The influence of the European Commission on health effects of climate change – The world in 2050: Scenario planning

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Abstract

Aims: Climate change, interacting with other environmental phenomena, affects human health. The impact of climate change worldwide and in Europe in 2050 is uncertain. Such uncertainty calls for the inclusion of a broad range of assumptions when studying the outcomes. This study presents a range of assumptions concerning the past and the ongoing influence of the European Commission on the health effects of global climate change in the year 2050.
Methods: Scenario planning and the evaluation of the adaptation options are core public health activities, aiming at development of strategies that steer the future towards the most desirable setting.
Results: Once the driving forces, key patterns and trends were identified, the assumptions were described extensively in the scenario plots. The studied dimensions include: temperature and UV-related illness and death, extreme weather-related and air-pollution-related health effects, water, food, vector and rodent-borne diseases, the effects of food and water shortages, infectious, mental, nutritional diseases, social and economic disruption and the role of politics and the society.
Conclusions: A series of strategies for the European Commission to implement are recommended. These include effective health monitoring and quality assurance, addressing medical needs, water and food shortages and the vulnerability of the European population, prevention of the natural disasters related hazard, addressing directly the driving forces of the climate change and efficient involvement of the European Union in global health politics.

Keywords: Climate change, Europe, scenario planning.

Introduction

Climate change is a process that operates over decades, occurring as a combined result of internal variability within the climate system and external, natural or anthropogenic factors (1). This process is nowadays primarily connected with the raise of global temperature and the direct and indirect consequences of the climate change. Between 1950 and 1993 night time daily minimum air temperatures over land increased by about 0,2 °C per decade (2). The Intergovernmental Panel on Climate Change (IPCC), established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) is the leading international body for the assessment of climate change. According to the third assessment report of IPCC, most of the warming observed over the last 50 years is likely to be attributable to anthropogenic factors (2,3). This opinion is at present accepted among the international academic society (4). According to the IPCC, even if it is managed to curb excess greenhouse gas emissions within the next 50 years, the oceans will keep rising for up to 1000 years, reflecting the great inertial processes concerning the transmission of heat from surface to deep water, with a sea level rise of approximately 1-2 meters (5). Surface temperature is anticipated to be greater at higher latitudes and on land, affecting primarily the daily minimum night-time temperatures (1). Additionally, glaciologists insist that it is slightly possible for large sections of ice mass of the Antarctic to melt, thus raising sea levels by several meters (1). Increased melt-water from the Arctic ice masses may significantly weaken and eventually shut down the northern Atlantic Gulf Stream, disturbing the circulation of the Pacific-equatorial warm water, resulting in a decrease in the temperature, especially of the Western Europe up to 5-7°C (1,3).

Climate change, interacting with environmental phenomena, including stratospheric ozone depletion, land degradation, freshwater decline and loss of biodiversity, affects human health directly and indirectly (1). Summarizing the effects of climate change on human health we would consider temperature-related illness and death, extreme weather-related health effects, air-pollution-related health effects as direct health problems. The indirect health problems would be water and food-borne diseases, vector-borne and rodent-borne diseases, effects of food and water shortages and infectious, mental and nutritional diseases as effects of social and economic disruptions (1,6).

Adaptations to the health hazard posed by climate change, a one-off global experiment, shall be both proactive and reactive, occurring on a population, community and individual level. Therefore there is a strong case for prudence, mitigating climate change and adapting to its impacts (1). Therefore the European Commission has decided to consider global climate change and the consequences on health with greater importance (7).

Methodology

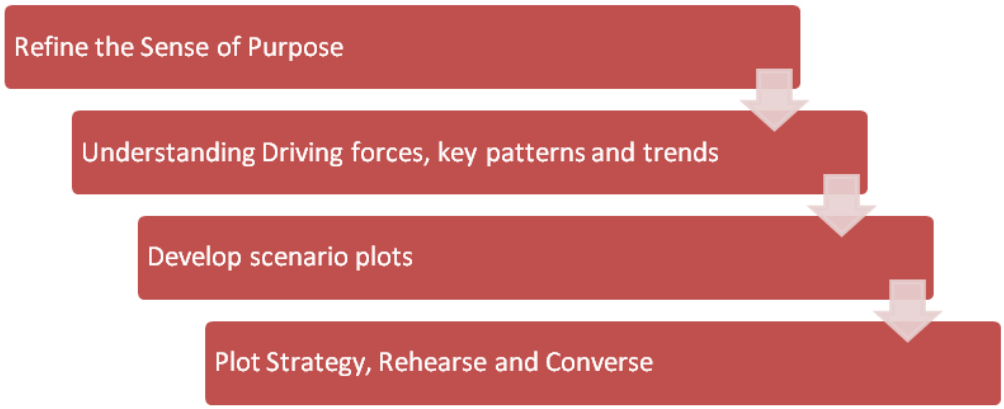
Next to climate change, various large-scale, interactive environmental phenomena affect simultaneously human health (8). The study of the outcomes of these interactive phenomena demands the inclusion of a broad range of assumptions for the future. Anticipating possible alternative futures is a method that is getting more and more useful not only in business sciences, but also in the field of public health in the last years. In order to document and analyse the alternative, futures economists and currently public health experts use the method of scenario planning (9,10). WHO sets scenario planning and the evaluation of the adaptation options as core public health activities, especially in the study of global climate change (1). Accordingly, this approach should not only be meant as a method to predict the future, but primarily as a method that will provide with guidance to avoid the undesirable and steer towards desirable futures (11,12).

Four steps should be recognized in the approach of scenario planning. The sense of purpose should be initially refined (11); the purpose and the relevance of issue should be clarified (9). Studying and understanding all driving forces, predetermined and unpredictable, and trends follows the first step in scenario planning (9,11). The development of different scenario plots is the third step in the process of scenario planning. Both scenario plots that are likely or unlikely to happen should be documented and analyzed and none should be dismissed (11). This step shall be followed by the last, crucial step of developing a plot strategy, by initially rehearsing and fine-tuning and later on analyzing and synthesizing the plots (11). The

outcome of this process is the development of strategies that are not only applicable but actually must be implemented regardless of the anticipated scenario plot (11).

The four steps of the scenario planning approach (9) are illustrated in figure 1.

Figure 1. The four steps of the scenario planning approach (Neiner, 2004)



The method of scenario planning in global climate change has already been implemented by the IPCC for the Third Assessment Report (3). The developed scenarios, collectively called SRES (Special Report on Emission Scenarios), portray the projection of the outcomes of future gas emissions of greenhouse gases and aerosols, including a broad range of assumptions about the potential technological and economic development to encompass the uncertainty about the societal structure in the year 2100. The assignment of probabilities to the SRES scenarios has been intentionally avoided (1,3).

Results

The sense of purpose

The enormous potential impact of climate change in the human health has signalized the great importance that the topic shall receive within the academic, health and meteorological society (4). Responding to this global health call, not merely legally bound to the Article 168 of the Treaty of Lisbon (13), but also regarding the EU collectively as the largest donor of development and humanitarian assistance, the European Commission has set the issue of climate change high in the political and global health agenda (7).

In this study we will present a range of assumptions concerning the past and ongoing influence of the European Commission on the health effects of global climate change in the year 2050. The complexity of the issue will be addressed using the methodology of scenario planning.

Driving forces, key patterns and trends

The next step for the study of the anticipated futures is the identification of driving forces, key patterns and trends. These can be predictable and unpredictable resulting in a wide range of uncertainty of the assumptions for the future to be made.

Generally, population dynamics and unstable, unorganized economic development are the key driving forces resulting in climate change. Practically, the greenhouse gas (GHG) emissions are considered to be a leading cause for the climate change (1). Anthropogenic gas emissions include emissions related to energy use, transport or waste-related and agricultural emissions. Although there is a trend in the decrease of the GHG emissions in the EU within the last decades, there is a dramatic increase in China and India, and a significant increase in the production of GHG emissions in the USA. In contrary there is a significant decrease in the GHG emissions in Russia within the last decades (14). Therefore the main driving force of the GHG emissions is still unpredictable.

Committed by the Treaty of Lisbon and the need for involvement in the global health scene, the EC shall be involved for the solution of the global climate change within the next decades. Although the involvement of the EC can be regarded as

predictable force, the extent and the effectiveness of involvement is uncertain. The financial crisis that the Union faces and will be facing during the first fifth of the century expands this uncertainty.

Since the problem of GHG emissions shows an increase globally, especially in China, India and the USA, the involvement of other governments, the cooperation with the respective UN Agencies, especially within the IPCC framework and the involvement of international NGOs and multinational companies, and also the personal involvement of every individual on earth are critical driving forces for the development of the phenomenon (14).

The ageing population in Europe and other regions is an additional, predictable pattern to be taken into consideration when studying the phenomenon of climate change. Ageing is a direct influencing factor for the response of the population to climate change. Older, weaker population suffers more often from temperature and extreme-weather related illnesses and death, vector, water and food-borne diseases and infectious and mental diseases related to climate change and social and economic disruption (1).

Increased population mobility both within the EU and internationally and the establishment of a free market are additional parameters that must be taken into consideration especially concerning vector-borne and other infectious diseases related to climate change (1,3).

All of the above mentioned driving forces, trends and key patterns will be taken into consideration for the development of the following scenario plots. Since the goal of this paper is to study the influence of the EC concerning the health effects of the climate change as anticipated in 2050, the development of the scenarios will follow health-related dimensions. The dimensions to be studied are as follows (1):

- Temperature and UV-related illness and death
- Extreme weather-related health effects
- Air-pollution-related health effects
- Water and food-borne diseases
- Vector-borne and rodent-borne diseases
- Effects of food and water shortages
- Infectious, mental, nutritional diseases / social and economic disruption
- Politics and the society.

Scenario plots

For this study, the anticipated futures depend both on the progress of the climate change and on the level of involvement of the European Commission in the global public health scenery. Therefore, four scenario plots have been developed and are presented in Figure 1.

Summarizing the plots, in the first two scenarios there is no or very weak involvement of the EC. In the other two there is a strong EC influence on the health issue. In the scenarios 1 and 3 the issue of climate change has been addressed appropriately, while the problem is not at all or only poorly addressed in the scenarios 2 and 4.

Figure 1. Scenario planning

	Background	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Temperature and UV-related illness and death (a)	Heatwaves can kill. Excess mortality is greater in those with pre-existing illness and the elderly, mainly due to due to CVDs, cerebrovascular and respiratory disease. In the past, a heatwave in 1987 Athens caused 926 heat-related deaths, while the excess mortality was estimated to be more than 2000 (15). Infants, people of low socioeconomic status or bad housing conditions without air-conditioning and specific clothing behaviours are more vulnerable. Winter mortality is a problem with similar consequences, mainly due to housing conditions. Influenza outbreaks are a major problem in the winter season, affecting mainly elderly and those with pre-existing illness. Excess UV radiation, a result of the stratospheric ozone depletion, leads to skin and eye cancer, sunburn, photodermatoses, cataract, keratoconjunctivitis, retinopathy, suppression of the cell-mediated immunity, impairment of prophylactic immunization, lymphoma (1).	Although heat or winter-related deaths are not the rule, significant outbreaks appear on a yearly basis, primarily because of unequal housing conditions. UV-related cancer has a high prevalence, increasing the financial burden of the EU.	Heatwaves kill hundreds of people in Southern and Central Europe every summer. During winter the population of northern Europe suffers from deaths. Influenza outbreaks are very often and the influenza-related deaths and hospitalizations have increased dramatically. Ageing works as a confounder in the phenomena. Patients with CVDs are most probably about to die during a heatwave or in the winter. The combined incidence of skin and eye cancer is higher than all other cancer forms. Mortality and morbidity rise. Europe has not managed to address the problem of CVDs during the last decades. European citizens' health literacy status decreases. The excess mortality and morbidity lead to a new financial crisis in the EU.	Heat or winter-related deaths are rare. Housing conditions in Europe have improved with environment-friendly and weather-tolerant houses. European citizens know how to protect themselves and why. The health literacy status has reached 95%. UV radiation is still a problem, but the ozone depletion has not deteriorated within the last decades. The EU has focused scientific efforts on cancer prevention with new effective sun-care products and personalized chemotherapeutics and the modern treatments have increased radically the 5 year life prognosis.	Health effects similar to Scenario 2. CVDs are now less in Europe, since the health promotion and education activities of the EC have been effective in the last decades. Russia and the Caucasian European countries have a higher temperature-related morbidity and mortality.

Extreme weather-related effects (b)	The effects are difficult to quantify because of poor reporting of secondary effects and delayed consequences. Increasing trend globally in natural disaster impacts. Costal populations and large shanty-towns, subject to floods are in high-risk. In 2002 100 people died due to flooding in Central Europe. Mortality and morbidity rises. Great economic losses (1).	Although natural disasters are not the rule, flooding is quite often in European cities and the coastal areas. Drought over longer periods is also a problem that results to financial losses in rural areas. Mortality due to flooding has increased. Phenomena similar to the ones of 2002 in Central Europe happen on a yearly basis.	Natural disasters happen practically on a biannual rhythm in Europe with great economic burden for the EU. Poorer urban areas, even in capital cities in the Western Europe suffer from floods and related death continuously. Coastal areas are devastated. The tourism rate in the Mediterranean Sea sinks resulting to greater economic loss. The real extent of the loss is still unclear.	Natural disasters are not often in Europe. Warning signals are published on time. Housing conditions in urban, coastal and rural areas have improved dramatically. The EU is a supporting actor for other regions that suffer from natural disasters. Extreme-weather related effects are reported efficiently using common indicators for the assessment.	Better housing conditions prevent from flooding in urban areas. Rural areas still suffer from floods and drought. Coastal populations suffer from floods with great economic losses. Tourists avoid the Mediterranean coasts, because of the floods and the extremely hot summer temperatures.
Air-pollution related effects (c)	Production of aeroallergens, fuel pollutants from household heating and energy demands and the transportation of air-borne pollutants and forest brands are associated with weather conditions (1,3).	Allergies are still a global problem and especially in big cities, including European cities. Forest brands are a major issue for the European south.	Explosion of atopies, allergies, lung cancer, respiratory infections and COPD that increases the mortality rates and the financial burden. Southern and coastal parts of Europe, having suffered from forest brands for decades are have now no plantation.	Air-pollution is controlled on a global level. Smoking is prohibited globally. Allergy prevention programmes are operating effectively. Forest brands are rare phenomena and there is the infrastructure (vehicles, helicopters, roads) to stop the brands within a few hours anywhere within the EU.	Health issues similar to scenario 2. Here urban air pollution is kept in a low level, so that the high temperature and the pollen allergies are the main issues.
Water and food-borne diseases (d)	Enteric viruses (HAV, Coxsackie B Virus), Vibrio (incl. V. cholerae) and Protozoa can be transmitted through fruit, vegetables, seafood but also groundwater, recreational and drinking water (1,5)	Water and food-borne diseases are not common. The real extent of the outbreaks though is unclear.	Storms, floods and other extreme weather effects will increase the transport from faecal and waste water sources. Increased growth of Vibrio and maturation and infectivity Protozoa, associated with high temperature. Establishment of epidemics in developing countries, remarkable outbreaks in industrialized countries.	Water and food-borne diseases are not common. The few outbreaks are monitored, are well documented and analyzed centrally	Situation similar to Scenario 2. In this case the outbreaks are well documented through an effective surveillance system within Europe and every member state can react appropriately in cases of outbreaks. There is little or no international cooperation.
Vector and rodent-borne diseases (e)	Pathogens spend part of their life-cycle in arthropods and rodents, subject to weather and climate changes, that can affect the transmission of the diseases. Regarding vector-borne diseases, survival can decrease or increase depending on the species. Often vectors have higher survival at higher latitudes and altitudes with higher temperatures. There are changes in the susceptibility of vectors to some pathogens. There are changes in the rate of vector population growth, in the feeding rate and host contact and in the seasonality of populations to be anticipated (1).	A few changes regarding the seasonality and the incubation rates of the pathogens have been detected. Floods are relative in the last five decades, but dry seasons are observed only in a few regions in Europe. Increased host mobility leads to only a slight increase of the incidence of infections. The few outbreaks are still badly and only nationally documented. All efforts for a proper biobank for rare diseases in Europe have failed.	Increased rain increased larval habitat and vector population size, creating new habitats. Low rainfall created habitat by causing rivers to dry into pools. Decreased rain can increase container-breeding mosquitoes by forcing increased water storage. Epic rainfall events can synchronize vector host-seeking and virus transmission. Increased humidity increases vector survival. Humidity effects on malaria parasite development in the mosquito host. Increased rain can increase vegetation, food availability, and population size of rodents. Increased rain can cause flooding, increasing human contact with rodents. The extrinsic incubation period of pathogens in vectors at higher temperatures will decrease. Significant changes in transmission season and the distribution of pathogens is anticipated. “Tropical” diseases are a routine in Europe. Only national, inadequate documentation of the outbreaks. All tries for a European health informatics system have failed. Non-harmonized data cannot be processed. Regional outbreaks of vector or rodent-borne diseases especially in the poorest regions of the EU. The lack of medical education and the increased patient and host mobility will deteriorate the situation (1)	The health effects are similar to scenario 1. A good monitoring system for outbreaks of vector and rodent-borne diseases in Europe and a proper biobank for the documentation of rare diseases have been established already since 30 years.	The health issues are similar to these of scenario 2. Outbreaks within the EU are here better documented and are epidemiologically and genetically analyzed. All countries use the same indicators and the common European patient informatics system is being used. Drugs for the new illnesses are being produced in the EU but still cost a lot to the countries. The health indicators show a new gap between the European citizens of rural and urban areas. The ageing population is more vulnerable. Climate change and the related harm are prioritized in the medical and health curricula.
Effects of food and water shortages (f)	Food and water shortage is primarily a political and demographic issue. Natural disasters, drought and massive population mobility are the main factors that can lead to food shortage (1).	Floods and drought seasons are not the rule, but happen now and then. European farmers in different countries are unequally prepared and the essential infrastructure is only partially there. Water is imported from Russia.	Natural disasters, floods and drought season are a routine globally and in Europe. Crops are very often destroyed from the weather. Vegetables and agricultural products are extremely expensive and usually are imported. European citizens keep planting vegetables in their gardens now and then for personal use. Poor populations in urban and rural areas are undernourished.	There is no shortage of food or water. Sea water is desalinated since twenty years. The agricultural production has increased in the last decades and an important amount of the production is exported to the USA.	Floods and drought season are a routine in Europe. The agricultural activities in Europe are minimized. Agricultural products are massively imported from South America and Asia.
Infections, mental, nutritional diseases (disruption) (g)	Factors influencing the vulnerability to climate change: disease status, socioeconomic status, demographic factors, integrity and capacity of water and sanitation systems, local food supplies, access to information and health literacy, and geographical factors, such as exposure to extreme events, altitude, rurality, proximity to high-prevalence disease areas, ecological integrity (1).	Minor health problems due to climate change. The rest of the trends, ageing, socioeconomic inequalities, etc within the EU still need to be addressed.	Dramatic increase of climate change related illness and deaths among poor people, patients with CVDs and elder patients. Population ageing in Europe will increase the significance of the hazard. There is no effective system of early warnings of extreme events in Europe. Coastal populations will need to move and are affected significantly from the sea level rise. Reimbursements will be asked centrally from the EU, leading to a new financial crisis in the Union. Populations in deforested or environmentally degraded areas will face extreme weather events on a daily basis.	Similar to scenario 1.	Similar to Scenario 2. However now in Europe health warnings are usual and relative effective to inform the population. Additionally, populations bordering non-EU member states will suffer significantly from vector-borne diseases.

Politics and the Society (h)	The EC and the respective DGs have just started working on the issue of climate change. The European citizen is only vaguely informed about the issue and ignores the relevance of the involvement of the EC in this global health problem. Climate change is still neglected in the medical and health curricula in Europe. There is no central system for the data collection and analysis of patients (1,3,5,14)	Although the EC has not been involved as a whole, the UN and especially IPCC have managed to lead effectively towards drastic reduction of emissions. BRICS and other flourishing economies, incl. Turkey, have been the leading actors within the last decade. The global warming process has stopped. The sea level has been raised for only 1-2 meters in the last years and will still raise for the next 50 years around 1 meter. The European citizens enjoy living in a better world. Since a few decades others decide for them in the global for a, since except from a few exceptions, the voice of the Union is quite weak.	The EC has failed to influence effectively the climate change problem. The respective DGs failed to cooperate neither proactive nor reactive to manage the problem. Too much money is being invested to treat the climate change-related harm. Drugs against former tropical diseases are imported massively. The member states do not agree in the measures to be taken. The former BRICS countries, now with a few new members, have also not prioritized the issue. The European citizens regard the EU as responsible for the situation and the Union is at risk.	The EC is a core actor within IPCC since 40 years. The cooperation with other countries, incl. BRICS has been fruitful. The emission rates within the EU have been minimized since30 years and currently in all IPCC countries. The central system for the documentation of patients' data has been used as an example for other countries. The united, European medical and health sciences curriculum includes global health issues. The European citizens are informed appropriately about climate change and the related hazard. They know that the situation is fragile, but they are committed to participate individually and as population.	The EC has worked hard within the last years. The emission rates within the EU have been minimized within the last 50 years. However there was a lack of cooperation internationally, especially with the US and the BRICS. The IPCC also failed guide all actors properly. Multinational companies kept earning money, ignoring the environmental consequences of their activity. European citizens know that the EU budget has been invested only within the Union, as the member states always wanted. The world starts where the EU ends.

Development of strategies

The final step in scenario planning is the development of strategies that steer the future towards the most desirable plot (S3), avoiding all less desirable ones (9). These strategies are presented in Figure 2. The letters that accompany the dimensions in Figure 1 will be used as references for the strategy planning in Figure 2, e.g. Scenario 1, politics and society is S1h.

Discussion

The impact that the climate change may have in Europe and globally in 2050 is uncertain. IPCC and WHO predict that in Europe it will be via thermal stress and air pollution, vector and food-borne diseases, water-related diseases and flood effects (1). These issues have been described extensively in the

Figure 2. Summary of strategies recommended for the European Commission to implement

Strategies addressing the vulnerability of the population

Improve health literacy about: climate change, UV-protection, heat-wave protection, dealing with allergies (S1a, S2a, S2c, S1h)

Develop strategies to deal with ageing, e.g. supporting young couples (S2a)Address and prevent CVDs and relevant co-morbidities (S2g)

Strategies addressing Monitoring and Quality Assurance

Monitoring outbreaks of influenza and climate change-related infectious diseases, e.g. water, food, vector and rodent-borne diseases· epidemiological analysis of the outbreaks (S2a, S2d, S2d, S4e)

Development of a central system for the surveillance of natural disasters and outbreaks of infections and harmonize the indicators for the assessment (S3b, S3d)

Develop an effective warning system for outbreaks of infections and natural disasters (S2b)

Strategies addressing water and food shortages

Water desalination to address water shortage (S1b)

Coordination of population mobility to avoid spreading of infectious diseases and food or water shortages (S3e, S1f)

Strategies addressing medical needs

Improve medical and health education about vector-borne and "tropical" diseases (S3e, S3h)

Support the research for the development of personalized therapeutics (S3a)

Produce drugs to treat patients with tropical diseases (S4e)

Strategies addressing natural disasters (proactively or reactively)

Improve housing conditions in the EU (environment-friendly, weather tolerant houses) (S1a, S3a)

Focus on flood prevention in cities (S1b)

Flood prevention at coastal, especially touristic areas (S2b)

Figure 2. Summary of strategies recommended for the European Commission to implement

Strategies addressing directly the driving forces of the climate change

Use exclusively alternative methods of energy, avoiding the production of fuel pollutants and GHG (S2c, S3h)

Developing a transnational rescue plan to deal with forest brands and support the fire-brigade with the essential infrastructure (forest roads, helicopters, vehicles) (S3c)

Elimination of smoking (S3c)

Develop and industrialize equally and environment-friendly the European agriculture (S2f)

Bridge the gap of socioeconomic inequalities within different regions of the EU (S2b)

EU Politics

Cooperate and play a leading role within IPCC (S2h)

Appoint liaison officers to cooperate with respective representatives of other international actors, e.g. USA, BRICS, OIC and Turkey (S3h)

Better coordination of the work and cooperation of the respective DGs (S2h)

Discussion among the member states about the importance of climate change· all member states should realize the necessity for the EC to play an active international role (S2h)

scenario plots. The strategies to be implemented to address them have also been presented in the previous section, after analysis of the elements of every anticipated future.

Generally, the EC should address the driving issues of vulnerability of the population, including ageing, and establish effective, international surveillance systems to monitor infections and their outbreaks, natural disasters and extreme temperatures. Water and drug shortages shall be addressed; socio-economic inequalities and bad housing conditions must be improved; GHG emissions must be minimized, forcing the use of alternative methods of energy production. Health literacy must be addressed; mobility within the Europe must be better coordinated.

Moreover, Europe must understand the core role to be played in the global health scene. Committed not merely by the health-related articles of the Treaties, but by the values and the call for global action of the European citizens themselves, the EC must work proactively through the internationally established fora, before the need for reactive behaviours is needed. Cooperation of the respective DGs, especially DG SANCO, DG Development and DG Environment and effective liaising with the BRICS, OIC and the Americas, within the IPCC network, shall be a core element in the European approach to address climate change and the related hazard within the next decades.

The time is short and the climate-related problems are inevitable to some extent. However, since the level of uncertainty in the anticipated futures is high, there are still options to ensure that the world in 2050 will be a better, or at least not a worse place.

Conflicts of interest: None declared.

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