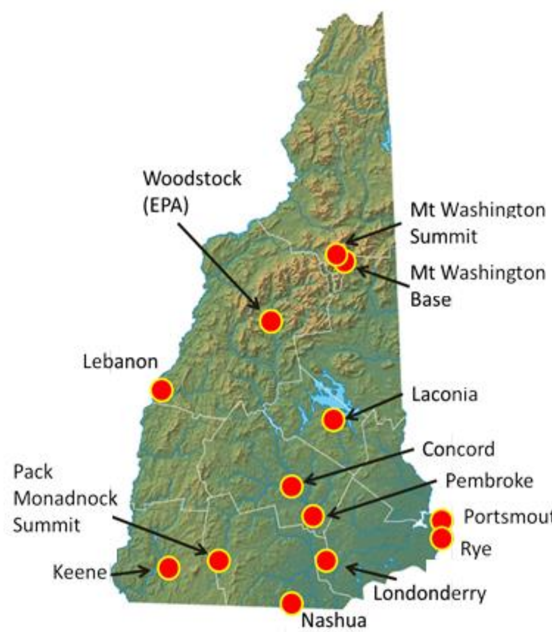
Key Point: Parts per billion (ppb) What does that mean?

70 ppb is like putting 70 drops of pollution into this Olympic-sized swimming pool. It may not seem like much but the pollution can still have a significant impact.

The current primary and secondary NAAQS for each criteria pollutant are listed in Table 4. The table also describes the form of the “design value” for each standard; this is a value used to determine whether a violation of the standard has occurred (see section 5.2). Air pollution standards are normally expressed in concentration units of parts per million (ppm), parts per billion (ppb), or micrograms per cubic meter (µg/m^3). These units reflect the average amount of the pollutant present in a certain volume of ambient air over a defined period of time (as set by the standard).

To establish compliance with the NAAQS, air pollution is measured in New Hampshire by a network of monitoring stations operated by NHDES (Figure 6). This monitoring network operates under strict guidance and quality control requirements as set by EPA. Collected data is posted in near-real time on the NHDES[5] and EPA AirNow[6] websites and is processed as part of air pollution attainment and maintenance tracking as well as to assess long trends.

Figure 6: New Hampshire Air Monitoring Stations, 2020



[5] NHDES Current air quality https://www4.des.state.nh.us/airdata/

[6] EPA AirNow for Concord, NH: https://www.airnow.gov/?city=Concord&state=NH&country=USA

Table 4: National Ambient Air Quality Standards (2020)[7,8]

Pollutant [final rule cite]		Primary/ Secondary	Averaging Time	Level	Form ("Design Value")
Carbon Monoxide [76 FR 54294, Aug 31, 2011]		primary	8-hr	9 ppm	Not to be exceeded more than once per year
			1-hr	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]		primary and secondary	Rolling 3 month	0.15 μg/m³ [a]	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		primary	1-hr	100 ppb	98th percentile, averaged over 3 years
		primary and secondary	Annual	53 ppb [b]	Annual Mean
Ozone (2015) [80 FR 65292, Oct 26, 2015]		primary and secondary	8-hr	0.070 ppm [c]	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution Dec 14, 2012	$PM_{2.5}$	primary	Annual	12 μg/m³	annual mean, averaged over 3 years
		secondary	Annual	15 μg/m³	annual mean, averaged over 3 years
		primary and secondary	24-hr	35 μg/m³	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hr	150 μg/m³	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]		primary	1-hr	75 ppb [d]	99th percentile of 1-hr daily maximum concentrations, averaged over 3 years
		secondary	3-hr	0.5 ppm	Not to be exceeded more than once per year

[a] Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

[b] The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

[c] Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O_3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O_3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.

[d] Final rule signed June 2, 2010. The 1971 annual and 24-hour SO_2 standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

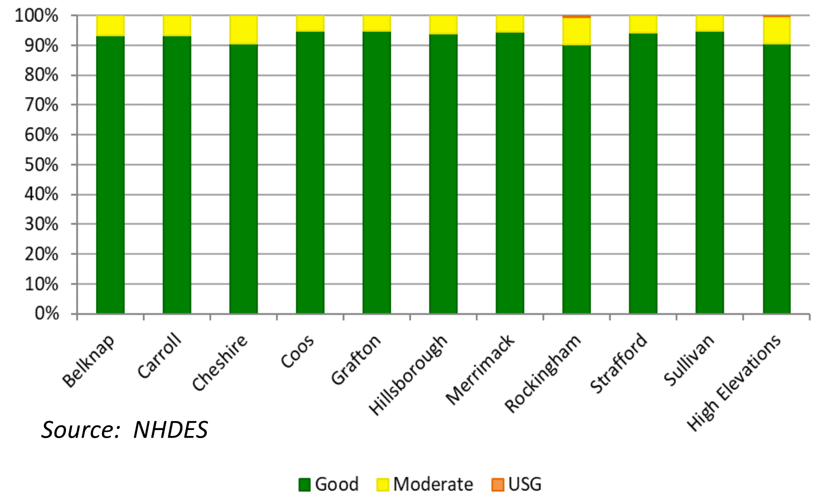
[7] For an updated summary of the NAAQS, see EPA's NAAQS Table, (https://www.epa.gov/criteria-air-pollutants/naaqs-table).

[8] For more information on EPA's process for reviewing the NAAQS, see NAAQS Review Process, (https://www.epa.gov/criteria-air-pollutants/process-reviewing-national-ambient-air-quality-standards).

5. Recent Air Quality

5.1 2018 to 2020 Air Quality Scoring by County and by Season

Figure 7: Annual Air Quality Ratings by County, 2018-2020 (Percent of Days)

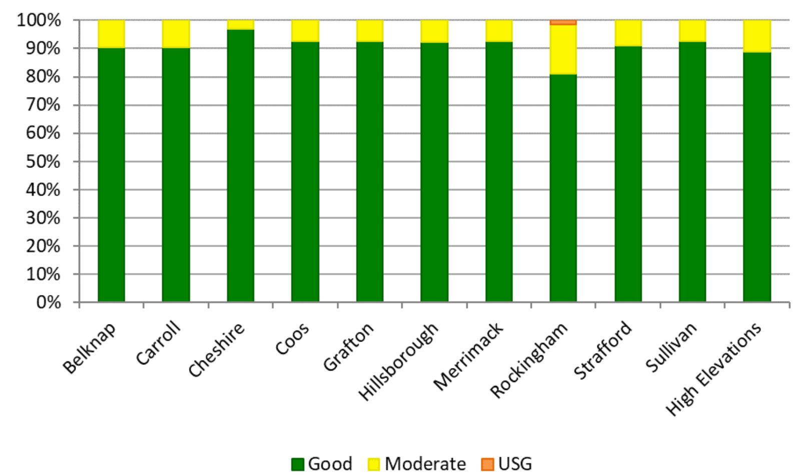


Source: NHDES

Throughout New Hampshire, the AQI is most often good or moderate and only reaches USG on isolated occasions. The AQI is primarily driven in the state by two air pollutants, ozone and $PM_{2.5}$. Figures 7 through 11 illustrate seasonal air quality trends for each county in New Hampshire between 2018 and 2020. Figure 7 provides an annual summary showing that about 90% of the days between 2018 and 2020 had good air quality. The remaining days are mostly moderate and a few were USG. There is considerable seasonal variation in air pollution patterns because meteorological patterns play a large role in New Hampshire's air quality.

Summer (June-August)

Figure 8: Summer Air Quality Ratings by County, 2018-2020 (Percent of Days)



The summer AQI is usually driven by how much ozone is transported[9] into the state by prevailing winds and mixed with local emissions (Figure 8). Due to higher populations, southern and southeastern counties have higher levels of emissions. This portion of the state also has wind patterns that are more directly in the path of transported air pollution than other parts of the state. Therefore, these counties can experience moderate or higher air quality as often as every one in four days during the summer. The summits of mountains (High Elevations) demonstrate a special case with a very high degree of transported pollution. During the summer or late spring, about two out of every 10 days can have moderate or USG air quality at high elevations. At high

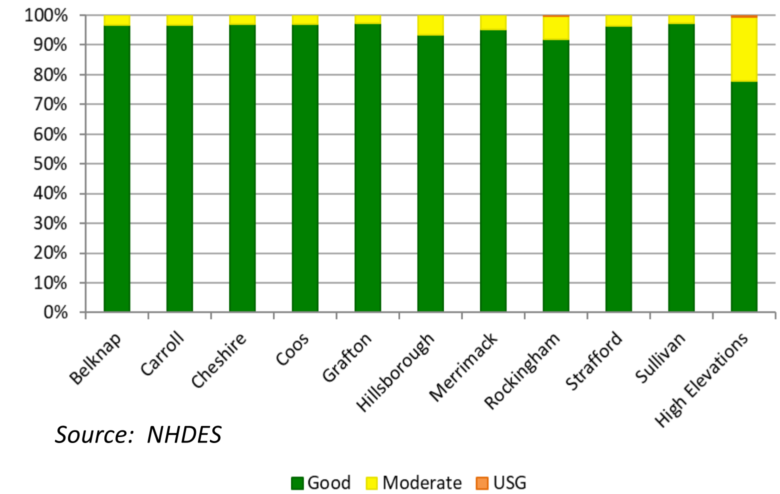
[9] *Transported contribution is estimated by air pollution modeling with the support of strategically located air monitoring stations in New Hampshire.*

altitudes, ozone and its precursor pollutants are able to travel unimpeded and build up over long distances, reaching the mountain summits at relatively high concentrations.

Spring (March-May) and Fall (September-November)

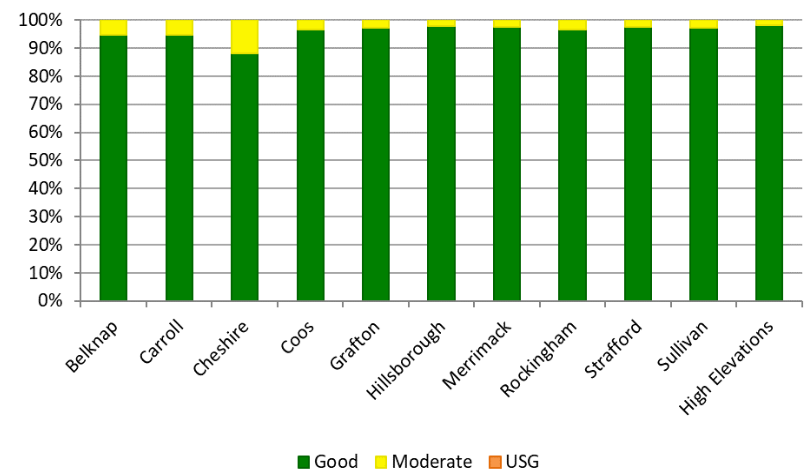
Air quality during spring and fall is very consistent throughout most of the state and presents some of the best air quality of the year (Figures 9 and 10). Days of moderate air quality in most areas of the state are usually the result of $PM_{2.5}$ from residential wood burning for heat, especially in the early spring and late fall. Conversely, ozone concentrations don't start reaching moderate thresholds or higher until late spring since ozone requires heat and sunlight to form. The lone ozone USG day in Rockingham County occurred in very late spring. While around 95% of the days have good air quality throughout the state, high mountain summits can be an exception. They can experience a high degree of interstate ozone transport as described above for the summer months, and on rare occasions, are impacted by ozone mixing down from the stratosphere.

Figure 9: Spring Air Quality Ratings by County, 2018-2020 (Percent of Days)



Source: NHDES

Figure 10: Fall Air Quality Ratings by County, 2018-2020 (Percent of Days)



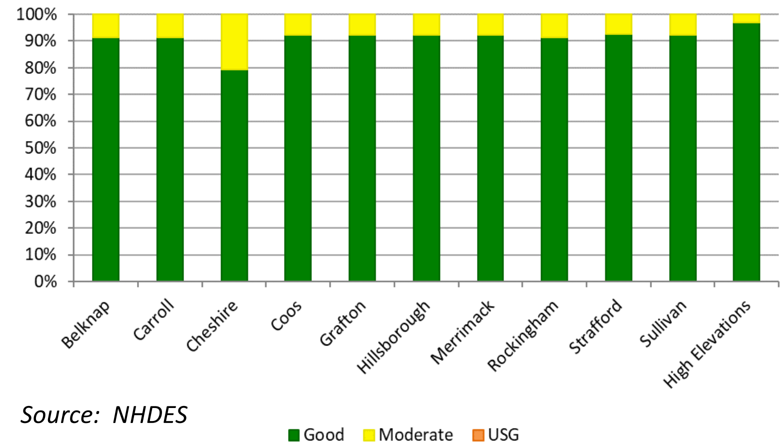
Additionally, leaves and other vegetation can absorb and remove ozone. However, in the early spring when the trees have not yet leafed out, even more of the transported ozone is able to arrive unimpeded at the mountain summits.

Air quality is often best in New Hampshire during the fall months when it gets too cold, and the sun's rays get too weak, for efficient ozone production but the air is not yet cold enough for residential wood heating.

Winter (December-February)

During the winter, residential wood heating in Keene causes about two out of every 10 days to experience moderate air pollution concentrations or higher (Figure 11). This is because the bowl-shaped valley of the Keene area can trap significant amounts of $PM_{2.5}$ in the community under certain weather conditions, specifically cold nights with temperature inversions. Residential wood burning can cause localized impacts that may not be directly measured by one of NHDES's monitoring devices.

Figure 11: Winter Air Quality Ratings by County, 2018-2020 (Percent of Days)



Source: NHDES

Key Point: COVID Air Quality Impacts

The COVID pandemic has reduced air pollution emissions throughout the world and in New Hampshire where vehicle counts (and vehicle emissions) are down from historical levels, especially during rush hours.

5.2 Health Standard Exceedances and Violations

To identify a violation of the NAAQS, EPA uses a calculated metric referred to as the design value (DV) that is then directly compared to the NAAQS (Table 4 on page 10). The form of the design value differs for each pollutant, but it normally does not represent a single year's maximum concentration. Instead, the design value is based on a statistical pattern of concentrations over multiple years (often three) within identified health exposure limits. The use of design values, as opposed to single maximum values, helps to prevent basing an area's nonattainment status on a single isolated incident, which may not reflect typical conditions over the season or year.

Table 5 provides measured air pollution summary data, including the calculated design values, at all New Hampshire monitoring locations from 2018 to 2020. For some pollutants, maximum concentrations are presented as well as a second value that directly relates to how the three-year design value is calculated. This can be the 4th highest concentration recorded during the year or a percentile (98th or 99th) which focuses on the highest 1 to 2% of measured daily maximum data (roughly the 8th or 4th highest concentration, respectively). The design values can then be compared to the relevant NAAQS (in red text) to determine if the area is in compliance.

Key Point: Exceedance vs. Violation of the NAAQS

When the level of the NAAQS is exceeded for a criteria air pollutant on any given day, it is referred to as an "Exceedance." When a multi-year pattern of a criteria air pollutant produces concentrations where the Design Value exceeds the level of the NAAQS, it is called a "Violation."

Table 5: 2018-20 Detailed Air Pollution Concentration Summary

	Camp Dodge (Mt Washington Base)	Concord	Keene	Laconia	Lebanon	Londonderry	Nashua	Pembroke	Portsmouth	Rye	Summit Mt Washington	Pack Monadnock
Ozone	***NAAQS: 70 ppb***											
'18-'20 DV 8-Hour	**53**	**56**	**54**	**53**	**53**	**59**	**58**	**--**	**55**	**63**	**60***	**59**
2020												
8-hr Max	56	62	55	58	56	64	67	--	64	67	62	63
8-hr 4th Max	52	55	50	53	50	56	55	--	53	60	58	58
2019												
8-hr Max	55	58	58	55	53	59	58	--	68	74	59	64
8-hr 4th Max	51	55	53	52	49	57	54	--	52	60	55*	57
2018												
8-hr Max	65	66	65	64	67	72	69	--	65	75	75	69
8-hr 4th Max	57	60	61	56	61	65	66	--	61	69	69	63
$PM_{2.5}$	***NAAQS: 35 µg/m³ (24-Hour) and 12 µg/m³ (Annual)***											
'18-'20 DV 24-Hour	**--**	**--**	**17**	**12**	**14**	**12**	**--**	**--**	**15***	**--**	**--**	**10**
'18-'20 DV Annual	**--**	**--**	**5.5**	**4.1**	**5.2**	**5.2**	**--**	**--**	**6**	**--**	**--**	**3.1**
2020												
24-hr Max	--	--	23.5	16.7	19.1	20.4	--	--	25.1	--	--	14.8
24-hr 98th %	--	--	18.3	10.2	13.5	12.8	--	--	15.9*	--	--	9
Annual	--	--	6.2	4.1	4.3	5.9	--	--	6.8	--	--	3
2019												
24-hr Max	--	--	25.5	23.2	16.5	15.1	--	--	24.6	--	--	12.2
24-hr 98th %	--	--	14.4	14.5	13.7	11.7	--	--	14.3*	--	--	9.5
Annual	--	--	4.8	3.6	4.9	4.7	--	--	6.2*	--	--	3
2018												
24-hr Max	--	--	27.9	17.7	17.9	15.6	--	--	20.6	--	--	14.3
24-hr 98th %	--	--	17.1	11.2	15.5	12.4	--	--	13.5	--	--	11.9
Annual	--	--	5.3	4.5	6.2	5	--	--	4.9	--	--	3.2
PM_{10}	***NAAQS: 150 µg/m³***											
'18-'20 DV[a] 24-Hour	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**39**	**--**	**--**	**--**
2020												
24-hr Max	--	--	--	--	--	24	--	--	39	--	--	--
2019												
24-hr Max	--	--	--	--	--	--	--	--	44	--	--	--
2018												
24-hr Max	--	--	--	--	--	--	--	--	34	--	--	--

-- Denotes no data or insufficient data collected at that site.

** Denotes insufficient data, presented for illustrative purposes only.*

[a] EPA rules define PM_{10} design values as the average number of exceedances per year over three years. However, to show New Hampshire's monitored values relative to the standard, PM_{10} values in this table are the maximum 24-hour averages over three years.

Source: NHDES, 2021

Table 5: 2018-20 Detailed Air Pollution Concentration Summary (Continued)

	Camp Dodge (Mt Washington Base)	Concord	Keene	Laconia	Lebanon	Londonderry	Nashua	Pembroke	Portsmouth	Rye	Summit Mt Washington	Pack Monadnock
SO_2	NAAQS: 75 ppb (Primary)											
'18-'20 DV 1-Hour	--	--	--	--	--	**3**	--	**19**	**10**	--	--	**2**
2020												
1-hr Max	--	--	--	--	--	4.8	--	28.8	15.4	--	--	1.5
1-hr 99th %	--	--	--	--	--	2	--	24	6	--	--	1
2019												
1-hr Max	--	--	--	--	--	5.8	--	53.6	17.5	--	--	2.3
1-hr 99th %	--	--	--	--	--	3*	--	19	10	--	--	1
2018												
1-hr Max	--	--	--	--	--	4.6	--	30.7	20.9	--	--	4
1-hr 99th %	--	--	--	--	--	4	--	15	14	--	--	3
CO	NAAQS (1-Hr): 35 ppm NAAQS (8-Hr): 9 ppm											
2020 DV 1-Hour	--	--	--	--	--	**0.5**	--	--	--	--	--	**0.4**
2020 DV 8-Hour	--	--	--	--	--	**0.4**	--	--	--	--	--	**0.3**
2020												
1-hr Max	--	--	--	--	--	0.6	--	--	--	--	--	0.4
8-hr Max	--	--	--	--	--	0.5	--	--	--	--	--	0.3
2019												
1-hr Max	--	--	--	--	--	0.5	--	--	--	--	--	0.2
8-hr Max	--	--	--	--	--	0.4	--	--	--	--	--	0.3
2018												
1-hr Max	--	--	--	--	--	0.5	--	--	--	--	--	0.3
8-hr Max	--	--	--	--	--	0.4	--	--	--	--	--	0.4
NO_2	NAAQS: 100 ppb											
'18-'20 DV 1-Hour	--	--	--	--	--	**20**	--	--	--	--	--	--
2020												
1-hr Max	--	--	--	--	--	24.7	--	--	--	--	--	--
1-hr 98th %	--	--	--	--	--	20.6	--	--	--	--	--	--
2019												
1-hr Max	--	--	--	--	--	33.6	--	--	--	--	--	--
1-hr 98th %	--	--	--	--	--	19.5	--	--	--	--	--	--
2018												
1-hr Max	--	--	--	--	--	27.9	--	--	--	--	--	--
1-hr 98th %	--	--	--	--	--	19.4	--	--	--	--	--	--

-- Denotes no data or insufficient data collected at that site.

** Denotes insufficient data, presented for illustrative purposes only.*

Table 6 summarizes all exceedances of NAAQS thresholds in New Hampshire since 2012 for three of the six criteria pollutants that have registered an exceedance during the period. As mentioned earlier, it is possible for an area to exceed the NAAQS and not violate it. An exceedance occurs when a single day's air quality exceeds the threshold of the standard while a violation occurs when the design value for the particular pollutant is above the NAAQS.

Table 6: Community Summary of NAAQS Exceedance Days, 2012-2020

Parameter/Primary Standard/Location	Number of Days with Exceedances									Most Recent
	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Ozone (8-Hour) Total	**14**	**6**	**4**	**9**	**6**	**5**	**5**	**1**	**0**	**2019**
Concord	0	0	0	**1**	0	**0**	0	0	0	2015
Keene	0	0	0	0	**1**	0	0	0	0	2016
Laconia	0	0	0	0	0	0	0	0	0	2010
Londonderry	**2**[a]	0	0	**1**	**1**	**1**	**1**	**1**	0	2019
Mt. Washington Summit	0	**2**[a]	0	**6**	**2**	**3**	**2**	0	0	2018
Nashua	**2**[a]	0	0	**1**	**1**	0	0	0	0	2016
Pack Monadnock Summit	**2**[a]	0	**1**[a]	**2**	**3**	**1**	0	0	0	2017
Portsmouth	**1**[a]	**1**[a]	0	**1**	0	0	0	0	0	2015
Rye	**1**[a]	0	0	**1**	**1**	**1**	**2**	0	0	2018
$PM_{2.5}$ (24-Hour) Total	**1**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2013**
Keene	**1**	**3**	0	0	0	0	0	0	0	2013
Laconia	0	0	0	0	0*	0*	0*	0	0	None
Lebanon	0*	0*	0*	0*	0*	0*	0*	0	0	None
Pack Monadnock Summit	0*	0*	0*	0*	0*	0*	0*	0	0	2002^
Pembroke	0	0	0	--	--	--	--	--	--	2010
SO_2 (1-Hour) Total	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2012**
Concord	0	0	0	0	0	0	0	0	0	2011
Londonderry	0	0	0	0	0	0	0	0	0	None
Manchester	--	--	--	--	--	--	--	--	--	2011
Pack Monadnock Summit	0	0	0	0	0	0	0	0	0	None
Pembroke	**1**	0	0	0	0	0	0	0	0	2012
Portsmouth	0	0	0	0	0	0	0	0	0	2008

[a] Denotes exceedance count based on the 2008 ozone NAAQS. Other ozone counts are relative to the 2015 ozone NAAQS.
[b] The 1-Hour SO_2 NAAQS was promulgated for the first time in 2010.
-- Denotes no data or insufficient data collected at that site.
**Denotes measured by FEM equipment; otherwise measured by FRM method.*
^Exceptional Event
Site comments: Includes all monitoring stations in operation since 2008. Manchester closed in 2012; Londonderry opened January 1, 2011; Concord station began SO_2 monitoring in 2011, Pembroke ($PM_{2.5}$) shut down in 2015

Key Point:
There have been no violations of the NAAQS in New Hampshire since 2011, when a portion of central New Hampshire violated the new 1-hour standard for SO_2. Historically, there have also been violations of the ozone and carbon monoxide NAAQS in the state (prior to 2011).

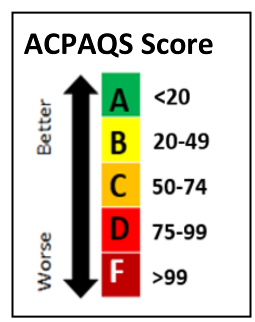
5.3 Adjusted Air Quality Score

As described earlier in Table 1 and Section 2, the ACPAQS is a value calculated by NHDES to comprehensively assess annual anthropogenic air pollution in the state. It calculates an air pollution exposure score by considering hourly and daily measured air pollution concentrations over the full year, as well as the frequency of days exceeding the thresholds for moderate, USG, and unhealthy AQI classifications. This differs from the AQI which is a short term, or daily metric. The ACPAQS uses a scale that starts at zero, indicating natural concentrations, and increases with increasing ozone and $PM_{2.5}$ concentrations. Lower scores and lower moderate/USG/unhealthy day counts represent cleaner air. In the ACPAQS, $PM_{2.5}$ and ozone are considered since they are the most common air pollutants in the state. $PM_{2.5}$ concentrations are given more weight to account for the higher rates of health impacts compared to ozone. The ACPAQS considers daily 24-hour $PM_{2.5}$ concentrations on a rolling clock basis whereas the official NAAQS records considers only 24-hour average concentrations occurring from midnight-to-midnight. As a result, the ACPAQS typically counts more moderate days (and to some degree more USG days) than the NAAQS calculation.

Table 7 below summarizes multi-pollutant ACPAQS scoring by county for each of the most recent three years (2018, 2019, and 2020). The ACPAQS score is highlighted using coloring similar to the AQI where green is desirable and warmer colors represent increasing air pollution levels. Counts by category of moderate, USG and unhealthy are provided along with a partial calculated ACPAQS for the pollutant.

Table 7: ACPAQS Combined Scoring for New Hampshire Counties (2018 – 2020)

	Belknap	Carroll	Cheshire	Coos	Grafton	Hillsborough	Merrimack	Rockingham	Strafford	Sullivan	High Elevations	Sea Coast
2020												
# Days Moderate	17	17	47	44	16	46	45	53	43	16	42	53
# Days USG	0	0	0	0	0	0	0	0	0	0	0	0
# Days Unhealthy	0	0	0	0	0	0	0	0	0	0	0	0
Score	9.3	9.3	22.6	20.1	8.8	20.7	20.7	22.2	20.1	8.8	20.7	22.2
Grade	A	A	B	B	A	B	B	B	B	A	B	B
2019												
# Days Moderate	23	23	27	23	21	16	18	28	22	21	19	28
# Days USG	0	0	0	0	0	0	0	1	0	0	0	1
# Days Unhealthy	0	0	0	0	0	0	0	0	0	0	0	0
Score	12.1	12.1	13.6	12.2	11.4	8.4	8.7	15.3	11.8	11.4	8.4	22.3
Grade	A	A	A	A	A	A	A	A	A	A	A	B
2018												
# Days Moderate	59	59	68	36	58	46	38	44	36	58	59	40
# Days USG	0	0	0	0	0	0	0	2	0	0	2	2
# Days Unhealthy	0	0	0	0	0	0	0	0	0	0	0	0
Score	25.4	25.4	29.4	17.0	25.2	17.8	16.2	22.3	17.4	25.2	21.2	22.3
Grade	B	B	B	A	B	A	A	B	A	B	B	B



Note: Moderate day counts are highlighted in yellow if they exceed 50 days and orange if they exceed 75 days. USG day counts are yellow for 1-3 days and orange for 4-7. Unhealthy day counts are orange for 1-3 days and red for more than 3 days.

ACPAQS Scores below 20 are considered good overall and rarely have USG or unhealthy day counts. Scores between 20 and 50 have a higher degree of moderate days and up to 3 days of USG or unhealthy day counts. Scores above 50 have an even higher degree of moderate, USG, or unhealthy day counts and are at risk for violating federal clean air standards. As shown in the table, 2018 had a majority of locations within New Hampshire with an ACPAQS grade B and a few locations with an A. 2019 had fewer days with moderates or above and therefore most locations had an ACPAQS grade of A. 2020 had similar scoring compared to 2018 even with no reported exceedances due to higher numbers of moderate days. Though lower emission levels in the beginning of the COVID-19 pandemic may have contributed some to the lack of exceedances, there were still many days where New Hampshire saw moderate levels of air pollution.

6. Attainment Status

"Attainment status" is a federal designation of whether air quality in a state, or area therein, meets the NAAQS. As described in Section 4, geographic areas where air quality meets the NAAQS are in "attainment" and those where air quality is above the NAAQS are in "nonattainment." If an area is designated as "nonattainment," states must develop a State Implementation Plan (SIP), that details how the state plans to attain, and then maintain, the NAAQS. In the past, portions of New Hampshire have been designated nonattainment for the 1971 CO standard, the 1979 1-hour and 1997 8-hour ozone standards, and 2010 SO_2 standard. New Hampshire developed a SIP for each one of these nonattainment scenarios and now **New Hampshire's air quality meets all federal standards and is designated attainment for each NAAQS[10].**

Key Point:
All portions of New Hampshire currently meet the national ambient air quality standards.

7. Measured Air Pollution and Estimated Emission Trends

7.1 Measured Air Pollutant Trends in New Hampshire

Air pollution trends in New Hampshire show that air quality has improved significantly over recent decades.

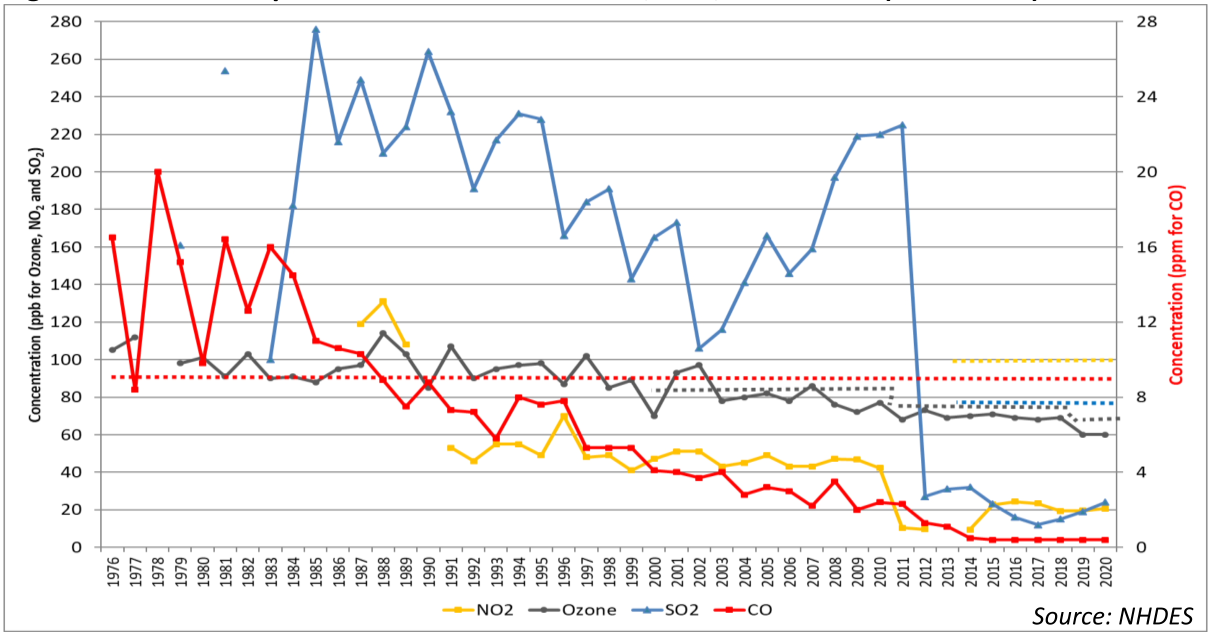
7.1.1 Criteria Air Pollutants

In the past, measured CO, ozone, NO_2, and SO_2 concentrations were substantially higher in the state than they are now (Figure 12). The four colored solid lines represent the annual maximum measured concentration of each of the pollutants. The dotted lines represent the NAAQS for the

[10] Refer to Table 8 "New Hampshire 2019 Attainment Status" in the State of the Air Report 2019 Update for previous nonattainment and current maintenance areas in New Hampshire for carbon dioxide, ozone and sulfur dioxide.

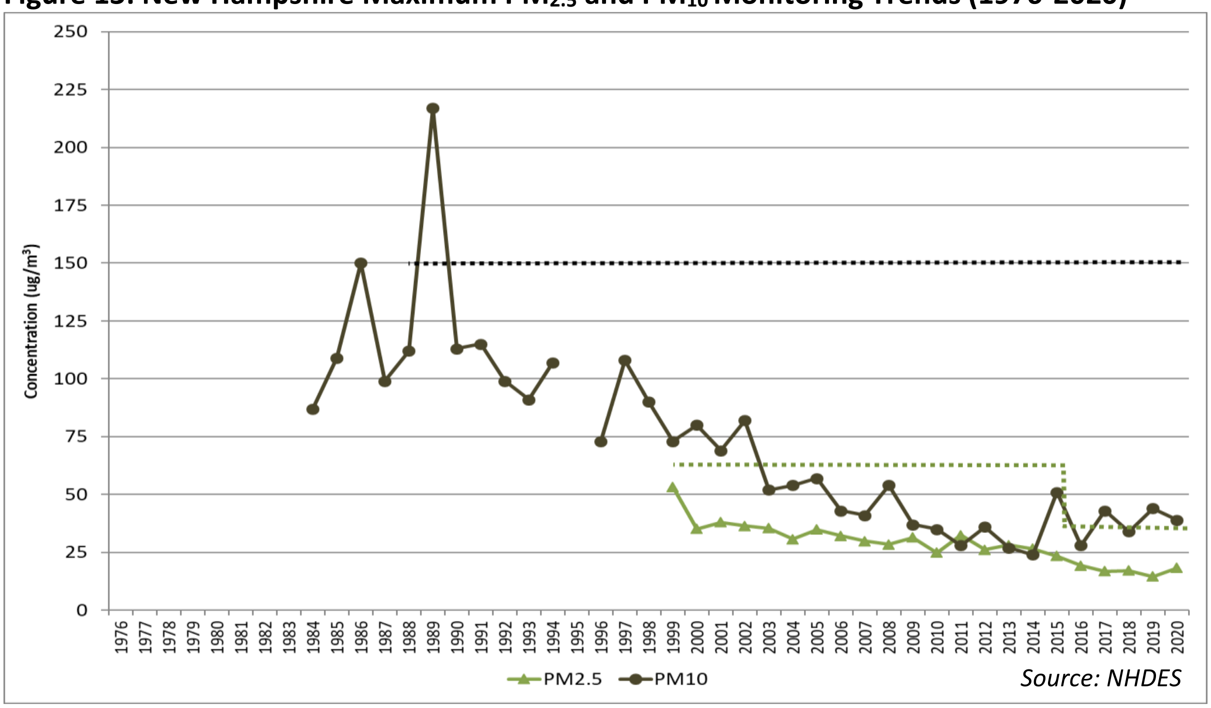
pollutant in corresponding color. $PM_{2.5}$ and PM_{10} monitoring trends are shown separately in Figure 13.

Figure 12: New Hampshire Annual Maximum CO, NO_2, O_3 and SO_2 (1976-2020)



Notes: CO (2nd maximum 8-hour), NO_2 (98th percentile 1-hour), Ozone (4th maximum 8-hour), SO_2 (99th percentile 1-hour). Health standards are indicated by dashed lines of corresponding color.

Figure 13: New Hampshire Maximum $PM_{2.5}$ and PM_{10} Monitoring Trends (1976-2020)



Notes: $PM_{2.5}$ (98^{th} percentile 24-hour) and PM_{10} (maximum 24-hour). Health standards are indicated by dashed lines of corresponding color.

There are many other emission reductions implemented by New Hampshire that have helped to reduce measured air pollution in the state. But it's not only New Hampshire's emission reductions that have benefited the state. Large quantities of ozone forming emissions often originate from regions to the south and southwest of New Hampshire and enter the state by long-range pollution transport. These transported emissions can mix with local emissions to create ozone when sufficient sunlight and heat is present to drive the chemical reaction. By their participation and membership in organizations such as the Ozone Transport Commission (OTC), the Mid-Atlantic/Northeast States Visibility Union (MANE-VU) and Northeast States for Coordinated Air Use Management (NESCAUM), New Hampshire and other Northeast and Mid-Atlantic states have had a successful track record for reducing criteria pollutant and precursor emissions over the region, resulting in steady ozone and $PM_{2.5}$ decreases over the last decade.

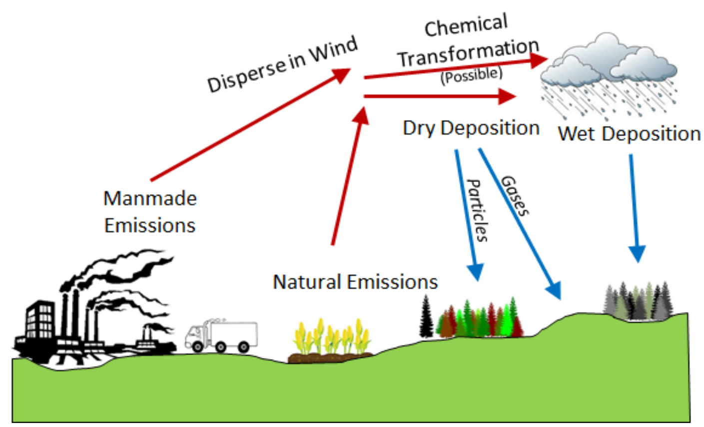
7.1.2 Air Toxics

In addition, air toxics measured in New Hampshire saw a steady decrease from 2001 to 2007 when a regular monitoring program was in place in New Hampshire. Monitoring for ambient air toxic pollutants was discontinued after 2008 and replaced with "as needed" monitoring. Emissions for toxic air pollutants continue to be tracked to ensure public safety, and if significant changes are noted, monitoring could return.

7.1.3 Deposition

Virtually all air pollutants deposit onto ground and water surfaces to some extent, either through wet or dry deposition. Wet deposition occurs when pollutants are washed out of the atmosphere by rain, snow, or fog. Dry deposition occurs when pollution is directly deposited onto the surface by gravity (Figure 14).

Figure 14: How Deposition Forms



Acid rain falls in the form of nitric (HNO_3) and sulfuric (H_2SO_4) acids hundreds to thousands of miles downwind.

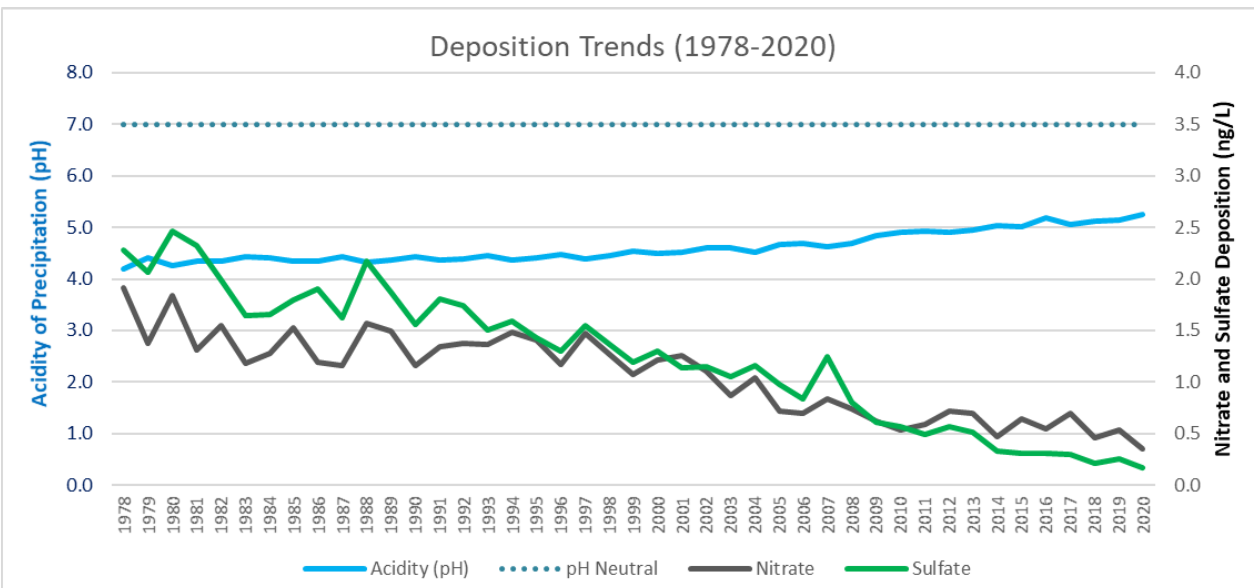
Though commonly known as acid rain, the more accurate term for this process is acid deposition since acids can deposit in more forms than just rain. The most significant contributors to acid deposition are SO_2 and nitrogen oxides (NO_x). Other compounds such as mercury and perfluorinated compounds have been found to deposit and affect the food chain and water quality; this includes per- and polyfluoroalkyl substances (PFAS) (perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA)).

Efforts have been ongoing for decades to reduce acid deposition. Lakes and streams in the Northeast were found to be acidified as a result of the low pH values of precipitation in the region which is lethal to vegetation and wildlife. Beyond acids, deposited nitrogen compounds can affect watersheds and mercury can affect the food chain. A small amount of deposited nitrogen can act as a natural fertilizer, but large amounts can lead to algae blooms, which can deplete oxygen dissolved in the water, suffocating fish.

Mercury reaches surface waters primarily through wet and dry atmospheric deposition. Once in the watershed, mercury can convert into toxic methylmercury, which is consumed by fish and bioaccumulates over time. When contaminated fish are consumed, the methylmercury is passed along to the consumer, adding to their bioaccumulation. Since people eat fish, this is a human health concern. Mercury emissions in New Hampshire and the United States has declined in recent years, which has resulted in lower mercury deposition rates in New Hampshire. Unfortunately, worldwide emissions of mercury are increasing, and some of those emissions can make their way into the United States. This could slow improvements in our region. Unfortunately, due to years of mercury deposition, New Hampshire still has a state-wide fish consumption advisory due to mercury levels measured in fish caught in the state.

In New Hampshire, acid, nitrogen and sulfur deposition has been officially tracked since 1978 and is shown in Figure 15. Both nitrogen and sulfur deposition have decreased by about 50% over the last 25 years. Acidity, measured by pH, shows a slow return in the direction of a neutral value of 7.0. Therefore, the upward trend of the blue line in Figure 15 is a positive indicator that acidity is being reduced.

Figure 15: Annual Average Nitrate and Sulfate Deposition and Precipitation Acidity at Hubbard Brook Experimental Forest in Woodstock, NH, 1978-2020

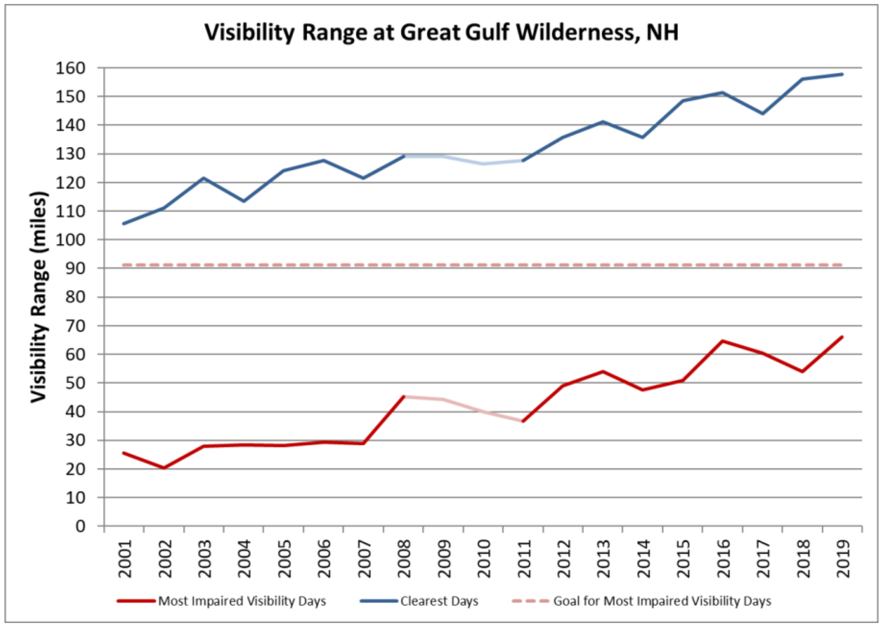


Source: NADP and NHDES

7.1.4 Regional Haze

Haze is an atmospheric phenomenon caused by particle pollution and it obscures views in scenic areas. The most significant haze-causing pollutants in the Northeast are sulfates (e.g., ammonium sulfate) and organic carbon. These pollutants may originate far away from the areas where they ultimately degrade visibility. Haze is of special concern in ecologically sensitive and scenic areas, such as the Class I national parks and wilderness areas. In New Hampshire, this includes the Great Gulf Wilderness and the Presidential Dry River Wilderness, both of which surround Mt. Washington. The red dotted line in Figure 16 indicates the long-term visibility goal included in the federal Regional Haze Rule for Great Gulf is for at least 90 miles of visibility for the most impaired days (solid red line). The federal Regional Haze Rule is a nation-wide effort to reduce haze and the Interagency Monitoring of Protected Visual Environments (IMPROVE) program tracks visibility and visibility-reducing pollutants in these areas. The Regional Haze Rule provides location-specific visibility goals to be reached by the year 2064.

Figure 16: Visibility Trend for Great Gulf Wilderness near Mt Washington



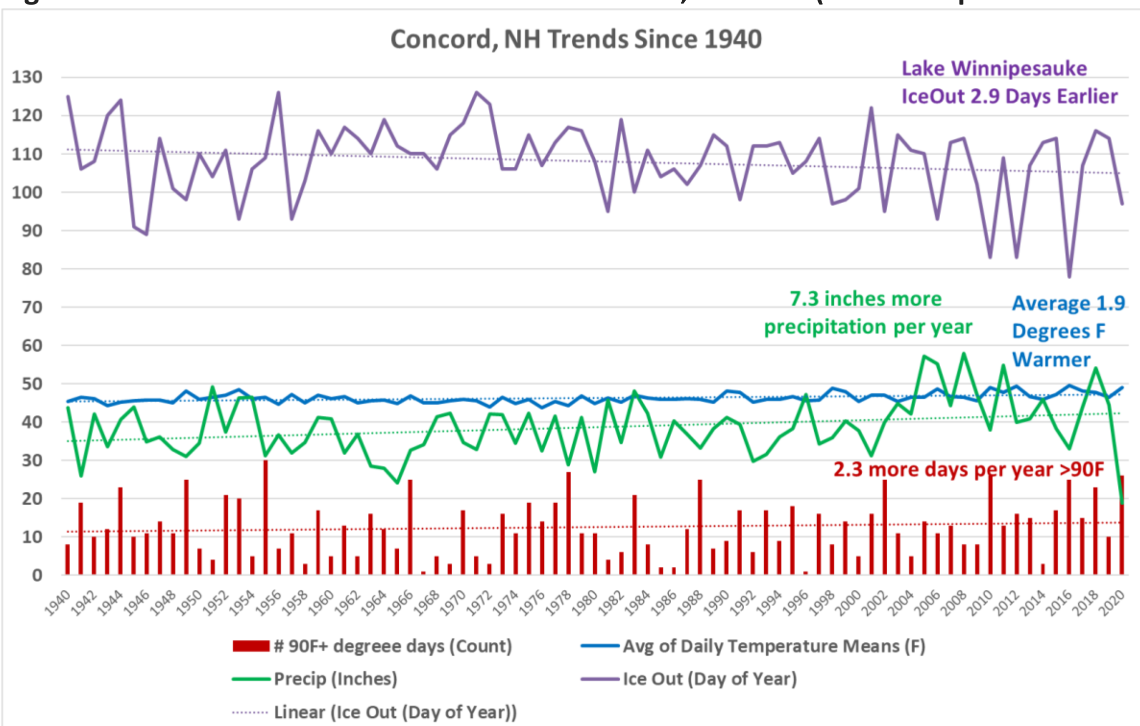
Note: IMPROVE Data for 2009 and 2010 does not meet completeness requirements. Most Impaired Days refer to the dirtiest, or haziest, days of the year.

Monitoring in New Hampshire indicates that visibility is improving and that recent efforts to reduce air pollution levels have been working. New Hampshire tracks visibility daily and separates the data into clearest days, defined as the cleanest, or least hazy days, and most impaired days, defined as the dirtiest, or haziest days. Energy generation trends have helped the effort significantly. Lower natural gas prices and increasing use of clean, renewable energy sources have offset electricity generation from coal burning power plants. The increase in visible distance on both most impaired days and clearest days are positive indicators that visibility range is increasing and therefore regional haze levels are decreasing.

7.1.5 New Hampshire Climate Indicators

Historical temperature and precipitation is available for the Concord National Weather Service station at Concord Airport. Summarizing this data unveils distinct trends showing changes over an 80-year period since 1940 including: daily average temperatures increasing by about 1.9 degrees (F), an average of 2.3 more days per summer exceeding 90 degrees (F), about 7.3 inches more precipitation per year, and ice-out on Lake Winnipesaukee is now about 3.7 days earlier on average. Sea Level has been measured continuously at Portland, Maine, Casco Bay since 1912 and shows about an 8.4-inch rise over the 108-year period.

Figure 17: Climate Indicator Trends for the Concord, NH Area (2020 Compared to 1940)



7.2 Emission Trends in New Hampshire

The progress made in reducing measured air pollution in New Hampshire is the direct result of a decades-long effort to reduce emissions. Pollution reduction requirements typically include application of add-on controls, switching to cleaner fuels, operational limitations and/or complying with emissions caps established under market-based emission trading programs.

In New Hampshire, air pollution reduction requirements have been implemented through a variety of federal and state air quality regulations and pollution control programs. Some of these regulations and control programs are directed at **stationary sources**, including power plants and factories; others pertain to **mobile sources**, such as cars and trucks; some to **non-road sources** such as boats, trains, airplanes and construction vehicles; and some cover **other source categories**. Table 8 presents emission reductions of these categories achieved between 1990 and 2020 for NOx, SO_2, VOCs, CO, and particulate matter. Note the slower progress in reducing emissions of particles, especially the smaller $PM_{2.5}$. Much of the particle emissions come from residential wood burning for heat. Emission reductions for these pollutants between

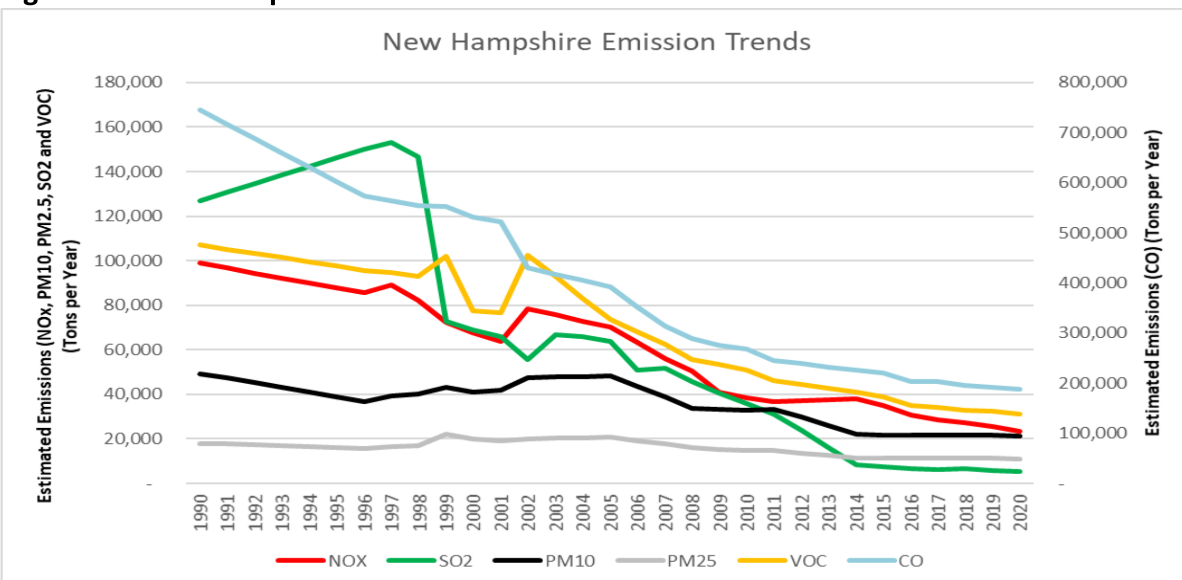
1990 and 2020 are presented graphically in Figure 17 for New Hampshire and Figure 18 for the nation.

Table 8: Estimated 2020 Emission Reductions Since 1990

	NOx	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$
New Hampshire	76%	96%*	71%	75%	57%	38%
National	68%	91%	31%	59%	39%	25%

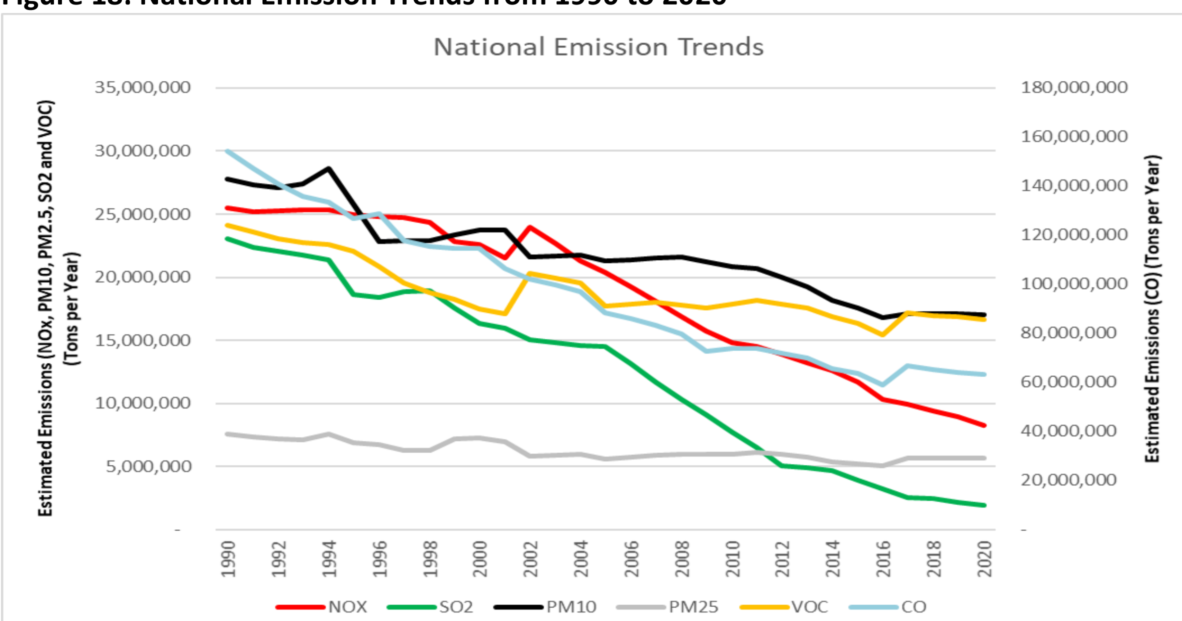
**Since 1997* *Source: EPA and NHDES, 2021*

Figure 17: New Hampshire Trends from 1990 to 2020



Source: EPA and NHDES, 2021

Figure 18: National Emission Trends from 1990 to 2020

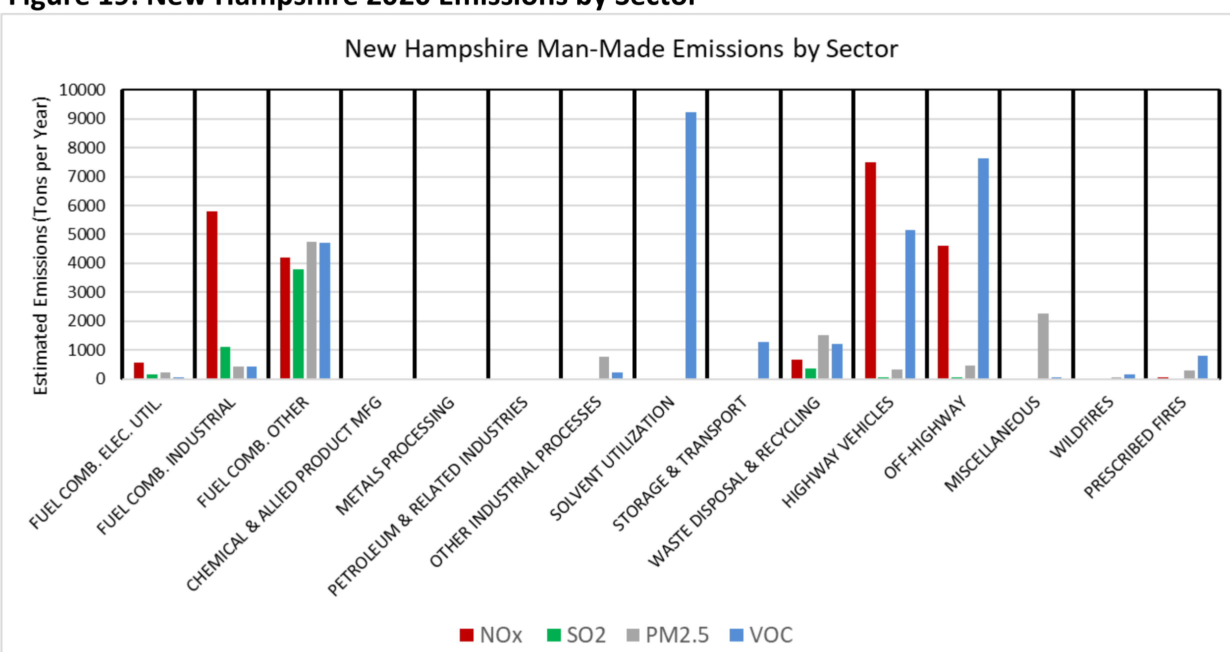


Source: EPA and NHDES, 2021

Improvements in mobile source fuel economy, changes in gasoline consumption, and more comprehensive vehicle inspections have helped to reduce emissions of CO, NOx, VOCs and greenhouse gasses. Emissions controls and better operational practices on power plants and large emitting industries have reduced emissions of NOx, SO_2 and greenhouse gasses and cap and trade programs have enabled faster and lower cost emissions reductions for large power plants. Emission trading programs include the Acid Rain Program, the NOx SIP call, the Clean Air Interstate Rule, the Cross-State Air Pollution Rule, and the Regional Greenhouse Gas Initiative (RGGI). The Regional Haze Rule has also helped to reduce emissions of SO_2, NOx and PM (PM_{10} and $PM_{2.5}$) from large stationary emission sources. Modification to gasoline, solvents, and paints have helped to substantially reduce emissions of VOCs, especially in the Northeast and New Hampshire.

Emission source type information for New Hampshire's anthropogenic (i.e., human-caused) NOx, SO_2, $PM_{2.5}$, and VOC emissions are shown in Figure 19. The vast majority of the NOx emissions are emitted by vehicles (on-, and off-highway). Burning of fuels for electricity generation and industrial activities produce the next largest category of NOx emitters. Home and commercial fuel combustion for heat, lawn and yard maintenance, etc., make up the third largest category of NOx emitters. New Hampshire SO_2 emissions are overwhelmingly from just a few emission categories. Residential and commercial heating with oil dominates the SO_2 emitting sectors. Industrial, electric generation, and waste combustion are the remaining significant SO_2 emitting sectors. $PM_{2.5}$ emissions in New Hampshire come from a wide variety of emission sources, but is dominated by residential wood combustion during colder months for heating purposes. Additional sources of $PM_{2.5}$ emissions include fuel combustion, industrial processes and fugitive/frictional activities. VOC emissions are primarily from mobile sources, solvent usage and fuel combustion, especially for 2-stroke engines.

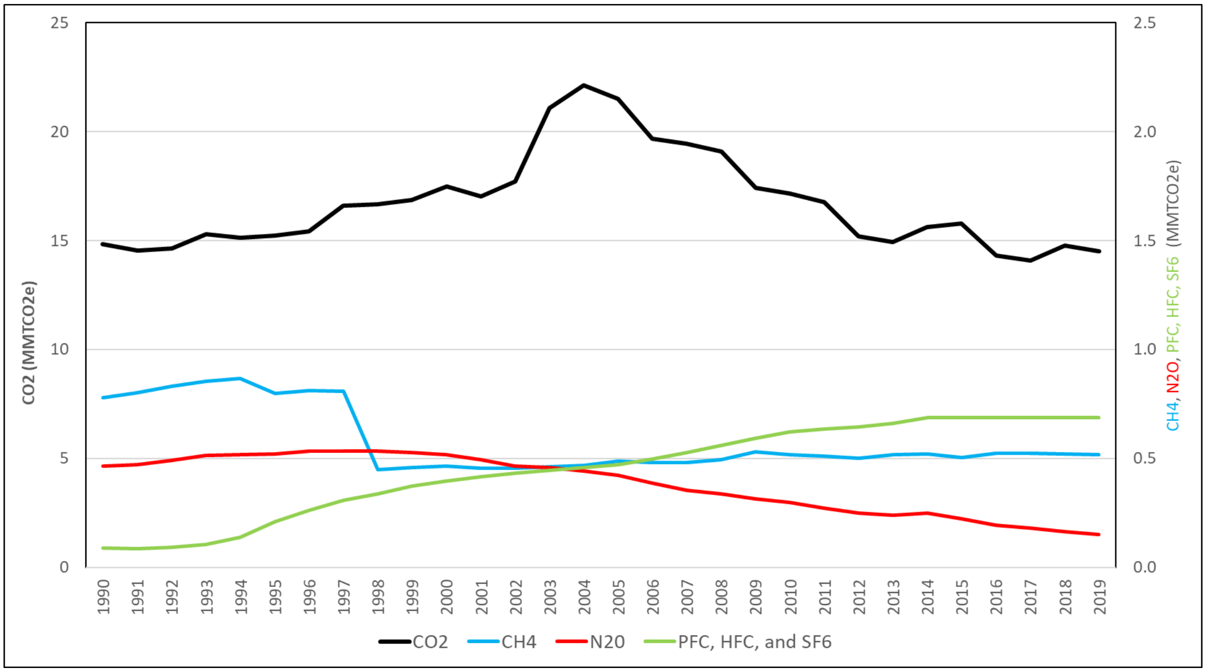
Figure 19: New Hampshire 2020 Emissions by Sector



Source: EPA and NHDES, 2021

Figure 20 shows New Hampshire greenhouse gas emissions from 1990 through 2019. Methane (CH_4) and nitrous oxide (N_2O) have declined since base year (1990) while carbon dioxide (CO_2) peaked in the state around 2004/2005 but remains relatively unchanged from baseline. Perfluorocarbons (PFC), hydrofluorocarbons (HFC), and sulfur hexafluoride (SF_6) are groups of fluorinated gases originating from human-related activities.

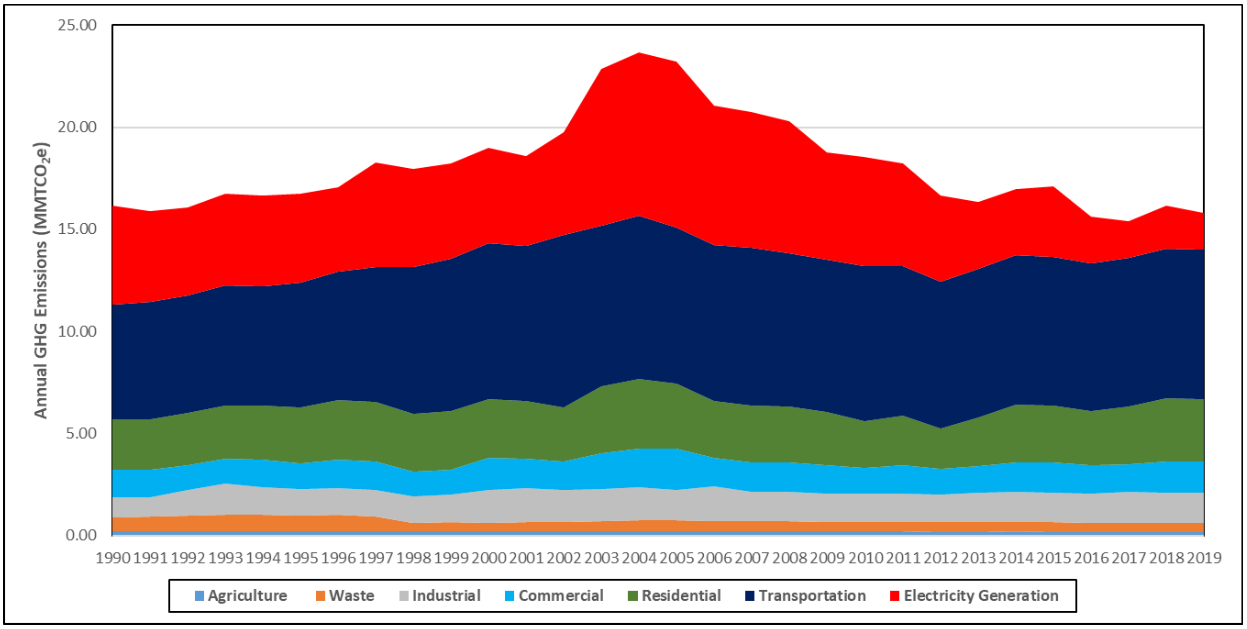
Figure 20: New Hampshire Greenhouse Gas Emission Trends by Pollutant from 1990 to 2019



Data Source: NHDES Analysis based on 2019 NH GHG Emissions Inventory: US Energy Information Administration, EPA Data, RGGI Inc.; Subject to revision. August 2021. https://www.des.nh.gov/climate-and-sustainability/climate-change/greenhouse-gas

Figure 21 presents greenhouse gas emissions from 1990 through 2019 by major emission sector. Compared to base year (1990), total greenhouse gas emissions are virtually unchanged in 2019. Compared to peak emissions in 2004/2005, emissions have fallen more than 30%. Electric sector greenhouse gas emissions (top/red) have fallen nearly 74% since 2005. Other sectors declined through 2011, and have remained flat or begun rising. Transportation is the largest source sector.

Figure 21: New Hampshire Greenhouse Gas Emission Trends by Emission Sector from 1990 to 2019



Data Source: NHDES Analysis based on 2019 NH GHG Emissions Inventory: US Energy Information Administration, EPA Data, RGGI Inc.; Subject to revision. August 2021. https://www.des.nh.gov/climate-and-sustainability/climate-change/greenhouse-gas

8. Conclusion

In 2020, New Hampshire was fortunate to enjoy a majority of good air quality days. There were no reported exceedances of the NAAQS for any pollutant during 2020, which has never happened in the 45-year history of NHDES' recordkeeping. This outstanding news can be credited to nearly 30 years of research, regulation and air pollution control implementation in the United States. However, emission reductions during the beginning of 2020 were unique due to the COVID-19 pandemic, which may have contributed to the lack of exceedances in addition to meteorological conditions that were not conducive to pollution build-up and transport. Air pollution concentrations in New Hampshire are down by 70% to over 90% from levels measured in the late 1970s and early 1980s. Emissions of the most common air pollutants in New Hampshire are down between 38% and 96% from 1990 levels.

New Hampshire air quality improvements have out-paced improvements seen in other portions of the country. These improvements can be attributed to factors such as strict regulation of certain pollutants in the Northeastern Ozone Transport Region, energy efficiency from programs such as RGGI, emissions reductions from the federal acid rain program, and upwind states improving their own air quality to help benefit downwind states like New Hampshire.

New Hampshire met all six criteria air pollutant requirements in 2020 in all portions of the state. Even though all areas of the state are currently meeting the health standards, some areas of the state still experience occasional days when one or more air pollutants exceed or are forecasted to exceed the level of the health standard. When exceedances are forecasted, NHDES issues an Air Quality Action Day for public protection and to advise on how to reduce emissions of air pollution.

Meeting federal health standards, as required under the federal CAA, is important for the protection of public health. It reduces physician and hospital visits, improves work and school attendance and productivity, and reduces air pollution related mortality. Ensuring current heath standards are met and eliminating the remaining Air Quality Action Days in New Hampshire could provide additional health valuation benefits, an average of $1.6 million per year based on the past five years. Should the air quality get even cleaner than currently required, there will be additional benefits, up to $3 billion per year in health-related benefits based on modeling.

The air quality outlook in New Hampshire over the next 10 years looks promising. NHDES anticipates that air pollution trends will continue to improve in most cases throughout the state. Year-to-year weather variability, transport patterns, and the economic variability in fuel costs and consumption will likely cause some intermittent increases, but long-term regulation and commitments promise continued long-term improvement. Ultra-long-range transport from other countries along with the likelihood of increasing global temperatures presents concerns and creates uncertainty over the long-term, especially at higher elevations in the state, however, indications are that New Hampshire will continue to benefit from increasingly cleaner and healthier air over the next decade.

COMMONLY USED ACRONYMS

ACPAQS	Adjusted Criteria Pollutant Air Quality Score
AQI	Air Quality Index
ARD	Air Resources Division
CAA	Clean Air Act
CO	Carbon monoxide – a criteria pollutant
DV	Design Value (a measure of multi-year compliance with a clean air standard)
EPA	U.S. Environmental Protection Agency
GHG	Greenhouse Gases
H_2SO_4	Sulfuric Acid
HNO_3	Nitric acid
IMPROVE	Interagency Monitoring of Protected Visual Environments
NAAQS	National Ambient Air Quality Standard
NADP	National Atmospheric Deposition Program
NHDES	New Hampshire Department of Environmental Services
NO_2	Nitrogen Dioxide – a criteria pollutant
NOx	Nitrogen oxides of multiple oxidation levels – usually used as a measure of emissions
O_3	Ozone, a chemically reactive air pollutant – a criteria pollutant
OTR	Ozone Transport Region
PFAS	Per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
pH	Acidity measure based on the number of free hydrogen radicals
PM	Particulate Matter
PM_{10}	Particulate Matter smaller than 10 microns in diameter – a criteria pollutant
$PM_{2.5}$	Particulate Matter smaller than 2.5 microns in diameter – a criteria pollutant
Pb	lead
ppb	parts per billion, a measure of concentration (by volume for air pollutants)
ppm	parts per million, a measure of concentration (by volume for air pollutants)
RGGI	Regional Greenhouse Gas Initiative
s	second
SIP	State Implementation Plan
SO_2	Sulfur Dioxide – a criteria pollutant
SO_x	Sulfur oxides of multiple oxidation levels – usually used as a measure of emissions
tpy	tons per consecutive 12-month period
$\mu g/m^3$	Micrograms per cubic meter – a measure of concentration
USG	Unhealthy for sensitive groups
UV	Ultraviolet (radiation), a type of light from the sun
VOCs	Volatile Organic Compounds