Direction de l'environnement et du développement durable

2010

Environmental Assessment Report

Air Quality in Montréal

Highlights

- 65 poor air quality days in Montréal
- A state-of-the-art monitoring network
- A new Web graphic interface
- Gaseous pollutants: 2000-2010 portrait
- Extension of autoroute 25: reference state
- Fine particles responsible for 63 of the 65 poor air quality days
- 24 smog days due to forest fires and summer heat waves
- Benzene: stability coming soon
- Canada-wide standards: summary 2008-2010

Fine particles: air has no boundaries

In 2010, the number of days where air quality was poor on the territory of the agglomeration of Montréal was only 65, three less than in 2009. The pollutant category that dominated all others, having resulted on its own in no less than 63 of these poor air quality days, was that of fine particles ($PM_{2.5}$).

The situation is preoccupying as there is no safe exposition threshold for this pollutant. Considering the adverse effects of fine particles on the environment and human health, the Council thus adopted Bylaw 09-012 concerning solid-fuel-burning equipment. The Bylaw prohibits the installation, within a new or existing construction, of a solid-fuel-burning equipment, with the exception of an EPA or CAN/CSA-B415.1 pellet-burning certified stove. The adoption of this Bylaw, that limits the growth in the number of solid-fuel-burning equipment, is a key first step towards improving the quality of air in Montréal.

However, additional efforts are required to reduce the presence of this pollutant. That is why the municipal administration is calling on both the federal and provincial governments for the necessary funds to implement a program for the replacement of the wood burning equipment present on the territory of the agglomeration of Montréal by equipment that is more efficient and that uses cleaner fuel. Those municipal authorities that have not yet legislated toward this end are invited to do so.

Achieving this $PM_{2.5}$ reduction objective involves the implementation of concerted actions by various municipal stakeholders. The Montréal Community Sustainable Development Plan for 2010–2015 also solicits a commitment by its partners for carrying out of concrete actions in this respect.

Aerial view of autoroute 25's bridge under construction

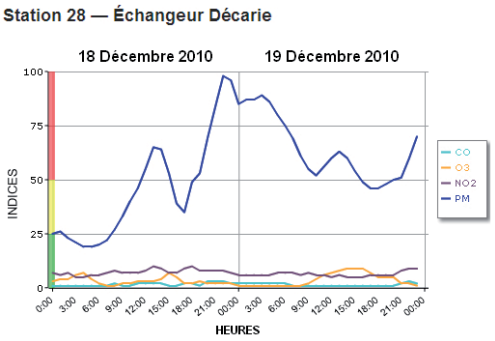
Montréal

Web: internauts will be charmed by the graphic interface

A state-of-the-art monitoring network

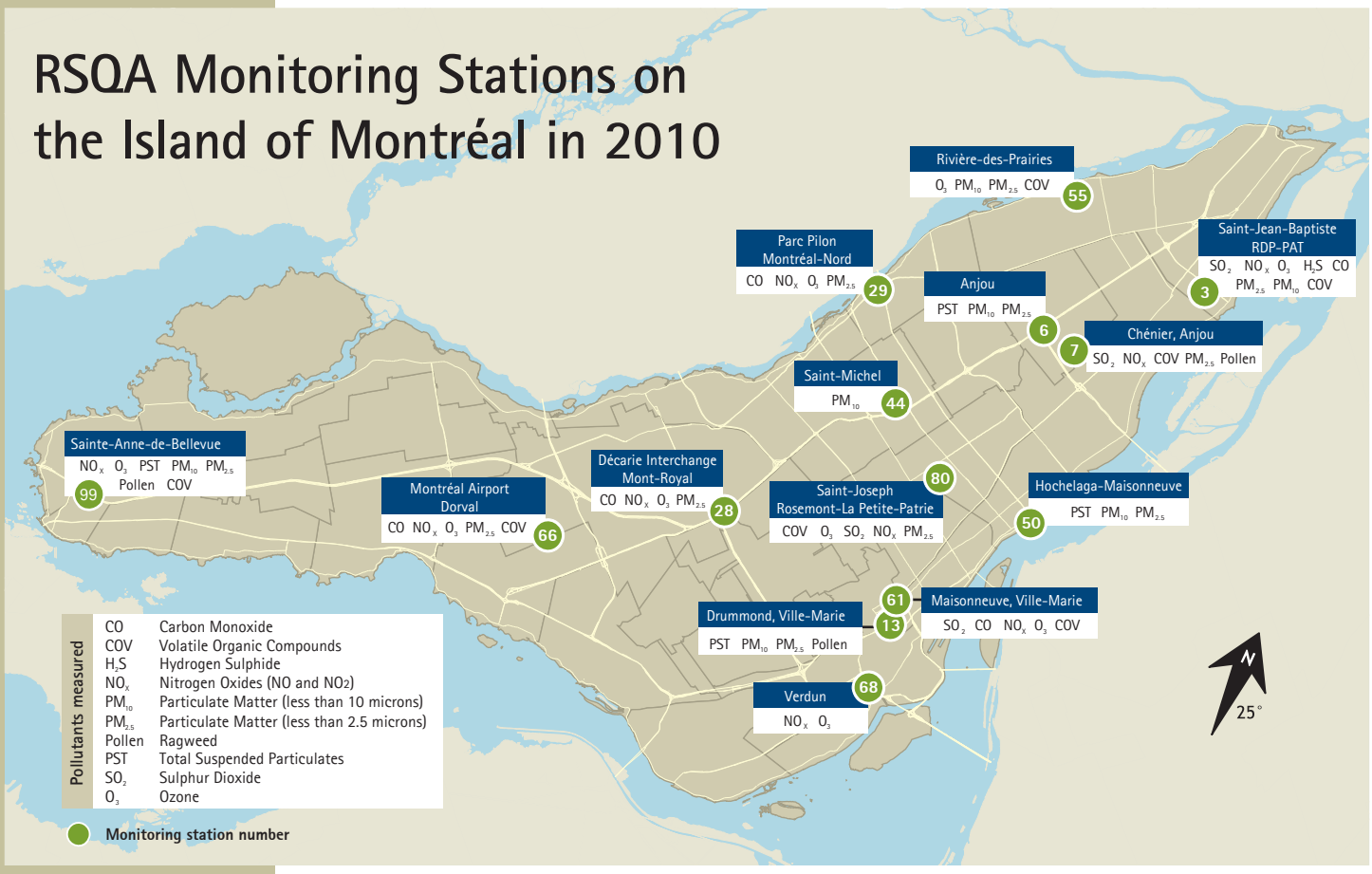
Ville de Montréal, attentive to the quality of life of its citizens, measures the quality of ambient air according to a well established monitoring program. Towards this end, 14 monitoring stations are located throughout the Island of Montréal in 2010 and represent the Réseau de surveillance de la qualité de l'air (RSQA). Of these, eleven are equipped with continuous air monitors to measure the concentrations of certain pollutants 24 hours a day. The data collected over the years allows us to observe trends and help solving certain problems.

In order to facilitate the consultation of these results, the graphic interface of the Web site has been improved. Indeed, it is now possible to post, on a variable scale graphic, the concentrations of pollutants measured at a given station over a 48-hour period, whereas in the past this could only be done for a period of 24 hours. This allows for a much better appreciation of what happens overnight. The interactive legend also enables one to observe one pollutant at a time. As to the color coded qualification criteria (fair, acceptable and poor), it allows one to easily observe, at a glance, the situation prevailing in each of the stations.



It is possible to check at all times the state of air quality on the territory of Montréal, by consulting the rsqa.qc.ca Web site which broadcasts the results on an hourly basis.

RSQA Monitoring Stations on the Island of Montréal in 2010



Gaseous pollutants: 2000-2010 Portrait

What does a comparison of concentrations of pollutants measured on the Island of Montréal over the last decade reveal? Globally, that air quality has improved, particularly the following gaseous pollutants: sulphur dioxide (SO_2), carbon monoxide (CO), hydrogen sulphide (H_2S), nitrogen dioxide and monoxide (NO_2 and NO), of which the majority of emissions come from industrial or transportattion activities.

However, concentrations of ozone, a pollutant formed in the atmosphere by the sun from precursors like nitrogen oxides and volatile organic compounds are on the increase. Although no exceedance of the hourly standard was recorded in 2010, the same cannot be said of the 8 and 24-hour standards that are frequently exceeded. For the majority of the stations that measure ozone, these exceedances were mainly observed between the months of March and September.

As is the case with the presence of $PM_{2.5}$ in the ambient air, the rise in concentrations of ozone is preoccupying, because it is a powerful oxidant that has the propertty of reacting with other pollutants in the air. Also, these chemical reactions contribute to the formation of secondary fine particles responsible for almost all poor air quality days. In the same way that we must strive to reduce $PM_{2.5}$ emissions in the ambient air, all of the measures that tend to reduce the emission of ozone precursors in the atmosphere must be encouraged and this, both locally and regionally, given that many of these precursors originate from outside the territory of Montréal and are considered as being transborder pollutants.

Polluant	2000-2010
Sulphur dioxide (SO_2)	↓ 65 %
Carbon monoxide (CO)	↓ 59 %
Nitrogen dioxide (NO_2)	↓ 31 %
Nitrogen monoxide (NO)	↓ 67 %
Hydrogen sulphide (H_2S)	↓ 75 %
Ozone (O_3)	↑ 37 %

Trend curves are available in the History and Trend section of the Web site.

Ozone standards in µg/m³

1 hour: 160
8 hours: 75
24 hours: 50

Extension of autoroute 25: something new in the air!

It is common knowledge that automobile traffic influences air quality. One of the requirements of the Order-in-Council governing the extension of the autoroute 25 project, between Henri-Bourassa Boulevard in Montréal and autoroute 440 in Laval, consists in setting up an air quality monitoring program. This program, implemented in collaboration with the Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP), is intent on preserving the existing situation, in addition to assessing the possible impact of the new traffic flow on air quality in the vicinity of the project.

The program includes measurement of contaminants such as total suspended particulates (TSP), fine particles (PM_{10} and $PM_{2.5}$), ozone, nitrogen oxide, sulphur dioxide and volatile organic compounds. It also provides for measures during the reference period, before the autoroute's opening (scheduled in the spring of 2011), and the continuation of these measures for a minimum period of three years after that.

In order to attain these objectives, monitoring equipment was added to some existing RSQA stations and six new stations, operated by the MDDEP, were put into service on this stretch of autoroute (two in Laval and four in Montréal). Monitoring equipment, now in operation since July 2010, takes measures that will help qualify the reference state and, eventually, help us understand the trends in this area.

Smog days:
24 days

Intensity:
$PM_{2,5}$ > 35µg/m³
O_3 > 160 µg/m³
During at least 3 hours

Range:
Montréal region

Local issues:
41 days

$PM_{2,5}$ > 35 µg/m³
Mobile average
3 hours

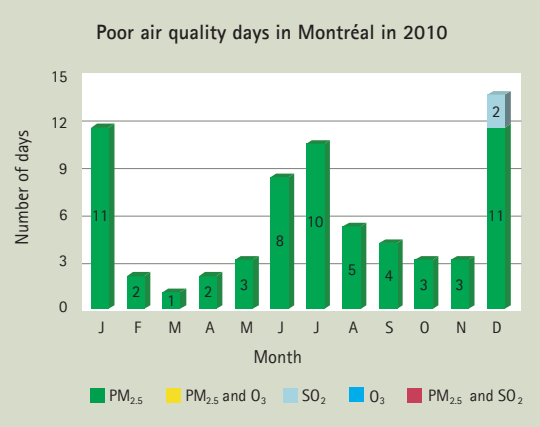
SO_2 > 500 µg/m³
Mobile average
10 minutes

Poor air quality in Montréal

63 of the 65 poor air quality days are due to fine particles

A poor air quality day is a day during which the Air Quality Index (AQI) is "poor" in at least one monitoring station and this, for at least one hour. This indicator includes both smog days occurring at the regional level and days where poor air quality is observed locally over a short period of time. In 2010, there were 65 days where the air quality was poor on the territory of the agglomeration of Montréal, three days less than in 2009.

Fine particles ($PM_{2.5}$) were the first responsible for this situation, having caused on their own no less than 63 of these poor air quality days. Second place went to sulphur dioxide (SO_2), a pollutant emitted in the eastern sector of Montréal, with two poor air quality days in December.



24 smog days

In 2010, the 24 poor air quality days recorded simultaneously in at least three Island of Montréal sub-regions satisfied the criteria for smog days and were spread out over nine months of the year. Again, it is worthwhile mentioning that the year 2010 was one of the hottest on record, not only in the Montréal region, but also everywhere in the country, as reported by Environment Canada. Consequently, it is not abnormal to observe that certain smog episodes are associated with conditions where temperatures were high, particularly during the heat waves that we experienced in July, August and September. Considering that July was qualified as being the warmest on record since 1955, the air's quality during that month was still deemed acceptable or good. As far as the winter months are concerned, a spell of milder weather can result in the formation of winter smog. This was the case with smog episodes observed in December and January, when temperatures rose above the freezing point during many hours.

Local issues

Poor air quality days recorded in at least one station of the monitoring network measuring the effects of a more local source were distributed as follows:

- 23 poor air quality days observed downtown over a number of months were directly related to the presence of a wood burning stove in the sector (stations 13 and 61);
- 2 poor air quality days in June and July were due to the fireworks (station 50);
- 2 poor air quality days in December were the result of high concentrations of SO_2 in the East end of the Island (station 3);
- 14 poor air quality days were associated with human activities, e.g. traffic, wood burning and industries.

A polluting human activity: a pizza oven and fine particles

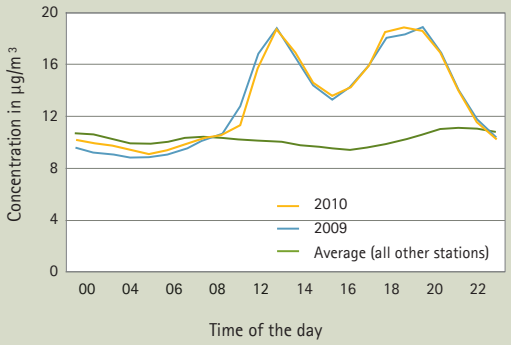
In 2010, 23 poor air quality days were related to the emissions of fine particles by a restaurant downtown that uses wood to fuel its pizza oven. Last year, this activity was responsible for 17 poor air quality days.

To better illustrate this situation, the average concentrations obtained over the year for each of the hours recorded in this station located in downtown Montréal were compared with the average concentrations obtained for these same hours for all of the Island's other monitoring stations. The opposite figure emphasizes the impact of this activity on the quality of air found in the sector neighboring the monitoring station.

For the period between 11 p.m. and 9 a.m., the average hourly concentration is very similar to what is measured elsewhere on the Island of Montréal, between 9 and 11 µg/m³. However, when the oven is started up around 10 a.m., the concentration of fine particles increases gradually, reaching a maximum of 19 µg/m³ around noon, whereas elsewhere on the Island, concentrations are closer to 10 µg/m³. From 2 p.m. to 5 p.m., the concentration of fine particles decreases slightly to around 14 µg/m³ but then increases and again reaches the level of 19 µg/m³ during dinner hours. Between 8 p.m. and 9 p.m., this concentration starts to diminish to regain the levels similar to those of other stations around 11 p.m. The distribution pattern of the fine particles observed at this station for the year 2010 is almost identical to that observed in 2009.

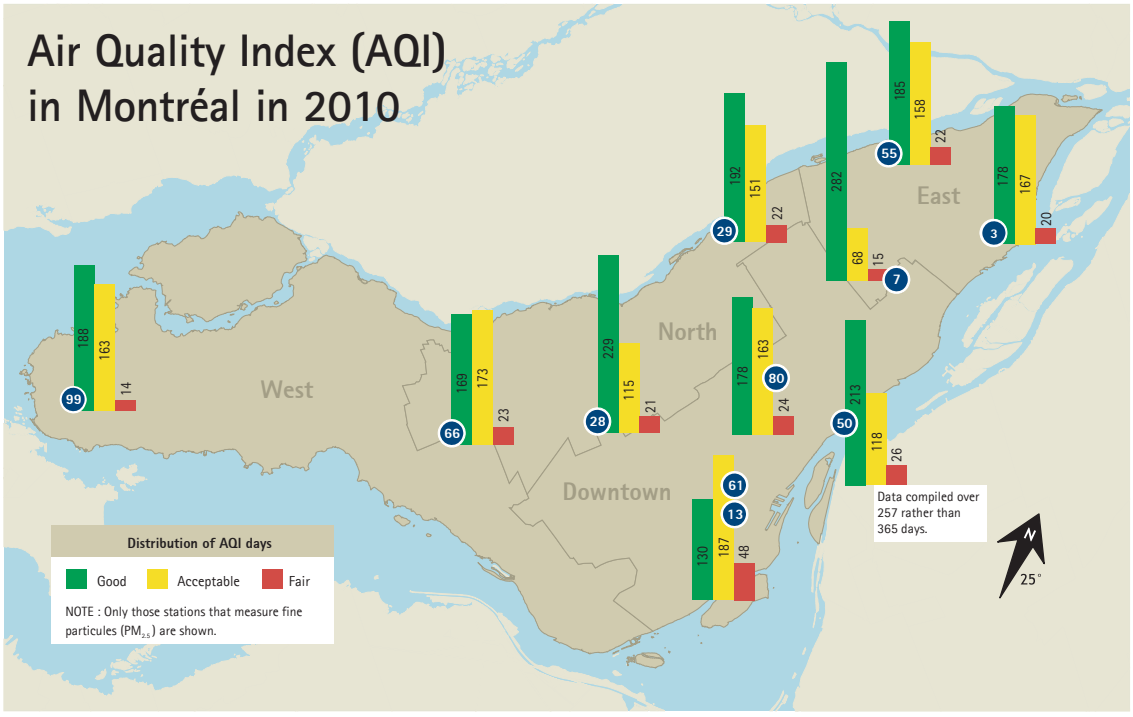
These results confirm that the use of a solid fuel, like wood, in a commercial equipment that is not outfitted with a purification system results in a deterioration of air quality in its immediate surroundings.

Impact of the use of a wood burning stove downtown (station 13) on the hourly concentration of $PM_{2.5}$ in 2010



It is worthwhile mentioning that similar problems have also been observed in residential neighbourhoods where wood heating equipment is frequently used. The results of a survey conducted in November 2006 indicated that there were nearly 85,000 such equipment on the territory of the agglomeration of Montréal.

Half of the poor air quality days recorded at station 13 were due to the wood burning oven.



Fine particles and benzene are pollutants emitted by wood combustion

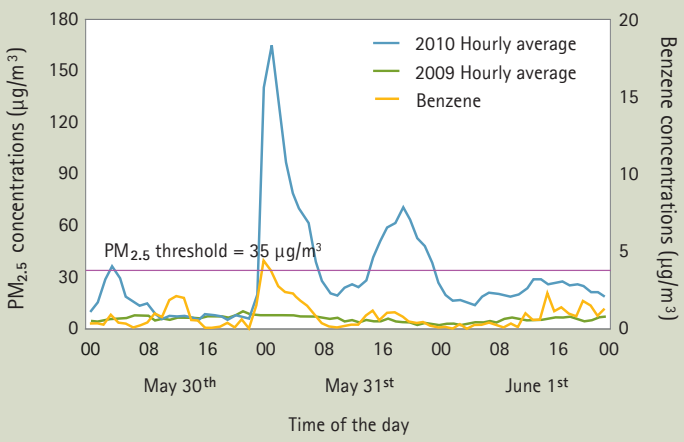
Smog episodes

Forest fires

A smog episode, which made history, occurred from May 30th to June 1st, when raging forest fires in the Upper Mauricie region, more precisely North of La Tuque, forced the evacuation of many of the region's residents. The conditions favourable to the forest's flashover were the lack of precipitations (snow and rain) recorded in the previous fall and winter seasons followed by a hot and dry spring. The fires were ignited by the lightning that fell during the violent storms that occurred during the day of May 25th. The weather conditions were such that the smoke plume travelled over 200 km, reaching the Montréal region in the night of May 30th to 31st.

The figure showing the variation in hourly concentrations of fine particles, obtained by calculating the average of all stations, clearly demonstrates that they all established absolute records, as they resulted in concentrations 5 to 6 times greater than the criteria of 35 mg/m^3 for a 3-hour mobile average, the threshold set to qualify a poor air quality day. For comparison purposes, the average hourly concentrations of $PM_{2.5}$ for the same days in 2009 are represented by the green line. At the worst point during the night, the $PM_{2.5}$ results were up to 20 times superior to those of a normal day. These data well represent the impact of an event of such a magnitude.

Variation in $PM_{2.5}$ and benzene concentrations during the forest fires in the Upper Mauricie region



The last time such an occurrence happened was on July 8, 2002, when the smoke plume of some forty forest fires blazing in the North of Québec over a number of days gradually spread, reaching the South of Québec and the US East Coast states. In the Montréal region, more than 700 km away from these fires, measured concentrations of fine particles were 3 to 4 times greater than the established standards.

Given the great distances travelled by the smoke plume, measuring other pollutants associated with wood combustion, for instance volatile organic compounds (VOC), may be difficult to conduct, particularly when the concentrations of these pollutants are much smaller than those of $PM_{2.5}$. During the night of May 31st, an apparatus used to continuously monitor VOC, located in the East end of Montréal (station 3), detected 2.5 times more benzene than normal for that sector. Represented by the yellow line in the graph, the hourly distribution profile seems to correspond to the behavior of the smoke plume. However, the forest fires are not the only factor explaining the presence of benzene in this highly industrialized sector. In the future, these measurements may be compared to other similar events for reference purposes.

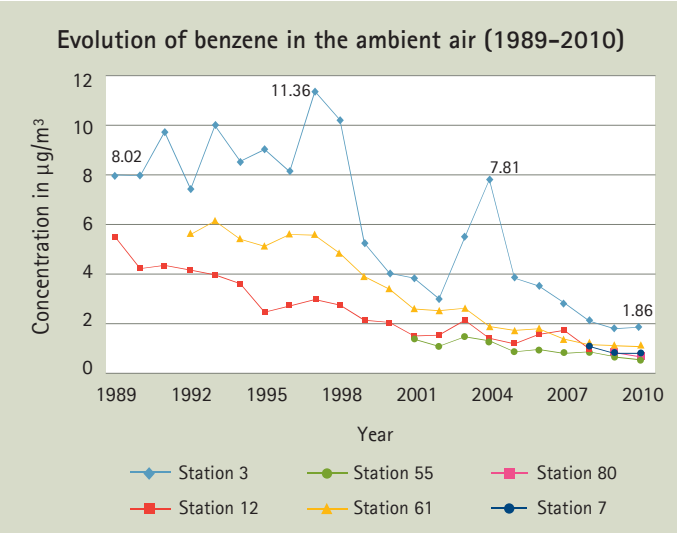
A hot summer

Among the other events liable to draw our attention in 2010 are two smog episodes that occurred in the summer. The first happened from July 5th to 9th, when daytime temperatures in Southern Québec exceeded 33°C with a very high humidex index. And the second, over two days, occurred during the heat wave experienced in the region from August 29th to September 3rd. In both cases, it is the high concentrations of fine particles that occasioned the warnings broadcast by the Info-Smog program.

Benzene: stability coming soon

For a few years now, the industry's efforts to reduce emissions of volatile organic compounds (VOC) in the atmosphere have yielded positive results and benzene concentrations as measured in the East end of Montréal have decreased.

In 2010, the average annual results recorded of 1.86 µg/m³ seem to indicate a stabilized concentration of this pollutant in the sector. These data are derived from samples taken over 24 hours, once every six days, and analysed by Environment Canada's laboratory.



Assuring the consistency of the measures

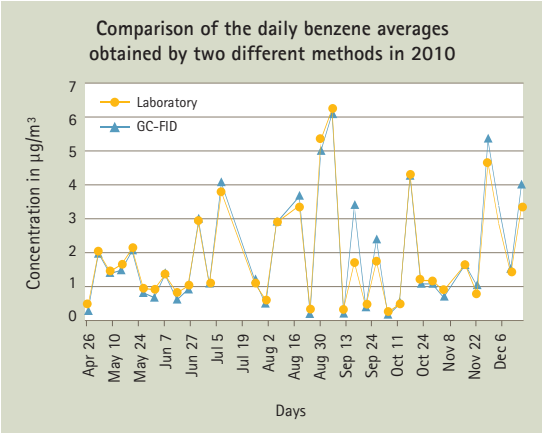
In January 2010, the news that Shell was closing its refinery did not go unnoticed. Many bailouts were also attempted before the industry definitely ceased its refining operations in October 2010. A question then raised much interest: what would be the impact of this closing on air quality in the sector?

First, despite the refinery's shut down, certain hydrocarbon handling and storage activities are maintained and the possibility that new activities will be added is still present. Air quality monitoring is conducted by complex monitors of which the results cannot be extrapolated. Indeed, there are no simple mathematical calculations that allow one to make predictions. For the time being, the past two months have not resulted in any significant differences in the benzene concentrations measured in that sector.

In fact, the only way to really know the impact of this closing will be to monitor, as Ville de Montréal has done and will continue to do, using the very best technologies available.

More accurate monitoring

After the installation of a new BTEX (benzene, toluene, ethylbenzene, xylene) continuous monitoring apparatus in 2009 and a few months of breaking it in at the beginning of 2010, the City can now count on the technology of a gas chromatograph with a flame ionization detector (GC-FID) to quantify the benzene concentrations present in the sector. The controls implemented indicate that the results obtained by this method of analysis are similar in all respects to the results obtained by the in-laboratory analysis method. The annual averages of benzene measured in 2010 are 1.86 µg/m³ for the two methods.



Added value: the GC-FID measures on a daily basis whereas the other method measures once every six days

Canada-wide standards: summary 2008-2010

Preoccupied by the high concentrations of fine particles ($PM_{2.5}$) and ozone in the ambient air, and their negative effects on human health and the environment, the Canadian Council of Ministers of the Environment (CCME) adopted Canada-wide standards in June 2000. The results gathered this year are the third and final reference year for the purpose of analysing the situation with these pollutants in ambient air.

The following tables compare results obtained in various monitoring stations with the criteria of the Canada-wide standards. The comparison is made without having complied with all of the guidelines of the federal application guide, since these require a much more complex exercise that exceeds the scope of this report.

Although smog episodes are often associated with heat waves, the number of poor air quality days in the summer is not only due to the presence of ozone, but also to high concentrations of secondary fine particles, generated by chemical oxidation reactions occurring in the atmosphere. Ozone plays a role in this phenomenon since it is a powerful oxidant.

The 2010 results for ozone, though inferior to the threshold of 127 µg/m³, are superior to those of 2009. This is mainly explained by the fact that the summer of 2009 beat records for gloomy weather, whereas the summer of 2010 was characterized by many warm spells. The ozone formation is closely linked to the action of the sun's rays on certain precursors present in ambient air. Excluding stations 28 and 61, where traffic competes with the formation of ozone, the three-year average used for comparative purposes with the Canada-wide standard is 117 µg/m³ for the whole of the Island of Montréal.

Generally speaking, despite the fact that ozone complies with the Canada-wide standard, this pollutant must however be carefully monitored since, as was demonstrated in page 3 of this report, the concentrations of the last decade have risen.

With respect to $PM_{2.5}$, the adverse health effects of these pollutants are one of the reasons why a reduction of their concentrations in the ambient air is recommended. In this respect, the threshold of 30 µg/m³ indicated in the table does not so much represent an absolute objective but rather a threshold that must not be exceeded. A comparison of the results for each station exhibits few variations in annual averages from one year to another. Given this situation, the efforts to reduce this contaminant in the ambient air are conditional on major behavioral changes and will need to be sustained over many years.

Fine particles ($PM_{2.5}$), threshold: 30 µg/m³

Station	Annual value of the 98th percentile - 24 hrs			Three-year average
	2008	2009[C]	2010	
3	31	33	29	31
7[A]	31	--	32	32
13	33	31	34	33
28	35	34	31	33
29	31	33	34	33
50	31	--	31	31
55	32	31	31	31
66	34	33	32	33
80[A]	--	28	31	30
99[A]	--	29	28	29
Annual average	32	32	31	31

Ozone (O_3), threshold: 127 µg/m³

STATION	4th highest daily maximum 8-hr mobile average			Three-year average
	2008	2009	2010	
3	115	108	121	115
28	100	93	93	95
29	117	109	123	116
55	124	114	125	121
61	92	100	107	100
66	119	111	124	118
68	115	105	116	112
80[A]	--	112	121	117
99	124	109	126	120
Annual average[B]	119	110	122	117

A: Incomplete data
B: Annual average calculated excluding stations 28 and 61
C: Corrected 2009 data

Graphic design
Rachel Mallet

Errata
A few mistakes occurred in the 2009 Environmental Assessment Report. In page 7, the data in the table of fine particles were mistaken owing to an interpretation error of the results. The current version of this table presents these corrected data according to the interpretation guide published by the CCME.

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