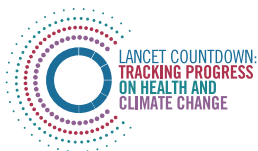


The Lancet Countdown on Health and Climate Change

Policy brief for Germany

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HelmholtzZentrum münchen
German Research Center for Environmental Health



POTSDAM INSTITUTE FOR
CLIMATE IMPACT RESEARCH



 **Hertie School**

Climate change and health in Germany

Climate change presents an unacceptably high risk for the current and future health of populations around the world.¹ In Germany, under a business-as-usual scenario, the average temperature is projected to increase 1.0-1.3°C by 2050 and 3.7°C by 2100 compared to 1971-2000.² The impacts of the changing climate on human health, which are already felt today, are expected to intensify in the future.^{3,4}

Harm to health is directly caused by extreme weather events, in particular by high ambient temperatures during heatwaves.⁵⁻⁸ The frequency and intensity of heatwaves is projected to increase in central Europe.⁹ Under a business as usual scenario, five additional heatwaves per year between May and September in Northern Germany and up to 30 additional heatwaves in Southern Germany are forecast by the end of the century compared to 1971-2000.¹⁰ Heat stress and high ground-level ozone concentrations during heatwaves can have serious health consequences, especially among the elderly and people with cardiovascular and respiratory diseases.¹¹ For example, it has been forecast that the impact of higher temperatures on acute myocardial infarction overrides the benefits of less frequent cold exposure by the end of the century.¹²

Climate change also affects human health through changes in ecosystems. Rising temperatures enable vectors (mosquitoes and ticks) of infectious diseases to spread. This includes infectious diseases that are already present in some parts of Germany, such as tick-borne encephalitis (FSME) and Lyme disease (Borreliose),³ but also others not yet transmitted in Germany, such as dengue, Zika or chikungunya,¹³ or West Nile virus – for which the first autochthonous human infection was diagnosed in the State of Saxony this year.¹⁴

National political context

With the ratification of the Paris Agreement,²⁰ Germany committed jointly with all other EU Member States to reduce domestic greenhouse gas emissions 40% by 2030 and 80-95 % by 2050, aligned with limiting global warming to well below 2°C.²¹ In accordance with EU goals and regulations, Germany's Climate Change Mitigation Plan 2050 (Klimaschutzplan 2050) outlined strategic actions to ensure carbon neutrality by 2050.²² Interventions to be implemented by the health sector are not explicitly included, and, accordingly, are absent from climate change mitigation policies and strategies of the 16 Federal States. Germany is well positioned to support the integration of health considerations within the interventions proposed in the EU's Nationally Determined Contributions (NDC) under the UNFCCC, due to be submitted in 2020.

Germany's preparedness, or 'adaptive capacity' to respond to the challenges of climate change has been assessed as medium to high, based on national cross-sectoral vulnerability analyses

Hence, continuous monitoring of disease-transmitting vectors is essential for an adequate risk assessment.^{3,13,15} Rising temperatures alter the allergenic pollen biology by extending seasonal duration and pollen load of plants, for instance of ragweed (*Ambrosia artemisiifolia*), increasing the burden of asthma and air-borne allergic reactions.¹⁶ Temperature increases can also cause Cyanobacteria (blue-green algae) blooms in lakes and the Baltic Sea, which may cause skin irritations.^{17,18} Furthermore, the warming of the Baltic Sea is predicted to increase the risk of *Vibrio* infections.³

Interventions to address the causes of climate change also offer substantial benefits for health: less fossil fuel combustion in the energy and transportation sectors, for example, decreases exposure to air pollution. In addition, the promotion of cycling and walking and the use of public transportation contributes to increased physical activity. Reduced air pollution and increased physical activity can both substantially reduce the burden of non-communicable diseases such as cardiovascular disease, cancer, diabetes, and chronic respiratory conditions, with considerable potential cost savings.¹⁹

There is a need to further investigate effective adaptation policies and to improve the understanding of potential health co-benefits of climate change mitigation measures. The scientific community and the health community could strengthen risk communication on current and potential future health effects of climate change to raise awareness.¹⁹

considering potentially available federal resources.²³ Since 2008, the German Climate Adaptation Strategy (Deutsche Anpassungsstrategie an den Klimawandel, DAS) provides the political framework at federal level for adaptation to climate change in all 16 Federal States of Germany and outlines the specific vulnerabilities to climate change.²⁴ Human health has been identified as one of 15 priority adaptation areas (Handlungsfelder) by the DAS. Concrete activities were first defined in the German Adaptation Action Plan (Aktionsplan Anpassung der Deutschen Anpassungsstrategie an den Klimawandel, APA I) in 2011,²⁵ and updated in 2015 according to results of the first monitoring report.^{23,26} Health is mostly addressed in adaptation strategies and action plans at state level, contributing to the DAS and the updated APA II, taking into consideration specific vulnerabilities and the strategic focus of each Federal State.^{23,24}

Key messages and recommendations

1

Health impacts from increasing heat are becoming more frequent and more severe in Germany.

There is a need to accelerate the implementation of heat health action plans at state, district and local level, as well as in health and social care facilities, following existing national recommendations.

2

The carbon footprint of the healthcare sector in Germany is substantial, accounting for approximately 5% of overall national greenhouse gas emissions and directly contributing to climate change.

Decision-makers should initiate the reduction of the healthcare sector's carbon footprint by designing and implementing climate change mitigation plans at federal, state and local level.

3

A widespread understanding of climate change as an increasing health threat is vital to delivering an accelerated response.

It is necessary to ensure rapid inclusion of climate change and planetary health education in the curricula of all health and medical schools as well as in continuous health professional training (Aus-, Fort- und Weiterbildung in Gesundheitsberufen).

Selected Lancet Countdown indicators in the context of Germany

This briefing focuses on two themes from the 2019 global Lancet Countdown report which are currently particularly relevant to Germany,¹ namely vulnerability to the heat-related risks of climate change and implementation of respective adaptation measures, and mitigation in the healthcare sector. A third focus is on a set of measures related to training and capacity building for health professionals.

Vulnerability to the heat-related risks of climate change and implementation of respective adaptation measures

Due to its ageing population, high rates of urbanisation, and high prevalence of diabetes, cardiovascular and respiratory diseases, the European population is highly vulnerable to heat exposure.¹ Health impacts of heat include heat exhaustion and heat stroke, heart attack, heart failure and acute kidney injury due to dehydration.^{11,27} Most at risk are the elderly, infants, patients with chronic diseases such as cardiovascular and kidney disease, and outdoor workers.²⁸

Increased temperatures are associated with increased acute mortality both in Germany and worldwide. In Germany, the number of heatwave exposure events* increased in recent years, when compared to the years 1986-2005.¹ The highest number of heatwave exposures on record occurred in 2018, with 12.8 million more heatwave exposures compared to the baseline. The summers of the years 2003, 2006 and 2015 claimed high

numbers of deaths attributable to heat exposure, for instance 6100 heat-related deaths in 2015.⁷ By the end of the century, Germany is estimated to face an average of 8500 heat-related excess deaths per year.²⁹

An extended time-series study in the area of Augsburg suggests that over the past decade, high temperatures serve as a clear trigger for myocardial infarction (Figure 1).³⁰ While the impact of cold was responsible for most of the temperature-associated risk between 1987 and 2000, elevated temperatures during the summer were clearly linked to myocardial infarction in vulnerable populations from 2001 to 2014.³⁰ Patients with diabetes or hyperlipidaemia were at higher risk of heat-related myocardial infarction in recent years than before.³⁰ These effects may only represent the “tip of the iceberg” as other organs and diseases are likely affected by weather extremes as well.

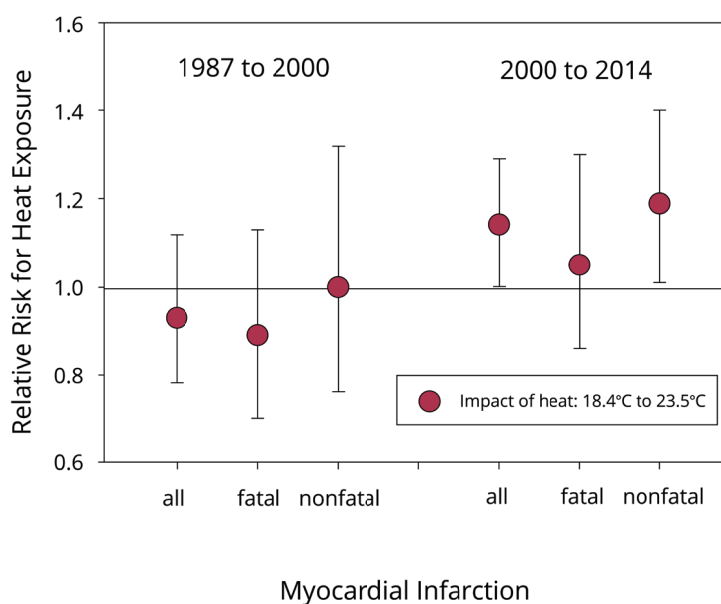


Figure 1: Associations between daily temperature and onset of myocardial infarction stratified into two time periods between 1987 and 2014, based on the KORA Myocardial Infarction Registry, Augsburg, Germany.** (adapted from 30)

In 2017, the Federal Government and respective agencies published national guidance for the development of heat health action plans at state level and their implementation at local level.³¹ To date, heat health action plans have not been systematically implemented at state and local level in Germany, but some examples of heat health measures exist.^{32,33} There is a need to comprehensively implement heat health action plans at state and local level, specifically targeting vulnerable population groups, and to evaluate and improve the effectiveness of existing plans. Reporting and registering heat-related excess mortality in “real time”, as recommended in the monitoring report of the German

Adaptation Strategy,²⁶ is necessary for monitoring and evaluation.

Strengthening climate change adaptation measures in other sectors, such as increasing green spaces through urban planning, can contribute to reducing urban heat island effects and thus to making cities more resilient to the effects of heatwaves.³ Climate change risk assessments at city level can be a preliminary step in this process. In 2018, of six cities surveyed in Germany, only Rostock had carried out a climate change risk assessment, while in three other cities (Heidelberg, Mannheim and Magdeburg) such assessments were underway.¹

*One exposure event being one heatwave experienced by one person.¹ **Cooperative Health Research in the Region of Augsburg

Mitigation in the healthcare sector

The 2019 global Lancet Countdown Report indicates that the healthcare sector was responsible for approximately 2250 Mt CO₂ equivalent emissions* in 2016, a total of 4.6% global net carbon emissions (excluding land use change);¹ a figure which is consistent with other estimates.^{34,35} In the same year, the German healthcare sector accounted for about 70 Mt CO₂ equivalent emissions, corresponding to 5.2% of overall national emissions (including those originating from outside Germany).¹ Countries show wide variation in the proportion of their healthcare sector's carbon emissions that occur inside versus

outside the country's borders; only about 40% of the carbon emissions of the German healthcare sector, for example, occur domestically.¹ Emissions per capita in Germany are higher than for other EU countries on average (Figure 2). It should be noted however that Germany has a well-established and accessible health system, which inherently leads to higher emissions. There are thus two factors to consider when monitoring healthcare sector emissions: the extent of services offered and used (which should not necessarily be reduced) and the emissions resulting from these services.

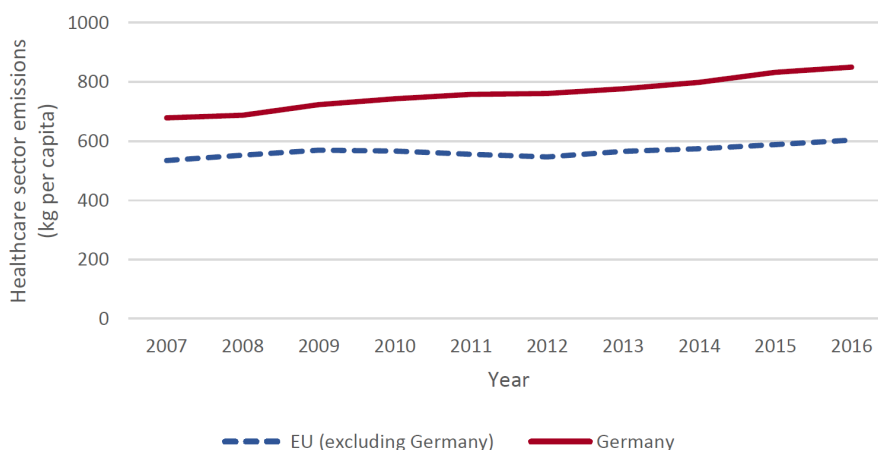


Figure 2: Healthcare sector emissions in Germany and the EU (kg of CO₂ equivalent emissions per capita).¹

The healthcare sector thus has considerable potential as well as responsibility to contribute to climate change mitigation, in line with the ambitions of the Paris Agreement to achieve carbon neutrality by 2050,²⁰ responding to its mission to protect and promote human health. Efforts to reduce greenhouse gas emissions as well as other environmental impacts of the healthcare sector are gaining momentum.

German hospitals, for example, have great potential to reduce their energy consumption. To date, the BUND (Bund für Umwelt und Naturschutz Deutschland; German branch of Friends of the Earth) awarded the quality label "Energy saving hospital" to 47 hospitals in the country.

Assessments showed that the hospitals achieved an overall reduction of about 79,000 tons CO₂ since 2001. At the same time, every hospital saved 100,000 to 2.1 million Euro per year after investing in improving their energy supply. The German project KLIK (also lead by BUND) offers advanced qualification for climate officers in hospitals, who are trained to develop specific climate mitigation goals for their health facility and

implement them.³⁶ Between 2014 and 2016, the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supported the project KLIK to implement low-investment energy-saving methods in 50 hospitals. In total, these hospitals saved 9 million Euro in operating costs and reduced their emissions in CO₂ equivalents by over 34,000 tons over three years.³⁷ Since 2019, 250 hospitals participate in the project, now named "KLIK green", aiming to implement measures in the energy sector, but also of logistics, food supply and procurement. With nearly 2000 hospitals in Germany, there is a huge potential for additional similar activities.

To further reduce the healthcare sector's carbon footprint in Germany, climate change mitigation plans in the healthcare sector should be developed on the basis of existing guidance,^{38,39} and implemented at state and local level, including in all healthcare facilities. To achieve net zero emissions by 2050, while ensuring that the standards, quality and safety of medical care are not compromised, joint efforts and close cooperation of managers of healthcare facilities, health professionals, patients, suppliers, and government are required.

*A carbon dioxide equivalent or CO₂ equivalent, is a metric measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential, by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.⁴⁵

Climate change and health in education and capacity building for health professionals

The relationship between climate change, other global environmental changes and human health is largely neglected in health professional education in Germany,⁴⁰ despite the response to climate change being a key factor in shaping the health of nations for centuries to come.²⁷

A widespread understanding of climate change as an increasing health threat is vital for health professionals to ensure that they are ready to deal with new challenges. Extreme weather events may compound the symptoms of cardiometabolic diseases in vulnerable patients or result in unforeseen mental health impacts. An additional challenge will be to recognise emerging infectious diseases in a timely manner. The health-system response at state and local level needs to be tailored towards managing events such as heat emergencies.⁴¹ Furthermore, health professionals, with their moral

authority and public influence, can play an important role in the societal response to the climate and other global environmental crises,⁴² by emphasising the short- and long-term benefits of climate change mitigation for human health,¹⁹ and the ultimate dependence of human health on a healthy environment and stable climate⁴³ and by calling for an accelerated response.

Responsible authorities and institutions are called upon to ensure rapid integration of education on climate change and health, and Planetary Health more broadly, in graduate, post-graduate and professional training curricula for health professionals in Germany. Cross-disciplinary and cross-professional perspectives as well as transformational methods should be an integral part of these training units.⁴⁴



Photo: Oskar Masztalerz, Charité Berlin

References

1. Watts N, Amman M, Arnell N. The 2019 report of the Lancet Countdown on health and climate change. *Lancet* 2019; 394: 1836–78
2. German Weather Service (DWD). Nationaler Klimareport [National climate report] [Internet]. 3rd correk. Offenbach am Main; 2017 [cited 2019 Sep 17]. Available from: https://www.dwd.de/DE/leistungen/nationaler_klimareport/download_report_aufgabe-3.pdf?__blob=publicationFile&v=5
3. Augustin J, Sauerborn R, Burkart K, Endlicher W, Jochner S, Koppe C, et al. Gesundheit [Health]. In: Klimawandel in Deutschland [Climate change in Germany] [Internet]. Berlin, Heidelberg: Springer; 2017. p. 137–49. Available from: https://link.springer.com/content/pdf/10.1007/978-3-662-50397-3_14.pdf
4. IPCC. Climate change 2014- Impacts, adaptation and vulnerability: summary for policy makers. In: Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach MDM, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy SM, P.R. Mastrandrea and LLW, editors. Climate Change 2014: Impacts, Adaptation, and Vulnerability Part A: Global and Sectoral Aspects Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Internet]. Geneva: Cambridge University Press; 2014. p. 34. Available from: http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/ar5_wgii_spm_en.pdf
5. Breittner S, Wolf K, Peters A, Schneider A. Short-term effects of air temperature on cause-specific cardiovascular mortality in Bavaria, Germany. *Heart*. 2014;100(16):1272–80.
6. Brachat-Schwarz W, Winkelmann U. Führt der Klimawandel zu einem Anstieg der »Hitzetoten«? Zur Abschätzung der Sterbefälle aufgrund hoher Temperaturen in Baden-Württemberg. *Stat Monatsh (Statistisches Landesamt Baden-Württemberg)* [Internet]. 2017;8:5–12. Available from: https://www.statistik-bw.de/Service/Veroeff/Monatshefte/PDF/Beitrag17_08_02.pdf
7. an der Heiden M, Buchholz U, Uphoff H. Schätzung der Zahl hitzebedingter Sterbefälle und Betrachtung der Exzess-Mortalität; Berlin und Hessen, Sommer 2018. *Epid Bull*. 2019;23:193–202.
8. an der Heiden M, Muthers S, Niemann H, Buchholz U, Grabenhenrich L, Matarakis A. Schätzung hitzebedingter Todesfälle in Deutschland zwischen 2001 und 2015 [Estimation of heat-related deaths in Germany between 2001 and 2015]. *Bundesgesundheitsblatt - Gesundheitsforsch - Gesundheitsschutz* [Internet]. 2019;62(5):571–9. Available from: <http://link.springer.com/10.1007/s00103-019-02932-y>
9. Fischer EM, Schär C. Consistent geographical patterns of changes in high-impact European heatwaves. *Nat Geosci*. 2010;3:398–403.
10. Jacob D, Petersen J, Eggert B, Alias A, Bössing Christensen O, Bouwer LM, et al. EURO-CORDEX: new high-resolution climate change projections for European impact research. *Reg Env Chang*. 2014;14:563–78.
11. Schneider A, Rückerl R, Breittner S, Wolf K, Peters A. Thermal control, weather and aging. *Curr Env Heal Rep*. 2017;4(1):21–9.
12. Chen K, Breittner S, Wolf K, Rai M, Meisinger C, Heier M, et al. Projection of Temperature-Related Myocardial Infarction in Augsburg, Germany—moving on from the Paris Agreement on Climate Change. *Dtsch Arztebl Int*. 2019;116:521–7.
13. Thomas SM, Tjaden NB, Frank C, et al. Areas with High Hazard Potential for Autochthonous Transmission of Aedes albopictus-Associated Arboviruses in Germany. *Int J Env Res Public Heal*. 2018;15(6):1270.
14. ECDC. Weekly updates: 2019 West Nile virus transmission season [Internet]. 27 September 2019. 2019 [cited 2019 Oct 9]. Available from: <https://www.ecdc.europa.eu/en/west-nile-fever/surveillance-and-disease-data/disease-data-ecdc>
15. European Commission. Adaptation preparedness scoreboard - country fiche for Germany [Internet]. 2018 [cited 2019 Oct 6]. p. 29. Available from: https://ec.europa.eu/clima/sites/clima/files/adaptation/what/docs/country_fiche_de_en.pdf
16. Ziska LH, Makra L, Harry SK, Bruffaerts N, Hendrickx M, Coates F, et al. Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis. *Lancet Planet Heal* [Internet]. 2019;3(3):e124–e131. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/30904111>
17. Stark K, Niedrig M, Biederick W, Merkert H, Hacker J. Die Auswirkungen des Klimawandels. Welche neuen Infektionskrankheiten und gesundheitlichen Probleme sind zu erwarten? [Climate change impacts- Which new infectious diseases and health issues are to be expected?]. *Bundesgesundheitsblatt - Gesundheitsforsch - Gesundheitsschutz*. 2009;52(7):699–714.
18. National Environment Agency (Umweltbundesamt – UBA). Vulnerabilität Deutschlands gegenüber dem Klimawandel [Vulnerability of Germany to climate change] [Internet]. Dessau-Roßlau; 2015 [cited 2019 Sep 14]. Available from: https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/climate_change_24_2015_vulnerabilitaet_deutschlands_gegenueber_dem_klimawandel_1.pdf
19. Haines A, Ebi K. The Imperative for Climate Action to Protect Health. *Solomon CG, editor. N Engl J Med* [Internet]. 2019 Jan;380(3):263–73. Available from: <http://www.nejm.org/doi/10.1056/NEJMra1807873>
20. United Nations. Paris Agreement [Internet]. New York: United Nations; 2015. p. 27. Available from: https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf
21. European Commission. The INDC of the European Union and its 28 Member States. 2015.
22. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). Climate Action Plan 2050. Principles and goals of the German government’s climate policy [Internet]. Berlin, Germany; 2016 [cited 2019 Sep 14]. Available from: https://www.bmu.de/fileadmin/Daten_BMU/Pool/Broschueren/klimaschutzplan_2050_en_bf.pdf
23. The Federal Government of Germany. Fortschrittsbericht zur Deutschen Anpassungsstrategie an den Klimawandel [Progress report to the German Adaptation Strategy to Climate Change] [Internet]. 2015 [cited 2019 Oct 6]. p. 275. Available from: <https://www.bmu.de/download/fortschrittsber-icht-zur-klimaangepassung/>
24. The Federal Government of Germany. Deutsche Anpassungsstrategie an den Klimawandel [German adaptation strategy to climate change] [Internet]. Berlin, Germany; 2008 [cited 2019 Sep 17]. Available from: https://www.bmu.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/das_gesamt_bf.pdf
25. The Federal Government of Germany. Aktionsplan Anpassung der Deutschen Anpassungsstrategie an den Klimawandel [Adaptation action plan of the German adaptation strategy to climate change] [Internet]. Berlin, Germany; 2011 [cited 2019 Sep 17]. Available from: https://www.bmu.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/aktionsplan_anpassung_klimawandel_bf.pdf
26. National Environment Agency (UBA). Monitoringbericht 2015 zur Deutschen Anpassungsstrategie an den Klimawandel [Monitoring report of the German Adaptation Strategy to Climate Change 2015] [Internet]. 2015 [cited 2019 Oct 6]. p. 258. Available from: <https://www.umweltbundesamt.de/publikationen/monitoringbericht-2015>
27. Watts N, Amann M, Arnell N, Ayeb-Karlsson S, Belesova K, Berry H, et al. The 2018 report of the Lancet Countdown on health and climate change: shaping the health of nations for centuries to come. *Lancet* [Internet]. 2018;392(10163):2479–514. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/30503045>
28. Matthies F, Bickler G, Cardenas Marin N, Hales S, editors. Heat health action plans- guidance [Internet]. Copenhagen: WHO Regional Office for Europe; 2008. 58 p. Available from: http://www.euro.who.int/__data/assets/pdf_file/0006/95919/E91347.pdf
29. Eis, D., Helm, D., Laußmann, D., Stark K. Klimawandel und Gesundheit – Ein Sachstandsbericht. [Climate Change and Health- Assessment Report] [Internet]. Berlin; 2010. Available from: <http://edoc.rki.de/oa/articles/re0BdUKX-9pUL6/PDF/29ETCuO6Z0tk.pdf>
30. Chen, K.; Breittner, S., Wolf, K., Hampel, R., Meisinger, C., Heier, M., von Scheidt, W., Kuch, B., Peters, A., Schneider A for the KORA study group. Temporal variations in the triggering of myocardial infarction by air temperature in Augsburg, Germany, 1987-2014. *Eur Heart J*. 2019;40:1600–8.
31. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). Recommendations for Action: Heat Action Plans to protect human health [Internet]. Bonn; 2017 [cited 2019 Sep 14]. p. 30. Available from: https://www.bmu.de/fileadmin/Daten_BMU/Download_PDF/Klimaschutz/hap_handlungsempfehlungen_en_bf.pdf
32. Landeszentrum Gesundheit Nordrhein-Westfalen (LZG.NRW). Gesundheitliche Auswirkungen von Hitze [Health effects of heat] [Internet]. 2019 [cited 2019 Sep 17]. Available from: <http://www.hitze.nrw.de/>
33. Kandarr J, Mücke H-G, Reckert H. Results of a survey about activities on climate change and health in Germany 2014 [Internet]. Vol. 1. UMID: Umwelt und Mensch – Informationsdienst. 2015 [cited 2019 Sep 16]. p. 39–45. Available from: https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/erhebung_klimawandel_39-45.pdf
34. Health Care Without Harm A. Health care’s climate footprint. How the health sector contributes to the global climate crisis and opportunities for action [Internet]. Reston (VA), USA; 2019 [cited 2019 Sep 16]. Available from: https://noharm-global.org/sites/default/files/documents-files/5961/HealthCaresClimateFootprint_090619.pdf
35. Pichler P, Jaccard IS, Weisz U, Wiesz H. International comparison of health care carbon footprints. *Environ Res Lett* [Internet]. 2019;14 064004. Available from: <https://doi.org/10.1088/1748-9326/ab19e1>
36. BUND. KLIK green- Krankenhaus trifft Klimaschutz [hospitals meet climate change mitigation] [Internet]. [cited 2019 Oct 10]. Available from: <https://www.klik-krankenhaus.de/impressum/>
37. BUND. Energie-sparendes Krankenhaus [energy saving hospital] [Internet]. 2019 [cited 2019 Oct 10]. Available from: <http://energiesparendes-krank-enhaus.de/impressum/>
38. World Health Organization, Health Care Without Harm. Healthy hospitals, healthy planet, healthy people: Addressing climate change in healthcare settings [Internet]. 2009. p. 28. Available from: https://www.who.int/global-change/publications/healthcare_settings/en/
39. Health Care Without Harm. Global green and healthy hospitals- a comprehensive environmental health agenda for hospitals and health systems around the world [Internet]. 2011. p. 44. Available from: <https://www.hospital-esporlasaludambiental.net/wp-content/uploads/2016/07/Global-Green-and-Healthy-Hospitals-Agenda.pdf>
40. Bundesvertretung der Medizinstudierenden in Deutschland e.V. (BVMd). Positionspapier Klimawandel und Gesundheit [Position paper climate change and health] [Internet]. Berlin, Germany; 2018 [cited 2019 Sep 17]. Available from: https://www.bvmd.de/fileadmin/user_upload/Grundsatzentscheidung_2018-11_Klimawandel_und_Gesundheit.pdf
41. The World Medical Association (WMA). WMA Declaration of Delhi on Health and Climate Change [Internet]. 2017 [cited 2019 Sep 17]. Available from: <https://www.wma.net/policies-post/wma-declaration-of-delhi-on-health-and-climate-change/>
42. Horton R, Beaglehole R, Bonita R, Raeburn J, McKee M, Wall S. From public to planetary health: a manifesto. *Lancet* [Internet]. 2014;383(847). Available from: [https://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736\(14\)60409-8.pdf](https://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(14)60409-8.pdf)
43. Whitmee S, Haines A, Beyrer C et al., Boltz F, et al. Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health. *Lancet Comm* [Internet]. 2015;386(10007):1973–2028. Available from: [https://doi.org/10.1016/S0140-6736\(15\)61214-4](https://doi.org/10.1016/S0140-6736(15)61214-4)
44. Frenk J, Chen L, Bhutta ZA, Cohen J, Crisp N, Evans T, et al. Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. *Lancet* [Internet]. 2010;376(9756):1923–58. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0140673610618545>
45. Eurostat. Glossary: Carbon dioxide equivalent [Internet]. 2017 [cited 2019 Oct 10]. Available from: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Carbon_dioxide_equivalent

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THE LANCET COUNTDOWN

The Lancet Countdown: Tracking Progress on Health and Climate Change is an international, multi-disciplinary collaboration that exists to monitor the links between public health and climate change. It brings together 35 academic institutions and UN agencies from every continent, drawing on the expertise of climate scientists, engineers, economists, political scientists, public health professionals, and doctors. Each year, the Lancet Countdown publishes an annual assessment of the state of climate change and human health, seeking to provide decision-makers with access to high-quality evidence-based policy guidance. For the full 2019 assessment, visit www.lancetcountdown.org/2019-report.

THE GERMAN MEDICAL ASSOCIATION (BUNDESÄRZTEKAMMER)

The German Medical Association (Bundesärztekammer) is the central organisation in the system of medical self-administration in Germany. As the joint association of the State Chambers of Physicians (Landesärztekammern), it represents the interests of over 500,000 physicians in matters relating to professional policy, and plays an active role in opinion-forming processes with regard to health and social policy and in legislative procedures.

CHARITÉ – UNIVERSITÄTSMEDIZIN BERLIN

Charité – Universitätsmedizin Berlin is one of the largest university hospitals in Europe, boasting approximately 100 departments and institutes spread across 4 separate campuses. At Charité, the areas of research, teaching and medical care are closely interlinked. Approximately 18,000 members of staff are employed across its group of companies. Charité's Medical Faculty is one of the largest in Germany, educating and training more than 7,500 medical and dentistry students.

THE HELMHOLTZ ZENTRUM MÜNCHEN - GERMAN RESEARCH CENTER FOR ENVIRONMENTAL HEALTH

The Helmholtz Zentrum München- German Research Center for Environmental Health pursues the goal of developing personalized medical approaches for the prevention and therapy of major common diseases such as *diabetes mellitus*, allergies and lung diseases. To achieve this, it investigates the interaction of genetics, environmental factors and lifestyle. The Helmholtz Zentrum München is a member of the Helmholtz Association, a community of 19 scientific-technical and medical-biological research centers with a total of about 37,000 staff members.

THE POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH (PIK)

The Potsdam Institute for Climate Impact Research (PIK) is one of the leading research institutions addressing relevant questions in the fields of global change, climate impacts and sustainable development. Natural and social scientists work closely together to generate interdisciplinary insights that provide a sound basis for decision-making for society, businesses and politics. PIK is a member of the Leibniz Association.

THE HERTIE SCHOOL

The Hertie School in Berlin offers master's, doctoral and executive education programmes distinguished by interdisciplinary and practice-oriented teaching, as well as research. Its international network positions it as an ambassador of good governance, characterised by public debate and engagement. The school was founded in 2003 by the Hertie Foundation, which remains its major funder. The Hertie School is accredited by the state and the German Science Council.