

## 10. Environment<sup>1</sup>

The indicators of the Environment domain aim at monitoring the evolution of citizens' well-being with respect to the natural environment in which they live. The objectives of the ecological transition include more sustainable production and consumption, decoupling economic growth from the use of resources, as reported in the European Commission's Strategic Foresight Report 2023<sup>2</sup>.

The many actions implemented in our country to start the transition have not yet achieved the desired outcomes. Several indicators show that the recovery of economic and social activities following the pandemic crisis has contributed to the increase in pressures on the environment and - consequently - on its condition. In particular, in 2022 air quality worsens compared to the previous year (76.2% exceedances of the reference threshold, against 71.7% in 2021), after a period of constant improvement; CO<sub>2</sub> emissions increase, returning to 2019 levels (7.3 tonnes per inhabitant in both years); consumption of internal material increases (516 million tonnes, against 505 in 2021 and 500 in 2019) and energy production from renewable sources decreases (30.7% of energy consumed from renewable sources, against 35.1% in 2021 and 34.9% in 2019). Furthermore, it does not improve the level of soil sealing (7.14% of the total surface area, compared to 7.11% in 2021 and 7.07% in 2019) and total losses in public water supply networks, which have remained consistently high throughout the last two decades (42.4% of the water input into the municipal network). The exception is the improvement in indicators on municipal waste generation (492.3 kilograms per inhabitant, compared to 500.5 in 2021 and 503.0 in 2019) and on their disposal in landfill (17.8% of urban waste produced). In particular, this last indicator is constantly decreasing at national level despite the management of disposal at regional level being highly differentiated.

In 2023, the effects of climate change are increasingly evident in terms of temperature extremes (maximum, minimum and average) and heterogeneous distribution of precipitation quantities compared to the reference climate period, as can be seen from the indicators on extreme phenomena connected to the intensity of the heat (+36 days compared to the reference period 1981-2010) and the extension of drought events (+5.5 consecutive days without rain).


































Citizens' concern for climate change (70.8% of people aged 14 and over) and the indicator of satisfaction with the environmental situation (69.1%) are confirmed with similar levels to 2019. Concern for the loss of biodiversity, however, remains higher than in 2019, despite the decrease compared to 2022 (23.0%, against 23.9% in 2022 and 22.2% in 2019).

Finally, regarding the contaminated sites subject to remediation, the apparent improvement is due to the revision of the site perimeters.

<sup>1</sup> This chapter was edited by Domenico Adamo and Stefano Tersigni, with contributions from Luigi Costanzo, Elisabetta Del Bufalo, Aldo Femia, Flora Fullone, Silvana Garozzo, Antonino Laganà, Maria Rosaria Prisco, Simona Ramberti, Silvia Zannoni. The box Beached marine waste was edited by Antonino Laganà. The box Energy consumption and CO<sub>2</sub> emission intensity of energy consumption was edited by Giusy Vetrella.

<sup>2</sup> Strategic Foresight Report 23 - "Sustainability and wellbeing at the heart of Europe's Open Strategic Autonomy" [https://commission.europa.eu/document/f8f67d33-194c-4c89-a4a6-795980a1dabd\\_en](https://commission.europa.eu/document/f8f67d33-194c-4c89-a4a6-795980a1dabd_en).

**Table 1. Environment indicators: value for the latest available year and percentage changes compared to the previous year and 2019**

| INDICATORS  | Year | Value | Unit of measure        | Polarity | Percentage changes  |   |
|---|------|-------|------------------------|----------|---|---|
|   |      |       |                        |          | compared to the previous year   | compared to 2019  |
| Air quality - PM <sub>2.5</sub>                         | 2022 | 76.2  | %                      | -        |    |    |
| Emissions di CO <sub>2</sub> and other greenhouse gases | 2022 | 7.3   | t/inhab.               | -        |    |    |
| Population at risk of landslides                        | 2020 | 2.2   | %                      | -        |    | ....  |
| Population at risk of flood                             | 2020 | 11.5  | %                      | -        |    | ....  |
| Total water losses in public water supply network (a)   | 2022 | 42.4  | %                      | -        |    |    |
| Protected natural areas                                 | 2022 | 21.7  | %                      | +        |    |    |
| Urban green   | 2022 | 32.8  | m <sup>2</sup> /inhab. | +        |    |    |
| Soil sealing from artificial land cover                 | 2022 | 7.1   | %                      | -        |    |    |
| Domestic material consumption                           | 2022 | 516   | mIn of t               | -        |    |    |
| Municipal waste generated                               | 2022 | 492.3 | kg/inhab.              | -        |    |    |
| Landfill of waste                                       | 2022 | 17.8  | %                      | -        |    |    |
| Contaminated sites                                      | 2021 | 7.1   | ‰                      | -        |    |    |
| Electricity from renewable sources                      | 2022 | 30.7  | %                      | +        |    |    |
| Concern for climate change                              | 2023 | 70.8  | %                      | +        |   |   |
| Satisfaction for the environment                        | 2023 | 69.1  | %                      | +        |  |  |
| Concern for biodiversity loss                           | 2023 | 23.0  | %                      | +        |  |  |
| <b>WEATHER AND CLIMATE INDICATORS</b>                   |      |       |                        |          | <b>COMPARISON WITH CLIMATIC PERIOD 1981-2010</b>                                      |   |
| Warm Spell Duration Index                               | 2023 | 42.0  | days                   | -        |  |   |
| Extreme precipitation events                            | 2023 | 0.0   | days                   | -        |  |   |
| Consecutive Dry Days                                    | 2023 | 29.0  | days                   | -        |  |   |

Source: Istat, Bes Indicators

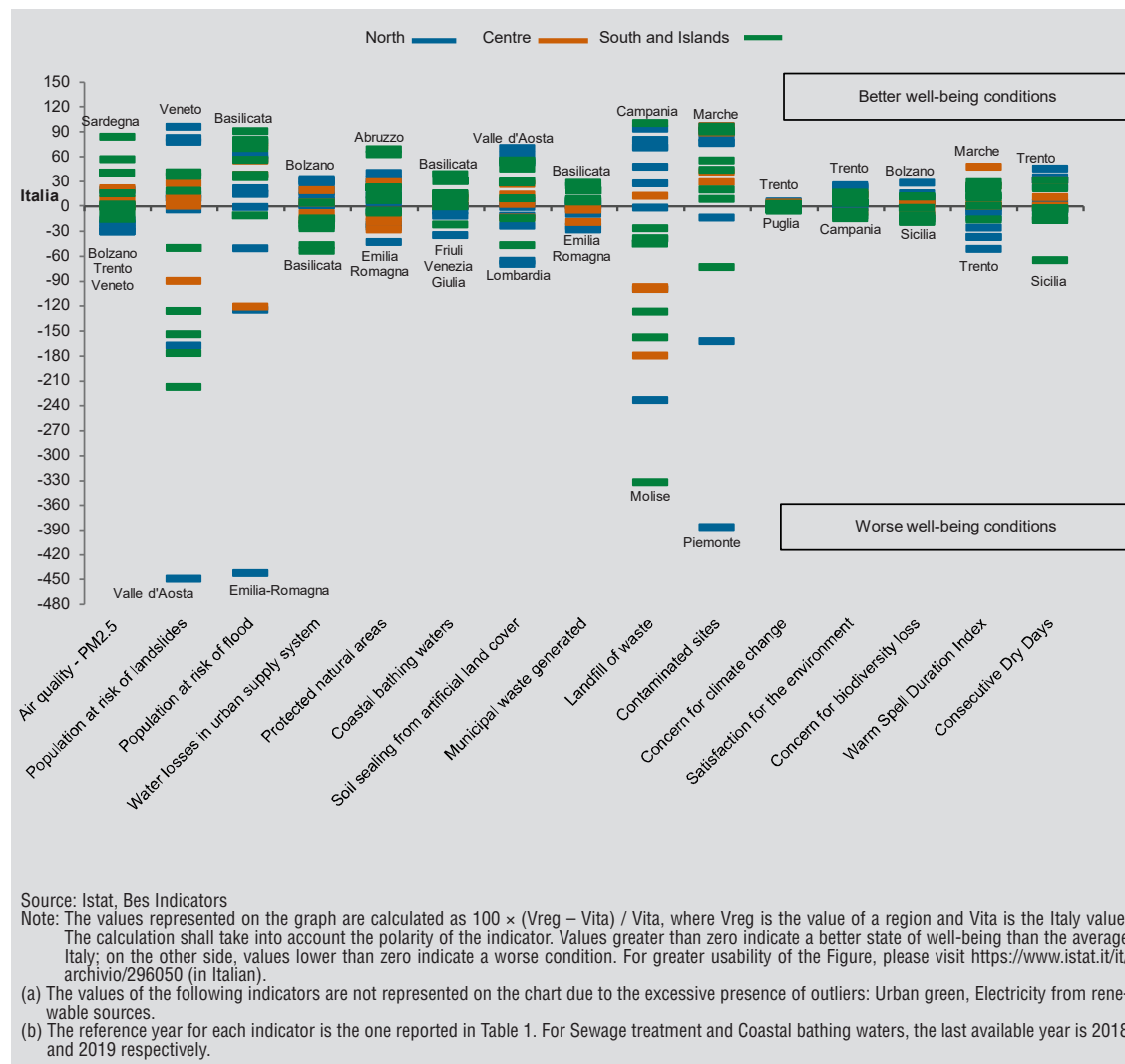
Note: The green colour indicates improvement, red worsening and grey stability, taking into account the polarity of the indicator. The indicators have positive polarity if the increase in their value shows an improvement in well-being, negative polarity if the increase in their value shows a deterioration in well-being. For variations within  $\pm 1\%$  the indicators are considered stable in the reference period.

(a) For the indicator Total water losses in public supply network, the 2019 and 2021 data are not available, the change is calculated with respect to 2018 and 2020. For the indicators Population at risk of landslides and floods, the 2019 and 2021 data are not available, the change is calculated with respect to 2017. The indicators Sewage treatment and Coastal bathing waters are not represented in the Table as no comparisons are available for the reference periods. The indicators Warm Spell Duration Index, Extreme precipitation events and Consecutive Dry Days are compared with the reference climatic period 1981-2010.

At regional level, in most cases, it is possible to find wide differences in these indicators: for 10 out of 15 indicators, the extreme values observed at regional level are contained within a maximum range of 100% variation compared to the Italian average, while for the other cases there are so many and distant extreme values, that the analysis of the regional distribution is not very meaningful (Figure 1).

The maximum dispersion is observed among the measures of exposure to hydrogeological risk: for floods, the share of the population exposed to the risk varies between the minimum of Basilicata (1.1% of the population) and the maximum of Emilia-Romagna (62.5%, five times higher than the national average); for landslides, the figure ranges from almost zero in Veneto to the maximum in Valle d'Aosta (12.1%, almost 6 times the average). The data related to distribution of the share of urban waste disposed in landfill is also very dispersed, with Molise in the worst condition (77.1%, a value four times higher than the Italian average) far from the province of Bolzano (1.1%, about a tenth of the average). In Campania the values are zero because the waste disposed in landfill are managed outside the region. A high variability is also observed for the indicator of contaminated sites, with maximum values in Piemonte (34.7‰ of the surface, five times the national average) and almost close to zero in Marche.

Figure 1. Environment indicators: percentage differences between regional values and the Italian value. Latest available year (a)(b). Italy = 0



The territorial variability of the indicators related to soil sealing, due to artificial surfaces, is relatively smaller: the percentages of land consumption are between the minimum value in Valle d'Aosta (2.2% of the regional surface, 0.4 times the average) and the maximum value in Lombardia (12.2%, 1.7 times). The distances between the extreme values and the Italian average are even smaller for the indicator related to total losses in public water supply networks: the level in Valle d'Aosta (29.8% of water input in municipal networks) is equal to about half of the national value, while at the opposite side Basilicata (65.5%) shows values equal to 1.5 times the average. Despite the lower degree of heterogeneity found in the distribution of the air quality indicator, it shows different values mainly due to the morphology of the territories, weather and climate conditions: Veneto and the autonomous provinces of Trento and Bolzano (100% of the exceeding values if compared to the reference threshold) exceed the Italian average by approximately one third, while at the opposite side it can be found the region of Sardegna (12.5%).

Finally, the distributions of the three perception indicators (concern for climate change, satisfaction for the environment, concern for biodiversity loss) are more concentrated - despite the clear polarisation of the values according to the usual North-South scheme.

### Air quality from PM<sub>2.5</sub>: spread of pollution increasing especially in the Centre and South

The World Health Organization (WHO) indicates air pollution as the main environmental risk for health at a global level<sup>3</sup>. It is a complex phenomenon that depends on multiple factors and different pollutants, at a micro, local and regional scale<sup>4</sup>, and this makes it difficult to select a limited set of significant air quality indicators. Usually, we focus on those for which a link between exposure and short and long-term health effects is recognised. Among these, particulate matter (PM<sub>2.5</sub> e PM<sub>10</sub>), nitrogen dioxide (NO<sub>2</sub>) and tropospheric ozone (O<sub>3</sub>) represent the main components for monitoring.

The WHO defines PM<sub>2.5</sub> as the air pollutant most harmful to health. The concentrations of this substance in the air reflect, at least in part, levels and temporal variability of the concentrations of other pollutants<sup>5</sup>. The PM<sub>2.5</sub> indicator is suitable for assessing air pollution in both urban and suburban and rural areas. It is defined with reference to the percentage of valid measurements above the interim target (IT4) defined by the WHO (10 µg/m<sup>3</sup>)<sup>6</sup> on the total valid measurements of the annual average concentrations of PM<sub>2.5</sub> for all types of monitoring stations, stratified by main source of pollution (traffic, background and industrial)<sup>7</sup> and location area (urban, suburban and rural)<sup>8</sup>.

3 For further details: <https://www.who.int/data/gho/data/themes/air-pollution/ambient-air-pollution>.

4 Micro scale means a portion of territory that is homogeneous in terms of detection area and main source of pollution, in some cases sub-municipal, monitored by a single station. Local and regional scale, on the other hand, means portions of territory monitored by multiple stations with different main sources of pollution.

5 The analysis of the air quality dimension was carried out in collaboration with ISPRA - Silvia Brini and Giorgio Cattani.

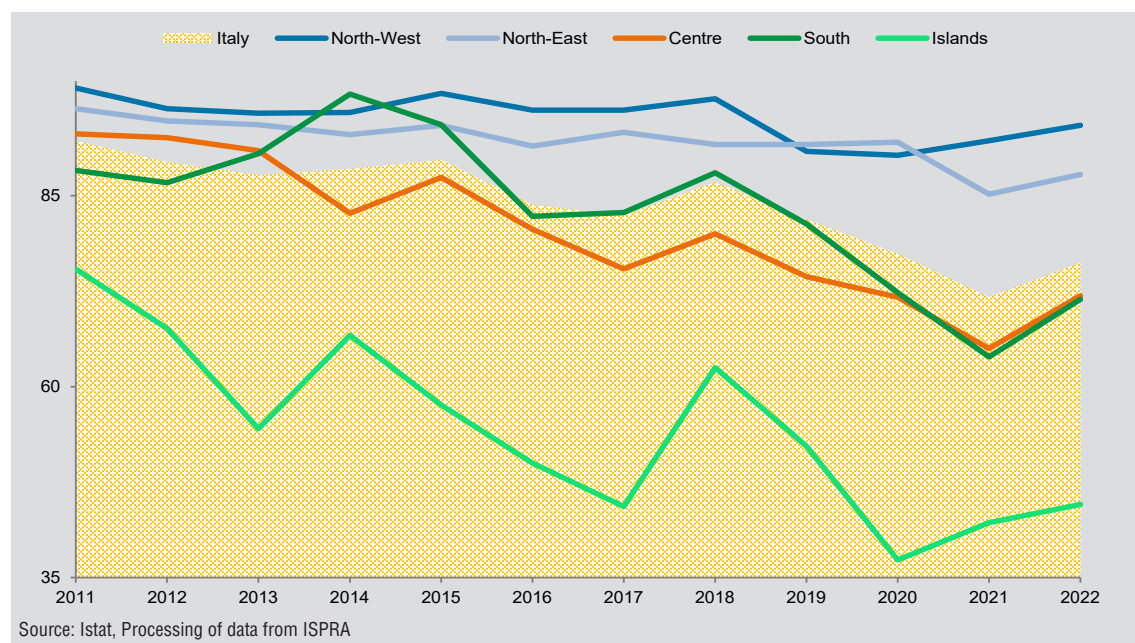
6 In its assessments, the WHO (2021 update of the guidelines) does not define a value below which there is no risk, but identifies the lower limit of average annual exposure as 5 micrograms per cubic metre (µg/m<sup>3</sup>) for PM<sub>2.5</sub> (reference level). This is the lowest level for which an increase in total mortality, mortality from cardiopulmonary causes, and mortality from lung cancer was observed, with a 95% confidence level. The WHO has also defined "interim targets", or higher reference levels to be considered as future objectives, through the implementation of air quality improvement policies. The *interim target* for PM<sub>2.5</sub> are 10 µg/m<sup>3</sup> (IT4), 15 µg/m<sup>3</sup> (IT3), 25 µg/m<sup>3</sup> (IT2) and 35 µg/m<sup>3</sup> (IT1).

7 *Traffic station*: station located in such a position that the pollution level is mainly influenced by emissions from nearby roads. In other words, a sampling point representative of the pollution levels defined mainly by traffic emissions from nearby roads, with medium-high traffic flows. *Background station*: station located in such a position that the pollution level is not mainly influenced by a single source or a single road. *Industrial station*: station located in such a position that the pollution level is mainly influenced by single industrial sources or nearby industrial areas. For further information: <https://www.istat.it/it/files/2021/12/Glossario-1.pdf>.

8 Given the widespread distribution of regional monitoring stations, the indicator is representative of the situation of the whole territory of the regions and autonomous provinces. The representativeness of the indicator was also strengthened thanks to the estimate of PM<sub>2.5</sub> concentrations in the monitoring stations that measured only PM<sub>10</sub>.

In 2022, an increase in the percentage of exceedances is observed, reaching 76.2% against 71.7% in 2021 (minimum value of the historical series). Indeed, since 2010 (the first year of availability of comparable data) the indicator has shown a constant decrease, with the exception of 2022 and 2018<sup>9</sup> (Figure 2). For Italy, therefore, it seems extremely difficult to contain the level of PM<sub>2.5</sub> within the threshold of 10 µg/m<sup>3</sup>, which would lead to clear benefits in terms of reducing premature mortality caused by PM<sub>2.5</sub> pollution. Compared to the previous year, the worsening of PM<sub>2.5</sub> pollution is found in all areas, but it can be clearly seen in the Centre (from 65.0% in 2021 to 71.9% in 2022) and in the South (from 63.9% to 71.4%). The only exception is Calabria, which improves from 50.0% to 45.0%. In the north-western and eastern areas, where historically the highest values of the indicator are observed, a more contained growth in the percentage of exceedances is recorded. A similar trend is also observed in the Islands where, however, the share of exceedances is historically lower (Figure 2).

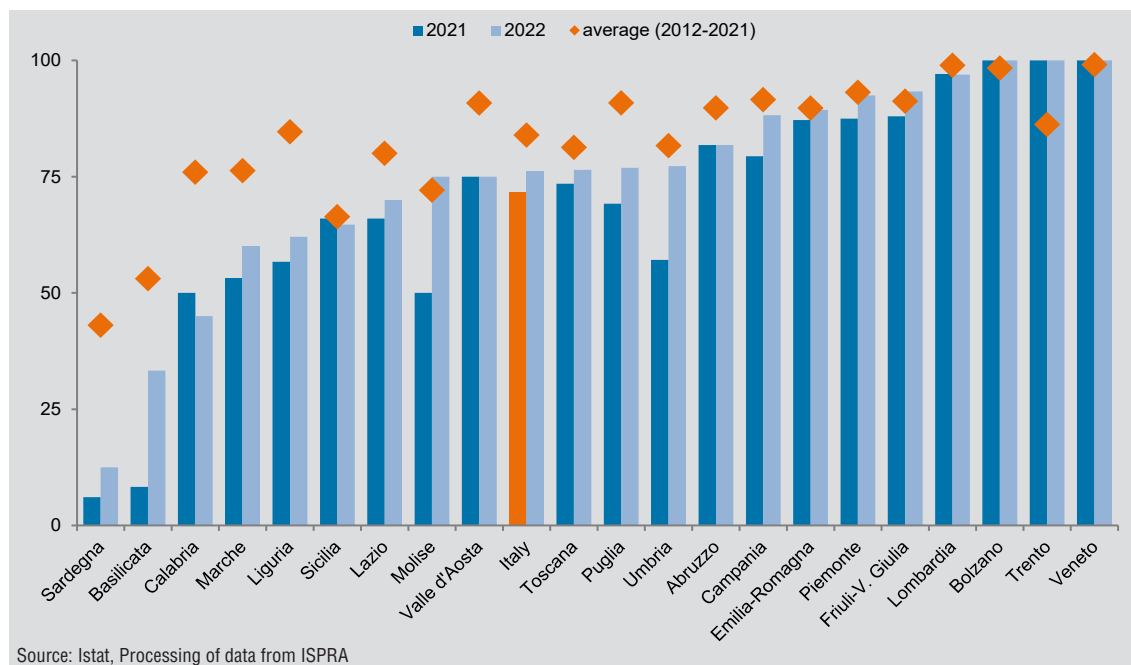
Figure 2. Exceedances of the annual mean concentrations of PM<sub>2.5</sub> of the WHO *interim target* (IT4) (10 µg/m<sup>3</sup>) by geographic area. Years 2011-2022. For 100 valid measurements



Regional data between 2021 and 2022 show a radical change of direction if compared to the trend in the 2012-2021 period: the indicator increases in almost all regions, excluding Calabria (-5 percentage points), Sicilia (-1.3), Lombardia (-0.1) and Veneto and the autonomous provinces of Bolzano and Trento, which were on average stable throughout the period (Figure 3).

<sup>9</sup> L'analisi dei *trend*, tuttavia, non può prescindere dalla valutazione del ruolo che le condizioni meteorologiche giocano nel determinare le differenze riscontrabili tra le concentrazioni di un anno e quelle dell'anno precedente (per approfondimenti si veda il Rapporto Bes 2021, p 183, <https://www.istat.it/it/files/2022/04/10.pdf>).

Figure 3. Exceedances of the annual mean concentrations of PM<sub>2.5</sub> of the WHO *interim target* (IT4) (10 µg/m<sup>3</sup>) by region. Years 2021 and 2022 and average 2012-2021. For 100 valid measurements



### The percentage of exceedances of nitrogen dioxide and ozone is substantially stable, moderate growth for those of PM<sub>10</sub>

Due to the repeated exceeding of the limits of PM<sub>10</sub>, NO<sub>2</sub> and PM<sub>2.5</sub>, Italy is subject to infringement procedures<sup>10</sup> of the European Directive 2008/50/CE<sup>11</sup>. One of the first proceedings for non-compliance against our country was started by the European Commission in 2014, due to the systematic and continued exceeding of these parameters and, in particular, of PM<sub>10</sub> in different areas of the national territory. According to the Commission, the measures provided by Italy to control these pollutants are not yet sufficient to shorten the period of exceedance and to guarantee compliance with the threshold values.

Comparing 2022 with the previous year and with the 2012-2021 average, the trends of the exceedances of PM<sub>2.5</sub> and PM<sub>10</sub> are strongly correlated<sup>12</sup> and for both there is a worsening compared to 2021 although an improvement was achieved on average in the previous ten years. If, however, we consider the exceedances for nitrogen dioxide (NO<sub>2</sub>) and the ozone indicator (related to the failure to reach the long-term objective), it is possible to see a moderate improvement compared to 2021 and the average of the previous ten years (Figure 4).

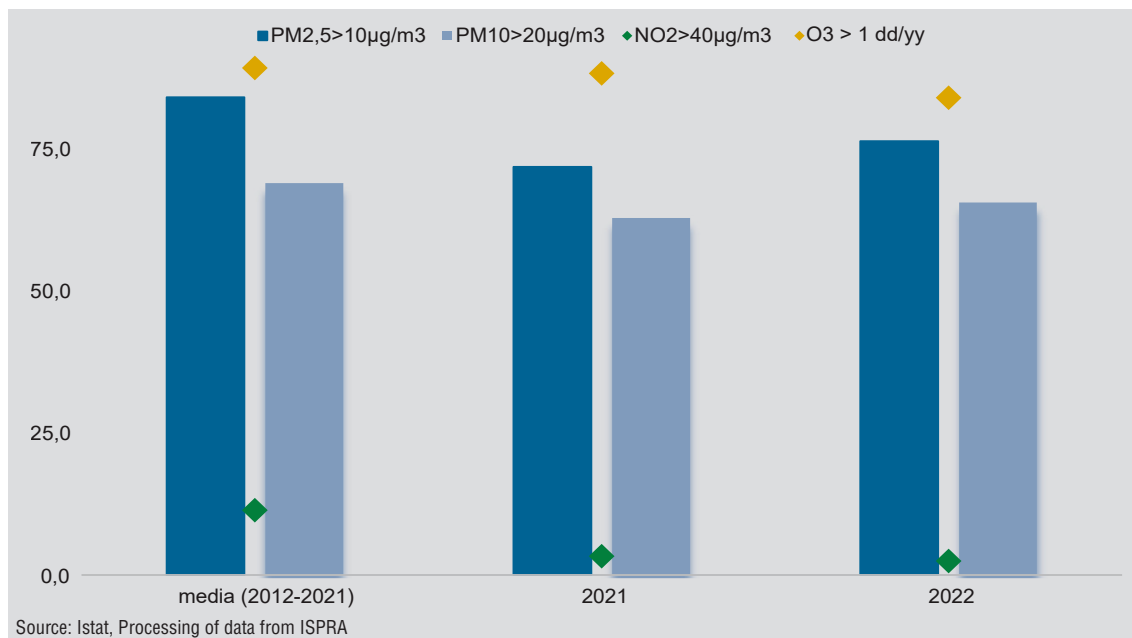
10 There are currently three active infringement procedures: Procedure n. 2014/2174 for exceeding PM<sub>10</sub> (already resulting in a conviction); Procedure n. 2015/2043 for exceeding NO<sub>2</sub>; Procedure n. 2020/2299 for PM<sub>2.5</sub>.

11 Although the limits for PM<sub>2.5</sub> and PM<sub>10</sub> established by European Directive 2008/50/EC (respectively 25 and 40 µg/m<sup>3</sup>) are higher than the WHO reference values (respectively 10 and 20 µg/m<sup>3</sup>), Italy is in infringement proceedings.

12 Given that PM<sub>2.5</sub> is a fraction of PM<sub>10</sub>.



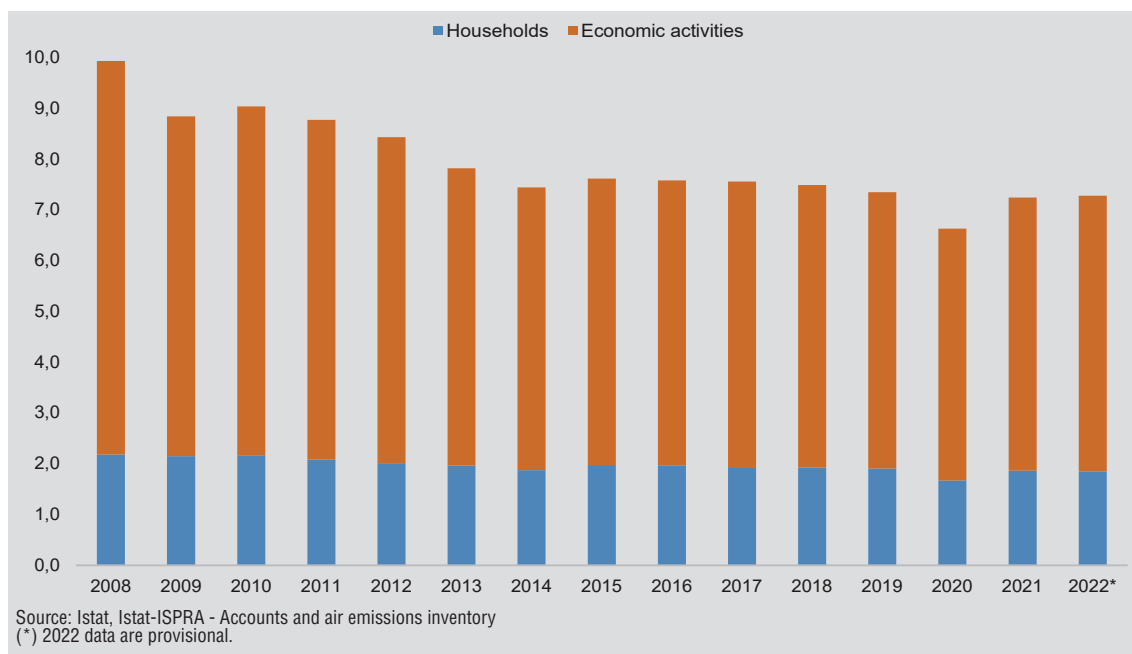
Figure 4. Exceedances of annual mean concentrations for PM<sub>2.5</sub> (IT4, 10 µg/m<sup>3</sup>), PM10 (20 µg/m<sup>3</sup>), NO<sub>2</sub> (40 µg/m<sup>3</sup>) and the long-term objective for O<sub>3</sub> (>1 day/year of the daily mean limit of 120 µg/m<sup>3</sup>). Years 2021-2022 and average 2012-2021. For 100 valid measurements



### The growth of CO<sub>2</sub> and climate-altering gas emissions continues

In 2022, emissions of CO<sub>2</sub> and other climate-altering gases (or greenhouse gases) produced by economic and household activities continued to grow, reaching 7.3 tonnes of CO<sub>2</sub> equivalent per inhabitant, 0.1 tonnes more than the previous year. However, they did not exceed the levels recorded in the pre-pandemic period, settling at the same value as 2019, which was gradually reached starting from 2009 (Figure 5).

Figure 5. Total emissions of CO<sub>2</sub> and other climate-altering gases and amounts generated by household and economic activities. Years 2008-2022. Tons of CO<sub>2</sub> equivalent per inhabitant



Climate-changing emissions per capita from households in 2022 amounted to 1.8 tonnes of CO<sub>2</sub> equivalent, down 0.1 tonnes compared to 2021. Emissions from households represent approximately a quarter of the overall emissions generated by the country and mainly derive from the use of fuels for private transport and from heating and cooling activities in domestic environments.

### A warmer Italy and an increase in precipitation

The general trend of increasing temperatures (average, maximum and minimum) across the country is confirmed<sup>13</sup>. In 2023, temperatures at the national level were still higher than the median of the reference period (1981-2010), with positive thermal anomalies in line with 2022, going from +1.5 to +1.7 °C for minimum temperatures and from +2 to +1.8 °C for maximum temperatures. As in the previous year, this condition was more marked in the North and in particular in the North-West (+2 °C for minimum temperatures and +2.4 °C for maximum temperatures). The largest differences, however, are noted in the autonomous provinces of Trento and Bolzano, where they reach values of +2.7 and +2.8°C for minimum temperatures. Heavy precipitations have been recorded if compared to 2022, exceeding the climatic median value of 6% at the national level, with a surplus of 12% in the South and 10% in the North-East, normal values in the Islands and a slight deficit in the North-West (-3%). It is important to point out that the considerable irregularity in the temporal distribution of rainfall, characterised by significant events of very intense precipitation concentrated in short intervals of time, can have dangerous consequences, as occurred in Emilia-Romagna and Marche in May<sup>14</sup>, as well as in Toscana in November, when the phenomena extended to a large part of the Tyrrhenian coast.

### Hot periods increase in all regions

The Warm Spell Duration Index<sup>15</sup> allows us to identify persistent conditions of temperatures much above the normal value and is representative of the variations in the local climate, identifying periods of relatively extreme heat that can occur at any time of the year.

In general, between 2011 and 2023 the number of days falling within hot periods is almost always greater than the median of the reference period 1981-2010. In the last two years, the phenomenon is much more marked than in the previous period and in 2023 the national value reached 42 days of intense heat (+36 compared to the median value of the reference period). However, it must be noted the data from the North-West with 52 days (+46) of intense heat during the year (Figure 6).

In the last two years, even at a regional level, it has been possible to record positive events of anomalies almost everywhere. In fact, the number of days in the year in which the maximum temperature is above the 90th percentile of the distribution in the reference climate period (1981-2010) for at least six consecutive days is significantly increasing.

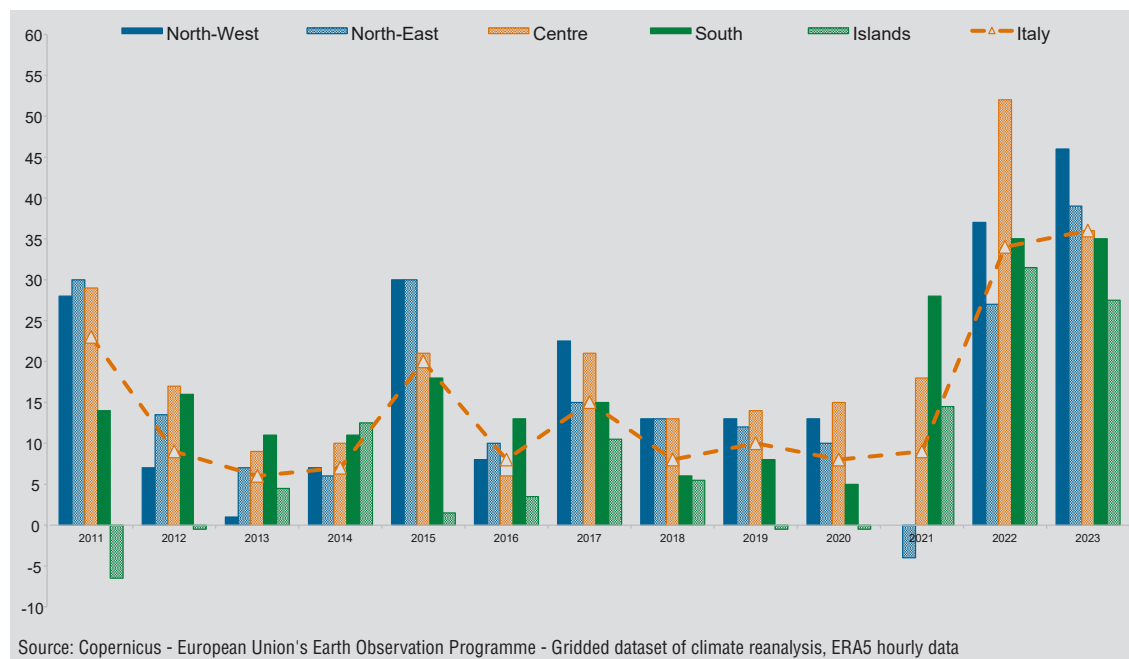
<sup>13</sup> The analysis of the dimension on weather and climate events was carried out in collaboration with CREA Agricoltura e Ambiente - Roberta Alilla, Flora De Natale, Barbara Parisse.

<sup>14</sup> <https://www.pianetapsr.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/2933>.

<sup>15</sup> WSDI, *Warm Spell Duration Index*.

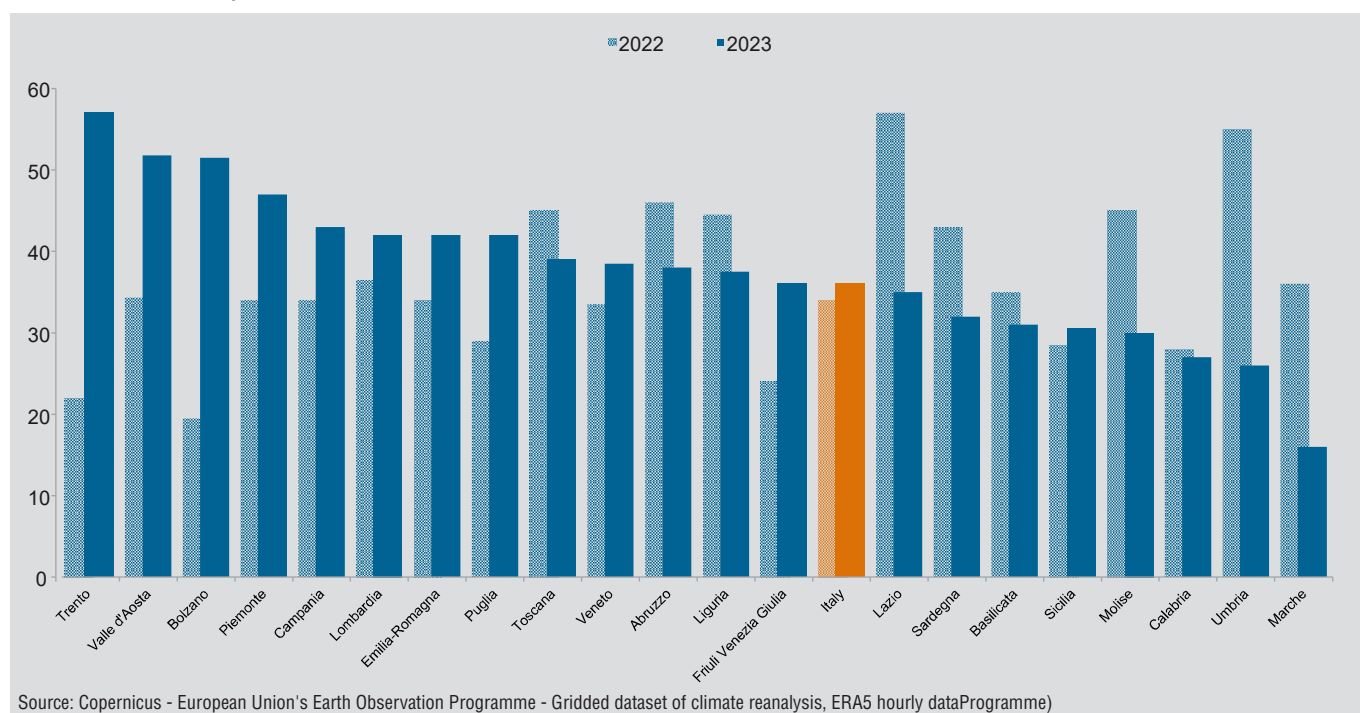


**Figure 6. Warm Spell Duration Index: deviations from the climatic median value (reference period 1981-2010) by geographic area. Years 2011-2023. Number of days**



In 2023, a widespread trend towards an increase in these phenomena is confirmed, particularly in the autonomous provinces of Trento and Bolzano, as well as in Valle d'Aosta, with deviations from the reference value ranging between +52 and +57 days (Figure 7). Compared to 2022, the anomalies are decreasing mainly in the Central regions, in part of the South and in Sardegn.

**Figure 7. Warm Spell Duration Index: deviations from the climatic median value (reference period 1981-2010) by region. Years 2022 and 2023. Number of days**

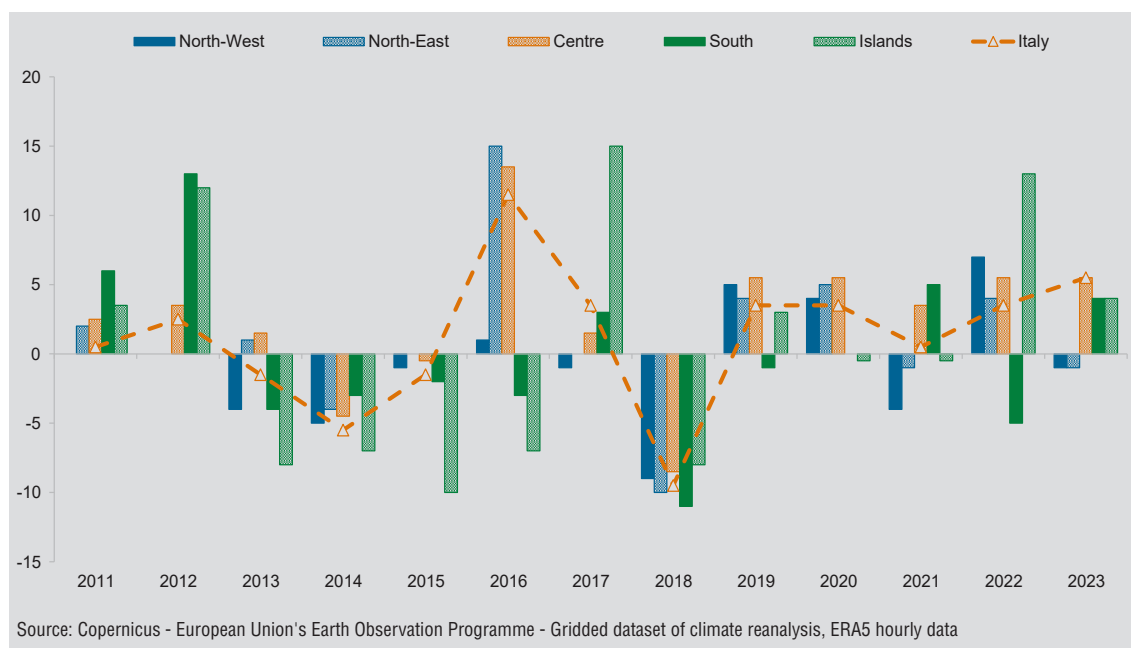


## The number of consecutive dry days is increasing except in the South

The maximum number, in a year, of consecutive days without rain<sup>16</sup> (or with daily precipitation less than 1 mm) is among the most used indicators of extreme events to determine drought periods, the effects of which also have an impact on environmental conditions, favouring the persistence of concentrations of pollutants in the atmosphere and reducing the supply of water resources.

In 2023, the number of consecutive days without rain continues to grow at a national level, reaching the value of 29 days (+5.5 compared to the average value of the climatic period). However, the phenomenon is less heterogeneous than the previous year, with weak negative anomalies in the Northern areas (-1) and very close values in the other three areas, with the largest gap in the Centre (+5.5). Compared to 2022, it is worth noting the radical change of direction for the South and the sharply decreasing values in the Islands (Figure 8).

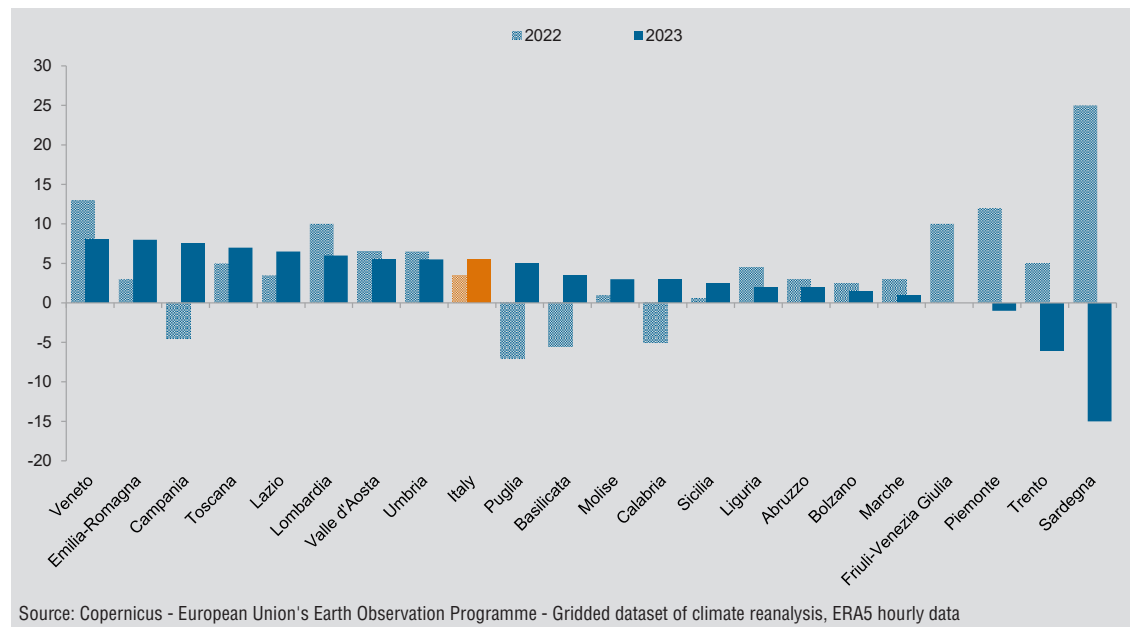
**Figure 8. Index of consecutive days without rain: deviations from the climatic average value (reference period 1981-2010) by geographic area. Years 2011-2023. Number of days**



At the regional level, in 2023 the highest anomalies of the index affected Veneto and Emilia-Romagna (+8), Campania (+7.5) and Toscana (+7). Compared to the previous year, an increase in the phenomenon can be noted in different regions of the South (Campania, Puglia, Basilicata and Calabria) and an opposite signal in other areas, with a strong reduction especially in Sardegna (from +25 to -15) (Figure 9).

<sup>16</sup> CDD - Consecutive Dry Days.

Figure 9. Index of consecutive days without rain: deviations from the climatic average value (reference period 1981-2010) by region. Years 2022 and 2023. Number of days



### Confirmation of extreme precipitation at local level

The indicator of extremely intense precipitation days<sup>17</sup> represents the number of days of the year in which the total daily precipitation is at least 50 mm, a threshold with a particular impact on people's well-being and health. In fact, most of the floods that have affected our country are associated with such extreme events.

At a national level, the median values of the R50mm index, in the three-year period 2021-2023, do not show variations compared to the reference period 1981-2010. The indicator, calculated as a territorial median value, is not very sensitive to these very intense and violent phenomena, often localized in limited areas.

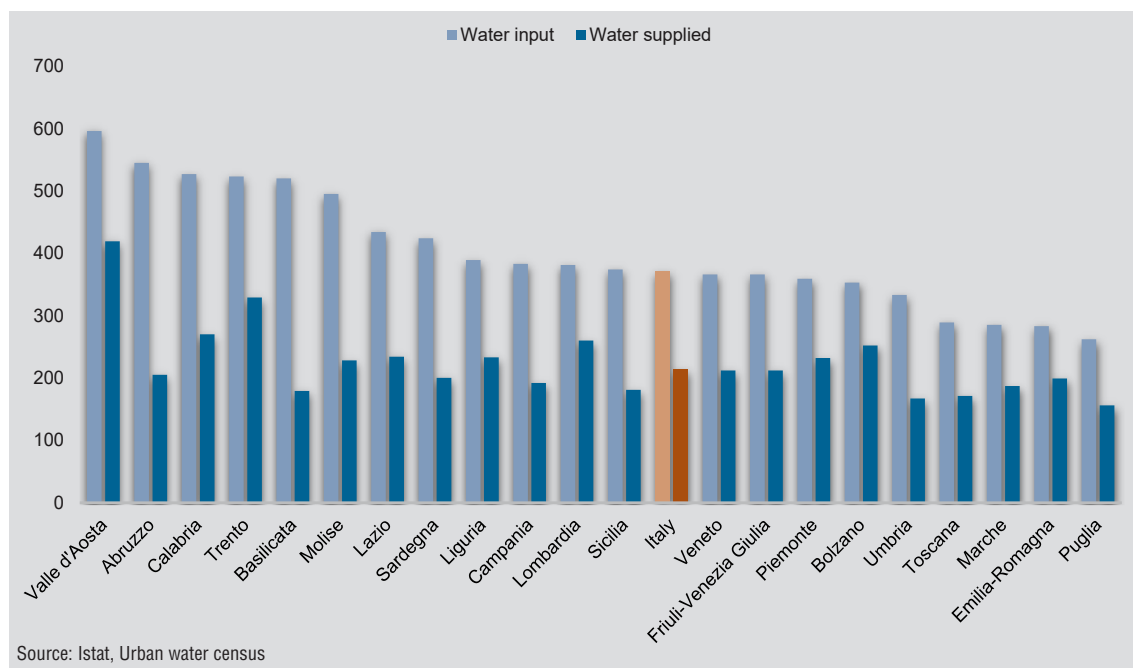
In 2023, at least one day with very intense precipitation was recorded in ten regions, reaching up to five days in Friuli-Venezia Giulia and two days in Lombardia and in the province of Trento. In Emilia-Romagna, the same value as in 2022 is confirmed for 2023.

### High levels of total water losses in public water supply networks

In 2022, 8.0 billion cubic meters of drinking water were input into municipal supply networks (371 litres per inhabitant per day). The daily volumes input per capita vary greatly at regional level: from 262 litres per inhabitant per day in Puglia to 596 in Valle d'Aosta. The volume input into the network is reduced by 1.4% if compared to 2020. Due to losses in public supply networks, a total of 4.6 billion cubic meters of water are supplied to end users for authorized uses (214 litres per inhabitant per day), including billed and unbilled volumes to end users (Figure 10).

<sup>17</sup> R50mm - Number of severe rain days.

Figure 10. Water input and water supplied in public water supply networks by region. Year 2022. Litres per inhabitant per day



The volume supplied is reduced by 1.6% compared to 2020. Therefore, the slow contraction in water use that has been observed for over twenty years still continues, related to greater attention in the water resources, also due to the related higher costs, as well as better monitoring of use and the necessary rationing of the resource, in some cases, due to the water emergency. Compared to 1999, the volume supplied records a decrease of 13% in volume and of 36 litres per inhabitant per day per capita.

The daily supply per capita is on average higher in the North municipalities. The maximum value is found in the North-West (251 litres per inhabitant per day) which shows a significant regional differential (from 232 litres per inhabitant per day in Piemonte to 419 in Valle d'Aosta, the region with the highest value). The presence of fountains in urban centres, especially in mountain areas, can imply considerable supplies, although in 2022 some water operators declared that they had kept them closed for part of the year due to the ongoing water emergency.

The Islands are confirmed as the geographic area with the lowest volume of water supplied per capita (186 litres per inhabitant per day), even if the lowest regional values of the indicator are observed in Umbria (167) and Puglia (156).

In 2022, the volume of total water losses in the public water supply networks is equal to 3.4 billion cubic metres, 42.4% of the water input into the municipal supply networks. The indicator is substantially stable compared to 2020 (when it was at 42.2%), confirming the state of inefficiency of many municipal supply networks.

Although in recent years many water operators have launched initiatives to ensure greater capacity for measuring use and the containment of network losses, the amount of water lost in distribution continues to represent a considerable volume, an amount of 157 litres per inhabitant per day. With an estimation of a per capita use equal to the national average, the volume of water lost in 2022 would satisfy the water needs of 43.4 million people for an entire year.

### Slight growth in public green per inhabitant

In 2022, the availability of public greenery in provincial capitals and metropolitan cities is 32.8 square metres per inhabitant (in 2021 it was 32.4). Since 2011, this value has recorded minimal annual increases in the overall surface of green areas. However, public greenery is not equally distributed among the provincial capitals, varying from 3.5 square metres in Crotone to 1,022 square metres in Isernia, characterized by the presence of many woodland areas (over 17 million m<sup>2</sup>).

Not all regional capitals are able to guarantee their citizens an availability of urban greenery per capita adequate to the minimum standard, required by law, of 9 square meters per inhabitant. Per capita availability is very low in 9 provincial capitals: Imperia and Savona in the North, Andria, Barletta, Trani and Crotone in the South, Trapani Messina and Siracusa in the Islands. On the other hand, in 8 provincial capitals it is very high, with values higher than three times the national average (over 100 m<sup>2</sup>/inhabitant): Verbania, Sondrio, Trento, Bolzano and Gorizia in the North, Terni and Rieti in the Centre, Isernia and Potenza in the South.

### Land consumption continues to grow

In 2021, the total amount of soil sealed is equal to 7.14% of the national territory. The increase in impermeable artificial covers concerned 76.8 km<sup>2</sup> more than in 2020, on average over 21 hectares per day, showing a worrying acceleration if compared to previous years. Also due to the demographic decline, the soil sealing per capita increases from 2021 to 2022 by 2.46 m<sup>2</sup>/inhab. and by 16.23 m<sup>2</sup>/inhab. since 2006.

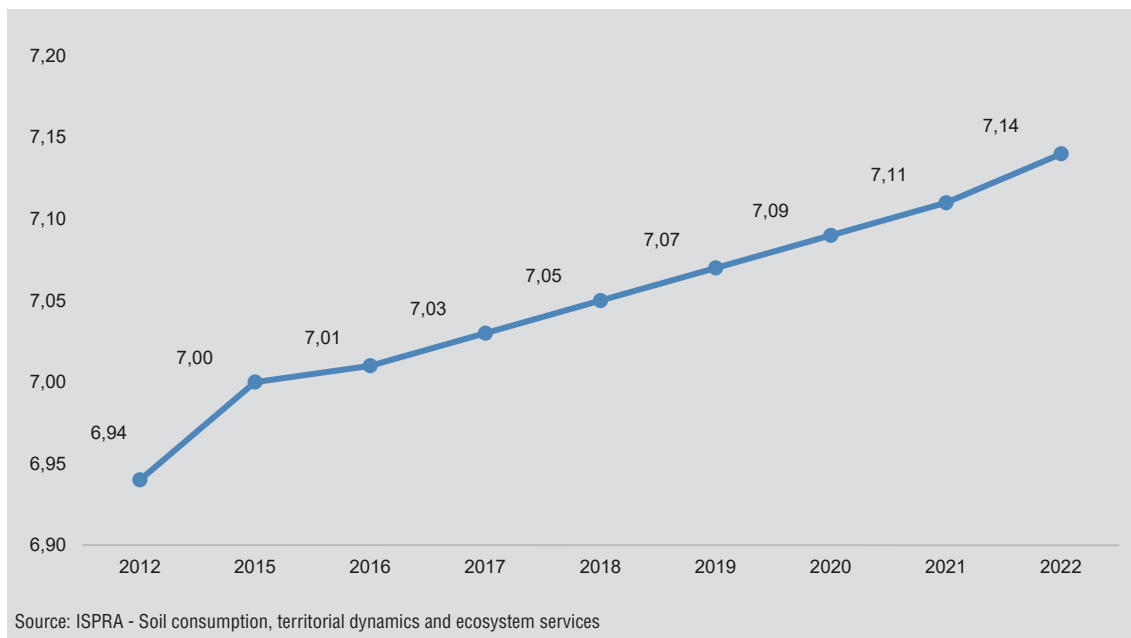
The growth of artificial surfaces has been only partially compensated by the restoration of natural areas, equal to 6 km<sup>2</sup>. A signal not yet entirely sufficient to reach the objective of zeroing net land consumption<sup>18</sup> that, during 2022, instead showed an amount of 70.8 km<sup>2</sup>, of which 14.8 of permanent consumption.

Furthermore, it must be considered that in 2022 a further 7.5 km<sup>2</sup> changed from a reversible condition (detected in 2021) to a permanent condition: permanent waterproofing therefore grew, overall, by 22.3 km<sup>2</sup>.

In 15 regions, the estimated soil sealed exceeds 5%: the highest percentage values remain those of Lombardia (12.16%), Veneto (11.88%) and Campania (10.52%); Valle d'Aosta is confirmed as the region with the lowest percentage (2.15%). To better understand these observed values, it must be considered the different regional morphology and the historical and peculiar evolution of the territory. The density with which the changes occur continues to increase from year to year, despite the decrease in the available territory, with greater intensity on the same regions if compared to previous years.

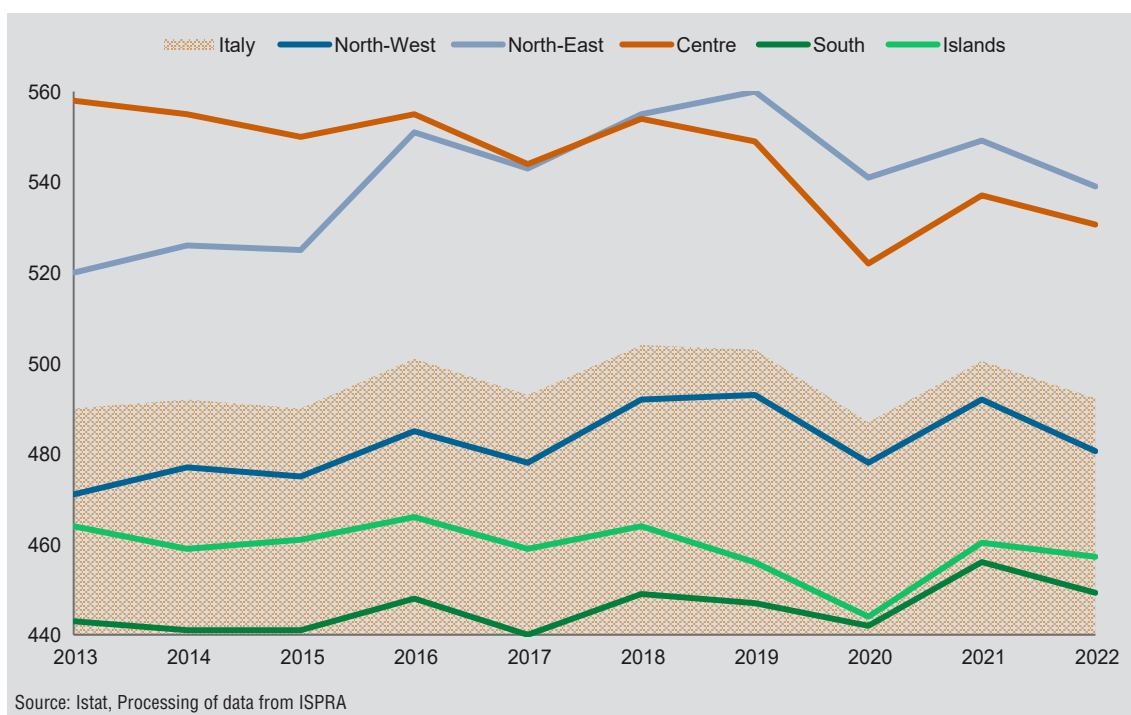
<sup>18</sup> Net land consumption is assessed through the balance between land consumption and the increase in agricultural, natural, and semi-natural surfaces due to recovery, demolition, de-impermeabilisation, renaturalisation or other interventions (European Commission, 2012).

**Figure 11. Soil sealing at national level. Years 2012-2022. Percentage of soil sealed following a change from non-artificial to artificial coverage**



Waste management at every stage – collection, processing for reuse, recycling, incineration (with or without energy recovery), landfill disposal – must be oriented towards sustainability, to limit the impact on human health and the environment. In 2022, compared to the previous year, municipal waste generation in Italy decreased, reaching 29.05 million tonnes overall (-1.8% compared to 2021), equal to 492 kilograms per inhabitant (-8.2 kg/inhab.), and returning almost to the 2020 level (487 kg/inhab.)

**Figure 12. Municipal waste generated by geographic area. Years 2013-2022. Kilograms per inhabitant**



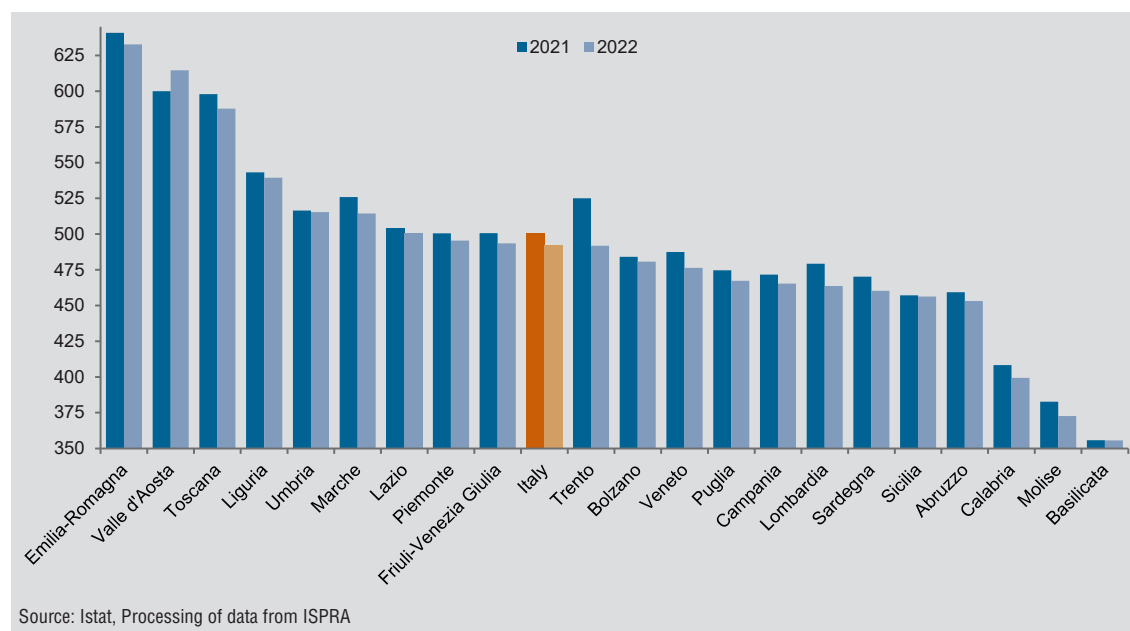


This decline appears more significant in light of the positive results of the economy in 2022 that, therefore, did not have the usual boosting effect on the production of urban waste. In the coming years it will be possible to evaluate whether this is the beginning of a virtuous phase or just a cyclical data.

In 2022, the territorial differences in per capita values are confirmed to be almost constant as in previous years, with more significant values in the North-East (539 kg/inhabitant) and in the Centre (531 kg/inhabitant). On the other hand, the North-West (481 kg/inhabitant) is below average together with the Islands (457 kg/inhabitant) and in the South (449 kg/inhabitant) (Figure 12).

Compared to 2021, decreases in urban waste produced are observed in all areas, more significant in the North-West (-11.4 kilograms per inhabitant, with a decrease of 2.4% of tons) and in the North-East (-10.1 kg/inhabitant and -2.0% t). It must be noted also that the reductions in the other areas are below average. The decrease, in terms of both per capita value and amount in tons of urban waste produced, is observed in all regions and autonomous provinces, with the exception of Valle d'Aosta (+14 kilograms per capita and +2.0% tons). The most significant reductions are in Trento (-33.2 kg/inhabitant and -6.3% t), Lombardia (-15.6 kg/inhabitant and -3.3% t), Marche (-11.5 kg/inhabitant and -2.7% t), Veneto (-11.1 kg/inhabitant and -2.5% t), Toscana (-10.2 kg/inhabitant and -2.1% t), Molise (-10.0 kg/inhabitant and -3.2% t), Sardegna (-9.9 kg/inhabitant and -2.5% t) and Calabria (-8.8 kg/inhabitant and -2.5% t). In the other regions, the decrease is lower than the average level (Figure 13).

Figure 13. Municipal waste generated by region. Years 2021 and 2022. Kilograms per inhabitant



### Landfill of waste registers a decreasing value, EU 2035 target achievable

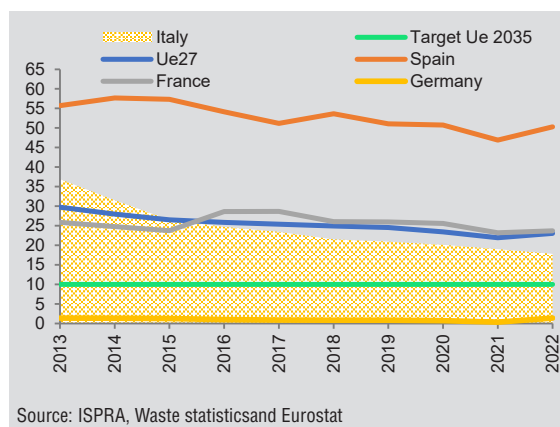
Waste that cannot be recovered in any way, including waste from recovery treatments, can be disposed through incineration without energy recovery or by landfilling, which is the lowest place in the waste hierarchy<sup>19</sup>.

<sup>19</sup> Directive 2008/98/EC establishes a hierarchy of priorities, in waste management, related to measures aimed at protecting the environment and human health and also reducing the overall impacts of resource use. The hierarchy goes, in fact, from prevention, to preparation for reuse, to recycling, to other types of recovery (for example of energy) up to disposal.

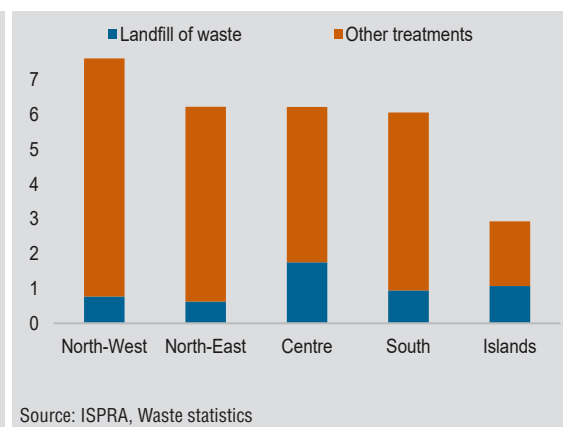
This type of urban waste disposal, which has a high impact on the environment and human health, continues to decrease in 2022, reaching 17.8% of urban waste produced (-1.2 percentage points compared to 2021). The EU objective is to landfill a maximum of 10% of urban waste by 2035<sup>20</sup>. Considering that the percentages recorded in the different territories are affected by the extra-regional flows of incoming and outgoing waste, the assessment in reference to the 10% target is applicable only at national level. Over the last ten years, the landfilling of urban waste has decreased on average by around 2 percentage points per year (from 36.9% in 2013). Even considering a slowdown in the last five years (on average around 1 percentage point per year since 2018), meeting the EU objective of 10% for Italy seems something achievable. In the European context and with reference to the period 2013-2022, Italy is always below Spain. Furthermore, starting from 2016 has had amounts of landfill urban waste that are lower than the EU27 average and France (Figure 14a).

Despite the positive trend of the indicator, the critical issues are to be found in the territorial distribution of urban waste disposed in landfill, with a total of 5.2 million tonnes (-7.9% compared to 2021). For what concerns this amount, 1.8 million tonnes are disposed in the Central regions (34% of the total), followed by the Islands (1.1 million tonnes, 21% of the total), the South (0.9 million tonnes, 18% of the total), the North-West (0.8 million tonnes, 15% of the total) and the North-East (0.6 million tonnes, 12% of the total), although the largest amount of urban waste is produced in the North (Figure 14b).

**Figure 14a. Landfill of waste in some European countries, EU27 average and EU 2035 target. Years 2013-2022. Percentage values**



**Figure 14e. Municipal waste generated by type of treatment and geographic area. Year 2022. Millions of tons**



Alongside the unequal pressure exerted on the territories regarding landfilling, the most critical data concerns the failure to comply – in many regions – with the principle of proximity provided by the legislation<sup>21</sup>. In fact, only 90% of the total amount of urban waste sent to landfill remains in the same region that generated it<sup>22</sup>.

<sup>20</sup> As provided by Directive 2018/850/EU, of the circular economy package, which modifies Directive 1999/31/EC on waste landfills, implemented by Legislative Decree n. 121 of 03/09/2020.

<sup>21</sup> According to the principle of proximity, mentioned in Article 182-bis of Legislative Decree 152/2006, the disposal of unsorted urban waste must take place in one of the suitable plants closest to the places of production or collection.

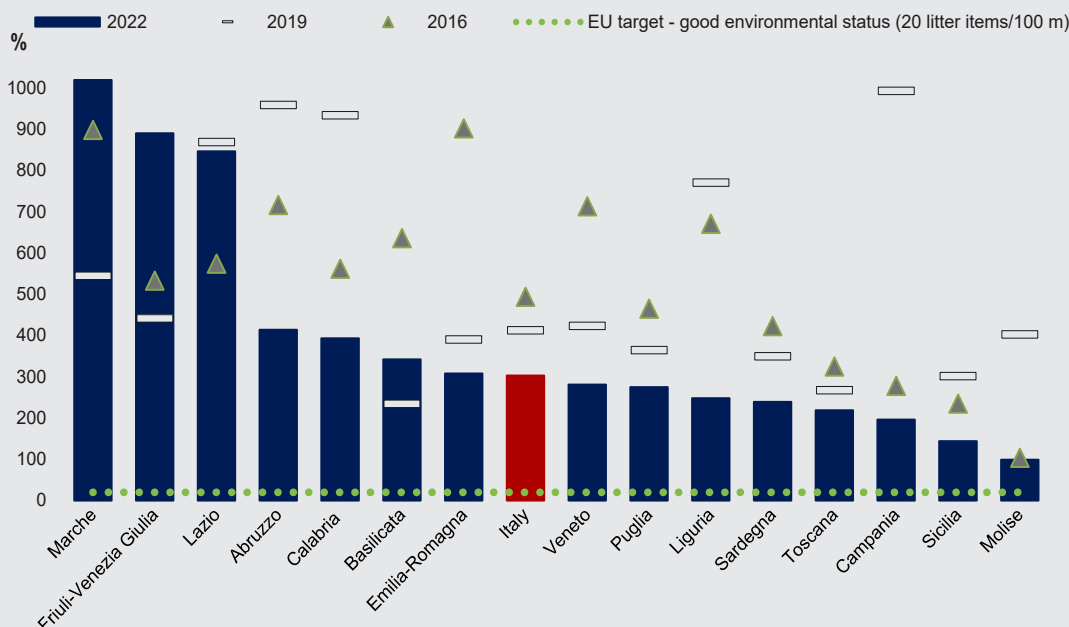
<sup>22</sup> For further information, see the Bes 2022 Report: <https://www.istat.it/it/archivio/282920>.

## BEACHED MARINE WASTE

In 2008, the EU adopted the Marine Strategy Framework Directive to monitor the environmental state of European seas, promoting strategies aimed at protecting marine ecosystems. The objective is to achieve a "good" environmental status (Good Environmental Status - GES<sup>1</sup>) by 2020 on the basis of eleven qualitative descriptors.

One of these descriptors takes into account the marine waste component and its reduction: in coastal areas, in the surface layer of the water column and on the seabed. The Italian coastal territory is characterised by both a high population concentration, on average 354 inhabitants per km<sup>2</sup> compared to 158 in non-coastal municipalities, and by a higher tourist pressure, with a density of presences five times higher than that of non-coastal areas (2,772 inhabitants/km<sup>2</sup>, compared to 536). These aspects particularly affect the presence of waste in coastal marine waters. Thanks to the monitoring carried out in Italy for some years now, it is possible to provide the first evidences of marine waste in over 5,000 km<sup>2</sup> of Italian marine areas, and in particular for what arrives on our beaches. In 2022, an average of 303 pieces of beached marine waste were recorded<sup>2</sup> per 100 meters of beach, densities higher than the threshold established by the European Commission (20/100 m). Although a six-year time series (2016-2022) is not enough for a long-term statistical analysis, a slow and progressive decrease in the total of marine waste along Italian beaches can be observed, from 494 pieces of litter per 100 m in 2016 to 413 in 2019 and 303 in 2022. If we consider the evolution of beached marine waste in the Italian regions, we observe that between 2016 and 2022 almost all coastal regions show a decrease in these amounts, also associated with the implementation of measures aimed at reducing plastic waste in the sea, as required by the directive.

**Figure A. Beached marine litter by region (median value). Years 2016, 2019 and 2022. Per 100 meters of beach**



Source: Istat, Processing from ISPRA

- <sup>1</sup> *Good Environmental Status*, ability to preserve ecological diversity, the ocean and sea life in order to be clean, healthy and productive at a sustainable level for present and future generations.
- <sup>2</sup> The indicator represents the number of different types of waste (total waste, single-use plastic, waste related to fishing and aquaculture, plastic bags and waste related to smoking) visible objects on the shoreline greater than 2.5 cm (longest side), with the exception of cigarette butts, those found through excavation are excluded.

The most significant reductions were recorded in Emilia-Romagna and Veneto, where the level went from 902 wastes per 100 metres detected in 2016 to 308 in 2022, and from 713 to 281, respectively. On the contrary, the most significant increases were recorded in Friuli-Venezia Giulia (from 533/100 m to 890) and Lazio (from 574 to 846) (Figure A).

Another measure taken into consideration by the directive is the type of floating macro litter, monitored both in the coastal and offshore sectors, through the investigation of the surface layer of the water column with 3-5 samplings per season along the 31 points identified (line transects) in the three Italian marine sub-regions (Western Mediterranean, Ionian Sea, Central Mediterranean and Adriatic Sea). In the years 2019-2020, an average of 35 surveys were carried out per transect in the coastal environment and waste belonging to 9 categories of materials were found, in the majority of cases artificial polymers (94.6%). In the offshore areas, 62 surveys were carried out along the 5 transects identified for a total of 314 km<sup>2</sup> of covered marine surface, where mostly artificial polymers were found (86.5%).

In the two sectors examined, over 70% is composed of macro waste, in the form of unidentifiable fragments. Among the first identifiable objects, there are waste generated by industrial packaging, food consumption, personal hygiene and fishing activities (aquaculture in coastal environments and offshore fish boxes).

### Environmental pollution and health risks in contaminated sites subject to remediation

The picture defined by the 2021 update of the indicator on contaminated sites subject to remediation is substantially the same as that presented for last year. This situation is due both to the slow progress of remediation operations and to the partial availability of updated data which, for 2021, only relate to the surfaces of the 42 Sites of national interest (SIN) whose competence is delegated to the Ministry of the Environment and Energy Security (MASE). The information on contaminated sites under regional competence, however, remains updated to 2019. As regards the SIN, the decreases in surface area recorded are only partly attributable to progress in remediation. For 2021, in fact, the data show that the land area of the SIN decreased from 171,211 hectares in 2020 to 148,721 hectares in 2021. If we read the data from a regional point of view, the decrease is due to the SIN of Piemonte (-20,145 hectares), Liguria (-2,104 hectares), Friuli Venezia Giulia (-245 hectares) and Abruzzo (-4 hectares). For Piemonte and Liguria, these variations are due to the use of estimated data for the surface area of Cengio and Saliceto site, subject to verification by MASE. For Friuli-Venezia Giulia and Abruzzo, to a new perimetrical areas, respectively, of the SIN of Trieste and Bussi sul Tirino. However, these variations leave the situation of the contaminated areas in Italy unchanged. Piemonte (88,132 hectares) remains in fact the region most affected by the serious problem of soil contamination, followed by Sardegna (29,903 hectares), Lombardia (19,460 hectares), Friuli-Venezia Giulia (14,471 hectares), Puglia (12,780 hectares) and Toscana (11,717). This record, unfortunately a bad one, is also confirmed in relative terms, analysing the share of contaminated surface compared to the total regional surface.

### The continuous decrease in the amount of energy consumption generated from renewable sources

In 2022, the consumption of electricity generated from renewable sources (hydroelectric, geothermal, wind, photovoltaic, thermal from biomass) is 30.7% of gross domestic consumption. The indicator is significantly lower than in 2021 (35.1%) and the values recorded since 2013 (Figure 15).

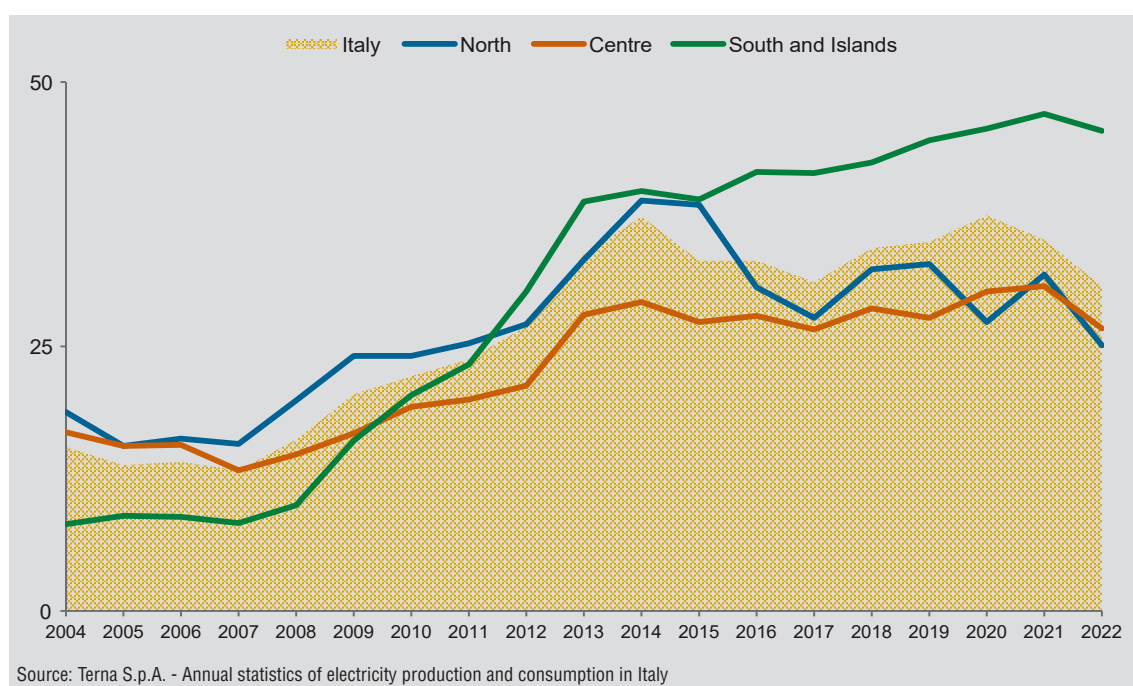
The overall decrease (-13.6%) in production from renewable sources (bioenergy, hydro, wind, photovoltaic and geothermal power) is mainly due to the decline in hydroelectric energy production which recorded a value of 10.5 billion kWh. In detail, compared to 2021, the trend in the production of renewable sources<sup>23</sup> saw a slight contraction in the wind source, which reached 20.5 billion kWh (-1.9% compared to 2021). The photovoltaic source recorded a strong growth, reaching the historical record of 28.1 billion kWh (+12.3%). The water source, as mentioned, was the one that recorded the greatest decrease with a variation of -37.4% and a production equal to 28.4 billion kWh, 17 billion less than in 2021. This decrease was caused by two phenomena, namely the absence of snow, which affected the hydraulic power of the spring and summer months, and the reduction in rainfall throughout the year (with the exception of the months of September and October). Bioenergy also registered a decrease of -7.6% and, through this variation, stands at 17.6 billion kWh. For the third consecutive year, production from geothermal sources shows a decrease of -1.3%, standing at 5.8 billion kWh.

<sup>23</sup> The data source is: Terna S.p.A. - Statistical data on electricity in Italy 2022.

Thermal production increased its incidence on national net production to 69.7% (in 2021 this value was 65.1%). Among the fuels used for thermoelectric production, natural gas continues to lead the way in 2022, accounting for 69.7% of total thermoelectric production (it was 77.1% in 2021).

In terms of geographical distribution, it is clear that in the South the amount of electricity from renewable sources, compared to gross domestic consumption, has been increasingly higher since 2011 compared to other areas and the national average (Figure 15). As regards the Northern and Central regions, the percentage values fall to the levels recorded before 2013.

**Figure 15. Electricity consumption from renewable energy sources by geographic area. Years 2004-2022.**  
Percentage values on gross domestic electricity consumption



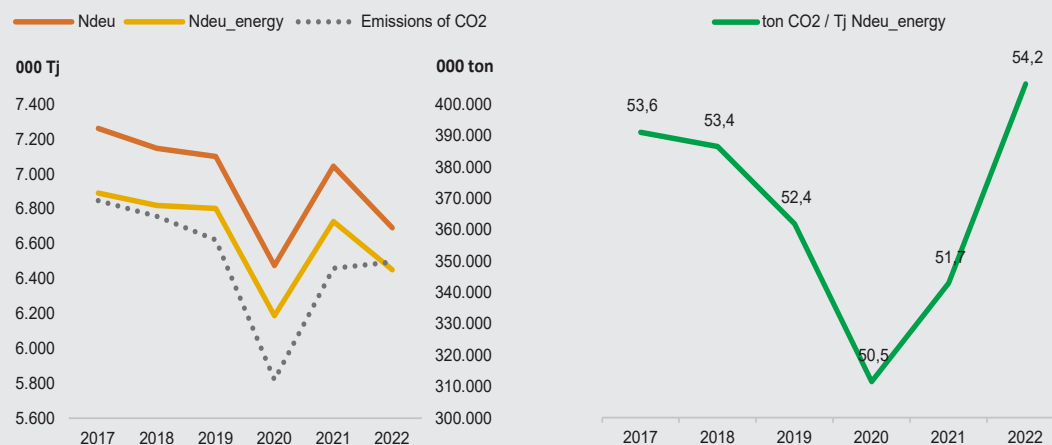


## ENERGY CONSUMPTION AND CO<sub>2</sub> EMISSION INTENSITY OF ENERGY CONSUMPTION

The energy consumption of productive activities and families resident in Italy, measured through *Net domestic energy use* (Ndeu)<sup>1</sup>, in 2022 is equal to 6,7 million terajoules (provisional estimates), 7,8% less than in 2017. Production activities, whose consumption decreases in the period considered by 9.2%, represent 68.4% of the total (from 69.4% in 2017), drive the overall reduction in energy consumption, while the decline in household consumption is more limited and equal to 4.8%, with a very different situation between consumption for own-account transport (+4.3%) and domestic energy consumption (-10.5%).

Energy consumption through combustion is one of the main causes of atmospheric emissions of pollutants and in particular of climate-altering gases. It is therefore particularly important to combine the indications provided by the Ndeu, related to the overall size and dynamics of the energy needs of the economic system, with those of the indicator "CO<sub>2</sub> emission intensity of energy consumption", calculated as the ratio between CO<sub>2</sub> emissions and the Ndeu for energy purposes (Ndeu\_energy)<sup>2</sup>. It represents the environmental impact in terms of CO<sub>2</sub> emissions by each unit of energy used by the economic system: a reduction in this pressure indicates that we are moving in the direction of using "cleaner" energy. The CO<sub>2</sub> emission intensity of energy consumption shows a decreasing trend until 2020, when the Italian economy has a production of 50.5 tons of CO<sub>2</sub> for every terajoule of energy used, and then rises again to reach 54.2 tons of CO<sub>2</sub> in 2022, 4.9% more than the previous year. This increase is the result of the significant

**Figure B. Energy consumption (Ndeu and Ndeu\_energy, thousands of terajoules), CO<sub>2</sub> emissions (thousands of tons) and CO<sub>2</sub> emission intensity of energy consumption (ton CO<sub>2</sub>/TJ Ndeu\_energy). Years 2017-2022 (a)**



Source: Environmental Accounting - Physical Energy Flow Accounts (PEFA) and Air Emissions Accounts (AEA)

(a) The data for the year 2022 are provisional.

- 1 The *Net domestic energy use* (Ndeu) represents the total energy used in the Italian economy by resident units for production and consumption activities. This consumption measure is the net value of the energy that in the transformation processes remains included in the products derived (it is therefore free from double counting). It expresses the energy consumed and no longer usable for another energy purpose including all the energy dissipated (through combustion and otherwise), all types of energy loss and the amount of energy used for non-energy purposes.
- 2 This indicator is included in the set of key indicators identified by the UNECE (United Nations Economic Commission for Europe) to describe the determinants of climate change. Net domestic energy use for energy purposes (Ndeu\_energy) is obtained by excluding from the calculation of Net domestic energy use (Ndeu) the energy used for non-energy purposes, such as the energy contained in energy products used to produce plastic or asphalt or to lubricate gears. It therefore represents the energy actually consumed and never again usable for anthropic purposes that leaves the economic system and is returned to the natural environment in the form of degraded energy.

contraction in energy consumption (-5.0% for Ndeu and -4.1% for Ndeu\_energy compared to 2021), mainly due to the reduction in demand for natural gas, which is not accompanied by a reduction in CO<sub>2</sub> emissions. The reduction in natural gas consumption is attributable to a combination of factors: rising prices, also resulting from the Russian-Ukrainian conflict; measures to contain energy consumption imposed by the government; particularly mild weather conditions in the second half of 2022. The increase in CO<sub>2</sub> emissions (+0.6%) is mainly due to the change in the energy mix used in the electricity production in response to the energy crisis and the record drought during the year. Given a slight decline of the electricity produced (-1.8%), there is a sharp decline in hydroelectric production (-37.4%) in favour of traditional thermoelectric production (+6.5%) and, for the latter, a lower use of natural gas (-1.8%) in favour of fossil fuels with a higher carbon content, such as coal and petroleum products (which together contribute to 12.5% of total electricity production, compared to 7.5% in 2021).

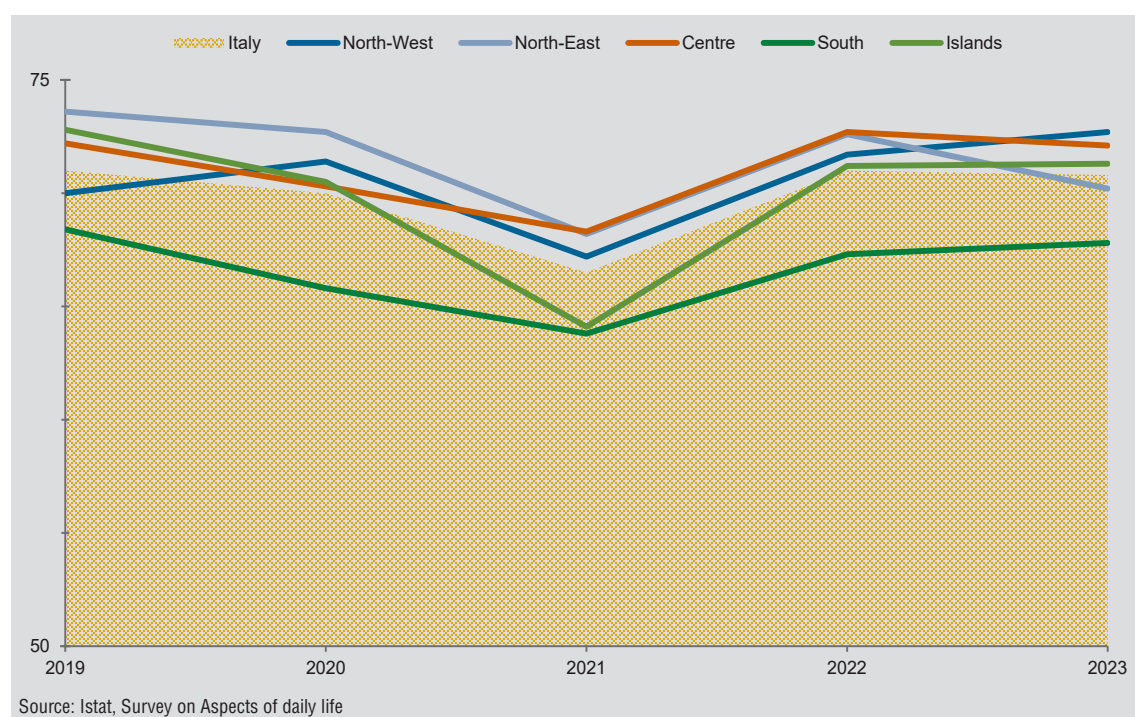
### The increase in domestic material consumption continues

The growth in production activities drives the increase in Domestic material consumption (Dmc). In 2022, according to the first provisional estimates (especially for the "non-energy minerals" component), there will be a further increase in Dmc of approximately 10 million tonnes (+2.1% compared to 2021). Already in 2021, Dmc had increased by more than 10%, with an increase of 46.8 million tonnes compared to the previous year, thus once again exceeding half a billion tonnes and pre-pandemic levels.

### Concern about climate change and the greenhouse effect remains stable, with a decrease in the North-East

The effects of climate change and the increase in the greenhouse effect are one of the environmental problems that most concern people and the indicator that takes these concerns into account can be considered a general measure of the level of social attention to these issues. In 2023, the percentage of people aged 14 and over who believe that climate change or the increase in the greenhouse effect and the hole in the ozone layer are among the 5 priority environmental concerns (70.8%), remains basically the same if compared to the previous year in all areas except the North-East, where a reduction is observed (from 72.6% to 70.2%). In 2023, after the reduction in the two-year period 2020-2021, the return to 2019 levels is confirmed, with values ranging from 72.7% in the North-West, to 72.1% in the Centre, 71.1% in the Islands and 70.2% in the North-East. Only in the South (67.8%), the percentage is significantly below 70% (Figure 16).

Figure 16. Concern for climate change and/or for the increase in the greenhouse effect by geographic area. Years 2019-2023. Values per 100 people aged 14 and over



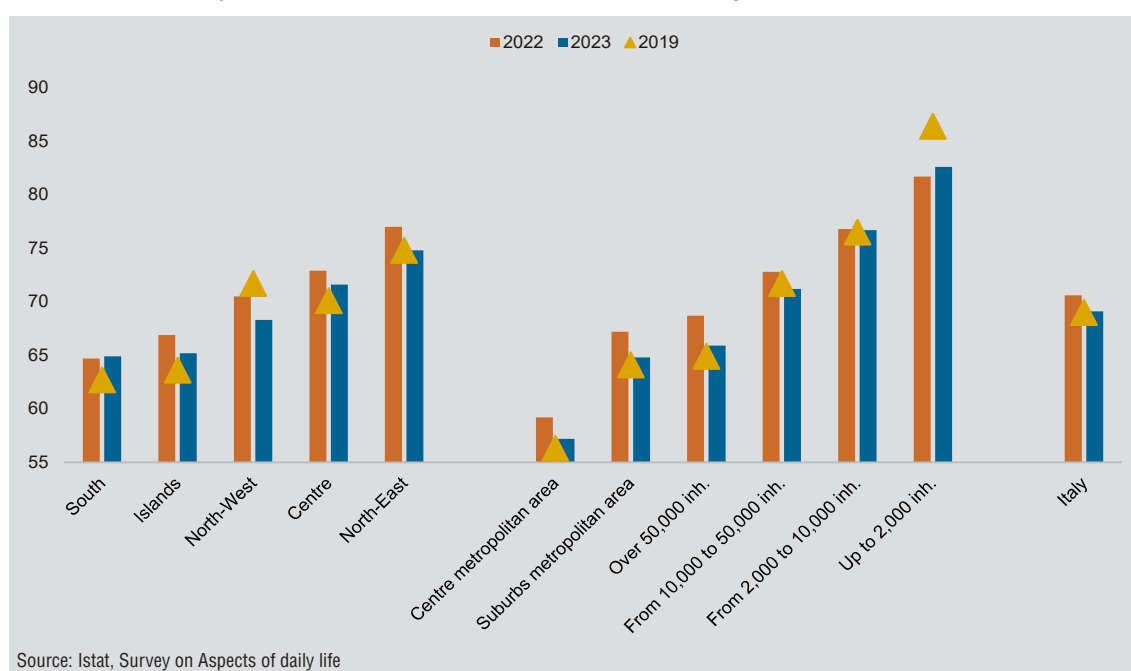
Higher levels of concern about climate change can be observed among people aged 60-64 and among younger people. In both cases, women show greater sensitivity to the issue, with a difference between men and women of about 4 percentage points among 60-64 year old and over 6 percentage points among 20-24 year old. In 2023, in almost all age groups, a percentage close to or greater than 70% is found, with the exception of women aged 75 and over (65.4%) and men of the same age group (68.1%). However, it should be noted that in this older age group, concern about environmental issues has grown on average by one percentage point per year since 2012.

Concern about climate change is associated with the level of education regardless of age group and as the level of education increases, sensitivity to the problem increases: from 66.7% of people with a low level of education to 76.2% of those with a high level of education.

### A stable value, on average, of the satisfaction with the environmental situation in the place where they live, but a decreasing value in the most populous municipalities

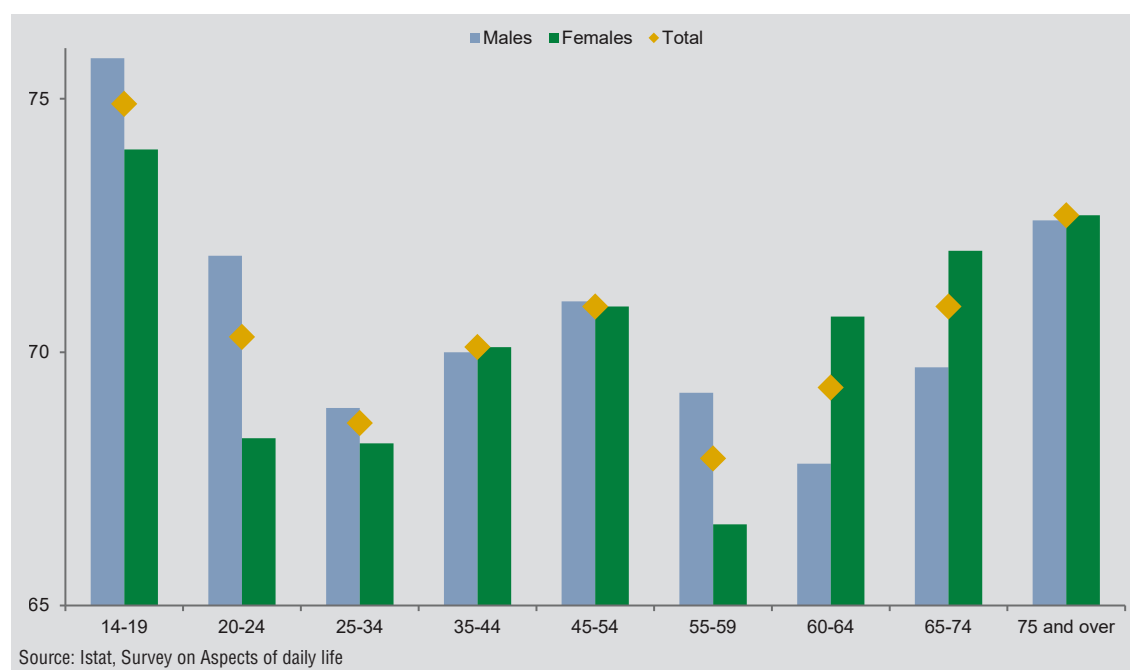
In 2023, the percentage of people aged 14 and over who declare themselves very or quite satisfied of the environmental situation of the area where they live (69.1%) is substantially stable compared to the previous year, a figure that is in line with that one of 2019, after the increase observed in the two-year period 2020-2021. At the geographical area level, no significant variations can be observed in the satisfaction expressed by people aged 14 and over, which continues to be above average in the North-East (74.8%) and in the Centre (71.6%); followed below average by the North-West (68.3%), the Islands (65.2%) and the South (64.9%). Compared to the previous year, the share of satisfied people has significantly decreased in the central municipalities of metropolitan areas (from 69.2% in 2022 to 57.2% in 2023) or in those on their outskirts (from 71.4% to 64.8%) and in municipalities with more than 50 thousand inhabitants (from 69.6% to 65.9%) (Figure 17).

Figure 17. Satisfaction for the environmental situation of the area in which one lives by geographic area and type of municipality. Years 2019, 2022 and 2023. Values per 100 people aged 14 and over



There are some significant differences related to age: the share of very or quite satisfied with the environmental situation is higher among young people aged 14 to 19 (75.8%), followed by people aged 75 and over (72.7%). Gender differences vary across age groups, with higher percentages of satisfied people among men in the younger age groups (14-24 years) and among people aged 55-59. On the contrary, women aged 60 to 74 are more satisfied than men of the same age group (Figure 18).

**Figure 18. Satisfaction for the environmental situation of the area in which one lives by gender and age group. Year 2023. Values per 100 people aged 14 and over**

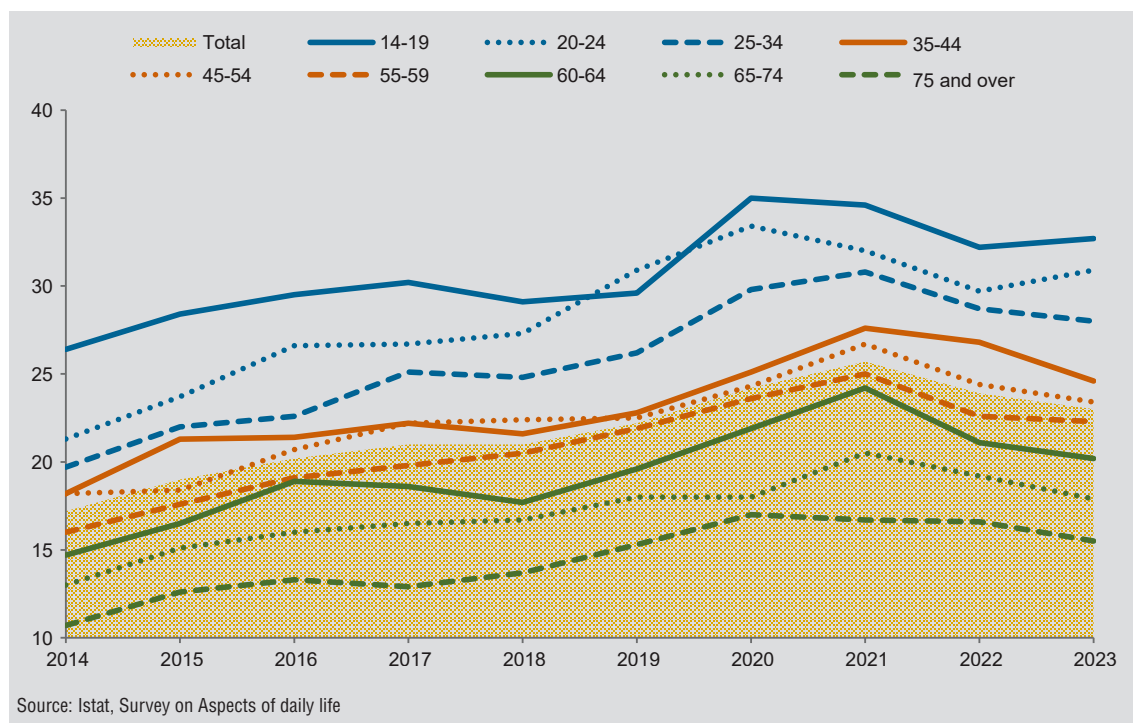


### Concern about the loss of biodiversity is stable, but decreases in the Islands

In 2023, compared to the previous year, the percentage of people aged 14 and more concerned about the loss of biodiversity (or the disappearance of animal and plant species) is substantially stable and equal to 23.0%, with a significant decrease except for the Islands (from 22.7% to 20.2%), to a lesser extent the Centre (from 25.2% to 23.6%) and the North-West (from 25.5% to 24.2%). However, the concern for this indicator shows almost the same value in all areas of the country, percentages above the average are found in the North-East (25.0%), North-West (24.2%) and Centre (23.6%), while a below average value, however, can be found in the South (20.5%) and the Islands (20.2%).

Sensitivity to the issue of biodiversity loss is greater among girls and young women (in the 14-19 age group it is equal to 37.3%, in the 20-24 age group and 25-34 age group it is respectively 35.3% and 29.5%) and among women who have obtained a higher educational qualification (26.9%) (Figure 19).

Figure 19. Concern for biodiversity loss by age group. Years 2014-2023. Values per 100 people aged 14 and over





## The indicators

1. **Air quality - PM<sub>2.5</sub>:** Percentage of valid measurements above the WHO health reference value (10 µg/m<sup>3</sup>), out of the total number of valid measurements of annual average PM<sub>2.5</sub> concentrations for all station types (urban and suburban traffic, urban and suburban industrial, urban and suburban background, rural).  
Source: Istat, Processing of data from ISPRA.
2. **Emissions of CO<sub>2</sub> and other greenhouse gases:** Emissions of CO<sub>2</sub> and other greenhouse gases of the Italian economy expressed in tons of CO<sub>2</sub> equivalent per capita.  
Source: Istat-ISPRA, Accounts and air emissions inventory.
3. **Warm Spell Duration Index:** Warm spell duration index (WSDI) is defined as annual or seasonal count of days with at least 6 consecutive days when the daily maximum T exceeds the 90<sup>th</sup> percentile in the calendar 5-day window for the base period 1981-2010.  
Source: Copernicus - European Union's Earth Observation Programme - Gridded dataset of climate reanalysis, ERA5 hourly data.
4. **Extreme precipitation events:** Frequency of daily rainfall exceeding 50 mm/day.  
Source: Copernicus - European Union's Earth Observation Programme - Gridded dataset of climate reanalysis, ERA5 hourly data.
5. **Consecutive Dry Days:** Maximum number of consecutive dry days per time period with daily precipitation amount of less than 1 mm.  
Source: Copernicus - European Union's Earth Observation Programme - Gridded dataset of climate reanalysis, ERA5 hourly data.
6. **Population at risk of landslides:** Percentage of population resident in areas subject to high and very high landslide hazard.  
Source: ISPRA, Hydrogeological instability in Italy: hazard and risk indicators.
7. **Population at risk of flood:** Percentage of population resident in medium flood hazard zones (Return period 100-200 years; Legislative Decree 49/2010).  
Source: ISPRA, Hydrogeological instability in Italy: hazard and risk indicators.
8. **Water losses in urban supply system:** Percentage of the total volume of water losses in municipal drinking water supply networks (difference between volumes fed into the network and supplied authorised volumes) on total water input.  
Source: Istat, Urban Water census.
9. **Sewage treatment:** Percentage of polluting loads collected in secondary or advanced plants, in equivalent inhabitants, compared to the total urban loads (Aetu) generated.  
Source: Istat, Urban Water census.
10. **Protected natural areas:** Percentage share of terrestrial protected natural areas included in Italian Official List of Protected Areas (Euap) and Natura 2000 Network.  
Source: Istat, Processing of data from Ministry of the Environment and Energy Security.
11. **Coastal bathing waters:** Percentage of authorised coastal bathing waters on the total of the coastal line in accordance with the regulations in force.  
Source: Istat, Processing of data from Ministry of Health.
12. **Urban green:** Square meters of urban parks and gardens per inhabitants in provincial capital Municipalities.  
Source: Istat, Survey on urban environmental data.
13. **Soil sealing from artificial land cover:** Percentage of soil sealed following a change from non-artificial to artificial coverage.  
Source: ISPRA, Soil consumption, territorial dynamics and ecosystem services.
14. **Domestic material consumption:** Domestic material consumption measures the quantity of matter, other than water and air, used every year by the socio-economic system and released into the environment (incorporated into emissions or effluents) or accumulated in new anthropogenic stocks (both capital goods and other durable goods and waste).  
Source: Istat, Material flow accounts.
15. **Municipal waste generated:** Municipal waste generated per capita (in Kg).  
Source: Istat, Processing of data from ISPRA.
16. **Landfill of waste:** Percentage of municipal waste sent to landfill on total municipal waste collected.  
Source: ISPRA, Waste statistics.
17. **Contaminated sites:** Size of contaminated sites.  
Source: Ministry of the Environment and Energy Security - Processing of data from Ministry of the Ecological Transition and ISPRA.
18. **Electricity from renewable sources:** Percentage of energy consumption provided by renewable sources on gross electricity consumption. The indicator is calculated as the ratio between the gross electricity production from RES (actual, non-normalized) and the gross domestic consumption of electricity (e.g. the gross production of electricity, including pumping, plus trade balance).  
Source: Terna S.p.A., Annual statistics of electricity production and consumption in Italy.
19. **Concern for climate change:** Percentage of people aged 14 and over who consider climate change or the increase in the greenhouse effect and the hole in the ozone layer to be among the 5 priority environmental concerns.  
Source: Istat, Survey on Aspects of daily life.
20. **Satisfaction with the environmental situation:** Percentage of people aged 14 and over who are very or fairly satisfied with the environmental situation (air, water, noise) of the area in which they live.  
Source: Istat, Survey on Aspects of daily life.
21. **Concern for the loss of biodiversity:** Percentage of people aged 14 and over who consider the extinction of plant/animal species to be among the 5 priority environmental concerns.  
Source: Istat, Survey on Aspects of daily life.

## Indicators by region and geographic area

| REGIONS<br>GEOGRAPHIC AREAS  | Air<br>quality -<br>PM <sub>2.5</sub><br>(a) | Emissions<br>of CO <sub>2</sub><br>and other<br>greenhouse<br>gases<br>(b) | Warm<br>Spell<br>Duration<br>Index<br>(c) | Extreme<br>precipitation<br>events<br>(c) | Consecu-<br>tive Dry<br>Days<br>(c) | Population<br>at risk of<br>landslides<br>(d) | Population<br>at risk of<br>flood<br>(d) | Total water<br>losses in<br>public wa-<br>ter supply<br>network<br>(e) | Sewage<br>treatment<br>(f) |
|------------------------------|--|--|---|---|-------------------------------------|---|--|--|----------------------------|
|                              | 2022   | 2022 (*)   | 2023                                      | 2023                                      | 2023                                | 2020  | 2020                                     | 2022   | 2015                       |
| Piemonte                     | 92.5   | ....   | 53  | 1   | 20                                  | 1.9   | 4.9                                      | 35.4   | 69.7                       |
| Valle d'Aosta/Vallée d'Aoste | 75.0   | ....   | 58  | -   | 20                                  | 12.1  | 9.1                                      | 29.8   | 66.0                       |
| Liguria                      | 62.1   | ....   | 45  | 1   | 23                                  | 5.9   | 17.4                                     | 40.0   | 61.2                       |
| Lombardia                    | 97.0   | ....   | 48  | 2   | 28                                  | 0.5   | 4.4                                      | 31.8   | 62.9                       |
| Trentino-Alto Adige/Südtirol | 100.0  | ....   | 61  | 1   | 19                                  | 2.1   | 18.0                                     | 33.8   | 78.9                       |
| Bolzano/Bozen                | 100.0  | ....   | 58  | -   | 19                                  | 2.3   | 9.8                                      | 28.8   | 99.7                       |
| Trento                       | 100.0  | ....   | 64  | 2   | 16                                  | 2.0   | 25.9                                     | 37.1   | 63.6                       |
| Veneto                       | 100.0  | ....   | 45  | 1   | 31                                  | 0.1   | 11.7                                     | 42.2   | 49.4                       |
| Friuli-Venezia Giulia        | 93.3   | ....   | 43  | 5   | 20                                  | 0.4   | 9.9                                      | 42.3   | 50.7                       |
| Emilia-Romagna               | 89.4   | ....   | 42  | 1   | 30                                  | 2.0   | 62.5                                     | 29.7   | 67.7                       |
| Toscana                      | 76.5   | ....   | 42  | -   | 29                                  | 4.2   | 25.5                                     | 40.9   | 49.5                       |
| Umbria                       | 77.3   | ....   | 32  | -   | 26                                  | 2.0   | 7.2                                      | 49.7   | 68.7                       |
| Marche                       | 60.0   | ....   | 22  | -   | 20                                  | 2.2   | 5.2                                      | 34.4   | 48.5                       |
| Lazio                        | 70.0   | ....   | 41  | -   | 30                                  | 1.6   | 3.2                                      | 46.2   | 67.0                       |
| Abruzzo                      | 81.8   | ....   | 38  | 1   | 20                                  | 5.6   | 7.2                                      | 62.5   | 63.9                       |
| Molise                       | 75.0   | ....   | 30  | -   | 23                                  | 6.1   | 2.3                                      | 53.9   | 58.0                       |
| Campania                     | 88.2   | ....   | 49  | 1   | 33                                  | 5.0   | 5.1                                      | 49.9   | 60.5                       |
| Puglia                       | 76.9   | ....   | 42  | -   | 34                                  | 1.4   | 3.4                                      | 40.7   | 68.3                       |
| Basilicata                   | 33.3   | ....   | 37  | -   | 30                                  | 7.0   | 1.1                                      | 65.5   | 67.2                       |
| Calabria                     | 45.0   | ....   | 33  | -   | 30                                  | 3.3   | 12.8                                     | 48.7   | 46.0                       |
| Sicilia                      | 64.7   | ....   | 37  | 1   | 48                                  | 1.8   | 2.6                                      | 51.6   | 43.9                       |
| Sardegna                     | 12.5   | ....   | 32  | -   | 34                                  | 1.3   | 7.5                                      | 52.8   | 58.8                       |
| North                        | 90.8   | ....   | 48  | 1   | 21                                  | 1.3   | 16.6                                     | 35.0   | 62.4                       |
| North-West                   | 94.2   | ....   | 52  | 1   | 21                                  | 1.5   | 5.9                                      | 33.5   | 64.6                       |
| North-East                   | 87.8   | ....   | 45  | 1   | 21                                  | 1.0   | 31.4                                     | 37.2   | 59.6                       |
| Centre                       | 71.9   | ....   | 39  | -   | 27                                  | 2.5   | 10.8                                     | 43.9   | 58.5                       |
| South and Islands            | 61.1   | ....   | 37  | -   | 33                                  | 3.2   | 5.1                                      | 50.9   | 56.7                       |
| South                        | 71.4   | ....   | 38  | -   | 30                                  | 3.9   | 5.6                                      | 50.5   | 60.9                       |
| Islands                      | 44.6   | ....   | 34  | -   | 48                                  | 1.7   | 3.8                                      | 51.9   | 47.8                       |
| Italy                        | 76.2   | 7.3  | 42  | -   | 29                                  | 2.2   | 11.5                                     | 42.4   | 59.6                       |

(a) Percentage of valid measurements above the reference value defined by the WHO (10 µg/m<sup>3</sup>) on the total valid measurements of the annual average concentrations of PM<sub>2.5</sub>;

(b) Tonnes of CO<sub>2</sub> equivalent per inhabitant;

(c) Number of days;

(d) Percentage of the total population;

(e) Percentage of volumes introduced into the network;

(f) Percentage of total urban loads generated;

(g) Percentage of territorial surface area;

(h) Percentage of shore on the total coastline;

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| Protected natural areas (g) | Coastal bathing waters (h) | Urban green (i) | Soil sealing from artificial land cover (l) | Domestic material consumption (m) | Municipal waste generated (n) | Landfill of waste (o) | Contaminated sites (p) | Electricity from renewable sources (q) | Concern for climate change (r) | Satisfaction for the environment (r) | Concern for biodiversity loss (r) |
|-----------------------------|----------------------------|-----------------|---|-----------------------------------|-------------------------------|-----------------------|------------------------|--|--------------------------------|--------------------------------------|-----------------------------------|
| 2022                        | 2019                       | 2022            | 2022  | 2022                              | 2022                          | 2022                  | 2021                   | 2022                                   | 2023                           | 2023                                 | 2023                              |
| 16.7                        | ....                       | 29.7            | 6.7   | ....                              | 496                           | 13.0                  | 34.7                   | 29.2                                   | 71.3                           | 67.4                                 | 24.3                              |
| 30.3                        | ....                       | 19.4            | 2.2   | ....                              | 615                           | 59.4                  | 0.7                    | 213.9                                  | 72.3                           | 83.4                                 | 26.5                              |
| 27.2                        | 57.4                       | 18.3            | 7.3   | ....                              | 540                           | 35.7                  | 1.2                    | 7.0                                    | 71.4                           | 78.5                                 | 23.5                              |
| 16.1                        | ....                       | 27.3            | 12.2  | ....                              | 464                           | 3.5                   | 8.2                    | 19.0                                   | 73.5                           | 67.0                                 | 24.2                              |
| 26.4                        | ....                       | 319.4           | 3.0   | ....                              | 486                           | 5.3                   | 0.4                    | 97.1                                   | 71.5                           | 85.7                                 | 24.9                              |
| 24.5                        | ....                       | 227.5           | 2.7   | ....                              | 481                           | 1.1                   | 0.3                    | 135.3                                  | 68.5                           | 85.2                                 | 29.4                              |
| 28.7                        | ....                       | 402.2           | 3.4   | ....                              | 492                           | 9.3                   | 0.6                    | 62.0                                   | 74.3                           | 86.2                                 | 20.5                              |
| 22.7                        | 64.2                       | 34.3            | 11.9  | ....                              | 476                           | 18.3                  | 1.7                    | 21.3                                   | 69.7                           | 72.1                                 | 25.2                              |
| 20.1                        | 42.2                       | 56.7            | 8.0   | ....                              | 494                           | 5.0                   | 18.7                   | 22.4                                   | 67.7                           | 84.5                                 | 24.6                              |
| 12.1                        | 61.7                       | 44.8            | 8.9   | ....                              | 633                           | 5.2                   | 1.7                    | 19.6                                   | 71.0                           | 72.4                                 | 25.1                              |
| 15.5                        | 71.3                       | 24.3            | 6.2   | ....                              | 588                           | 35.7                  | 5.1                    | 38.5                                   | 71.1                           | 78.9                                 | 24.5                              |
| 17.5                        | ....                       | 101.2           | 5.3   | ....                              | 515                           | 35.2                  | 0.8                    | 32.9                                   | 71.4                           | 77.2                                 | 23.0                              |
| 18.8                        | 73.2                       | 30.2            | 7.0   | ....                              | 514                           | 50.0                  | 0.2                    | 26.5                                   | 69.4                           | 79.4                                 | 21.0                              |
| 27.9                        | 69.5                       | 22.1            | 8.2   | ....                              | 500                           | 15.7                  | 4.2                    | 15.1                                   | 73.5                           | 64.0                                 | 23.7                              |
| 36.6                        | 75.5                       | 29.2            | 5.0   | ....                              | 453                           | 22.7                  | 0.6                    | 39.4                                   | 71.8                           | 77.7                                 | 25.5                              |
| 26.4                        | 71.9                       | 319.3           | 3.9   | ....                              | 373                           | 77.1                  | 0.3                    | 79.3                                   | 72.2                           | 80.1                                 | 19.5                              |
| 35.3                        | 70.0                       | 15.6            | 10.5  | ....                              | 465                           | 0.0                   | 5.8                    | 31.6                                   | 67.1                           | 58.8                                 | 20.2                              |
| 24.5                        | 74.7                       | 10.6            | 8.2   | ....                              | 467                           | 24.8                  | 6.5                    | 56.4                                   | 66.7                           | 63.8                                 | 18.6                              |
| 23.1                        | 90.8                       | 93.0            | 3.2   | ....                              | 356                           | 46.1                  | 4.0                    | 117.4                                  | 68.8                           | 74.1                                 | 19.4                              |
| 26.6                        | 85.3                       | 35.2            | 5.1   | ....                              | 399                           | 25.8                  | 0.7                    | 76.4                                   | 68.4                           | 71.8                                 | 22.6                              |
| 20.3                        | 50.8                       | 15.3            | 6.5   | ....                              | 456                           | 40.5                  | 3.2                    | 28.6                                   | 72.0                           | 60.7                                 | 18.4                              |
| 19.9                        | 64.9                       | 42.9            | 3.3   | ....                              | 460                           | 25.0                  | 12.4                   | 39.1                                   | 69.3                           | 78.3                                 | 25.5                              |
| 18.8                        | 56.9                       | 41.6            | 8.6   | ....                              | 505                           | 10.1                  | 10.9                   | 25.1                                   | 71.7                           | 71.0                                 | 24.5                              |
| 18.2                        | 57.4                       | 26.4            | 8.7   | ....                              | 481                           | 10.1                  | 18.7                   | ....                                   | 72.7                           | 68.3                                 | 24.2                              |
| 19.4                        | 56.5                       | 62.3            | 8.4   | ....                              | 539                           | 10.0                  | 3.6                    | ....                                   | 70.2                           | 74.8                                 | 25.0                              |
| 20.0                        | 71.1                       | 27.5            | 6.8   | ....                              | 531                           | 28.2                  | 3.4                    | 26.7                                   | 72.1                           | 71.6                                 | 23.6                              |
| 25.2                        | 65.8                       | 24.7            | 5.9   | ....                              | 452                           | 22.5                  | 5.2                    | 45.4                                   | 68.9                           | 65.0                                 | 20.4                              |
| 28.7                        | 77.0                       | 27.2            | 6.6   | ....                              | 449                           | 15.6                  | 3.6                    | ....                                   | 67.8                           | 64.9                                 | 20.5                              |
| 20.1                        | 58.5                       | 20.5            | 5.0   | ....                              | 457                           | 36.6                  | 7.6                    | ....                                   | 71.3                           | 65.2                                 | 20.2                              |
| 21.7                        | 65.5                       | 32.8            | 7.1   | 516.0                             | 492                           | 17.8                  | 7.1                    | 30.7                                   | 70.8                           | 69.1                                 | 23.0                              |

(i) Square meters per inhabitant;  
(l) Percentage of territorial surface area;  
(m) Millions of tons;  
(n) Kilograms per inhabitant;  
(o) Percentage of total urban waste produced;

(p) Incidence of territorial surface area, values per 1,000;  
(q) Percentage of total gross domestic consumption;  
(r) Per 100 persons aged 14 and over;  
(\*) Provisional data.

