Ph.D. in Science, Technology and Policy for Sustainable Change

Thesis Defense - XXXVIII cycle

Stefania Renna

Title: Essays on informing policies to abate air pollution

Supervisor: Prof. Massimo Tavoni

Tutor: Prof. Andrea Castelletti

Abstract Air pollution is a complex phenomenon and one of the major environmental risks for public health and ecosystems worldwide. This doctoral dissertation uses data-driven methods to inform policy on air pollution through five studies spanning mitigation and adaptation, and scales from global to local. First, we develop an air quality modeling tool that evaluates how sectoral emission scenarios affect ozone and particulate matter (PM) at national and subnational level for policy support. Second, we build a harmonized classification and metadata set for ground monitoring stations, enabling consistent comparisons of sectoral exposure across countries, regions, and station types for comparative studies and health impact assessments. Third, we assess the global feasibility of meeting the World Health Organization's air quality guidelines for fine PM, combining diverse datasets to identify where adaptation policies are most needed to reduce exposure. Fourth, using composition data on coarse PM, we quantify agriculture's contribution to air pollution and health in Lombardy, Italy, showing that single-sector policies are unlikely to deliver large PM reductions. Finally, the fifth chapter turns towards adaptation, and evaluates the impact of a technological intervention involving air purifiers in primary schools in a highly polluted urban setting. Through a randomized controlled trial, it estimates causal effects on indoor air quality, students' health, attendance, and behavioral outcomes. Together, these chapters try to advance evidence for air quality policy, employing approaches from linear modeling to deep learning and using both measured and derived data in ambient and indoor environments.

PhD Committee

Prof. Freire Cardoso Ferreira Francisco Manuel, Universidade Nova de Lisboa

Prof. Giovanni Lonati, Politecnico di Milano

Prof. Marialuisa Volta, Università degli Studi di Brescia