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Cap and trade legislation for greenhouse gas emissions:

Public health benefits from air pollution mitigation

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Legislation to cap and trade greenhouse gas (GHG) emissions was approved by a 219-212 vote of the United States House of Representatives on June 26, 2009. Cap and trade policy articulated in the American Clean Energy and Security (ACES) act of 2009 regulates GHGs including carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, perfluorocarbons and nitrogen trifluoride. Debate over the ACES act focused heavily on economic issues contrasted against concerns about climate change[1]. However, discussion largely ignored the potential for cap and trade legislation to contribute to reductions in levels of other harmful air pollutants, such as sulfur dioxide, particulate matter, and ozone precursors that share emission sources with GHGs.

Under the bill, domestic GHG emissions are to be *capped* at 2005 annual levels, and reduced to 17% of those marks by 2050[2]. The bill provides for an initial round of pollution permits to be made available, some free, others at auction. Subsequently, these permits can be bought and sold in the open market by organizations such as utility companies and manufacturing firms. A key provision in the ACES act requires the president to impose tariffs on countries that do not implement similar regulations on GHG emissions. While other potentially viable legislation, such as a tax on carbon emissions, has been proposed[3], the current cap and trade legislation is the first bill to pass in either the House or Senate.

The greenhouse gases regulated under the ACES act do not generally pose serious direct health risks. For example, nitrous oxide is used in dental procedures, and carbon dioxide is an ingredient in carbonated beverages. Other GHGs, like nitrogen trifluoride and sulfur hexafluoride, are not harmful at their current concentration levels, but can be hazardous to persons working with them if safety precautions are not taken.

Instead, substantial human health benefits from cap and trade legislation could potentially come from reductions in ambient levels of harmful pollutants, such as particulate matter and ozone, that share emissions sources with GHGs. For example, 94% of CO_2 emissions in the US result from combustion of fossil fuels, with electricity generation and transportation alone comprising nearly 70%. These are also the leading source of sulfur dioxide, fine particles having diameter small than 2.5 micrometers ($PM_{2.5}$), and precursors to ozone such as mono-nitrogen oxides (NO_x)[4].

While the time scale for potential impacts of cap and trade legislation on climate change and related health benefits is likely decades or centuries, ancillary air pollution mitigation could have immediate health benefits. In two nationwide epidemiological studies, daily levels of ambient ozone and $PM_{2.5}$ have been linked to increased risk of cardiovascular and respiratory mortality[5] and to increased risk of emergency hospital admissions, especially for

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heart failure[6], respectively. Estimates of the potential health benefits attributable to reductions in harmful air pollutants resulting from mitigation of GHG emissions, at the city, region and national, have been substantial[7].

While US cap and trade legislation would likely reduce domestic air pollution levels, two caveats deserve consideration. First, methods for reducing GHG emissions typically reduce air pollution levels, but not always. This problem can be highlighted using airplanes as an example[8]. Two methods to reduce CO_2 emissions from airplanes are to decrease aircraft weight or increase engine combustion temperatures. The former reduces both GHG and air pollution emissions, whereas the later reduces GHG emissions at the cost of increasing precursors to ozone. In the broader context of energy production, it is likely cap and trade legislation would drive a shift away from fossil fuel combustion to sources such as solar technology that produce much less air pollution. However, the exact technology development path is still uncertain.

A second problem is the potential for domestic cap and trade legislation to transfer US emissions to newly industrialized nations. Countries facing lower production costs associated with looser regulations on GHG emissions would have an economic advantage over manufacturing industries in the US. However, increased air pollution from new manufacturing could be a key public health issue for developing regions, such as China's Pearl River delta, where air pollution levels are already much higher than standards in the US[9].

The economic and physical systems that would be affected by cap and trade legislation are extremely complex, and impacts on air pollution will have to be considered in a broad context. For example, while the absence of tariffs would likely push manufacturing, air pollution and related negative health effects to developing regions, those regions might experience health benefits associated with increased per capita income. The discussion is similarly complex in the physical domain. For example, some air pollutants, such as sulfate particulate matter, can contribute to short term climate cooling. Though still somewhat unclear, there is an emerging debate over the possibility that air pollution mitigation could actually exacerbate global warming in the short term[10].

While it faces potentially significant opposition and alteration in the Senate, the cap and trade bill recently passed in the House has progressed further through Congress than any other similar legislation. There is tremendous potential for legislation regulating GHG emissions, via cap and trade or other strategies, to simultaneously decrease emissions of harmful air pollutants and reduce morbidity and mortality attributable to cardiovascular and respiratory illness. Such improvements in public health have been linked to economic benefits from recovered workforce productivity[8], and add important support for progress on cap and trade legislation versus delayed action.

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