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Greenhouse gas emissions reduction in different economic sectors: Mitigation measures, health co-benefits, knowledge gaps, and policy implications[☆]

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ABSTRACT

To date, greenhouse gas (GHG) emissions, mitigation strategies and the accompanying health co-benefits in different economic sectors have not been fully investigated. The purpose of this paper is to review comprehensively the evidence on GHG mitigation measures and the related health co-benefits, identify knowledge gaps, and provide recommendations to promote further development and implementation of climate change response policies. Evidence on GHG emissions, abatement measures and related health co-benefits has been observed at regional, national and global levels, involving both low- and high-income societies. GHG mitigation actions have mainly been taken in five sectors: energy generation, transport, food and agriculture, household and industry, consistent with the main sources of GHG emissions. GHGs and air pollutants to a large extent stem from the same sources and are inseparable in terms of their atmospheric evolution and effects on ecosystem; thus, GHG reductions are usually, although not always, estimated to have cost effective co-benefits for public health. Some integrated mitigation strategies involving multiple sectors, which tend to create greater health benefits. The pros and cons of different mitigation measures, issues with existing knowledge, priorities for research, and potential policy implications were also discussed. Findings from this study can play a role not only in motivating large GHG emitters to make decisive changes in GHG emissions, but also in facilitating cooperation at international, national and regional levels, to promote GHG mitigation policies that protect public health from climate change and air pollution simultaneously.

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1. Introduction

According to the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), climate change is unequivocal, and during the period 1880 to 2012, there was a warming of 0.85 °C in the global average surface temperature (Pachauri et al., 2014b; Stocker et al., 2013). Without further mitigation actions, the average temperature may rise by 2.6–4.8 °C by the end of this century (Watts et al., 2015). The health of human beings is sensitive to shifts in weather patterns and other changes of climate systems (e.g., temperature, precipitation and extreme weather events) (Smith et al., 2014; Woodward et al., 2014). Thus, climate change, both directly and indirectly, can and has already started to damage human health through various pathways, and is projected to lead to increasingly adverse impacts in future (Fig. 1) (Field et al., 2014; McMichael et al., 2006; Pachauri et al., 2014b; Watts et al., 2015; Woodward et al., 2014). In 2000, the World Health Organization (WHO) estimated that climate change could cause more than 150,000 deaths and 5.5 million disability-adjusted life years (DALYs) lost worldwide (McMichael et al., 2004). Benefits from social and economic development may offset, to a certain degree, the adverse influences of climate change on human populations, but cannot eliminate them. For instance, considering only a subset of the associated health risks—well understood impacts—and assuming continued progress in socioeconomic development and health protection, climate change is still projected to have substantial impacts on future public health (Chan, 2015; Hales et al., 2014). In 2014, WHO estimated an additional approximately 250,000 deaths due to climate change annually between 2030 and 2050. WHO suggested that their assessments represent a conservative prediction of the overall effects of climate change, because they omit several important causal pathways (Hales et al., 2014; Watts et al., 2015). If no further climate change mitigation actions are undertaken, the combined effects of the

selected impacts on global annual gross domestic product (GDP) are expected to rise over time to likely levels of 1.0%–3.3% by 2060, with the largest negative economic consequences suffered by regions in Africa and Asia (Organization for Economic Co-operation and Development, 2015). Climate change has been described as the biggest global health threat of the 21st century (Costello et al., 2009).

Anthropogenic greenhouse gas (GHG) emissions, primarily from human activity-related energy generation, transport, food and agriculture, household and industrial processes, are considered as the main driver of climate change (Pachauri et al., 2014b; Stocker et al., 2013). In order to hold the increase in global temperature to less than 2 °C relative to pre-industrial levels to avoid the risk of potentially catastrophic climate change impacts, total anthropogenic carbon dioxide (CO₂) emissions were required to be kept below 2900 billion tonnes (Gt) by the end of this century (Watts et al., 2015; Whitmee et al., 2015). However, in the years 2003–2011, an average global annual emissions growth rate of 3% per year was observed, whereas the growth figure over the 1980–2002 period was 1.2% annually (Olivier et al., 2015; Netherlands Environmental Assessment Agency, 2007). In 2014, emissions from the combustion of fossil fuels and industrial processes totaled 35.7 Gt CO₂ (Fig. 2), with current trends expected to exceed the required emissions target over the next 15–30 years (Olivier et al., 2015; Watts et al., 2015).

In terms of the potential expensive and far-reaching health consequences of climate change, as well as the likely increasing GHG emission trends, urgent and substantial actions are needed to reduce GHG emissions and thus stabilize the global climate system before the extent and magnitude become more dangerous. It has been suggested that tackling climate change could be the greatest global health opportunity in the 21st century (Watts et al., 2015). International climate change negotiations are in progress regarding further GHG reductions and increasing the number of countries

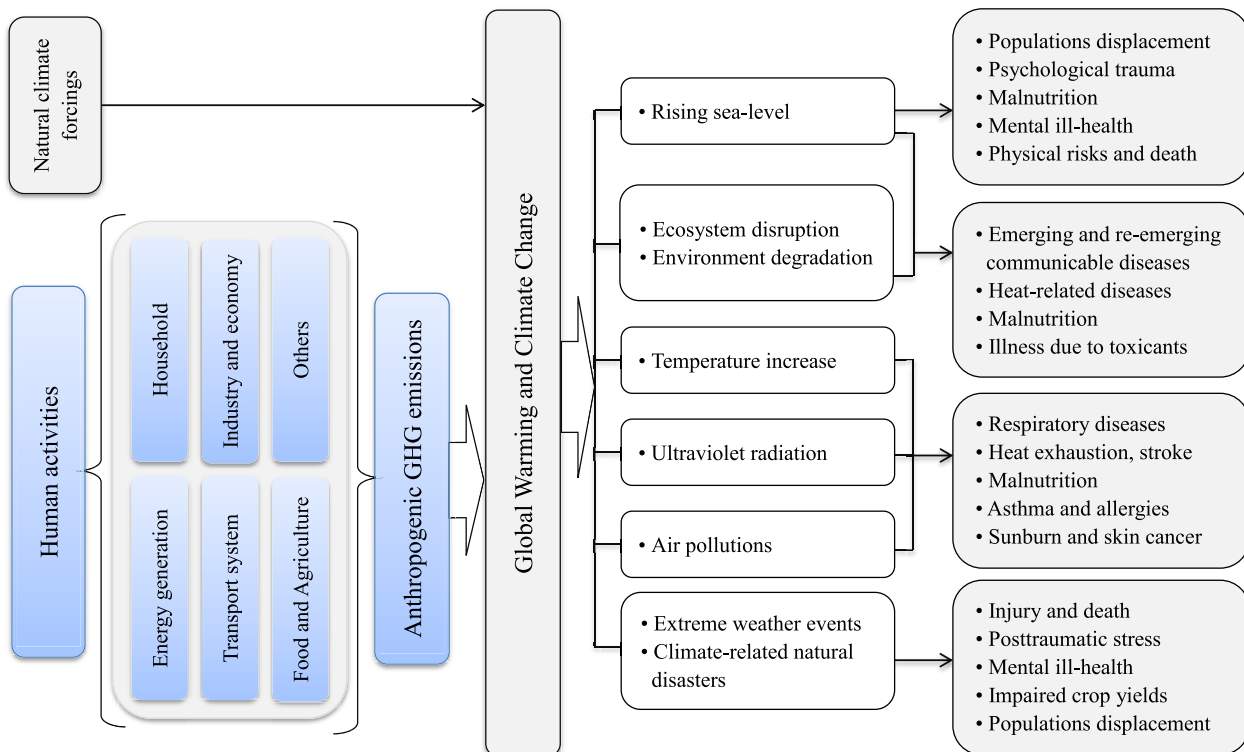


Fig. 1. Main drivers of climate change and potential pathways through which climate change impacts public health.

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