



European Green Capital Award 2025

Brescia application Indicator 1

1. Air Quality

1.A Present Situation

Please complete the following table with **official data** from sampling points reporting under the Ambient Air Quality Directive (2008/50/EC) ^{1 2}. Please provide the most recent data that is available.

Table 1: Benchmarking Data - Air Quality

* For EGL applicants the following applies: in case there are no sampling points reporting under the Ambient Air Quality Directive in the city, indicate to which air quality zone the city belongs and briefly describe the latest air quality assessment available for this zone.

Indicator for each sampling point (only sampling points reporting under the Ambient Air Quality Directive (2008/50/EC))		Unit	Year of Data
Number of sampling points reporting PM _{2.5}	3	No.	2022
Annual average PM _{2.5} concentration for each sampling point	17 Broletto 23 Villaggio Sereno 21 San Polo	µg/m ³	2022
Number of sampling points reporting PM ₁₀	3	No.	2022
Annual average PM ₁₀ concentration for each sampling point	31 Broletto 33 Villaggio Sereno 32 Tartaglia	µg/m ³	2022
Number of days where the daily limit value for PM ₁₀ of 50 µg/m ³ has been exceeded per year for each sampling point	47 Broletto 60 Villaggio Sereno 47 Tartaglia	No.	2022
Number of sampling points reporting NO ₂	5	No.	2022
Annual average NO ₂ concentration for each sampling point	26 Broletto 26 Villaggio Sereno 37 Turati 37 Tartaglia 24 San Polo	µg/m ³	2022
Number of hours in which the hourly limit value for NO ₂ of 200 µg/m ³ has been exceeded per year for each sampling point	0 Broletto 0 Villaggio Sereno 0 Turati 0 Tartaglia 0 San Polo	No.	2022

Please elaborate on the benchmarking data entered in the table above. Please provide the following information:

¹ <https://www.eea.europa.eu/themes/air/air-quality-concentrations/classification-of-monitoring-stations-and>

² <https://www.eea.europa.eu/themes/air/explore-air-pollution-data>

1. A breakdown of the sources of air pollution (e.g. the contribution of different local sources and from long-range transport to the annual mean concentration of PM_{2.5}, PM₁₀ and NO₂, as mentioned in the table above).
2. Maps of air pollutant concentrations. If there are other sampling points in your city besides those reporting under the Ambient Air Quality Directive (2008/50/EC), please also provide data from this additional monitoring and/or modelling, and indicate clearly which data falls into which category.
3. The existence and implementation status of an air quality plan as per the Ambient Air Quality Directive (2008/50/EC).
4. The city's current approach to informing, raising awareness and engaging citizens in terms of air quality.

(max. 1000 words and five graphics, images or tables)

Framework of emissions

The city of Brescia is in the middle of *Po Valley*, a broad flat area surrounded on three sides by mountains (Alps and Apennines) and thus characterized by weak wind circulation and weather conditions prone to the accumulation of air pollution.

In the winter months, it is frequently noted the phenomenon of ***thermal inversion***. When the mixing layer height decreases significantly, the accumulation of pollutants intensifies, as shown in the following figure.

As a result of this complex situation of pollutant accumulation, the municipal administration installed two weather stations (currently owned by *A2A Calore & Servizi s.r.l.*), in addition to the meteorological network of the Regional Agency for Environmental Protection (*ARPA*) of the Lombardy Region, namely:

- ✓ Mompiano station: equipped with ultrasonic anemometer, global radiometer, net radiometer, thermohygrometer, barometer, and rain gauge.
- ✓ Verzano station: equipped with ultrasonic anemometer, global radiometer, net radiometer, infrared radiometer, thermo-hygrometer, and rain gauge. The station is also equipped with a SODAR (SONic Detection And Ranging) able to measure upper-level wind (up to a height of about 300 m).

Besides meteorological data, the mixing height (H_{mix}) is calculated on both stations.

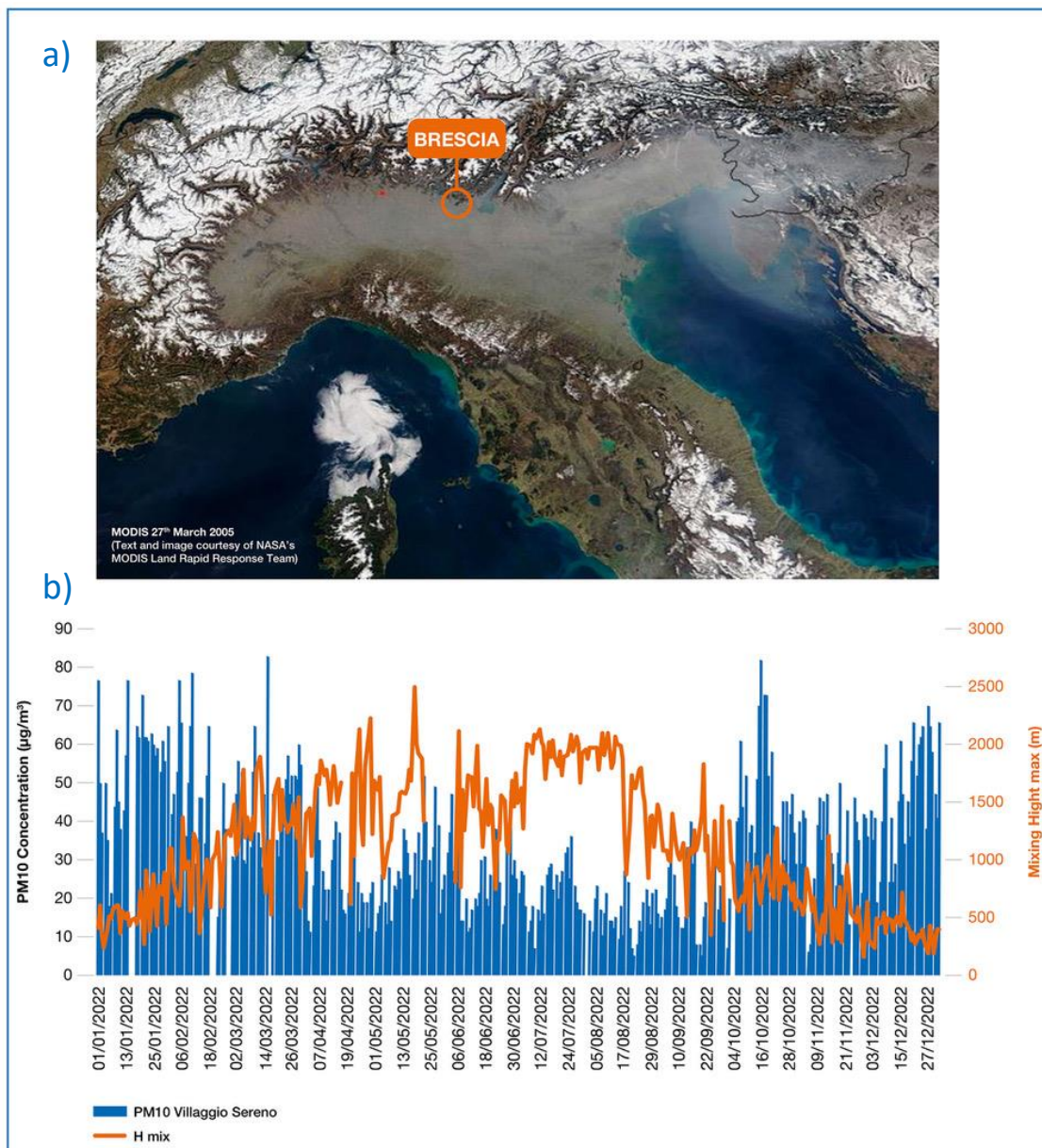


Figure 1: a) Po valley and city of Brescia's localisation; b) h-mix max values and PM10 daily concentrations years 2022

The emission inventory (Inemar)

The INEMAR emissions inventory [1], developed by *ARPA Lombardy*, inter alia estimates the direct emissions of NO_x , PM10 and PM2.5 for the Municipality of Brescia and the regional territory. The percentage breakdown into emission macro sectors of the latest available data (2019) is shown in the graph (Figure 2(a)).

Source Apportionment

In 2015, the University of Brescia assessed in a study [2] the role of emissions from human activities in the production and accumulation of PM10 particulates and Nitrogen Dioxide (NO_2) concentrations. According to the emission framework considered in the study, the CAMx multi-phase model was applied to the domain related to the Po Valley. Figure 2(b) and Figure 2(c) show the source apportionment (the impact of emissions from the different groups on PM10 and NO_2 concentrations

in the Municipality of Brescia). Emission sources within the territory of the Municipality of Brescia account for about 20% of NO₂ concentrations and 7% of PM₁₀ concentrations.

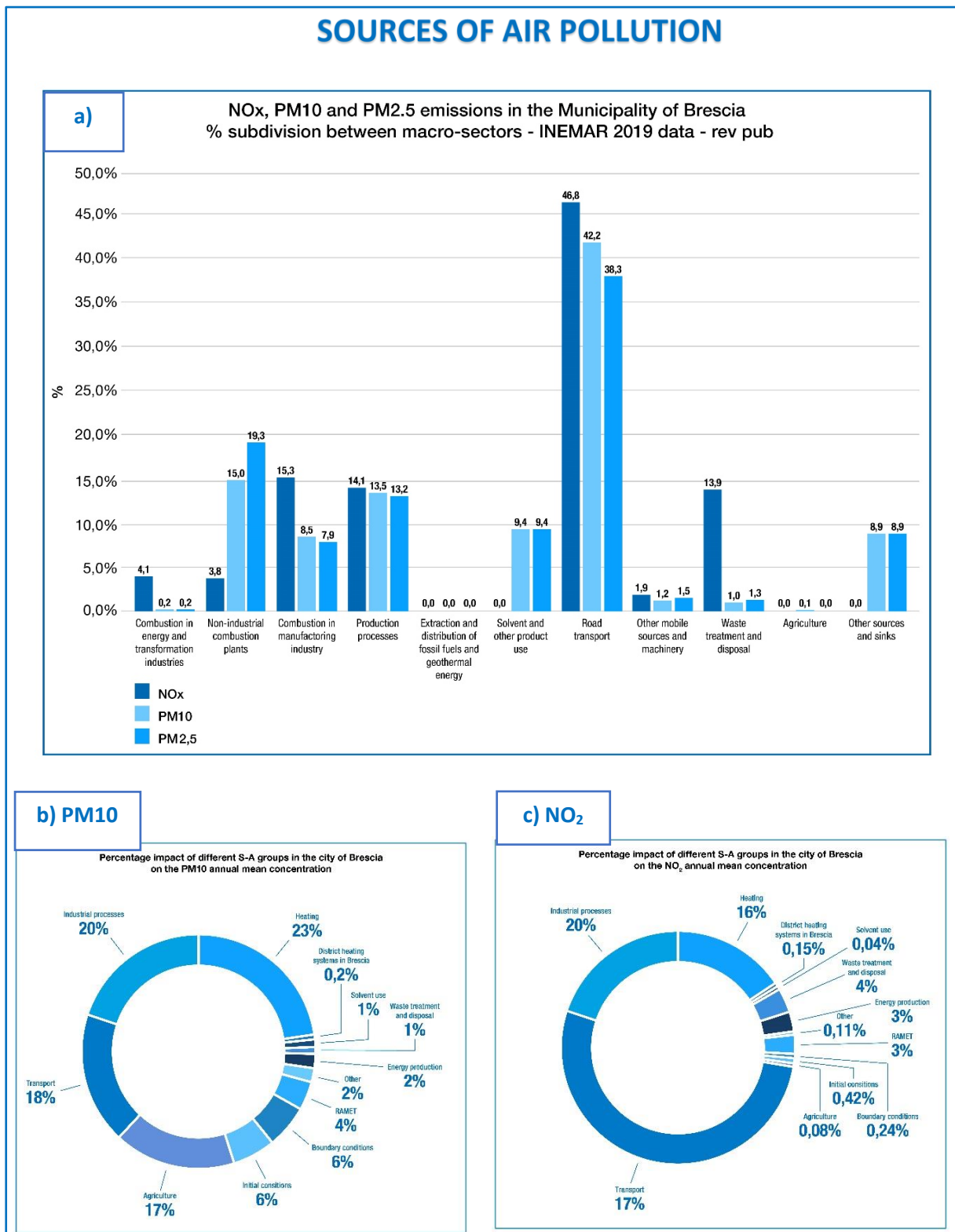


Figure 2: a) PM₁₀, NO_x, PM_{2.5} emissions. b) c) PM₁₀ and NO₂ source apportionment % breakdown in macro-sectors

Air-quality modelling assessment

ARPA Lombardy performs annual and daily modelling assessments (concentrations of PM10, PM2.5, NO2, O3) of air quality throughout the Lombardy Region and in the municipal area [3]. This process allows to assess pollution levels and trends even in areas not monitored with fixed monitoring stations.

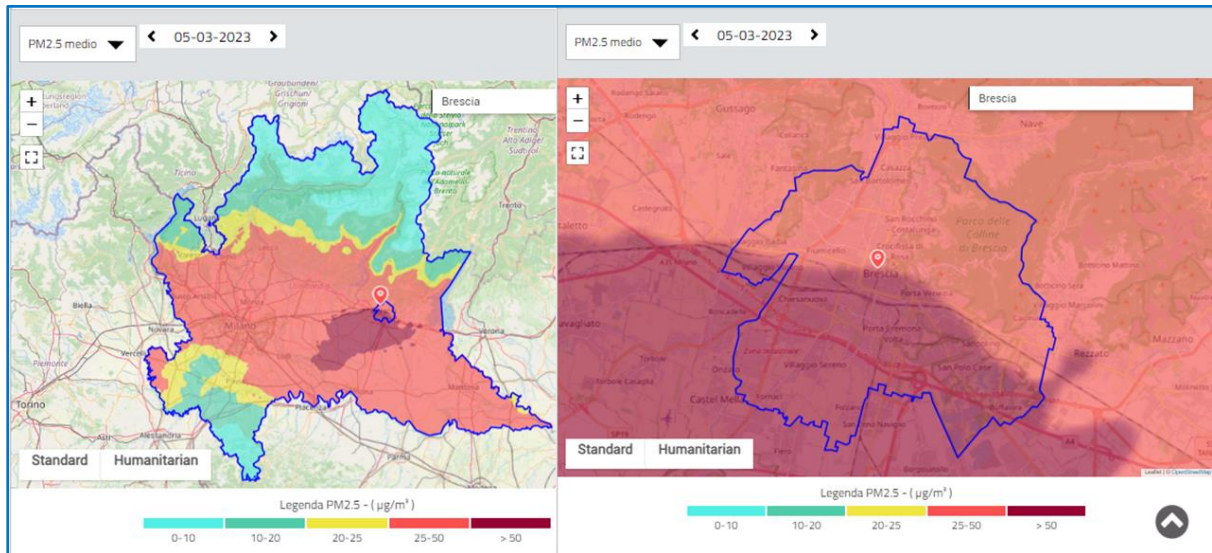


Figure 3: Maps of the simulated daily average PM2.5 concentration _ Lombardy Region and Municipality of Brescia_ ARPA Lombardy_05_03_2023

Brescia agglomeration

The Lombardy Region established the agglomeration of Brescia as including the provincial capital and 18 neighbouring municipalities. It is a densely populated area, characterized by high emissions of primary PM10, NOx and VOC, weather conditions frequently unfavourable to pollutant dispersion, high density of industrial activities and heavy road traffic.

Monitoring network and pollutant trends

The following image shows the structure of the city air quality monitoring network, owned and managed by ARPA Lombardy.

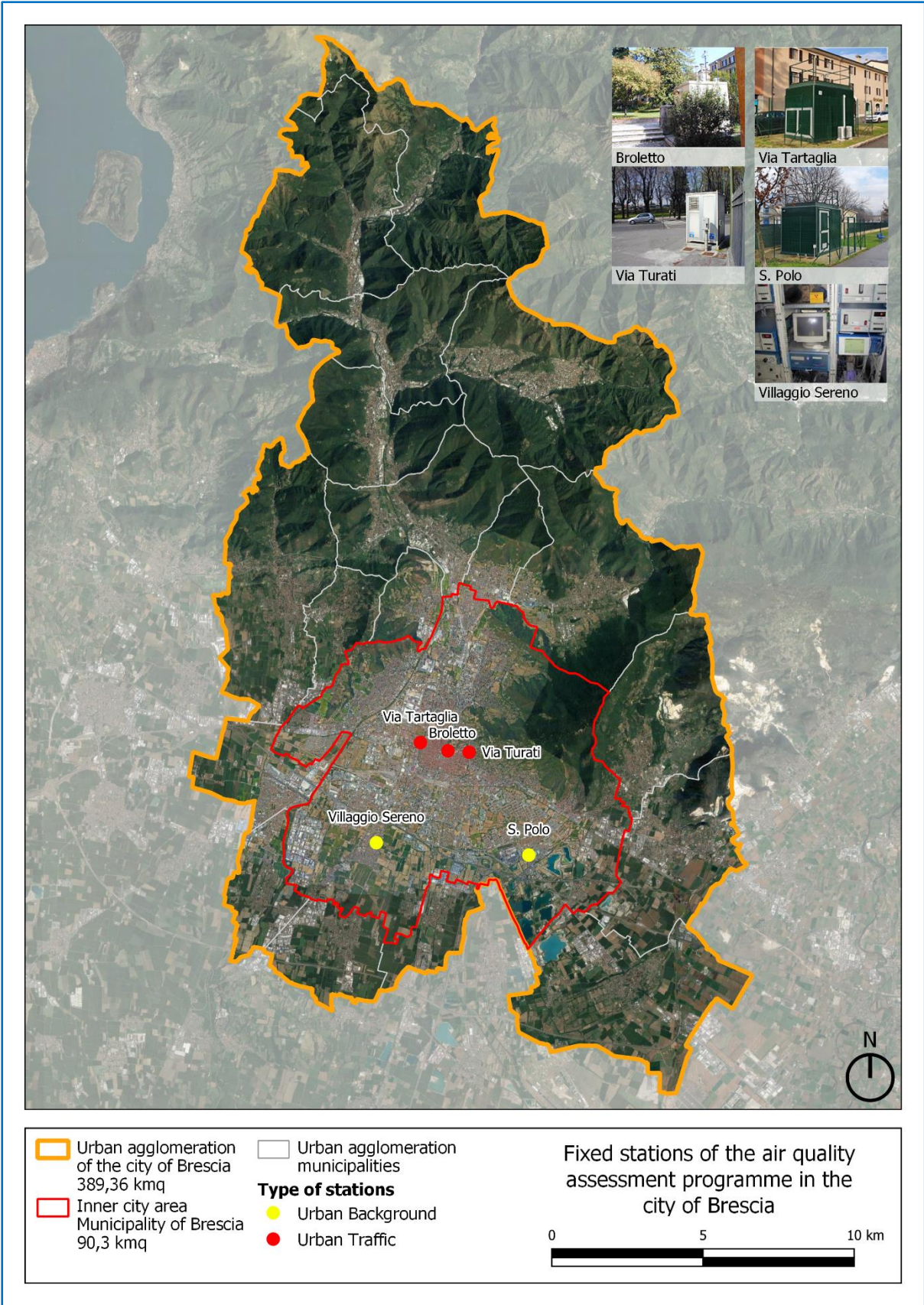


Figure 4: fixed stations of the air quality assessment program in the city of Brescia

Italy approved the *National Air Pollution Control Program* in December 2021, under the provisions of Directive (EU) 2016/2284 (National Emission Ceiling).

Regional Air Quality Plan (RAQP)

The *Regional Air Quality Plan (RAQP)* of the Lombardy Region [4] represents the main planning and scheduling tool for air quality in the regional territory. The actions planned in the *RAQP* are combined with other sectoral planning (e.g. mobility, energy, waste management). Lombardy Region has identified **three key macro sectors of action L'ELENCO NE MOSTRA 2:**

- ✓ **Energy efficiency measures in the civil sector**
At the regional level, measures are mainly aimed at reducing NOx emissions.
The City of Brescia, as presented in Section 1B, is extremely virtuous. Indeed, the city is equipped with district heating powered by cogeneration plants and recovery of thermal waste.
- ✓ **Proper domestic use of wood biomass [5]**
The presence of biomass plants in the Municipality of Brescia is not numerically significant.
- ✓ **Transport infrastructure**
The focus was placed on reducing the traffic of the most polluting vehicles, mainly diesel engines. These types of emissions produce about 56% of NOx emissions in the regional territory. The Municipality of Brescia, as reported in Section 1B, has implemented extremely concrete policies to reduce vehicle traffic.
- ✓ **Agriculture: Improvement of livestock waste management**
Livestock waste management is the main source of emissions (over 96%) of ammonia in the regional territory. This aspect represents a relatively insignificant factor in the municipal territory.

Activities of the City Administration aimed at raising citizens' awareness and engagement on air quality

The accumulation of pollutants and the relative breach of legal limits with regard to some parameters, coupled with the potential resulting health and environmental effects, has generated, even at the local level, a heated debate among the citizenry and particular attention from the *media*.

The various points of view concerning this topic, the complex access to the data as well as the necessity to start an effective confrontation on the issue, led the municipal administration to create, in November 2015, **the 'Aria Bene Comune' Observatory [6]**.



Figure 5: *Aria bene comune Observatory: objectives, members, activities, publications*

In addition, a section devoted to air quality is available on the website of the Municipality of Brescia. It shows trends in PM10 and PM2.5 values as well as an overview of current legal limits.

1.B Past Performance

The aim of this section is to make clear how the situation described in the previous section has been achieved in the past ten years. Please provide the following information:

1. Charts showing the following trends over a period of 10 years:
 - a. Annual average concentration of PM_{2.5}, PM₁₀ and NO₂ for each sampling point reporting under the Ambient Air Quality Directive (2008/50/EC), clearly indicating if and when annual limit values were exceeded.
 - b. Number of daily limit value exceedances for PM₁₀ per year for each sampling point reporting under the Ambient Air Quality Directive (2008/50/EC).
 - c. Number of hourly limit value exceedances of NO₂ per year for each sampling point reporting under the Ambient Air Quality Directive (2008/50/EC).
2. Actions and measures taken by the city authorities in the last 10 years that significantly affected the trends and changes mentioned under point 1.

(max. 600 words and five graphics, images or tables plus the requested charts detailed above)

Air quality trends in the city

The following graphs show the trends of PM10, PM2.5 and NO2 concentrations detected in the monitoring station of the city over the last few years.

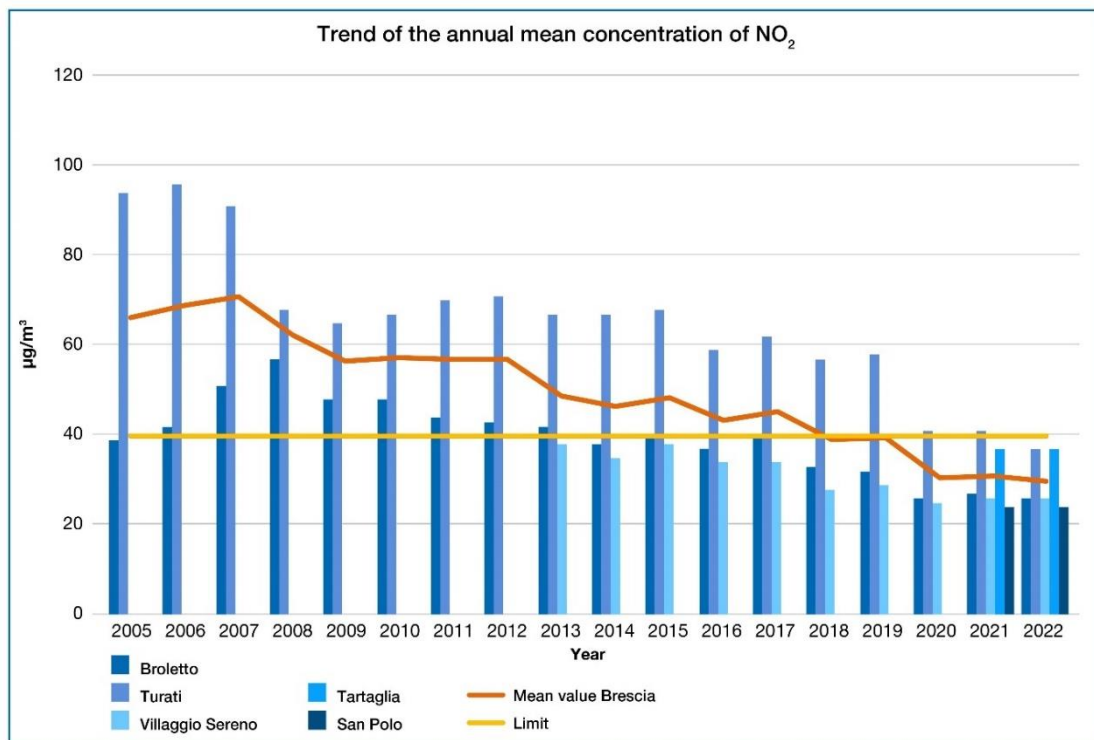


Figure 6: Trend of the annual mean concentration of NO₂

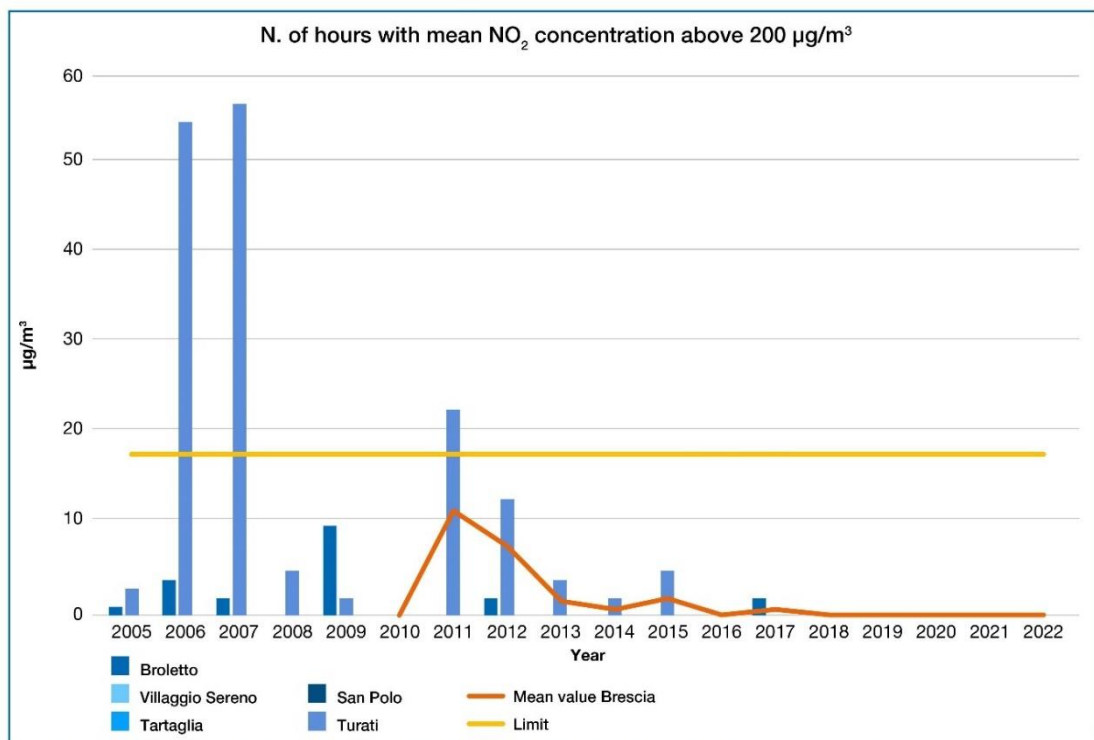


Figure 7: Number of hours with mean NO₂ concentration above 200 µg/m³

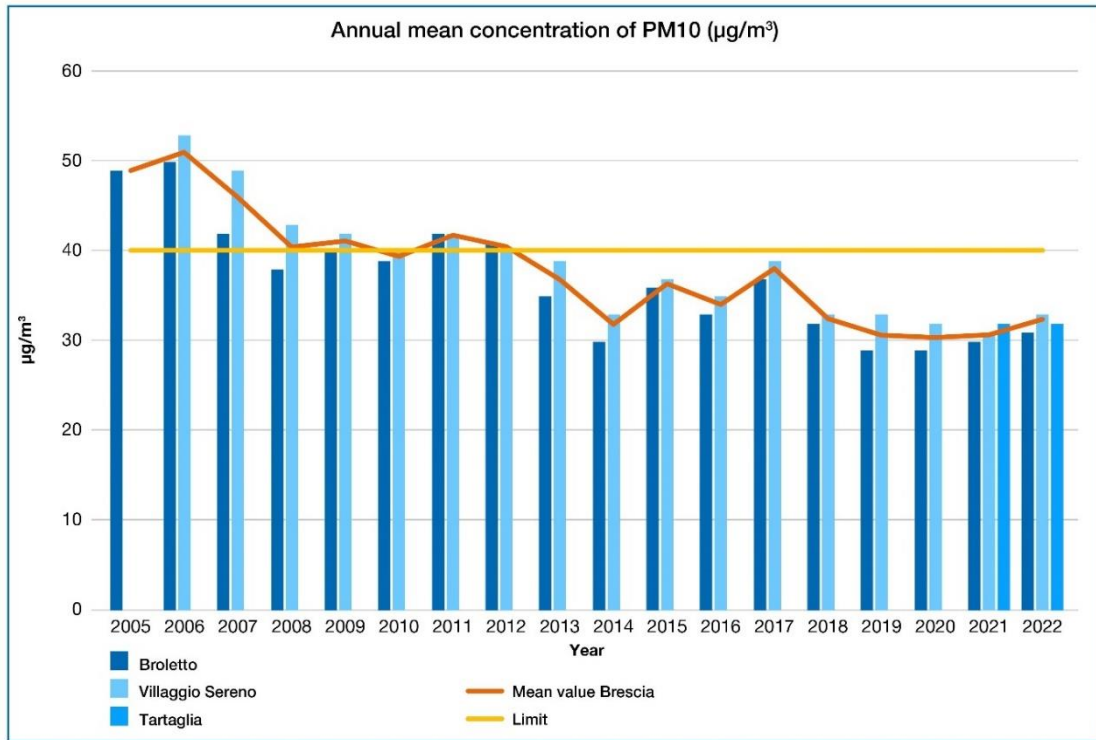


Figure 8: Annual mean concentration of PM10

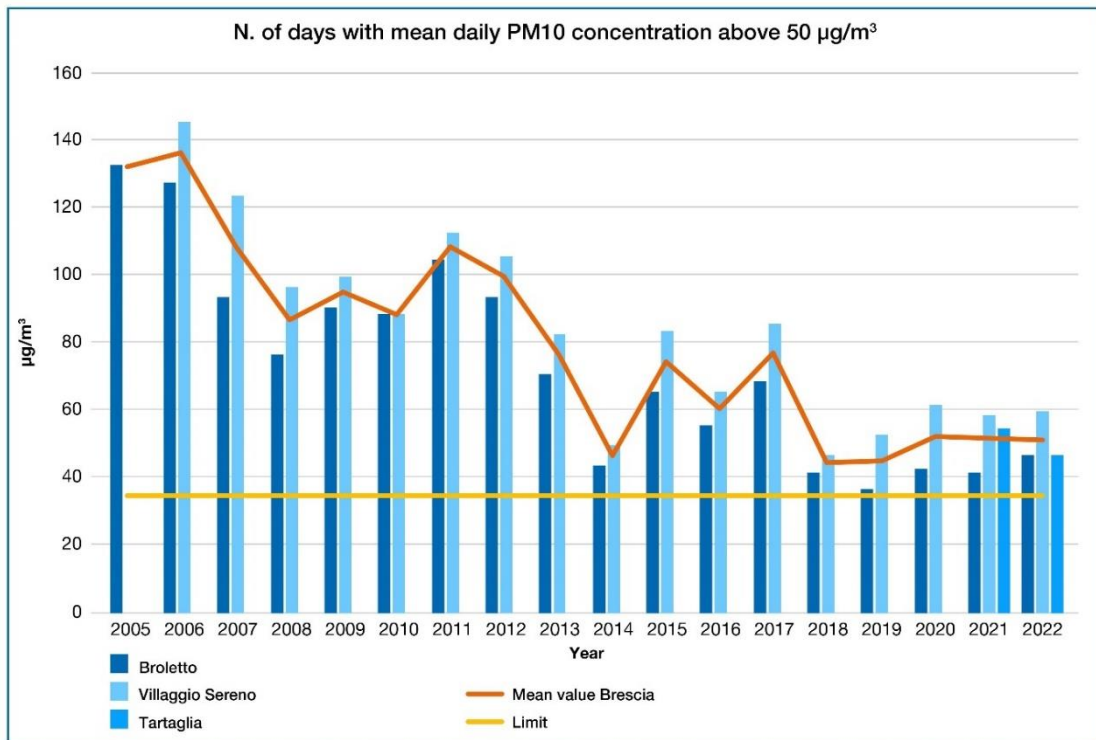


Figure 9: Number of days with mean daily PM10 concentration above $50 \mu\text{g}/\text{m}^3$

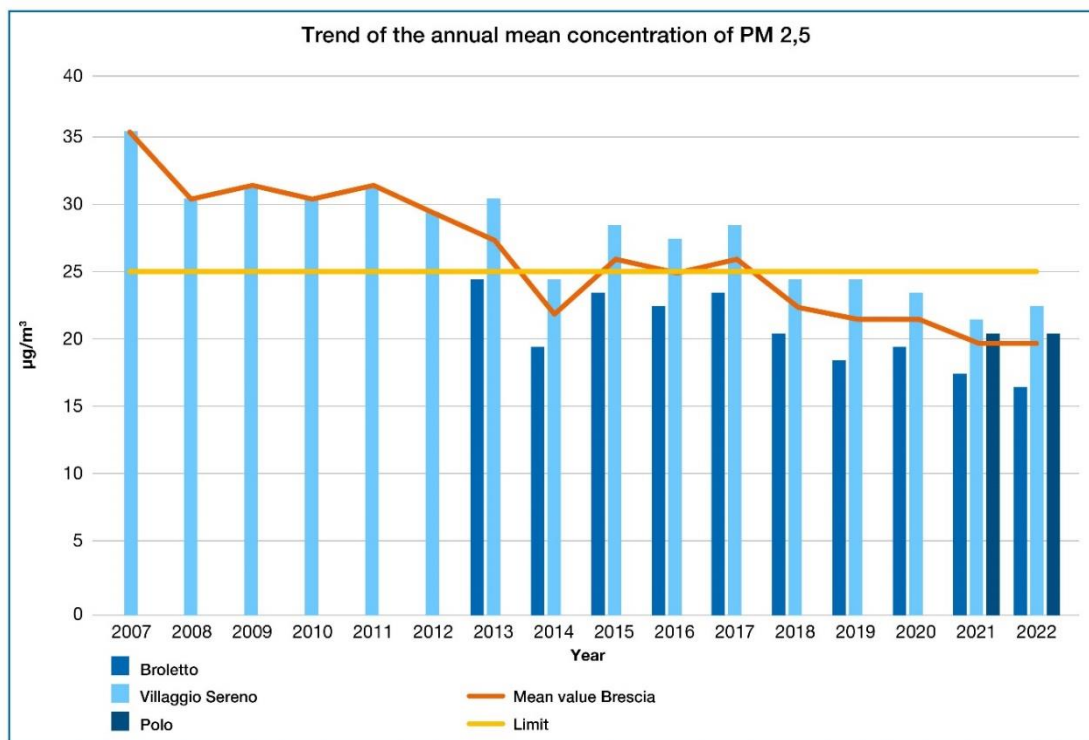


Figure 10: Trend of the annual mean concentration of PM2,5

The data shows a steady reduction in the annual average concentrations of PM10, PM2.5 and NO2 over time. However, the number of days exceeding the threshold established for the daily average of PM10 remains a critical issue.

Municipal actions to tackle air pollution

The emission framework, presented in the previous section, shows the primary contributions of emissions related to two domains: **energy consumption of buildings and mobility**. Therefore, the Municipal Administration has specifically focused its policies on reducing emissions from these two emission sectors, as described in the following sections.

The Brescia Environment and Energy System

The *Environment and Energy System*, as described in the ‘City Introduction and Context’ section, contributes beneficially to the energy balance of the city of Brescia.

The extension of the district heating network, the introduction of municipal cogeneration systems (1978-1982: Lamarmora and Nord power stations), the waste-to-energy plant (*Termoutilizzatore*, 1998) and the recovery of thermal waste from industry as well as upgrades on the system, have contributed significantly to the improvement of air quality in the last few years, reducing emissions and pollutants from energy consumption of buildings.

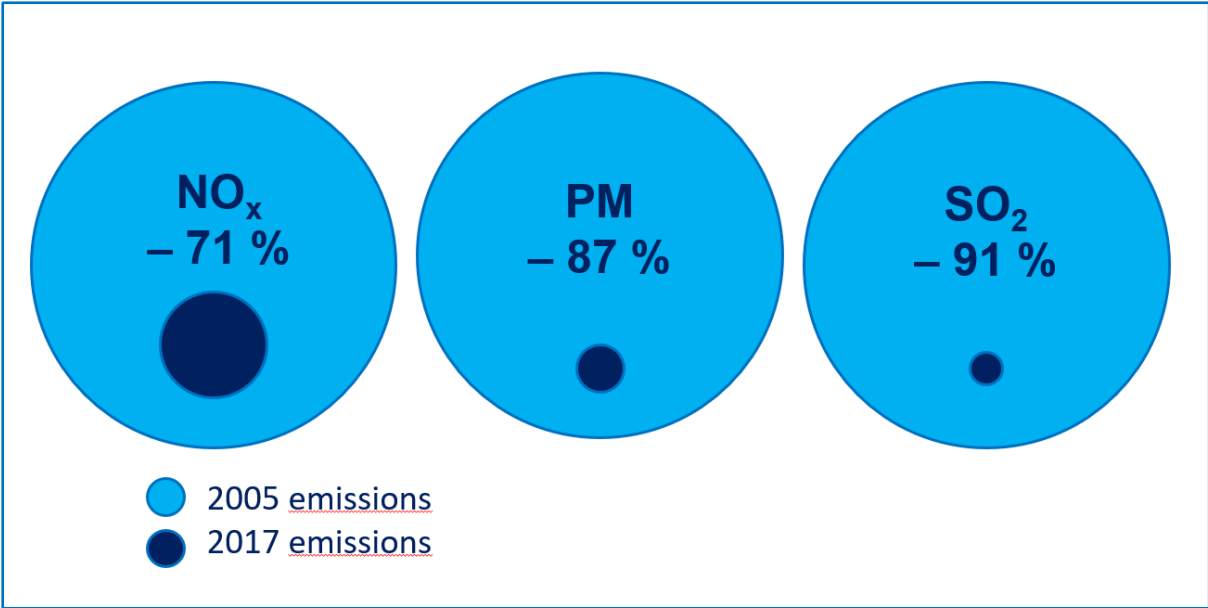


Figure 11: Impact of recent measures on the Environment and Energy System (2005-2017) (A2A spa – data)

In general, the Environment Energy System allowed the city of Brescia to reduce the burning of fossil fuels, avoiding the emission of 908 kton of CO₂ in 2021 and significantly reducing emissions of NO_x, SO₂ and PM₁₀.

One of the main parts of the Energy Environment System is represented by the district heating network, described in the figure below.

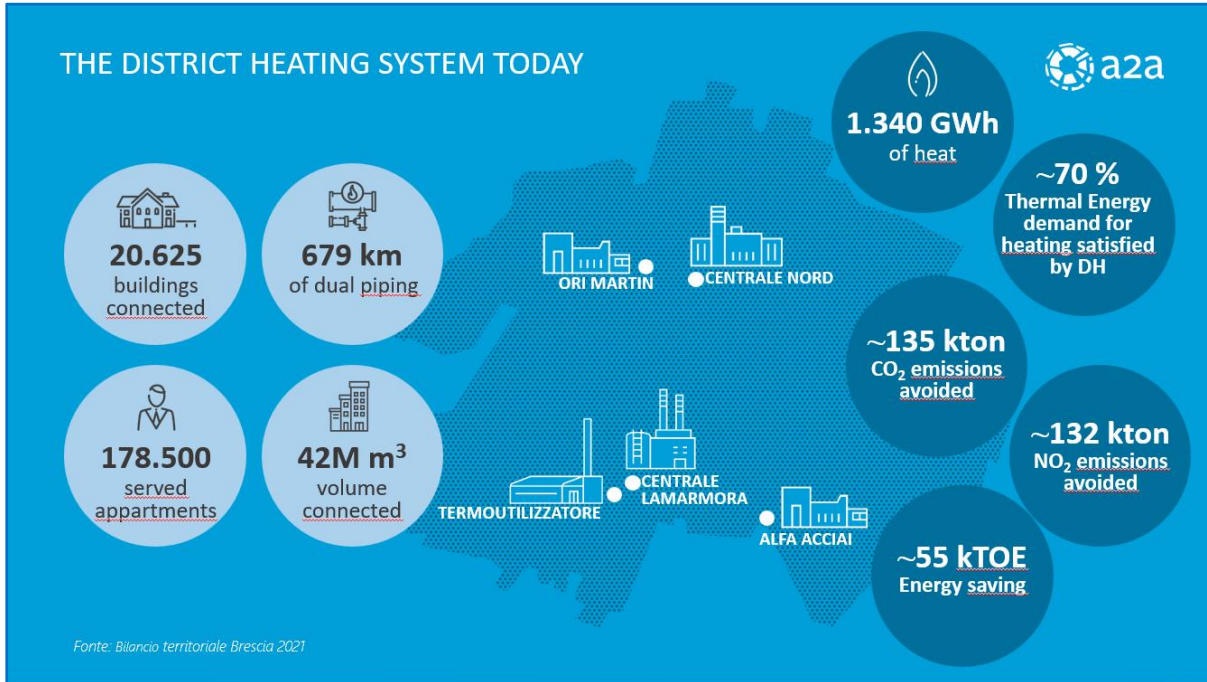


Figure 12: Brescia district heating network and the main Key Performance Indicators [7]

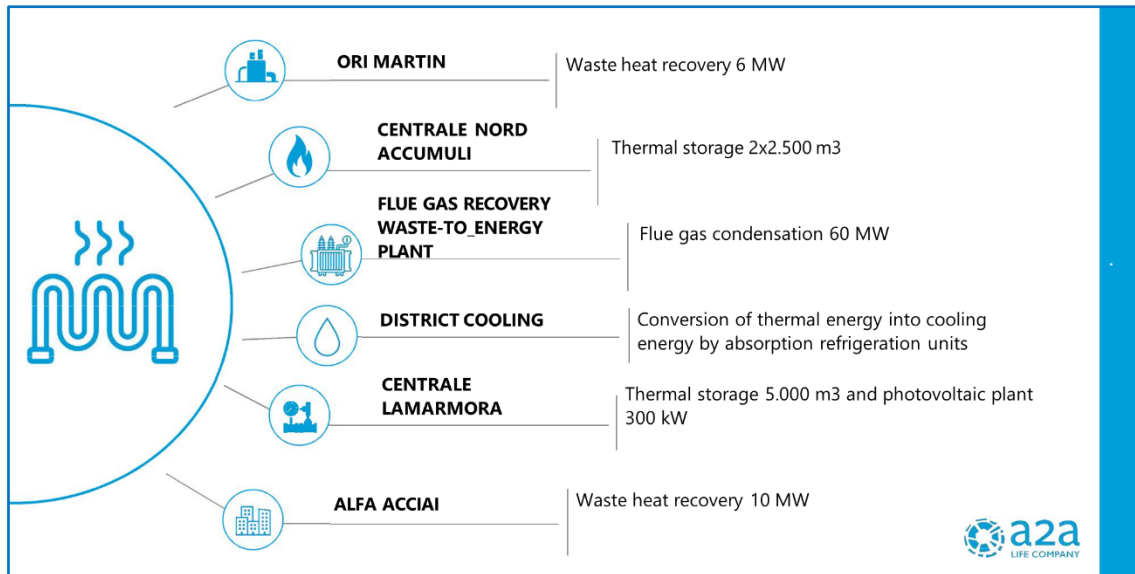


Figure 13: Evolution of the Environment Energy System 2018 - 2023

Mobility

The *SUMP (Sustainable Urban Mobility Plan)* of Brescia, approved in 2018 [8], planned sustainable mobility policies for the horizon 2016-2026. It identifies the following strategic lines: fostering active mobility, strengthening of local public transport and railway services as well as the adoption of guiding policies on mobility demand.

The main actions implemented include:

- ✓ the launch of the automatic subway (2013): implementation cost of approximately 777.1 million euros and annual running costs of €36 million.
- ✓ full methanization of the bus fleet in the urban area: €20.5 million.
- ✓ overall readjustment and redevelopment of the railway station (tracks, sidewalks, shelters, elevators, underground passages, etc.).
- ✓ redevelopment and strengthening of the bicycle network, development of bike-sharing and bike parking in the city.
- ✓ pedestrianization and implementation of 30 km zones and LTZ.

Moreover, several initiatives were undertaken to reduce CO₂ emissions through the development of e-mobility, notably the charging network for electric vehicles.

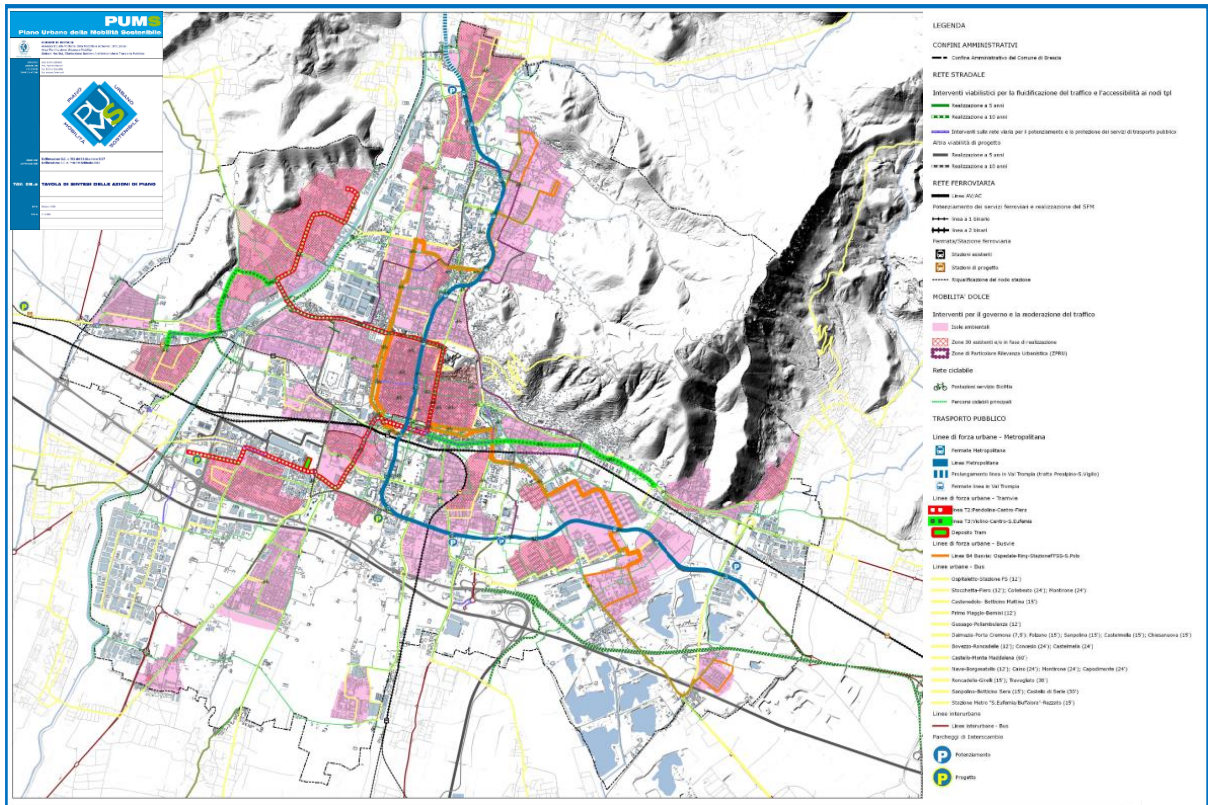


Figure 14: Summary table of the actions outlined in the SUMP

The supported investments, combined with an intensive campaign to promote the use of public transport, have resulted in a unique achievement in Italy: an increase of more than 40% of passengers using public transport in the urban area (city and fourteen hinterland municipalities) between 2012 and 2019.

1.C Future Plans

Please describe the following:

1. The medium term (2030) and long term (2050) objectives regarding air quality, with a focus on PM_{2.5} and NO₂, and keeping in mind the 2030 targets and zero pollution objective for air recently proposed by the Commission³.
2. The planned measures to achieve the ambitions described under 1. Please also describe:
 - a. which innovations your city is planning to use.
 - b. whether and how air quality measures are integrated with other plans in the city, such as Sustainable Energy & Climate Action Plans (SECAPs) under the Covenant of Mayors, Sustainable Urban Mobility Plans or Climate City Contracts under the EU Mission on Climate-Neutral and Smart Cities.
3. To what extent measures and ambitions described under 1 and 2 are supported by:
 - a. strategic and policy commitments
 - b. budget and resource allocations
 - c. plans for monitoring of impacts
 - d. participatory approaches
4. Current or outstanding ongoing environmental legal proceedings, including infringement procedures under the Ambient Air Quality Directives (2008/50/EC and 2004/10/EC) that concern exceedances of air quality standards or issues with air quality monitoring in your city. If there are, please indicate how and when you are planning to have ensured compliance in your city.

(max. 600 words and five graphics, images or tables)


³ https://environment.ec.europa.eu/news/zero-pollution-ec-proposes-rules-cleaner-air-and-water-2022-10-26_en

Objectives

The *Regional Air Quality Action Plan* defines air quality objectives, mainly for PM 2.5 and NO₂, in the regional territory. The city of Brescia and the *Aria bene Comune* Observatory will evaluate the most effective actions to achieve the objectives of the *EU Zero Pollution Action Plan*.

Climate Transition Strategy (CTS)

The *Climate Transition Strategy (CTS)* is the city's main planning and implementation tool to achieve the challenging goals of climate change mitigation and adaptation. It defines a set of mitigation actions (already funded) to reduce atmospheric and climate-altering gas emissions.



Mitigation actions	Climate change risk				Cost
	hydrogeological	flood	heat	extreme meteoric events	
3.1 CREDIT ASSIGNMENT AND RETROFIT OF THE BUILDING HERITAGE			X	X	401.000
3.2 ZERO ENERGY DISTRICT IN VIA MILANO			X	X	650.000
3.3 SUSTAINABLE MOBILITY INCENTIVES	X	X	X	X	300.000

Figure 15: mitigation actions planned in the CTS

Sustainable Energy and Climate Action Plan

The Municipality of Brescia signed the Covenant of Mayors in 2020 and in 2021 the City Council approved the *Sustainable Energy and Climate Action Plan (SECAP)* [10]. The goal set envisages a 50% reduction in CO₂ emissions per capita by 2030, compared to 2010. This reduction corresponds to approximately 312,000 tonnes of CO₂.

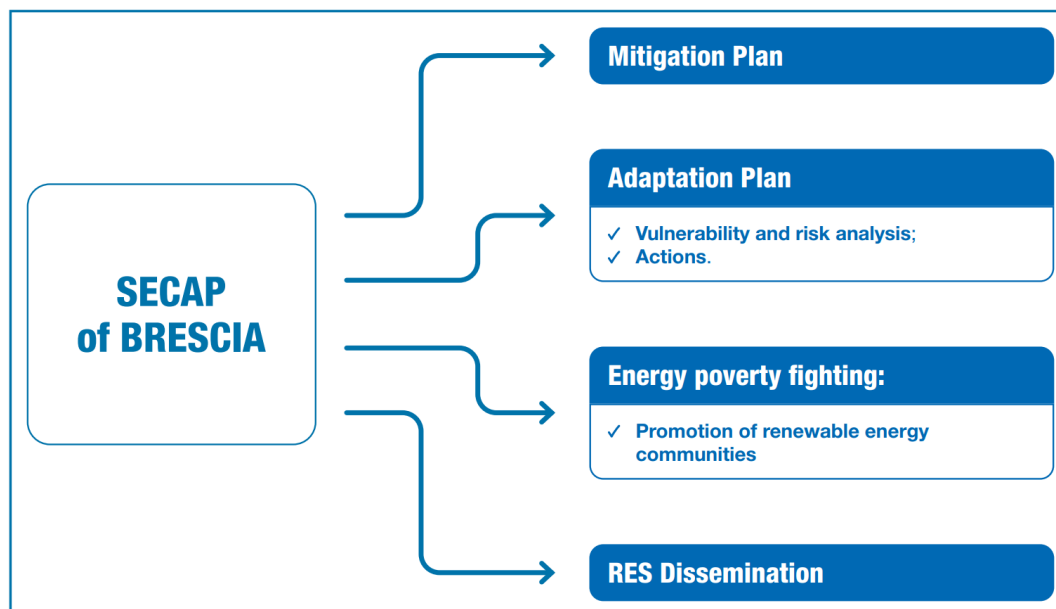


Figure 16: SECAP: RES dissemination, mitigation and adaptation plan

The monitoring activities, carried out by CTS, SECAP and SUMP, will be interlinked.

The energy efficiency of buildings

At the European level, the guidelines under discussion - the *Energy Performance of Buildings Directive*—are aimed at indicating, for the Member States, the objective of raising the energy class of the park-building. The connection to the Brescia district heating network allows the city's buildings to acquire a higher energy class than buildings not connected to the DH, thanks to the use of renewable sources and cogeneration.

Mobility: future actions

In the public transport sector, the SUMP planned the following future actions:

- ✓ The extension of the subway line (M1) beyond the northern city limits and upgrading of the park-and-ride at three subway stations; (€16 million funded).
- ✓ Reorganization of the urban surface public transport network: two new tram lines (T2 €360 million state funding, and T3), one new high-capacity bus line (B4).
- ✓ Quadrupling the existing railway tracks and activation of high-speed train services connecting Brescia to the Veneto region.
- ✓ Implementation of “*La Piccola Velocita*” freight yard and intermodal terminal to move long-distance freight transport from road to railway.
- ✓ Expansion of the public electric car charging service (300+ charging points).
- ✓ Development of a "mobility credits" system to direct travel choices towards the most sustainable ones.
- ✓ Electrification of the bus fleet (acquisition of 50+ new 100% electric buses by 2030).
- ✓ Upgrade of the entire city street network to encompass “bicycle-friendly” mobility; promotion of a “bike-friendly” culture.
- ✓ Creation of Zone 30 in all the city residential areas.

A2A Strategic Plan Update 2021-2030

A2A's Strategic Plan (2021-2030) envisages [11] the following measures directly addressing air quality:

- ✓ Development of a project related to hydrogen (Hydrogen Valley - H2Valcamonica) produced through electrolysis to be used to power hydrogen trains on the Brescia-Iseo-Edolo route.
- ✓ Efficiency optimization of the Brescia *Termoutilizzatore*, performed through the flue gas recovery project to increase energy production, maximize heat recovery, and further reduce emissions.
- ✓ Further developments in the bio-methane sector to reduce reliance on fossil fuels, according to the objectives of the *REPower EU plan*. Biomethane from agricultural/food waste could be used, in a circular economy perspective, within cogeneration plants feeding district heating.

Infringement procedures under the Ambient Air Quality Directives

Italy is subject to the following infringement procedures undertaken by the European Commission: 2015/2043, 2014/2147, plus the letter of formal notice procedure 2020/2299. Lombardy, along with the other regions of the Po Valley, is directly involved in the aforementioned procedures in relation to some areas of its territory.

1.D References

List supporting documentation, adding links where possible. Further detail may be requested during the pre-selection phase. Documentation should not be forwarded at this stage.

(max. 400 words)

[1] atmospheric emissions Inventory - INEMAR di ARPA Lombardia

<https://www.inemar.eu/xwiki/bin/view/Inemar/HomeLombardia>

[2] University of Brescia: “Integrated assessment of air pollution”

<https://www.comune.brescia.it/sites/default/files/imported/servizi/ambienteeverde/Ambiente/Documents/Osservatori/Osservatorio%20Aria/Studio%20UniBs%20Atmosfera.pdf>

[3] ARPA Lombardia Air Quality web site

<https://www.arpalombardia.it/Pages/Aria/qualita-aria.aspx>

[4] The Regional Air Quality Plan (RAQP) of the Lombardy Region

<https://www.regione.lombardia.it/wps/portal/istituzionale/HP/DettaglioRedazionale/istituzione/direzioni-general/direzione-generale-ambiente-e-clima/piano-regionale-interventi-qualita-aria-pria>

[5] Municipality of Brescia: domestic use of woody biomass

<https://www.comune.brescia.it/aree-tematiche/ambiente/impianti-termici/impianti-termici-alimentati-biomassa-legnosa>

[6] Municipality of Brescia: Aria Bene Comune Observatory

<https://www.comune.brescia.it/aree-tematiche/ambiente/osservatori/osservatorio-aria-bene-comune-dal-2019>

[7] A2A territorial sustainability report of the Province of Brescia 2021

<https://content.gruppoa2a.it/sites/default/files/2022-07/260722-bilancio-territoriale-brescia.pdf.pdf>

[8] The *SUMP (Sustainable Urban Mobility Plan)* of Brescia

<https://www.comune.brescia.it/aree-tematiche/mobilita-e-trasporti/documenti-di-pianificazione/piano-urbano-mobilita-sostenibile>

[9] *Climate Transition Strategy (CTS) of Brescia:*

<https://www.comune.brescia.it/sites/default/files/imported/servizi/urbancenter/unfilonaturale/Documents/210720 UC AT 188-RELAZIONE STC BS rev2.pdf>

[10] SECAP of Brescia:

<https://www.comune.brescia.it/sites/default/files/imported/servizi/ambienteeverde/Documents/P AESC MAGGIO%202021.pdf>

[11] A2A spa Strategic Plan upgrade

<https://content.gruppoa2a.it/sites/default/files/2022-11/22122-CS-Piano-Strategico-ita.pdf>

Word Count Check

Please complete the below word count check.

Section	Number of words in graphics/images/tables	Number of words in body of text	Total number of words in graphics/ images/ tables and body of text	Max. words
1A	0	844	844	1000
1B	0	473	473	600
1C	0	576	576	600