FCTUC, University of Coimbra, PORTUGAL

URBAN TRAFFIC EMISSION MODELLING FOR POLICY-RELATED APPLICATIONS

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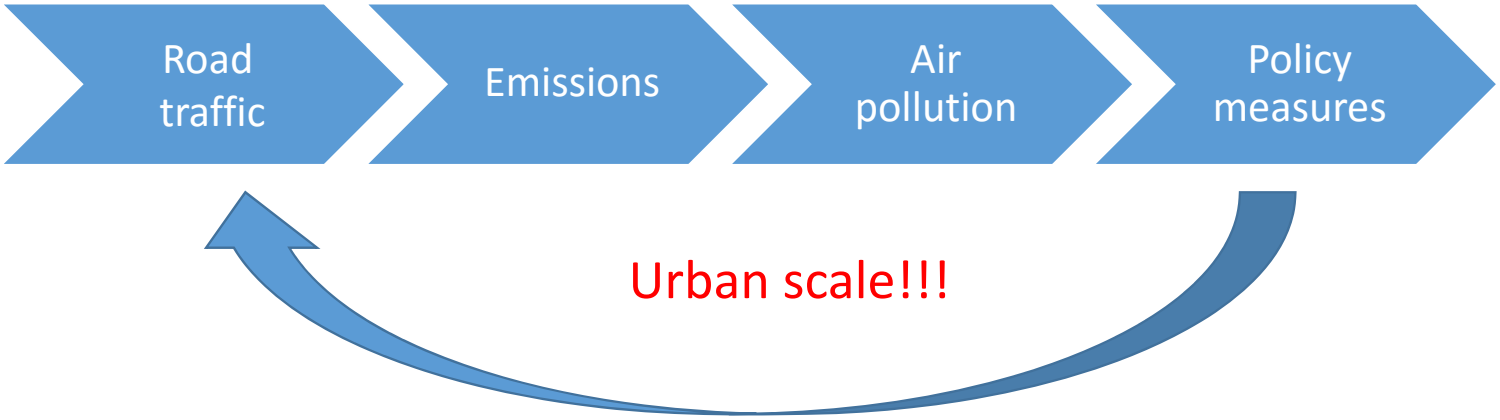
Outline

- INTRODUCTION
- OBJECTIVES
- METHODOLOGY
- RESULTS
- FINAL REMARKS

Introduction



- Protected zones
- Restricted zones
- Low Emission Zones
- …….

Circulation restrictions

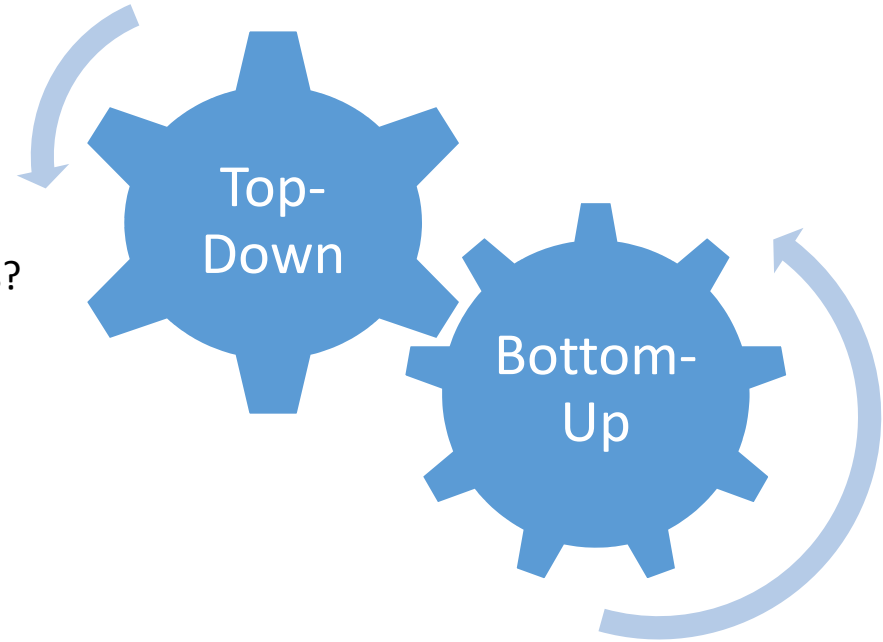
- Road charging /tolls
- High occupancy vehicles
- Parking fee
- …….

Charging schemes

Objectives

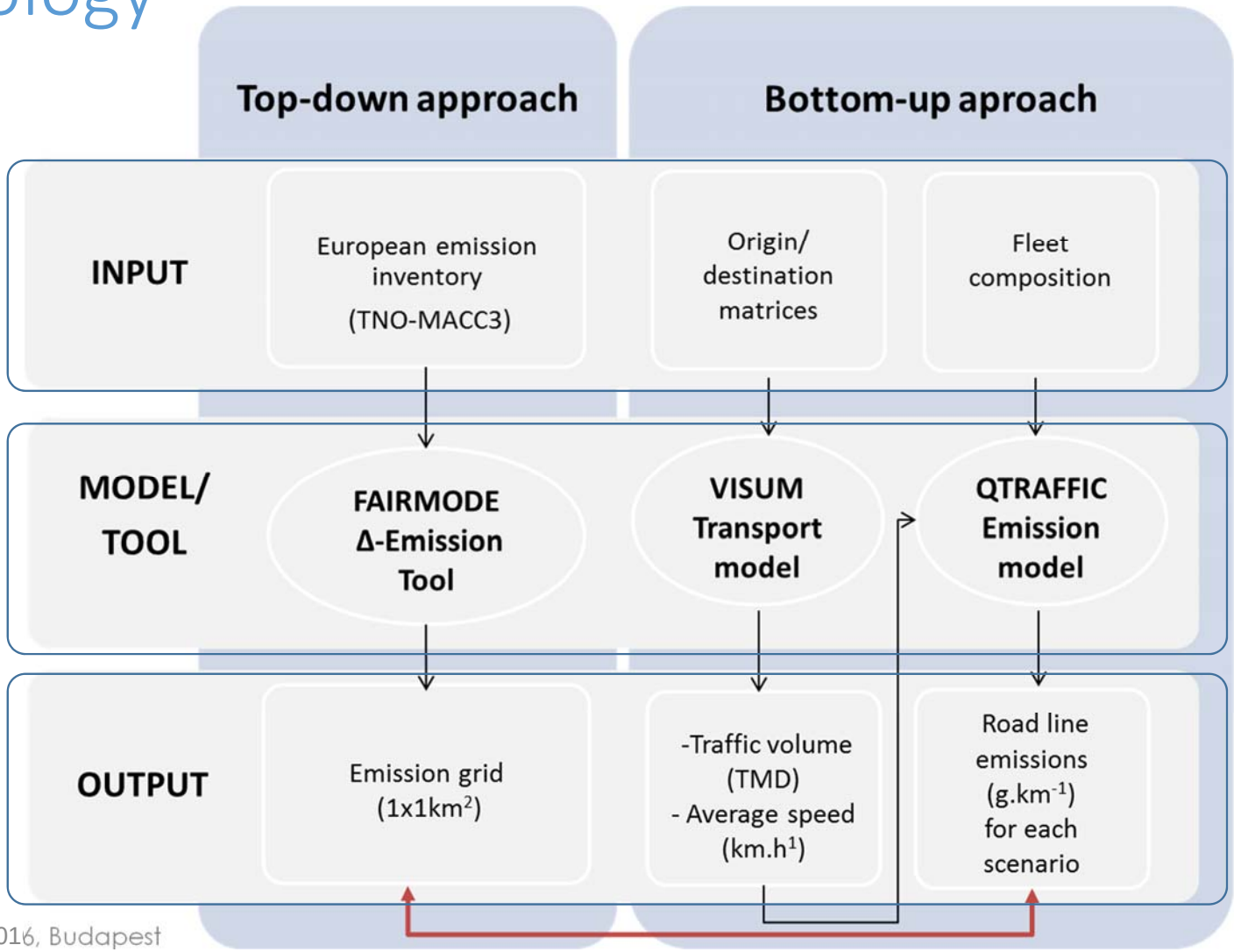
The prime objective of the current work is evaluation of traffic related emissions inventory based on inter-comparison of bottom-up and top-down methodologies.

- Different results?
- Why?
- Advantages/Limitations?



- Reference scenario
- LEZ implementation

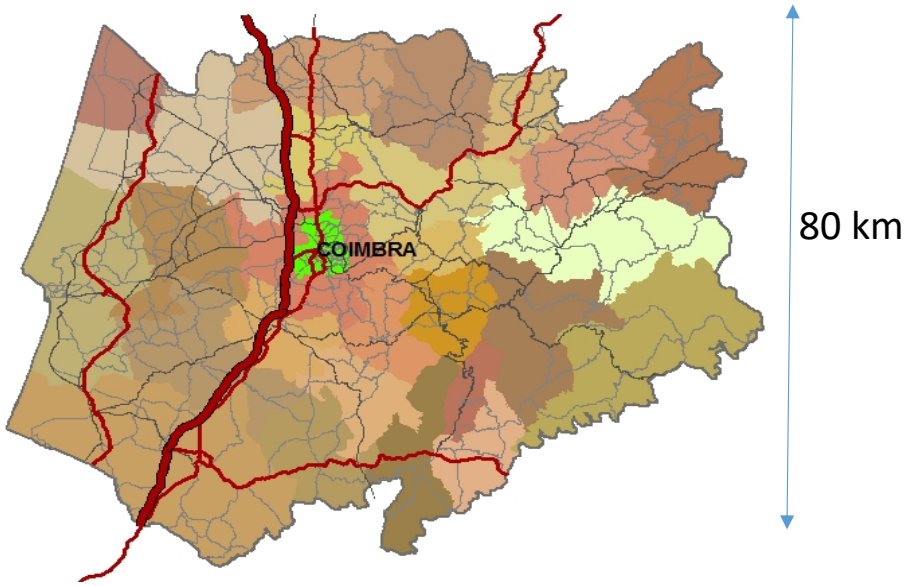
Methodology



Methodology

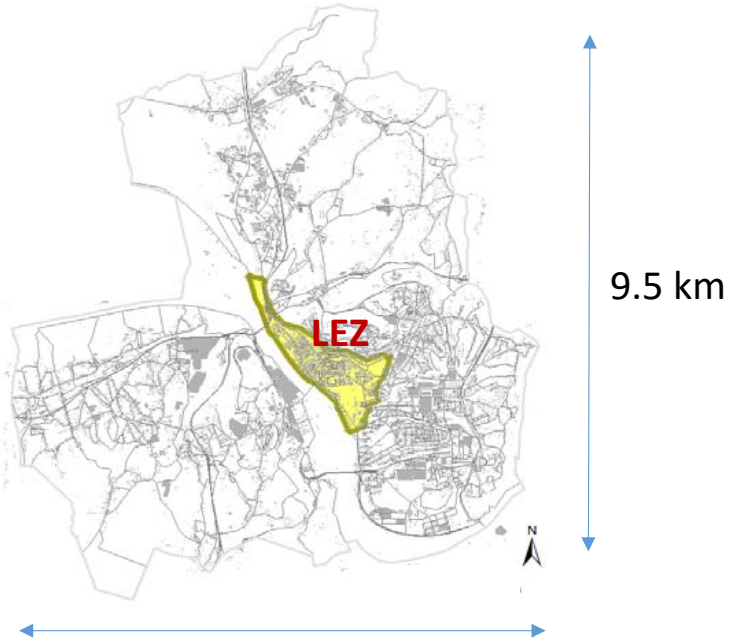
Study domain

Coimbra Region



Population - 576 500 inhabitants

Coimbra Urban area



Population - 115 000 inhabitants

Methodology

LEZ implementation area:

Same as the protection zone defined for cultural heritage protection:

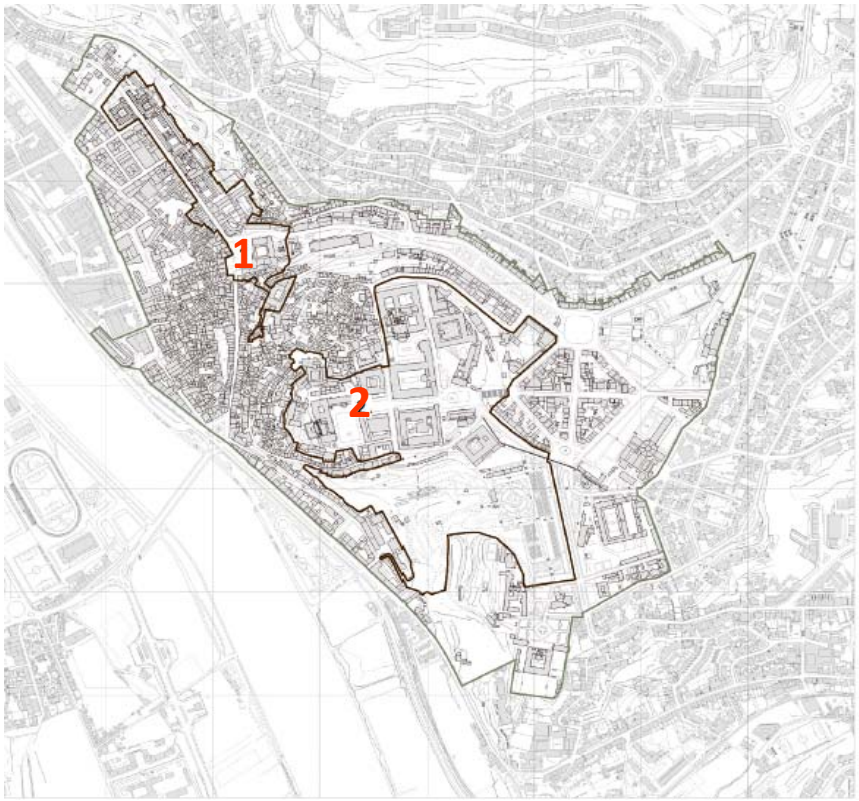
- University of Coimbra and Sofia

Emission criteria:

- Entry restriction applied to **private vehicles**

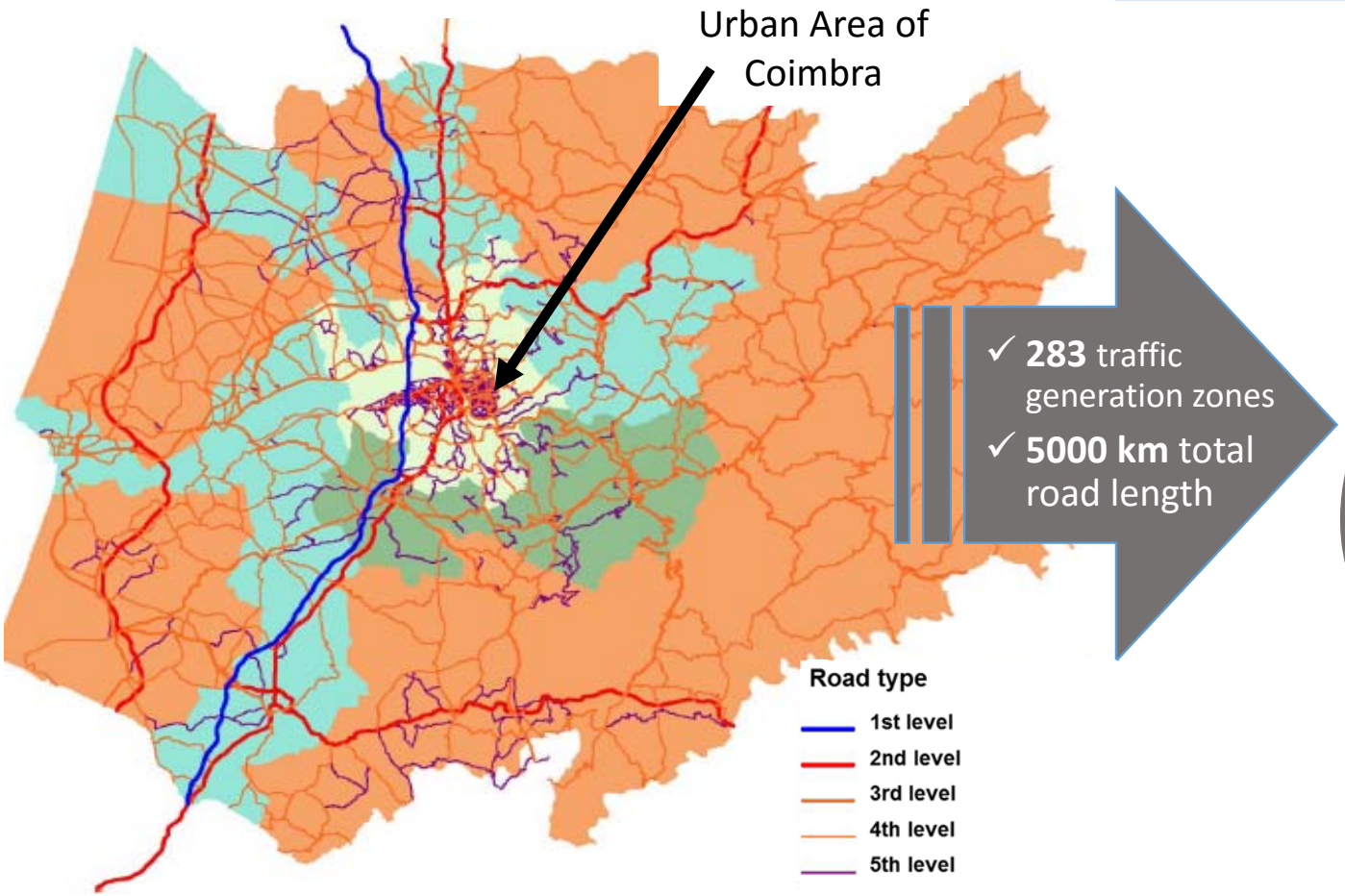
Euro 0	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5

- Enforcement 24 hours per day.



Historic centre and UNESCO World Heritage sites of Coimbra
(1 - Rua da Sofia, 2 - Alta Universitária)

Methodology



- ✓ **283** traffic generation zones
- ✓ **5000 km** total road length

Transportation modelling

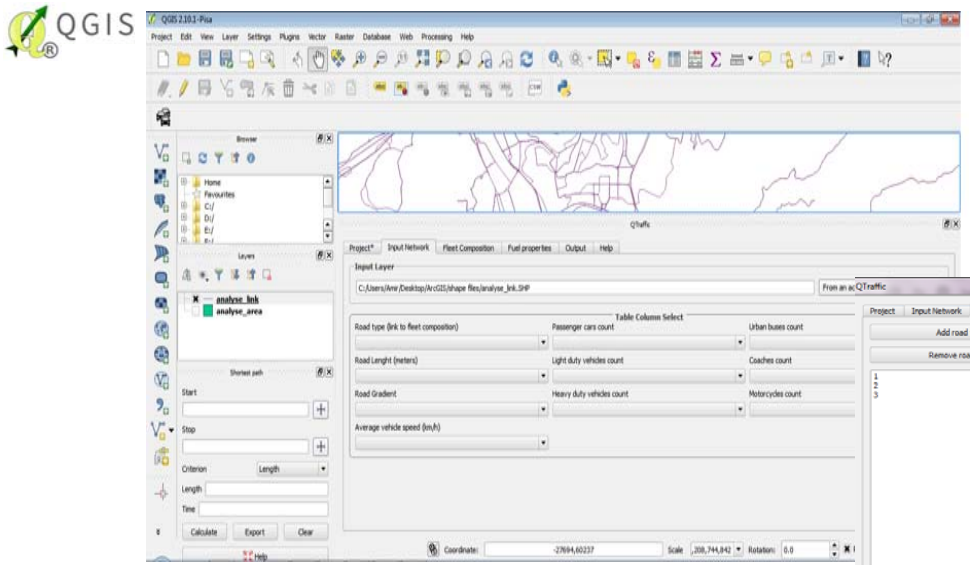
- •Road network
- •O/D matrix by transport mode

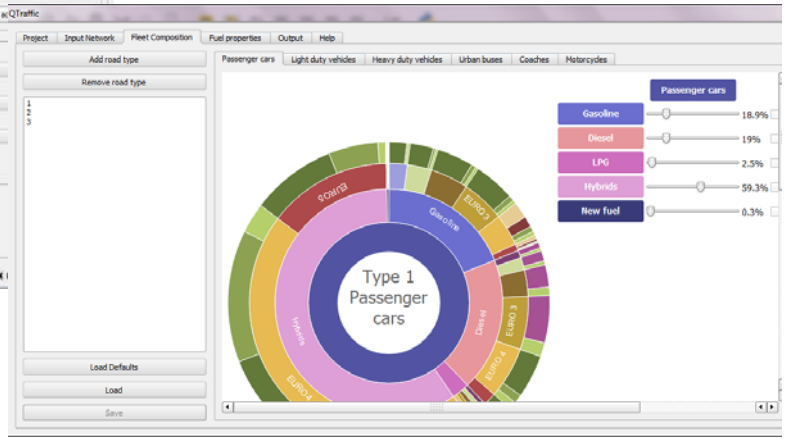
VISUM
Transport model

- • Traffic volume
- •Speed
- •Trip lenght

Methodology

Emissions modelling





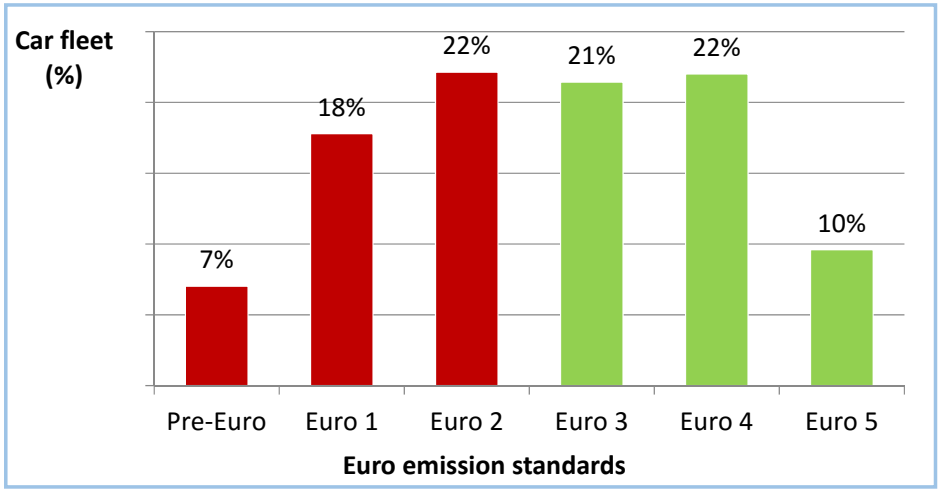
QTraffic -

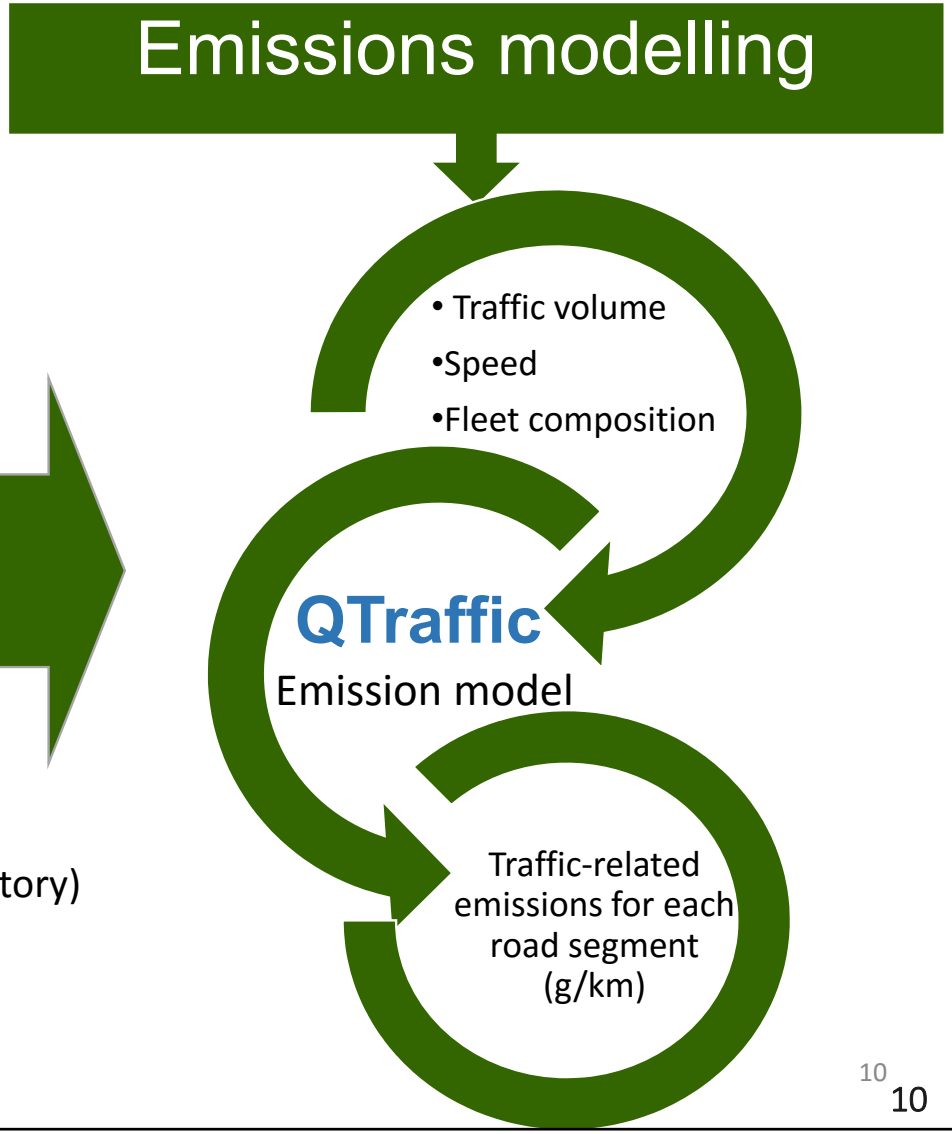
Traffic Emission and Energy Consumption Model for open-source QGIS

Website Location of the QTraffic model:
https://github.com/QTrafficmodel/QTrafficPluginRepository

- Emission factors based on EEA guidelines – average speed approach
- Inteface for user-defined emission factors (e.g. alternative fuels)

Methodology





- Reference year 2011 (to compare with the MACC inventory)
- Outputs separately for gasoline cars and diesel vehicles

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Results - LEZ

Results

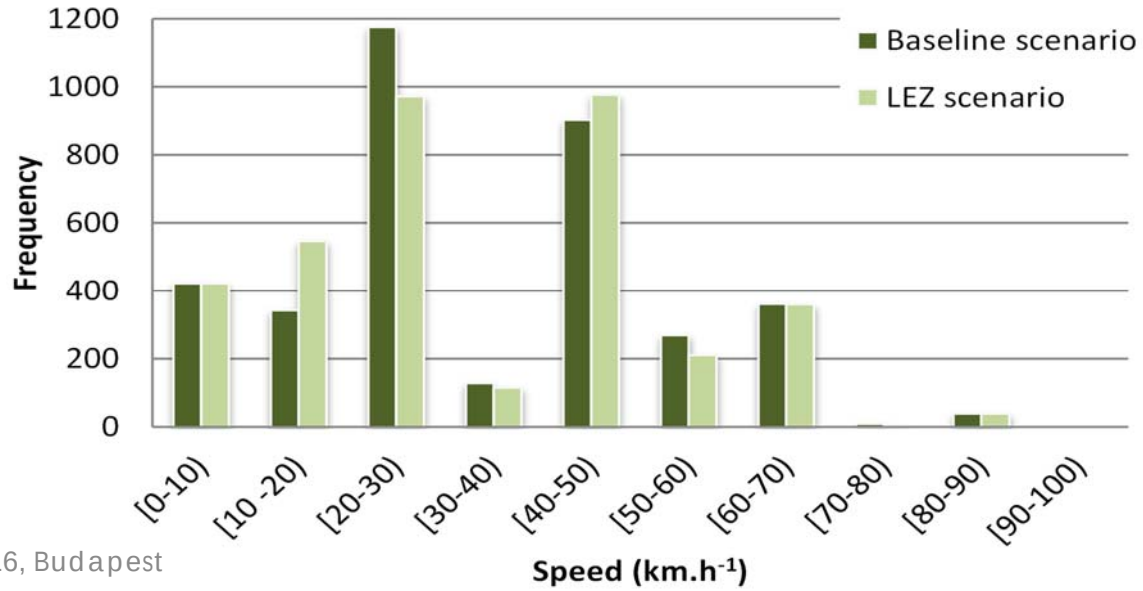
LEZ implementation - road traffic:

☑ leads to a **reduction of 27.2%** in the VKT inside the historic centre of Coimbra;

☑The most striking traffic volume decrease takes place at Avenida Fernão de Magalhães (40.3%);

☒ VKT in Coimbra **globally increases** by 2.2%.

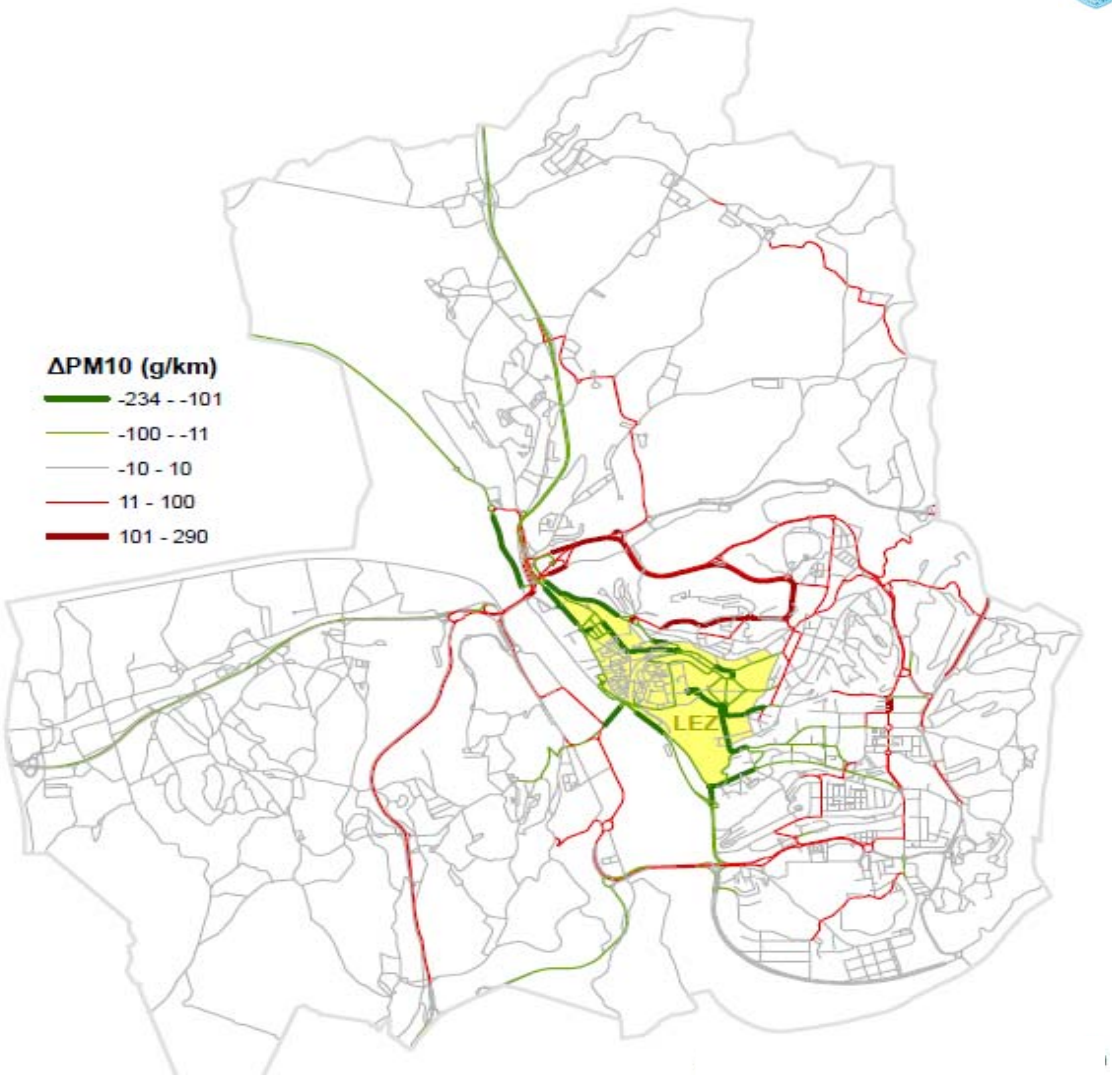
❑ Different frequency distribution of road-link vehicle speed for a typical working day with and without LEZ



Results

LEZ implementation - emissions:

- leads to emission **reduction inside the historic centre** of Coimbra
  - ⬇ 63% for PM10
  - ⬇ 52% for NO_x
- leads to a **global increase** of emissions for the urban area
  - ⬆ 1.2% PM10
  - ⬆ 1.5% for NOx



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Research article

Integrated modelling approach for the evaluation of low emission zones

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ABSTRACT

Low emission zones (LEZ) are areas where the most polluting vehicles are restricted or deterred from entering. In recent years, LEZ became a popular option to reduce traffic-related air pollution and have been implemented in many cities worldwide, notably in Europe. However, the evidence about their effectiveness is inconsistent. This calls for the development of tools to evaluate ex-ante the air quality impacts of a LEZ. The integrated modelling approach we propose in this paper aims to respond to this

Results

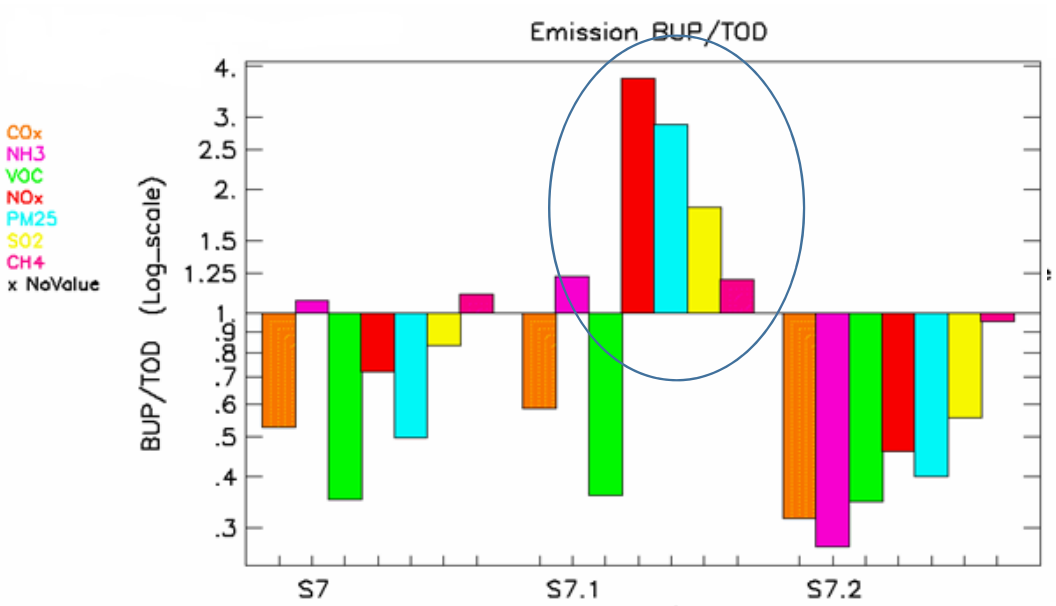
Bottom-Up / Top Down intercomparisons

Results – FAIRMODE Δ Emis Tool

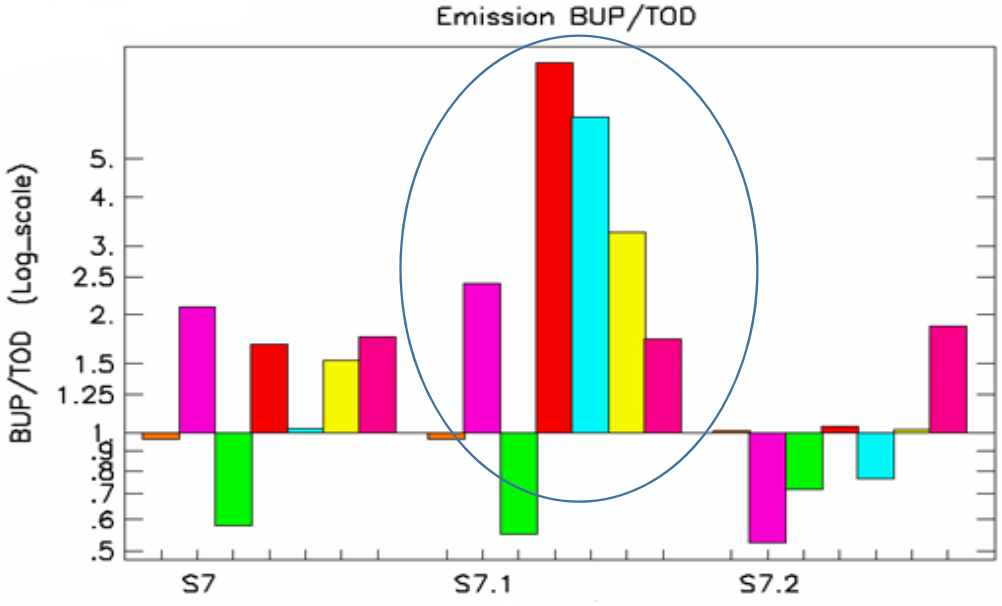
University of Coimbra, PT

Ratios of Bottom-Um to Top-Down emissions

Regional emissions



Urban emissions



S7 – total traffic emissions
S7.1 – gasoline traffic emissions
S7.2 – diesel traffic emissions

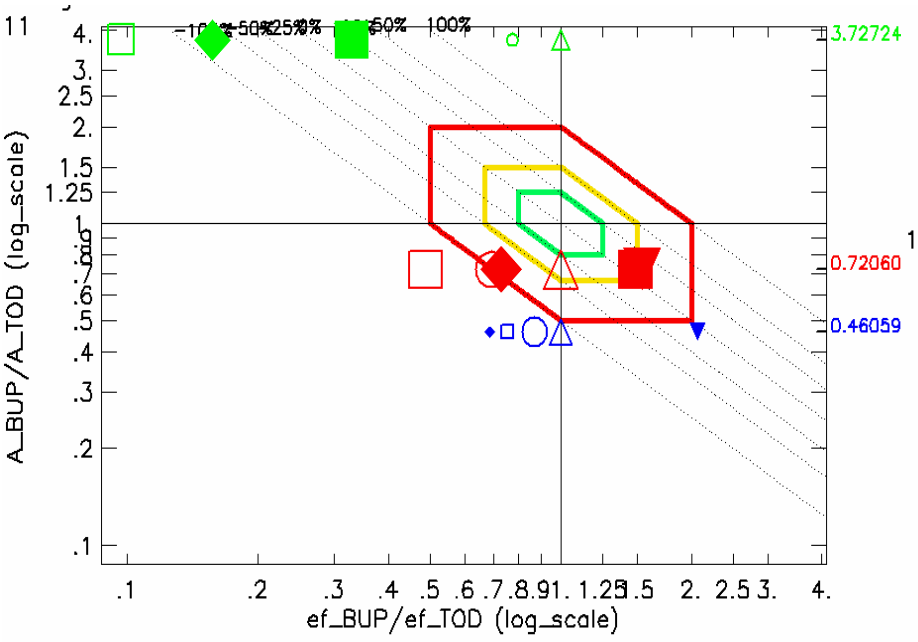
- Significant overestimation for gasoline traffic emissions at both, regional and urban scales
- The highst discerpancy for NOx;

Results – FAIRMODE Δ Emis Tool

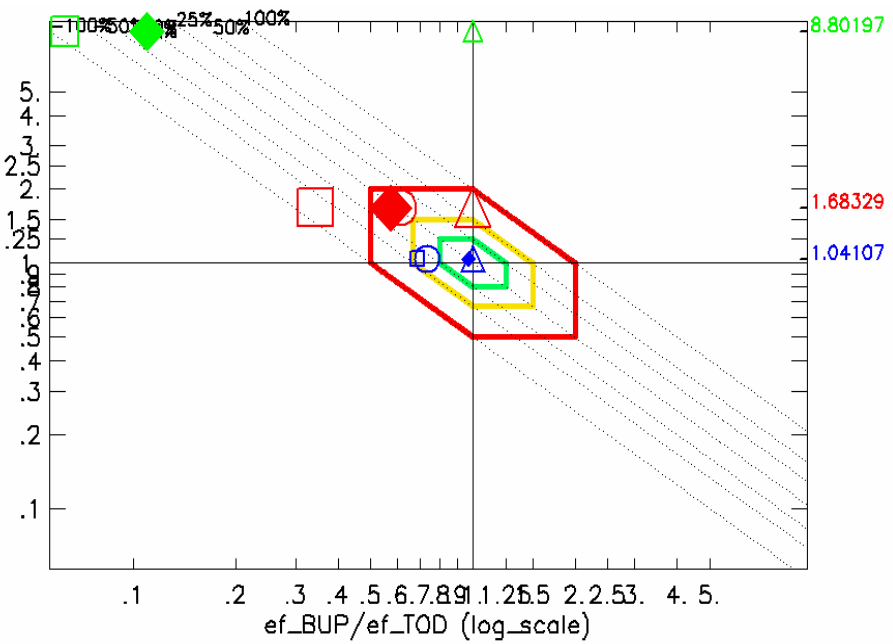
University of Coimbra, PT

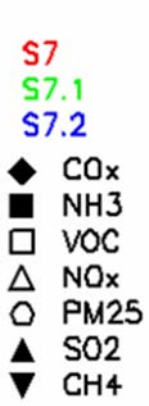
Diamond diagram (Activity vs emission factors)

Regional emissions



Urban emissions





Better aggreement for Urban emissions!

Results for LEZ are not presented because total emissions are similar to the reference scenario

Final remarks

- The DELTA-tool provide an important inside on potential sources of inconsistency presented in the inventories in terms of the emission factors and activity data.
- However, the benchmarking tool is addressing the total emissions for the study area and it could be a limitation for urban scale studies where spatial distribution is an important factor for the decision making.
- Complementarity of top-down and bottom-up methodologies could be the answer for traffic emission inventories.
- “fitness to purpose”! To study traffic related pollution in urban areas the methodologies should be able to implement adequately the road traffic scenarios.

Acknowledgments

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