

POLICY FORUM: CLIMATE CHANGE

Hidden Health Benefits of Greenhouse Gas Mitigation

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Most public discussion of climate change has focused on long-term considerations, such as raised temperatures and sea level, extremes of weather, alterations in the ecology of infectious diseases, or radical changes in land use (1, 2). However, the same actions that can reduce the long-term buildup of greenhouse gases (GHG)—reductions in burning of fossil fuels—can also yield powerful, immediate benefits to public health by reducing the adverse effects of local air pollution. Building upon studies conducted in both developed and developing countries, we assess an array of immediate health benefits that can result from adopting existing technologies to reduce GHG emissions.

Air Pollution and Human Health

While debates about energy choices, long-term climate change impacts, and the capacity to adapt to those impacts continue to evolve, there is little doubt that air pollution from current patterns of fossil-fuel use for electricity generation, transport, industry, and housing are already sickening or killing millions throughout the world. Increasing power generation by conventional fossil-fuel combustion further threatens human health and welfare by increasing air pollution. It has been estimated that reducing emissions from older coal-fired power plants in the United States could provide substantial benefits to public health, including the avoidance of

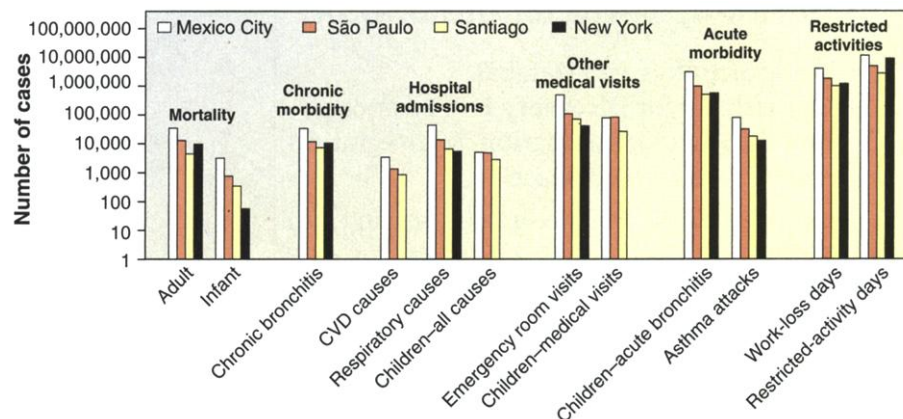
18,700 deaths, 3 million lost work days, and 16 million restricted-activity days each year (3). By reducing emissions from nine older coal plants in the Midwest, roughly 300 deaths, 2000 respiratory and cardiac hospital admissions, 10,000 asthma attacks, and 400,000 person-days of respiratory symptoms could be avoided each year (4).

Deaths from air pollution, including indoor and outdoor sources, have been ranked as one of the top 10 causes of disability by the World Health Organization (WHO) (5). In 1995, WHO (6) estimated that 460,000 avoidable deaths occur annually as a result of suspended particulate matter, largely from outdoor urban exposures. In 1997, WHO joined with the World Resources Institute (WRI) and others to estimate that, annually, nearly 700,000 deaths are related to air pollution and that about 8 million avoidable deaths will occur worldwide by 2020 (7).

Although there are numerous health and life-style benefits to society from fossil fuels, efforts to promote cleaner and less carbon-intensive energy need to be understood to have both near-term and long-term advantages. One example of the immediate

benefits of improved air quality was documented during the Olympic Games held in Atlanta, Georgia, in 1996. The impact of reduced air pollution on asthma was derived by comparing the average morbidity rates during the Games in the summer of 1996 with those of the same period during the years before and after (8). When alternative transportation policies during the Games reduced vehicle exhaust and related air pollutants (such as ozone) by about 30%, the number of acute asthma attacks and Georgia Medicaid claims fell by 40%, and pediatric emergency admissions dropped 19%.

Reductions in GHG emissions can similarly reduce associated co-pollutants that affect human health, providing these reductions are based on lowered fossil-fuel combustion. In addition, if climate change is avoided as a result of mitigation efforts, then related air-quality shifts, such as rising ozone air pollution from higher temperatures, can also be avoided (9). There are now hundreds of reports from developed and developing countries consistently showing that short- and long-term exposures to current air pollution levels of particulate matter and ozone affect death rates, hospitalizations and medical visits, complications of asthma and bronchitis, days of work lost, restricted-activity days, and a variety of measures of lung damage in children and adults (10, 11). A recent joint industry-government and private sector multi-city analysis found that a daily increase of 20 $\mu\text{g}/\text{m}^3$ in inhalable particulate matter (PM_{10}) increases the death rate by about 1% (12). In



Potential human health benefits from reductions in ozone and particulate matter air pollution associated with implementing GHG mitigation measures (2001–2020) (18). CVD, cardiovascular disease.

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addition, a reanalysis of two key prospective studies confirmed that a $25 \mu\text{g}/\text{m}^3$ increase in lifetime average concentration of fine particles ($\text{PM}_{2.5}$) in a city increases the overall total annual death rate by some 15% (13). A study by the Ontario Medical Association reported that for every death from air pollution, there are an additional 5.1 hospital admissions, 6.8 emergency room visits, and 24,128 minor illness days. For the year 2000, about 1900 premature deaths associated with air pollution occurred in Ontario, as well as 47 million minor illness days (14).

In some regions, such as the Czech Republic (15) and Mexico City (16), the risk of infant death is doubled when pollution levels are highest. A recent report from the United States found that from 1994 to 1996 babies born to mothers residing in North-eastern urban areas with greater exposures to air pollution had a significantly higher risk of low birth weight, which places infants at risk for related health problems (17).

Mitigation Benefits in Four Major Cities

We have evaluated the reductions in adverse health effects that might be achievable over the next two decades in Mexico City, Mexico, New York City, USA, Santiago, Chile, and São Paulo, Brazil, which have a combined

population of 45 million. Based on published studies, we developed quantitative estimates of the change in selected health end points that can be projected to occur per million people exposed to a given unit of particulate matter and ozone. We have developed coefficients derived from local health studies when available for specific age groups. We did not assume that all populations were affected in the same way (e.g., differences in the population-age distributions were taken into account). Using projected emission patterns in these cities, we applied health impact factors to population distributions for the time period 2001–2020 to calculate potential health benefits of using existing, readily acquirable technologies that reduce GHG emissions from fossil fuels (see figure, p. 1257).

We calculate that adoption of GHG mitigation technologies would reduce particulate matter and ozone ambient concentrations by about 10% and, thereby, avoid some 64,000 (95% CI: 18,000 to 116,000) premature deaths (including infant deaths), 65,000 (95% CI: 22,000 to 108,000) chronic bronchitis cases, and 37 million (95% CI: 27 to 47 million) person-days of restricted activity or work loss in just these four cities through 2020 (18). These findings illustrate that GHG mitigation can provide considerable local pub-

lic health benefits from air pollution reduction alone to countries that choose to abate GHG emissions by reducing fossil-fuel combustion.

For these four cities, the potential public health benefits we project are likely to be conservative. This is because we have not included the impacts of other pollutants (such as benzene, polycyclic aromatics, and other toxic air pollutants), and because many effects are not yet quantifiable on the basis of available literature. Also, we have only looked at airborne, outdoor emissions and have not assessed related impacts on other media such as water systems, wildlife, and agriculture.

We have also not factored in the major distortions of traffic and energy supply that have hit several cities within the past few months. However, even with these limitations, our results illustrate that a major public health opportunity is afforded by taking mitigation steps now, rather than waiting for a crisis. In general, the more GHG abatement a country achieves by reducing fossil-fuel combustion, the more air pollution reduction-related health benefits will accrue.

We have not developed analogous analyses to our four cities for the world's major urban areas because we lack detailed baseline information (19). However, of the 24 cities in the world today with populations approach-

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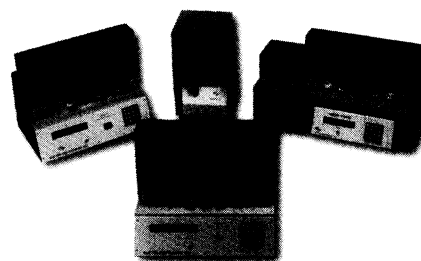
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ing 10 million, three out of four are in rapidly developing countries. The benefits of developing and applying cleaner alternative energy production technologies, conservation, and enhanced efficiencies would apply throughout the developed and developing world (20).

Implications

For every day that policies to reduce fossil-fuel combustion emissions are postponed, deaths and illness related to air pollution will increase. Policies to mitigate GHG can yield substantive and immediate benefits to the 3 billion people currently residing in urban areas throughout the world. Moreover, these largely unappreciated air pollution reduction-related health benefits could be a strong motivator for GHG mitigation action. This type of information has often been overlooked in climate policy discussions. The challenge to the policy-making community will be to forge specific practical strategies to encourage the funding and adoption of more efficient, less polluting technologies. If the substantial public health impacts we have charted here become more widely recognized, and their full economic and social impact are integrated into discussions of climate policy, this could prompt a major rethinking of the climate debate and help break the present impasse.

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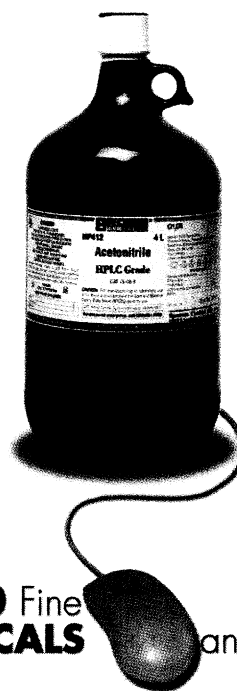
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