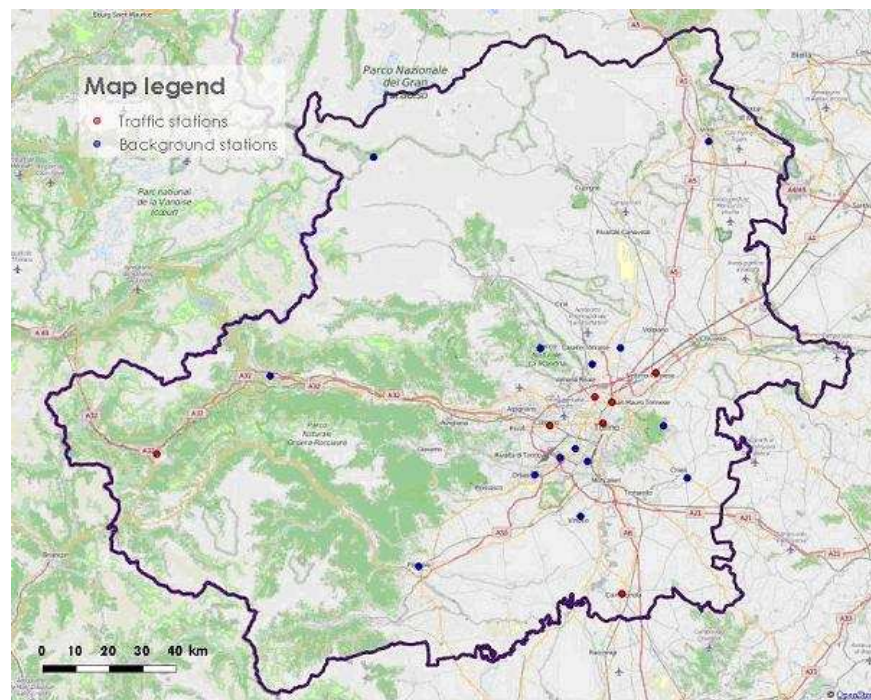


The air quality monitoring network operating on the territory of the Metropolitan City of Turin is managed by Arpa Piemonte. It is composed of 21 monitoring stations (14 background stations and 7 traffic stations) and one mobile station for short measuring campaigns.

All the stations are connected to the data acquisition centre by telephone lines and transmit hourly measurement result. This setup allows a continuous monitoring of the main factors that may affect air quality.

Location of measurement stations on the territory is a key factor to achieve a cost-effective air quality monitoring. In some cases the selected sites must be representative of a large portion of territory, in other cases stations must represent specific pollution situations like traffic hot spots or single source emissions. A strategic location of measurement points gives extremely representative information on air quality.



MEASUREMENT STATIONS

Station	Address	Pollutants	Type of station
Baldissero (GDF) ⁽¹⁾	Str. Pino Torinese, 1 – Baldissero	NO _x , O ₃ , CO, PM10 _B , deposimeter PAHs	Rural background
Beinasco (TRM) ⁽¹⁾	Via San Giacomo c/o giardino pubblico Aldo Mei - Beinasco	NO _x , PM10, PM10 _B , PM2,5, BTX, PCDD/DF sampler, deposimeter Metals/PAHs, deposimeter Hg, deposimeter PCDD/DF, Mercury analyzer	Suburban background
Borgaro	Via Italia, sn – Borgaro	NO _x , O ₃ , PM10, PM2,5, (As-Cd-Ni-Pb), B(a)P, BTX	Suburban background
Carmagnola	P.zza I Maggio sn – Carmagnola	NO _x , CO, PM10, (As-Cd-Ni-Pb), B(a)P	Urban traffic
Ceresole Reale	c/o cent. Idroelettrica - Ceresole	NO _x , O ₃ , PM10 _B , PM2,5 _B , (As-Cd-Ni-Pb), B(a)P	Rural background
Chieri	Via Bersezio sn – Chieri	NO _x , O ₃ , PM2,5	Suburban background
Collegno	C.so Francia, 137 – Collegno	NO _x , PM10	Urban traffic
Druento	Cascina Peppinella – Druento	NO _x , O ₃ , PM10, (As-Cd-Ni-Pb), B(a)P	Rural background
Ivrea	Viale della Liberazione, 1 – Ivrea	NO _x , O ₃ , PM10, PM2,5, (As-Cd-Ni-Pb), B(a)P	Suburban background
Leini (GDF) ⁽¹⁾	Via vittime di Bologna, 12 – Leini	NO _x , O ₃ , CO, PM10 _B , PM2,5 _B	Suburban background
Orbassano	Via Gozzano sn – Orbassano	NO _x , O ₃	Suburban background
Oulx	Via Roma sn – Oulx	NO _x , CO, PM10, (As-Cd-Ni-Pb), B(a)P	Suburban traffic
Pinerolo	P.zza III Alpini, 1 – Pinerolo	NO _x , O ₃	Suburban background
Settimo T.se	Via Milano, 31 – Settimo	NO _x , CO, PM10, PM2,5, BTX, B(a)P	Urban traffic
Susa	P.zza della Repubblica – Susa	NO _x , O ₃ , PM10, (As-Cd-Ni-Pb), B(a)P	Urban background
TO-Consolata	Via Consolata, 10 – Torino	NO _x , CO, SO ₂ , PM10, (As-Cd-Ni-Pb), B(a)P, BTX, Total PM	Urban traffic
TO-Grassi	Via P. Veronese, 305 – Torino	PM10, (As-Cd-Ni-Pb), B(a)P	Urban traffic
TO-Lingotto	Via A. Monti, 21 – Torino	NO _x , O ₃ , PM10-PM10 _B , PM2,5, (As-Cd-Ni-Pb), B(a)P, BTX	Urban background
TO-Rebaudengo	P.zza Rebaudengo, 23 - Torino	NO _x , CO, SO ₂ , (As-Cd-Ni-Pb), B(a)P, BTX, PM10 _B , PM2,5 _B	Urban traffic
TO-Rubino	Via Rubino sn - Torino	NO _x , CO, PM10, (As-Cd-Ni-Pb), B(a)P, BTX, PM10 _B hourly, PM2,5 _B hourly	Urban background
Vinovo	Via Garibaldi, 3 – Vinovo	NO _x , O ₃ , BTX	Suburban background

⁽¹⁾ Station owned by private body managed by Arpa Piemonte

Pollutant	Description
As-Cd-Ni-Pb	Arsenic, Cadmium, Nickel, Lead
B(a)P	Benzo(a)pirene
BTX	Benzene, toluene, xilene
CO	Carbon monoxide
NO _x	Oxides of nitrogen
O ₃	Ozone
PM10	Particulate matter < 10 µm gravimetric method
PM10 _B	Particulate matter < 10 µm Beta Gauge Continuous Ambient Particulate Monitor
PM2,5	Particulate matter < 2,5 µm
PM2,5 _B	Particulate matter < 2,5 µm Beta Gauge Continuous Ambient Particulate Monitor
PTS	Total particulate
SO ₂	Sulphur dioxide



AIR QUALITY IN THE METROPOLITAN CITY OF TURIN

Data collected during the last 10 years by the air quality monitoring network operating on the territory of the Metropolitan City of Turin and managed by Arpa Piemonte show, in spite of annual meteorological variability, an overall and significant improvement but at the same time confirm the critical situation of the territory, in particular of the Turin urban area.

In 2015 7 out of 12 regulated pollutants – carbon monoxide (CO) sulphur dioxide (SO₂), benzene and metals (Pb, As, Cd, Ni) fully comply with the limit or target values throughout the metropolitan territory.

As regards PM10, 12% of the monitoring stations – in particular traffic stations - do not comply with the annual limit value: the percentage grows to 65% in case of the daily limit value; only the monitoring stations located at high altitude or in alpine valleys usually comply with daily limit value.

The percentage of monitoring stations exceeding PM2,5 annual limit value (25 µg/m³) is 62%, mostly in urban areas on the plain. In 2015 the situation worsened in comparison to 2014: 5 out of 8 stations show exceedances, whereas in 2014 all stations complied with the limit except for one.

As regards NO₂ annual limit value, 32% of the monitoring stations – in particular those located in Turin urban area – exceeded the annual limit value, whereas the hourly limit value was exceeded only in the To-Rebaudengo traffic station.

In 2015 23% of the sampling points exceeded the benzo(a)pyrene target value. The highest concentrations were found in Turin urban area traffic stations. A widespread increase has been observed in comparison with previous years.

Data confirm that ozone is critical throughout the territory of the Metropolitan City of Turin during summertime. Target value for the protection of human health is exceeded in 92% of monitoring stations.

Overall, the highest levels of PM10, PM2,5 and NO₂ were found in Turin urban area, whereas rural areas showed the highest ozone concentration. A worsening trend was observed in 2015 compared with 2014, which is believed to be mainly due to unfavorable atmospheric dispersion conditions in the winter months; in particular, November and December were the worst months in respect of the "number of days favourable to atmospheric pollutants accumulation" indicator over the last ten years.

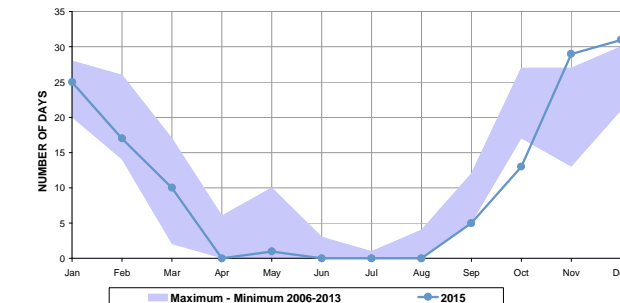
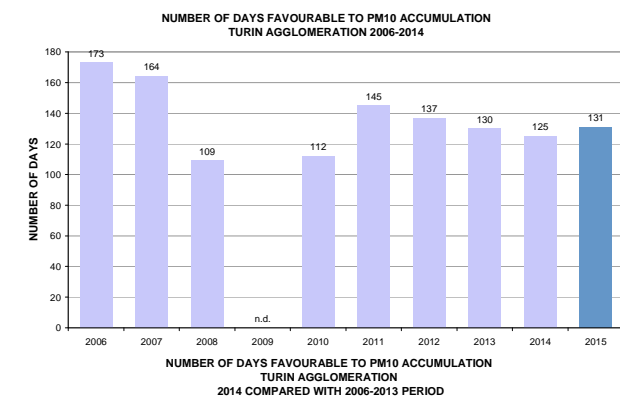
Pollutant	Situation
sulphur dioxide	All indicators concerning human health protection are fulfilled.
carbon monoxide	
benzene	
lead	
arsenic	
cadmium	
nickel	Most monitoring stations comply with the annual target for human health protection but a general increase in concentrations must be highlighted in comparison with previous years. Two traffic stations and one background station exceed the target value.
benzo(a)pirene	
nitrogen dioxide	The annual limit value concerning human health protection is often exceeded in Turin urban area. The hourly limit value is fulfilled throughout the metropolitan city of Turin with the exception of To-Rebaudengo traffic station.
PM10	The annual limit value concerning human health protection is substantially fulfilled all over metropolitan city of Turin with the exception of some traffic stations. The hourly limit value is fulfilled only in Rural areas and in alpine valleys
PM2,5	The annual limit value concerning human health protection is often exceeded especially in flatland areas with discrete levels of human settlement.
ozone	The target limit value for the protection of human health is exceeded all over the the metropolitan city of Turin.

METEOROLOGY

Month	Temperature (°C)		Precipitation (mm)		Rainy days	
	mean 2015	mean 2005-2014	mean 2015	mean 2005-2014	mean 2015	mean 2005-2014
January	3,9	2,9	21	45	3	5
February	4,2	4,3	132	42	6	5
March	9,9	9,3	136	76	5	6
April	14,0	13,9	89	104	7	8
May	18,5	18,0	35	109	6	8
June	22,6	22,0	76	118	6	9
July	27,9	24,3	31	88	3	6
August	23,5	23,2	185	79	10	6
September	18,0	19,1	51	95	6	7
October	12,5	13,6	204	43	8	5
November	8,1	8,1	1	128	0	7
December	4,7	3,2	1	64	0	5
year	14,0	13,5	962	990	60	76

The year 2015 was assessed by the index "number of days favourable to PM10 accumulation" from a meteorological viewpoint. The index, which is referred to Turin urban area, analyzes the interactions of transport, chemical transformation and dispersion of pollutants with meteorology. The aim of the index is to pick out the days when stability conditions favourable to PM10 increase occur. The index provides a useful tool to connect annual variability of pollutant concentrations and meteorology.

In 2015 the number of days favorable to the accumulation of PM10 was similar to the previous 3 years. Analyzing the monthly trend and comparing it to the 2006-2014 period, is clearly visible that the months of November and December were very critical, while the first ten months of the year fall in the average of the reference period. The precipitation data show that the 2015 is less rainy than the average 2005-2014, both in terms of total precipitation (962 mm against 990 mm) and also considering the number of rainy days (60 days against 76 days of average), especially in the months of November and December when it never rained.



AIR QUALITY DATA

<http://www.sistemapiemonte.it/ambiente/srqa/conoscidati.shtml>

TURIN URBAN AREA AIR QUALITY FORECAST

<http://www.cittametropolitana.torino.it/cms/ambiente/qualita-aria/dati-qualita-aria/ipqa>

ANNUAL REPORTS

<http://www.cittametropolitana.torino.it/cms/ambiente/qualita-aria/dati-qualita-aria/relazioni-annuali>
<http://www.arpa.piemonte.it/approfondimenti/territorio/torino/aria/Pubblicazioni>

PM10 REGIONAL FORECAST AND WEEKLY DATA BULLETINS

<http://www.arpa.piemonte.it/bollettini>

OZONE BULLETINS

<http://www.arpa.piemonte.it/bollettini>

All air quality data presented in tables and graphs were subjected to two out of three validation steps (daily, monthly and annual) of Arpa Piemonte Quality Management System. The 2015 edition of "A glance at our air" - which will be available for download at websites of Metropolitan City of Turin and Arpa Piemonte - will include a circumstantial report on measurement data, further information on pollution sources and in-depth studies on specific issues.

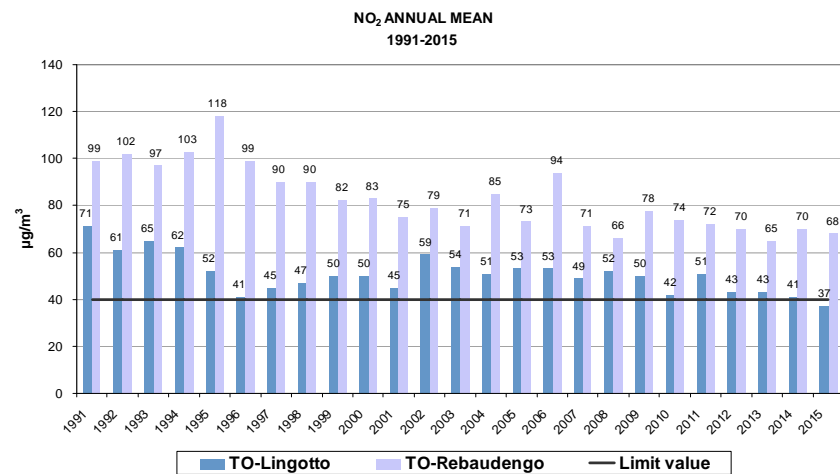
NITROGEN DIOXIDE

NO ₂ 2015	Annual mean (µg/m ³)	Exceeding number
Baldissero	14	0
Beinasco TRM	47	0
Borgaro	29	2
Carmagnola	38	0
Ceresole	5	0
Chieri	25	1
Collegno	36	0
Druento	16	0
Ivrea	26	0
Leini	31	1
Orbassano	35	1
Oulx	20	0
Settimo	41	0
Susa	22	0
To-Consolata	53	1
To-Lingotto	37	0
To-Rebaudengo	68	21
To-Rubino	44	0
Vinovo	44	0

Limit values:
40 µg/m³ annual mean
200 µg/m³ hourly mean not to be exceeded more than 18 times a calendar year.

Nitrogen dioxide (NO₂) is considered one of the most dangerous air pollutant because it irritates the mucous membranes and it is a precursor of ozone and PM in photochemical processes. Diesel vehicles emission is the main source of NO₂ and its derivatives.

In 2015 the annual limit value was exceeded in 6 out of 19 stations. Values greater than the 200 µg/m³ threshold was occasionally measured in 6 stations in the critical months of November and December, the hourly limit value (200 µg/m³ not to be exceeded more than 18 times per calendar year) was only exceeded in the traffic station of To-Rebaudengo. The time series shows a slight decrease of concentrations over the last 30 years.



SULPHUR DIOXIDE

SO ₂ 2015	Annual mean (µg/m ³)	Maximum hourly mean (µg/m ³)
To-Consolata	7	19
To-Rebaudengo	6	17

Limit values:
125 µg/m³ daily mean not to be exceeded more than 24 times a calendar year;
350 µg/m³ hourly mean not to be exceeded more than 24 times a calendar year.

Sulphur dioxide (SO₂) is the natural oxidation product of sulphur and compounds containing it. The main source is the combustion of fossil fuels like diesel oil, fuel oil and coal.

Time series analysis shows that ambient air concentrations of SO₂ complied with the limit values for the last twenty years

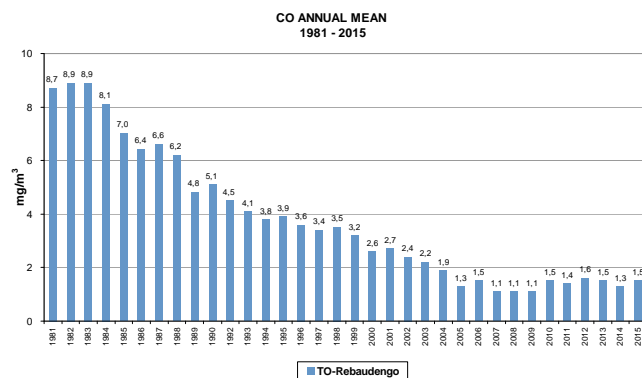
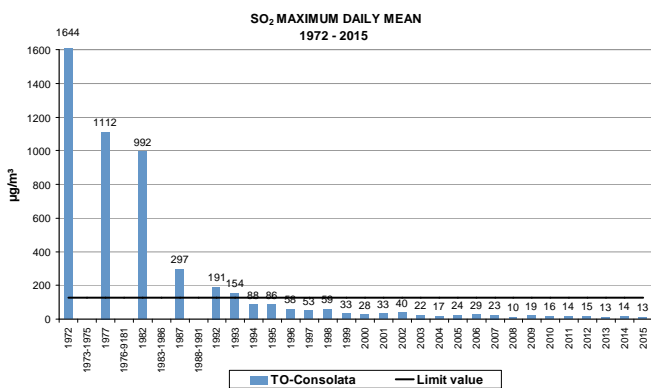
CARBON MONOXIDE

CO 2015	Annual mean (mg/m ³)	Maximum 8h mean (mg/m ³)
Baldissero	0,6	1,2
Leini	0,7	2,0
Oulx	0,5	1,8
Settimo	0,9	2,9
To-Consolata	1,5	3,8
To-Rebaudengo	1,5	3,1
To-Rubino	1,1	3,0

Limit value:
10 mg/m³ maximum daily 8 hour mean

Carbon monoxide (CO) is a colourless and odourless gas. It is mainly produced by the incomplete combustion of organic materials. The main source of CO is traffic and in particular gasoline vehicles.

Limit value is widely fulfilled. Time series analysis shows that CO concentrations have not substantially changed over the last 10 years, the annual means are always below 2 mg/m³.



HEAVY METALS

Metals 2015	As Annual mean* (ng/m ³)	Cd Annual mean* (ng/m ³)	Ni Annual mean* (ng/m ³)	Pb Annual mean* (µg/m ³)
Beinasco TRM	0,7	0,13	3,3	0,006
Borgaro	0,7	0,15	4,9	0,008
Carmagnola	0,7	0,13	3,5	0,006
Ceresole	0,7	0,09	1,2	0,001
Druento	0,7	0,09	4,9	0,004
Ivrea	0,7	0,13	3,4	0,005
Oulx	0,7	0,13	2,2	0,002
Susa	0,7	0,09	3,4	0,004
To-Consolata	0,7	0,15	5,4	0,009
To-Lingotto PM10	0,7	0,15	3,6	0,008
To-Rebaudengo	0,7	0,40	5,0	0,021
To-Rubino	0,7	0,15	3,6	0,007

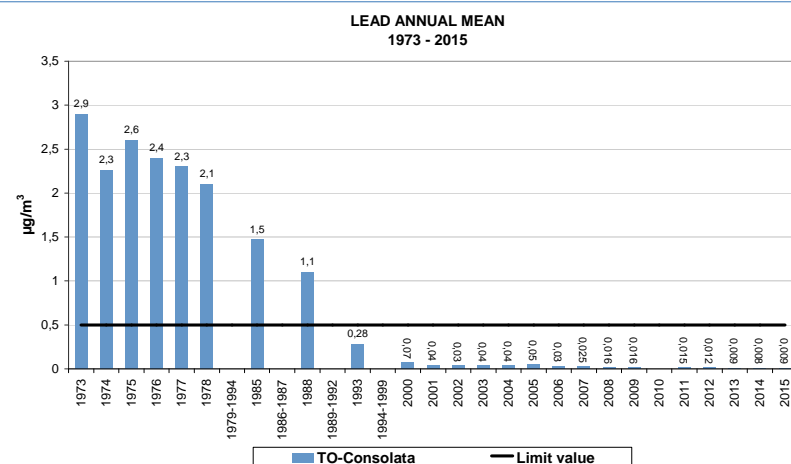
(* Estimation based on the first 10 months of measurement)

Limit value:
lead 0,5 µg/ m³ annual mean
Target value:
arsenic 6 ng/ m³ annual mean
cadmium 5 ng/ m³ annual mean
nickel 20 ng/ m³ annual mean

Heavy metals are a class of pollutants extremely widespread. Natural sources, like erosion or volcanic eruptions, can be the cause of their presence in air but also many human activities (traffic, metallurgical industry, combustion processes) have an important role. Heavy metals may affect human health in several ways depending on the kind of metal, the kind of exposure and, of course, the quantity absorbed.

Nickel, Cadmium, Lead and Arsenic are metals with harmful effect on human health for which the Legislative Decree no. 155 of 13/08/2010 sets limit or target values.

These values are widely respected in all the monitoring sites for all metals. Time series shows that lead concentration in atmosphere have decreased around 300 times over the last 40 years and it is now stabilised at very low levels.



PARTICULATE MATTER

PM10 2015	Annual mean (µg/m ³)	Exceeding number
Baldissero (B)	17	8
Beinasco TRM (B)	33	68
Borgaro	35	71
Carmagnola	41	107
Ceresole (B)	7	0
Collegno	36	81
Druento	23	23
Ivrea	28	55
Leini (B)	36	84
Oulx	18	7
Pinerolo (B)	21	11
Settimo	39	98
Susa	18	11
To-Consolata	40	93
To-Lingotto	38	86
To-Rebaudengo(B)	42	99
To-Rubino	36	84

TO-Grassi data still under validation

Limit value:
40 µg/m³ annual average
50 µg/m³ daily mean not to be exceeded more than 35 times a calendar year

PM2,5 2015	Annual mean (µg/m ³)
Beinasco TRM (B)	26
Borgaro	26
Ceresole(B)	6
Chieri	24
Ivrea	24
Leini (B)	30
Settimo	31
To-Lingotto	27
To-Rebaudengo data	still under validation

Limit value:
25 µg/m³ annual mean

Atmospheric particulate matter (PM) is microscopic solid (or liquid) matter suspended in the atmosphere. There is growing epidemiological evidence that exposure to PM may increase chronic diseases of breathing apparatus, in particular asthma, bronchitis and emphysema. As regards PM10 the data collected in 2015 show exceedance of the annual limit value in two traffic monitoring stations, while the daily limit value is exceeded in 11 out of 17 stations. The months of November and December were extremely critical, therefore 51% of the exceedances days occurred in this period. Normally, only the stations located at high altitude or in the alpine valley comply with the daily limit value, but over the last two years the flatlands monitoring stations of Druento and Pinerolo have shown compliance. For PM2,5 the situation has worsened compared with 2014; the annual limit value of 25 µg/m³ is exceeded in 5 monitoring stations out of 8, while in 2014 only one station reported exceedances.

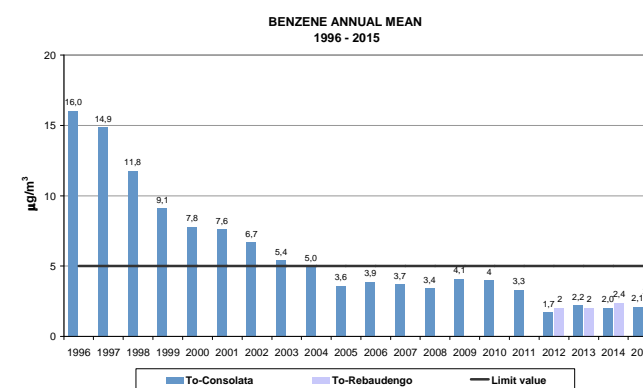
BENZENE

BENZENE 2015	Annual mean (µg/m ³)
Beinasco (TRM)	1,3
Borgaro	1,3
Settimo	2,3
To-Consolata	2,1
To-Lingotto	1,1
To-Rebaudengo	2,6
To-Rubino	2,1
Vinovo	1,5

Limit value:
5 µg/m³ annual mean

Benzene (C₆H₆) is an aromatic hydrocarbon mainly emitted from gasoline cars. It is classified as carcinogenic belonging to EU category 1-R45.

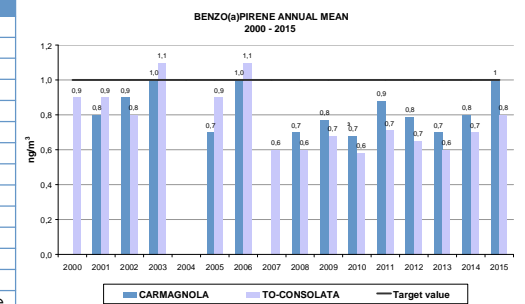
Monitoring data show in 2015 full compliance with the limit value for the protection of human health. Data collected in 2015 confirm the trend of the last four years to a substantial stability of concentrations.



BENZO(a)PYRENE

B(a)P 2015	Annual mean* (ng/m ³)
Beinasco (TRM)	0,8
Borgaro	0,8
Carmagnola	1,0
Ceresole	0,1
Druento	0,3
Ivrea	1,1
Oulx	0,6
Settimo	1,4
Susa	0,6
To-Consolata	0,8
To-Lingotto	0,8
To-Rebaudengo	1,4
To-Rubino	0,8

(* Estimation based on the first 10 months of measurement)
Target value:
1 ng/m³ annual mean



As regard the PAHs group, current legislation sets a target value only for benzo(a)pyrene. The IARC includes B(a)P in group 1, i.e. "carcinogenic to humans".

Annual averages of B(a)P, estimated on the basis of the first 10 months of 2015, show a widespread increase of concentrations compared with previous years, with 2 traffic and 1 background stations above the target value. Data will be confirmed when definitive annual means (including November and December measurements) are available. Data from To-Grassi station are not available in 2015 due to an insufficient data capture percentage (27%).

OZONE

O ₃ 2015	Number of exceedances of information threshold	Number of exceedances of the target value for the protection of human health
Baldissero	26	67
Borgaro	32	36
Ceresole	0	47
Chieri	0	50
Druento	69	51
Ivrea	4	40
Leini	3	27
Orbassano	68	58
Susa	0	21
To-Lingotto	8	51
To-Rubino	3	36*
Vinovo	1	30

(* Value calculated as an average over two years)

information threshold :
180 µg/m³ hourly average
Target value for the protection human health:
120 µg/m³ maximum daily 8-hour mean not to exceed more than 25 days per calendar year averaged over three years

Ozone (O₃) is a secondary pollutant. It is formed through a series of photochemical reactions involving nitrogen oxides and volatile organic compounds. Low concentrations of O₃ may cause throat inflammation, breathing apparatus and eye irritation; higher concentrations can lead to respiratory function worsening.

The target value for the protection of human health (as an average over the last three years) is exceeded in all the monitoring stations of the metropolitan city of Turin. The only exception is the Susa station whose compliance is mainly due to the values measured during the rainy summer of 2014.