

Air Pollution Co-Benefits Associated with the Healthy Climate and Family Security Act of 2014

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Abstract

This study estimates the air quality co-benefits that would accrue from implementation of the Healthy Climate and Family Security Act of 2014. Reducing carbon emissions as mandated by the Act will cut emissions of hazardous air pollutants, too. Benefits of improved air quality include fewer premature deaths, lower incidence of respiratory and other diseases, fewer days lost from work and school, and reduced damages to infrastructure and ecosystems. We estimate that between 2016 and 2050, the Act would prevent 700 thousand premature deaths, an average of 20 thousand per year. We estimate that reduced illness burdens from the Act would prevent 90 million lost work days, 89 million lost school days, and 43 million cases of asthma exacerbation over this period. The monetized air quality benefits from 2016 to 2050 are estimated at \$2.0-\$5.7 trillion dollars, an average of \$56-\$160 billion per year.

Introduction

The Healthy Climate and Family Security Act of 2014 proposes to set a cap on U.S. carbon emissions from the burning of fossil fuels. The cap will be lowered gradually through the year 2050. Revenue from sale of permits will be returned to all U.S. residents with a valid social security number through equal per-person dividend payments.

The burning of fossil fuels emits not only carbon dioxide, the principal contributor to global climate change, but also a number of co-pollutants, including particulate matter (PM), sulfur dioxide, nitrogen oxides, and carbon monoxide, that are hazardous to human health. These pollutants cause lung disease, hospitalizations and premature deaths. Reduction of these adverse health impacts is an important co-benefit of climate policy. Other co-benefits of improved air quality include reduced damage to ecosystems, buildings and infrastructure.

Unlike carbon dioxide, the impacts of which are global and long-run, these air quality impacts are local and more immediate (Bell, Ebisu and Peng 2011). Economic

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assessments of the air quality co-benefits of reduced use of fossil fuels have found them to be of an order of magnitude comparable to those of the climate benefits from reduced carbon emissions (Nemet, Holloway and Meier 2010).

In this note we estimate the air quality co-benefits of implementation of the Healthy Climate and Family Security Act, first in terms of reductions in premature deaths, second in terms of other health benefits, and third in terms of monetary benefits.

Data

Emissions

Historical carbon dioxide emissions from fossil fuels were obtained from the U.S. Energy Information Administration (*Total Energy CO2 Emissions, Annual 2015*).

Projected carbon dioxide emissions through 2040 were obtained from the U.S. Energy Information Administration (*Per-Capita Carbon Dioxide Emissions, United States, Annual Energy Outlook 2015*). We extend these through 2050 assuming continuation of the projected trend.

Population

Population projections were obtained from the U.S. Census Bureau (*Projections of the Population and Components of Change for the United States: 2015 to 2060*).

Abatement

The Healthy Climate and Family Security Act of 2014 sets caps on fossil fuel-based carbon dioxide emissions percentage reductions against 2005 emissions as shown below:

Year	Percentage reduction in emissions
2016	10
2020	20
2025	30
2030	40
2035	50
2040	60
2045	70
2050	80

Reductions in emissions mandated by the Healthy Climate and Family Security Act

In our analysis we assume that co-pollutant emissions will be reduced by the same percentages.

Mortality

Deaths from air pollution are taken from a study by U.S. Environmental Protection Agency scientists that estimates total premature mortality from outdoor air pollution in the United States for the year 2016 (Fann, Fulcher and Baker 2013). The study considers damages from two of the most serious pollutants – particulate matter and ozone – and estimates the impacts of different pollution sectors to the total.

To estimate the fraction of the total attributable to fossil fuels, we take the sum of deaths from the electricity generation and mobile sectors plus one-quarter of the deaths from the industrial point source and area pollution sectors. We exclude deaths attributable to pollution from other sectors (international emissions, secondary organics and biogenics, and wildfires). This yields an estimate of 48 thousand premature deaths from air pollution from fossil fuels.

This figure is substantially lower than the air pollution mortality estimates in two other recent studies conducted by researchers at MIT using alternative models (Caiazzo et al. 2013; Dedoussi and Barrett 2014). It also omits the effects of other air pollutants generated by fossil fuel combustion. For both reasons the mortality estimate presented here can be regarded as conservative.

Illness burdens

Illness burdens attributable to outdoor air pollution for the year 2016 are taken from the same study (Fann, Fulcher, and Baker 2013). Here we report three burdens: lost work days due to particulate matter pollution; lost school days due to ozone pollution; and asthma exacerbations due to particulate matter.

These figures omit other health effects, which include respiratory hospital visits and admissions, acute bronchitis and heart attacks. They also omit the effects of other air pollutants. For these reasons the estimates of illness burdens presented here again can be regarded as conservative.

Monetary benefits

Overall monetary benefits are based on a recent meta-analysis of studies that have quantified the monetary value of total air quality co-benefits per unit carbon dioxide reduction (Nemet, Holloway and Meier 2010). These studies have produced a range of values.

The table below shows low, median and high values reported in the meta-analysis, here expressed in 2015 dollars. The low value corresponds to estimates in the 5th quantile of the range, and high values to those in the 95th quantile.

In our calculations, we use the median value, which is \$64 per ton of carbon dioxide.

Quantile	Dollars per ton carbon dioxide
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Low	11
Medium	64
High	122

Co-benefits per ton carbon dioxide (in 2015 dollars)

Discount Rates

Three discount rates were used to calculate the present value of benefits that accrue in future years: 0%, 2%, and 5%.

Calculations

Projected business-as-usual emissions were calculated by multiplying projected per capita emissions by projected population.

We calculate the ratios of mortality, illness burdens, and monetary costs to historic emissions, and assume linear relationships between these impacts and projected emissions.

Mortality and monetary benefits of the Healthy Climate and Family Security Act were calculated based on the difference between projected business-as-usual emissions and emissions mandated by the Act.

Results

Mortality

The air quality improvements resulting from implementation of the Healthy Climate and Family Security Act would prevent an estimated 700 thousand premature deaths between 2016 and 2050. The number of averted deaths per year rises over time as emissions decline. Over the 35-year period as a whole, the average is approximately 20,000 lives saved annually. The trend in mortality reductions is shown below.

Time period	Lives saved (thousands)
2016-2020	20
2021-2030	120
2031-2040	230
2041-2050	330
Total	700

Mortality benefits of air quality improvements

Illness burdens

Implementation of the Act would prevent an estimated 90 million days lost from work, 89 million lost school days, and 43 million cases of asthma exacerbation between 2016 and 2050. Time trends in these illness burden reductions are shown below.

Time period	Lost school days (millions)	Asthma exacerbations (millions)	Lost work days (millions)
2016-2020	2.3	1.1	2.4
2021-2030	15.4	7.5	15.6
2031-2040	29.1	14.0	29.4
2041-2050	41.8	20.2	42.3
Total	88.7	42.8	89.6

Reduced illness burdens from air quality improvements

Monetary benefits

Total monetary benefits from air quality improvements resulting from implementation of the Health Climate and Family Security Act are estimated at between \$2.0 and \$5.7 trillion, depending on the choice of the discount rate, as shown below.

Time period	Discount rate: 0%	Discount rate: 2%	Discount rate: 5%
2016-2020	0.1	0.1	0.1
2021-2030	1.0	0.8	0.6
2031-2040	1.9	1.2	0.7
2041-2050	2.7	1.5	0.6
Total	5.7	3.6	2.0

Monetary co-benefits of air quality improvements (\$ trillion in 2015 dollars)

Discussion

The analysis presented above indicates that implementation of the Healthy Climate and Family Security Act would yield substantial air quality benefits from reduced emissions of hazardous air pollutants. These are independent from and additional to the climate benefits from reduced emissions of carbon dioxide. Extrapolating from recent studies of hazardous air pollution impacts attributable to the burning of fossil fuels, we estimate that over the 35-year period from 2016 to 2050 the Act would avert approximately 700 thousand premature deaths, 90 million lost work days, 89 million lost school days, and 43 million cases of asthma exacerbation. In monetary terms, we estimate that the benefits would total \$2.0 trillion to \$5.7 trillion.

These estimates are based on recent studies of mortality, illness burdens and monetary damages from air pollution in the United States and the contributions of different

sectors to these impacts. To extrapolate from these estimates we assume that co-pollutant emissions will vary proportionally with carbon dioxide emissions, and that mortality rates, illness burdens and monetary benefits vary proportionally with co-pollutant emissions.

The mortality and illness burden estimates presented here are based of the impacts of particulate matter and ozone pollution. The impacts of other co-pollutants, including carbon monoxide and other air toxics, are not included. For this reason, our estimates may understate the total public health benefits of implementation of the Act.

The impacts of air pollution are not distributed equally across the U.S. population. Disadvantaged groups often bear disproportionate pollution burdens (Boyce and Pastor 2013). For this reason, implementation of the Act could not only yield public health and monetary benefits but also improvements in equity. Again, these gains are in addition to the climate benefits that are the Act's central rationale.

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