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ADOPTING BLACK CARBON/ELEMENTAL CARBON AS A TOOL IN MOBILITY PLANNING: THE GENERAL URBAN TRAFFIC PLAN OF THE CITY OF MILAN, ITALY

INTRODUCTION AND AIMS

As part of the **Strategic Environmental Assessment (SEA)** procedure of the General Urban Traffic Plan, the Municipality of Milan introduced Elemental Carbon among **quantitative indicators**, basing on the experience with the airborne Black Carbon measurement Project performed in the city [see Poster Abstract ID 4573 presented at this conference (Moroni *et al.*, 2013)] that confirmed BC as a more appropriate indicator than PM10 and PM2.5 in evaluating impact of traffic measures (WHO, 2013).

The **aim of this study** is to obtain a particulate toxicity indicator, easy-to-use within the normal planning activities of a local Public Authority, **estimating environmental and health potential effects of different policy scenarios**.

BACKGROUND AND METHODS

There is sufficient evidence to support a causal relationship between exposure to traffic-related air pollution and exacerbation of asthma, and suggestive evidence of a causal relationship with onset of childhood asthma, nonasthma respiratory symptoms, impaired lung function, total and cardiovascular mortality, cardiovascular morbidity and lung cancer (Health Effects Institute, 2010; Raaschou-Nielsen *et al.*, 2013).

Being the carbonaceous nanoparticles such as Black Carbon (BC), a sensitive indicator of the spatial variation of road traffic emissions ('traffic proximity' indicator) and of their health-related effects (WHO, 2013), the emissions of Elemental Carbon (EC), pollutant closely related to BC, have been adopted as tracers of the population exposure (Keuken *et al.*, 2012, Lefebvre *et al.*, 2011).

Tab.1 - Mobility Planning scenarios at 2015, evaluated for the SEA of the Urban Traffic Plan (UTP)

Reference	UTP Base	UTP Base + Road pricing	UTP Base + Loop
business as usual scenario, with traffic emissions variation due to the merely renewal of the car fleet	implementation of the 'Base' measures included in the Urban Traffic Plan (i.e. 30 km/h Zones, Pedestrian Areas, reserved lanes for public transport and bikes) without considering any specific vehicular circulation control scheme within the Bastioni Ring Area	Base scenario together with the adoption of the 'Road pricing' scheme to access the Bastioni Ring Area	Base scenario together with the adoption of the 'Loop' scheme for vehicle circulation inside the Bastioni Ring Area

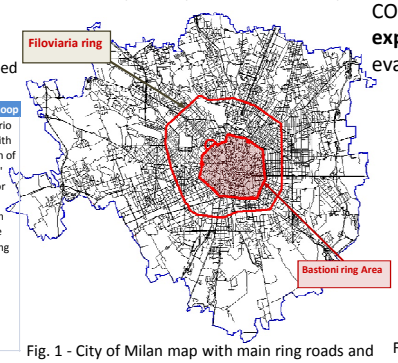


Fig. 1 - City of Milan map with main ring roads and Bastioni ring area

According to the literature, a critical distance from the vehicular traffic source has been identified to which refer evaluations of some health effects that have 'sufficient evidence' (i.e. childhood asthma) on population. Children living closely than 75 m to major roads have an increased probability by about 30% of receiving a diagnosis of asthma and by about 40%-50% to be on medication for asthma or have had recent acute episodes (McConnell *et al.*, 2006; Perez, 2012; Brugge *et al.*, 2007).

In order to obtain an exposure indicator for the different mobility planning scenarios considered within the Urban Traffic Plan [Table 1, Figures 1-3] the **daily mean vehicular EC emissions** released **at a distance less than 75 meters from places of residence** have been calculated [Tables 2-3] using COPERT IV model emission factors (Katsis *et al.*, 2012) and the **population exposed to different levels of EC traffic emissions** [Figures 4-5] has been evaluated.

Fig. 2 - 'Road pricing' scheme to access Bastioni Ring Area

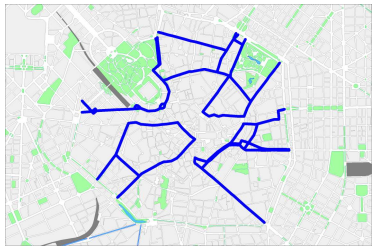


Fig. 3 - 'Loop' circulation scheme within Bastioni Ring Area

RESULTS

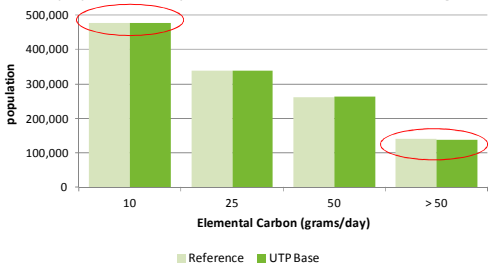
Urban Traffic Plan (UTP) 'Base' measures scenario compared with 'Reference' scenario at 2015

Tab. 2 - Averaged on population Working day mean Vehicular exhaust Emissions of Elemental Carbon [grams/day] released within 75 meters from residences: Urban Traffic Plan (UTP) 'Base' measures scenario *vs* 'Reference' scenario at 2015

Elemental Carbon traffic emissions [grams/day] released within 75 meters from residences	Reference	UTP Base	%
Milan (whole city)	22.0	21.8	-1%
Inside Bastioni ring	20.4	20.8	+2%
Between Bastioni ring and Filoviaria ring	30.9	29.5	-5%
Between Filoviaria ring and city boundaries	19.2	19.2	0%

- Slight increase of EC traffic emissions (+2%) and related population exposure inside Bastioni ring
- Reduction of EC traffic emissions (-5%) and related population exposure in the area between Bastioni ring and Filoviaria ring
- Decrease (-2.2%) of population exposure in the whole city (Fig. 4) to higher emissions level (>50 grams/day), corresponding to about 3,000 inhabitants and slight increase of population exposure to lower EC level (<10 grams/day)

Fig. 4 - Population exposed to different traffic EC emissions levels released within 75 meters from residences: Urban Traffic Plan (UTP) 'Base' measures scenario *vs* 'Reference' scenario at 2015



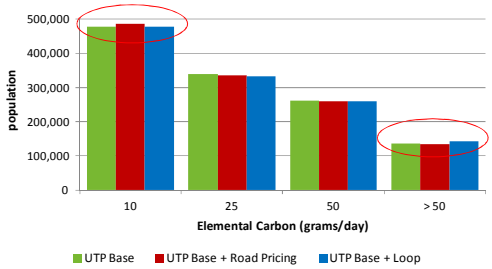
Different mobility planning scenarios ('UTP Base +Road pricing' or 'UTP Base +Loop') compared with Urban Traffic Plan (UTP) 'Base' measures scenario at 2015

Tab. 3 - Averaged on population Working day mean Vehicular exhaust Emissions of Elemental Carbon [grams/day] released within 75 meters from residences: 'UTP Base+ Road pricing' and 'UTP Base + Loop' scenarios *vs* Urban Traffic Plan (UTP) 'Base' measures scenario at 2015

Elemental Carbon traffic emissions [grams/day] released within 75 meters from residences	UTP Base	UTP Base + Road Pricing	%	UTP Base + Loop	%
Milan (whole city)	21.8	21.5	-1%	22.1	+1%
Inside Bastioni ring	20.8	18.3	-12%	19.2	-8%
Between Bastioni ring and Filoviaria ring	29.5	29.3	-1%	30.6	+4%
Between Filoviaria ring and city boundaries	19.2	19.1	-1%	19.5	+2%

- 'UTP Base+Road pricing' scenario: most important EC traffic emissions reduction (-12%) inside Bastioni ring and a small variation in the same direction (-1%) in the whole city
- 'UTP Base+Loop' scenario: EC traffic emissions reduction (-8%) inside Bastioni ring, but increase (+4%) outside it
- 'UTP Base+Road pricing' scenario: decrease of population exposure (Fig. 5) to higher emission levels and increase for lower emission levels, corresponding in a shift of about 9,000 inhabitants, respect to the 'Loop' scenario

Fig. 5 - Population exposed to different traffic EC emissions levels released within 75 meters from residences : 'Base+ Road pricing' and 'Base + Loop' scenarios *vs* 'Base' measures of Urban Traffic Plan (UTP) scenario at 2015



CONCLUSIONS

BC/EC, excellent tracer of 'traffic proximity' exposure, offers the possibility to verify the effectiveness of different policies in mobility planning. In the city of Milan, **'road pricing' scenario** at 2015 leads to a **decrease of about 9,000 inhabitants exposed to highest EC traffic emission levels** (>50 grams/day) respect to the 'Loop' circulation scheme, with an important benefit for public health. This assessment has supported the **confirmation of the 'Area C' Congestion Charge** scheme adopted as a pilot measure in 2012.

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Milano
Comune di Milano

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