Public health co-benefits from traffic related greenhouse gas emission policies

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Climate Change is a major environmental concern of our time. Cities have a significant impact on greenhouse gas emissions as most of the traffic, industry, commerce and more than 50% of world population is situated in the urban areas. Under the continuous pressure for climate change mitigation and adaptation measures, there have been several studies in the latest years, for assessing the co-benefits of GHG reduction emission policies. A major advantage of public health co-benefits in contrast to the effects of mitigation policies on the climate, is that health co-benefits are associated and observed is a well-defined spatial scale (e.g. an urban agglomeration) and within a shorter time frame (e.g. reduced number of daily respiratory hospital admissions). On the contrary, GHG reduction emission policies will benefit the global scale environment and these benefits will take time to manifest. The case study of Thessaloniki is selected, as it is one of the only two cities in Greece with hammered out climate change action plans and monitoring systems, where future policies could be assessed. The effects of feasible traffic policies to air and noise pollution in year 2020 are assessed and their potential health impact is compared to a business as usual scenario. In particular, two traffic measures are investigated, including the operation of an underground rail (metro) in the city centre and changes in vehicle fleet composition in favour of vehicles with the new emission fuel standards (Euro V and VI), the use of hybrids and electric passenger vehicles. Their effect to human health (mortality and morbidity) is computed, utilizing state of the art concentration response functions to PM_x, NO_2, C_6H_6, noise and city level background health data. It is hence, possible, to evaluate the potential co-benefits from the reduced green-house gases to the health impact by the year 2020. This is particularly important, especially when the air quality in the city is poor, with high levels of ambient noise.

An integrated full-chain methodological framework is utilized, including the traffic assignment (VISUM), the pollutant emission (COPERT), the generation of suitable meteorological maps (CALMET), the pollutant dispersion in the traffic corridors (AirGIS and OSPM) and the motorways (CALPUFF), the noise generation and its propagation (NMPB), the use of data fusion and bias adjustment techniques to the computed air quality maps and lastly the exposure and health impact assessment. It is also noted that air and noise calculations are presented on a high resolution grid and the corresponding health impact at building block level. The health end points considered included, mortality due to PM_{10}, $PM_{2.5}$ and NO_2 exposure and morbidity i.e. cases of leukaemia due to C_6H_6 exposure and cases of myocardial infraction, sleep disturbance and annoyance due to the elevated ambient noise.

Simulations show significant environmental, health and monetary co-benefits: coupling the city's metro with appropriate changes in the traffic composition (including a 22% share in diesel fuelled passenger vehicles, an 8% in hybrids and 2% in the electric vehicles), will reduce air and

noise pollution, as the result of the drop in traffic load (from 22% to 44%) and emissions. Savings in the monetary cost due to PM_{10}, $PM_{2.5}$ and NO_2 induced mortality and leukemia cases are 56.6, 45.0, 37.7 and 1.0 million Euros respectively, which correspond to the reduction in PM_{10}, $PM_{2.5}$, NO_2 and C_6H_6 exposure. With respect to noise exposure, in the city of Thessaloniki, reductions in the attributed morbidity cases are computed, including 34% in heavy sleep disturbance, 13% in sleep annoyance and 29% in myocardial infraction. Similarly, the wide the promotion of 'green' transportation (50% to the total passenger vehicles) in the city, will provide savings in monetary cost of 60.4 and 49.1 of 41.2 and to 1.08 million Euros, resulting from the reduction in PM_{10}, $PM_{2.5}$ NO_2 and C_6H_6 exposure respectively. For the case of noise, in the city of Thessaloniki, significant reductions in the attributable noise cases are computed, including 80% in heavy sleep disturbance, 50% in sleep annoyance and 49% in myocardial infraction.

From the methodological point of view, health impact calculation at very high spatial resolution (building block), allows for a more in-detail assessment of the actual benefits associated to the different sub-areas of the urban agglomeration. This in-turn is associated to the broader urban planning and the different socioeconomic components that are affected. In addition, with respect to the air pollution, the estimated differences in health impact are based on the overall air quality levels and not only on the traffic component of the air pollution. This allowed us to determine the 'actual' effect of these policies to the urban air quality and consequently to the public health, as well as to differentiate the 'partial effect' in those areas where traffic is not the dominant pollution component.