Pollution prevention (P2) planning notice for the synthetic rubber manufacturing sector (isoprene)

Final Performance Report 2020

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Summary

Isoprene is an industrial chemical, is produced naturally by plants and humans, and is also present in tobacco smoke.

This pollution prevention (P2) planning notice (P2 notice) was published in 2012 with the risk management objective of reducing human exposure to isoprene through the reduction of industrial emissions of isoprene to the environment by 80% relative to the baseline year, using best available techniques economically achievable (BATEA). One facility, ARLANXEO, located in Sarnia, Ontario, was subject to the notice and implemented a P2 plan with a 2009 baseline year. In 2018, the facility's emissions of isoprene reduced by 78% compared to their 2009 baseline year, an achievement within 2% of the objective.

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Introduction

2-Methyl-1,3-butadiene, also known as isoprene, is an industrial chemical, and is also produced naturally by plants and humans. Isoprene is used in the manufacture of rubbers, plastics and some other types of products and is present in tobacco smoke. Based on the most recent data, isoprene is manufactured in, and imported into, Canada.

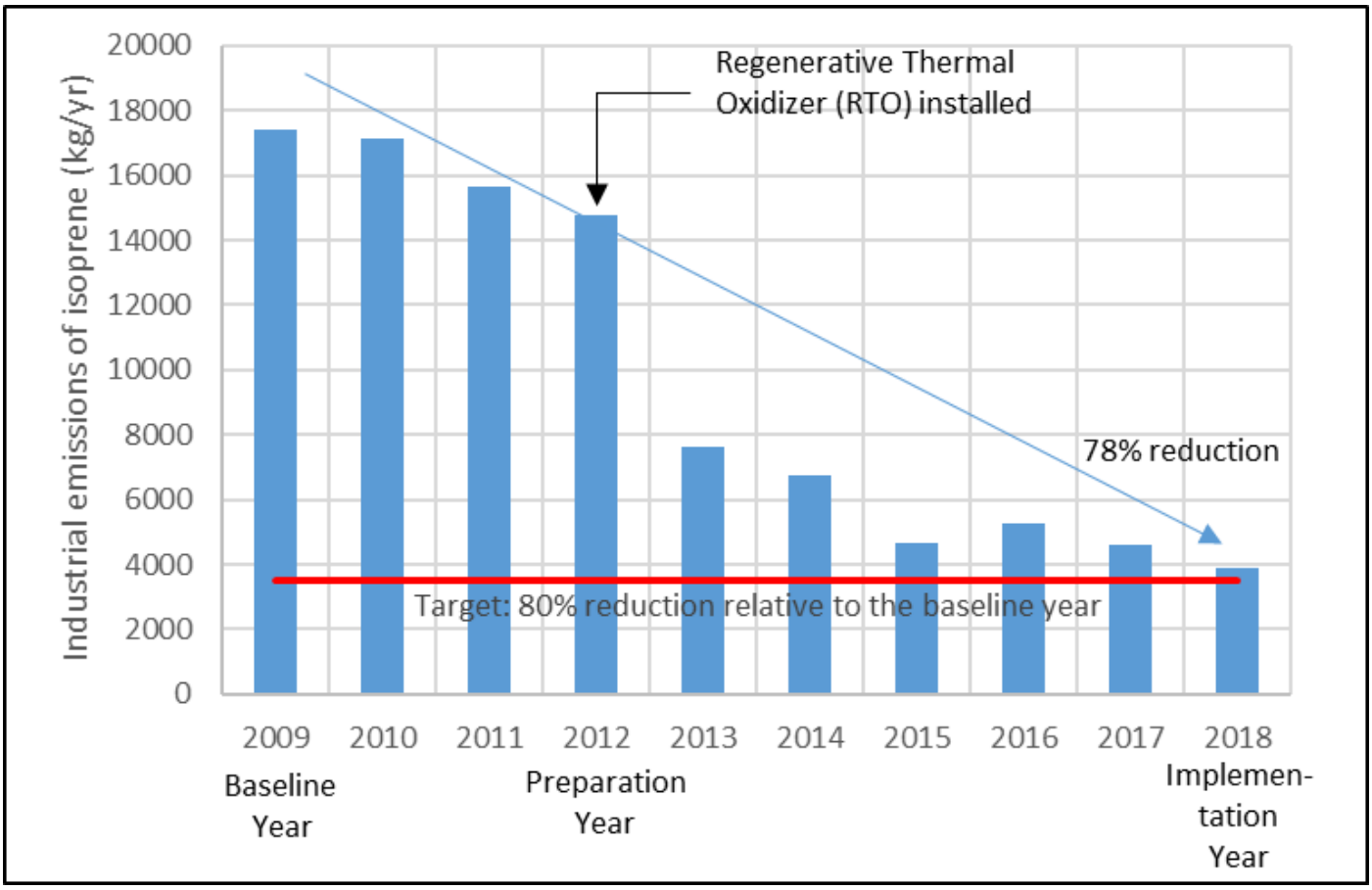
On June 9, 2012, Environment and Climate Change Canada published a P2 notice in the *Canada Gazette, Part I* titled "*Notice requiring the preparation and implementation of pollution prevention plans in respect of specified substances on Schedule 1 of the* Canadian Environmental Protection Act, 1999*, related to the synthetic rubber manufacturing sector*". One facility, ARLANXEO, located in Sarnia, Ontario, was subject to the notice at the time of its publication.

Objective and general results

The risk management objective of this P2 notice is to reduce human exposure to isoprene through the reduction of industrial emissions of isoprene to the environment by 80% relative to the baseline year, using BATEA.

One facility, ARLANXEO located in Sarnia, Ontario, was subject to the P2 notice upon publication and was required to prepare and implement a P2 plan with a baseline year of 2009. No other facilities have become subject to this notice since its publication. The subject facility was very close to achieving the objective (their result was within 2% of the target), having reduced their emissions of isoprene to the environment by 78% relative to the 2009 baseline year, from 17 401 kg in 2009 to 3 862 kg in 2018. Over the same time span, production volumes increased at the subject facility by 17%. The installation of a regenerative thermal oxidizer (RTO) to treat isoprene emissions at the facility contributed most substantially to achieving this reduction. The subject facility initially expected to implement its P2 plan by June 9, 2016; however, due to a significant failure of their RTO in 2014, the facility requested, and was granted, a time extension until December 31, 2018. Despite issues with the startup and reliability of their RTO in 2013 and 2014, the facility's emissions continued to decrease over that time period and they met their extended deadline. Details regarding the operational time and related decrease in isoprene emissions are provided below. Reports submitted by the subject facility are available upon request to ec.planp2-p2plan.ec@canada.ca. Some of the information presented in this document is derived from two reports submitted by the facility: the declaration of preparation and the declaration of implementation.

Figure 1: Overall change in industrial emissions of isoprene from the baseline year to the implementation year for the subject facility[1]



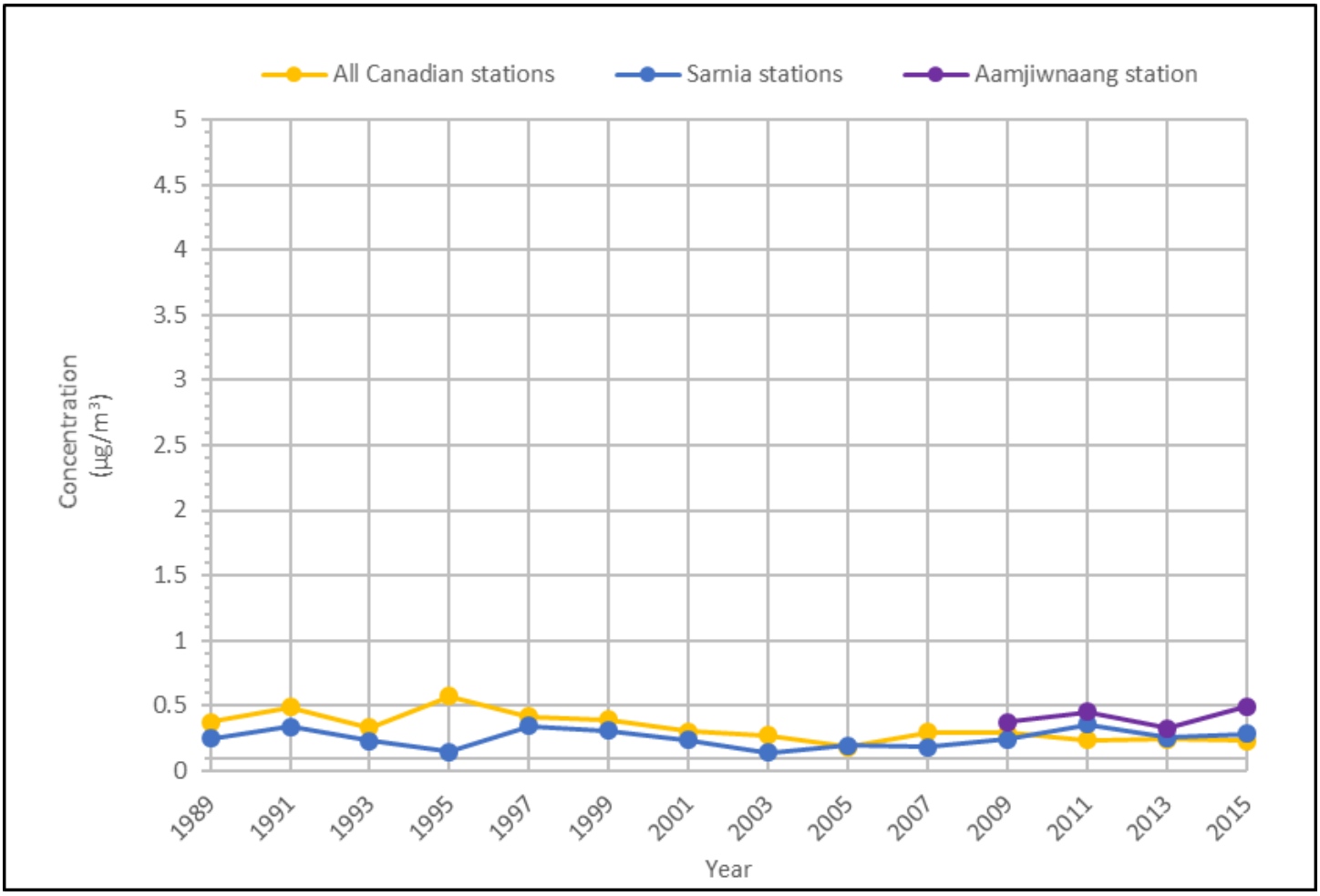
The RTO was installed in late 2012, and after the completion of commissioning and start-up, the RTO was operational for approximately 65% of the year 2013 resulting in a decrease of 48% in isoprene emissions between 2012 and 2013. Prior to the RTO failure in 2014, the equipment was operational for approximately 73% of the year. Therefore, the isoprene emissions released between the years 2013 and 2014 are similar and the RTO failure did not result in an average annual increase in isoprene emissions over the previous year. In 2015, the facility underwent a maintenance outage, which resulted in the RTO being operational for approximately 74% of the year. In 2016 and 2017, the RTO was operational for 83% and 86% of those years respectively, and resulted in further reductions to isoprene emissions, despite higher production levels during that time.

In order to evaluate the overall impact to the environment of these reductions in isoprene emissions, ECCC and HC have reviewed ambient air monitoring data. The National Air Pollution Surveillance (NAPS) program uses ISO 17025 accredited standardized methods to collect air quality data from outdoor stations across Canada. Data from the NAPS program, since 1989, are presented in Figure 2. Data is shown as 2-year averages for a

[1] National Pollutant Release Inventory (NPRI) data as of May 9, 2019.

combined three stations in Sarnia, a single station located in Sarnia closest to the subject facility (Aamijwnaang), and an average of all other stations monitoring isoprene across Canada. The 2-year average concentrations were used in order to account for seasonal variations of isoprene that occur in ambient air due to non-anthropogenic sources. The Aamjiwnaang monitoring station is located adjacent to the Aamjiwnaang First Nation, at 1300 Tashmoo Avenue, and approximately 4 km south of the subject facility. Figure 3 shows the locations of all NAPS stations across Canada that monitor for isoprene.

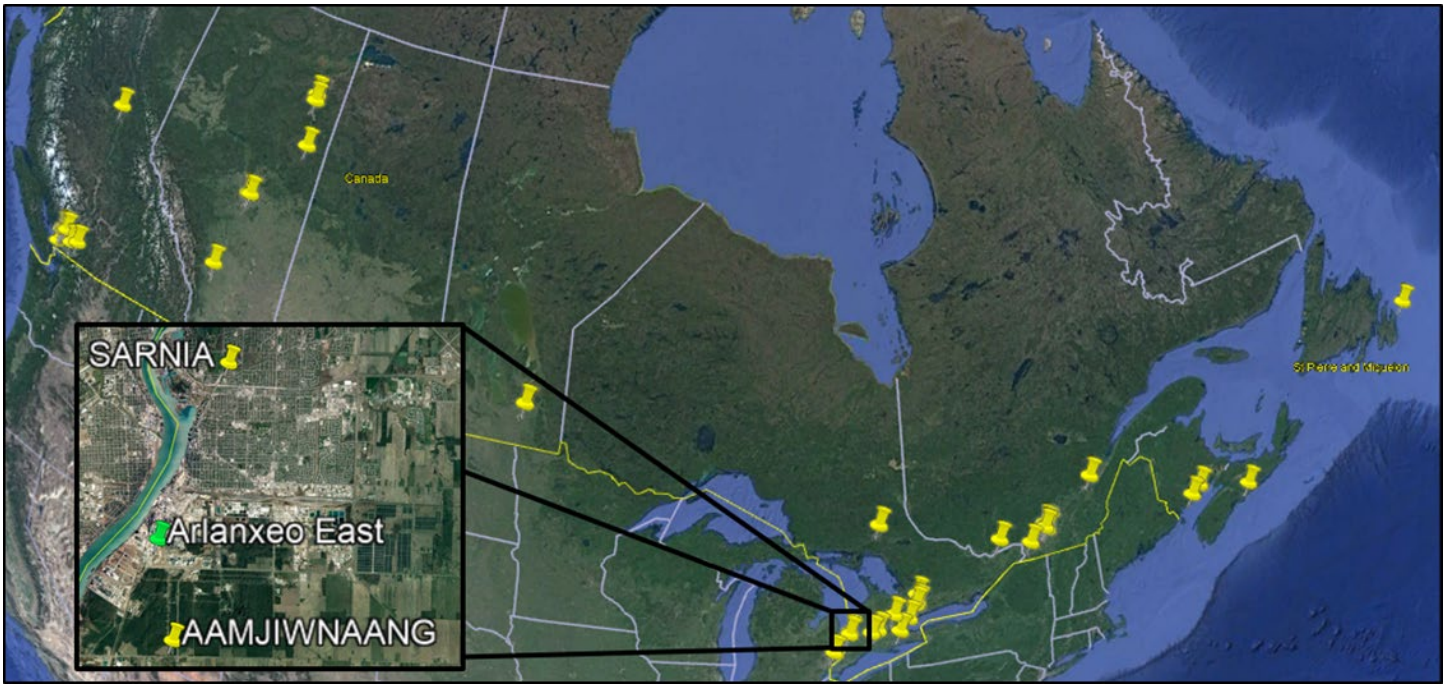
Figure 2: Isoprene ambient air concentrations



As Figure 2 shows, concentrations of isoprene at the Aamijwnaang station are slightly higher, but not significantly different than, the averages measured at the other three Sarnia stations and the averages measured at all other Canadian stations. The maximum 2-year average concentration measured at the Aamijwnaang station since monitoring began was determined to be 0.493 µg/m3. It should be noted that all 2-year average values, as well as all daily values recorded, are much lower than the non-carcinogenic effects threshold determined by Health Canada (final Screening Assessment Report) of 11,000 µg/m3. All 2-year average values are also lower than the concentrations found in a monitoring study conducted in homes and workplaces in the Philadelphia, Pennsylvania area. In the monitoring study, mean concentrations of isoprene in

personal air samples ranged from 4.65 µg/m3 in non-smoking homes to 18.2 µg/m3 in homes with smokers, and from 5.29 µg/m3 in non-smoking workplaces to 22.8 µg/m3 in workplaces with smokers.[2]

Figure 3: Geographic locations of NAPS stations monitoring for isoprene in 2017



Actions taken to achieve the objective

The subject facility took four actions contributing to the objective. Three actions were pollution prevention methods and one was a pollution control method. Pollution prevention actions focus on avoiding the creation of pollutants, rather than trying to manage them after they have been created. The subject facility took the following actions to contribute to the objective:

- installation of a regenerative thermal oxidizer (RTO) to treat atmospheric exhaust (pollution control)
- improvement of their stripping and recovery process (pollution prevention);
- elimination of certain wastewater handling (pollution prevention); and
- enhancement of their leak detection and repair (LDAR) program (pollution prevention)

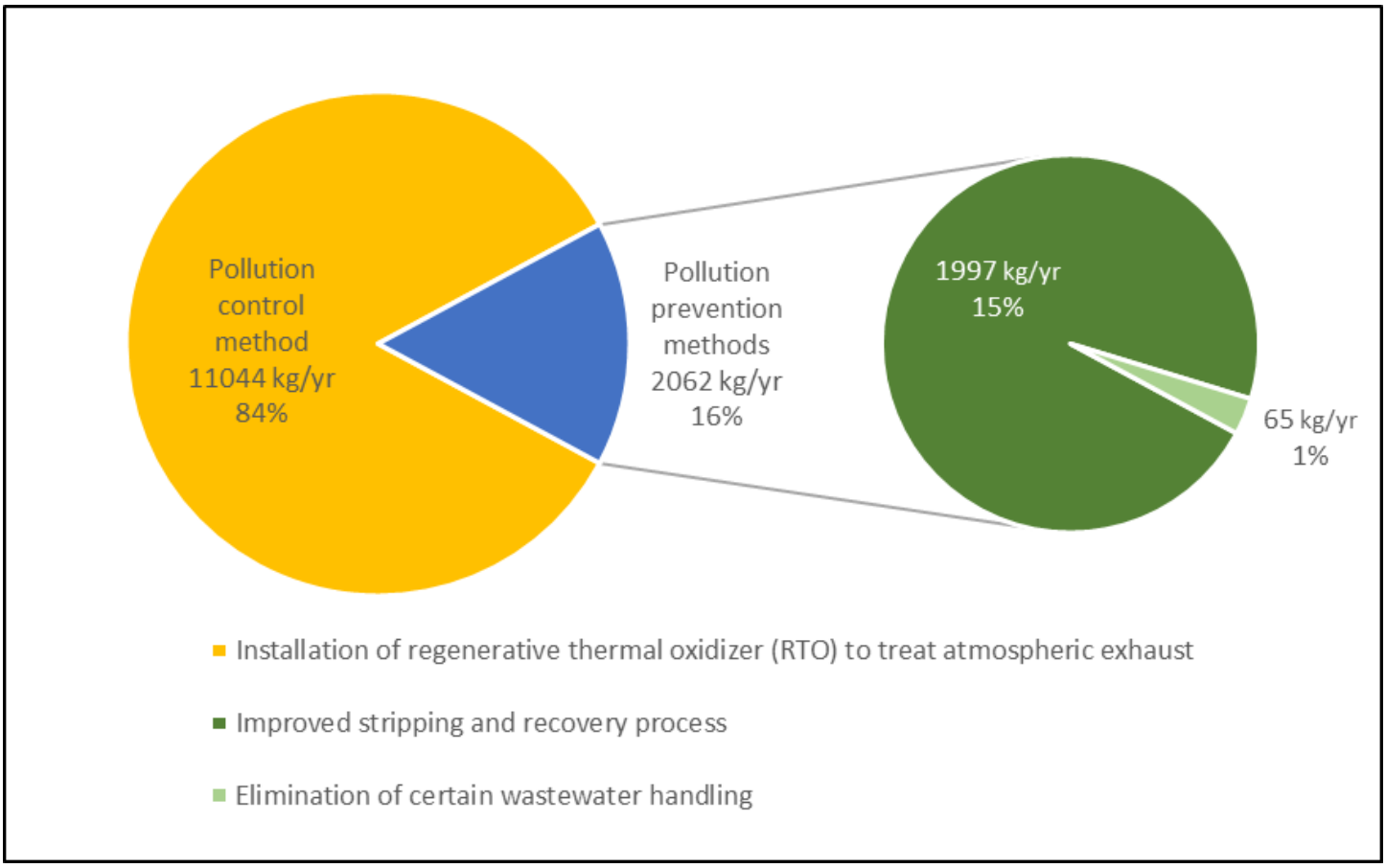
Reductions in emissions of isoprene achieved at the subject facility are broken down by action in Figure 4. The action with the largest impact on isoprene emissions was the installation of the RTO to treat atmospheric

[2] Heavner DL, Morgan WT, Ogden MW. 1996. Determination of volatile organic compounds and respirable suspended particulate matter in New Jersey and Pennsylvania homes and workplaces. Environ Int 22(2): 159-183

exhaust, which accounts for 84% of the overall reduction.

The enhancement of the facility's LDAR program did not result in a measurable reduction in isoprene emissions, therefore this action is not shown on Figure 4. However, the facility expects that the enhanced LDAR program will allow them to detect and repair leaks more quickly. Some year-to-year variability in fugitive emissions from equipment leaks is considered normal and expected.

Figure 4: Reductions in emissions of isoprene achieved by the implementation of actions at the subject facility by action type



Factors to consider

The Minister of the Environment requires any person subject to the P2 notice to consider a number of factors when preparing their P2 plan. Below is the summary of factors to consider and some information on how these factors were taken into consideration by the subject facility:

- Using BATEA to prevent or control the release of isoprene to air from the following emission sources: stack or point, storage or handling, fugitive, wastewater processes, and accidental or non-routine spills
    - The facility installed a RTO, which is considered BATEA, in 2012. Since the installation, the facility has encountered unplanned outages affecting the number of operation hours, but has worked

to refine RTO operation. The installation of BATEA had the greatest impact on the reduction of isoprene emissions.

- Establishing and implementing a leak detection and repair (LDAR) program
    - The facility enhanced their LDAR program in 2012. Although no measurable decrease in isoprene emissions to air in the implementation year was observed as a result of this action, the facility expects that the enhanced LDAR program will allow them to detect and repair leaks more quickly. Some year-to-year variability in fugitive emissions from equipment leaks is considered normal, and expected.
- Adopting standards and operating practices for controlling air emissions
    - The facility had certain emissions controls in place prior to the notice coming into force and have implemented additional operating practices over the course of the notice to help achieve reductions in fugitive isoprene emissions.
- The use of pollution prevention methods as a means of addressing the release to the environment of isoprene
    - The facility implemented a number of pollution prevention methods, including improved stripping and recovery operations and the elimination of certain wastewater handling, to reduce isoprene emissions to air.

Conclusion and next steps

Given that the objective of the notice was achieved within 2% of the target, and the human health objective to address identified concerns was to minimize exposure to isoprene to the extent practicable, it can be determined that the notice has contributed to the identified human health objective for isoprene by reducing anthropogenic emissions by 78% from the single largest industrial emitter. In general, anthropogenic sources of isoprene account for a small fraction of isoprene concentrations in ambient air. More information on the aggregate effectiveness of all actions taken by the Government of Canada in relation to isoprene is available here on the Government of Canada's website.

The presence of isoprene in Canada is not expected to increase in the near term, and monitoring will continue under the NPRI and NAPS programs. Up to date information about the notice including its status is available on the Government of Canada's website.

Background

In November 2008, the Ministers of the Environment and of Health concluded that isoprene meets the criterion set out in section 64(c) of the *Canadian Environmental Protection Act, 1999 (CEPA 1999)* and is toxic to human health.

On June 9, 2012, Environment and Climate Change Canada published a P2 notice in the *Canada Gazette,*

Part I. The P2 notice applies to persons or classes of persons who meet the following criteria:

- own or operate a facility within the synthetic rubber manufacturing sector which, at any time, purchases, imports or uses 100 kg/yr or more of isoprene; and
- are involved in one or more of the following activities:
    - manufacturing of butyl rubber, halobutyl rubber, styrene-isoprene-styrene block copolymers, polyisoprene (cis-1,4-polyisoprene) rubber, styrene-isoprene rubber, any other type of synthetic rubber
    - any other type of manufacturing activity within the synthetic rubber manufacturing sector that involves the use of isoprene

Isoprene storage is included in these activities.

Persons subject to the notice must prepare and implement a P2 plan, based upon consideration of all the factors to consider listed in the P2 notice, including determining industrial releases of isoprene to air and reducing on-site releases of isoprene to air by 80% relative to their baseline year releases. In addition, information must be submitted to Environment and Climate Change Canada twice during the implementation of the notice.

As of late 2019, one facility in Canada has reported meeting these criteria and submitted a declaration of preparation in 2013 and a declaration of implementation in early 2019. This facility declared that it manufactures butyl rubber and halobutyl rubber.