CLIMATE AND HEALTH COUNTRY PROFILE
ITALY

World Health Organization

United Nations
Framework Convention on
Climate Change

OVERVIEW

Italy, located in the middle of the Mediterranean basin, is comprised of a continental northern sector, a peninsular central-southern sector, two large islands (Sardegna and Sicilia) and various archipelagos and minor islands. Italy has a heterogeneous climate which leads to differences in the immediate risks posed by climate change throughout the country.

Climate change impacts are already exacerbating existing infrastructural deficiencies, post-industrial pollution phenomena and the intrinsic hydro-geological and seismic vulnerability of the country. Rising temperatures, coastal erosion, flooding and drought may lead to water scarcity (6 out of 20 regions called on the government to declare a state of emergency due to water stress in 2017). Water stress could also lead to a reduction in agricultural production, higher risk of forest fires, increased desertification and could threaten economic progress. In addition, climate change impacts air quality, particularly in urban settings, and may lead to changes in the spatial distribution of flora and fauna which degrades biodiversity.

Furthermore, there is a concrete risk of the re-emergence of previously endemic agents (such as tick-borne encephalities, Lyme disease, Mediterranean spotted fever and West Nile fever), or the arrival of tropical communicable diseases, such as dengue, chikungunya, Zika, Crimean-Congo fever, or Rift Valley fever and diseases occurring in animals, including, Bluetongue disease and lumpy skin disease. Protection strategies have been strengthened, but the risk is increasing. Italy is also impacted by population movements. There are approximately 5 million immigrants residing in Italy, which represents about 8.4% of the total resident population. Of this total, there are about 150,000 refugees [1], most of which are economic migrants moving from areas of drought and desertification.

OPPORTUNITIES FOR ACTION

In Italy, the Ministry for the Environment Land and Sea is carrying out activities on climate change at the national level. In 2015, Italy adopted the National Adaptation Strategy to climate change (NAS) with the aim to give a common path, at national level, to deal with the impacts of climate change on natural systems and socio-economic sectors. The Ministry for the Environment is currently working for the implementation of the NAS through the development of the National Adaptation Plan to climate change (NAP). It updates background information about the impacts of climate change and outlines possible adaptation actions for specific sectors, including the health sector. Specific cooperation projects driven by the Ministry of Health are being implemented in parallel to strengthen adaptive and preventative measures to cope with environmental health and climate change-related hazards. These include:

1) Adaptation

- Evaluation of existing national information systems on climate and health.
- Estimation of the costs of the impacts of climate change on health.

2) National Policy Implementation

- Strengthening of the efforts to raise awareness and capacity building to deal with the impacts of climate change on health.
- Strengthening of multilevel governance on the issue of climate change and health, with the aim to ensure coherence between national, regional and local planning.

DEMOGRAPHIC ESTIMATES	
Population (2017) [1]	60,579,000
Population growth rate (2017) [1]	0%
Population living in urban areas (2017) [2]	69.3%
Population age average, years (2017) [3]	44.9
Population 65 years or over (2017) [3]	22,3%
Life expectancy at birth, years (2017) [4]	80,6 (males), 85,1 (females)
ECONOMIC AND DEVELOPMENT INDICATORS	
GDP per capita (current US$, 2016) [5]	30,527 USD
Total expenditure on health as % of GDP (2014) [6]	9.3%
Average annual HDI growth, 2010–2015 (%) [7]	0.34

* For references please see page 16.

1 CURRENT AND FUTURE CLIMATE HAZARDS

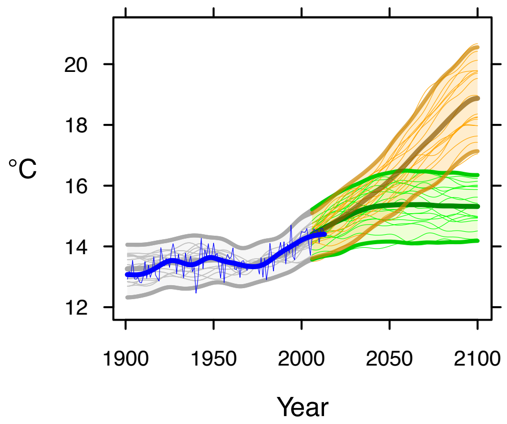
Due to climate change, many climate hazards and extreme weather events, such as heat waves, heavy rainfall and droughts, could become more frequent and more intense in many parts of the world.

Outlined here are country–specific projections up to the year 2100 for climate hazards under a 'business as usual' high emissions scenario compared to projections under a 'two-degree' scenario with rapidly decreasing global emissions. Most hazards caused by climate change will persist for many centuries.

COUNTRY-SPECIFIC CLIMATE HAZARD PROJECTIONS

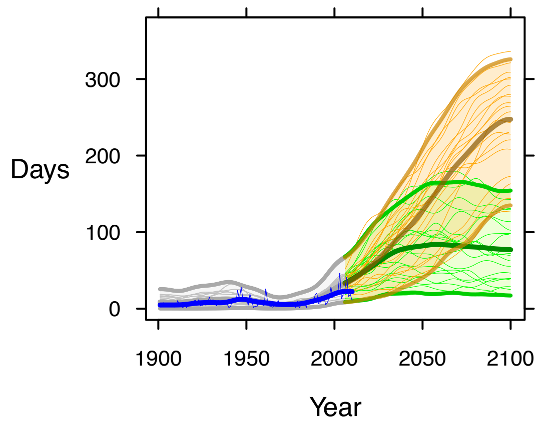
The model projections below present climate hazards under a high emissions scenario, Representative Concentration Pathway 8.5 [RCP8.5] (in orange) and a low emissions scenario, [RCP2.6] (in green).[1] The text boxes describe the projected changes averaged across about 20 models (thick line). The figures also show each model individually as well as the 90% model range (shaded) as a measure of uncertainty and, where available, the annual and smoothed observed record (in blue).[2,3]

MEAN ANNUAL TEMPERATURE



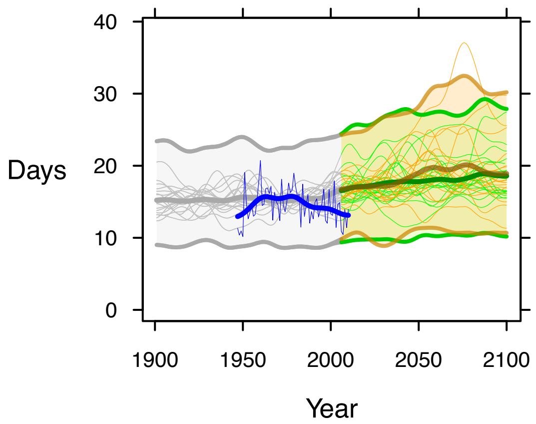
Under a high emissions scenario, mean annual temperature is projected to rise by about 5.1°C on average from 1990 to 2100. If global emissions decrease rapidly, the temperature rise is limited to about 1.6°C.

DAYS OF WARM SPELL ('HEAT WAVES')



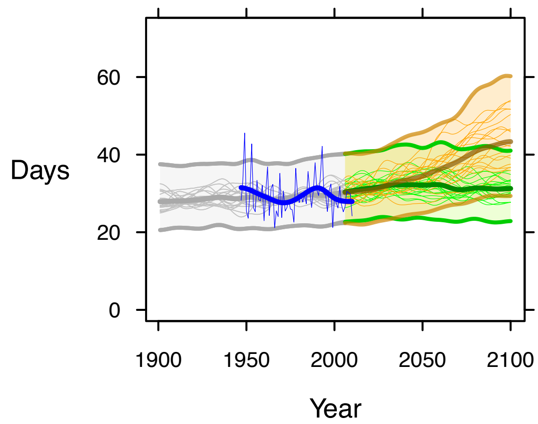
Under a high emissions scenario, the number of days of warm spell [4] is projected to increase from about 10 days in 1990 to about 250 days on average in 2100. If global emissions decrease rapidly, the days of warm spell are limited to about 75 on average.

DAYS WITH EXTREME RAINFALL ('FLOOD RISK')



Under a high emissions scenario, the number of days with very heavy precipitation (20 mm or more) could increase by about 4 days on average from 1990 to 2100, increasing the risk of floods. Some models indicate increases outside the range of historical variability, implying even greater risk. If global emissions decrease rapidly, the risk is slightly reduced.

CONSECUTIVE DRY DAYS ('DROUGHT')



Under a high emissions scenario, the longest dry spell is indicated to increase from an average of about 30 days to just under 45 days, with continuing large year-to-year variability. If global emissions decrease rapidly, there is little change in the length of dry spells.

* For references please see page 16.

2 CURRENT AND FUTURE HEALTH RISKS DUE TO CLIMATE CHANGE

Human health is profoundly affected by weather and climate. Climate change threatens to exacerbate today's health problems – deaths from extreme weather events, cardiovascular and respiratory diseases, infectious diseases and malnutrition – whilst undermining water and food supplies, infrastructure, health systems and social protection systems.

HEAT-RELATED MORTALITY

In the international context, Italy has the highest heat-related effects on daily mortality considering both hot temperatures (from 90th to 99th percentile, 4 degrees on average) and overall summer temperatures (from minimum mortality temperature (MMT) to 99th percentile) (1). However, there is heterogeneity among Italian cities both in the heat effect and in the MMT. Heat effects are greater in larger urban areas (Turin, Milan, Bologna, Florence, Rome, Naples) and a progressive increase in MMT levels can be observed from North to South of Italy and throughout summer, thus accounting for local climate and population physiological adaptation. A decreasing trend in heat related mortality risk was observed in Italian cities after the introduction of the national heat prevention plan. In particular, the reduction was shown for extreme temperatures when warnings were issued and prevention measures were activated (2). The increase in frequency and intensity of heat waves together with population ageing will have a significant impact on health in the future. Summer 2015 was associated with a 13% increase in deaths attributable to heat among the population aged 65+ (3).

Fig 2.1. Pooled relative risks for the association of hot temperatures with deaths cumulated over lags of 0–21 days in 12 countries/regions

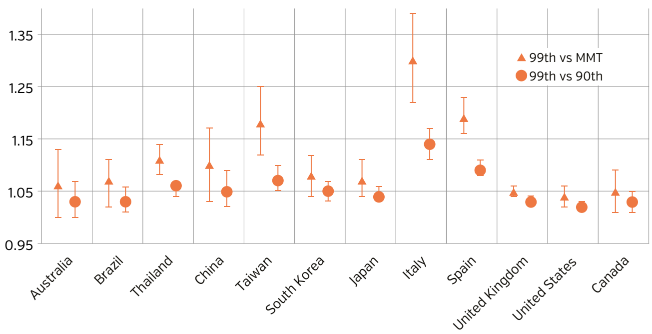


Figure adapted from: Guo, Yuming, et al. "Global variation in the effects of ambient temperature on mortality: a systematic evaluation." *Epidemiology* (Cambridge, Mass.) 25.6 (2014): 781.

KEY IMPLICATIONS FOR HEALTH

The greatest contribution in terms of heat-related effects is in terms of cardiovascular and respiratory diseases on both fatal and non-fatal outcomes. High risk subgroups more susceptible to the effect of heat comprise the elderly, individuals living alone, residents of low-income neighborhoods, those affected by chronic diseases such as diabetes, COPD, mental diseases, neurological diseases, or those taking medications for these diseases (4). Seasonal exposures, such as cold spells, air pollution and circulation of respiratory viruses, in particular influenza, also have an impact on heat susceptible subjects and influence summer mortality (3).

STRATEGY FOR PREVENTION OF HEAT-RELATED EFFECTS IN ITALY

Since 2004, the Department of Civil Protection and the Ministry of Health, have implemented a national program for the prevention of heat health effects focused on the elderly and including all regional capitals and cities with more than 200,000 inhabitants (5). Starting from the largest urban areas, the program was gradually extended to all regions, and to date, has reached national coverage, to include 34 major cities and 93% of urban residents aged 65 years and over.

The national program includes the following core components in line with WHO guidelines (6):

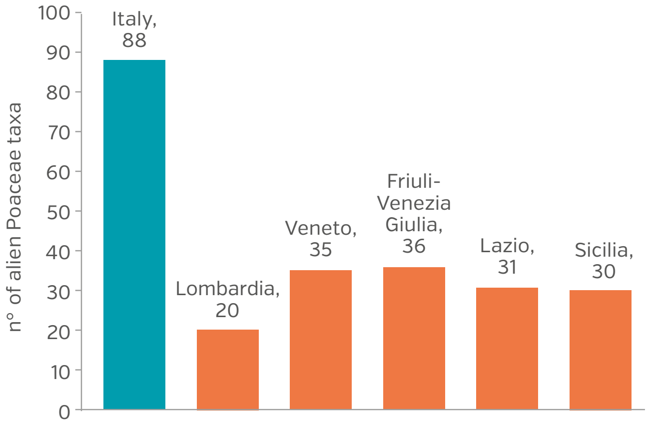
- identification of lead body;
- city-specific warning systems;
- national prevention guidelines and information campaign (7);
- preparedness and emergency response for health and social care systems;
- registries for the identification of susceptible subgroups;
- local prevention plans targeted to susceptible subgroups during heat waves a rapid "real time" mortality and morbidity surveillance;
- evaluation of warning systems and prevention programs introduced.

* For references please see page 16.

ECOSYSTEM BIODIVERSITY

The Italian vascular flora consists of 6,711 species, divided into 1,267 genera and 196 families [1]. As Italy extends from the Alps to the Mediterranean Basin, it hosts about half of the European vascular flora. At a national scale the non-native (alien) flora consists of 1023 species and subspecies (13.4% of the Italian flora), divided into 103 archaeophytes (introduced before the year 1492) and 920 neophytes (introduced after 1492) [2]. As far as allergenic flora is concerned in Italy the family with the highest number of taxa is Poaceae (535 species, of which 88 are non-native to Italy). At a regional scale Lombardia, Friuli-Venezia Giulia, Veneto, Lazio and Sicilia host the highest number of alien taxa of Poaceae (see Fig 2.2); in recent years a strong increase of these taxa was detected for Toscana and Sardegna. Other families including many allergenic and alien species are *Asteraceae* and *Amaranthaceae.*

Fig. 2.2. Number of alien Poaceae taxa [1,2,3]



KEY IMPLICATIONS FOR HEALTH

The future climatic scenario with less precipitation and higher temperatures is expected to cause an increase of annual anemophilous and/or anemochorous plants, many of them are alien and allergenic, with a distribution in a wider elevation belt than the actual, occupying a hypothetical range from the sea level up to 1,000–1,200 m a.s.l. The expected increase in occurrence of allergenic species would cause health impacts with allergopathies.

Strategy

The following strategic actions are defined:

- To promote a management of green areas (especially in urban areas) aimed at cleaning and, where possible, the eradication of allergenic species;
- To define strict guidelines for private green areas to limit the diffusion of allergenic plants.

CLIMATE CHANGE AND MIGRATION

Italy has been facing high numbers of migrant and refugee arrivals in the past few years through the Mediterranean route. UNHCR estimates that 129,000 people arrived by sea to the European shores in 2017 (as of 12 September) [4]. In 2016, 181,000 people arrived to the Italian shores via the Mediterranean Sea, and the figure has already reached over 93,000 as of July 2017 [5]. It is possible that climate change effects on subsistence economies in Sub-Saharan Africa will also push increasing numbers of people not only to move across borders, but also to cross the sea to reach Europe and Italy specifically. Nevertheless, with the available data it would be impossible to attribute exact numbers of arrivals to climate change-driven intercontinental migration.

Italy is putting in place an extraordinary response in terms of rescue operations in the sea and migration management inland. Sicilian point-of-entry locations are receiving regular arrivals of refugees and migrants. Local authorities in Italy are currently managing the public health challenges related to migration. However, increasing pressures require a strengthening of key areas such as emergency preparedness and response, inter-ministerial coordination and aspects of the existing health information system. In this context the new national guidelines on health controls at the point of entry and in the welcoming centres (hot-spots) will be a powerful tool in the hands of the health personnel [6].

The implementation of the Health 2020 policy framework and the national SDG strategy supports attention to migrant and refugee health based on improvable whole-of-society approaches. Addressing migrants' health needs is crucial to tackle broader inequalities, taking into account the social determinants of health in all policies. Moreover the 2030 agenda for SDGs, despite the local challenges, leads the way to answer global issues such as the inclusion of the migrant population.

Under high emissions climate change scenarios, predictions indicate that climate-driven migration will happen and will be very clearly identifiable in the Mediterranean area, with tens of millions of people at a time displaced by extreme weather events, and many millions more displaced by climate processes like desertification, salinization of agricultural land and sea level rise [7].

* For references please see page 16.

INFECTIOUS AND VECTOR-BORNE DISEASES

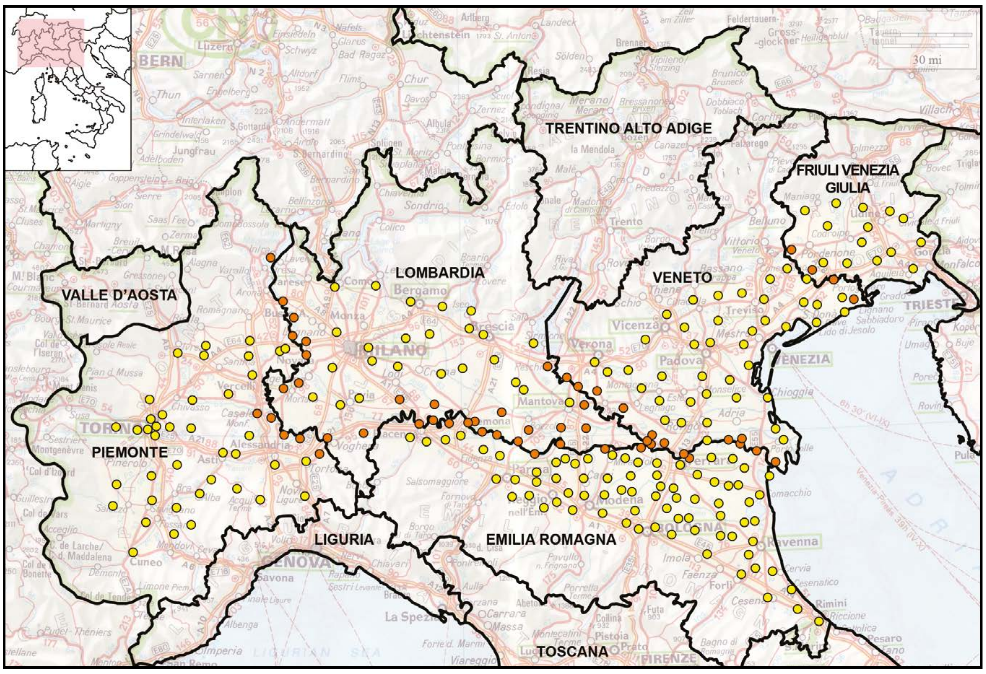
Mosquito-borne diseases (MBDs) are spreading worldwide, including in temperate regions, due to the impact of climate change, the increase in human travel and commercialization, and other factors such as urbanization and land-use changes [1,2]. Several emerging mosquito-borne outbreaks reported recently in the Mediterranean basin were caused by viruses mainly belonging to the family Togaviridae (Chikungunya virus) and to the Flavivirus genus as West Nile virus (WNV) and Usutu virus (USUV) transmitted by Culex sp. or Dengue virus and Zika virus (ZIKV), transmitted by *Aedes* sp. In 2007, a Chikungunya (CHIK) outbreak occurred in the Emilia-Romagna region of Italy [3,4,5]. Another outbreak caused by this tropical virus occurred in the summer of 2017 [6].

Likewise, an increasing number of outbreaks of West Nile disease, with occurrences of human cases, have been reported since 2008, mainly in the North Eastern regions of the country [7].

KEY SURVEILLANCE STRATEGIES

Mosquito-based surveillance is a key component of the response to emerging vector-borne disease outbreaks. First, the surveillance of mosquito populations allows to identify which species are present in an area as well as their relative abundance. This is of utmost importance because different species can have different vector competence or susceptibility to insecticides. Second, mosquito-based surveillance allows the early detection of pathogens before cases of disease are reported in animals and/or humans. The early detection of pathogens might be considered a mainstay in most surveillance programs for arboviruses [8].

Fig. 2.3. The surveillance network in Northern Italy of West Nile Disease [9]. Yellow circles: sites of entomological surveillance. Orange circles: inter-regional sites of entomological surveillance.



STRATEGY FOR VECTOR-BORNE DISEASE CONTROL IN ITALY

A surveillance network has been adopted in Northern Italy aimed at developing a system that allows the monitoring of mosquito species as well as the early detection of viruses in vectors before the occurrence of human cases permitting the application of national plan procedures for blood screening. This surveillance system was able to detect and monitor the occurrence of both autochtonous and introduced mosquito vectors, such as *Aedes albopictus* and the more recently introduced *Ae. japonicus and Ae. koreicus*. Moreover, the surveillance system allowed to detect WNV and USUV in mosquitoes before cases were reported in birds and humans in Emilia Romagna, Lombardia, and Piemonte [8–14]. Likewise, in the course of small-scale preliminary screening in 2012, Japanese encephalitis virus (JEV) was detected for the first time in Europe in a mosquito pool collected in Emilia Romagna: no cases of disease were reported, but the event raised important health issues nonetheless [15]. Considering the emergence of other flaviviruses in which humans could be the reservoir (such as the recent ZIKA infection in South America) and the World Health Organization (WHO) call to European countries to implement entomological surveillance for virus spread prevention [16], the mosquito-based surveillance system, integrated with human and animal surveillance, will provide strong data which may inform public health authorities to set up effective preparedness and control strategies.

* For references please see page 16.

WATER RESOURCES AND HEALTH

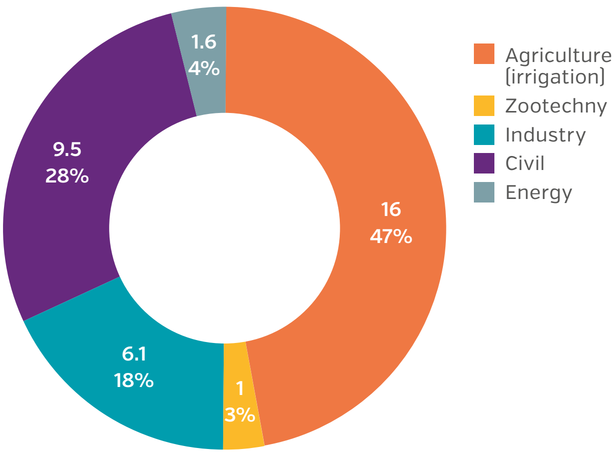
Italy is using, on average, between 30% and 35% of its renewable water resources, and is therefore considered a medium-high water stressed country. Data from the decade 2001-2010 indicate a 6% increase in the use of renewable water resources as compared with the previous 30-year period (1971-2001) (1), and this positive trend is confirmed by recent figures from 2011-2015.

Water scarcity is occurring in Italy, particularly in southern areas and inlands, with critical peaks in summer seasons due to low rainfall combined with increasing demand, from higher population density in coastal areas, and increasing demand for agriculture and animal husbandry [2]. Dramatic reductions of water availability is also a concern in northern Italian regions because of deglaciation of Alpine glaciers (the most important freshwater reservoir in Europe). The loss of ice mass has almost doubled over the last 35 years due to the increase of summer temperatures and the reduction of winter precipitation at high altitudes [3].

The future scenario related to climate change, with less precipitation and higher temperatures (see figures 2.6 and 2.7) is exacerbating water scarcity phenomena in the already affected regions; more frequent occurrence of aquifer over-exploitation, reduction of water availability and drought phenomena are expected to have severe consequences on water access (quantity and continuity of supply), and quality (e.g., turbidity for drinking water reservoirs), also affecting food production, forestry, energy and tourism [1]. Droughts and extreme temperatures are exacerbating the water crisis with 6/20 Italian regions calling for a "state of emergency" in the summer of 2017.

A general warming of maximum temperature is expected by EURO-CORDEX high resolution simulations [Figure 2.6] [2–4].

Fig. 2.4. Water volumes (billions of cubic meters) abstracted from aquifers to be destined to different human uses



Source: ISS elaboration on data "ISTAT - Censimento delle acque per uso civile, 2012."

* For references please see page 16.

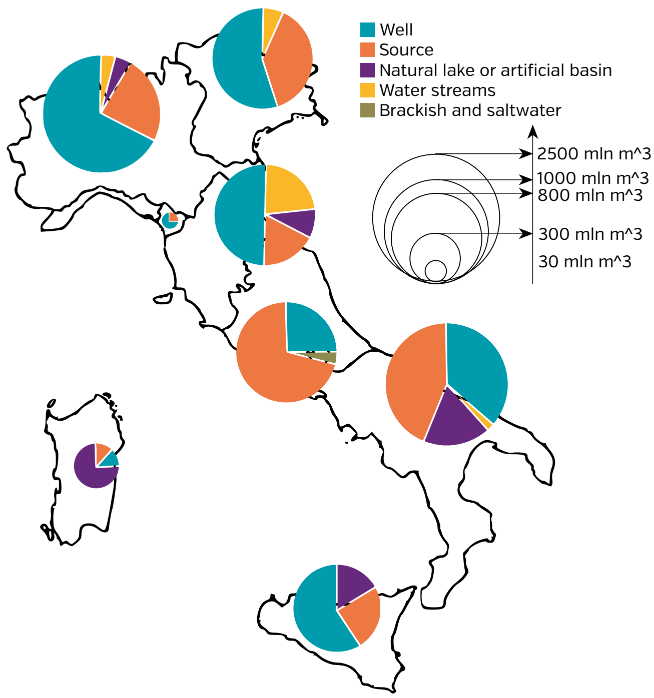
KEY IMPLICATIONS FOR HEALTH

Water scarcity and water pollution can have direct and sometimes severe consequences for health.

Decreases in mean precipitation, together with over-exploitation of water resources and lack of adequate management, investments and practices, are resulting in challenges to ensure water availability and safely managed water supply in several Italian regions.

Aquatic ecosystems and groundwater resources may also be seriously impacted resulting in; insufficient water level in rivers and lakes, intrusion of salt-water into aquifers, increased frequency and severity of water quality deficiencies with possible health impacts (non communicable and communicable diseases) due to algal blooms, lower potential of dilution of pollutants in aquifers and bio-accumulation of contaminants in the aquatic food chain. An increased risk of diseases caused by lack of water for human consumption, sanitation and hygiene could be envisaged in circumstances of extreme water crises.

Fig 2.5. Water volumes (billions of cubic meters) abstracted from aquifers to be destined to human consumption



Source: ISS elaboration on data "ISTAT - Censimento delle acque per uso civile, 2012."

Fig. 2.6 and Fig 2.7. EURO-CORDEX high resolution simulations showing an expected general warming of maximum temperature, light for RCP2.6 (in green) and more accentuated for RCP8.5 (in yellow) scenario (Fig. 2.6). No substantial variations are expected for annual total precipitation (Fig. 2.7). Also reported are: historical reference period data (in grey), average climatic projection (thick line) and 90% model range giving a measurement of uncertainty (shaded area). Plots are obtained using using 5 years running mean.

Fig 2.6. Mean Annual Maximum Temperature

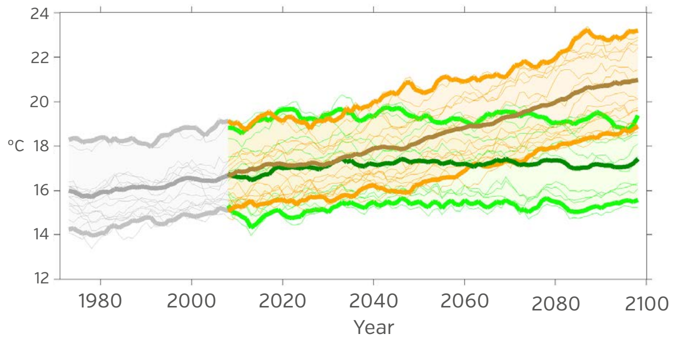
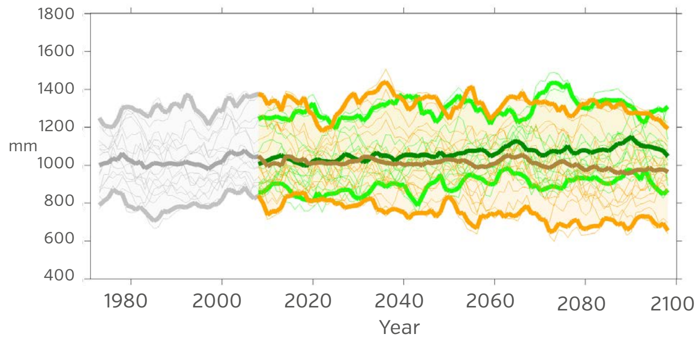


Fig 2.7. Annual Total Precipitation



There is growing concern on the effects of climate change in the marine environment, as for the increasing of surface temperatures, intensification of the deepest stratification of water masses, causing changes in the inter-relationships between deep and coastal environments, alteration of biogeochemical cycles, variability and instability of marine ecosystems, with risks from alien species, changes in the distribution and effects of contaminants and their impacts, increasing of sea level. These impacts, combined with strong anthropogenic pressures, have consequences that are difficult to predict on social and health risks related to the exposure and use of the seas in our country, taking also into account that, with over 8,000 km of coastline, basic economic resources derive from the sea (approx. 2.7% of GDP), especially for the most disadvantaged areas.

WATER RESOURCE STRATEGY IN ITALY

To cope with the challenging scenario of water quality and quantity depletion, Italy is strengthening a strategic vision for the water sector, with national policy supporting regional and local authorities in managing water resources and surveying water quality. However, any development within the water supply and sanitation sector have to cope with serious problems of inadequacy and aging of drinking and wastewater infrastructures.

The following strategic actions are defined:

- to promote natural water conservation, reclaimed water reuse, investments in renovation of water networks and infrastructure, by development of a holistic water policy, and strategy to aggregate the fragmentized surveillance authorities and water management companies, also by using economic instruments, such as water pricing;
- to promote water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity in short- medium- and long-term, and by also adopting advanced technologies such as desalination.
- to strengthen capacity building regarding climate adaptation in water management, especially regarding flood and drought controlling;
- to promote cross-sectoral, regional and national policies to increase resilience of water supply, treatment, storage and delivery systems as well as sanitation systems, by ensuring adequate knowledge and implementation of hygiene practices;
- to support the adoption and implementation of risk based approach in water and sanitation sector (i.e., water safety plans [5], sanitation safety plans), including waterborne diseases risk assessment and management, early warning systems based on forecasts of pathogen distributions, identification and monitoring of legacy and emerging chemical contaminants;
- to support modelling and monitoring of biogenic harmful substances, including algal blooms and toxin production in the aquatic environment [6–8];
- to support the development and up-scaling of technologies and methods to ensure safe and affordable drinking water in sufficient quality and quantity (e.g., desalination technologies for contingency water supply) [9].

* For references please see page 16.

CLIMATE CHANGE AND FOOD SAFETY AND SECURITY

Climate change is likely to have both direct and indirect impacts on food safety and food security. It can cause or intensify food (and feed) safety problems during all phases of production and supply. However, the interactions between climate change and food safety are very complex because of the many associated uncertainties. Climate change might alter both microbiological and chemical risks to food safety. Food and water-borne diseases are caused by the ingestion of bacteria, viruses, parasites or chemicals, in food or water, and they can have severe effects on health. This is the case especially in developing countries where food- and waterborne diarrheal disease kills an estimated 2 million people annually. However, climate change can threaten food safety even in European Countries (1). Examples include:

Microbiological food contamination, foodborne diseases and waterborne diseases

Waterborne and foodborne enteric pathogens, such as Salmonella spp., Campylobacter jejuni, E. coli, Shigella spp., Vibrio spp., Norovirus, Giardia and Cryptosporidium, show typical seasonal patterns. This suggests that climate change could play a role in changing the incidence of many foodborne diseases. 3821 cases of salmonellosis, 1041 of campylobacteriosis, and 153 of listeriosis were reported in Italy in 2015 in the last joint EFSA/ECDC report (2). Extreme climatic events such as flood can influence the incidence of foodborne diseases because of their impact on the infrastructures, the environment and the ecology of microorganisms. An association between water-borne diseases such as leptospirosis (3), salmonellosis and infectious diarrhea and flood events seems to exist in Italy (4).

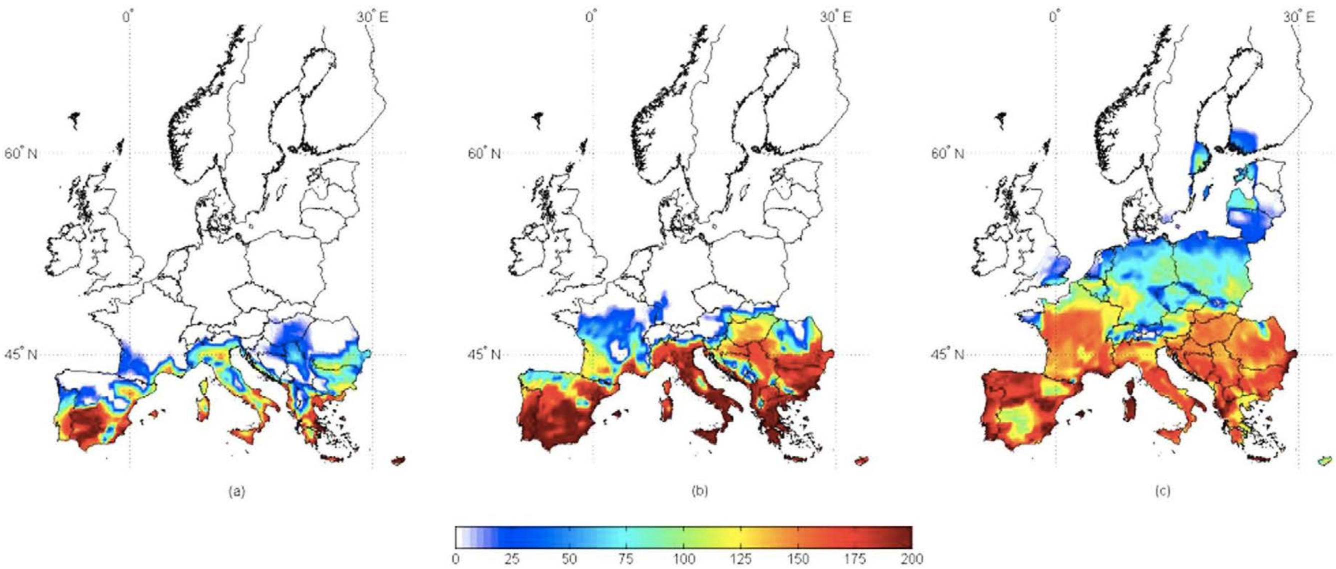
Mycotoxins

Mycotoxins, produced by toxigenic moulds affecting crops, are one of the most investigated and paradigmatic example of the potential impact of climate change on food safety and security. The production of mycotoxins is greatly influenced by environmental factors, such as temperature, humidity and drought. Until a few years ago, aflatoxins, among the most harmful mycotoxins, were not a matter of concern in Europe. However, 2003 and 2012 will be remembered in Italy and southern Europe, respectively, because of the alarming contamination in maize. Models aimed at predicting aflatoxin contamination in maize and wheat crops in Europe over the next 100 years indicate Italy will be one of the most heavily affected countries [5] (See Fig 2.8.)

Environmental contaminants and chemical residues in the food chain

There are many pathways through which climate change may impact environmental contamination and chemical hazards in foods. Contamination of agricultural and pastureland soil with PCBs and dioxins have been associated with extreme climate events, particularly with the inland floods. Soil contamination can result from the mobilization of river sediments or contaminated terrestrial sites such as industrial sites, landfills and sewage treatment plants and the subsequently deposition of chemicals on the flooded areas (6).

Fig. 2.8. Risk maps for aflatoxin contamination in maize at harvest in 3 different climate scenarios, present, +2 °C, +5 °C. Mean daily data used as input result from 100-year run of the predictive model AFLAmaize in 2254 geo-referenced points throughout Europe, in the 3 scenarios. The scale 0–200 refers to the aflatoxin risk index (AFI), output from the predictive model; increasing the (present (a), +2ÆC (b), +5ÆC (c)) number, the risk of contamination increases.



* For references please see page 16.

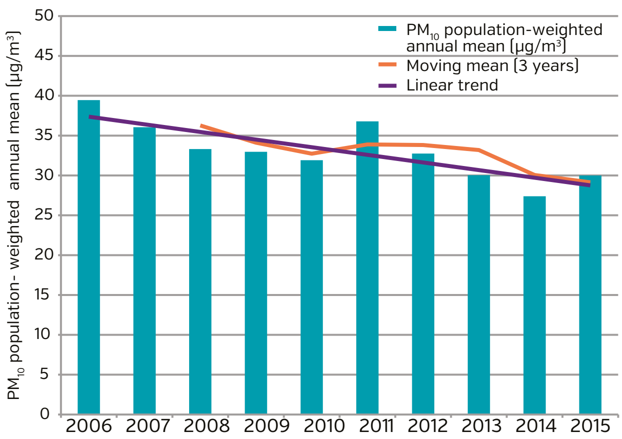
3 CURRENT EXPOSURES AND HEALTH RISKS DUE TO AIR POLLUTION

Many of the drivers of climate change, such as inefficient and polluting forms of energy and transport systems, also contribute to air pollution. Air pollution is now one of the largest global health risks, causing approximately seven million deaths every year. There is an important opportunity to promote policies that both protect the climate at a global level, and also have large and immediate health benefits at a local level.

OUTDOOR AIR POLLUTION: RECENT TRENDS IN EXPOSURE

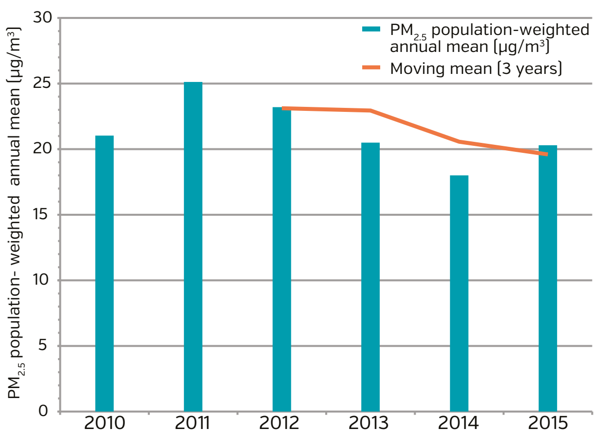
In Italy, significant progress has been achieved during the last decades in improving outdoor air quality. The adoption of specific measures and regulations, as in the rest of Europe, allowed a significant reduction of main pollutants emissions, determining, therefore, a coherent decrease in the measured concentration of primary pollutants (i.e. SO_2, CO, C_6H_6).

Fig 3.1. PM_{10} exposure at national level, population-weighted annual mean (µg/m³).



Source: Environmental Data Yearbook ISPRA (2018). Data from urban background monitoring stations.

Fig 3.2. $PM_{2.5}$ exposure at national level, population-weighted annual mean (µg/m³).



Source: Environmental Data Yearbook ISPRA (2018). Data from urban background monitoring stations.

KEY IMPLICATIONS FOR HEALTH

Both short- and long-term exposure to air pollution can have direct and sometimes severe consequences for health. Air pollutants, especially fine particulate matter, which penetrate deep into the respiratory tract subsequently increase risk of ischemic heart disease, stroke, chronic obstructive pulmonary disease, (COPD) and other respiratory diseases such as asthma in adults, and poses a considerable health threat to future generations. Outdoor air pollution is carcinogenic to humans, with the PM component of air pollution most closely associated with increased cancer incidence, especially lung cancer.

The health impacts of air pollution can be amplified in urban environments, where most of the Italian population lives. The population is exposed to a mix of chemical pollutants and physical stressors dangerous for health, mainly produced by traffic, domestic heating and, in some areas, by closeness to industrial plants.

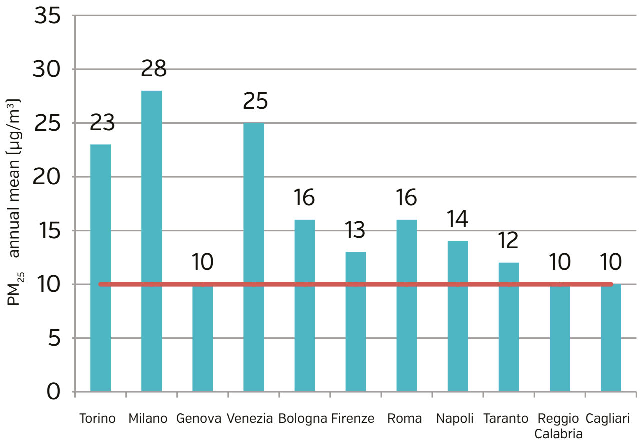
The chemical composition of particulate matter, due to the spatial distribution of different sources in Italy (industrial, heating, transport, natural, etc), could lead to differences in the incidence of specific pathologies in the exposed population.

PM_{10} population weighted concentrations from 2006 to 2015, show a overall reduction trend at national level, (fig 3.1), while for $PM_{2.5}$, there is a lack of sufficient years available to evidence a statistically significant trend, in data observed by monitoring stations (Fig. 3.2). However it is evident that annual means at national level, in both PM_{10} and $PM_{2.5}$, are above WHO guidelines values.

OUTDOOR AIR POLLUTION: CURRENT CONCENTRATION LEVELS

Even though important improvements in air quality have been reached, primary and secondary pollutants concentration levels, PM_{10}, $PM_{2,5}$, NO_2 and O_3, still remain of concern for air quality.

Fig 3.3. $PM_{2.5}$ annual mean concentration at city level (μg/m³). Most of these Italian major cities show background values close to or exceeding the $PM_{2.5}$ annual mean WHO guideline value of 10 μg/m³, (2016).



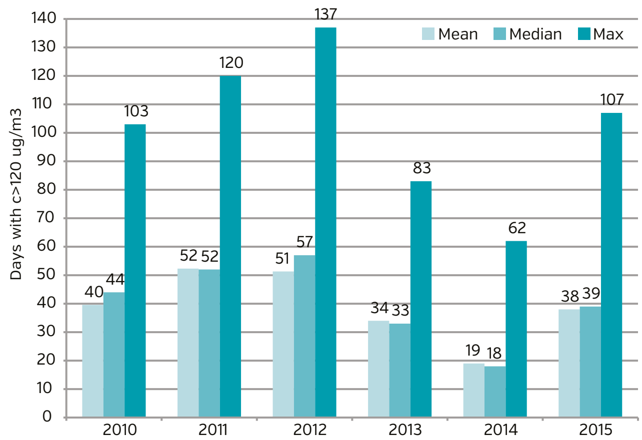
Source: Data from Italy Regional /Provincial Agencies for Environmental Protection (ARPA, APPA) elaborated by ISPRA (National Institute for Environmental Protection and Research). Data are from urban background station. Data from urban background monitoring stations.

ITALIAN CRITICAL AREAS

In Italy, the improvement of air quality is hampered by different causes, such as the orography, the peculiar meteo-climatic conditions of some areas, the high population density, and the lack of structured measures aimed at health protection of population exposed to atmospheric pollution.

Italy has identified critical areas which have particularly high contributions to air pollution, these include: harbours due to shipping emissions; the Po Valley in Northern Italy due to intensive industrial and agricultural activities as well as biomass burning; and the South of Italy due to the Saharan dust intrusions and increasing wildfires in the summer period.

Fig 3.4. Number of days in which ozone concentrations exceeded the long-term objective for the protection of human health (120 μg/m³) (mean and median are calculated from data measured by all the monitoring stations, while max value refers to the station registering the greater number of exceedings), (2010-2015).



Source: Environmental Data Yearbook ISPRA (2017). Data from urban background monitoring stations.

The emission trends for PM_{10} and $PM_{2.5}$ for example, show a decrease by 16% between 2003 and 2012 (full trend not shown here), and in this period, a statistically significant decreasing trend in the PM_{10} concentrations has been observed in 73.7% of monitoring stations distributed over the national territory. For $PM_{2.5}$, there is a lack of sufficient data to evidence a statistically significant trend in data observed by monitoring stations. The NO_X emissions trend (not shown here), on a national basis, shows a decrease by 36% between 2003 and 2012, and a statistically significant decreasing trend has been identified in 66.1% of monitoring stations all over the national territory.

Non-compliance with annual or daily mean air pollution limits or the surpassing of permitted numbers of exceeding days set by regulations is still an issue in Italy. For example, for O_3 the long-term objective for health protection is still exceeded in most stations (See Fig 3.4).

AIR POLLUTION STRATEGY IN ITALY

In Italy, local authorities, as Regions or municipalities, have the responsibility to plan activities for the assessment and management of air quality despite the global nature of the air pollution issue. Therefore, in the last years the Ministry of the Environment has promoted a series of initiatives in order to strengthen coordinated actions with the Regions to make interventions more homogeneous, in particular during emergency periods, when pollutant limits are exceeded. It is worth noting that Indoor Air Quality is included in the action plans promoted by the Ministry of Health to reduce population exposure to air pollution. Recent studies indicate that The 2020 National Energy Strategy could prevent 17% of the $PM_{2.5}$, and 57% of the NO_2 attributable deaths.

Compliance with the EU Directive 50/2008 with a 2005 baseline situation could reduce attributable mortality due to $PM_{2.5}$ or NO_2 by around 20% (30% in urban areas).

With these aims, the following strategic actions are defined:

- to promote a stronger integration and coordination between national and regional administrations to achieve uniform air pollution management at local and national level;
- to improve the air quality monitoring network, in particular in the southern regions;
- to implement and apply regional air quality plans as primary long-term planning tools;
- to identify preventive criteria on the basis of the reliable predictive model simulations, to manage emergency events as well as planning long-term strategies;
- to identify actions and promote research activity to both improve air quality and mitigate climate change (win-win policies);
- to assess interventions on air quality, in terms of reduction of adverse health effects and social inequalities;
- to update the air quality regulations taking into account the most up-to-date scientific knowledge;
- to support initiatives (political, cultural, structural, research) to promote health in the urban environment;
- to define national guidelines for managing the indoor air pollution, also supporting the activities of the National Indoor Air Research Group, set up at the National Heath Institute;
- to promote integration and updating of national Law on Health and Safety in the workplace, with specific references to indoor environments quality;
- to promote a European Indoor Pollution Directive.

URBAN AND PERI-URBAN FORESTS AND REGULATING ECOSYSTEM SERVICES: A CASE STUDY IN ITALIAN METROPOLITAN CITIES

Air pollution removal by Green Infrastructure

The potential of Green Infrastructures (GI), an approach towards nature-based solutions addressed at countering air pollution, climate change and urban heat island effect, has been demonstrated across many European cities [1]. Natural Capital and Biodiversity, such as number of species, and their structural and functional traits, are positively related to Ecosystem functions and Services they provide [2, 3, 4]. GI represents a key factor in nature-based solutions that aims at improving human well-being with a relevant monetary value, in particular in urban areas where human exposure to air pollution often exceed the legislative limits. A 2016 study reports that the Ecosystem Service of PM_{10} and O_3 removal by vegetation in 10 Italian metropolitan cities, accounts for a total of 7,150 Mg of PM_{10} and 30,014 Mg of O_3 in the year 2003, with a relative monetary benefit of 47 and 297 million USD for PM_{10} and O_3 removal, respectively [5].

Nature based solution strategy in Italy

In this context, strategic actions to sustain air quality in Italian cities should include:

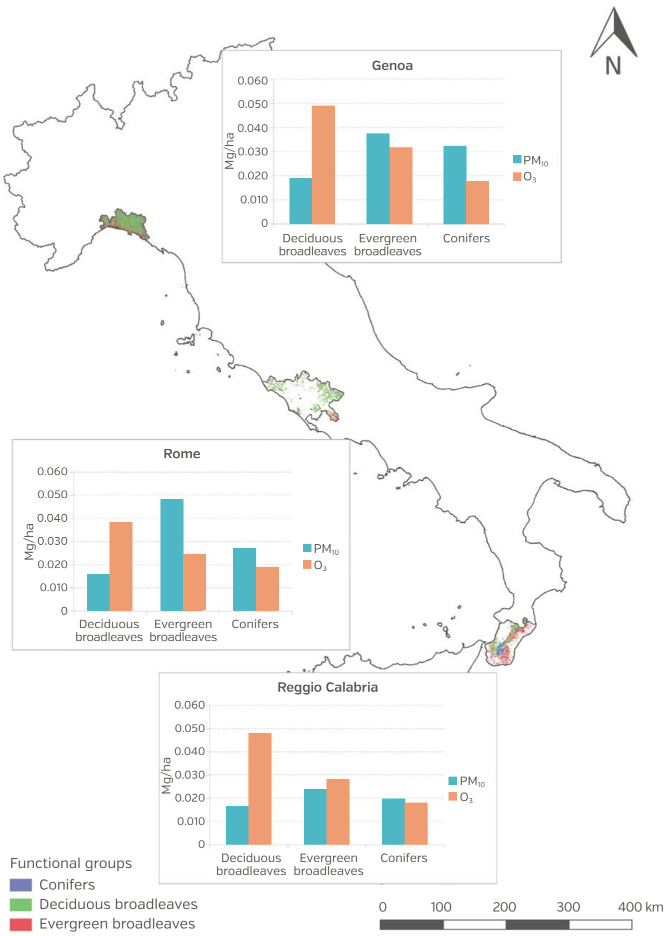
- Implementing nature-based solutions as a tool to improve air quality standards and increase resilience of urban areas in a climate change context;
- Enhancing the functional and structural biodiversity in urban and periurban forests and promoting the selection of native species for forestation plans;
- Restoring degraded ecosystems and establishing new GI as highlighted in the Target 2 of the EU Biodiversity Strategy to 2020;
- Addressing GI planning in terms of selection of functional types on the basis of air quality targets.

The important role that functional and structural biodiversity in urban and natural areas of Metropolitan Cities (MC) can have on air quality amelioration is illustrated by three study cases carried out on MC of Genoa, Rome and Reggio Calabria, selected on latitudinal gradients, with different landscape and vegetation as well as air pollutant concentrations and climate characteristics (Fig. 4.1).

KEY IMPLICATIONS FOR HEALTH

The impact that atmospheric pollutants have on human health results in an estimate of a total of 555,000 premature deaths in 2013, with 91,050 premature deaths only in Italy, the highest number among the European countries. In particular, in Italy, a number of 66,630, 21,040 and 3,380 premature deaths for exposure to $PM_{2,5}$, NO_2 and O_3 respectively was estimated [6].

Figure 4.1: Contribution of three different functional groups of vegetation (evergreen broadleaves, deciduous broadleaves, and conifers) to the removal of two air pollutants (PM_{10} and O_3; Mg/ha) in the Metropolitan Cities of Genoa, Rome and Reggio Calabria.



* For references please see page 16.

4 CO-BENEFITS TO HEALTH FROM CLIMATE CHANGE MITIGATION: A GLOBAL PERSPECTIVE

Health co-benefits are local, national and international measures with the potential to simultaneously yield large, immediate public health benefits and reduce the upward trajectory of greenhouse gas emissions. Lower carbon strategies can also be cost-effective investments for individuals and societies.

Presented here are examples, from a global perspective, of opportunities for health co-benefits that could be realised by action in important greenhouse gas emitting sectors.*

Transport

Transport injuries lead to 1.2 million deaths every year, and land use and transport planning contribute to the 2–3 million deaths from physical inactivity. The transport sector is also responsible for some 14% (7.0 $GtCO_2e$) of global carbon emissions. The IPCC has noted significant opportunities to reduce energy demand in the sector, potentially resulting in a 15%–40% reduction in CO_2 emissions, and bringing substantial opportunities for health: A modal shift towards walking and cycling could see reductions in illnesses related to physical inactivity and reduced outdoor air pollution and noise exposure; increased use of public transport is likely to result in reduced GHG emissions; compact urban planning fosters walkable residential neighborhoods, improves accessibility to jobs, schools and services and can encourage physical activity and improve health equity by making urban services more accessible to the elderly and poor.

Electricity Generation

Current patterns of electricity generation in many parts of the world, particularly the reliance on coal combustion in highly polluting power plants, contribute heavily to poor local air quality, causing cancer, cardiovascular and respiratory disease. Outdoor air pollution is responsible for 3.7 million premature deaths annually. High-income countries still have work to do in transitioning to cleaner and healthier energy sources.

The health benefits of transitioning from fuels such as coal to lower carbon sources, including ultimately to renewable energy, are clear: Reduced rates of cardiovascular and respiratory disease such as stroke, lung cancer, coronary artery disease, and COPD; cost-savings for health systems; improved economic productivity from a healthier and more productive workforce.

Food and Agriculture

Agricultural emissions account for some 5.0–5.8 $GtCO_2eq$ annually, with food and nutrition constituting an important determinant of health. Many high-income countries are feeling the burden of poor diet and obesity-related diseases, with some 1.9 billion adults overweight globally.

A wide range of interventions designed to reduce emissions from agriculture and land-use will also yield positive benefits for public health. For example, policy and behavioural interventions to encourage a reduction in red meat consumption and a shift towards local and seasonal fruit and vegetables, which tend to have lower carbon emissions associated with their production, will improve diets and result in reductions in cardiovascular disease and colorectal cancer.

Healthcare Systems

Health care activities are an important source of greenhouse gas emissions. In the US and in EU countries, for example, health care activities account for between 3–8% of greenhouse gas (CO_2-eq) emissions. Major sources include procurement and inefficient energy consumption. Modern, on-site, low-carbon energy solutions (e.g. solar, wind, or hybrid solutions) and the development of combined heat and power generation capacity in larger facilities offer significant potential to lower the health sector's carbon footprint, particularly when coupled with building and equipment energy efficiency measures. Where electricity access is limited and heavily reliant upon diesel generators, or in the case of emergencies when local energy grids are damaged or not operational, such solutions can also improve the quality and reliability of energy services. In this way, low carbon energy for health care could not only mitigate climate change, it could enhance access to essential health services and ensure resilience.

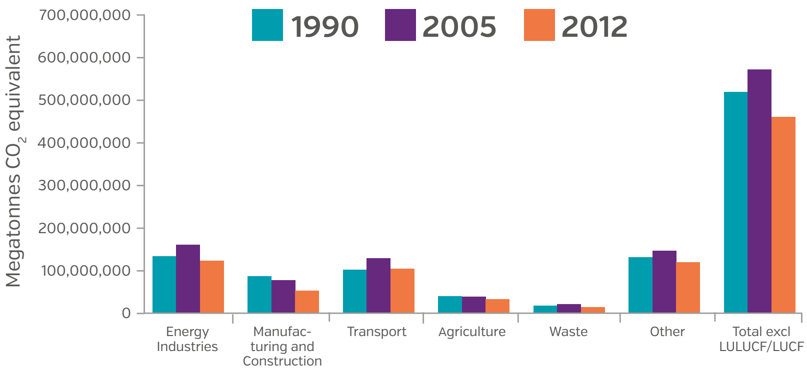
* For a complete list of references used in the health co-benefits text please see the Climate and Health Country Profile Reference Document, http://www.who.int/globalchange/en/

5 EMISSIONS AND COMMITMENTS

Global carbon emissions increased by 80% from 1970 to 2010, and continue to rise [1,2]. Collective action is necessary, but the need and opportunity to reduce greenhouse gas emissions varies between countries. Information on the contribution of different sectors, such as energy, manufacturing, transport and agriculture, can help decision-makers to identify the largest opportunities to work across sectors to protect health, and address climate change.

ITALY ANNUAL GREENHOUSE GAS EMISSIONS

(metric tonnes CO_2 equivalent)



Source: UNFCCC Greenhouse Gas Data Inventory, UNFCCC [2015].

The most recent greenhouse gas emissions data for Italy is from 2013 [data not shown here]. At that time, carbon emissions were continuing to decrease across most sectors. The largest contributions of emissions were from the energy and transport sectors. Through intersectoral collaboration, the health community can help to identify the best policy options not only to eventually stabilize greenhouse gas emissions, but also to provide the largest direct benefits to health.

NATIONAL RESPONSE [3]

2004	NATIONAL HEAT-HEALTH PREVENTION PLAN
2006	FUND FOR SUSTAINABLE MOBILITY ESTABLISHED
2012	REDUCING GREEN HOUSE GAS EMISSIONS (CLIMATE CHANGE MITIGATION) BY REDUCTION OF THE TAXES (55%) FOR PRIVATE BUILDINGS (LAW 134, 7TH AUGUST 2012)
2013	NATIONAL STRATEGY APPROVED BY THE CIPE, DELIBERATION N. 17/2013. MINISTRY OF ECONOMIC DEVELOPMENT AND THE ITALIAN MINISTRY FOR THE ENVIRONMENT LAND AND SEA (IMELS) APPROVED A NEW “NATIONAL ENERGY STRATEGY”
2014	NATIONAL PREVENTION PLAN BY MINISTRY OF HEALTH (ONE HEALTH)
2015	NATIONAL ADAPTATION STRATEGY (NAS) ADOPTED
2016	RATIFICATION OF PARIS AGREEMENT
2017	IMELS PROVIDED A DRAFT NATIONAL PLAN FOR ADAPTATION TO CLIMATE CHANGE (NAP, IN PROGRESS)
2017	JOINT PROJECT COORDINATED BY MOH AND NATIONAL INSTITUTE OF HEALTH (ISS) ON “CLIMATE CHANGES AND HEALTH WITHIN THE “PLANETARY HEALTH” VISION

* For references please see page 16.

6 NATIONAL POLICY RESPONSE

The following table outlines the status of development or implementation of climate resilient measures, plans or strategies for health adaptation and mitigation of climate change (reported by countries).[a]

GOVERNANCE AND POLICY	
Country has identified a national focal point for climate change in the Ministry of Health	✓
Country has a national health adaptation strategy approved by relevant government body	✓
The National Communication submitted to UNFCCC includes health implications of climate change mitigation policies	✓
HEALTH ADAPTATION IMPLEMENTATION	
Country is currently implementing projects or programmes on health adaptation to climate change	✓
Country has implemented actions to build institutional and technical capacities to work on climate change and health	✓
Country has conducted a national assessment of climate change impacts, vulnerability and adaptation for health	YES/ IN PROGRESS
Country has climate information included in Integrated Disease Surveillance and Response (IDSR) system, including development of early warning and response systems for climate-sensitive health risks	PARTLY
Country has implemented activities to increase climate resilience of health infrastructure	PARTLY
FINANCING AND COSTING MECHANISMS	
Estimated costs to implement health resilience to climate change included in planned allocations from domestic funds in the last financial biennium	✗
Estimated costs to implement health resilience to climate change included in planned allocations from international funds in the last financial biennium	✗
HEALTH BENEFITS FROM CLIMATE CHANGE MITIGATION	
The national strategy for climate change mitigation includes consideration of the health implications (health risks or co-benefits) of climate change mitigation actions	✓
Country has conducted valuation of co-benefits of health implications of climate mitigation policies	PARTLY

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World Health Organization

United Nations Framework Convention on Climate Change

WHO/FWC/PHE/EPE/15.52 DESIGN: INIS COMMUNICATION – WWW.INISCOMMUNICATION.COM

REFERENCES

PAGE 1

1 ISTAT https://www.istat.it/it/files/2018/02/Indicatoridemografici2017.pdf?title=Indicatori+demografici+-+08%2Ffeb%2F2018+-+Testo+integrale.pdf).
2 World Urbanization Prospects: The 2014 Revision, UNDESA (2014).
3 http://www.istat.it/it/files/2017/03/Statistica-report-Indicatori-demografici_2016.pdf?title=Indicatori+demografici+-+06%2Fmar%2F2017+-+Testo+integrale+e+nota+metodologica.pdf
4 Istat - Noi Italia. 100 statistiche per capire il Paese in cui viviamo. http://noi-italia.istat.it/
5 World Development Indicators, World Bank (2017)
6 Global Health Expenditure Database, WHO (2016)
7 United Nations Development Programme, Human Development Reports (2016)

PAGE 2

1 Model projections are from CMIP5 for RCP8.5 (high emissions) and RCP2.6 (low emissions). Model anomalies are added to the historical mean and smoothed.
2 Observed historical record of mean temperature is from CRU-TSv.3.22; observed historical records of extremes are from HadEX2.
3 Analysis by the Climatic Research Unit and Tyndall Centre for Climate Change Research, University of East Anglia, 2015.
4 A 'warm spell' day is a day when maximum temperature, together with that of at least the 6 consecutive previous days, exceeds the 90th percentile threshold for that time of the year.

PAGE 3

1 Guo Y, et al. Global variation in the effects of ambient temperature on mortality: a systematic evaluation. Epidemiology 2014; 25: 781-789
2 Schifano P, et al. Changes in the effects of heat on mortality among the elderly from 1998-2010: results from a multicenter time series study in Italy. Environ Health 2012;11:58.
3 Michelozzi P, et al. [On the increase in mortality in Italy in 2015: analysis of seasonal mortality in the 32 municipalities included in the Surveillance system of daily mortality]. Epidemiol Prev. 2016 Jan-Feb;40(1):22-8. [in Italian]
4 Stafoggia M, et al. Vulnerability to heat-related mortality: a multicity, population-based, case-crossover analysis. Epidemiology. 2006 May;17(3):315-23.
5 Michelozzi P, et al. Surveillance of summer mortality and preparedness to reduce the health impact of heat waves in Italy. Int J Environ Res Public Health. 2010 May;7(5):2256-73.
6 WHO Regional Office for Europe. Heat-health action plans. Guidance. [Matthies F, Bickler G, Cardeñosa Marín N, Hales S eds.]. World Health Organization; 2008.
7 National Ministry of Health Campaign for prevention of heat-health effects. HYPERLINK "http://www.salute.gov.it/caldo" www.salute.gov.it/caldo [in Italian]

PAGE 4

1 Conti F, Abbate G, Alessandrini A, Blasi C (Eds). 2005. An annotated checklist of the Italian vascular flora. Roma: Palombi Editori. (available from: http://lnx.ondeweb.net/ccb2/uploaded/1/a005d397abc62c548e09f451fa3045b6___56B-_CHECKLIST_FLORA_ITALIANA_(2005).pdf)
2 Celesti-Grapow L, Alessandrini A, Arrigoni PV, Banfi E, Bernardo L, Bovio M, Brundu G, Cagiotti MR, Camarda I, Carli E, Conti F, Fascetti S, Galasso G, Gubellini L, La Valva V, F. Lucchese, Marchiori S, Mazzola P, Peccenini S, Poldini L, Pretto F, Prosser F, Siniscalco C, Villani MC, Viegi L, Wilhalm T & Blasi C. 2009. Inventory of the non-native flora of Italy. Plant Biosystems, 143 (2): 386-430, DOI: 10.1080/11263500902722824.
3 Banfi E, Galasso G. 2010. La Flora esotica Lombarda. Milano: Regione Lombardia.
4 http://data2.unhcr.org/en/situations/mediterranean
5 https://www.iom.int/news/mediterranean-migrant-arrivals-top-363348-2016-deaths-sea-5079
6 I controlli alla frontiera – La frontiere dei controlli. Controlli sanitari all'arrivo e percorsi di tutela per migranti ospiti nei centri di accoglienza - Linee guida Salute Migranti –INMP, ISS, SIMM
7 Migration and climate change –IOM Migration Research Series – IOM International Organization for Migration

PAGE 5

1 Urbanelli S., R. Bellini, M. Carrieri, P. Sallicandro and G. Celli 2000. Population structure of Aedes albopictus (Skuse): the mosquito which is colonizing Mediterranean countries. Heredity, 84 (3), pp. 331-337
2 Porretta D, Canestrelli D, Bellini R, Celli G, Urbanelli S. (2007). Improving insect pest management through population genetic data: the case study of the mosquito Ochlerotatus caspius (Pallas). Journal Of Applied Ecology., 44 (3), 682–691
3 Angelini R, Finarelli AC, Angelini P, Po C, et al. An outbreak of chikungunya fever in the province of Ravenna, Italy. Euro Surveill 2007; 12:E070906.1.
4 Liumbruno GM, Calteri D, Petropulacos K, Mattivi A, et al. The Chikungunya epidemic in Italy and its repercussion on the blood system. Blood Transfus 2008; 6:199–210.
5 Rezza G, Nicoletti L, Angelini R, et al. Infection with chikungunya in Italy: an outbreak in a temperate region. Lancet 2007; 370: 1840-6
6 Venturi G, Di Luca M, Fortuna C, et al. Detection of a chikungunya outbreak in Central Italy, August to September 2017. Euro Surveill 2017; Sep;22(39).
7 Rizzo C, Napoli C, Venturi G, Pupella S, et al. 2016. Italian WNV surveillance working group. West Nile virus transmission: Results from the integrated surveillance system in Italy, 2008 to 2015. Euro Surveill; 21. DOI: 10.2807/1560-7917 .ES.2016.21.37.30340.
8 Calzolari M, Monaco F, Montarsi F, Bonilauri P, et al. New incursions of West Nile virus lineage 2 in Italy in 2013: The value of the entomological surveillance as early warning system. Vet Ital 2013; 49:315–319.
9 Regione Lombardia, Istituto Zooprofilattico Sperimentale Della Lombardia e Dell'Emilia Romagna. Sorveglianza WND Lombardia: dati attività 2014-2015, 2016.
10 Angelini, P., M. Tamba, A. C. Finarelli, R. Bellini, A. Albieri, P. Bonilauri, F. Cavrini, M. Dottori, P. Gaibani, E. Martini, A. Mattivi, A.M. Pierro, G. Rugna, V. Sambri, G. Squintani and P. Macini, 2010: West Nile virus circulation un Emilia-Romagna, Italy: the integrated surveillance system 2009. Euro. Surveill. 16, 11–15.
11 Cavrini F, Gaibani P, Longo G, Pierro AM, et al. Usutu virus infection in a patient who underwent orthotropic liver transplantation, Italy, August-September 2009. Euro Surveill 2009; 14:pii: 19448.
12 Pecorari M, Longo G, Gennari W, Grottola A, et al. First human case of Usutu virus neuroinvasive infection, Italy, August-September 2009. Euro Surveill 2009; 14:pii: 19446.
13 Verna F., Modesto P., Radaelli M.C., Francese D.R., Monaci E., Desiato R., Grattarola C., Peletto S., Mosca A., Savini G., Chianese R., Demicheli V., Prearo M., Chiavacci L., Pautasso A. and Casalone C. 2017Control of Mosquito-Borne Diseases in Northwestern Italy Preparedness from One Season to the Next.VECTOR-BORNE AND ZOONOTIC DISEASES Volume 17, Number 5, Mary Ann Liebert, Inc.DOI: 10.1089/vbz.2016.2047
14 Centro Agricoltura Ambiente "G. Nicoli", CAA 2014-2016. Relazione tecnica sulle attività condotte nell'ambito del "Progetto per la realizzazione di un sistema integrato di sorveglianza sanitaria delle malattie da vettori in Emilia Romagna".
15 Ravanini, P., E. Huhtamo, V. Ilaria, M. G. Crobu, A. M. Nicosia, L. Servino, F. Rivasi, S. Allegrini, U. Miglio, A. Magri, R. Minisini, O. Vapalahti, and R. Boldorini, 2012: Japanese encephalitis virus RNA detected in Culex pipiens mosquitoes in Italy. Euro. Surveill. 17, pii: 20221.
16 WHO. 2016. Available at www.euro.who.int/__data/assets/pdf_file/0007/304459/WEB-news_competence-of-Aedes-aegyptiand-albopictus-vector-species.pdf?ua=1.

PAGE 6

1 ISTAT 2017: Giornata mondiale dell'acqua: le statistiche dell'Istat 22 marzo 2017. https://www.istat.it/it/archivio/198245
2 D. Zingaro, I. Portoghese and G. Giannoccaro, Modelling Crop Pattern Changes and Water Resources Exploitation: A Case Study, Water 2017, 9, 685; doi:10.3390/w9090685
3 GIORNATA MONDIALE DELL'ACQUA. 22 marzo 2017. Le statistiche dell'Istat

PAGE 7

1 I. Portoghese, M. Vurro and A. Lopez, Assessing the Impacts of Climate hange on Water Resources: Experiences From the Mediterranean Region, In book: Managing Water Resources under Climate Uncertainty, Publisher: Springer International Publishing, Editors: Shrestha, Sangam and Anal, Anil K. and Salam, P. Abdul and van der Valk, Michael, pp.177-195, DOI: 10.1007/978-3-319-10467-6_9
2 Bucchignani E., Montesarchio M., Zollo A.L., Mercogliano P. (2015). High-resolution climate simulations with COSMO-CLM over Italy: performance evaluation and climate projections for the XXI century. International Journal of Climatology DOI:10.1002/joc.4379
3 Zollo A.L., Rillo V., Bucchignani E., Montesarchio M., Mercogliano P. (2015). Extreme temperature and precipitation events over Italy: assessment of high resolution simulations with COSMO-CLM and future scenarios. International Journal of Climatology DOI:10.1002/joc.4401
4 EURO-CORDEX program data are reported in http://euro-cordex.net/index.php.en.
5 Linee guida per la valutazione e gestione del rischio nella filiera delle acque destinate al consumo umano secondo il modello dei Water Safety Plans. A cura di Luca Lucentini, Laura Achene, Valentina Fuscoletti, Federica Nigro Di Gregorio e Paola Pettine Rapporti ISTISAN 14/20
6 Bogialli S, Nigro di Gregorio F, Lucentini L, Ferretti E, Ottaviani M, Ungaro N, Abis PP, Cannarozzi de Grazia M. 2012. Management of a toxic cyanobacterium bloom (Planktothrix rubescens) affecting an Italian drinking water basin: a case study. Environmental science and technology, 47(1):574-583.
7 L Lucentini e M Ottaviani. Cianobatteri in acque destinate a consumo umano. Stato delle conoscenze per la valutazione del rischio. Volume 1. 2011, Rapporti ISTISAN 11/35 Pt. 1.
8 L Lucentini e M Ottaviani. Cianobatteri in acque destinate a consumo umano. Linee guida per la gestione del rischio. Volume 2. 2011. Rapporti ISTISAN 11/35 Pt. 2.
9 L Bonadonna, R Briancesco R, S Della Libera, P Paradiso, M Semproni. Microbial safety of drinking water: assessing and reducing risks. Improved approaches and methods. Roma: Istituto Superiore di Sanità; 2012 Rapporti ISTISAN 12/01.

PAGE 8

1 Miraglia M, Marvin HJP, Kleter GA, Battilani P, Brera C, Coni E, Cubadda F, Croci L, De Santis B, Dekkers S, Filippi L, Hutjes RWA, Noordam MY, Pisante M, Piva G, Prandini A, Toti L, van den Born GJ, Vespermann A. 2009. Climate change and food safety: An emerging issue with special focus on Europe. Food and Chemical Toxicology 47 (2009) 1009–1021
2 EFSA and ECDC (European Food Safety Authority and European Centre for Disease Prevention and Control). The European Union Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and Foodborne Outbreaks in 2015. EFSA Journal 2016;14(12):4634.
3 Pellizzer P, Todescato A, Benedetti P, Colussi P, Conz P, Cinco M. Leptospirosis following a flood in the Veneto area, North-east Italy. Ann Ig. 2006 Sep-Oct;18(5):453-6.
4 Marcheggiani S, Puccinelli C, Ciadamidaro S, Della Bella V, Carere M, Blasi MF, Pacini N, Funari E, Mancini L. Risks of water-borne disease outbreaks after extreme events. Toxicological & Environmental Chemistry Vol. 92, No. 3, March 2010, 593–599.
5 Battilani P, Toscano P, Van der Fels-Klerx HJ, Moretti A, Camardo Leggieri M, Brera C, Rortais A, Goumperis T, Robinson T. (2016). Aflatoxin B1 contamination in maize in Europe increases due to climate change. Scientific Reports 6:24328.
6 Tirado MC, Clarke R, Jaykus LA, McQuatters-Gollop A, Frank JM. (2010). Climate change and food safety: A review. Food Research International 43:1745–1765.

PAGE 12

1 Norton, B. A., Coutts, A. M., Livesley, S. J., Harris, R. J., Hunter, A. M., & Williams, N. S. (2015). Planning for cooler cities: A framework to prioritise green infrastructure to mitigate high temperatures in urban landscapes.Landscape and Urban Planning, 134, 127-138.
2 Lehmann, I., Mathey, J., Rößler, S., Bräuer, A., & Goldberg, V. (2014). Urban vegetation structure types as a methodological approach for identifying ecosystem services–Application to the analysis of micro-climatic effects. Ecological Indicators, 42, 58-72.
3 Manes, F., Incerti, G., Salvatori, E., Vitale, M., Ricotta, C., & Costanza, R. (2012). Urban ecosystem services: tree diversity and stability of tropospheric ozone removal. Ecological Applications, 22(1), 349-360.
4 Fusaro L., Marando F., Sebastiani A., Capotorti G., Blasi C., Copiz R.,Congedo L. , Munafò M., Ciancarella L. and Manes F. (2017). Mapping and Assessment of PM_{10} and O_3 Removal by Woody Vegetation at Urban and Regional Level. Remote sens., 9,791, 1-17.
5 Manes, F.; Marando, F.; Capotorti, G.; Blasi, C.; Salvatori, E.; Fusaro, L.; Ciancarella, L.; Mircea, M.; Marchetti, M.; Chirici, G.; et al. Regulating Ecosystem Services of forests in ten Italian metropolitan Cities: Air quality improvement by PM10 and O3 removal. Ecol. Indic. 2016, 67, 425–440.
6 EEA 2016: Air quality in Europe – 2016 Report.

PAGE 14

1 Boden, T.A., G. Marland, and R.J. Andres (2010). Global, Regional, and National Fossil-Fuel CO2 Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi 10.3334/CDIAC/00001_V2010.
2 IPCC (2014) Blanco G., R. Gerlagh, S. Suh, J. Barrett, H.C. de Coninck, C.F. Diaz Morejon, R. Mathur, N. Nakicenovic, A. Ofosu Ahenkora, J. Pan, H. Pathak, J. Rice, R. Richels, S.J. Smith, D.I. Stern, F.L. Toth, and P. Zhou, 2014: Drivers, Trends and Mitigation. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom
3 Country reported data