# Air Quality Management along the Brenner Corridor in the Italian Alps: the BrennerLEC Project

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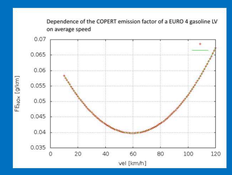
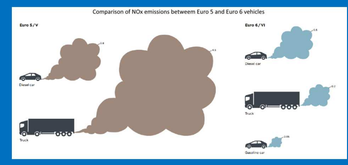
## Background

Trentino-Alto Adige/Südtirol is an Italian region that is crossed by the Brenner corridor, a strategic route for Europe, connecting Italy with Austria and Germany. Road traffic is responsible for 60% of nitrogen oxides ($NO_x$) emissions in this area. On the Italian side, the A22 highway generates 41% of $NO_x$ emissions from road traffic. The peculiar meteo-climatic conditions occurring in Alpine valleys and the proximity of the highway to populated urban areas enhance the problem of nitrogen dioxide ($NO_2$) concentrations, which generally exceed the limit value of 40 μg/m$^3$ on annual mean, set by the 2008/50/EC Directive. In the light of this issue, it is strategic to reduce emissions from road traffic. Traffic jams induce the so-called "stop & go" events, which produce higher emissions than constant speed conditions. In addition, emissions show a dependence on speed, strongly increasing above 80 km/h. Heavy-duty vehicles (HDVs) complying with their speed limit ensure the minimum $NO_x$ emissions. Furthermore, the technological advances made on HDVs have significantly reduced their $NO_x$ emissions compared to LVs. As a result, EURO 6 HDVs emit about 60% less $NO_x$ than EURO 6 LVs. Innovative policies aiming at pursuing improved environmental quality objectives should then consider LVs as an important target.




## Aims of the Project

The "Brenner Lower Emissions Corridor" (BrennerLEC, BLEC) project aims at implementing and demonstrating the benefits expected from three types of dynamic policies to improve air quality (AQ), climate protection and noise:

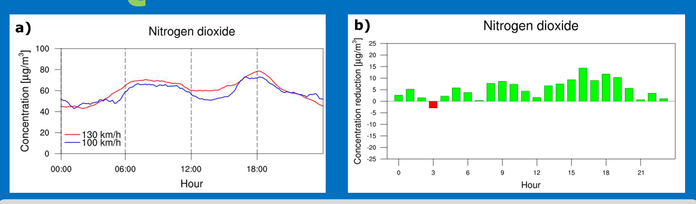
- dynamic road capacity management, to reduce speed limits and during highly saturated traffic conditions;
- dynamic speed limits management, to be applied to LVs as a function of the predicted AQ conditions;
- dynamic integrated traffic management, to improve the management of highway traffic in correspondence of urban areas.

## Field Measurements

In order to support the policies implemented in the project, a dense network of AQ and meteorological sensors has been deployed along the Brenner highway. Three air quality stations were installed to monitor $NO_x$, $NO_2$ and other pollutants, including black carbon (BC). Air quality monitoring is performed using both conventional and innovative resistive and electrochemical sensors, in particular for measuring $NO_2$ and NO concentrations. Evaluation of the performance of these instruments is still limited and their reliability not yet extensively validated. The performance of this kind of sensors under true ambient conditions is continuously monitored, by comparing their measurements against the conventional stations.

## Results: Air Quality

Air quality measurements have been correlated with meteorological, traffic and emission data, to analyze the decrease of concentration induced by the reduced speed limits on the highway between the ex-ante and ex-post situations. Results show a decrease of $NO_2$ concentration of about 10% with a mean decrease of light vehicles speed of about 14 km/h. The efficiency of the reduction of the speed limit depends on meteorological conditions, being more effective in stable atmospheric conditions.




Diurnal cycle of $NO_2$ concentrations close to the highway with and without reduced speed limit; b) difference between $NO_2$ concentrations close to the highway with and without reduced speed limits.

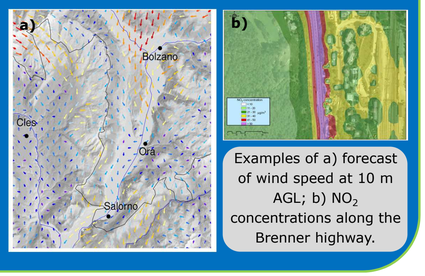
## Study Area

Three pilot-test areas were selected for applying the proposed environmental policies:

- **BLEC-ENV**: a stretch of about 90 km hosting the field verification of the dynamic road capacity management strategies.
- **BLEC-AQ**: a stretch of about 20 km hosting the tests of the dynamic speed limits management strategies.
- **BLEC-LEZ**: three stretches, in the correspondence of the urban areas of Bolzano, Trento and Rovereto, which host the tests on the strategies for urban-highway integrated traffic management.


## Modelling Activities

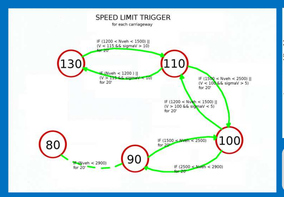
An advanced modelling chain, composed of the WRF (meteorology) and R-Line (dispersion) models is implemented to support the extensive testing and application of temporary reduction of speed limits connected to critical air quality situations. Air quality forecasts are used as input to a decision support tool for the application of reduced speed limits on the highway, in order to maximize the benefits of the policies implemented limiting negative impacts for the highway users, by putting in action measures only when necessary and anticipating environmental issues.

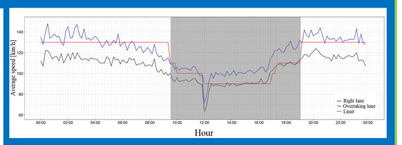



Examples of a) forecast of wind speed at 10 m AGL; b) $NO_2$ concentrations along the Brenner highway.

## Results: Traffic

An algorithm based on measured traffic count, mean velocity and velocity variance has been implemented to regulate dynamic speed limits in situations with high traffic. Preliminary results show traffic regularization with less stop & go situations.




Example of application of reduced speed limit in situations with high traffic.

## Acknowledgements

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