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Sezione I

Pianificazione di sistema ed economica, Innovazione e ricerca, sviluppo di nuovi modelli di servizio nel SSN

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"Policy of health co-benefits of climate change mitigation"

Coordinator: Prof. Paolo Vineis

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EXECUTIVE SUMMARY

The sixth report of the United Nations' Intergovernmental Panel on Climate Change (IPCC), the main international body for the assessment of scientific evidence, clearly shows a worsening of climate change and related phenomena. The report emphasises the urgent need for action to reverse the current, largely unchallenged trend of emitting greenhouse gases. Moreover, for years (at least since the Conference of Parties, COP 21, Paris 2015) the close connections between health and climate change have been highlighted, which have several ramifications. On the one hand, climate change directly and increasingly affects the health of Italians (through heat waves, periodic floods, droughts that reduce agricultural productivity, the spread of new infectious diseases). On the other hand, the prevention of chronic diseases requires multiple interventions, some of which can help mitigate climate change, through the so-called *co-benefit* policy.

This issue had already been addressed by a Working Group (WG) of Section I of the Healthcare High Council (Consiglio Superiore di Sanità, CSS) in 2019, which gave rise to the document *'The convergence of chronic disease prevention and climate change mitigation goals: a contribution to the National Prevention Plan'*, intended as a commentary and supplement to the National Prevention Plan (PNP).

In the light of the new acquisitions of the last 3 years, which include the COP25 and 26 resolutions, the production of an Istisan Report by the Istituto Superiore di Sanità (by a Working Group coordinated by prof. P. Vineis), the publication of an issue of Lancet Countdown, which includes data on Italy and a related commentary in *Lancet Planetary Health*, and, finally, the entry into force of the National Prevention Plan 2020-2025, the CSS, and specifically Section I in charge of the subject, deemed it appropriate to set up a new Working Group with the aim of pursuing the following objectives

- Assessing up-to-date data on the impact of climate change on the health of Italians;
- Analysing the National Prevention Plan in relation to co-benefit policies;
- Propose concrete short- and long-term solutions to implement effective policies based on co-benefits, in the areas of food, agriculture, energy, transport and urban planning, with reference to similar policies initiated in other European countries;
- Identify stakeholders relevant to these policies and propose models for dialogue and consultation;
- Anticipating the medium- and long-term implications of climate change on the National Health Service;
- Estimate the contribution the NHS can make to climate mitigation and initiate a 'zero emissions' pathway for the NHS;
- Estimate the resources needed, in light of the current meagre funding for prevention in Italy and the objectives of the PNRR;
- **Offer a contribution from the Ministry of Health to the Italian delegation that will participate in the COP 27 meeting** (Sharm El-Sheikh, Egypt, 7-18 November 2022), i.e. the countries that have ratified the United Nations Framework Convention on Climate Change (UNFCCC).

It is worth remembering that the Convention is an international environmental treaty that was signed during the United Nations Conference on Environment and Development (UNCED), informally known as the Earth Summit, held in Rio de Janeiro in 1992. The treaty aimed to reduce greenhouse gas emissions, already recognised as a likely cause of global warming. The treaty did not set mandatory limits on greenhouse gas emissions but provided for protocols that would set mandatory limits on emissions, the main one being the Kyoto Protocol. For almost three decades, the UN has brought together almost all the countries of the earth for global climate summits (COPs) and, since then, climate change has been transformed from a marginal issue to a global priority.

Climate change is already affecting the health of Italians: between 2010 and 2020, there was an annual average of almost 100 million more person-days of exposure to heatwaves than between 1986 and 2005,

and heatwaves carry a quantifiable burden of mortality and morbidity in Italy each summer; at least 2-3% of the total deaths observed in 2015 were attributable to heat exposure *(1)*. The continued use of fossil fuels still contributes to high concentrations of air pollution, leading Italy to have the second highest number of deaths attributable to PM2.5 exposure in the EU in 2019 *(2)*. In 2020, twice as much of the earth's surface was affected by at least one month of drought compared to 1950, putting food and water security at risk; and changes in climatic conditions are affecting ecosystems and biodiversity. Regarding the food system, greenhouse gas emissions from the consumption of animal products accounted for 82% of all emissions from agricultural products used in Italy in 2018. Lancet Countdown estimation models show how excess consumption of red meat may have contributed to mortality from chronic diseases in Italy *(1)*. Zoonoses, i.e. infectious diseases transmitted from animals to humans - caused by bacteria, viruses, parasites or prions -, are a category of pathologies strongly influenced by climate change. We are faced with the real risk of the re-emergence of previously endemic agents (such as tick-borne encephalopathies, Lyme disease, Mediterranean fever and West Nile fever) or the arrival of vector-borne tropical diseases (such as Dengue, Chikungunya, Zika), as well as animal diseases such as bluetongue and lumpy skin disease. In Italy, Chikungunya has recently caused relatively large outbreaks in several areas (*3)*. According to the Internal Displacement Monitoring Centre (USA), in 2018, 17.2 million people around the world fled their homes due to climate-induced disasters - floods, storms, cyclones, droughts, among others - while remaining within their country's borders. By 2050, climate change is expected to displace 200-250 million people, affecting about 3% of the population of sub-Saharan Africa, South Asia and Latin America. This means that one out of every forty-five people in the world could be a climate migrant in the future (4*)*.

With this document we aim to contribute to orientate health policies related to Italy's commitment to COP27. The document has been prepared in collaboration with the Ministry of Ecological Transition and is addressed to the Minister of Health, with the involvement of the Ministry of Foreign Affairs.

In this context, the document drawn up by the CSS represents an effective and proactive contribution to the Italian position that will be upheld on the institutional tables of the EU and the United Nations, since it is now incontrovertible that action must be taken to curb the serious climate emergency, which envisages a 55% reduction in CO_2 emissions by 2030 and net zero in 2050.

Having established that climate change is primarily combated through energy choices, limiting the use of fossil fuels and promoting renewables and energy savings, a very effective but so far little considered tool is the implementation of actions that mitigate climate change and, at the same time, prevent diseases, i.e. the so-called **co-benefit policy**.

The convergence of climate change mitigation and disease prevention policies can lead to enormous benefits, including economic ones. An important reduction (up to 30-40%) (5, 6) in the incidence of chronic diseases (cancer, diabetes, cardiovascular, respiratory and neurological diseases) can be achieved by preventive policies implemented outside the health system (food, transport, agriculture). Although the literature also speaks of co-benefits from climate change adaptation measures, e.g. saving deaths from *early warning of* extreme weather events, this paper is limited to mitigation.

Financing these policies through the relevant ministries would lead to large savings in the health service and would have a very positive impact on reducing social inequalities. Moreover, **these policies would also have a positive impact on climate change**, since the same risk factors that act on chronic diseases are agents of climate change. Keeping the health effects in mind is very important for the choice of mitigation actions to be put in place (7). For example, many pollutant compounds released into the atmosphere that contribute to climate change have health consequences**. If mitigation policies were to focus exclusively on carbon dioxide (e.g. through the solution defined as Carbon Capture and Storage), the positive health effects of a broader spectrum action would be lost** (8). Hence the importance of **investing in renewable energies even before investing in greenhouse gas absorption technologies;** this

investment represents a great opportunity for Italy, given its strong background of technological innovation, small and medium-sized companies and innovative start-ups, and its dependence on foreign countries for non-renewable sources.

It is very important to consider the economic aspects of environmental sustainability. The simple calculation of changes in GDP is very limited as it is calculated without including sustainability depreciation costs and external diseconomies. In other words, if GDP grows - for example - due to the sale of one million more cars, the **sustainability debt** combined with the energy and carbon footprint of car production, which is essentially passed on to the next generations, is not considered in the calculation. **A low-impact, high-sustainability circular economy corresponds to a significantly better overall calculation, also in terms of health gains, to appreciate which would require aligning traditional economic estimates with longer-term estimates and indicators capable of accounting for these benefits. This is why a policy aimed at co-benefits needs full collaboration between the different ministries (Health, Ecological Transition, Sustainable Infrastructures & Mobility, Economy & Finance), for which this paper intends to lay the foundations.**

(1) Vineis P, Romanello M, Michelozzi P, Martuzzi M Health co-benefits of climate change action in Italy. Lancet Planet Health. 2022 Apr;6(4): e293-e294. doi: 10.1016/S2542-5196(22)00061-4.
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(4) Silenzi A, Marotta C, Sa Machado R, Severoni S, Rezza G. Climate change, human migration and health nexus: what do we know about public health implications? 2022. Epidemiology and Prevention (in publication

(5) https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases; Vineis and Wild; 2015

(6) Vineis P, Wild CP. Global cancer patterns: causes and prevention. Lancet. 2014 Feb 8;383(9916):549-57

(7) Thurston GD, De Matteis S, Murray K, Scheelbeek P, Scovronick N, Budolfson M, Spears D, Vineis P. Maximizing the Public Health Benefits from Climate Action. Environ Sci Technol. 2018 Apr 3;52(7):3852-3853.

(8) There are numerous compounds released into the atmosphere that contribute to climate change: carbon dioxide (CO2), elemental carbon, nitrogen oxides and fluorinated gases (to name a few), some of which also have health consequences. If mitigation policies were to focus solely on carbon dioxide, the health benefits of broader action would be lost. A policy based solely on CO2 (carbon capture and storage, CCS) would not be accompanied by the full benefits of eliminating other contaminants from the combustion of coal and petroleum derivatives, including particulate matter, polycyclic aromatic hydrocarbons, heavy metals and others.

Preface: The New Cities (by Stefano Boeri)

As human beings today, we are experiencing an epochal change, in terms of geopolitics, climate, international relations, social transformations. With the outbreak of the Covid-19 pandemic, we have gained an undeniable - and irreversible - awareness of the fragility of our species.
At the same time, the climate and environmental crisis poses a dramatic contradiction. The human species, one of the last to inhabit the Earth, occupies a tiny space - just over 3 per cent of the Earth's entire surface - but has already consumed 75 per cent of the planet's natural resources, with very serious damage to all other living species and to itself.
This implies an urgent critical rethinking of the role of the human species on the planet and the current anthropic impact on the environment, to prevent the environmental crisis from becoming an uncontrollable accelerator of social inequalities and health crises. The challenge is to understand how this necessary change is not an act of renunciation, but a chance to improve the quality of the environment, the health of the population, the economy of the territories, as well as to generate new businesses, multiply forms of creativity, and produce new tools for economic growth and social equity. It is precisely the convergence of objectives, the policy of co-benefits, that must become the driving force of an urgent and unavoidable conversion.

It is therefore necessary to intervene on the condition of contemporary cities that will increasingly become the habitat of the human species, also in the perspective of the massive phenomenon of urbanisation underway in developing countries, changing the logic of urban life at its roots. This means first of all rethinking the relationship between the density of spaces in the city and the intensity of the functions within it, favouring the criteria of proximity, equity and accessibility over the entire urban extension: transforming neighbourhoods into 'urban villages' where every inhabitant can access retail trade, schools, cultural institutions, health services - precisely those decentralised services in the area that were dramatically lacking in the most aggressive period of the Covid-19 contagion - within a spatial radius of 500 metres and a 15/20 minute radius, on foot or by bicycle. This is a drastic transformation, which would bring obvious benefits for the environment and public health, and would significantly reduce private road mobility.

Connected to this is a second important issue, related to mobility: redesigning the street sections within the 'urban boroughs' to make room for *dehors*, pedestrians and bicycle lanes, with driveway access for residents only. The roads around the boroughs could be used for public surface transport and the traffic of private, increasingly electric cars.
Precisely on the subject of energy - an essential aspect for tackling the environmental crisis as well as reducing health risks - we had presented with Jeremy Rifkin in 2008 for the "Architecture Biennale" the idea of transforming buildings from CO2 producers into renewable energy collectors, self-sufficient in terms of energy.
The first step in this direction is the transition to new forms of heat exchange (e.g. with sewerage or datacentres), with the aim of replacing the more than four million degraded, energy-guzzling, obsolete buildings with which Italy is riddled, with sustainable, energy self-sufficient architecture suited to new housing needs. This an important part of our economy, as well as improving the air we breathe in cities - drastically reducing emissions of pollutants that cause millions of deaths every year.
Finally, in addition to reducing CO2 and particulate emissions, the last necessary challenge is to reduce what has already been emitted. And in this direction, the only technology at our disposal is trees: implementing urban forestation strategies, in all its forms - multiplying ecological corridors and urban greenery in the courtyards, on the façades and roofs of buildings - helps to clean the air we breathe, but also to shade public areas by regulating the microclimate, thus alleviating the pressure of heat waves responsible for a high mortality rate.

It also plays a fundamental role in implementing and multiplying the biodiversity of species, which is of great value in terms of developing immune defences, guaranteeing that ecosystem balance that is fundamental to preserving public health.

All these individual actions are indispensable, but it is even more indispensable to promote them simultaneously if we want to have even the slightest positive impact on the health of the planet and our species. And while it is necessary for individual actions to open up new possibilities, it is just as important to implement a policy that involves states, national and regional governments, urban and metropolitan municipalities, the big companies of the digital revolution and multinational energy companies, private stakeholders and financial centres all over the world, and to bring together the proposals of researchers and scientists active in different fields and in different parts of the planet.

1. Co-benefit policy: introduction

There is a clear need for action to curb the serious climate emergency. Climate change mitigation is mainly pursued by limiting the use of fossil fuels and promoting renewable sources, through policies in different sectors (industry, food, transport, agriculture). A very effective tool to promote the adoption of such policies is also the so-called **co-benefits** policy. The convergence of climate change mitigation and disease prevention policies can lead to enormous benefits, including economic ones.
A major reduction (up to 30-40%) (1, 2) in the incidence of chronic diseases (cancer, diabetes, cardiovascular, respiratory and neurological diseases) can be achieved by preventive policies implemented outside the health system, e.g. by improving air quality in the urban environment, promoting active mobility, improving diet. Funding these policies through the relevant ministries would lead to large savings in the health service and would have a very positive impact on reducing social inequalities. Many of these policies would also have an impact on climate change, since the same risk factors that act on chronic diseases are agents of climate change.
Investing in chronic disease prevention, in other words, tends to enhance climate change mitigation. On the other hand, some policies that aim at mitigation can have important positive effects on health. For example, there are numerous pollutant compounds released into the atmosphere that contribute to climate change and also have health consequences. If mitigation policies were to focus solely on carbon capture and storage, the health benefits of broader action would be lost. **Keeping health effects in mind is therefore very important when choosing which mitigation actions to put in place** (3), hence the importance of investing in renewable energy and not only in greenhouse gas absorption technologies. This investment is **a great opportunity for Italy**, given its strong background of technological innovation, small and medium-sized companies and innovative start-ups, and its dependence on foreign countries for non-renewable sources. Italy can also play a key role in the Mediterranean basin.
Let us assume that the package of measures proposed by the European Commission *fit for 55*, which are very similar to those of the International Energy Agency (IEA) and the International Renewable Energies Agency (IRENA), are actually followed in Europe. The goal is to reach net zero emissions (as an increase compared to 1990) in 2050, and minus 55 per cent by 2030 (in eight years' time, i.e. an average reduction of 7 per cent per year). *Fit for 55* and the IEA guidelines hardly mention health, yet decarbonisation will certainly have positive effects on health as well. A British study (4) attempted to estimate these effects by running three scenarios, one of *business as usual*, one of meeting the *fit for 55* targets and one enriched with a health component, which we will call the 'co-benefit scenario'. The study examined the energy, food production and transport sectors in 9 different countries around the world and the related reforms that should lead to greenhouse gas reductions. According to the scenario geared towards compliance with the Paris Treaty, but without a specific focus on health, there would be a reduction of 1.18 million deaths by 2040 (in those nine countries) due to reduced air pollution, 5.86 million due to interventions in food production, and 1.15 million due to increased physical activity. In the scenario that also considers the implementation of interventions explicitly aimed at both climate change mitigation and disease prevention, there would be a further reduction of 462,000, 572,000 and 943,000 deaths, respectively.

Some estimates based on the Global Calculator

The Global Calculator tool developed by Imperial College and available online (5) allows one to estimate the temperature impact of various mitigation measures and to assess their relative importance. The calculator suggests several pathways compatible with keeping the temperature increase within 2 degrees by 2100 (with a 50-50 probability). The pathways take into account the projected increase in population, consumption, energy demand and increase in food production. Elsewhere (Vineis, article in preparation) we have calculated the different contribution of sectors in which mitigation policies can be implemented. The Global Calculator provides 40 'levers' that can be manoeuvred, each with 4 levels, from BAU (business

as usual) up to an extremely ambitious level. In our estimates, we take BAU as the reference level, and compare level 2 (moderately ambitious) with it. This exercise is carried out for each sector and taking 2030 or 2050 as the time horizon. The metric used is the percentage reduction in emissions for level 2 compared to level 1. Only for food level 1 cannot be used as a benchmark because it would be incompatible with population growth and increased need for food; therefore level 3 is used here. If all levers are set to 1 except food, emissions by 2030 would be 132.4 Gt CO2eq/year. If all levers are placed at 2, emissions decrease to 41.1. The same values in 2050 are 308.2 and 25.9 GtCO2eq/year.

Calculations (Vineis, in preparation) show the importance of fossil fuel and renewable energy measures, but also of food and agriculture. The fact that food and agriculture are so important is demonstrated by a simple example: a football pitch can be used to produce 250 kg of meat, 1,000 kg of poultry, or 15,000 kg of fruit and vegetables. Reducing meat consumption would have great benefits for both climate and health. If by 2050 everyone would adapt to the diet suggested by the World Health Organisation (2100 calories per day on average, of which 160 calories would come from meat), this would save 15 GtCO2eq/year, due to the space left free for forests and biomass (to be used as fuel), as well as reduced methane emissions from livestock. These concepts are also expressed in Figure 1.1 (below) (6).

The Global Calculator is an accurate, tried and tested tool, but it has some limitations: it takes 2011 as the base year, and was produced in 2015 (it is now being updated). It is therefore possible that some of the estimates in Table 1 are not entirely correct, especially for developing sectors such as Carbon Capture and Storage. Furthermore, the high weight assigned to food is largely dependent on the land consumption associated with projected population growth in the coming years, with the loss of natural *carbon sinks* and the expansion of agriculture and livestock farming. Only part of the role assigned to food is attributable to direct emissions of methane and other greenhouse gases by ruminants, while other components are land consumption, transport, etc.

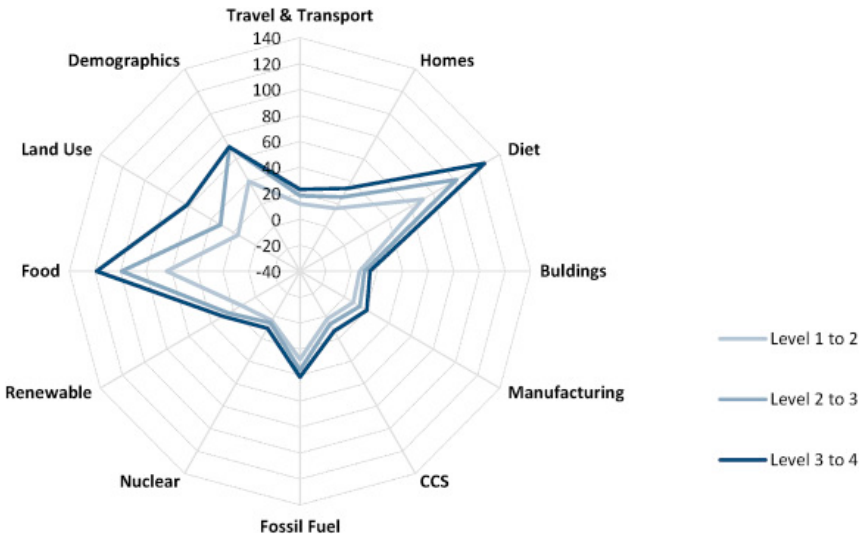

Figure 1.1 - from Strapasson et al, Modelling carbon mitigation pathways by 2050: Insights from the Global Calculator. Energy Strategy Reviews, Volume 29**, May 2020, 100494**

The Global Burden of Disease: which causes of death can benefit from climate change mitigation measures

Figure 1.2 below, taken from the Global Burden of Disease, a global quantitative exercise to monitor the evolution of causes of death and risk factors over time, shows which were the main preventable causes of death or risk factors in the world in 2019 (7).

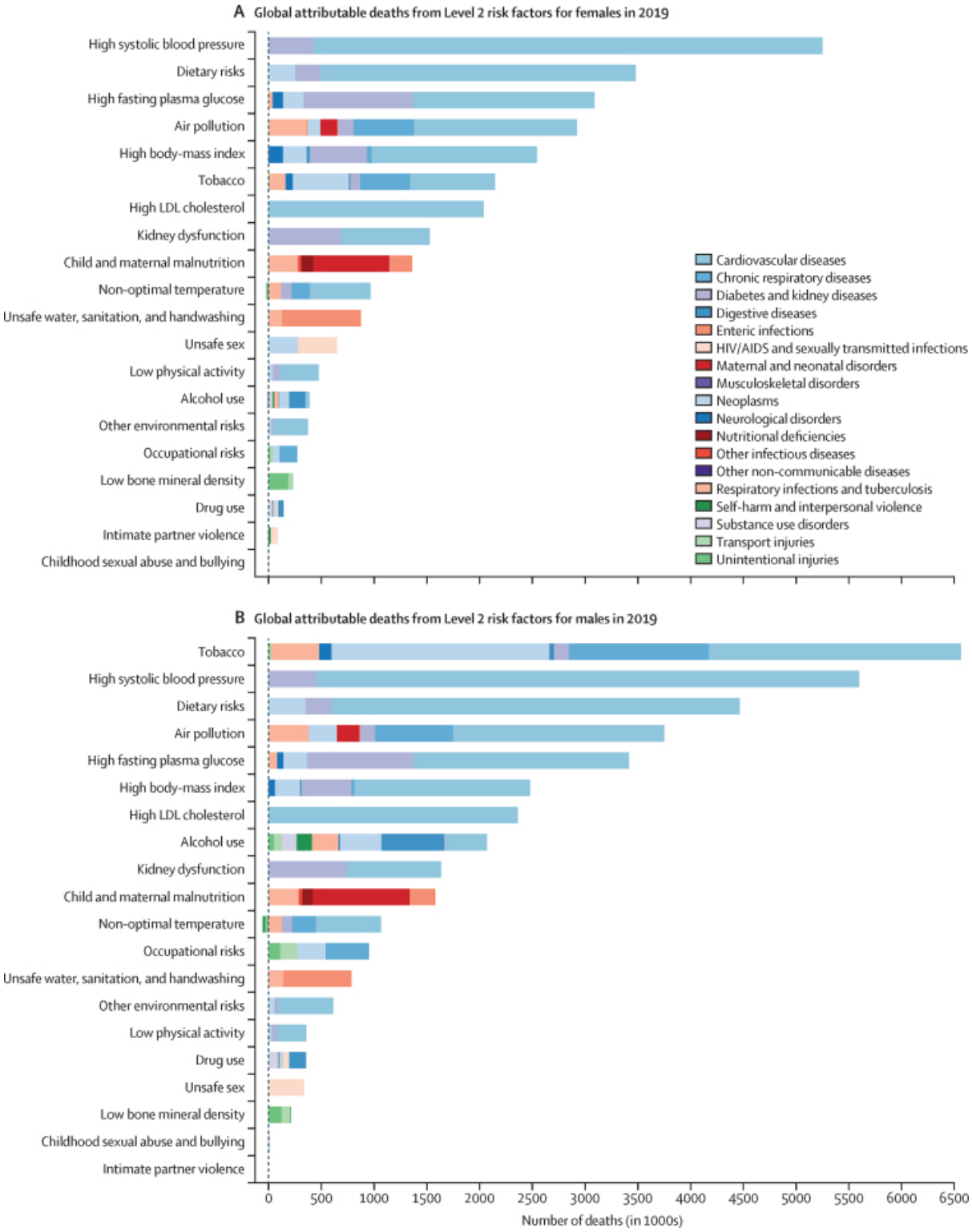

Figure 1.2.

If we exclude tobacco, many of the main risk factors in the figure are also the subject of climate mitigation policies: malnutrition, air pollution, dietary hazards, excess weight, some occupational hazards (e.g. from exposure to high temperatures), low physical activity and poor availability of clean water. High blood pressure itself in some areas of the world is linked to the salinisation of drinking water as a consequence of climate change. The application of the co-benefits policy, therefore, could lead to the identification of actions that maximise gains in combined mitigation and primary prevention. Tobacco, although a volatile exposure, is not exempt from effects on greenhouse gas emissions and water consumption in cultivation: emission data has been published by Philip Morris, for example, and 4.5 tonnes of CO2eq were emitted for one year for this producer alone (8). The use of land for tobacco plantations is also not insignificant at a time when land for cultivation competes with the extent of forests. Tobacco production is, in fact, one of the most impactful and least sustainable agricultural activities. This is particularly true for low-income countries where production is very high, but also - albeit to a lesser extent - for Italy, which is Europe's largest producer. For this reason, the co-benefit policy may also apply, to an extent to be assessed, to tobacco consumption.

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2. Data on the impact of climate change on the health of Italians

As a result of constant greenhouse gas emissions, the world is 1.2°C warmer than in pre-industrial times, and almost all of the last few years have been the hottest in history since measurements were taken. These changes are already having profound effects on the health determinants of the planet's inhabitants including Italians, with more frequent extreme events, including fires, heat waves, rising sea levels and the spread of infectious diseases. We are only 8 years away from the first deadline of Fit for 55, when we should have cut emissions by 55%, but the trajectory does not seem to be going in that direction; the current trend seems to be taking us to levels of 2-3 degrees increase by the end of the century, with much more serious consequences than we are already seeing. *All the agencies dealing with the subject insist that a single solution is insufficient, and investment is needed on multiple fronts, including finance to support the green economy in all its manifestations.* Italy in particular is at high risk due to its high proportion of elderly people, geographical location, high population density and consequent high ecological footprint (including hydro-geological vulnerability).
An ambitious climate change mitigation policy offers the opportunity for big dividends on the health side. According to Lancet Countdown, putting health at the centre of climate policy would save millions of lives worldwide in the coming years.

This chapter summarises observations on the impact of climate change on health in Italy, using indicators published by Lancet Countdown in 2021. *The Lancet Countdown: Tracking Progress on Health and Climate Change* is an international collaborative research project that aims to monitor the health dimension of climate change, based on a network of international experts and a system of indicators created for this purpose. Although data are provided globally, national data are also available, and are used in this chapter for Italy (17 indicators of the 44 collected by Lancet Countdown).

Climate change impacts, exposures and vulnerability

Heat waves and temperature increases (to which water crises and water rationing may be added in the future) tend to exacerbate pre-existing pathological conditions, which include cardio-vascular and respiratory diseases, diabetes, kidney disease, mental health and behavioural disorders (1, 2). The elderly, infants, pregnant women, outdoor workers, migrants and the socially deprived are particularly at risk, especially if they do not have access to refrigeration systems (2, 3).
Climate change is already affecting the health of Italians. Lancet Countdown indicator 1.1.2 (4) estimates the total number of days on which the elderly over 65 and children up to 1 year old were exposed to life-threatening heat waves, according to data from the World Meteorological Organization and other sources (5, 6). Heat waves were defined as a minimum two-day period with daily minimum and maximum temperatures above the 95th percentile of what was observed in 1986-2005.
Research results show a steady increase in person-days over 65 years of exposure to heat waves, with an annual average of almost 100 million more person-days in 2010-2020 compared to 1986-2005 (Figure 2.1). For children under 1 year, the estimate is 3.68 million more person-days in 2010-2020 compared to the reference period (Figure 2.1).

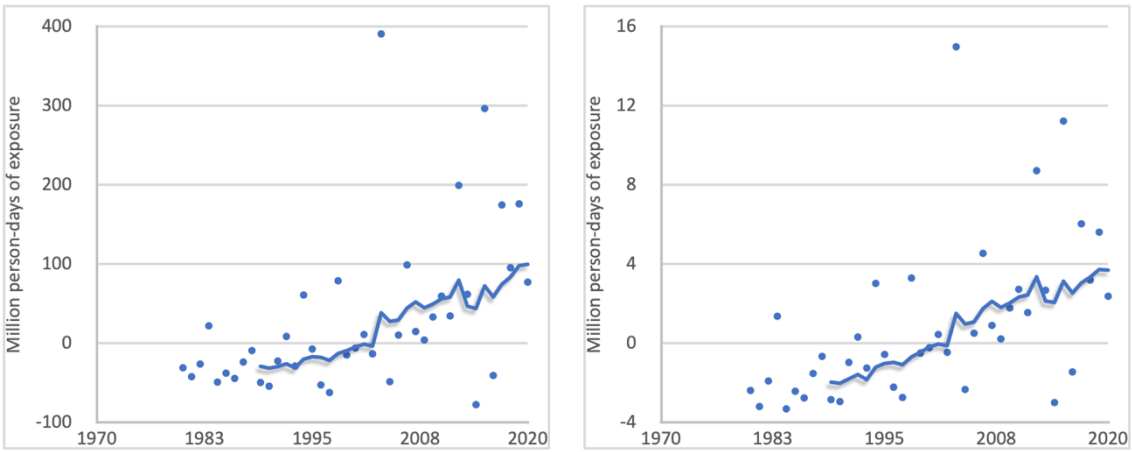

Figure 2.1. Change in the number of person-days of exposure to heat waves above 65 years of age (left) and below 1 year of age (right) compared to 1986-2005. The dots represent annual averages, the lines 10-year moving averages.

Lancet Countdown is now working on applying to Italy the heat wave definition used in the Health Heat Adaptation Plan (HHAP), which uses a finer resolution to more adequately capture geographical differences and impacts.

Drought

Climate change is responsible for an increase in the frequency, intensity and duration of drought episodes. These pose a threat to drinking water availability, sanitation, agricultural productivity, fire risk and exposure to pollutants (7,8). The Lancet Countdown indicator 1.2.2 (4) measures the percentage of the total area in Italy affected by at least one month of drought, defined according to the Standardised Precipitation-Evapotranspiration Index (SPEI). The SPEI captures changes in precipitation, and the effects of temperature on evaporation and soil moisture loss. An extreme drought is defined as SPEI ≤ -1.6, and an exceptional drought SPEI ≤ -2, according to the Federal Office of Meteorology and Climatology MeteoSwiss (9).

The area of Italy affected by drought has increased since the 1950s, with more rapid increases since 2000 (Figure 2.2). On average, in 2016-2020 an additional 41.6% of the area experienced at least one month of extreme drought, and 27.1% exceptional drought.

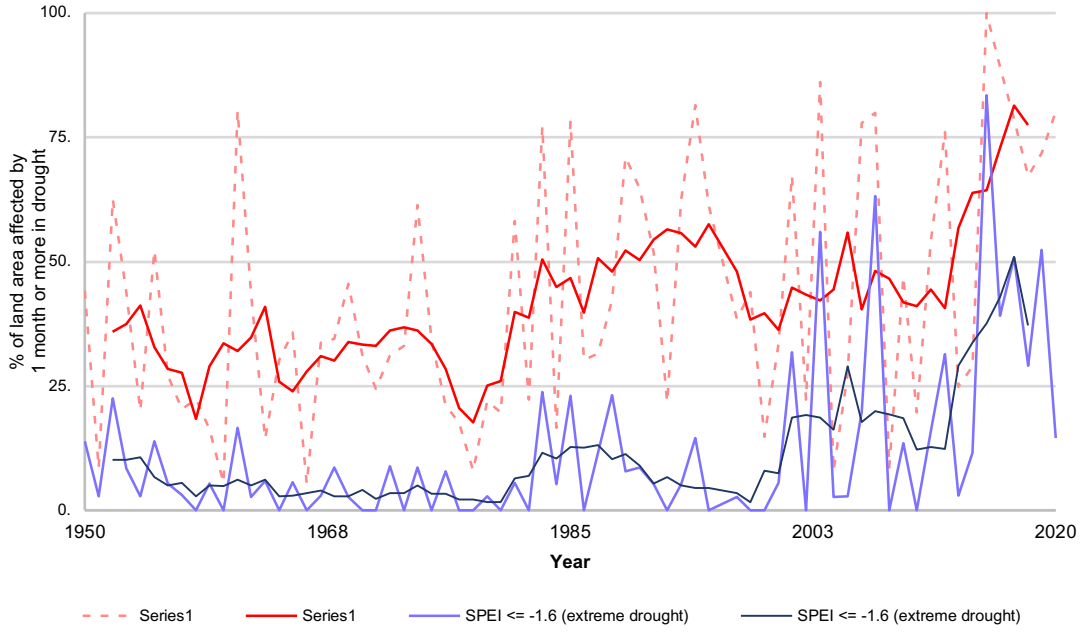

Figure 2.2. Percentage of land area affected by at least 1 month of severe (red) and extreme (blue) drought. The thin lines represent the percentage of land area affected in each year, the solid lines the 5-year moving averages.

This problem poses a particularly high risk for Italy, the second largest country in Europe, after Greece, in terms of volume of extraction for public water supply, with 153 m³ of water extracted per inhabitant in 2018 (10). In 2019, water shortages forced nine Italian cities to implement rationing measures (a scenario that is being repeated in 2022) (11). Together with the ageing infrastructure of the water and sewage network (60% were over 30 years old in 2016) (12), these problems may lead to a decline in the quantity and quality of water in the coming years, also jeopardising hygiene conditions and food safety, especially in the most vulnerable areas of the country.

Transmission of infectious diseases linked to climate change

Climate change also results in changes in the spread of infectious diseases transmitted by arthropods, food or water (13, 14). Cases of dengue, transmitted by the mosquitoes *Aedes aegypti* and *Aedes albopictus*, have doubled every decade since 1990, and climate change has been identified as a major cause of this increase (15, 16). This Lancet Countdown indicator, presented in the 2021 report (indicator 1.3.1) (4), uses a model that incorporates the influence of temperature and rainfall on the quantity and activity of vectors and superimposes it on human population density to estimate the baseline dengue reproduction number (R_0). The results indicate that R_0 for dengue transmitted by *Aedes albopictus* mosquitoes is relatively low in Italy (0.19 in 2020). However, the models suggest that as a consequence of increases in temperature and precipitation, R_0 increased by 31% in 2020, compared to the 1950-1954 average (Figure 2.3).

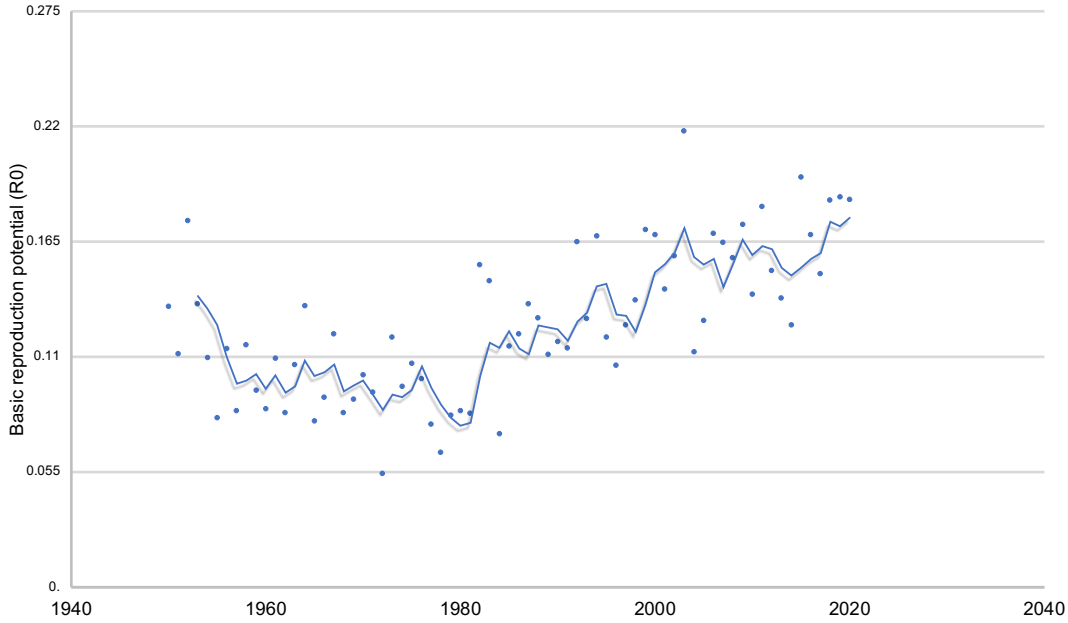

Figure 2.3. Estimates of the baseline reproduction number (R0) for dengue transmission by *A. albopictus* mosquitoes in Italy. The dots represent the total annual values, the lines the 5-year moving averages.

The greatest increase in R_0 was estimated for northern Italy, particularly in Friuli Venezia Giulia, Veneto and Lombardy. According to these projections, the first outbreak of indigenous dengue in Veneto was reported in 2020 (17). Moreover, with similar environmental niches, R_0 for Zika and Chikungunya are also likely to follow similar trends. Two outbreaks of Chikungunya were identified in Italy in 2007 and 2017 (18, 19). As these risks are likely to increase with increasing climate change, Italy must build an appropriate adaptation system, both in the short and long term. A national preparedness plan for arbovirus infections was launched in 2020 (20).

This section provided data on the fact that climate change is already endangering the health of Italians in various ways. The indicators we used in Lancet Countdown showed a worsening trend over the period considered. In addition to these, other Lancet Countdown indicators are relevant: a reduction in the number of hours worked due to heat, an increase in fires, changes in crop growth, and a rise in sea level (4). These results underline the need for more vigorous adaptation measures. The heterogeneity of geographical and climatic conditions across Italy implies that exposure and vulnerability to climate change vary considerably in different regions. Adaptation measures need to be diversified with strong central coordination. Lancet Countdown and DEP Lazio are working to produce temperature-related mortality indicators with a fine resolution and identify areas at greatest risk.

Mitigation activities and health co-benefits

In Italy, greenhouse gas emissions decreased from 519 to 418 $MtCO_2$ equivalents between 1990 and 2019, for a total decrease of 19.5% (21). Despite this moderate progress, Italy would need to reduce greenhouse gases by 17 $MtCO_2$ eq (million tonnes) per year from 2020 to reach the EU target of 55% reduction by 2030, followed by a reduction of 12Mt per year over the next twenty years to reach the EU target of 2050 (net zero). It is worrying to note that Italy is not currently in line with these targets, since the trend of decrease has flattened out in recent years (4), with a cut of only 1Mt per year between 2015 and 2019. The COVID-19 restrictions allowed for a further 9% reduction in 2020 compared to 2019, but this change was transitory (22) and probably not significant in the long run (23). An acceleration towards decarbonisation may not only prevent the worst impacts of climate change, but also have a positive effect on the health of

Italians. The indicators in this section, taken from Lancet Countdown, attempt to track progress in Italy in different sectors, with a reference to co-benefits.

Energy system and health

With the speed of decarbonisation observed between 2015 and 2020, it will take 79 years from 2020 to make the entire system neutral. The situation has worsened recently due to the war in Ukraine. After rapid initial growth, the shift to renewables stalled until 2022, in 2019 accounting for only 17% of all electricity generated.

The combustion of fossil fuels in the energy production system is the single most important source of greenhouse gas emissions, accounting for 65% of all emissions (24). A rapid transition to renewable sources is therefore crucial, not least to prevent fossil fuel emissions.

Lancet Countdown indicator 3.1 (4), based on data from the International Energy Agency (IEA), monitors three components: the carbon intensity of the energy system in Italy; the reduction of coal consumption; and the production of electricity from renewables (solar, wind, geothermal, tidal and wave energy).

The carbon intensity of Italy's energy system declined slowly, reaching its lowest level since 1970 in 2019, a 25 per cent reduction from that year. However, with the speed of decarbonisation observed between 2015 (the year the Paris Agreement was signed) and 2020, it will take 79 years from 2020 to decarbonise the entire system. The situation has worsened recently due to the war in Ukraine. After rapid initial growth, the shift to new renewables (excluding hydropower) stalled until 2022, accounting for only 17% of all electricity generated in 2019. In contrast, in recent years Italy has made good progress in reducing the use of coal: in 2015, 16% of energy was produced from this source, and this figure dropped to 6% in 2019 (Figure 2.4). But much remains to be done. In particular, much of the energy previously produced from coal was in 2015-2019 produced using natural gas, which in 2019 accounted for 49% of all energy produced (39% in 2015).

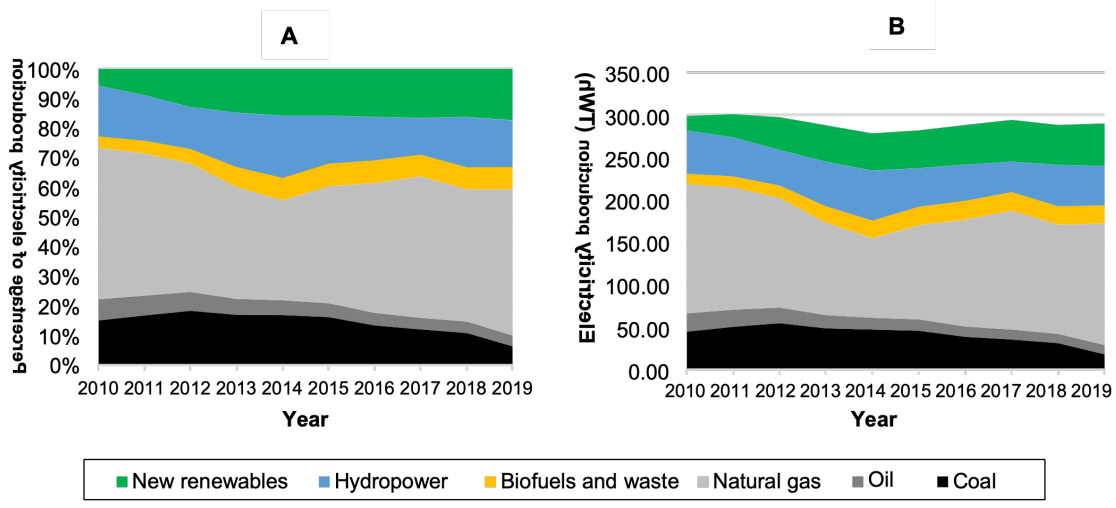

Figure 2.4. Electricity production in Italy, by source, from 2010 to 2019, presented as a percentage of total electricity produced (A) and as total electricity produced in terawatt-hours (B). From International Energy Agency

Sustainable transport

With road transport accounting for 25 per cent of global CO2 emissions in Italy in 2019, the transition to electric vehicles is an important mitigation and health protection measure (25). Promoting walking and cycling (active transport) not only reduces greenhouse gas emissions, but also produces huge health dividends through increased physical activity and reduced pollution (26). Lancet Countdown indicator 3.4

(4) uses data from the IEA and the Italian Ministry of Transport (now Mims, Ministry of Infrastructure and Sustainable Mobility) to monitor fuels used for road transport and electric cars (27-29).
The carbon intensity of road transport has remained stable in Italy since 1990 (Figure 2.5). While energy used for road transport has seen a decrease since 2006, this is probably a side effect of the reduction in road freight transport (45% less in 2018 than in 2005). In contrast, car traffic was 38% higher in 2018 than in 1990 and still accounts for 87% of all road passenger transport.
Italy's strategy to reach the net-zero target includes electric mobility with the goal of reaching 19 million Battery Electric Vehicles (BEVs) in 2050, or 80% of the entire car fleet, and 4 million hydrogen cars, or 17% of the total (23). However, in 2017, electric cars accounted for only 0.026% of all energy used for road transport (Figure 2.6). Fossil fuels still largely dominate road transport (96% of all energy used in it, Figure 6).
The transition from fossil fuels in road transport would not only lead to a reduction in greenhouse gases but also to health benefits, including a reduction in air pollution.

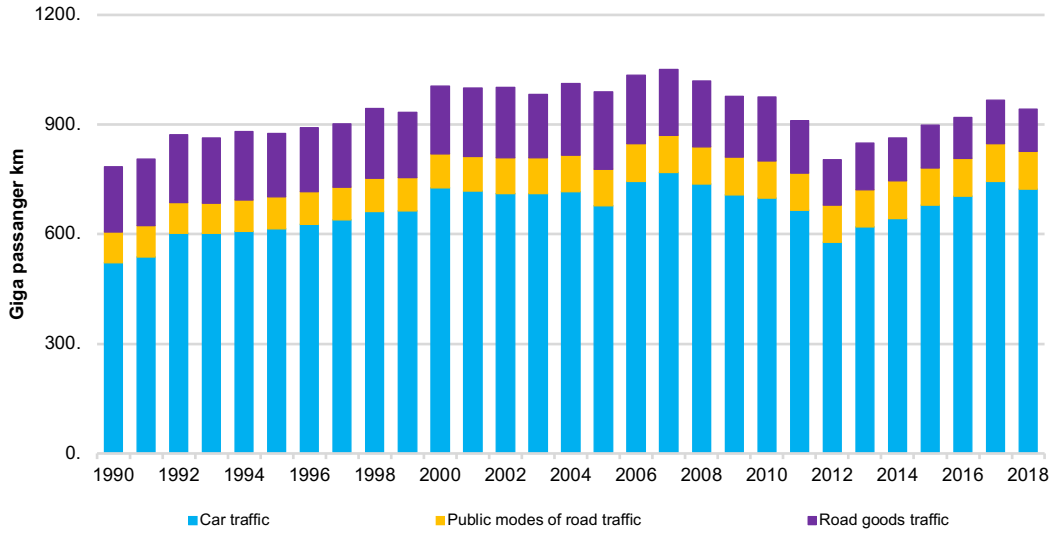

Figure 2.5. Road transport in Italy: passengers and goods. The bars represent travel distances of passengers or goods, using cars or public transport. Based on data from the Ministry of Transport and ISTAT.

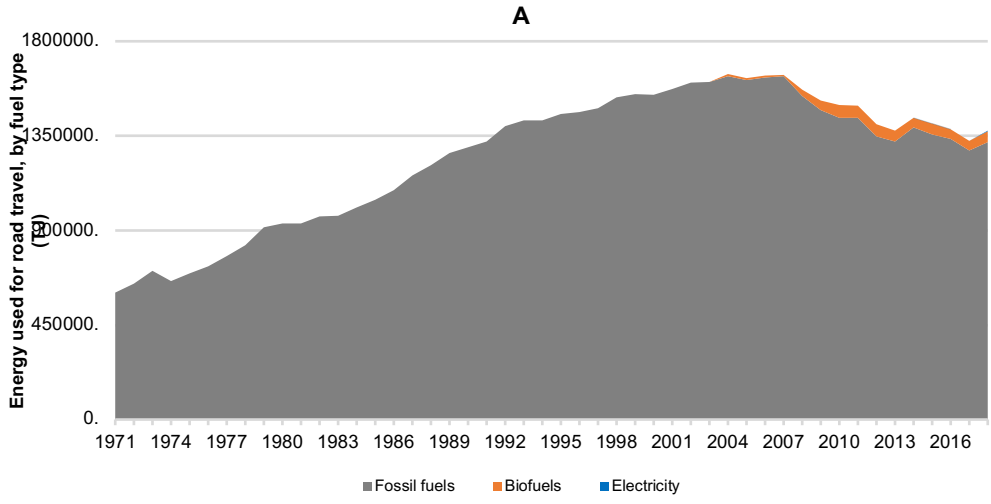

Figure 2.6: Energy used for road transport: fossil fuels and biomass (electric cars: 0.026%, not visible) in Italy.

Emissions from agricultural activities

The food system, including agricultural production, is responsible for 21-37% (depending on estimates) of all greenhouse gas emissions, but at the same time offers great potential for carbon sequestration (30). These characteristics make it one of the key factors in limiting emissions and containing temperature rise.

Lancet Countdown indicator 3.5.1 (4) monitors emissions from the consumption of agricultural products, modelling emissions from each product and taking into account sales and trade data produced by the Food and Agriculture Organisation of the United Nations (FAO) (31).

Data from this indicator show that per capita GHG emissions resulting from the consumption of agricultural products in Italy decreased by 27% in 2018 compared to 2000 (Figure 2.7). This was mainly due to a 34% decrease in emissions related to meat and dairy products. However, emissions related to animal products still contributed 82% of all emissions from agriculture in 2018, with the largest contribution from cattle (74%). In the absence of action to increase the efficiency of meat production to reduce greenhouse gas emissions, the only way forward is a drastic substitution of animal-derived foods with plant-derived foods. This measure would also save thousands of lives per year in Italy linked to excessive red meat consumption (32).

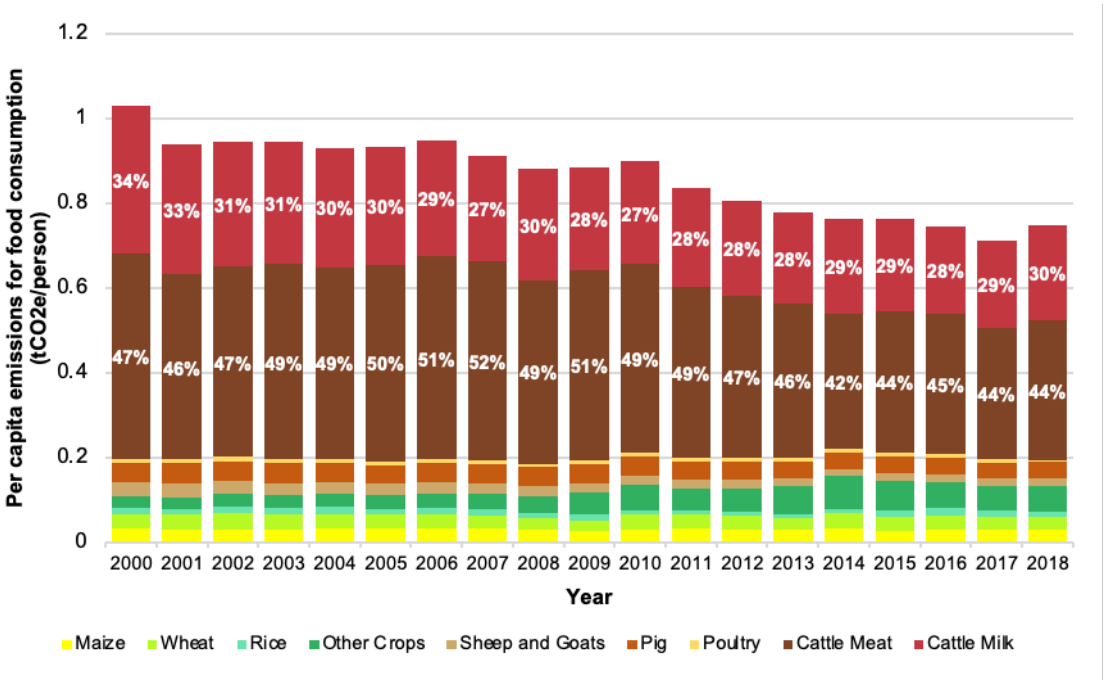

Figure 2.7. Per capita greenhouse gas emissions per year in Italy (in percent), associated with the consumption of agricultural products, by type of food.

Nutrition and health co-benefits

As the previous indicator showed, the consumption of foods of animal origin, particularly red meat, is a major source of greenhouse gas emissions in Italy. Another Lancet Countdown indicator modelled the number of deaths attributable to red meat consumption by linking consumption information derived from the FAO to previously published estimates of relative risks. Using this approach, we estimated that about 17,000 deaths, or 15% of all food-related deaths, were attributable to excessive red meat consumption in Italy in 2018. This makes Italy the second highest country for mortality attributable to red meat consumption in Europe, after Germany (Lancet Countdown estimates). A previous study in Italy assessed the health co-benefits and emission reductions from changes in eating styles (54). Considering different scenarios of reduced red meat consumption, approximately 4% of colon rectal cancers and deaths from

cardiovascular disease would be avoided - with some geographical heterogeneity - while there would be a decrease in greenhouse gas emissions in the range of 8000- 14000 Gg CO_2 eq per year (32).

Emissions from the health system

The health sector is central to improving human development. In providing essential services, it mobilises a wide range of resources, raw materials, manufactured goods, specialised products, medicines and uses energy in various forms, all of which result in the emission of greenhouse gases and other pollutants. The waste generated by the health sector also requires costly and impactful disposal.

Lancet Countdown indicator 3.6 (4), tracks both direct and indirect emissions from the health sector as a whole, using input-output models, combined with annual health expenditure data from the WHO. Italy is among the countries with the highest quality of health care, as measured by access and quality indicators - and is also one of the countries with the lowest GHG emissions from the health sector when compared to other countries with similar quality levels. This reflects an effective use of resources in the health sector. However, the Italian healthcare sector has made no progress in further curbing its emissions, remaining stable (in terms of per capita emissions) since 2005, at 449 kgCO_2 eq per inhabitant (Figure 2.8).

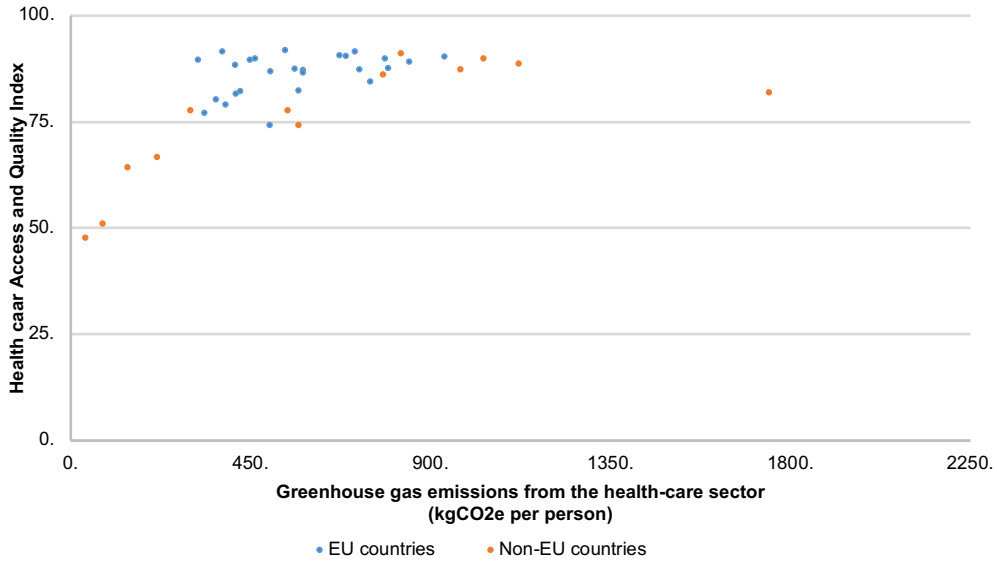

Figure 2.8. National per capita emissions from the health sector (2017) compared with the HAQ (2015). From 2020 Lancet Countdown report. Each circle represents a country.

Conclusions

Although Italy has made progress in reducing emissions since 1990, all indicators used in this chapter show that the rate of reduction is insufficient to meet the Paris agreement. At present, 6 per cent of the energy produced in Italy still comes from coal, and a much larger share - as the current energy crisis shows - from gas, while oil derivatives such as diesel and petrol largely dominate road transport. In turn, food production of animal origin makes a significant contribution to the greenhouse gases emitted by agriculture. On the one hand, therefore, accelerating decarbonisation through a rapid replacement of fossil fuels with renewable sources offers the possibility of planning a more sustainable and secure future, but also brings immediate health benefits for Italians through cleaner air; on the other hand, more physical activity and healthier low-carbon diets offer additional benefits both in terms of health and further progress towards the EU decarbonisation targets of 2030 and 2050.

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3. Climate change, human migration and health: what implications for public health?

Since the dawn of humanity, migration has been a necessary and strategic adaptive response to the risks that nature and the environment posed to the existence of individuals and communities. Political and economic crises, conflicts, globalisation, socio-economic inequalities, innovations in mobility and communication, together with demographic changes, have become the main drivers of modern and contemporary migration. Recently, anthropogenic climate change is influencing the scope and patterns of human mobility (1), not only as a driver of migration, but also interacting with and amplifying the effects of the very determinants of migration, including the determinants of health (2).

According to the Internal Displacement Monitoring Centre (3), in 2018, 17.2 million people fled their homes due to climate-induced disasters (e.g. floods, storms, cyclones, droughts) while remaining within their country's borders. By 2050, climate change is expected to displace 200-250 million people, affecting about 3% of the population of sub-Saharan Africa, South Asia and Latin America. (4). This means that in the future, one out of every forty-five people in the world could be a migrant due to climate change.

The pace of migration can be gradual, when it is generated by slow processes such as rising sea levels, salinisation of agricultural land, desertification, drought, famine and increasing water scarcity; or sudden, during and after high-impact, life-threatening climatic events such as floods, cyclones and storms (5). In addition, non-climatic factors, such as government policies, population growth and the resilience of communities to natural hazards, also play a key role in mobility patterns (6). These factors can influence the level of vulnerability people experience and can also lead to various migration responses to climate change, such as forced displacement due to climate-related civil conflicts, planned resettlement and labour migration for climate change adaptation initiatives. Different migration scenarios can have different health consequences for people on the move at all stages of the migration journey, as well as for communities of origin, transit and destination (7, 8).

The ability to migrate is a function of willingness and resources, both financial and social: the people most vulnerable to climate change are not necessarily those most likely to migrate (so-called trapped populations). It is therefore crucial to address the health of climate-related migrants and the health of people migrating or staying in sites with climate-related health risks.

Over the past decade, the social and health policy landscape has referred several times to climate, migration and health issues, most notably in the Sustainable Development Goals (SDGs) (9), the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) (10), the Global Compact on Refugees (11), the Global Compact on Migration (12) and the WHO Global Plan of Action on Refugee and Migrant Health 2019-2023 (13).

Implications for public health

Although much progress has been made in recent years through studies on the topics of climate change, health and migration, focusing in particular on the relationships existing in the binomials 'climate change and migration' and 'climate change and health', little attention has been paid to the relationships between climate change, migration and health (14). There is thus little empirical research on this triad, with limited results of a global nature (15).

Available evidence investigating various health problems (15, 16) associated with migration in the context of climate change may include changing patterns of transmission of infectious diseases and their risks (17),

such as increased incidence of water-borne diseases (e.g. cholera, typhoid) due to increased flooding; increased cases of malnutrition (18) due to salinisation and pollution of soil and drinking water, land degradation, reduced crop viability, desertification and other slowly but steadily evolving consequences; trauma and injury (15) due to extreme weather events; changing patterns of non-communicable diseases (19), as severe respiratory conditions may be more frequent due to increased air pollution; mental health impacts (20) due to safety and security issues. Migrants forced to flee quickly due to climatic events are also more vulnerable to exploitation, human trafficking and sexual and gender-based violence, lack of social ties, demographic pressure and, ultimately, difficulties in accessing health services (4, 8) due to weakened and overburdened health systems.

Moreover, the evidence suggests that climate change and structural inequalities are linked in a vicious spiral. Vulnerability and exposure to climate risks are inextricably linked to existing inequalities. Addressing the nexus and the implementation of mitigation and adaptation strategies is key to tackling rising health inequalities and climate-related inequalities. In particular, most climate-related mobility will occur in low-income countries and regions, where population health challenges already exist (21).
The ability to respond to the health effects of climate migration also depends on the availability of relevant and up-to-date data. Strengthening information systems, technologies and data analysis capacity is also crucial to explore the relationship between climate change and migration in order to propose effective interventions in terms of prevention and mitigation (8).

From global to local perspective: the Italian context

The WHO Global Plan of Action on Promoting the Health of Refugees and Migrants (22) proposes priorities and options for action that also apply to the relationship in the climate change-migration-health triad.
Preventing inequalities in the health status of refugees and migrants, guaranteeing their right to health, limiting discrimination or stigmatisation and removing obstacles to accessing health services are fundamental principles for all migrants, regardless of their reasons for migrating or their migration status.
At the global level, WHO's work on the climate change-migration-health nexus aims to intensify efforts to ensure climate-resilient (23) and migrant-inclusive health systems. In other words, climate solutions must integrate a health and migration approach.
WHO is in the process of defining its global research agenda, which is essential to ensure policy impact through the support of evidence-based decision-making, where the climate change-migration-health nexus has also been included in the priority themes. In addition, WHO is providing technical assistance to host countries and communities to provide assistance focused on people on the move, including those displaced by climate. The implementation of the WHO Global Standards (24), a set of competencies that can be incorporated into training and practice to help health workers provide culturally sensitive care to refugees and migrants, is critical to achieving a valuable health system.
In a country like Italy, composed of 20 regions where the climate is diverse and health outcomes are heterogeneous (including unjustified variations) (25), although the immediate threats posed by climate change differ from one area to another, these are already exacerbating the country's existing infrastructural deficiencies, industrial pollution and hydrogeological and seismic vulnerability. Although the National Climate Change Adaptation Strategy (NAS) (26) was adopted in 2015 with the aim of providing a common national pathway to address the effects of climate change on natural systems and socioeconomic sectors, there is still much work to be done in this direction. Indeed, Italy has the highest effects of heat on daily mortality in the international context, taking into account both hot temperatures and overall summer temperatures (27). In parallel, water scarcity is emerging as a major national threat.
In 2017, six Italian regions asked the government to declare a state of emergency due to water stress; in June 2022, the situation was even more serious, with drought conditions rapidly spreading across the

country as rivers and reservoirs dried up in several regions. Water shortages could reduce agricultural production, increase the risk of forest fires, end up causing desertification and negatively affect economic progress.

Climate change affects air quality, particularly in urban areas, and may cause changes in the spatial distribution of flora and fauna, reducing biodiversity. In addition, there is a real risk of re-emergence of previously endemic vector-borne diseases (such as tick-borne encephalopathies, Lyme disease, Mediterranean fever and West Nile fever) or the arrival of transmissible tropical diseases such as Dengue, Chikungunya, Zika, Crimean-Congo fever or Rift Valley fever, as well as animal diseases such as bluetongue and lumpy skin disease. In particular, Chikungunya has recently caused relatively large outbreaks in several areas of Italy (28). Although protection strategies have been strengthened, the risk has increased, especially due to the change in habitat of vectors (29). In this scenario, no one can rule out the possibility that these phenomena play a decisive role in exacerbating health problems or changing mobility within the country.
Moreover, Italy has historically been a destination country for several immigration flows via different migration routes, especially the Mediterranean route from Libya and Tunisia to Sicily, and the Balkan route on the border with Slovenia. In recent years, Italy has faced a surge of migrant and refugee arrivals via the Mediterranean route; in 2021, according to UNHCR, 67,477 people arrived by sea on Italian coasts, mainly at Sicilian entry points (30). It is possible that the consequences of climate change in sub-Saharan Africa are driving an increasing number of people to cross the sea to reach Europe, and Italy in particular. However, with the available data, it would be impossible to predict the precise numbers of arrivals of intercontinental migration driven by climate change.
To date, Italy is mobilising a major response in terms of sea rescue operations and internal migration management. The Ministry of Health and local authorities in Italy are currently dealing with public health issues related to migration. Of course, the Covid-19 pandemic has provided an opportunity to start working in this direction and, from a public health perspective, health surveillance at borders has been intensified (31). However, increasing pressures require the strengthening of critical areas such as *preparedness* and emergency response, inter-ministerial coordination and relations with regions and local authorities as well as aspects of the existing health information system.

Conclusions

Climate change, human migration and health must be considered as a single, complex issue, made up of many interconnected links. It involves a wide range of environmental, economic and social impacts on people's lives, culminating in individual decisions to migrate or not and all related aspects. It is crucial to provide clear evidence to policymakers, particularly in countries directly affected by climate-related migration, to promote effective interventions that can improve local living conditions. At the same time, from a global health and globalisation perspective, it is crucial to promote strong programmes at the international level, through both multilateral and bilateral partnerships, to strengthen health systems to protect migrants' health.
Indeed, a key to this emerging theme is the need to strengthen health systems to make them more climate resilient and inclusive for migrants. Moving towards 'climate resilient health systems' is a useful precautionary measure, as it aims to strengthen multiple programmatic and organisational aspects of health systems at national and sub-national levels, regardless of the extent to which climate-related migration might occur (15).

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4. The health system in the face of climate change: resilience and sustainability

Adaptation and resilience of the NHS

The World Health Organisation (WHO) defines a climate resilient health system as: *'a system capable of anticipating, responding to, coping with, recovering from and adapting to climate-related shocks and stresses, so as to bring lasting improvements to the health of the population, despite an unstable climate'* [WHO (World Health Organization), 2015, Operational framework for building climate resilient health systems. who.int/iris/bitstream/ handle/10665/189951/9789241565073_eng.pdf].

WHO has called on all countries to join and commit to the successful implementation of the 'Building climate resilient health systems' initiative, promoted by WHO and the Adaptation Action Coalition [WHO, 2021, Adaptation Action Coalition Health Launch: Building climate resilient health systems. who.int/news-room/events/ detail/2021/05/06/default-calendar/adaptation-action-coalition-health-launch]. Specifically, governments are asked to commit to:

- conducting vulnerability assessments of the health status and adaptive capacity of health systems to climate change;
- Developing the theme of health in the National Adaptation Plan [Health in national adaptation plans: review. Geneva: World Health Organization; 2021];
- allocate, or apply for, climate funding for health systems.

Over the past two years, Italy, especially due to the COVID-19 pandemic, which has accelerated measures that had been discussed for some time and can no longer be postponed, has made significant planning and funding interventions in this area. Firstly, thanks to **Mission 6 of the National Recovery and Resilience Plan,** substantial resources were allocated to the investment M6C2 I1.2 - Towards a safe and sustainable hospital (part of Component: M6C2 - Innovation, research and digitisation of the National Health Service). The investment, amounting to more than EUR 1.6 billion, plus a further EUR 1.4 billion from the National Fund for Complementary Investments (PNC), aims at outlining a path for structural improvement in the field of safety of hospital buildings, bringing them in line with the current seismic and energy-saving construction standards. Hospitals not only perform a fundamental function in rescuing the population, but are also among the most exposed and sensitive buildings in the event of seismic events, as they house a very large number of people with heterogeneous reaction capacities. In the face of climate change, it is increasingly necessary to adapt healthcare facilities to protect people from heat and cold in a sustainable manner.
However, structural investments in NHS facilities are necessary but not sufficient if they are not accompanied by investments in training and research for health workers who, as professionals dedicated to protecting and strengthening the health of individuals and communities, need to be equipped with the training and resources necessary to implement adaptation and mitigation programmes, especially in areas already facing severe environmental damage [WHO, 2020, WHO guidance for climate resilient and environmentally sustainable health care facilities. who.int/publications/i/ item/9789240012226].

In this context, it is worth mentioning that at the end of 2021 the 'Health, Environment, Biodiversity, Climate' Operational Plan was launched, within the framework of the Complementary National Plan (PNC), which supplements the PNRR with national resources. The Plan is closely linked to the reform action covered by Mission 6 - Health of the PNRR entitled 'Defining a new systemic institutional set-up for health, environment and climate prevention, in line with an integrated approach (One Health)'.

The investment is intended to strengthen the functional and operational integration of the NHS structures that operate to protect collective health, pursuing objectives of health promotion, disease and disability prevention, and improving the quality of life, particularly with respect to environmental and climatic risk determinants. The primary objective is the establishment of a National Health Protection

System (SNPS) that, at the central, regional and local levels, operates in constant coordination and integration with the existing National Environmental Protection System (SNPA).

The investment has the following objectives:

- the overall reinforcement of SNPS-SNPA structures and services at national, regional and local levels by improving infrastructure, human and technological capacities and applied research
- the development and implementation of specific pilot operational programmes for the definition of integrated health-environment-climate intervention models at selected contaminated sites of national interest;
- the creation of a national continuous training programme in health-environment-climate;
- the promotion and funding of applied research with multidisciplinary approaches in specific health-environment-climate intervention areas;
- the development of a national SNPS-SNPA digital network platform.

The Plan, financed with 500 million euro and managed by the MS Department of Prevention, has the Istituto Superiore di Sanità as its implementing body, and will end in 2026.

NHS sustainability

With the acceleration of the climate crisis, evidence on present and expected future health impacts has become consolidated. The negative health implications have brought to light the importance of involving the health sector in the scientific and political climate debate. Adaptation of health systems to anticipate emergencies and manage the growing demand for services related to extreme events, heat waves, pathogen emergencies, etc. has so far prevailed in this debate; less attention has been paid to mitigation. However, as indicated in the 'Mitigation activities and health co-benefits' section above, the health sector, in practice the NHS, is responsible for substantial GHG emissions in Italy. While boasting a good ratio of emissions to the volume and quality of services compared to other national systems, these emissions represent a non-negligible contribution to the country's overall emissions, suggesting that mitigation, alongside adaptation and resilience, is also an important issue.

Care activities are responsible for significant greenhouse gas emissions, from drugs (including inhalants), anaesthetic gases, air conditioning of buildings, electricity consumption, and waste generation. However, in order to assess the extent of the phenomenon and possible strategies to reduce emissions, it is important to consider health care systems as a whole, taking into account not only hospital in-patient and nursing care activities, but also including all the functions pertaining to the system, such as primary and specialist medicine, rehabilitation, home care, care of the elderly and so on. It is also necessary to consider the set of induced activities, e.g. transport, construction, food, which, through *procurement of* goods and services, entail substantial proportions of health expenditure and mobilisation of resources, with consequent environmental and climatic impacts. In other words, it is useful to refer to the WHO definition of a health system, which includes all organisations, people and actions whose main purpose is to promote, maintain or restore health[1] .

The health sector, especially in this sense, is an important component of the socio-economic structure of a nation, especially the more developed ones. OECD member states spent on average 9% of their GDP on health in 2019. In Italy, this proportion increased from 6.5% in 2018 to 7.2% in 2021 (data from the Chamber of Deputies), driven by the COVID-19 pandemic. A large part of these financial allocations are for the *procurement* of material goods and consumption and for services, which in turn entail significant economic activities.

[1] all organisations, people and actions whose primary intent is to promote, restore or maintain health

For some years now, there have been estimates of the proportion of GHG emissions due to health systems. Estimates on the subject are not always entirely consistent, but converge to indicate that 5-6% of total emissions in OECD countries are attributable to the health sector (5.1% for Italy in 2014) (1), a higher proportion than, for example, aviation. Globally, estimates are more uncertain and range between 1% and 5% (2). The main items making up these emissions are *procurement*, hospitals and clinics. Prevention activities, on the other hand, make the smallest contribution, reflecting the modest associated expenditure.

Since greenhouse gas emissions have a negative effect on health, the contribution of health systems represents a kind of 'taint' on the health gains they produce. In other words, if the performance of a health system is measured in an increase in life expectancy, or survival from a disease, the emissions associated with this performance result in a reduction in these gains.

Reducing the ecological footprint of a health system, therefore, makes it more effective. However, this is only one of the reasons why such an effort is a positive investment. Further considerations include:

- Reduction of energy consumption, use of materials and resources, reduction of special and non-special waste production, rationalisation of transport and *procurement* services in general, and more can result in substantial cost savings. Here again, consideration of co-benefits can help to identify the most effective improvements.
- Pursuing sustainability is important and rightful for all sectors, but ethically it is particularly so for health care, also with respect to the foundation of non-maleficence.
- Once a virtuous process of emissions reduction has been undertaken, the health sector may find itself in a position to spur other sectors to improve their own sustainability performance, including by assuming a *stewardship* role and promoting awareness of the urgency of mitigation actions.
- The healthcare sector is growing; the COVID-19 pandemic has clearly underlined its priority and at the same time offers an example of the environmental impact due to the necessary massive production of devices such as masks and diagnostic tests. This growth, if not accompanied by measures to reduce the ecological footprint, at least per unit of performance if not in absolute terms, will result in a further growth in the proportion of emissions attributable to the healthcare sector, with consequent impacts on the health that the systems aim to improve.

These considerations led to the formulation of the principle, or rather the aspiration for *net-zero health* care (3), a goal that would benefit "... the organisation [health system], its staff, patients, and communities in a variety of ways, from operational outcomes to morale, including resilience and financial, clinical and reputational aspects." (3).

Several health organisations are joining the UN 'Race to Zero' initiative (https://unfccc.int/news/health-institutions-join-the-united-nations-race-to-zero-campaign), pledging to halve their emissions by 2030, and eliminate them by 2050. These organisations include large hospitals in Europe and beyond. Reducing GHG emissions from the healthcare sector requires actions that depend to a large extent on the specific circumstances of each national and local system. However, some general measures can be considered. Some interventions in clinical practice, e.g. the use of asthma inhalers or low-carbon anaesthetic gases, are easy to implement; measures to reduce energy consumption and/or to use energy from renewable sources, as well as to optimise waste production and disposal, or staff and patient transport, may also represent operational savings. Other measures with implications for clinical practice (e.g. the choice of less impactful diagnostic or surgical procedures), on the other hand, are not easy to implement without an overall strategy.

In any case, the most promising approach is certainly that based on a system analysis, which considers all relevant components and includes emissions determined by *procurement* policies; it seems in this sense

appropriate to harmonise such a strategy with the one described in the section of this report dedicated to PA sustainability. An example of a strategy in this direction is that of the English NHS (https://www.england.nhs.uk/greenernhs/wp-content/uploads/sites/51/2020/10/delivering-a-net-zero-national-health-service.pdf), which has set itself the target of achieving emissions neutrality in 2040, ten years ahead of the United Nations. The strategy includes interventions in the hospital and outpatient sector, with the electrification of the vehicle fleet, the adoption of sustainable transport, the decarbonisation of supply chains, particularly the food supply chain, and interventions in the most polluting treatment practices. Emphasis is also placed on the necessary investment in research for the adoption of more sustainable prevention and treatment models.

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5. The solutions

a. Integration of the National Prevention Plan in relation to co-benefit policies

Having considered the mitigation side of climate change in Italy and its reflections on health, we now move on to consider the complementary problem, i.e. how to approach primary prevention of diseases and its reflections on climate change. Prevention policies are more effective if they are not only aimed at the individual (health education) but also have a **structural and economic character**. The aim is to combine individual health promotion with structural policies (such as urban planning, taxation, incentives, oriented *public procurement*) that make traditional educational activities more effective and enable a reduction in inequalities. For example, in many countries ultra-processed (industrial) foods have seen a progressive reduction in prices. It has been estimated that if in the UK the lowest social strata (10% of the population) were to follow the guidelines for healthy eating they would spend more than 50% of their disposable income (not counting rent) on food (https://foodfoundation.org.uk/publication/affordability-uks-eatwell-guide) (we have no similar data for Italy, where it is likely, however, that the phenomenon is much attenuated).
In general, health phenomena tend to follow trends in economic policies by a few years: for example, the concentration of distribution in supermarkets has been accompanied everywhere by the spread of ultra-processed food and the closure of small shops, with numerous negative consequences (desertification of city centres and decreased safety; increased car use).
The proposals below therefore reflect the more general objective of preventing non-communicable diseases, and most of them also have climate change mitigation as a side effect.

b. Prevention actions with (direct or indirect) impact on climate change mitigation

We propose a list of primary disease prevention actions that collectively also have a positive climate change mitigation effect.

1. **Promoting physical activity at all ages,** with particular attention to children and young adults, by increasing **weekly hours of** physical activity, both at school and elsewhere (**actors: school, active transport, urban planning choices, health)**; involving General Practitioners (GPs) and paediatricians in the promotion of physical activity
2. Protect children from the **marketing of foods high in sugar, red meat, salt and fat** by reducing TV advertising aimed at children and online marketing to zero (**actors: school, media)**
3. Introduce a **20% tax on** sugary drinks (as in many countries) and sugar in packaged foods, in proportion to the added sugar **(actors: government, MEF**)
4. Reducing **salt** consumption through agreements with producers (**actors: government)**
5. Limiting **alcohol-related** harm by introducing appropriate taxation (**actors: government, MEF)**
6. Tobacco: rapid standardisation of rules to limit tobacco advertising including 'plain packages' and implementation of the objectives of the Framework Convention for Tobacco Control (FCTC). Increase of **cigarette prices** (e.g. an increase of 10% per year as a sustainable and effective increase: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5607587/), support of smoking cessation centres, free prescription of smoking cessation medicines, demonstration campaign in the world of sport (**actors: government, MEF)**
7. Establish a uniform speed limit in all populated areas to reduce the impact of accidents and social inequalities (currently rich areas are better protected) (**actors: government, infrastructure, municipalities)**
8. Poverty alleviation and support measures for families in difficult economic conditions (**actors: government)**
9. Investing in public transport and **active sustainable mobility** (**actors: government, infrastructure, municipalities)**

10. Incisive action on plastics/mineral water bottles: e.g. starting with NHS facilities to reduce the use of plastic bottles to zero, then moving on to the world of education and the world of business (**actors: government**)
11. Actions to reduce **biomass consumption** and to limit the spreading of manure in agriculture and residual sludge from sewage treatment plants (factors responsible for pollution in the Po Valley and elsewhere in Italy) (**actors: government**)
12. Approve and then implement the **National Climate Change Adaptation Plan** (Ministry for Ecological Transition) and the resulting Regional Plans (indications of the State-Regions Conference) in order to secure territories and urban areas from the socio-economic and health impacts of extreme events.

In particular, **by 2030, it is proposed to set targets and consequent actions to**

- Reduce smoking rates by 30 per cent, with a focus on young people
- Reduce the prevalence of childhood obesity by 20 per cent
- Reduce the proportion of calories consumed from ultra-processed foods by 20 per cent
- Reduce average alcohol consumption by 10%.
- Reduce salt consumption by 30%
- Reduce consumption of sugary drinks by 20 per cent
- Reduce average red meat consumption by 20%
- Increase the number of hours per week devoted to physical activity by 10%.

These suggestions are purely indicative, reflecting similar proposals made in various countries around the world, but need realistic discussion and continuous monitoring (see also the PROMISE study as an example:
https://www.richmondgroupofcharities.org.uk/sites/default/files/the_promise_study_final_report.pdf).

We do not discuss in this paper the legislative or other instruments to achieve the proposed objectives. These instruments are very heterogeneous, ranging from bans, taxation, incentives, '*nudges*', *public procurement* to other specific initiatives proposed abroad (e.g. large reductions in public transport prices as in Germany, or the closure of entire neighbourhoods to traffic as in Barcelona). We believe that the realisation of the Paris goals, the European Green Deal and the goals we propose in this document require coordinated and incisive action at different levels and between different ministries.
We also believe that it is good practice, in the case of increased public spending on positive and often indispensable actions, to indicate how the sums needed to cover the expenditure are raised (revenue-neutral tax reforms).

c. The role of public administration and the streamlining of procedures

The role of the public administration in promoting health is typically seen in terms of the regulation and taxation of activities harmful to health. More rarely, one is inclined to think that a similar qualitative impact can be achieved with a third (quantitatively equally, if not more, powerful) instrument, that of public demand. In all the more developed countries, public administrations purchase *goods, services, work and infrastructures* (BSLI) to an average value of around 15% of the Gross Domestic Product: 1 euro out of every 6 or 7 is therefore produced annually by businesses at the request of the public administration to satisfy the needs of citizens.
For the same level of total public expenditure on BSLI, health promotion through BSLI purchases can thus be generated by:

a) increased public spending on health or favouring health at the expense of other expenditures;

b) increased spending efficiency through purchases at lower unit prices for the same quality, which allows resources to be generated for the purchase of additional health-promoting BSLI units;
c) greater effectiveness of health or health expenditure through, for the same price, the acquisition of better quality BSLI (this category can, of course, include purchases that enable more effective disease prevention as well as purchases that are completed more quickly).

Clearly, it is not only through changes in public spending on health that we can imagine acting on health promotion. As we know, the latter also involves, for example, more or better sports facilities, more or better infrastructure for environmentally friendly public transport; better school canteens; better public beverage purchases (both in terms of sugar content and, for example, through non-plastic container material); more restrained and environmentally friendly energy consumption in public buildings. The list would be long but these examples testify to the great impact that could be achieved through public demand for BSLI on climate change and health promotion.

It is equally clear that the key question is whether this public purchasing demand is already optimised today and does not need any further action or whether it is rather characterised by significant waste or by choices that do not take sufficient account of the impact of public purchasing on health promotion. In both cases, in fact, the fight for health promotion by means of appropriate public choices would also go through a fight against waste and/or an increased focus on specific, health-promoting purchases of BSLI, including those BSLI that are more sustainable and 'greener'. Generally speaking, it is *from 1) combating waste in public purchasing that more resources can be obtained for the same expenditure to purchase additional units of health-promoting products, and it is - even in the absence of waste - from 2) focusing on the purchase of more sustainable BSLI in terms of health impact that public demand can be complementary to regulation and taxation in driving a given country towards more sustainable health-promoting outcomes.*

With regard to Italian public administration waste in public procurement, the data available to the scientific community illustrate the dramatic nature of the situation but also the potential available for improvement and also the solutions to achieve it. In a pioneering work in the American Economic Review, (2009) (1) the authors showed how price waste alone (within the procurement of goods and services alone and therefore excluding works and infrastructure) is equal to 2% of GDP (almost EUR 40 billion). To this should be added waste in the works and infrastructure sector and waste due to excessive quantities purchased: 2% of GDP is therefore definitely a default estimate of waste in public purchasing in our country, probably around 20% of total expenditure. ANAC, the Anti-Corruption Authority, in its specific case studies has confirmed these numbers and insists on the potential that identifying and reducing this waste would have for improving the impact of a given level of public spending. For example, in its report on diabetes devices, it shows how 'in the regions where higher unit prices are paid for the aforementioned devices, in the face of smaller annual quantities in relation to international standards, keeping the overall expenditure unchanged would theoretically be possible to increase the number of self-monitoring devices supplied to patients by aligning the price paid to that of the more 'virtuous' regions.

It has to be added that the estimated benefits of public procurement to promote health are often underestimated because it is not taken into account how it ends up "spilling over" into the entire outlet market of the supplier company and the entire supply chain with effects that go beyond those of mere direct public procurement.

In fact, by inducing a company to produce and sell in a sustainable manner to the public administration, the latter learns to lower its production costs for new and sustainable products, and ends up opening up new and more sustainable markets also in the field of supply to private individuals. As far as downstream effects are concerned, it has been said that "the awarding of a contract may lead to more information for the company itself about the demand for the products it sells. By discovering this, companies decide to grow more (...); by winning a public contract companies begin to realise that their products can be sold not only to local governments but to governments in neighbouring municipalities and states (...) winning a public tender encourages companies to invest more. If, for example, the company has liquidity constraints

that prevent it from investing (lack of access to credit) winning is a way around those constraints. And if a company hires a person to manage the logistics of the contract, the probability of becoming more competitive increases, either because you have staff trained in new skills or because the skills of a particular worker increase, even once the contract is over and even outside the public sector' (2). A company thus winning a public procurement order for a particular BSLI may end up spreading that BSLI to other target markets, increasing its size and impact, even to the extent of making it a new standard for the market as a whole.

Pressures from a public purchaser on its suppliers to encourage them to transfer sustainable supply chain management practices within their supply chain are also representative of significant upstream effects. However, the effectiveness of these pressures depends on contextual factors, including the ability of public purchasers to integrate clear, specific health promotion requirements into the tender and then into the contract. While on the supplier's side, reputational risk and loss of profit are the identified factors that make the company reactive to these pressures (3).

How does this push towards health-promoting products take place through public procurement? One example will apply to all. In its demand for canteen products, the public administration can decide whether to demand more or less meat; such a decision can also bind all contracting stations if imposed by law. But the law can also, within a certain type of commodity, set the minimum level of quality required. The minimum environmental quotas of such criteria for obtaining bio products in canteen services vary from 50 per cent (cereals) to 20 per cent (for poultry and beef). In reality, purchasing authorities can then deviate upwards from these minimum values, and it is likely that the more competent the contracting authority is, the higher the bio quota required in the specifications or rewarded by the awarding rules (provided the contracting authority has the economic resources to spend to obtain that certain higher quality) and verified at the time of supply. But only competent contracting stations will be able to internalise the benefits of these choices and promote them.

Developing the skills of contracting authorities through substantial investment in human capital has in fact the main function (apart from reducing waste) of increasing awareness of the social and economic benefits of green procurement and improving technical knowledge on the use of green considerations in the procurement process. In this regard, it can be argued that a lack of training and information on sustainable procurement may not encourage the application of green considerations at different stages of the procurement process. For example, a lack of knowledge about green procurement may lead procurement officers to overlook this aspect when formulating requirements and/or conducting market research. Another aspect is that procurement officers may not be inclined to introduce green considerations without possessing the appropriate knowledge and skills on the subject. Lack of knowledge and training may also lead to inappropriate use of green criteria in the procurement process, leading for instance to the use of environmental criteria that restrict or distort the scope of competition, or to the imposition of additional economic burdens on bidders that may not be proportionate to the size or scope of the contract. Therefore, in order to promote the use of sustainable procurement, adequate training to build the capacity of procurement personnel is essential (4).

A key question for health promotion via public procurement therefore becomes this: what is the prevailing level of competence in our contracting authorities? The same study by Bandiera, Prat and Valletti, in its second part, identifies the causes of the documented extensive wastage, which may come as a surprise to some. 83% of waste (the total is 2% of GDP) is due to incompetence ('passive wastage'), 17% to corruption ('active wastage'). While 17% of 2% of GDP (0.35%, about EUR 6 billion) may not appear as little, the enormous amount of waste resulting from lack of training is surprising.

Efficiency losses, however, do not only relate to economic cost conditions, but also to delays in the delivery of the required product on time. In the case of infrastructures and works (a new hospital for example), it is estimated that the 'unnecessary' time, i.e. the time that could be recovered by increasing the efficiency of

the public administration, amounts to as much as 240 days on average. A public work could therefore become a reality as much as eight months earlier: in the case of health, this would obviously also affect the probability of survival and quality of life in the future.
Having identified the root cause of waste is no small consideration, because it points a way, a necessary condition, to achieve the goal of health promotion through the contribution of public procurement.

To this end, cooperation between institutions, universities and training centres should be promoted to implement programmes and/or symposia suitable for knowledge sharing between practitioners and academics. Such initiatives could create fruitful networks and debates, as they merge the theoretical aspect of public procurement with its practice. It is an investment that is more than self-financing, due to the amount of waste eliminated and the increased sustainability benefits it generates.

d. Communication and participation: identification of relevant stakeholders for co-benefit policies and proposal of dialogue and consultation models

The complex and dynamic nature of environmental problems inherently requires a flexible and transparent decision-making process that embraces a plurality of knowledge and values. Moreover, the effectiveness of climate change mitigation and adaptation policies is closely linked to the ability to actively mobilise stakeholders in policy implementation by raising their awareness of present and future risks. We must emphasise the need to act in a synergetic and integrated manner, pooling relevant knowledge and available resources.
For these reasons, stakeholder participation in decision-making on policies to foster the environmental sustainability of development has been progressively incorporated into national and international policies. Putting into perspective the development of policies focused on health **co-benefits** requires a careful assessment of the actors able to contribute the knowledge needed to characterise the different health and environmental needs to be addressed in an integrated manner, and the effective representation of the different interests at stake.
In general terms, the development of policies to address health in terms of its interdependence with environmental resilience requires the involvement of institutions governing **health policies, food health and nutrition policies, environmental policies, agricultural and forestry policies at national and regional levels, economic development policies, educational policies and technological innovation policies.**
In addition, a fundamental contribution can be made by subjects that can provide information and data to support decision-making. This area can include both universities and institutes that conduct research in the health, environmental, agronomic, zooprophylactic and technological innovation development fields.
With regard to collective stakeholders, it is necessary to consider the involvement of trade associations and trade unions in the agricultural and manufacturing sectors and in energy, water and waste collection and treatment services as well as associations and professional bodies in the health sector.
Finally, with regard to the diffuse stakeholders, it is necessary to assess the non-governmental organisations that play a key role both in the management and mobilisation of resources and in the generation and dissemination of knowledge. For example, the (now inescapable) strand of **'citizen science'** has gained strength in recent times. Also to be considered and developed are the instruments of **deliberative democracy**.
This framework represents only a starting point. It is advisable to proceed, making use of available techniques (e.g. snow-ball technique, network analysis and analysis matrices), to a specific mapping and analysis of the relevant stakeholders for the thematic scope and territorial scale on which action is to be taken. The mapping makes it possible to involve all the relevant stakeholders from the very **first phase of the decision-making process, thus** avoiding inducing the excluded ones to adopt hostile attitudes and/or offering room for a delegitimisation of the actual inclusiveness of the process.

Stakeholder analysis provides a clear preliminary view of the starting positions and interests represented by the various actors involved. This in turn can help to design - within the chosen dialogue and consultation models - methodologically structured paths capable of favouring, through the appropriate use of facilitation techniques, the search for shared solutions.
In the context of **co-benefit** policy development, the need to deepen the methodological aspects and the framework of relevant stakeholders is particularly evident as this approach is innovative and there is no previous experience to refer to.
We point out that it could be useful to build on the experiences and tools developed in the health sphere for dialogue and stakeholder consultation. One thinks, in this sense, of the Technical Health Committee and the Technical Committee for Nutrition and Animal Health set up within the Ministry of Health by Law No. 183 of 4 November 2010, through which a continuous model of consultation and cooperation between representatives of the various institutions relevant to the regulation of matters of health importance and representatives of research, the third sector and the productive world is realised. Both of these committees are divided into thematic sections within which members with relevant interests or expertise are called upon to discuss health policy matters.
Not only could this model be adopted for the development of a tool to facilitate stakeholder consultation and dialogue on policy-relevant co-benefit issues, but one could also consider including these issues in the agenda of existing co-benefit convergence tables. In general, it is necessary in the immediate future to experiment new ways of including different stakeholders through the tools of deliberative democracy.

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6. Estimate of the resources needed in the light of the current funding for prevention in Italy and the objectives of the PNRR (1)

The financing of prevention before the PNRR

The National Plan of Resilience and Recovery (PNRR) does not make any direct specific allocations for prevention and public health; through the Complementary National Plan (PNC), however, an investment of about half a billion is planned for the creation of a network for the prevention of environmental and climate risks. However, we observe how prevention is (inadequately) financed under ordinary circumstances. In 2021, the NHS was financed with a total of approximately 122 billion. Five per cent of this figure funds the ordinary prevention system (personnel and services, including food safety and veterinary care), mostly secondary and tertiary. A further 200 million is allocated to an additional tied fund linked to the programmes of the National Prevention Plan. In essence, very little is allocated to prevention policies other than screening and vaccinations. This is all the more true for primary prevention, which is articulated in programmes for which no cost standards or organisational models have been defined.
The current mechanisms for the distribution of health finances provide for the area of prevention the dry capital quota, while more specific needs for prevention (primary or secondary) and health promotion interventions - although highlighted by the surveillance systems - are not contemplated. The different prevalence of risk factors, moreover, does not lead to the definition of specific and adequate funding lines for intervention programmes capable of removing territorial differences.
The 2020-21 Health Pact confirmed the amount of funding for the National Prevention Plan allocated for the previous two-year period, i.e. EUR 200 million, a figure that was evidently formulated regardless of the Plan's contents and actual operational needs.
Moreover, the Plan Goals are not fully effective in tying funding to the specific interventions to which they would be destined, also by virtue of the mechanism for formulating and reporting on them, particularly in the regions with the greatest economic problems (practically all the regions of southern Italy), which have suffered a considerable reduction in the number of health personnel in recent years. This leads to an uneven distribution of health promotion and prevention interventions across the country, which can only result in a further worsening of health inequalities.
It is therefore essential to formulate an assessment of the costs associated with the plan forecasts, both at national and regional level, to ensure their feasibility. Provision must also be made for audit and accompanying mechanisms for regions that, in the face of adequate programming of interventions, show difficulties in achieving results for structural reasons.

Four essential points for prevention

Four points become essential for the development of prevention as a primary approach and tool for health, also bearing in mind the necessary integration between the PNRR and the PNP.
From science to legislation. The discussion around the PNRR offers the opportunity for an in-depth examination of the role and renewed structure of prevention in the NHS. It is an examination that must be conducted through consultation in the form of working groups of Italian and foreign professionals and researchers, particularly European ones: a procedure of this kind is capable of ensuring that the legal initiative is the vehicle not of itself but of a scientifically sound conception of public health projected into the future. The examination should concern the prevention instruments applicable at both the population and individual levels, with particular attention to how the 'health pathways' of citizens should begin, within all the NHS structures already envisaged by mission no. 6 of the PNRR, with the first stage of health promotion and primary prevention (instead of being limited, as is still largely the case, to 'diagnosis and treatment pathways'). The discussion on the 'health, environment, biodiversity and climate' system must include a wide-ranging discussion of environmental and health prevention technicians that prioritises the

technical over the administrative management component. Only in this way will it be possible to adopt the necessary system perspective, including *one-health* models, recognising the complexity of the environmental, climatic, social and individual processes involved, both locally and globally, and identifying the most effective interventions.

The policy of co-benefits Among primary prevention of non-communicable diseases (NCD) interventions of particular relevance are those that simultaneously act on several aetiological factors with consequent co-benefits on health, as discussed above. For example, interventions aimed at reducing greenhouse gas emissions are directed at reducing the use of fossil fuels, which are also responsible for air pollution, and thus contribute to jointly preventing both air pollution-induced and climate change-induced diseases. All the interventions envisaged in the other five missions of the PNRR (the sixth is the one on health) must be critically examined according to the criterion of what impact, favourable or unfavourable, they may have on health. In this sense, several constituent interventions of mission no. 2 (Green Revolution and Ecological Transition) and no. 3 (Infrastructure for sustainable mobility) can be optimized.

The support of research for public health The pandemic has highlighted in full the deficit of research, in Italy and other countries, integrated into public health practice in direct support of decisions to control the epidemic. In the component of the mission 'Health' dedicated to innovation and research, not a single mention is made of epidemiological research for public health, and this serious gap will certainly have to be filled.

The outcome measures. If GDP growth is the macroeconomic result criterion that the PNRR emphasises, it is clear that this must be accompanied by a broad spectrum of measures specific to the sectors of intervention envisaged in the plan. In the health sector - both at the national level and in the plans that will articulate it at the regional level - qualitative and quantitative health indicators will be essential, in relation on the one hand to the means (preventive or diagnostic-curative) and relative costs used to achieve them, and on the other to their distribution by territorial areas and socio-economic conditions.

In short, the 'Health' mission of the PNRR represents a positive development in compensating for structural deficits that have accumulated over the years in the NHS and revealed themselves in dramatic form under the shock wave of the pandemic. They also represent an indispensable update of the NHS in relation to scientific and technological developments. Without going into a paragraph-by-paragraph analysis of the Plan, however, one notices a dominant emphasis on communication and information technology (IT) infrastructures as a support for telemedicine and the digitisation of the health system, including the much-needed personal electronic health record on a national scale. The critical point that needs to be emphasised here is that compensation and upgrading do not correct the orientation and do not reset in the direction of prevention an NHS that, like those of all economically advanced countries, has in fact come to be realised as a continuously expanding system of diagnosis and treatment as the main, and often exclusive, operating method for dealing with illness and health. The epidemic has starkly highlighted how not only were these systems generally unprepared for the arrival of the coronavirus, but they have subsequently struggled at every stage of the epidemic's development to switch to a preventive mode of operation, almost always finding themselves taking measures later than the epidemic dynamic.

Unpredictable shocks such as epidemics from new or recurring pathogenic viruses or extreme weather events linked to climate change (both of which are likely to occur in the years to come), involve the healthcare system in its entirety and can only be effectively countered by acting as much as possible upstream, preventing the consequences downstream. The current epidemic is a clear demonstration of the insufficient resilience of the health system and, to a large extent, also of the social system: the excess of mortality (compared to pre-epidemic years) directly attributable to Covid-19 is accompanied by an excess of mortality from other causes, which in Italy is of the order of at least one third of the total excess. In fact, all diagnostic and treatment services are disrupted, with delays in planned activities, suspension of early diagnostic campaigns, postponement of non-urgent surgical operations, etc. This spectrum of effects requires each to be countered or remedied individually by a spectrum of different interventions where effective preventive action on the earliest stages of the epidemic would have avoided them all altogether. It

is difficult to imagine a more directly (and heavily) instructive lesson on the central role of prevention for health than the Covid-19 pandemic: and the degree to which the lesson will be concretely taken on board and translated into practice will be measured not exclusively but importantly by the funding, both absolute and relative to other health intervention approaches, that will be granted to prevention.

(1) This chapter is derived in part and with modifications from: Vineis, Saracci, Forastiere: Prevention is underfunded in Italy. In La finanza pubblica italiana, edited by M Baldini and S Tosi, Franco Angeli 2022

'Policy on the health co-benefits of climate change mitigation'
CONCLUSIONS AND PROPOSAL FOR COP 27

All scientific research agrees that we are witnessing rapid changes in the climate, which also impact the population in terms of health and threaten the stability of the economy. These changes originate from human activities and are therefore mitigable. The International Energy Agency (IEA), like other international agencies, believes that the situation is still reversible, through compliance with the Paris Agreement, *Nationally Determined Contributions (NDCs)* of individual countries and, in Europe, pursuit of the Net Zero strategy by 2050 ('*fit for 55*', cutting greenhouse gas emissions by 55% by 2030). However, meeting these targets requires immediate and radical investments starting with a transition to renewable energy (IEA World Energy Outlook, 2021; IRENA World Energy Transitions Outlook: 1.5°C Pathway, 2022).

Climate change has numerous adverse effects on human health. Heat waves, one of the direct effects, carry a quantifiable burden of mortality and morbidity in Italy; every summer, more than 2-3% of total deaths are attributable to heat exposure and these numbers are set to increase. In 2020, twice as much of the earth's surface was affected by at least one month of drought compared to 1950, putting food and water security at risk; in addition, changes in climatic conditions are affecting ecosystems and biodiversity. Zoonoses, i.e. infectious diseases transmitted from animals to humans - caused by bacteria, viruses, parasites or prions - are a category of diseases strongly influenced by climate change. We face a real risk of re-emergence of previously endemic agents or the arrival of vector-borne tropical diseases. In 2018, 17.2 million people worldwide fled their homes due to climate-induced disasters - floods, storms, cyclones, droughts, among others - while remaining within the borders of their own countries. By 2050, climate change is expected to displace 200-250 million people, affecting about 3% of the population of sub-Saharan Africa, South Asia and Latin America.
The contribution to total net greenhouse gas emissions comes mainly from energy production and distribution, followed by industry, agriculture (including loss of forests and other land uses), then transport and buildings (worldwide) (IPCC report 6, 2022; quantitative estimates tend to vary slightly depending on sources). Mitigation is implemented first of all by reducing the use of fossil fuels and promoting renewables and energy efficiency. However, several agencies, first and foremost the IEA, suggest that mitigation cannot be left to a limited number of uncoordinated measures. There is a spectrum of actions that can contribute significantly to this end and as many of them as possible should be pursued. Numerous coordinated actions, among those that can be pursued, also improve human health. Significant reductions (up to 30-40%) in the incidence of chronic diseases (cancer, diabetes, cardiovascular, respiratory and neurological diseases) can be achieved through preventive policies that also have a positive impact on climate. At the same time, many of the actions aimed at mitigating climate change in the areas of energy, transport, urban planning, agriculture and animal husbandry, food production, food, construction, urban planning, etc., have a positive impact on major diseases (see figure 1 in the appendix). There is a substantial body of research that supports the thesis that mitigating climate change contributes to improved health. The International Energy Agency has suggested that a 7% increase in investment to improve air quality would result in a decrease in premature deaths in the order of 3 million by 2040 (International Energy Agency. World Energy Outlook Special Report. Paris, France 2016). In the United States of America, policies to limit temperature increases to within an average of 2°C would prevent 175,000 premature deaths by 2030 (https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(17)30003 7/fulltext).

Several researches have shown that a transition from current animal protein-rich eating styles to more nutritionally and environmentally balanced diets would lead to a reduction in deaths of about 20 per cent, with a significant reduction in greenhouse gas emissions (more than 50 per cent) (https://pubmed.ncbi.nlm.nih.gov/30318102/; https://pubmed.ncbi.nlm.nih.gov/ 34688354/).

There is thus a substantial overlap between actions that mitigate climate change and primary prevention actions. Although this paper deals with mitigation, it is worth remembering that adaptation to climate impacts also has very relevant effects on health, representing another source of co-benefits (*early warning* for extreme events, coastal defence, land use, *nature-based solutions*, reforestation - not only for decarbonisation but also for cooling -, microclimate, etc.). This provides an opportunity to adopt policies that are simultaneously beneficial for climate and human health, also reinforcing considerations of the economic feasibility of interventions. Indeed, a frequent objection to necessary mitigation policies is that they are costly and hold back the economy. In fact, the IPCC (Report No. 6, 2022) has shown that in several areas the medium- to long-term economic benefits tend to outweigh the initial costs, as shown in Figure 2. What is not usually considered is that **the cost of doing nothing can be much higher than the cost of taking action**, when all external diseconomies are taken into account, including the diseases associated with the current condition and its likely developments. A low-impact, high-sustainability circular economy corresponds to a significantly better overall calculation, also in terms of health gain.

Recommendations

Some effects of climate change are already perceptible today; many other effects are mainly long-term, heterogeneous and dispersed in different parts of the world; similarly, the effects of mitigation policies are gradual. This fact is a further factor that may hinder the adoption of substantial measures, as the 'returns' of such investments are not immediate. In contrast, the human health effects of climate change mitigation are general and easily tangible in the short term, which improves the political 'expendability' of ambitious interventions and their acceptability to citizens.

We therefore recommend that:

- Improving health, both globally and locally, should become one of the main criteria motivating mitigation measures. Certain and potential health benefits should always be considered when planning mitigation activities.
- A broad model of health should be used. Important effects that are not easily measurable, e.g. on mental health, are another possible co-benefit of a more stable climate.
- Health co-benefits should be given greater prominence in climate initiatives, both nationally and internationally.
- The Ministry of Health should take an active part in planning mitigation activities that promote co-benefit policies. This should also play a key role in negotiations.
- Researchers, health professionals, industry and policy-makers should transcend national and disciplinary boundaries and collaborate with each other to develop co-benefit-driven mitigation initiatives.

Appendix to Conclusions

Figure 1C. The Global Burden of Disease: which causes of death can benefit from climate change mitigation measures

The Figures below, taken from the Global Burden of Disease, a global quantitative exercise to monitor the evolution of causes of death and risk factors over time, show which were the leading preventable causes of death or risk factors in the world in 2019 (Global burden of 87 risk factors in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. GBD 2019 Risk Factors Collaborators. Lancet. 2020 Oct 17;396(10258):1223-1249). Most of them are also preventable through climate-mitigating measures in transport, agriculture and food.

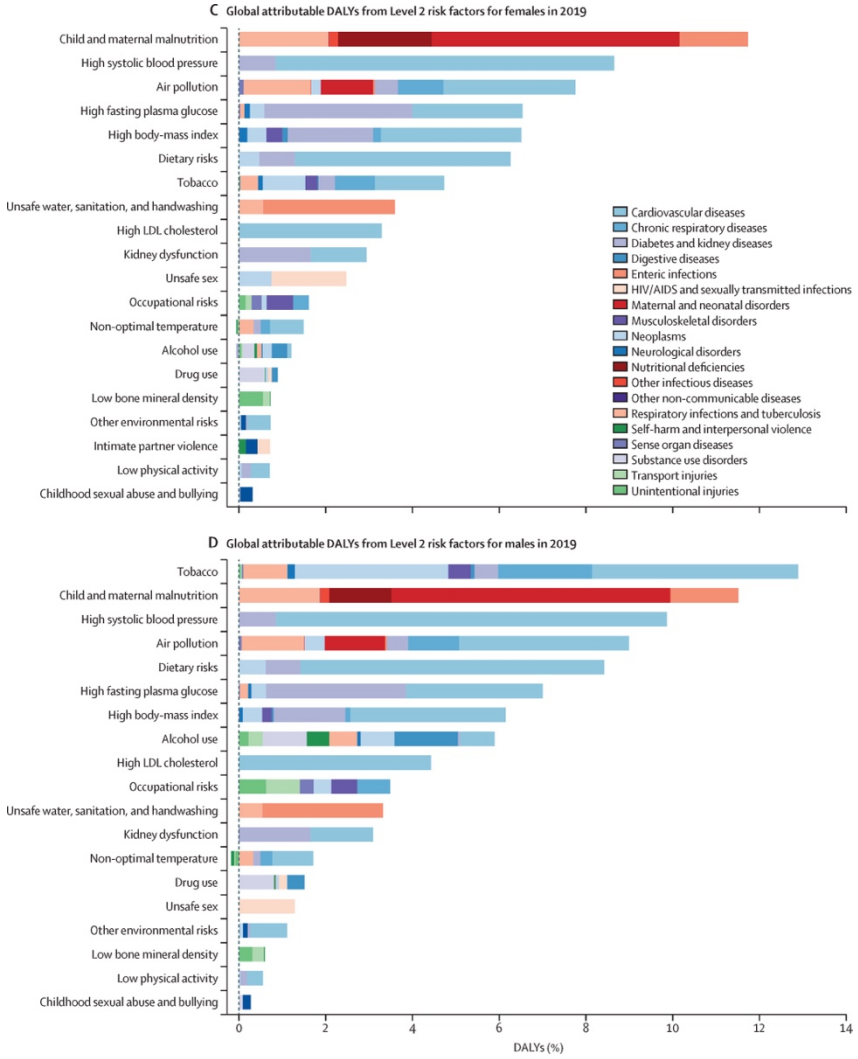
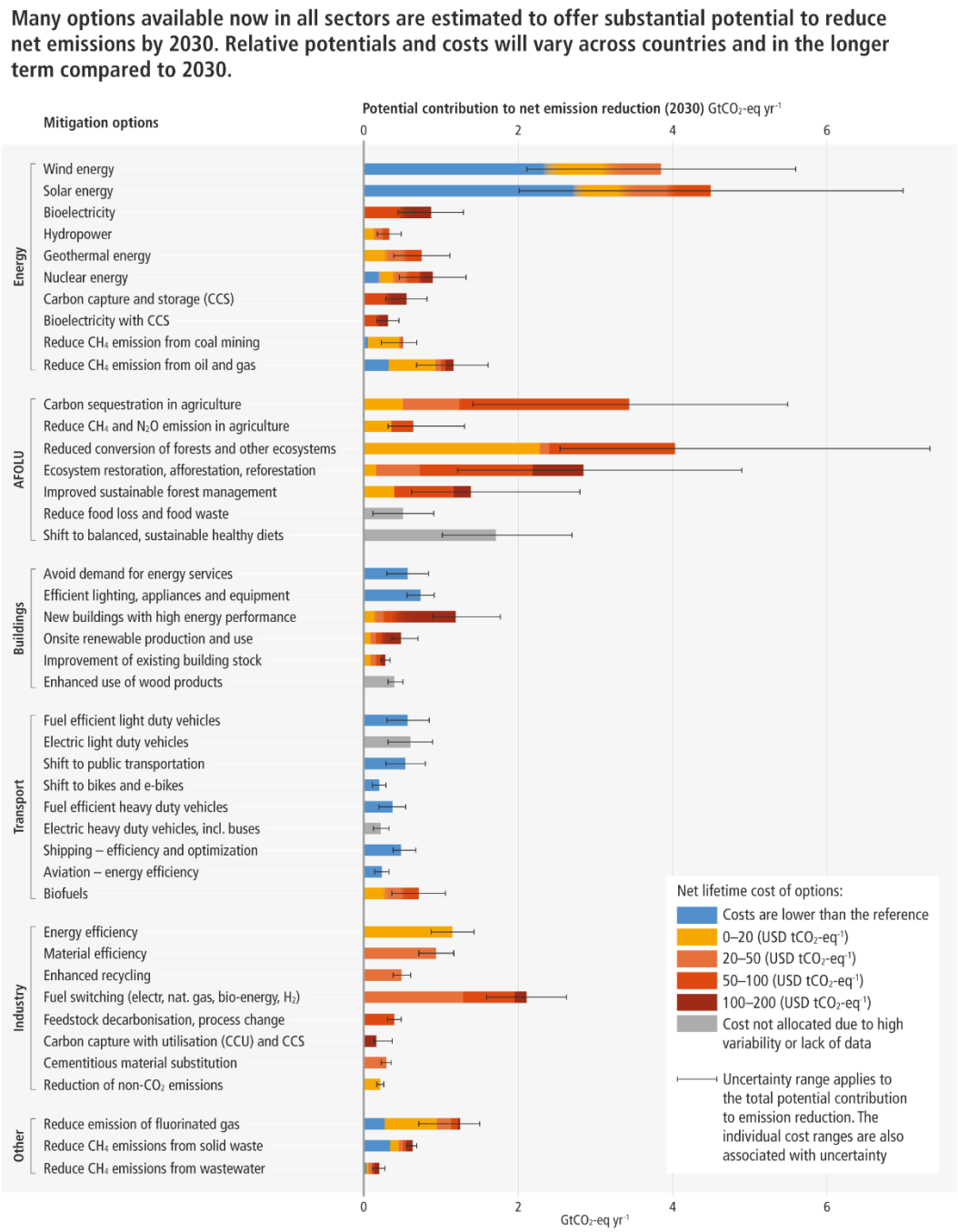

C Global attributable DALYs from Level 2 risk factors for females in 2019
Child and maternal malnutrition
High systolic blood pressure
Air pollution
High fasting plasma glucose
High body-mass index
Dietary risks
Tobacco
Unsafe water, sanitation, and handwashing
High LDL cholesterol
Kidney dysfunction
Unsafe sex
Occupational risks
Non-optimal temperature
Alcohol use
Drug use
Low bone mineral density
Other environmental risks
Intimate partner violence
Low physical activity
Childhood sexual abuse and bullying
Cardiovascular diseases
Chronic respiratory diseases
Diabetes and kidney diseases
Digestive diseases
Enteric infections
HIV/AIDS and sexually transmitted infections
Maternal and neonatal disorders
Musculoskeletal disorders
Neoplasms
Neurological disorders
Nutritional deficiencies
Other infectious diseases
Other non-communicable diseases
Respiratory infections and tuberculosis
Self-harm and interpersonal violence
Sense organ diseases
Substance use disorders
Transport injuries
Unintentional injuries
D Global attributable DALYs from Level 2 risk factors for males in 2019
Tobacco
Child and maternal malnutrition
High systolic blood pressure
Air pollution
Dietary risks
High fasting plasma glucose
High body-mass index
Alcohol use
High LDL cholesterol
Occupational risks
Unsafe water, sanitation, and handwashing
Kidney dysfunction
Non-optimal temperature
Drug use
Unsafe sex
Other environmental risks
Low bone mineral density
Low physical activity
Childhood sexual abuse and bullying
0
2
4
6
8
10
12
14
DALYs (%)

Figure 2C - The global economic benefits of limiting warming to less than 2 degrees by 2100 exceed the costs of mitigation in most published estimates, according to IPCC (Report 6, 2022)



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