Assessing Air Quality Co-Benefits and Tradeoffs of Sustainable Climate Solutions

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The U.S. and much of the world sit on the cusp of an electrification revolution – a moment driven largely by the need to reduce the emission of greenhouse gases to limit the impacts of anthropogenic climate change. The electrify everything movement aims to transition combustion-powered sectors into technologies powered solely by electricity, with the idea that the electric grid – currently comprised of a mix of combustion, renewable, and nuclear generation units – will become cleaner and greener over time. Studies indicate that electrifying high-efficiency devices, appliances, and vehicles will reduce greenhouse gas emissions regardless of the grid's composition, however ancillary air quality benefits and tradeoffs remain poorly resolved, particularly at impact- and equity-relevant scales. Here, I use a fine-scale CONUS-wide climate and air quality co-benefit and tradeoff analysis framework (i.e., 4 km^2 SMOKE-CMAQ-WRF simulations) to assess sustainable climate solutions. Analyses utilize emission scenarios that account for increased grid demand and uncertainties in grid evolution, simulate the interaction of meteorological and chemical processes, characterize changes in greenhouse gases and air pollutants, and assess economic, social, and public health consequences of sustainable transitions over two key, yet methodologically disparate, residential/commercial sectors: transportation: via the replacement of internal combustion vehicles with electric vehicles and lighting: via the replacement of low efficiency bulbs with high-efficiency LEDs.