

Tracking progress on health and climate change in Europe

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Left unabated, climate change will have catastrophic effects on the health of present and future generations. Such effects are already seen in Europe, through more frequent and severe extreme weather events, alterations to water and food systems, and changes in the environmental suitability for infectious diseases. As one of the largest current and historical contributors to greenhouse gases and the largest provider of financing for climate change mitigation and adaptation, Europe's response is crucial, for both human health and the planet. To ensure that health and wellbeing are protected in this response it is essential to build the capacity to understand, monitor, and quantify health impacts of climate change and the health co-benefits of accelerated action. Responding to this need, the *Lancet Countdown in Europe* is established as a transdisciplinary research collaboration for monitoring progress on health and climate change in Europe. With the wealth of data and academic expertise available in Europe, the collaboration will develop region-specific indicators to address the main challenges and opportunities of Europe's response to climate change for health. The indicators produced by the collaboration will provide information to health and climate policy decision making, and will also contribute to the European Observatory on Climate and Health.

Introduction

Since preindustrial times, global average temperature has risen by 1.2°C.^{1,2} In Europe, warming has been almost twice that, with an increase of 2.2°C over the same period.³ If unabated, climate change could result in multidimensional and irreversible impacts on the health of present and future generations, with more frequent and severe extreme weather events, altered environmental suitability for infectious disease transmission, and threats to food and water security undermining the social and physical determinants of good health.⁴

The EU countries and the UK contributed to 17% of global cumulative greenhouse gas emissions from 1950 to 2012.⁵ However, with ambitious climate change policies, the EU can become a leader in the low-carbon transition. Indeed, the EU reduced its emissions (as reported to the UN Framework Convention on Climate Change, and excluding aviation; maritime transport; and land use, land use change, and forestry) by 28.3% between 1990 and 2019.^{6,7} Its commitment to reduce net greenhouse gas emissions by at least 55% from 1990 levels and reach net-zero emissions by 2050 was provisionally accepted into law—an ambition underpinned by the European Green Deal.⁸ In the wider WHO European region, the European Environment and Health Task Force, through its Working Group on Health in Climate Change, is promoting the integration of climate change and health agendas. However, the nationally determined contributions of all countries in the region would still fail to deliver the commitments made under the Paris Agreement.^{9–11} Much remains to be done.

Central to ensuring health is maximised through accelerated action is the capacity to understand, monitor, and quantify the health impacts of climate change and the health co-benefits of climate change mitigation and adaptation measures.¹² Responding to this challenge, the *Lancet Countdown in Europe* is established as a research collaboration whose mission is to monitor health and climate change in the region. Building on the work of the

global *Lancet Countdown*,^{4,13} it will leverage the wealth of data and cross-disciplinary expertise in Europe to refine and build upon the contributions of the global *Lancet Countdown*, developing high-resolution Europe-specific indicators that explore in further depth aspects of particular relevance to the region. In particular, efforts will be made to reflect health inequalities and identify vulnerable populations. At the same time, the expertise and scientific developments of the *Lancet Countdown* in Europe will feed into the broader *Lancet Countdown* collaboration, with the coordination of the global *Lancet Countdown* ensuring synergy between this and the other regional efforts of the collaboration. In this way, the developments of the *Lancet Countdown* in Europe will contribute to refining the methods of and contributing new indicators to the global and other regional efforts.

The initiative will mirror the approach of the global *Lancet Countdown*, and monitor health dimensions of climate change in Europe across five key domains: (1) climate change impacts, exposures, and vulnerabilities; (2) adaptation, planning, and resilience for health; (3) mitigation actions and health co-benefits; (4) economics and finance; and (5) politics and governance.¹³ Indicators will be refined on an annual basis as new data and better methods become available. Indicators for the *Lancet Countdown* in Europe will be developed following the same criteria as the global *Lancet Countdown*,¹⁴ albeit with geographical resolution requirements adjusted to the scope of this project. The criteria for indicators are presented in the appendix. In its initial stages, the work will focus on the 38 European Environment Agency (EEA) member states and cooperating countries, with a view to expanding coverage to the whole WHO European region.

The outputs of this collaboration will be published annually and will further contribute to the European Climate and Health Observatory,¹⁵ of which the *Lancet Countdown* is a key partner. Through these platforms, the *Lancet Countdown* in Europe will provide decision

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See Online for appendix

For the webpage of the *Lancet* Countdown in Europe see <https://www.lancetcountdown.org/europe/>

makers with evidence to tailor policies to protect health. By offering standardised indicators across European countries, it will contribute to benchmarking, and promote countries' accountability against climate and health commitments. The data for the indicators of the *Lancet* Countdown in Europe will also be made openly available online for download, through the collaboration's webpage. Wherever possible, data will be displayed at a subnational level, an effort that is expected to provide a valuable resource to both national and local policy makers, better reflect the country's health and climate change profiles, enable the identification of vulnerable populations, and inform local policy making to protect the health of European populations. With 75% of the population in Europe living in urban centres,¹⁶ efforts will also be focused on contributing city-level indicators that can provide a useful resource to urban planners and city authorities.

This paper presents the framework for the *Lancet* Countdown in Europe.

Tracking progress on health and climate change in Europe

Climate change impacts, exposures, and vulnerabilities

Climate change is already affecting the health of European populations. Rising temperatures pose substantial health risks in Europe, leading to increasingly intense heatwaves over the past years and increases in heat-related mortality.¹⁷ Indeed, estimates suggest that heat-related mortality had increased by 33% in the WHO European region in 2018 compared with 2000.¹³ Furthermore, it has been estimated that one in three European deaths from heat between 1990 and 2018 were attributable to anthropogenic global warming.^{18,19} Due to Europe's ageing populations, urbanisation, and high prevalence of chronic health diseases, European populations are globally the most vulnerable to heat.^{20,21} Rising temperatures will intensify European heat-related health risks, particularly affecting the Mediterranean and eastern Europe.²²

The increased frequency and intensity of extreme weather-related events associated with climate change also threatens the health and wellbeing of European populations.^{23,24} Unabated, climate change puts northern coastal Europe at greater risk of river and coastal flooding,²⁵ while southern Europe is at increasing risk from droughts and wildfires.²⁶ Accordingly, in 2018, more European countries experienced wildfires than ever before, with Spain and Portugal seeing the biggest increases in exposure to high meteorological wildfire risk.¹³ These alterations also threaten agricultural systems, with potential immediate and indirect impacts on food security and nutrition.²⁷ In addition, the changing environmental conditions are also leading to shifts in allergenic pollen concentrations and longer pollen seasons in Europe, which could result in more allergic sensitisations and symptoms.^{28,29} With respiratory

allergies being a major health burden in Europe, this trend is particularly concerning.³⁰

Another important way in which climate change affects health is through increased risks of infectious disease transmission.³¹ The environmental suitability for the transmission of dengue and chikungunya in Europe has increased by almost 60% since 1950–59, with similar trends expected for West Nile virus.^{31,32} The compound risk of more suitable climate conditions and increased travel and transport with countries where these arboviruses are endemic enhances the probability of local transmission. Moreover, the lifecycle rate of *Ixodes ricinus* ticks, which transmit Lyme disease and tick-borne encephalitis to humans, substantially increased from 1950 to 2018, contributing to the spread of the diseases.³³ Likewise, environmental conditions are becoming increasingly suitable for transmission of water-borne *Vibrio* bacteria, particularly in the Baltic Sea.³⁴

Given the multifactorial effects of climate change on the health of Europeans, understanding, identifying, and monitoring risks and vulnerable populations is essential for delivering interventions protecting human health. Therefore, the *Lancet* Countdown in Europe will develop indicators that track climate change-related risks and health outcomes, along four tiers: (1) climate change-related hazards; (2) population exposure to those hazards; (3) population vulnerability to hazard-related health impacts; and (4) health impacts attributable to climate change. The wealth of health and disease surveillance data in Europe, together with high geospatial and temporal resolution of remote sensing tools, will enable accurate and relevant monitoring of changes in climate change-related health impacts, and the assessment of the health impacts of climate change-related adaptation measures. The collaboration will focus on health aspects relevant to Europe, including health impacts of changing exposure to extremes of heat and cold; infectious diseases relevant to Europe, such as Lyme disease, tick-borne encephalitis, and West Nile virus; impacts on agriculture and nutrition; and the health impacts of pollen.

Adaptation, planning, and resilience for health

The health of European populations is already affected by climate change-related processes.¹³ Even with ambitious mitigation efforts, further temperature increase is unavoidable. Health adaptation and resilience is therefore essential and can reduce health risks from climate hazards and minimise exposures and vulnerabilities. Rapid and proactive implementation of these measures is urgent and requires localised interventions and planning within Europe and its subregions.

Multiple climate change risk assessments and adaptation plans have been developed, both nationally and EU-wide. Although most governments recognise climate threats to health, concrete health or health-care systems objectives are often weak and specific health adaptation plans often absent.³⁵ Locally, adaptation remains largely

siloes in specific departments, with little or no inclusion of health authorities or consideration of potential co-benefits, impacts, or unintended harms to public health.³⁶ The EU is taking steps to improve the knowledge base for climate and health adaptation, championing the European Green Deal, EU4Health, and the EU Adaptation Strategy.^{8,37,38} The latter states a specific need for a deeper understanding of the climate and health risks.¹⁵ However, implementation of adaptation measures remains slow,^{39,13} and the EEA has called for urgent implementation of targeted early warning systems, nature-based solutions, and urban redesign. If designed in collaboration with public health experts, these adaptation tools can deliver major health co-benefits.³⁹

The burden of the multiple health risks that climate change poses on health systems is also expected to increase. The COVID-19 pandemic provided a glimpse of the fragility of Europe's health systems when faced with unexpected demands.⁴⁰ Increasing attention to climate resilience and adaptation in this sector is therefore crucial to protect the health of European populations.

The *Lancet* Countdown in Europe will adopt a multiple-level assessment of adaptation, planning, and resilience for health in Europe to inform the development of an evidence-based coordinated adaptation framework. The first set of indicators will monitor the extent to which authorities at national, local, and city level are prepared to deliver climate adaptation for health. For this issue, one aspect that the indicators will monitor is the degree to which health considerations have been incorporated in the national climate change adaptation strategies, plans, and policies compiled by the European Climate and Health Observatory⁴¹ and in the city-level adaptation plans submitted to the Covenant of Mayors for Climate and Energy.⁴² This will include monitoring the extent to which risks have been identified, and that information will be used to develop adaptation plans that protect human health.

The second set of indicators will monitor the implementation of adaptation strategies that can reduce the risks of climate change to human health identified by the relevant authorities, as well as the risks identified in the previous section indicators. This second set of indicators will include using remote sensing data to monitor urban green space, tree coverage, and blue space, which reduce urban heat and improve overall mental and physical health from increased green exposure. Changes in urban building fabric, green or cool roof coverage, and the use and availability of cooling services will also be tracked. Furthermore, with extreme weather events threatening essential infrastructure, indicators will track policies and interventions for adaptation and resilience in areas relevant to health, such as sewage systems.

The third set of indicators will monitor the extent to which there are systems in place to protect populations from climate risks, by tracking the implementation of

early warning, monitoring, and response systems for heatwaves and extreme weather events, as well as for relevant climate-sensitive infectious diseases. The latter is particularly relevant in the current context of the COVID-19 pandemic, which exposed deep flaws in the capacity of countries to promptly detect and respond to infectious disease outbreaks. Finally, these indicators will track the extent to which health systems in Europe are adapting and building resilience in the face of the rising climate change risks previously identified. Importantly, the implementation of adaptation measures will be monitored in the context of existing inequalities to assess how variation in coverage might impact vulnerable populations.

Mitigation actions and health co-benefits

Accelerated climate change mitigation is not only essential to meet the Paris Agreement goals, but also for promoting healthier lifestyles. The main sources of emissions in the EU are the power sector (25%), transport (22%), industry (20%), agriculture (12%), residential and commercial buildings (12%), international shipping (4%), aviation (3%), and waste (3%).⁴³

Health risks associated with these emission drivers are considerable.¹³ In 2019–20, only 127 of 323 cities in EEA member countries met WHO's guidelines for fine particulate matter (PM) concentrations,^{44,45} and anthropogenic PM_{2.5} contributed to 404 000 premature deaths in the WHO European region in 2018, with fossil fuel burning and agriculture the main contributors. In parallel, the WHO European region is the world's biggest red meat consumer; excess red meat consumption leads to 330 premature deaths per million inhabitants each year in the region, and accounts for 72% of all its agricultural emissions.¹³ Promoting better agricultural practices, reducing red meat consumption, and transitioning away from fossil fuels holds enormous potential for both climate change mitigation and for public health.^{13,46}

With over 75% of European populations residing in urban areas, mitigation through urban and transport interventions can also deliver health co-benefits. Promoting active travel could greatly reduce disease burden and overall mortality through increased physical activity, reduced air and noise pollution, and reduced traffic-related injuries, leading to healthier cities enjoyed by all.^{47–49}

To capture the health gains of Europe's low-carbon transition, the *Lancet* Countdown in Europe will develop indicators of mitigation and health co-benefits along three tiers, following the framework described by Hess and colleagues.⁵⁰ The first tier will track progress along each mitigation sector for which health-relevant policies can be developed. This tier will focus on energy, transportation, buildings, food systems, and land use and land cover based on their health co-benefits potential in Europe. The second tier will track exposures relevant to, and linked to, those mitigation pathways—including air pollution, red meat consumption, and urban noise

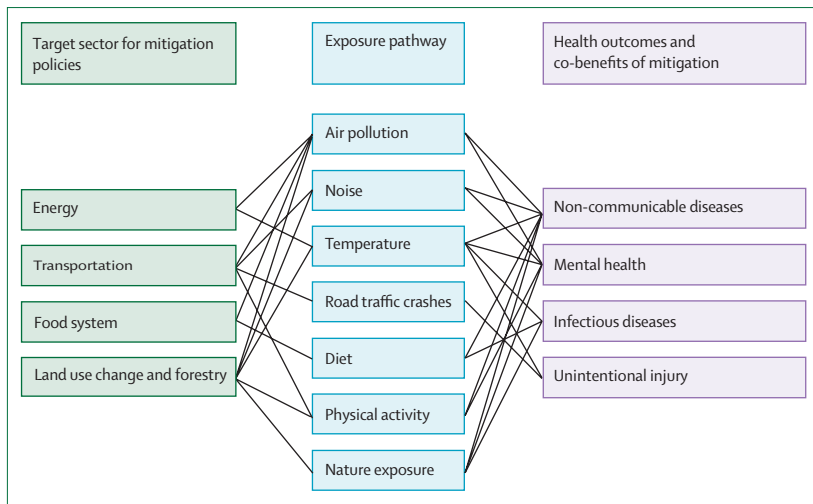


Figure 1: Conceptual model linking sectors targeted by mitigation policy, exposure pathways, and health co-benefits

levels. The third tier, leveraging available European epidemiological data, will monitor the attributable health outcomes of those exposure pathways. Accordingly, the conceptual model (figure 1) links mitigation actions to relevant exposure pathways and associated groups of health outcomes. This holistic approach allows identification of European sectors delivering the biggest health co-benefits from mitigation policies.

Indicators in this section will build upon those of the global *Lancet* Countdown, leveraging additional data sources with higher geographical resolution available for Europe,¹³ and incorporate Europe-specific indicators to cover aspects not currently tracked by the global *Lancet* Countdown. These indicators will include active travel uptake and building energy performance. Active travel uptake will be tracked through the availability of travel infrastructure in cities, as cycle network length has been shown to correlate with cycle mode share (a non-linear relationship that levels off at approximately 25% cycle mode share in European cities).⁵¹ This will be complemented by tracking walkability indices for European cities, which can capture the likelihood of walking as a travel mode. Longer-term improvements will focus on city-level travel mode share, which are not collected across cities or compiled in a harmonised way at present. Further work will focus on capturing the potential health benefits of carbon sinks and monitoring the health and environmental implications of building energy performance.

Economics and finance

Both the drivers and the health impacts of climate change have major economic implications. In 2018, the monetised value of European heat-related mortality was equal to 1.2% of regional gross national income, with the highest costs observed in Germany.¹³ Likewise, PM_{2.5} exposure driven primarily by fossil fuel combustion led

to years of life lost, with an economic value of €129 billion per year.¹³ Moreover, European climate change-related labour productivity losses, mostly caused by occupational heat stress, might be worth up to €670 million per year by 2080.⁵² In total, climate change will be detrimental for European economies, with potential losses amounting to 11% of its gross domestic product (GDP) by 2050 under a severe scenario of an average global temperature increase of 3.2°C over the next 30 years.⁵³ Importantly, the economic benefits of a low-carbon transition would far outweigh the costs of inaction, with global action to limit warming to 1.5°C by 2100 expected to avoid a loss of US\$264–610 trillion compared with the current trajectory.⁵⁴ Even if the cost of climate change itself is excluded, other economic benefits of transitioning away from fossil fuels and accelerating climate change adaptation are likely to substantially offset and even outweigh the costs of transition.⁵⁵

Representing 16% of the world's GDP, the EU is the third largest economy and, together with its member states, the world's biggest provider of finance for climate adaptation and mitigation action in “developing countries”, at €21.9 billion in 2019.⁵⁶ The European Commission has also proposed to assign at least 30% of expenditure from the 2021–27 EU budget and Next Generation EU to meeting its climate change mitigation targets.⁵⁷ With investment in renewable energies estimated to create three times more jobs per unit of spend than those in fossil fuel industries, this also represents an opportunity for net job creation.^{58,59} Accelerating its commitments in line with the Paris Agreement, the EU has therefore the potential to become a global leader in developing a green economy, and has the opportunity to create a more equitable and prosperous economy based on zero-carbon energy.^{60,61}

Understanding the economic dimensions of climate change and health provides context, justification, and incentive for policy action in Europe. Generating information on the costs of inaction and economic benefits of adaptation and mitigation policy is therefore essential. The *Lancet* Countdown in Europe will develop indicators falling within two broad domains: economic costs of climate change impacts on health, and the economic transition to a healthy, low-carbon economy. The first group of indicator domains will use data on health-care costs of morbidity and mortality compiled by the Organisation for Economic Co-operation and Development (OECD) and the WHO Regional Office for Europe, to monitor the economic costs of climate change-related health impacts. Associated costs, such as loss of labour supply and productivity resulting from changing climatic conditions, will likewise be tracked. Work under this domain will also be focused on measuring the avoided economic losses associated with climate change mitigation and adaptation interventions.

The second group of indicators will track investments in low-carbon industries and technologies, carbon tax

instruments and net carbon pricing in Europe, and other policy incentives and drivers of the green economy, data for which are tracked in detail in Europe. It will also track funds destined to support the implementation of relevant adaptation and mitigation policies, and track employment in the low-carbon sector. The high-resolution data collected by organisations such as EuroStat and the OECD will underpin the development of indicators in this sector. Given the expected long-lasting impact of COVID-19 recovery in the European economy, indicators in this domain will explore its influence in the transition to a healthy, low-carbon economy.

Politics and governance

The previous sections highlight why European governments must ramp up climate action. However, this process requires a supportive political context in which different actors and institutions in society engage with, and address, the health dimensions of climate change.⁶²

Understanding how different actors and processes address the health impacts of climate change is especially important in the European context. European policy change is rooted in democratic processes, which include political deliberation, public engagement, media coverage, civil society action, and multilevel governance structures. These processes involve a broad set of actors in society (including media, civil society, corporations, and citizens)⁶³ that can influence government responses to climate change and health. For these responses to be effective, their support and engagement is therefore essential.

For this to happen, it is paramount that the health dimensions of climate change are reflected across domains including scientific research, media coverage, policy and legislation, and citizens' attitudes. Existing research presents a mixed picture across these areas. For example, several European countries are at the forefront of scientific research on health and climate change, and media coverage in European newspapers is increasing.¹³ Yet, within global governance structures, European countries and the EU are largely silent on the health impacts of climate change.^{64,65} This is despite the EU long being considered a "normative power" in global politics driving climate action.⁶⁶ There are also concerns that rising populism in parts of Europe is fuelling anthropogenic climate change scepticism.⁶⁷

The *Lancet* Countdown in Europe adopts a broad societal approach to the politics and governance of climate change and health. The initiative tracks progress in domains that influence the shape and speed of the European response, as well as reflecting the societal impacts of the health consequences of climate change. The specific domains that will be considered are citizens, the media, government and parliament (including national and EU legislation and policies), civil society, the private sector, and scientific research. The guiding framework is based on a systems perspective conceptualising

society as a set of interconnected elements, each affecting one another. The main indicator domains identified in this way are presented in figure 2.

Greater European data availability across these domains enables the development of high-resolution indicators at different societal levels. For example, an indicator will be produced on political engagement with climate change and health in European Parliament debates using machine learning methods that track references to climate change and health in individual legislators' speeches. This can be used to assess whether there is engagement and support for climate change and health actions by legislators from different EU member states, and across the political spectrum. The wide use of social media (eg, Twitter) by Europeans enables the production of an indicator on individual online engagement with climate change and health. Such an indicator is especially important given concerns that misinformation on social media platforms is fuelling climate change denial.⁶⁸ In tracking progress on these indicators—and others linked to the media, private sector, civil society, and legal frameworks—the collaboration will shed light on the extent to which governments and societies in Europe are responding to health impacts of climate change.

Conclusion

The framework presented here will form the basis of the work of the *Lancet* Countdown in Europe. The multidisciplinary nature of the collaboration will foster a holistic approach to health and climate change in Europe, unifying research and presenting a more complete picture by considering infectious and non-communicable diseases; co-benefits of adaptation and mitigation policies; and the social, economic, and political drivers of climate change and health in Europe. The data produced will

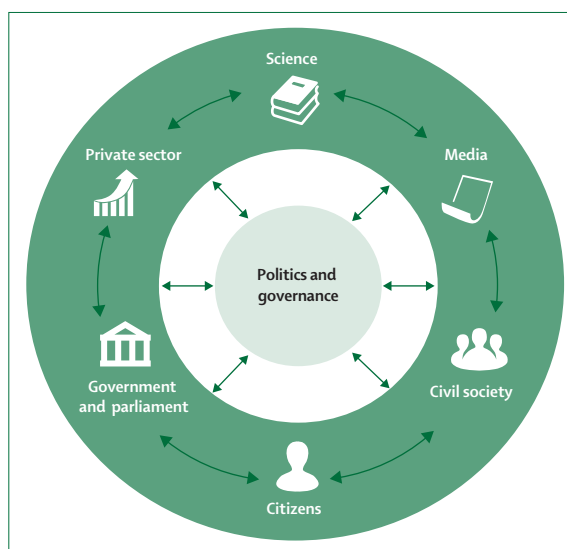


Figure 2: Domains identified through a systems perspective on the politics and governance of climate change and health in Europe

enable the identification of emerging risks, health opportunities of climate policies and actions, and monitoring of the transition towards decarbonised, healthy societies. Leveraging the wealth of data available for countries in Europe, the collaboration will assess health impacts and identify vulnerable populations, thereby informing policies to reduce the health inequalities.

By contributing indicators, insights, and analyses, this work will provide robust evidence to inform European adaptation and mitigation policies that protect health and the planet simultaneously. As the collaboration grows, we welcome input and suggestions from researchers and policy makers across Europe who are willing to contribute to this initiative.

Contributors

All authors contributed to the overall paper structure and concepts, and provided input and expertise to all sections. KvD, MR, RL, JCS, JR, CT, SJ, ND, PD, IGH, JMA, and MN participated in the drafting of the manuscript. Coordination, strategic direction, and editorial support were provided by MR, KvD, and MN.

Declaration of interests

IGH, KvD, and MR report grants from the Wellcome Trust, during the conduct of the study. All other authors declare no competing interests.

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