Chicago Metropolitan Agency for Planning

GO TO 2040

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Air Quality

CMAP Regional Snapshot

About this Snapshot…

Understanding regional air quality is important, as it affects our health, economy, and environment. The seven-county metropolitan Chicago region is in "nonattainment" with federal standards, meaning that air pollution levels do not meet Clean Air Act standards intended to protect human health. Recent years have seen improvement, however, and numerous partners across the region and the state have done much good work to quantify and improve air quality. One role of this snapshot is to compile that quantitative information on a regional scale and to describe those efforts.

This report will contribute to the *GO TO 2040* comprehensive regional plan for metropolitan Chicago, which will identify needed policies, strategies, and investments for our region. As a part of the *GO TO 2040* planning process, a Regional Vision was adopted, representing a set of shared values expressed through a comprehensive public participation process. Because air quality is specifically identified in the Regional Vision as an important aspect of protecting the environment, understanding its causes and effects at the regional level is essential to the *GO TO 2040* plan.

Air quality will also be used as an indicator to understand how the *GO TO 2040* plan's development scenarios will impact the environment. Various transportation options, patterns of development, and other policies and strategies will have differing impacts on the health and prosperity of the region. CMAP and its partners will evaluate these differences by using several indicators — one of which is air quality — to fully understand their impacts on the region.

Please note that this report does not directly address greenhouse gas emissions, including carbon dioxide. CMAP has other work underway to address this important issue.

In addition to this report, a more detailed technical document on air quality is available at http://www.cmap.illinois.gov/aq_tech_report/.

Why Air Quality Matters

The quality of the air is arguably one of the most important components of life. Air pollution can hinder normal activity and cause severe health impairment; it can damage trees, crops, and other plants and animals; it can impact water quality and obstruct vistas. Regulations governing air quality play a role in where industries locate, how much energy is used, how we travel and how our transportation systems grow. Air quality is integrated into daily life. It also exemplifies an issue that crosses jurisdictional boundaries, both on a local scale within the northeastern Illinois region, as well as a larger scale with our neighboring states and countries.

As important as it is, air quality is not easily measured or predicted — it represents a complex interaction between natural climate and weather patterns and human actions. Therefore, the goal of this snapshot report is to understand the current conditions of air quality in northeastern Illinois, including exploring related impacts and regulations, and potential next steps for promoting air quality improvement.

Standards

Northeastern Illinois is in nonattainment for two air pollutants — ground-level ozone, also known as smog, and fine particulate matter (PM2.5), such as soot. If a region is in nonattainment, it means that it doesn't meet National Ambient Air Quality Standards, standards set by the Clean Air Act to help mitigate air pollution. The following are the standards for these two pollutants.

Ozone

The standard for ozone is 0.075 parts per million (ppm). This is measured on an 8-hour average. If an ozone monitor records an 8-hour average value above 0.075 ppm, it is considered an exceedance. But this is different than a violation. A monitor is not considered in violation until the 3-year average of 4th highest daily maximum is above the standard.

Fine Particulate Matter (PM2.5)

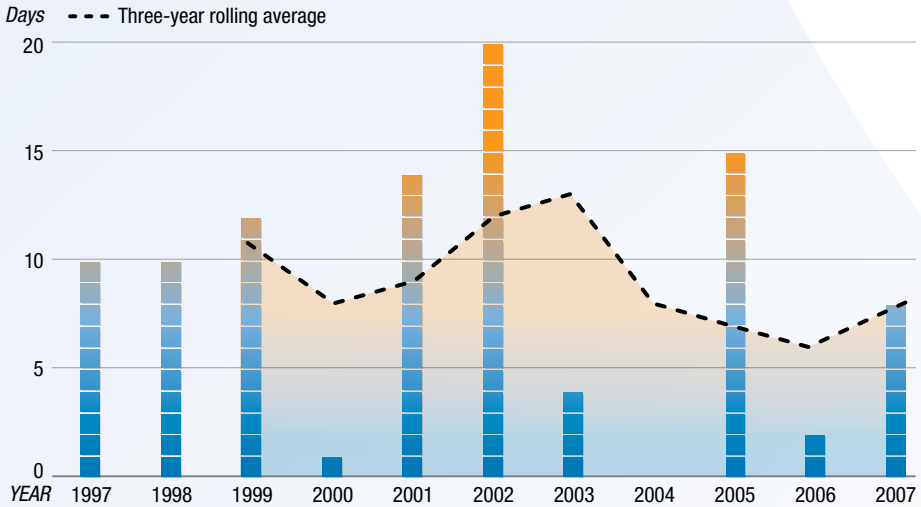
There are two standards for PM2.5, an annual standard and a daily standard. A monitor must not exceed a mean of 15 $\mu g/m^3$ annually, or 35 $\mu g/m^3$ daily, otherwise it is in violation.

The Illinois Environmental Protection Agency and the United States Environmental Protection Agency monitor ozone and PM2.5 for the purposes of meeting the standards, and are focused on violations as the measurement to track progress. But in order to also get a picture of "every-day" conditions, not just when violations occur, this snapshot reviews the data in a variety of ways, including exceedances (not all of which constitute a violation) and averaged data across all regional air quality monitors.

Ozone

To understand "every-day" ozone levels, data from all monitors across the region was analyzed. The chart below represents the total number of exceedances across all monitors in the region per year. An exceedance doesn't necessarily constitute a violation (according to the federal standards), but this gives a rough idea of regional ozone. The dotted line represents the 3-year rolling average, and shows a decrease in exceedance days over time.

Total Number of Ozone Exceedance Days

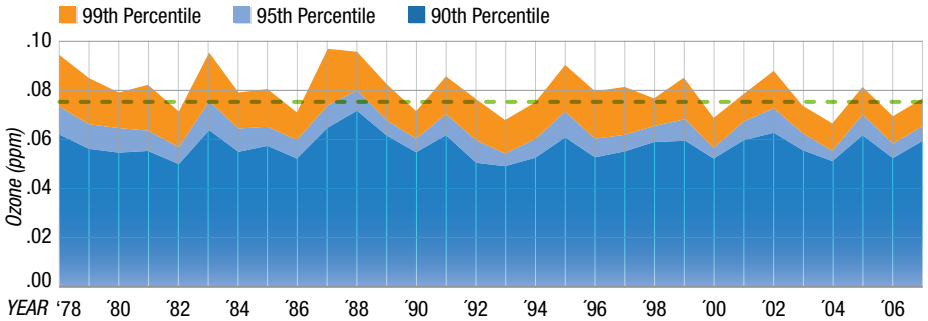


Source: U.S. Environmental Protection Agency Air Quality System Database

Although helpful, exceedance data only shows the number of times a monitor exceeded the standard; it doesn't reveal ozone pollution on a day-to-day basis. To do this, all the ozone levels from all the region's monitors were averaged, going back to 1978. However, a simple average has some key flaws, most important of which is that ozone formation is affected by different photochemical processes during different weather conditions. But trying to understand these complex processes is a research issue beyond the scope of this snapshot.

Therefore, rather than use the mean ozone level of all the region's monitors, data was analyzed for three higher ozone levels — the 90th, 95th, and 99th percentiles — of all the monitors. These percentiles represent the worst 20, 10, and 2 days per year respectively for this region. This data is shown in the chart below. It reveals that the worst 2 days each year, the 99th percentile, are usually above the standard, underscoring the region's nonattainment status. But perhaps a more interesting story is that the regional average's worst 10 days per year are in the range of values considered when the 8-hour ozone standard was most recently updated, and the worst 20 days per year periodically reach that range. (The dashed green line represents 0.075 ppm, the standard.)

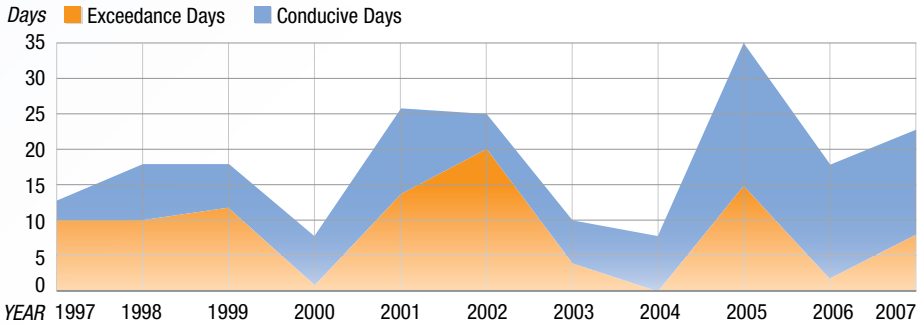
Ozone Concentration on Worst Two, Ten and Twenty Days of the Year



Source: U.S. Environmental Protection Agency Air Quality System Database

It is important to point out that ozone levels are highly related to weather. IEPA tracks "ozone conducive days" — days when weather patterns favor the chemical reaction that creates ozone from emissions. Conducive days are very sunny and warm, with light winds, and a lack of precipitation. Perhaps more than any other variable, the number of conducive days plays a key role in excessive ozone levels, as evidenced below, where the two values are clearly highly correlated. Although climate change will affect weather patterns, it is uncertain if the number of conducive days will change.

Ozone Exceedance vs. Ozone Conducive Days

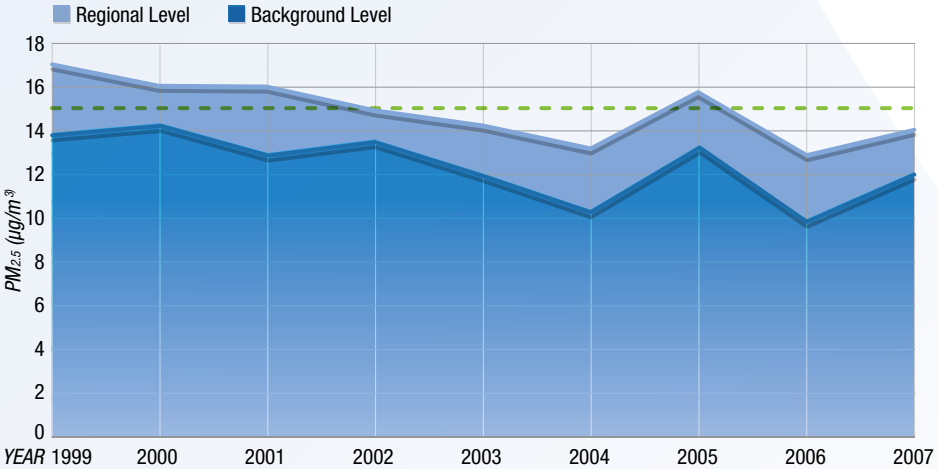


Source: U.S. Environmental Protection Agency Air Quality System Database

$PM_{2.5}$

To understand PM2.5 levels, data from all the monitors across the region was analyzed. There is an annual standard (mean of 15 µg/m³) as well as a daily standard (35 µg/m³) for $PM_{2.5}$. But $PM_{2.5}$ has only been monitored for the last ten years, with the standard just going into effect in 2005. Furthermore, data on daily exceedances is limited because the region was well below the daily standard until it was dramatically lowered in 2006. For 2007, when the new, lower standard went into effect, the data showed that each monitor exceeded the daily $PM_{2.5}$standard about 3 days, on average.

Average Concentration of Particulate Matter ($PM_{2.5}$)



Source: U.S. Environmental Protection Agency Air Quality System Database

The annual concentration of $PM_{2.5}$, averaged across all regional monitors, is plotted in the chart above, along with a plot line of the background level of $PM_{2.5}$. The background level is measured by a monitor in southwestern Will County, and helps discern what pollution is blowing in from outside the region, rather than generated here. This chart shows a clear downward trend, indicating that the annual average $PM_{2.5}$ levels are improving. (The dashed green line represents 15 µg/m³, the annual standard.)

Air Quality Index

Because of the challenges with averaging regional air quality data, another avenue for understanding the region's "every-day" air quality is looking at the Air Quality Index (AQI). The AQI is a national index for reporting daily air quality in a color-coded, user-friendly way. Although the data has been transformed into an index, it provides a picture of the number of days which meet both standards for ozone and $PM_{2.5}$, on a regional scale. The AQI is currently estimated every day of the year.

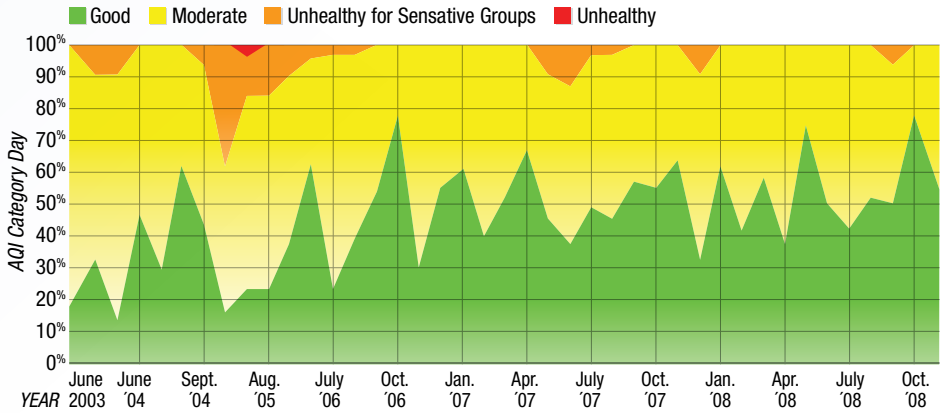
Air Quality Index – Categories

Category	AQI Value	Meaning	Ozone 8-hr (ppm)	$PM_{2.5}$ 24-hr (µg/m3)
Good	0-50	Air quality is considered satisfactory, air pollution poses little or no risk	0.000-0.059	0.0-15.4
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	0.060-0.075	15.5-35.5
Unhealthy for Sensitive Groups	101-150	Members of sensitive groups may experience health effects; the general public is not likely to be affected	0.076-0.095	35.5-55.4
Unhealthy	151-200	Everyone may begin to experience health effects; member of sensitive groups may experience more serious health effects	0.096-0.115	55.5-140.4
Very Unhealthy	201-300	Health alert; everyone may experience serious health effects	0.116-0.374	140.5-210.4
Hazardous	301-500	Health warning of emergency conditions; entire population likely to be affected	0.375+	210.5+

Sources: U.S. Environmental Protection Agency, www.airnow.gov

From available data, the majority of days in northeastern Illinois fall within this "good" and "moderate" range. These days have an AQI within federal standards. When analyzed over time, AQI can be tracked, shown in below. This reveals an increasing number of "good" days.

Air Quality Index, Selected Months



Source: U.S. Environmental Protection Agency, www.airnow.com

Sources

Although some emissions occur naturally, excessive levels are caused by interactions between human actions and weather conditions. The emissions caused by human sources are separated into point, area, and mobile sources.

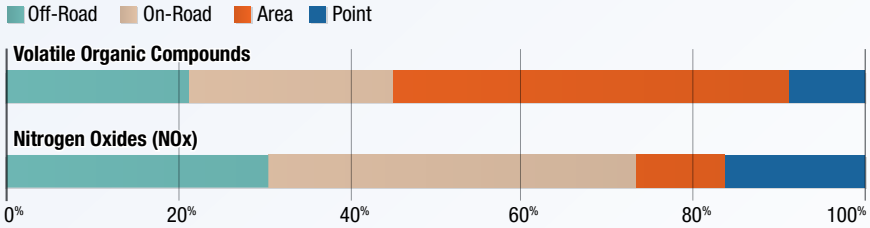
- Point sources are large, stationary emitters, such as power plants, chemical producers, manufacturing plants, or petroleum refineries.
- Area sources are small, stationary emitters, usually located in urban areas with other emitters that combine to form collectively significant emissions. Examples include gas stations, dry cleaners, motor vehicle refinishing shops, and households using consumer products.
- Mobile sources are those emitters which move under their own power. This typically means on-road transportation sources such as motor vehicles (cars, trucks, and buses); but a large portion of mobile source air pollution is generated by off-road sources such as gas-powered lawn and farm equipment, construction and industrial equipment, boats, planes, and trains.

IEPA measures these emission sources every few years, splitting mobile sources into on-road and off-road.

Ozone Precursors

Ozone is created from precursors, nitrogen oxides (NOx) and volatile organic compounds (VOC). The chart below shows how much of each precursor is caused by these four emission sources.

Ozone Precursors by Source Category, 2005

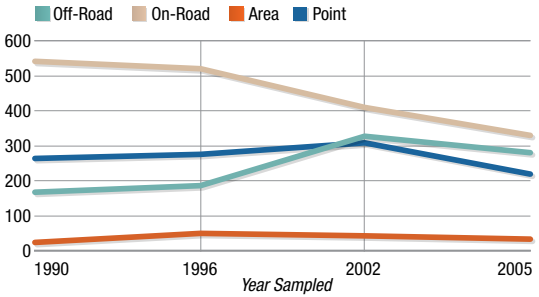


Source: Illinois Environmental Protection Agency

Trends

The change in NOx and VOC emitted by these sources over time is portrayed in the charts at right. The first chart reveals how there has been a small decrease in total NOx over time, and also how the on-road and point sources have shown the most improvement. Similarly, the chart below shows how total VOC has also declined, mostly due to the significant decrease in on-road and point source emissions.

Regional NOx, 1990-2005, by Emission Source Category, *tons per summer weekday*



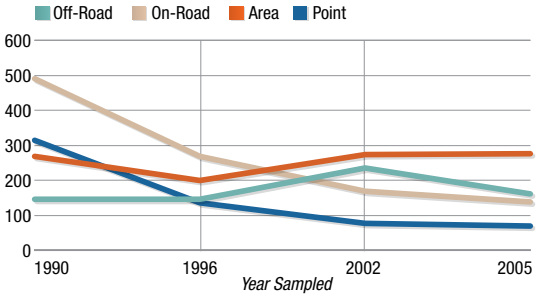
Source: Illinois Environmental Protection Agency

Particulate Matter ($PM_{2.5}$)

IEPA also evaluated the sources of particulate matter pollution in 2005, shown in the pie chart below. The vast majority of $PM_{2.5}$ pollution is attributed to area sources. Of this, more than half (approximately 14,438 tons) is due to road construction.

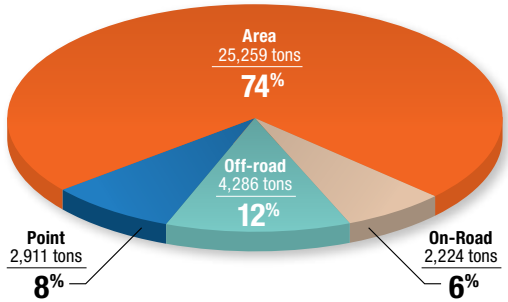
Because $PM_{2.5}$ hasn't been tracked as long as ozone, IEPA does not yet have any trend data with which to compare these 2005 $PM_{2.5}$ emissions. This data also only includes what is generated in the region, and does not take into consideration particulate pollution blown in from outside the region. But it reveals that even though the transportation sector have shown decreasing VOC and NOx emissions over time, road construction is still a major contributor to air pollution in our region.

Regional VOC, 1990-2005, by Emission Source Category, *tons per summer weekday*



Source: Illinois Environmental Protection Agency

Chicago Nonattaintment Area $PM_{2.5}$ Inventory by Source Category (2005)

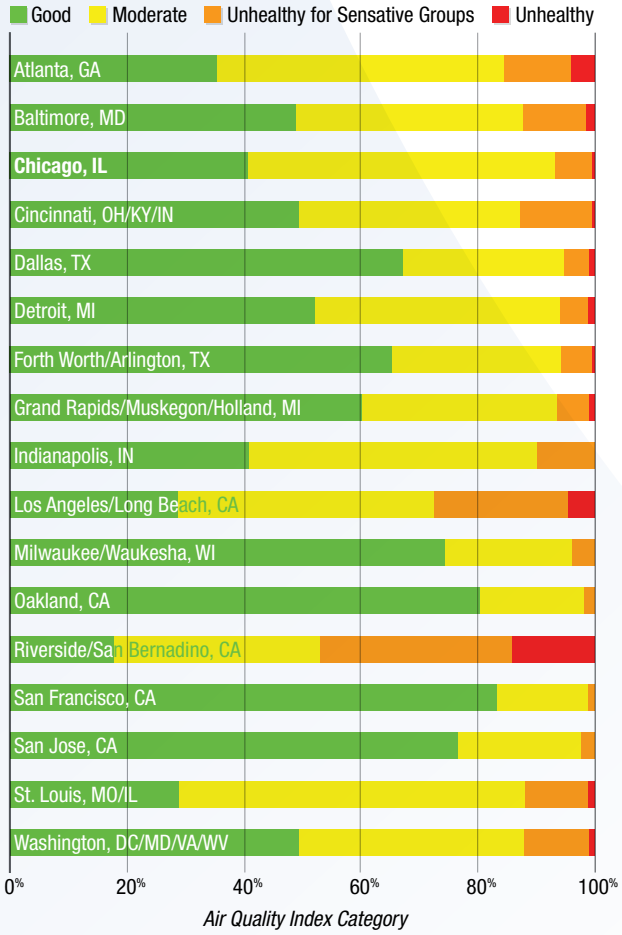


Source: Illinois Environmental Protection Agency

How Does Northeastern Illinois Stack Up?

Air quality is regulated and studied on several larger scales. In addition to the local monitoring done to ensure regions are meeting the regulations of the Clean Air Act, the U.S. EPA tracks air quality at the national scale, and compiles AQI data for metropolitan regions. Although this metric does not take into consideration several variables, such as the unique climate, geography, or land use features in each metropolitan region, it is a way to compare northeastern Illinois on a national stage. The comparison at right of the AQI category days for the metropolitan Chicago region with selected metropolitan regions across the nation.

Air Quality Index for Selected Regions,
in percent of days per year



Source: Air Quality Index Report, U.S. EPA Air Data, 2007

LADCO

Even for large regions such as northeastern Illinois, the effects of air pollution are not isolated. Weather conditions, particularly wind speed and direction, can transport air pollution from region to region, state to state, and country to country. The Lake Michigan Air Directors Consortium (LADCO) is made up of the states of Illinois, Indiana, Michigan, Wisconsin, and Ohio, and provides technical input on air quality issues in the larger region to the group. This coalition helps nonattainment areas in the larger region work together to meet regulations and improve air quality beyond their borders.

Current Regulations

Air quality is a heavily regulated issue. The IEPA and the U.S. EPA are involved in setting standards and monitoring and tracking conditions. The main legislation related to air quality are the Clean Air Act and SAFETEA-LU (the current transportation authorization act), although there are several others that impact air quality in more minor ways. Details about all the regulations relevant to air quality can be found in the technical report.

Clean Air Act

The single most significant piece of federal legislation regarding air quality is the Clean Air Act. Under the Clean Air Act, the U.S. EPA has the authority to place limits (NAAQS) on air pollution and emissions throughout the nation; states are not allowed to have weaker pollution controls than those set for the whole country.

If regions do not meet the standards set by the U.S. EPA, the states containing them must have plans for reducing air pollution. These state implementation plans (SIPs) explain how the state will take measures to achieve those standards. The law recognizes that states are better equipped to implement the regulations because pollution control problems often require specific understanding of local geography, development patterns, and industries as well as the authority to mandate air pollution controls. But the SIPs must be approved by the U.S. EPA, and if found unacceptable, the U.S. EPA can impose sanctions, or take over enforcement in that state.

A SIP is a collection of the regulations, programs, and policies that a state will use in each air quality control region within that state. Various SIP requirements and procedures are triggered depending on the degree of nonattainment of the federal standards. In addition, the SIP includes modeling to demonstrate that the efforts the state has adopted will improve air quality to the level of the federal standards by the federally-specified attainment date. This modeling is known as the attainment demonstration. If the state has achieved the standards, then an analysis referred to as a “Maintenance Plan” demonstrates that it will continue to do so.

In addition to setting acceptable standards and monitoring, the Clean Air Act authorizes additional regulatory actions. Some of these additional regulations and programs include:

- *Emission Standards for Vehicles* – the Clean Air Act sets levels of acceptable exhaust emissions from all mobile sources. They are divided into standards for on-road vehicles and nonroad vehicles (and equipment); with standards for both new and existing emitters.
- *Fuel Regulations* – As a counterpart to regulating vehicle and engine emissions, fuel regulations set limits on lead and sulfur in gasoline and diesel fuel, and encourage the use of alternative and renewable fuels.
- *Permit Programs* – stationary sources are subject to permitting, when they are first constructed, if they make any modifications, and regularly, in order to continue operations.

- *Inspection/Maintenance* – administered in the region by the IEPA, these programs ensure that emission control systems in vehicles are working properly.
- *Air Toxics Rules* – emission sources of hazardous air pollutants (different than criteria pollutants like ozone and $PM_{2.5}$) are required to use "maximum achievable control technology" to control emissions of air toxics.

SAFETEA-LU

SAFETEA-LU (Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users) is the main source of funding and programming for improvements to the country's surface transportation infrastructure, and incorporates opportunities to mitigate the impacts of mobile source air pollution.

The Congestion Mitigation and Air Quality Improvement Program (CMAQ), for example, provides funding in nonattainment areas for projects and programs that reduce transportation-related emissions or congestion. CMAP administers these funds for northeastern Illinois.

CMAP also has the responsibility to ensure that federally-funded transportation activities are consistent with air quality goals. This is called "conformity" — and ensures that transportation activities do not worsen air quality or interfere with the purpose of the SIP.

The transportation plan and the transportation improvement program (TIP) guide long- and short-term transportation investments. A regional emissions analysis is performed to demonstrate the consistency of the transportation plan and TIP with the SIP motor vehicle emissions budgets. This analysis forms the basis for the conformity determination, measuring the emissions impact of the plan's and TIP's projects, and weighing that against the budgets established in the SIP.

Other Regulations

There are several other regulations which impact air quality, including the Clean Air Interstate Rule, which is a relatively recently federal rule to regulate air pollution that travels from one region to another; Federal Energy Policy, which regulates fuel economy; and local enforcement and permitting of emitters, as done by the City of Chicago and Cook County.

Current Local/Voluntary Efforts

Although heavily regulated and monitored, air pollution is a persistent issue that is also addressed by voluntary efforts. There are non-government organizations dedicated to working for cleaner air, as well as government-sponsored air quality programs targeting private business and citizens. Some of the most significant of these are listed here:

- *Commuter Choice* – funded by U.S. EPA and U.S. Department of Transportation, this is a website (http://www.commuterchoice.com) and service dedicated to linking employees and employers with transportation providers.
- *ENERGY STAR* – managed by the U.S. EPA, this is a voluntary labeling program designed to identify and promote energy-efficient products to reduce emissions.
- *Clean Air Markets* – managed by the U.S. EPA, this is a series of market-based regulatory programs designed to cost-effectively lower emissions through the operation and evaluation of "cap and trade" and similar programs.
- *Fuel Economy and Green Vehicle Guides* – produced by the U.S. EPA and the U.S. Department of Energy, these guides help consumers choose the most fuel-efficient vehicle for their needs.
- *Diesel Emission Reduction Program/National Clean Diesel Campaign* – this U.S. EPA program promotes diesel emission reduction strategies by offering incentives and grants to help fund retrofitting projects.
- *Illinois Green Fleets* – a voluntary program in which Illinois businesses, organizations, and local governments gain recognition for having "green," domestic, renewable fuel vehicles in their fleets.
- *Illinois Clean School Bus and Clean Diesel Grant Program* – IEPA developed this program, similar to the National Clean Diesel Campaign, to help schools retrofit existing diesel-powered buses.
- *Training* – Lake Michigan Air Directors Consortium, U.S. EPA Region 5, and IEPA work to offer training on "maximum achievable control technology" standards, the levels of control for sources of hazardous air pollutants.
- *Partners for Clean Air* – regional coalition of businesses, transportation organization, health advocacy groups, and local governments in northeastern Illinois and northwestern Indiana, which pledge to reduce air pollution voluntarily, and offer public education and outreach on air quality.
- *Chicago Area Clean Cities Coalition* – a voluntary organization dedicated to encouraging the use of clean fuel and clean vehicle technologies, part of a national Clean Cities Campaign, sponsored by U.S. Department of Energy.
- *Clean Air Counts* – a public-private initiative to voluntary improve air quality in the region, managed by the Metropolitan Mayors Caucus.
- *Chicago Climate Exchange* – a self-regulatory cap and trade exchange for emissions in North America, which requires member to voluntarily sign a legally binding contract to meet annual emission reduction targets.

Little Village Environmental Justice Organization (LVEJO)

LVEJO is a community-based organization in the Chicago neighborhoods of Little Village and Pilsen. One of the most densely-populated areas in the region, the neighborhoods are also home to two coal-fired power plants, as well as other stationary source emitters. LVEJO has worked on several campaigns related to air quality. They have organized residents to demand enforcement by local polluters, negotiating "good neighbor agreements," partnered with local universities for research, and used the press to motivate City officials.

Clean Air Counts

Clean Air Counts is a public-private initiative, managed by the Metropolitan Mayors Caucus, to voluntarily achieve specific reductions of air pollutants and energy use. The strategies include incentives to encourage participants to make a commitment to reduce emissions, as well as agree to annual reporting of their strategies. The program also has a large education component, helping communities understand and assess the impact of air quality improvement policies.

Other Regions

In a brief survey of what other regional agencies are doing to promote cleaner air, the following ideas were included, many of which are currently underway in northeastern Illinois:

- Grassroots efforts by community organizations, supported by partners such as CMAP or universities;
- Land use planning to promote density, as well as transit usage, walking, and bicycling;
- Vehicle scrappage programs to get older, more polluting vehicles off the roads;
- Education about current programs to voluntarily retrofit older engines; and
- Leveraging air quality benefits in awarding contracts.

About CMAP

The Chicago Metropolitan Agency for Planning (CMAP) is the comprehensive regional planning organization for the seven counties of northeastern Illinois. By state and federal law, CMAP is responsible for producing the region's official, integrated plan for land use and transportation. The agency's innovative *GO TO 2040* planning campaign will develop and implement strategies to address projected population and employment growth and its serious implications for transportation, housing, economic development, open space, the environment, and other quality-of-life issues. See www.cmap.illinois.gov and www.*GOTO2040*.org for more information.

Conclusions

This snapshot report looks at air quality through a regional lens, in an attempt to understand current conditions, sources, regulations, and efforts specific to northeastern Illinois. Conclusions include:

- The region has made progress in improving air quality. But as Federal standards are strengthened, there will continue to be work to be done. In addition, as the region is predicted to grow, the region will need to consider new and innovative solutions to improve air quality.
- As the climate changes, air quality may be impacted. Ozone is highly correlated to weather conditions, and shifts in weather patterns may influence regional ozone. Although air quality regulations currently focus on specific pollutants, not greenhouse gas emissions, there is increasing interest in mitigating climate change by including these emissions as well. A separate CMAP snapshot report addresses our region's greenhouse gas emissions and energy use.
- Historically, controls implemented nationally, such as vehicle emissions and fuel standards, have provided much of the improvements in air quality. The state and local programs and regulations currently in place work. But greater reductions from area sources and off-road mobile sources may be required, especially with a new, stricter ozone standard in place. So new efforts may be needed, focusing on these sources — some of which are still related to transportation, like road construction.
- The overall reduction in ozone throughout the region continues, but the multi-state nature of the problem means that areas up- and downwind of the region must also be considered.
- In comparison to ozone, particulate matter is still a relatively new air quality concern in the region, and monitor data is limited. At this point, data show slightly declining levels of $PM_{2.5}$, but source data also points to area sources as the largest contributor.
- For public understanding of regional air quality, the AQI may be the best method for tracking progress. With daily measurements and designations based on federal standards, it is an excellent resource for assessing air quality (both $PM_{2.5}$ and ozone) throughout the region.

The *GO TO 2040* plan will use air quality as one of a set of indicators to track its progress toward achieving the goals set out in the Regional Vision and to evaluate potential recommendations made in the plan.

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