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Hidden Health Opportunities: The Role of Building Standards in Adapting to Air Pollution in a Changing Climate

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Air pollution, the largest global environmental health threat, associated with millions of premature death each year, is getting worse with climate change. To protect their health from air pollution, governments encourage people to stay indoors and avoid high pollution episodes. Moving indoors to reduce exposure to outdoor air is a form of avoidance adaptation. The frequency of this adaptive action can affect the amount of time people spend inside buildings. In Europe and North America, people already spend 90% of their time indoors. Air pollution from outdoors can infiltrate the building envelope, exposing people to pollution of outdoor origin at all times, and reducing the value of avoidance adaptation. To better understand the effect of this infiltration on human health, we examine the impact of building standards on the value of avoidance adaptation. This involves considering the costs of improving building envelopes and ventilation, and associated benefits due to avoided premature death from air pollution exposure. We conduct a historical study in the United States from 1980 to 2010 to examine the spatial and temporal patterns of costs and benefits associated with improving building standards to enhance adaptation to air pollution. This includes investigating past missed opportunities in reducing mortality and laying the foundation for future studies on existing long-term opportunities, all within the context of a changing climate. To achieve this, we establish baseline levels of exposure to the most harmful air pollutant, fine particulate matter, under this historical building stock across the United States. Subsequently, we assess the benefits and costs realized under each building standard improvement scenario (Improved Building Envelope and Improved Ventilation). This study will identify the demographics that can benefit the most from these improvements, quantifying, for example, the potential net gains of improving housing quality for low-income communities. It will address open questions on the value of adaptation in protecting human health under increasing risks from a changing climate.