Traffic, Transportation and Logistics Laboratory

## 4th Conference on Sustainable Urban Mobility – CSUM2018

**24-25 May, 2018, Skiathos Island, Greece**

# *Assessing the impact of changes in mobility behaviour to evaluate sustainable transport policies: case of university campuses of Politecnico di Milano.*


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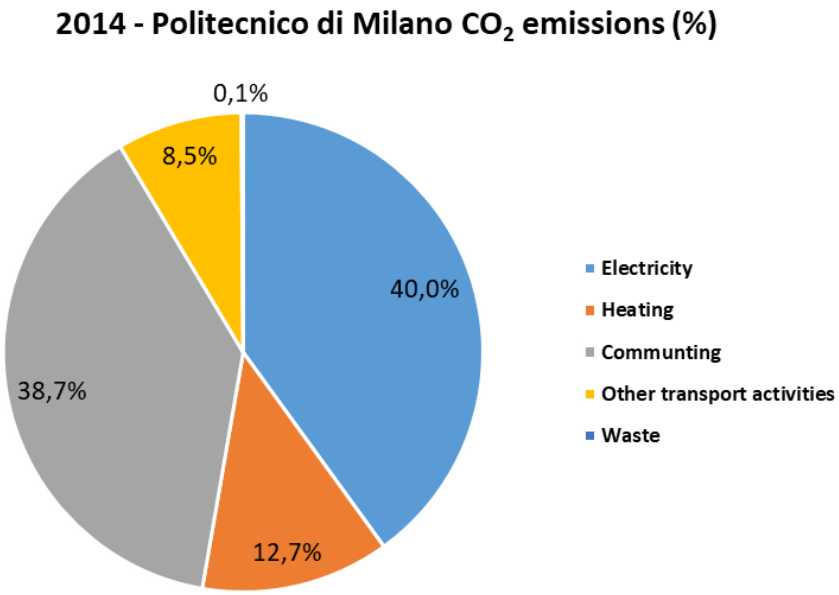
# Introduction

- "Città Studi Campus Sostenibile" project (CSCS) aims to turn the university district into an example for quality of life and environmental sustainability.

- Almost 40% of the total Politecnico $C0_2$ emissions are related to commuting.




Source: Servizio Sostenibilità di Ateneo (2016), Evaluation $CO_2$ emission project of Politecnico di Milano. REPORT 2015.

# Research question

- In which contexts possible mobility policies would be more effective in reducing $CO_2$ emissions?

# Tool

- Scenarios based on the survey on mobility and commuting of Politecnico Academic and Administrative Staff

# Survey

- Survey specifically designed to determine the impact of commuting behaviour in terms of $CO_2$ emissions.
- Sample questions: Means of transport for primary and secondary trips, kind of engine for private vehicle, distance or minutes travelled and frequency on weekly working days base, etc...

2015 results:

- 48,633 Politecnico Community
- 12,363 responses (25.4%)
- The use of private vehicles contributes to 67% of total $CO_2$ commuting emissions (while car use accounts for 20% of total students' trips and 28% of staff)

2017 results:

- 51,921 Politecnico Community
- 13,034 responses (25.1%)

# Survey


*Leonardo*:

53% of whole community

27% responses

*Bovisa*:

37% of whole community

26% responses

*Others*:

10% of whole community

19% responses

# Methodology

## Original Data

### 2017 Survey

13,034 responses (25.1% of the whole community)

Each record represents a primary double way trip and, eventually, a secondary double way trip.

Total means of transport: 11
car, motorbike, train, metro, tram, bus (urban or suburban), bike, skate, on foot (whole way or part)

Total used trip chains: 190

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*Data cleaning [Excel]*

42 filters to check the internal coherence of each record

87.4% of the initial responses were found to be suitable for data analysis

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Record disaggregation both on single way trip and on primary or secondary journey

Records weighted on trip frequency

Trip chains aggregation on prevalent mean of transport (from 190 to 4)

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Av. student weight: 4.8
Av. staff weight: 7.2

## Data elaboration

*Data representation [GIS]*

Trips distribution

Trips distance computation

Modal share

85% of the consolidate records are positively associated to motorized means of transport

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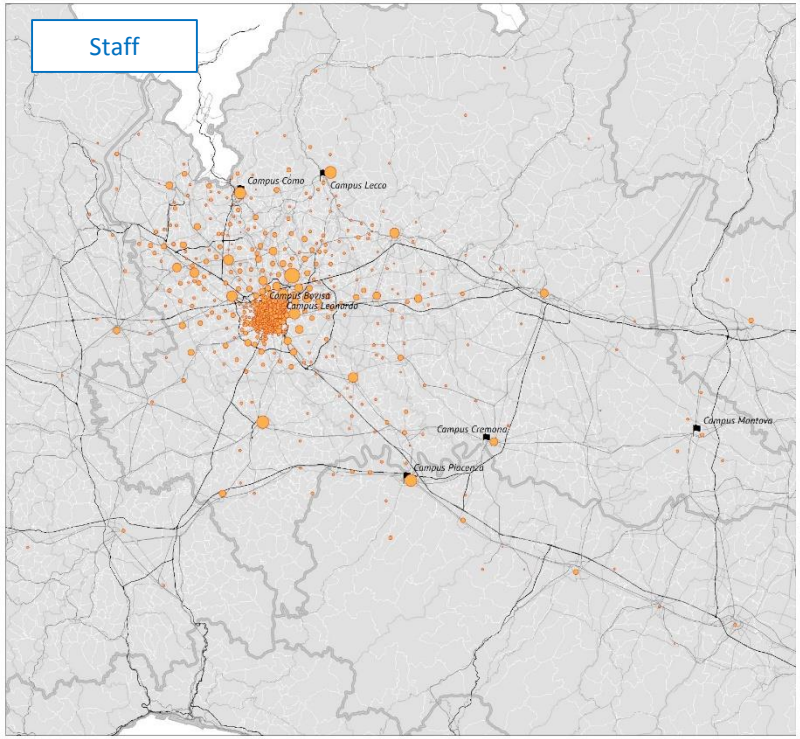
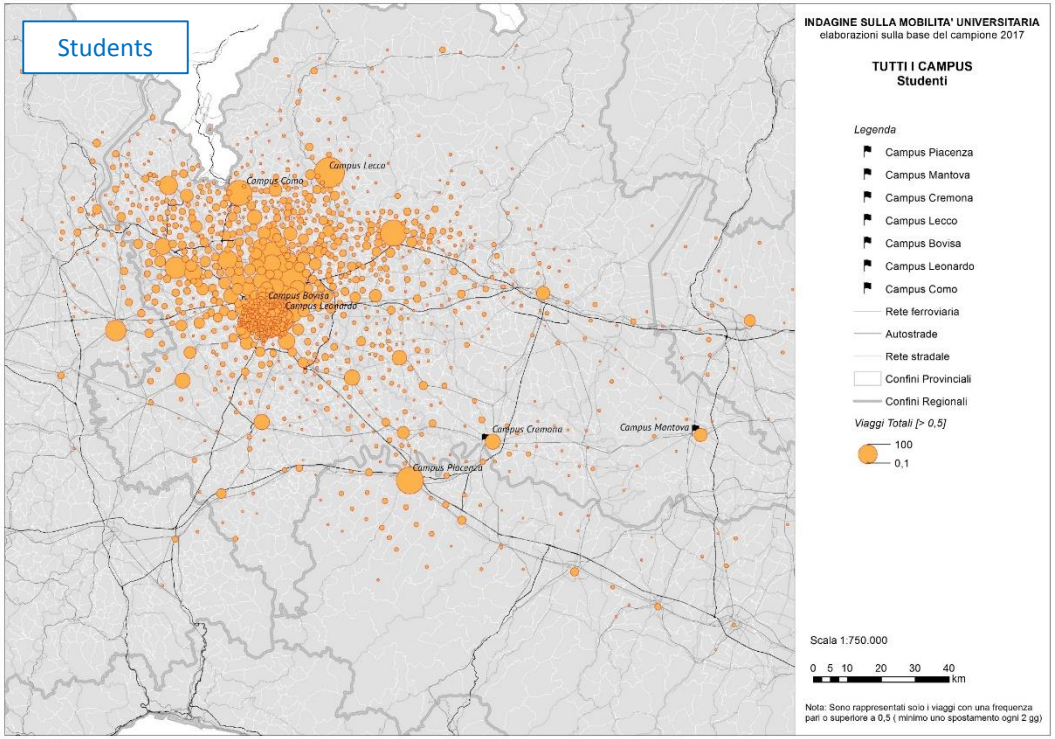
**GHG emission Scenarios**

# Trips Distribution

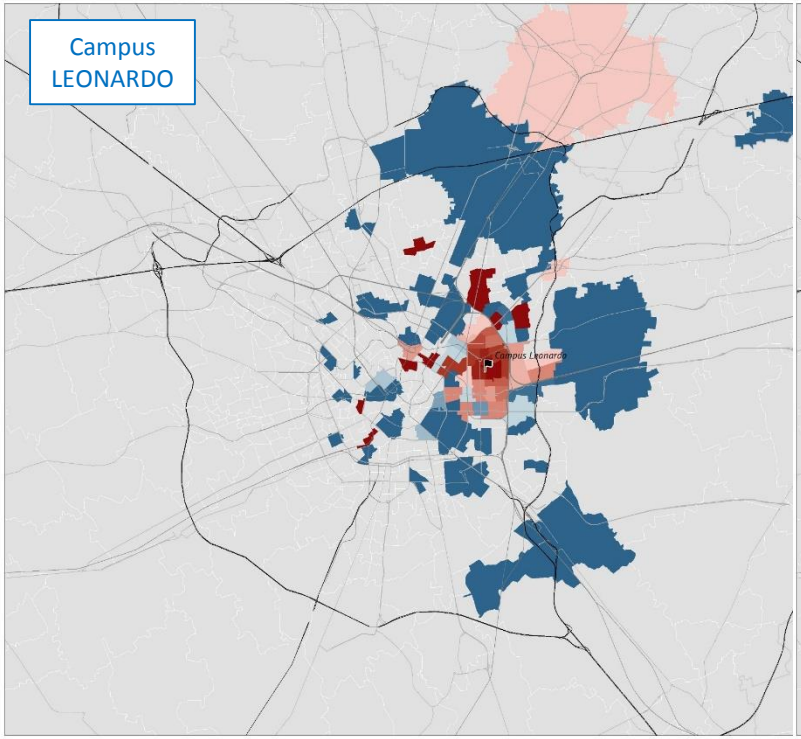
- Staff is concentrated around campuses while students are spread in the entire region (and beyond)

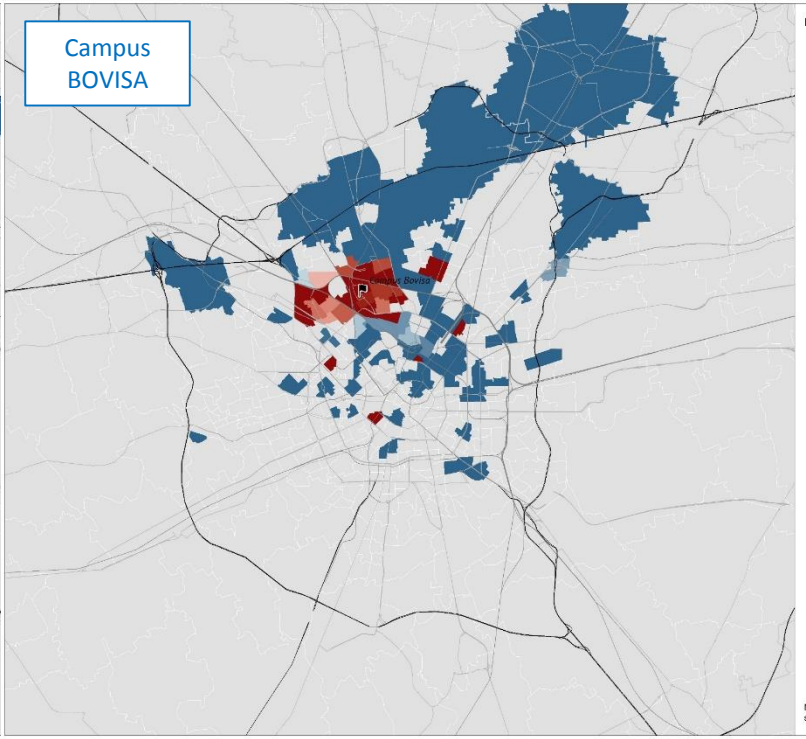


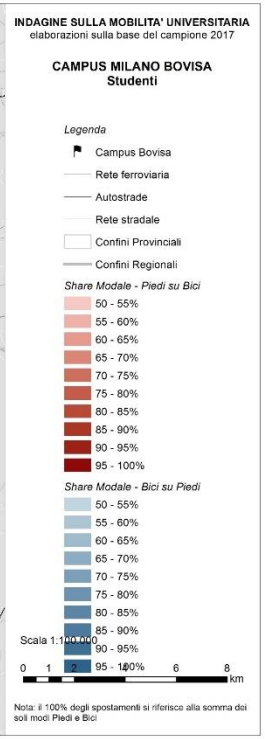



# Trips Distribution

- The catchment areas of the two campuses are well distinguishable within the municipality of Milan

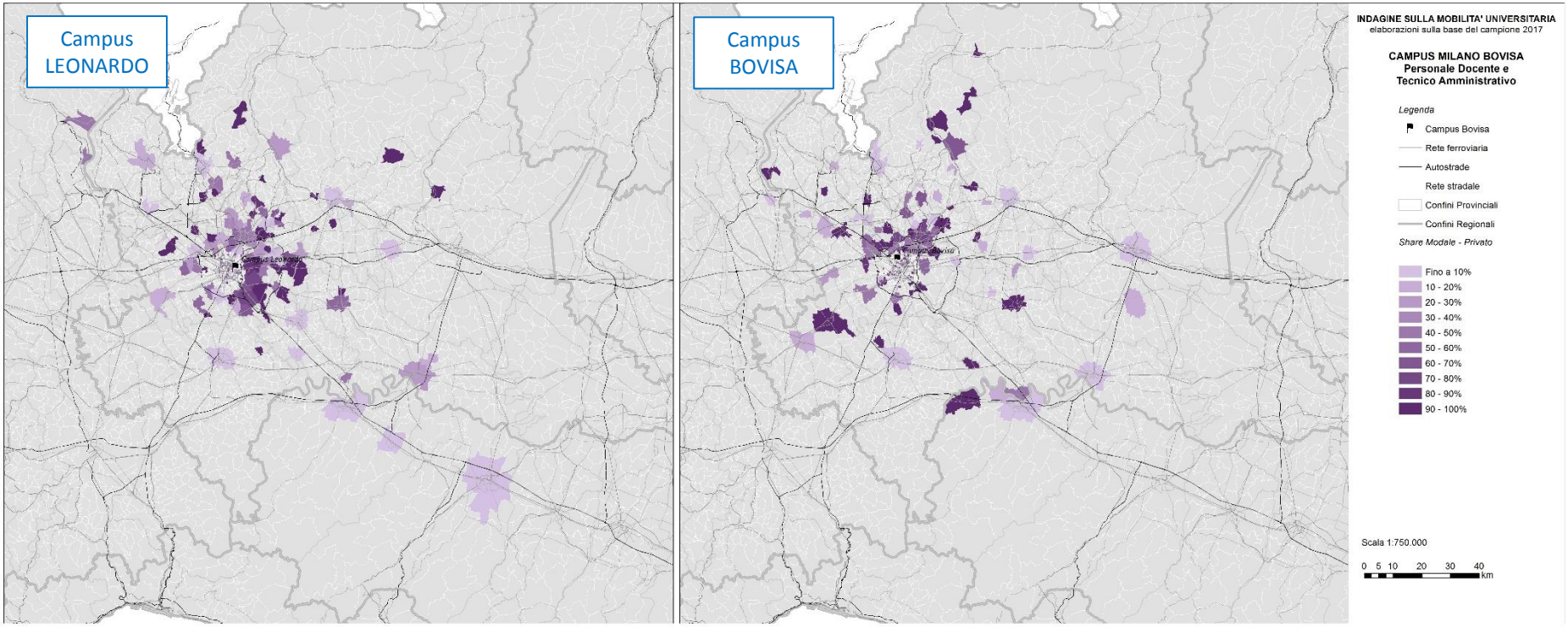


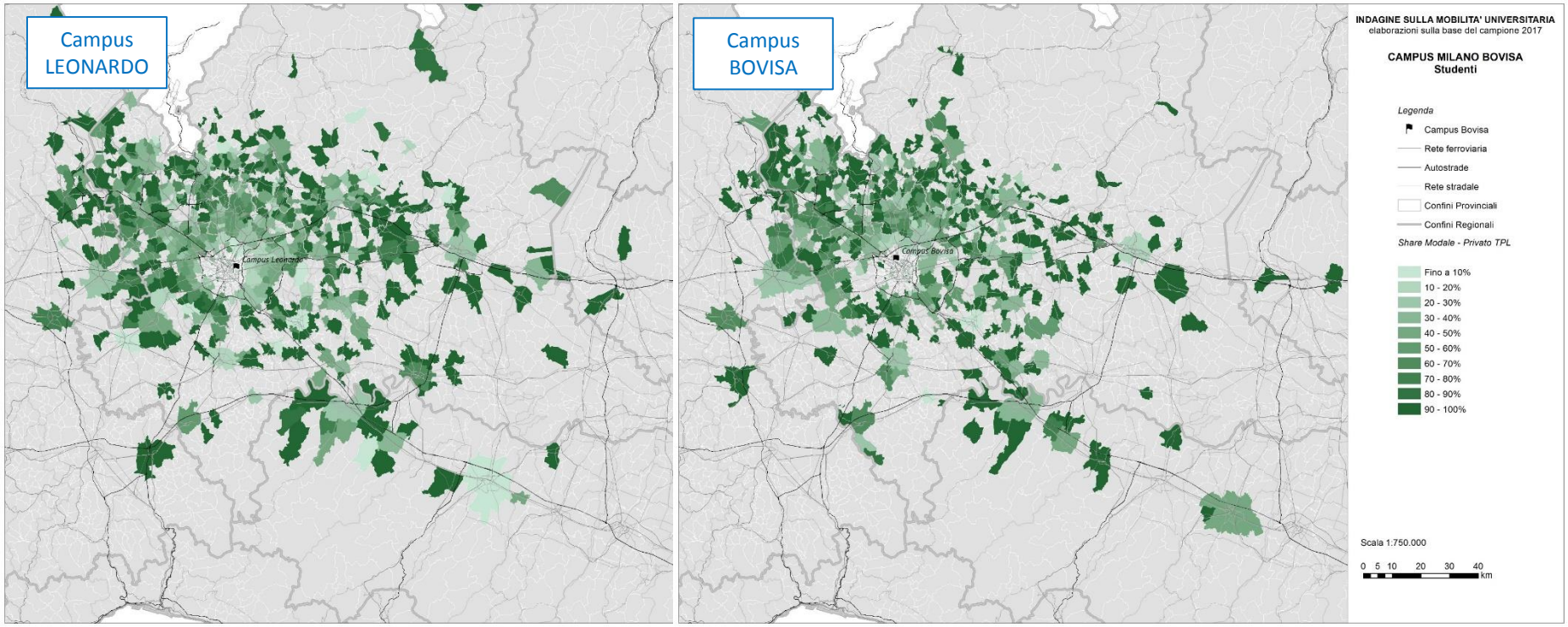
# Trips Distribution

- The majority of trips by car are generated from areas located from 5 to 20 km from the campuses



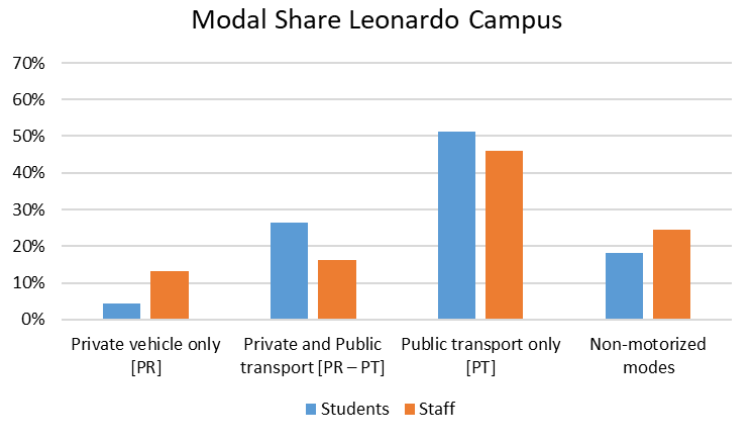
# Trips Distribution

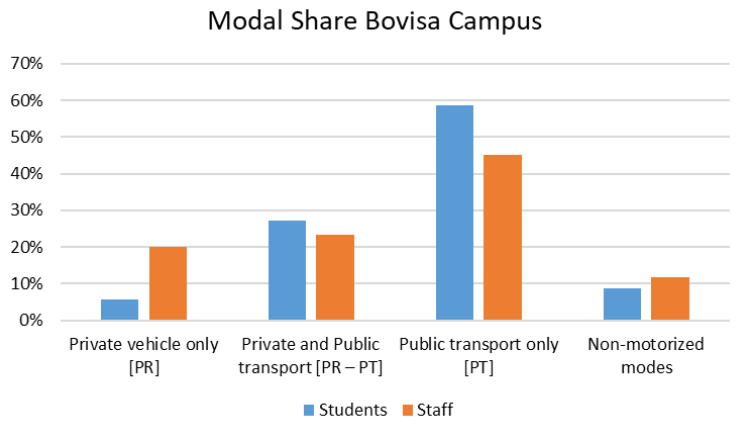
- Trips by public mode (or with an interchange between private and public) cover the entire region



# Modal Share

- On average, 66% of the total commuting trips are travelled using a combination of public and non-motorized modes.
- Non-motorized modes: from 10% (2015) to 18% (2017)



# Sampling weights

The number of respondents [$r$] was expanded to represent the entire Politecnico population [$P$].

Cluster on campus [$c$] and university career/job category [$j$]

$$Sw_{cj} = \frac{P_{cj}}{r_{cj}}$$

| CAMPUS | STUDENT | | | STAFF | | | |
|---|---|---|---|---|---|---|---|
| | Bachelor | Master | Single Course | Administrative staff | Professor | R. fellow & PhD | Technical staff |
| Leonardo | 3.1 | 4.8 | - | 7.3 | - | 8.8 | 1.6 |
| Bovisa | 3.3 | 4.6 | - | 4.7 | - | 23.6 | 2.2 |
| Others | 4.1 | 5.5 | - | 2.5 | - | 6.0 | 1.6 |
| All | - | - | 8.3 | - | 2.3 | - | - |

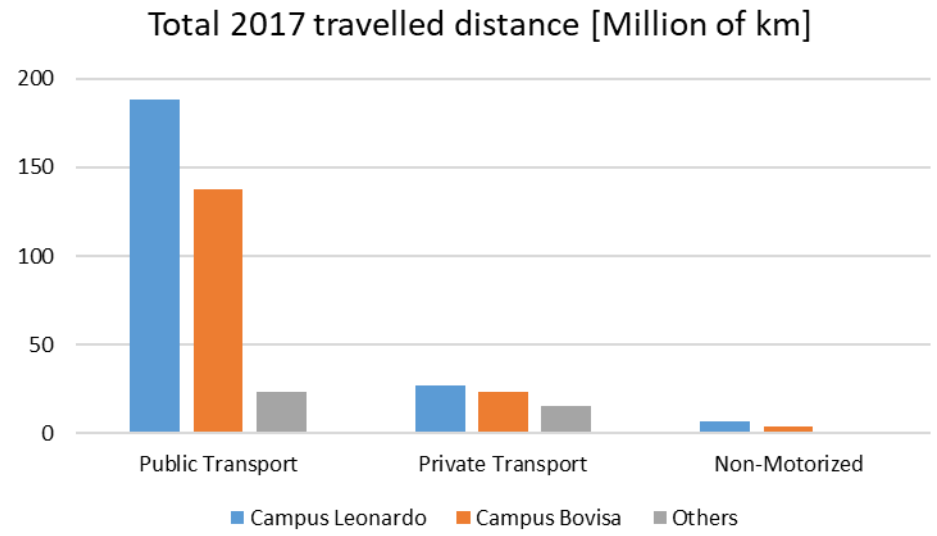
# $CO_2$ calculation

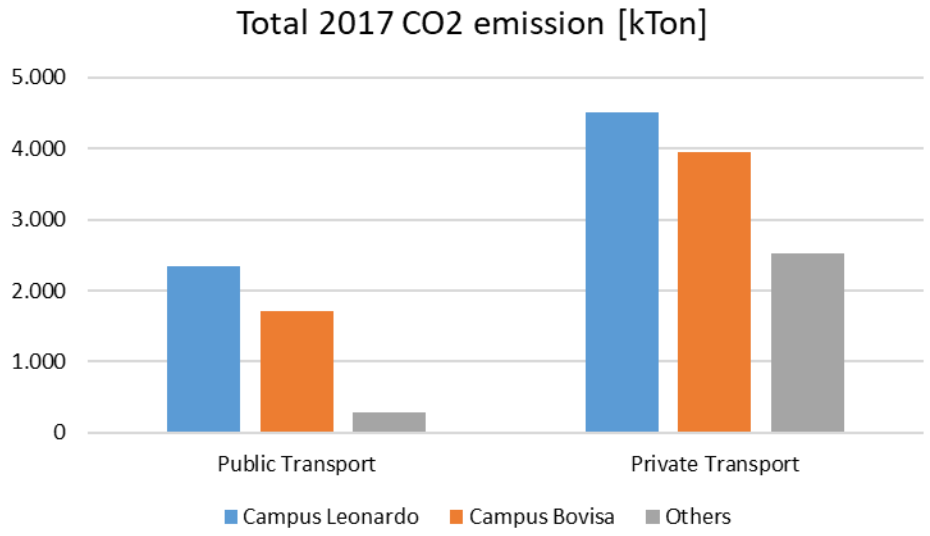
In order to estimate the $CO_2$ emission due to commuting trips [*j*], we calculate the total kilometres travelled [*D*] by the expanded university sample on an annual basis [*Nt*] by each mean of transport [*i*], and we multiply them for their specific $CO_2$ emission factor [*EF*] collected/calculated from a variety of sources

$$ECO2 = \sum_i \left( \sum_j D_{i,j} * Nt_j \right) * EF_i$$

# $CO_2$ calculation

- 81% of the total travelled distance and 28% of the total $CO_2$ emission are made by public transport users.
- 81% of the total $CO_2$ commuting emissions are generated by the two Milanese campuses



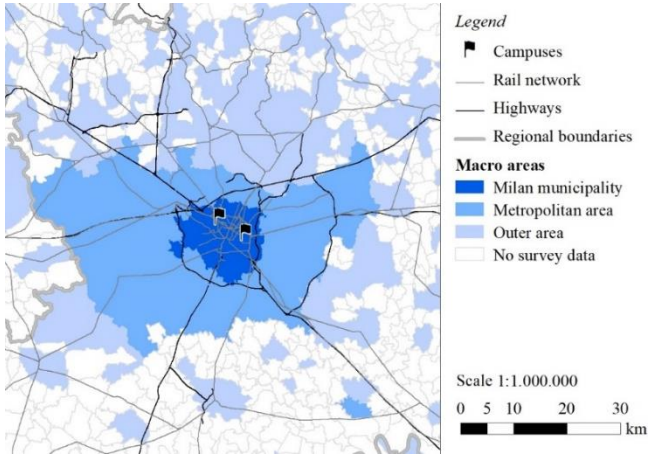



# Scenarios

- 2 main campuses (Milano Leonardo, Milano Bovisa)
- 3 macro areas of origin based on public transport networks, administrative boundaries and trip distribution (Milan municipality; Milan metropolitan area; Outside area)
- 3 scenarios with a progressive cumulate kilometres reduction (25%, 50%, 75%)
- Redistribution of kilometres travelled with the private mode to the public mode (as a primary choice) or the private-public mode (if the previous is not available)

**ASSUMPTION:** A certain transport mode, from a specific municipality to one of the two campuses, is available if at least one of the respondents use it.

| Zone | Trips [Mlm] | Trips [%] | Km [Mln] | Km [%] | Trip length [km] |
|---|---|---|---|---|---|
| **MI** | 7.2 | 45 | 33.0 | 9 | 4.6 |
| **Metr.** | 2.4 | 15 | 49.1 | 13 | 20.4 |
| **Outer** | 6.3 | 40 | 294.2 | 78 | 46.4 |
| **Total** | 15.9 | 100 | 376.3 | 100 | 23.6 |



# Scenarios

| HP | Zone | Staff | Student | Total | Over reference [%] |
|---|---|---|---|---|---|
| - | Outer | 1,779 | 7,628 | 9,407 | - |
| | Metr. | 576 | 1,727 | 2,303 | - |
| | MI | 210 | 597 | 807 | - |
| 25% | Outer | 1,683<br>-5% | 7,428<br>-3% | 9,111<br>-3% | -2.4% |
| | Metr. | 511<br>-11% | 1,614<br>-7% | 2,125<br>-8% | -1.4% |
| | MI | 191<br>-9% | 560<br>-6% | 751<br>-7% | -0.4% |
| 50% | Outer | 1,587<br>-11% | 7,228<br>-5% | 8,815<br>-6% | -4.7% |
| | Metr. | 446<br>-23% | 1,502<br>-13% | 1,948<br>-15% | -2.8% |
| | MI | 172<br>-18% | 524<br>-12% | 696<br>-14% | -0.9% |
| 75% | Outer | 1,491<br>-17% | 7,028<br>-8% | 8,519<br>-9% | -7.1% |
| | Metr. | 381<br>-38% | 1,390<br>-21% | 1,771<br>-23% | -4.3% |
| | MI | 153<br>-30% | 487<br>-19% | 640<br>-21% | -1.3% |

- Even though trips originated from the Metropolitan area are considerably less than those from the others, a change in their modal share leads proportionally to the most relevant change in the overall $CO_2$ emissions.
- A change in staff mobility behaviour would have proportionally a wider impact than the same change for students.

# Conclusions

- Main trend 2015/17: Slight modal shift (about 10%) from private means of transport to public and non-motorized modes.

- Due to the already high share of non-motorized and public transport users, even with a considerable modal shift from private to public mode (whenever already available), the effect on the overall GHG emission reduction will be quite limited (a shift of 75% in favor of public transport is equal to a reduction of 13% in GHG emission)

- Considering these findings, Politecnico could strengthen some already undergoing actions, like parking lots regulation (e.g. introducing fares or restrictions), and counterbalance them with incentives as discounts on integrated public transport subscriptions.

# Contact Details

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