2025 Best Practices of Carbon Neutral Cities in East Asia

# Tokyo: "Best Mix" of Regulation and Voluntary Participation in VOCs Reduction




## 1. Background

Tokyo, Japan's capital and political, economic, and cultural center, has a population of 14 million. It includes a bustling central area, the green Tama region, and islands like the UNESCO-listed Ogasawara Islands. Though covering just about 0.6% of Japan's land, Tokyo houses about 11% of its population. Its Gross Regional Product reached roughly 113.7 trillion yen (~752.6 billion USD) in FY2021 (Fiscal Year 2021), with 88% from the tertiary sector. The city hosts over 620,000 businesses, mostly small and medium-sized enterprises (SMEs).

Tokyo faced serious air pollution problems from the late 1950s as the population and industry concentrated in the city. Specifically, sulfur dioxide ($SO_2$) from heavy oil combustion became a major issue. National regulations encouraged taller smokestacks to disperse pollutants; however, this was ineffective in dense urban areas and sometimes worsened pollution.

In response, Tokyo began promoting low-sulfur heavy oil in 1968, signed a pollution prevention agreement with Tokyo Electric Power Company, and introduced low-sulfur oil in public facilities. From 1971, the city enforced sulfur content regulations stricter than national regulations, including for buildings in central Tokyo, significantly reducing $SO_2$ emissions. By 1983, all monitoring stations met national standards for $SO_2$.

With rising motor vehicle use, Tokyo pioneered vehicle emission control measures in 1970, guiding the installation of emission reduction devices. Despite this, nitrogen dioxide ($NO_2$) and suspended particulate matter (SPM) from diesel vehicles remained a problem. To address this issue, the "No Diesel Vehicle Campaign" was launched in 1999 to promote diesel replacement, emission control devices, and tax reforms.

In 2000, Tokyo revised its ordinance to restrict diesel vehicle operation. Following the enactment of corresponding ordinances in neighboring prefectures, the regulations were simultaneously implemented across the Tokyo metropolitan area in 2003. By 2004, nearly all monitoring stations in Tokyo met SPM standards. Responding to Tokyo's request, Japan's petroleum industry took decisive action to fully eliminate sulfur from gasoline and diesel fuel in 2005, after which the national government introduced the world's strictest diesel emission standards.

The Tokyo Metropolitan Government currently monitors air pollution at 84 sites, including 47 general stations in residential areas, 35 roadside stations along major roads, the Hinohara Station, and the Tokyo Skytree Elevated Station, with results published in real time online.

Thanks to the cumulative effects of various measures taken over many years, the concentrations of $NO_2$, SPM, $SO_2$, and carbon monoxide (CO) at all monitoring stations have consistently met national standards. Fine particulate matter ($PM_{2.5}$), which had long failed to meet environmental standards, also achieved compliance at all monitoring stations for the first time in FY2019. With this milestone achieved, Tokyo is moving beyond compliance and has set its own, even stricter $PM_{2.5}$ targets to further enhance its air quality.

Despite all those achievements, photochemical oxidant ($O_x$) levels continue to exceed national environmental standards at all monitoring stations. While the number of photochemical smog alerts issued each year has been on a declining trend, there are still alerts announced on several days across the year.




Kasumigaseki, Tokyo in 1970s and present

Source - Tokyo Metropolitan Government

Taken together, these observations show that Tokyo's remaining key challenges are the reduction of $O_x$ and $PM_{2.5}$, making the reduction of their common precursor, volatile organic compounds (VOCs), an urgent priority.

### • National Environmental Quality Standards in Japan (as of August 2025)

| | |
|---|---|
| **SPM** | · Daily average for hourly values ≤ 0.10 mg/m³; Hourly value ≤ 0.20 mg/m³ |
| **$SO_2$** | · Daily average for hourly values ≤ 0.04 ppm; Hourly value ≤ 0.1 ppm |
| **$NO_2$** | · Daily average for hourly values ≤ 0.04–0.06 ppm |
| **CO** | · Daily average for hourly values ≤ 10 ppm; 8-hour average ≤ 20 ppm |
| **$PM_{2.5}$** | · Annual average ≤ 15 μg/m³; Daily average ≤ 35 μg/m³ |
| **$O_x$** | · Hourly value ≤ 0.06 ppm |

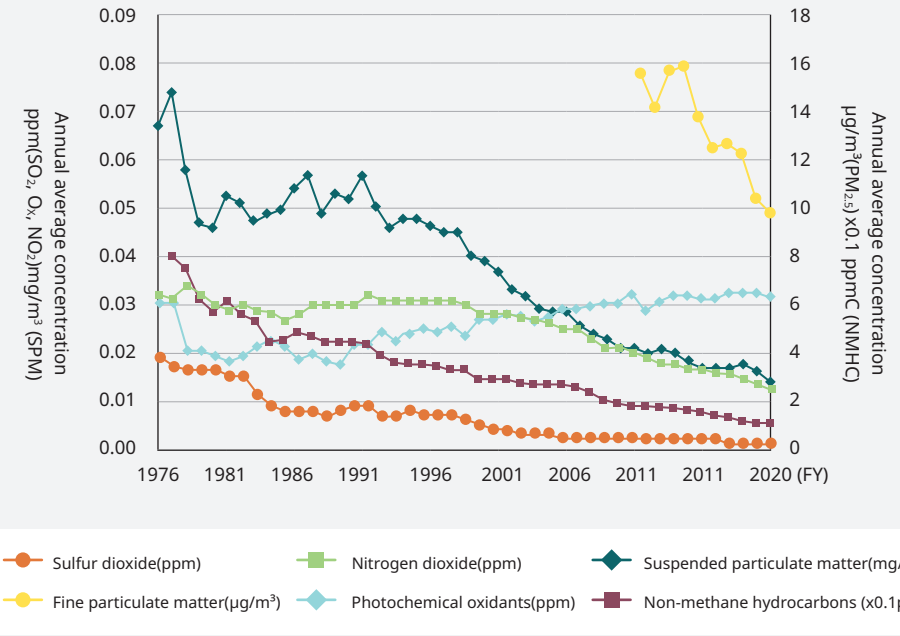
### • Tokyo's 2030 Targets for Air Quality

| | |
|---|---|
| **$PM_{2.5}$** | · Annual average ≤ 10 μg/m³ |
| **$O_x$** | · 3-year average of 4th-highest daily max 8-hour value ≤ 0.07 ppm |
| **Number of photochemical smog alert days** | **0** |

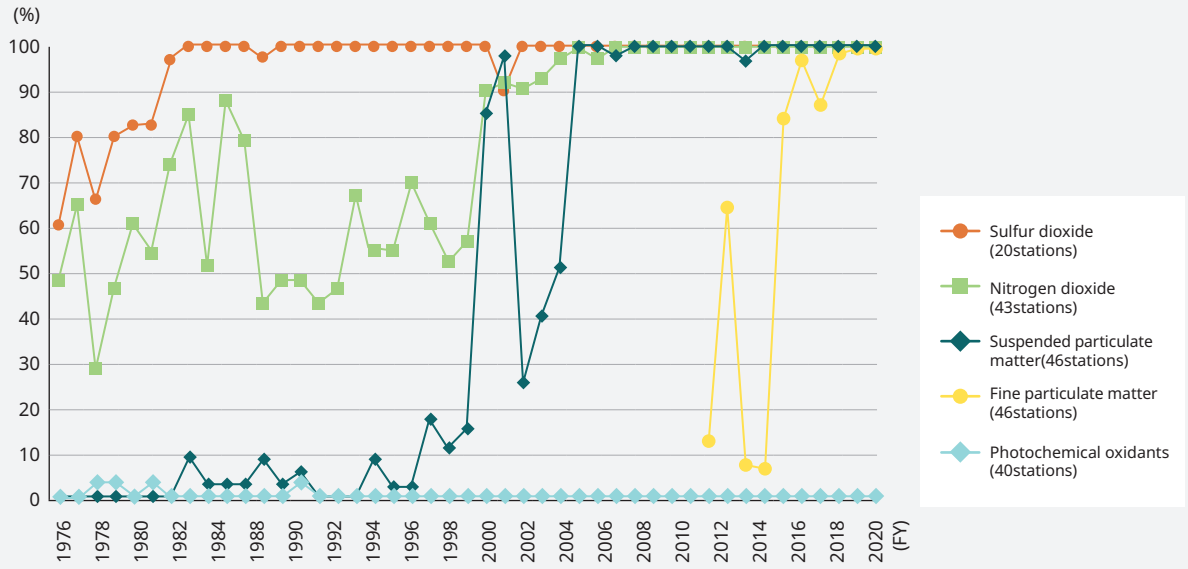
To effectively reduce and control VOCs emissions, identifying their primary sources within Tokyo is essential. The Bureau of Environment of the Tokyo Metropolitan Government calculates VOCs emissions every five years and subsequently publishes detailed emission inventories.

As the breakdown of VOC emissions and the table of emissions by source show, Tokyo's total VOCs emissions in FY2020 were around 50,800

**Changes in atmospheric concentrations** Source - Tokyo Metropolitan Government



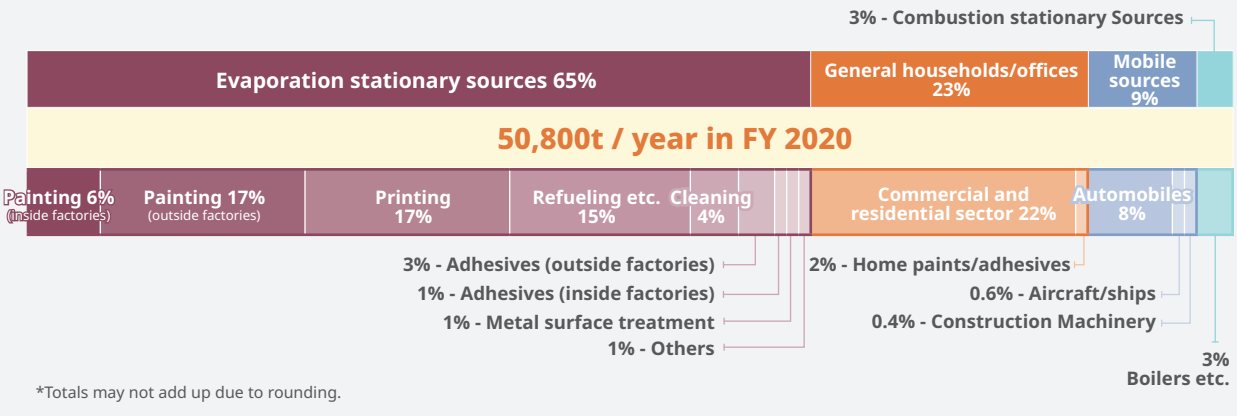
**Changes in environmental standard achievement rates** Source - Tokyo Metropolitan Government




tons: 68% from stationary sources (factories, gas stations, construction sites), 9% from mobile sources (vehicles, aircraft, ships), and 23% from households and offices. Among stationary sources, painting (6% indoor, 17% outdoor) was the largest contributor, followed by printing (17%), gas station refueling (15%), cleaning (4%), adhesives (4%), and boilers (3%). Among mobile sources, automobiles accounted for the highest emissions (8%).

From 2000 to 2020, total VOC emissions fell 63%, largely due to tighter vehicle standards, regulations, and voluntary business efforts. Mobile sources saw the largest reductions: automobiles (-90%), construction machinery (-86%), and aircraft/ships (-71%). Industrial activities also declined substantially, including metal surface treatment

**Breakdown of VOCs emissions in FY2020** Source - Tokyo Metropolitan Government




*Totals may not add up due to rounding.

• Table of VOCs Emissions by Source and Trends in Reduction Source- Tokyo Metropolitan Government

| | | FY 2000 | FY 2015 | FY 2020 | Reduction Rate 2000→2015 | Reduction Rate 2015→2020 | Reduction Rate 2000→2020 |
|---|---|---|---|---|---|---|---|
| Evaporation stationary sources | Painting (inside factories) | 11,440 | 4,440 | 3,190 | 61% | 28% | 72% |
| | Painting (outside factories) | 16,680 | 9,940 | 8,650 | 40% | 13% | 48% |
| | Printing | 20,540 | 8,770 | 8,710 | 57% | 1% | 58% |
| | Refueling etc. | 10,900 | 9,710 | 7,380 | 11% | 24% | 32% |
| | Cleaning | 6.010 | 4,090 | 1,810 | 32% | 56% | 70% |
| | Metal surface treatment | 3,080 | 840 | 580 | 73% | 31% | 81% |
| | Adhesives (inside factories) | 2,480 | 710 | 600 | 71% | 15% | 76% |
| | Adhesives (outside factories) | 2,280 | 2,000 | 1,510 | 12% | 25% | 34% |
| | Others | 1,870 | 390 | 470 | 79% | -21% | 75% |
| Combustion stationary Sources | Boilers etc. | 6,300 | 1,310 | 1,720 | 79% | -31% | 73% |
| Mobile sources | Automobiles | 37,450 | 5,540 | 3,830 | 85% | 31% | 90% |
| | Construction Machinery | 1,480 | 320 | 210 | 78% | 34% | 86% |
| | Aircraft / ships | 1,070 | 760 | 310 | 29% | 59% | 71% |
| General households/ offices | Commercial and residential sector | 13,910 | 10,470 | 10,950 | 25% | -5% | 21% |
| | Home paints / adhesives | 1,290 | 1,100 | 920 | 15% | 16% | 29% |
| **Total** | | **136,780** | **60,370** | **50,830** | **56%** | **16%** | **63%** |

*Totals may not add up due to rounding.

(-81%), indoor painting (-72%), indoor adhesives (-76%), cleaning (-70%), and printing (-58%). Outdoor painting (-48%) and gas station refueling (-32%) decreased moderately, while the reduction performance in commercial and residential sectors improved only 21%, raising its share of total emissions from 10.2% in 2000 to 21.5% in 2020.

# 2. Policy Analysis

## 2.1 VOCs Control Policies and Regulatory Frameworks

A distinctive feature of Tokyo's VOCs control strategy is its promotion of a "best mix" approach, balancing direct regulations and voluntary efforts. On the regulatory front, the **Air Pollution Control Act** and the **Tokyo Metropolitan Environmental Protection Ordinance** impose stringent emission controls on designated VOCs at facilities exceeding specific capacity thresholds. Tokyo also applies framework-based measures such as the **Pollutant Release and Transfer Register (PRTR) System** to strengthen the control. Specifically, while the national system requires reporting by businesses handling one ton or more of designated substances per year, Tokyo tightens this threshold to 100 kilograms. These measures promote proper chemical management by encouraging businesses monitor and control their emissions, thereby reducing environmental releases and mitigating potential health risks.

Beyond regulatory measures, voluntary initiatives are fostered with a sector-specific approach to reduce VOCs emissions. Measures include the adoption of emission-reducing practices and the promotion of low-VOCs products.

## 2.2 Sectoral Approaches to Advancing VOCs Reductions

Since many VOCs-emitting facilities in Tokyo are operated by SMEs that fall outside the scope of direct regulation, the Tokyo Metropolitan Government has strengthened efforts to promote voluntary action. This is implemented by providing source- and sector-specific guidance on emission reduction methods, technical assistance, promotion of low-VOCs products, financial support and provision of sector-based seminars.

### 1) Industrial Sources

The Tokyo Metropolitan Government focused on mitigating VOCs emissions from industrial facilities by providing sector-specific information to support emission reductions and by offering subsidies to SMEs for implementing reduction measures. Key targeted sectors include printing, painting, metal surface treatment, dry cleaning, construction and other related activities.

#### a. Technical Support

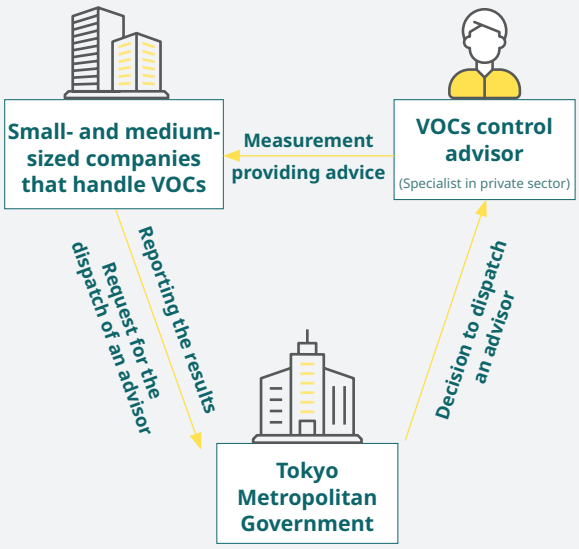
A flagship initiative of the Tokyo Metropolitan Government is the free **"Tokyo VOCs Reduction Advisor"** service for SMEs, including printing plants, painting facilities, and metal plating factories. Under this program, experts are dispatched to conduct simple VOCs measurements and provide tailored technical advice to facilities or organizations undertaking voluntary measures. For example, at an offset printing factory, the advisors conducted VOCs measurements at various spots following a preliminary consultation. Based on the findings, they provided targeted recommendations, including switching to alternative cleaning agents,

improving cleaning equipment, and revising the operation method of ventilation systems.

**VOCs Control Advisor Dispatching Program**

Advisors are dispatched to factories that use VOCs

Source - Tokyo Metropolitan Government






VOCs Reduction Advisor Activities at an Offset Printing Factory

Source - Tokyo Metropolitan Government

Complementing the VOCs Control Advisor Dispatching Program, the Tokyo Metropolitan Government has published industry-specific VOCs reduction guides, making control methods accessible to businesses lacking in-house expertise. These technical guides are available in two specialized editions: the **In-Factory Edition,** covering painting, printing, metal surface treatment, and dry cleaning (methods are also applicable to similar sectors); and the **Construction and Civil Engineering Edition,** which provide guidance on low-VOCs paints, waterproofing, floor coatings, and adhesives, while encouraging proactive emission reduction measures.




VOCs Reduction Guide

Source - Tokyo Metropolitan Government

Because VOCs emissions from outdoor painting and adhesive use are difficult to control at the source, reducing the VOCs content within the products themselves is essential. Recent advancements in paint technology allow low-VOCs products to perform on par with conventional solvent-based paints, simultaneously improving air quality, worker safety, and environmental protection. To encourage wider adoption, the Tokyo Metropolitan Government distributes educational brochures on low-VOCs solutions to both clients and contractors.




Low-VOCs Painting Application Brochures

Source - Tokyo Metropolitan Government

**b. Financial Support to Drive Market Transformation**

Recognizing that many SMEs face financial barriers when upgrading equipment to transitioning to low-VOCs materials, the Tokyo Metropolitan Government provides subsidies to SMEs in Tokyo that handle VOCs in operations such as in-factory painting, printing, or dry cleaning. The subsidies cover two-thirds of the total installation costs (with an upper limit) and assist with the expenses of installing VOCs emissions reduction equipment or air conditioning and ventilation systems equipped with VOCs reduction devices.

**c. Enforced Seasonal Management through Regional Cooperation**

During the summer months, intense solar radiation and high temperatures increase VOCs volatilization and $O_x$ formation, making regional coordination essential. To address this, the Tokyo Metropolitan Government actively participates in the **Kyuto-Kenshi Council's Environment Policy Committee**, collaborating with neighboring prefectures and cities on measures to reduce photochemical oxidants, $PM_{2.5}$, $NO_x$, and other pollutants.

### 2) Mobile/Transportation Sources

In Tokyo, VOCs emissions from motor vehicles account for only 8% of the total VOCs emissions. However, emissions during vehicle refueling represent a significant 15%. Therefore, the Tokyo Metropolitan Government has prioritized stringent measures to mitigate gasoline vapor loss.

**a. Vapor Recovery during Unloading: Stage I**

When gasoline is unloaded into underground tanks, vapors must be captured; otherwise, VOCs are released each time. Under the metropolitan ordinances, it is mandatory for stations exceeding specific storage capacity to install Stage I equipment. Similar requirements are enforced in neighboring municipalities to ensure regional consistency.

**b. Vapor Recovery during Refueling: Stage II**

Gasoline vapors are generated when fuel is dispensed into a vehicle's gas tank. To prevent these vapors from escaping into the atmosphere, Tokyo promotes the Stage II vapor recovery system. This system utilizes a double-structured pump nozzle to capture fuel vapors at the point of refueling, liquefy them, and return them to the storage system for reuse. The Tokyo Metropolitan Government incentivizes the adoption of this technology by offering SME subsidies covering up to two-thirds of installation costs (with an upper limit).

**c. Vapor Control while Parked: Idling Stop**

Under the Environmental Preservation Ordinance, the Tokyo Metropolitan Government mandates that drivers extinguish when their vehicle or motorcycle is stationary. In addition, owners and managers of parking facilities with 20 or more parking slots are legally required to ensure compliance through signage and active user notification.

**d. Diesel Vehicle Regulations and Tokyo Vehicle Emission Reduction Program**

The Tokyo Metropolitan Government introduced diesel vehicle regulations in 2003, prohibiting non-compliant diesel freight vehicles, large buses, and special-purpose vehicles from operating unless

they are equipped with Particulate Matter (PM) reduction devices. While primarily targeted at PM, the policy also significantly reduced VOCs and other pollutants, since vehicle exhaust is a major source of VOCs emissions. As shown in the Table of VOC Emissions by Source and Trends in Reduction, VOCs emissions from automobiles dropped by about 85% between 2000 and 2015, reflecting the impact of Tokyo's diesel vehicle regulations, alongside national emission standards for gasoline vehicles.

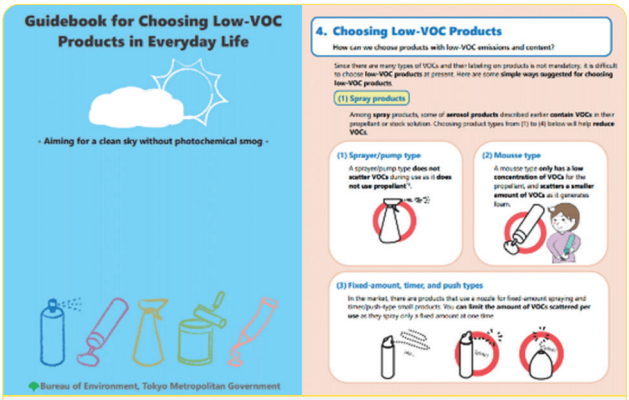
Complementing these regulations, the Tokyo Vehicle Emission Reduction Program requires businesses operating fleets of 30 or more vehicles to submit emission reduction plans and annual performance audits. To achieve their reduction targets, companies are encouraged to take measures such as introducing low-emission vehicles, promoting eco-driving, and improving fleet efficiency. Notably, large operators with 200 or more vehicles are mandated to achieve a 30% non-gasoline vehicle ratio by 2027. By reducing reliance on gasoline and diesel vehicles, which are key VOCs emitters, the program supports further reductions in $CO_2$, VOCs, and other air pollutants.

### 3) Domestic Sources

Of Tokyo's roughly 50,000 tons of annual VOCs emissions, households and offices contribute about 11,000 tons (23%). Major sources include aerosol sprays, paints, adhesives, cosmetics, and insect repellents. As these sources are not legally regulated, voluntary efforts are essential. To drive this shift, the Tokyo Metropolitan Government focuses on raising awareness of associated risks, such as sick building syndrome and fire hazards from flammable gases.

#### a. Guidebook for Choosing Everyday Low-VOCs Products

To empower residents to make informed purchasing decisions, the city published a guidebook on selecting low-VOCs products and services, such as pump-spray insect repellents, water-based paints and adhesives, and roller-applied paints. Using clear illustrations, the guide shows how daily choices contribute directly to reducing VOCs emissions. It also deciphers product labelling and highlights the multifaceted benefits of low-VOCs alternatives, including improved air quality with less odors, reduced sick building syndrome and less skin irritation, as well as enhanced safety, specifically the reduction of fire risks associated with volatile gases.

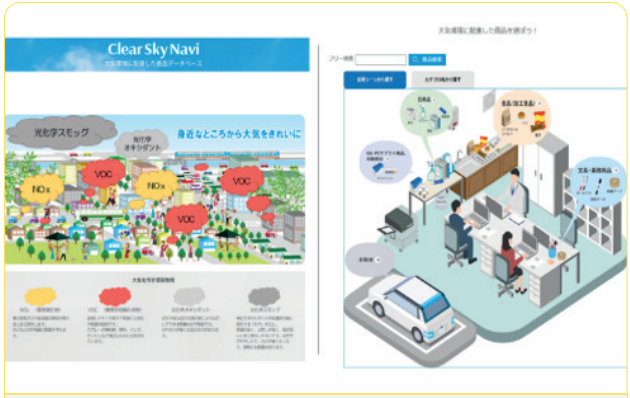



Guidebook for Choosing Low-VOCs Products in Everyday Life Source - Tokyo Metropolitan Government

#### b. Clear Sky Navi: a Database of Products for Improving Air Quality

The Tokyo Metropolitan Government, in partnership with the Green Purchasing Network, established "Clear Sky Navi," a database featuring products designed to minimize air quality impact.

Users can search for items using keywords, such as stationery using low-VOCs inks and adhesives, or food products with packaging printed using water-based inks or other environmentally friendly printing methods. Some search results include direct links to purchase sites, making it easy for Tokyo residents to identify and acquire low-VOCs products that contribute to improving air quality.




Clear Sky Navi Website

Source - Green Purchasing Network

# 3. Case Study: Clear Sky Project

## 3.1. Background and Objectives

By 2020, Tokyo had reduced VOCs emissions by 63% compared to 2000 levels, demonstrating the effectiveness of its “best mix” of regulatory measures and voluntary business initiatives. However, despite this substantial progress, concentrations of $O_x$ have not significantly declined. While the number of photochemical smog alerts has decreased, they continue to be issued every year. In addition, further reductions in $PM_{2.5}$ are required to achieve the newly established air quality targets.

To address these persistent challenges, the Tokyo Metropolitan Government introduced the “Clear Sky Project”, a new approach that focuses on areas where emission reductions have been limited, such as commercial and residential activities. The initiative also reinforces ongoing efforts in other sectors and encourages broader participation and awareness raising among individuals and businesses to further improve air quality. The “Clear Sky Project” establishes a cooperative framework in which citizens, businesses, and the government work together to improve air quality. By encouraging and advancing control measures on key precursors such as VOCs across all sectors, the project aims to lower $O_x$ and $PM_{2.5}$ levels, and ultimately achieve a visibly “Clear Sky” for everyone in Tokyo. Because air pollution is influenced by a wide range of daily activities, the project emphasizes that further progress is only possible through the active participation of all members of society.




Clear Sky Logo and project image
Source - Tokyo Metropolitan Government

## 3.2. Implementation

To encourage broad participation across society, the Clear Sky Project rests on three main pillars, which connect institutional initiatives with the actions of businesses and individuals, transforming abstract air-quality goals into concrete, community-based engagement.

### 1) Clear Sky Supporter System and Clear Sky Supporter Award

The Tokyo Metropolitan Government proactively certifies businesses and organizations that voluntarily implement measures to reduce air pollutants, including VOCs. Registered **Clear Sky Supporters** receive an official certificate and logo for use in their corporation communications, which serves to raise awareness among customers and employees.

To strengthen engagement, the city organizes

the **Clear Sky Supporter Award**, which highlights exemplary corporate efforts. The selection process involves a self-nomination phase, with finalists selected by citizen votes. The Tokyo Metropolitan Government produces promotional videos for the finalists and shares them through official websites and social media, creating a cycle of recognition, visibility, and motivation for voluntary improvement across industries.

### 2) Clear Sky Individual Supporter System and Clear Sky Photo Contest

To engage citizens, the Tokyo Metropolitan Government invites residents to become **Clear Sky Individual Supporters** by completing a simple air-quality quiz. Participants receive digital certificates and are encouraged to share project information about the Clear Sky Project, as well as their own air-friendly actions, on social media.

Complementing this, the annual Clear Sky Photo Contest, held on Instagram since 2021, invites residents to post photos of Tokyo's sky under specific themes such as "Tokyo's Sky × Vehicles". This initiative transforms everyday observations into environmental awareness, making clean air a tangible and essential goal in our daily lives.

### 3) Outreach Classes and Environmental Education

Targeting youth and the next generations, Tokyo also conducts specialized outreach classes at schools under the theme "Understanding Tokyo's Sky". These educational sessions introduce the history and science of air pollution and encourage students to reflect on their role in environmental protection. Delivered upon request to schools, these classes aim to foster a sense of awareness and civic responsibility among the younger generation, ensuring the sustainability of clean air initiatives.

## 3.3. Outcomes

Since its launch, the Clear Sky Project has successfully demonstrated that voluntary and participatory initiatives can effectively complement regulatory measures. As of August 2025, 328 businesses and organizations are registered as Clear Sky Supporters, representing diverse sectors ranging from transportation, construction to fuel sales, printing, and manufacturing. The Clear Sky logo has become a visible mark of environmental




Poster for the 8th Clear Sky Photo Contest
Source - Tokyo Metropolitan Government



Outreach Class at an Elementary School in Tokyo
Source - Tokyo Metropolitan Environmental Public Corporation

leadership, displayed on company websites and at office locations.

Public engagement has also grown steadily. Since 2022, 481 residents have registered as Individual Supporters, and the annual Photo Contest, now in its 8th edition, continues to encourage public participation and creative engagement with air quality issues. Furthermore, the Clear Sky Supporter Award has inspired companies to share effective practices, while the introduction of citizen voting further increased public interest in business-led air quality initiatives. Promotional videos of finalists received wide attention, boosting visibility and creating positive “peer pressure” across industries.

Educational outreach has also been impactful, with elementary school students gaining an early understanding of the causes and solutions of air pollution, which reinforces the project’s long-term social impact.

Overall, the Clear Sky Project has transformed awareness into collective action, fostering a shared sense of responsibility for Tokyo’s air among citizens, businesses, and the government. It has successfully communicated that VOCs reduction is essential for keeping Tokyo’s air clean, and that emissions come not only from industrial and business but also from individual activities, encouraging everyone to reflect on their own environmental footprint.

## 4. Reflections and Recommendations

Tokyo's experience demonstrates that focusing solely on reducing VOCs emissions from major sources like industrial and transportation is insufficient. As the remaining emissions increasingly stem from a wide range of everyday activities and diffuse sources, achieving further progress requires a broader and more comprehensive approach that integrates VOCs and $NO_x$ reduction with fundamental shifts in societal behavior and participation.

For this reason, Tokyo pursues a balanced strategy that not only targets remaining emissions in challenging sectors but also ensures continued progress toward overall good air quality. Engaging those SMEs that have not yet implemented voluntary measures, as well as individuals outside the scope of regulations, remains essential. In this context, the Clear Sky Project serves as a practical and effective model that shows how voluntary action can successfully complement regulatory frameworks to meet emerging environmental challenges.

Looking ahead, a key challenge will be to further embed the Clear Sky Project among Tokyo residents and businesses to stimulate a broader and self-sustaining movement. Furthermore, as air quality issues transcend administrative boundaries, expanding this initiative to neighboring prefectures and cities through regional cooperation will be vital. On a global scale, this replicable initiative holds strong potential as a best practice for international city-to-city collaboration in urban air quality management.

## References


- Bureau of Environment, Tokyo Metropolitan Government. (2006). 東京都環境白書2006 [Tokyo environmental white paper 2006]. https://www.kankyo.metro.tokyo.lg.jp/documents/d/kankyo/torikumi-cat8292-files-2006hakusyo
- Bureau of Environment, Tokyo Metropolitan Government. (2006, February). VOC対策アドバイザー派遣の様子 [VOC reduction advisor activities at an offset printing factory]. https://www.kankyo.metro.tokyo.lg.jp/air/air_pollution/voc/adviser/adviser_news
- Bureau of Environment, Tokyo Metropolitan Government. (2016, March). 低VOC塗装施工ハンドブック [Low-VOC painting application brochures]. https://www.kankyo.metro.tokyo.lg.jp/air/air_pollution/voc/low_voc_painting
- Bureau of Environment, Tokyo Metropolitan Government. (2016, March). 低VOC塗装施工リーフレット [Low-VOC painting application leaflet]. https://www.kankyo.metro.tokyo.lg.jp/documents/d/kankyo/low_voc_painting-index-files-low_voc_leaflet
- Bureau of Environment, Tokyo Metropolitan Government. (2016, March). 東京都VOC対策ガイド（工場内編）[Tokyo VOC reduction guide (In-factory edition)]. https://www.kankyo.metro.tokyo.lg.jp/documents/d/kankyo/guide-guide-files-kankyo1370
- Bureau of Environment, Tokyo Metropolitan Government. (July 2019)]. 大気中微小粒子状物質検討会報告書（令和元年7月）[Report of the committee on fine particulate matter (2019)]. https://www.kankyo.metro.tokyo.lg.jp/documents/d/kankyo/torikumi-pm25_ox-report2019-files-1
- Bureau of Environment, Tokyo Metropolitan Government. (2021, February). 東京都VOC対策ガイド（建築・土木工事編）[Tokyo VOC reduction guide (construction and civil engineering Edition)]. https://www.kankyo.metro.tokyo.lg.jp/documents/d/kankyo/guide-guide-files-vocguide_r02_all_light
- Bureau of Environment, Tokyo Metropolitan Government. (2022, September). Tokyo environmental master plan 2022. https://www.kankyo.metro.tokyo.lg.jp/documents/d/kankyo/masterplan-full_version
- Bureau of Environment, Tokyo Metropolitan Government. (2024, September). Creating a brighter future for all -a green and resilient global city Tokyo opens up a future. https://www.kankyo.metro.tokyo.lg.jp/documents/d/kankyo/-creating2024_e2
- Bureau of Environment, Tokyo Metropolitan Government. (2024, September). Guidebook for choosing low-VOC products in everyday life. https://www.kankyo.metro.tokyo.lg.jp/documents/d/kankyo/r5_guidebook_en_20240308
- Bureau of Environment, Tokyo Metropolitan Government. (2025, March). 東京都環境白書2024 [Tokyo environmental white paper 2024]. https://www.kankyo1.metro.tokyo.lg.jp/dbook/202503/2025-03_tokyo_hakusho/#page=1
- Bureau of Environment, Tokyo Metropolitan Government. (n.d.). Tokyo air Information. https://www.taiki.kankyo.metro.tokyo.lg.jp/taikikankyo/realtime/index_en.html
- Bureau of Environment, Tokyo Metropolitan Government. (n.d.). 揮発性有機化合物（VOC）対策 [VOC measures].

https://www.kankyo.metro.tokyo.lg.jp/air/air_pollution/voc

・Bureau of Environment, Tokyo Metropolitan Government. (n.d.). 大気をきれいにしてきた取組の歴史 [The history of efforts to clean the air]. https://www.kankyo.metro.tokyo.lg.jp/air/air_pollution/torikumi/cat8292

・Bureau of Environment, Tokyo Metropolitan Government. (n.d.). Clear sky実現に向けた大気環境改善促進事業 [Clear sky project]. https://www.kankyo.metro.tokyo.lg.jp/air/air_pollution/torikumi/clearsky/

・Bureau of Environment, Tokyo Metropolitan Government. (n.d.). 第8回Clear sky フォトコンテスト [the 8th Clear Sky Photo Contest]. https://www.kankyo.metros.tokyo.lg.jp/air/air_pollution/torikumi/clearsky/clearsky_photo/100

・Bureau of Environment, Tokyo Metropolitan Government. (n.d.). 身の回りにあるVOC製品 [Everyday VOC products]. https://www.kankyo.metro.tokyo.lg.jp/air/air_pollution/voc/voc_life/voc_around_us

・Bureau of Environment, Tokyo Metropolitan Government. (n.d.). Tokyo photochemical smog information. https://www.ox.kankyo.metro.tokyo.jp/print_english.php

・Bureau of Industrial Labor Affairs, Tokyo Metropolitan Government. (2024, September). 東京の産業と雇用就業2024 [Industries and employment in Tokyo 2024]. https://www.sangyo-rodo.metro.tokyo.lg.jp/documents/d/sangyo-rodo/5c91b50d56e-fac18e04208cf28dc5c6e

・Green Purchasing Network. (n.d.). 大気環境に配慮した商品データベース [A database of products for improving air quality]. https://www.gpn.jp/clearskynavi/

・Tokyo Metropolitan Environmental Public Service Corporation. (n.d.). Clear sky実現に向けた大気環境改善促進事業 [Clear Sky project]. https://www.tokyokankyo.jp/learn/clear-sky/

・Tokyo Metropolitan Environmental Public Corporation. (n.d.). Clear skyについての出前授業　[Outreach class at an elementary school in Tokyo]. https://www.tokyokankyo.jp/learn/clear-sky/

・Tokyo Metropolitan Environmental Public Service Corporation. (2005). Annual report 2005. Reduction of Polycyclic Aromatic Hydrocarbons by the Diesel Vehicle Regulation. https://www.tokyokankyo.jp/kankyoken_contents/report-news/2005/jidosha-1.pdf

・Ueno, H. (2018). ガソリンスタンドにおける燃料蒸発ガスについて [Fuel vapor emissions at gasoline stations]. https://www.tokyokankyo.jp/kankyoken/wp-content/uploads/sites/3/2018/02/5-5ueno.pdf

Author I **Ryoko Karaki**

Editor I **Yuan Yuan, Siqiao Yuan**

**Acknowledgement**

This report was prepared primarily based on publicly available information and open-source materials. The authors would like to acknowledge the Tokyo Metropolitan Government for providing background data for this report. The views expressed in this report remain those of the authors and do not necessarily reflect the official positions of the respective governments.