InSity - Indicadores de Mobilidade Urbana

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MINISTÉRIO DA CIÊNCIA E DA TECNOLOGIA Portugal

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Objectives

- Evaluation of **urban accessibility indicators** for non work destinations, considering a local scale (< 2 km), including:
  - internal costs (time or distance)
  - external environmental costs (energy consumption, CO_2 emissions and local pollutant emissions);
- Methodology considering different transport modes: walking, car and transit

Definitions

Accessibility ≠ Mobility

"the potential for interaction"

"the amount of effort for a person to reach a destination"

"the number of activities which can be reached from a certain location"

"the ease with which any land-use activity can be reached from a location, using a particular transport system"

"an ability to get what one needs, if necessary by getting to the places where those needs can be met"

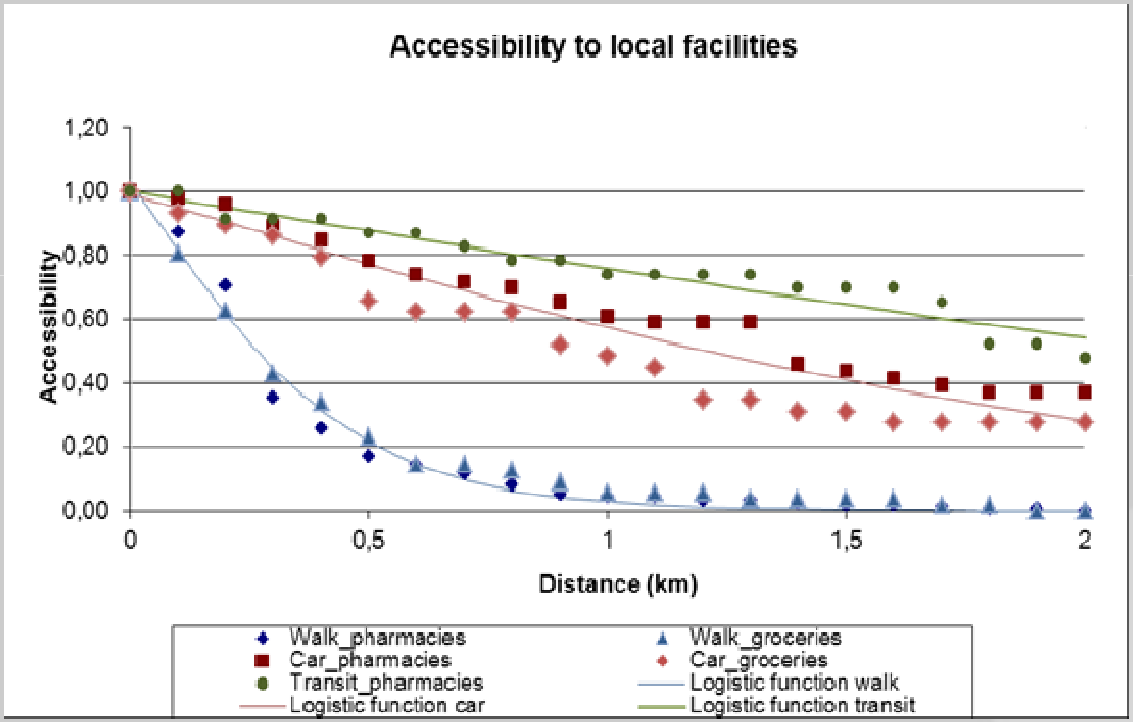
"potential for movement, the ability to get from one place to another"

Methodology

- The methodology for accessibility estimation considered 4 steps:
  - Measurement of individual accessibility, for a given mode, from origin to a pre-define destination
  - Estimation of the cumulative accessibility for different destinations
  - Estimation of the total accessibility of each neighborhood
  - Calculation of external cost of accessibility (energy consumption, CO_2 and local pollutant emissions)

Methodology

Individual accessibility: based on data collected from *in situ* and online surveys



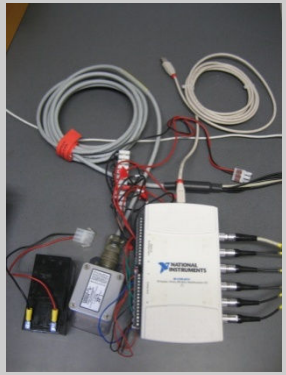
$$Y = \frac{a}{1 + bc^{-x}}$$

MoveLab

- *In situ* measurements for all transport modes (walking, bus, metro and car) using a laboratory:

Portable unit to monitor air quality

Computer



Accelerometer and USB Data acquisition

GPS

Walk trip

- Free-flow speed (literature) corrected with attenuation factor:
  - Pedestrian crossing sign
  - Marked crosswalk
  - No crosswalk

$$V_{corrected} = v_{ff} \times f_a = 1{,}30 \text{ m/s}$$

Car trip

- Sum of different events:
  - time from the origin to the car,
  - average time to find a parking space,
  - time lost to park,
  - time as a pedestrian, walking from the parking space to the destination
  - time driving the car

Car trip

- Parking scenarios:
  - **Low demand scenario** – areas where it is easy to find a parking space.
  - **Balanced scenario** – it is assumed for areas where there is a balance between rotation and saturation.
  - **High parking pressure scenario** – this is an opposite scenario to the low demand, here demand is greater than supply.

Scenarios	Parking search time (min)	Average distance between parking and destination (m)
Low demand (eg.: residential areas)	< 1	25
Intermediate	2,5	125
High pressure (eg.: historical centres, city centres)	5	250

Transit

- Two additional "distances" considered:
  - distance, as pedestrian, from origin to the initial bus stop and from final bus stop to the final destination;
  - average waiting time for the bus (converted into a distance)

Car and Transit considered not attractive if distance by foot to the destination < 200 m

Methodology

- Sum of different opportunities: based on resistance analogy calculation approach

$$R = \frac{1 - A}{A}$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + .. + \frac{1}{R_n} = \sum \frac{1}{R_i}$$

- For an entire neighborhood:

$$A_T = \frac{\sum A_i \times f_i}{\sum f_i}$$

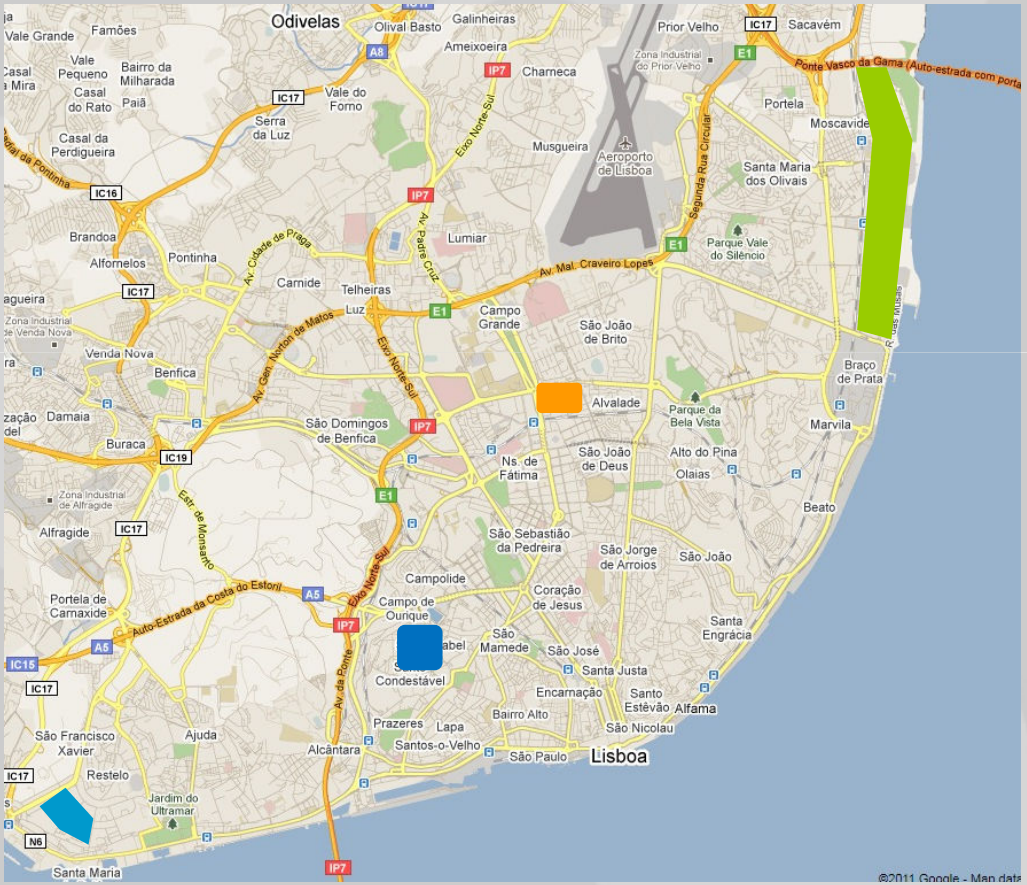
f_i - correction factor (exple: local block population density).
In the present study: simple non weighted average was used (i.e. $f_i = 1$).

Neighborhood comparison

Case study areas

- Bairro de São Miguel
- Bairro do Restelo
- Campo de Ourique
- Parque das Nações
  - South
  - Centre
  - North

- Accessibility to pharmacies, groceries, bakeries and primary schools

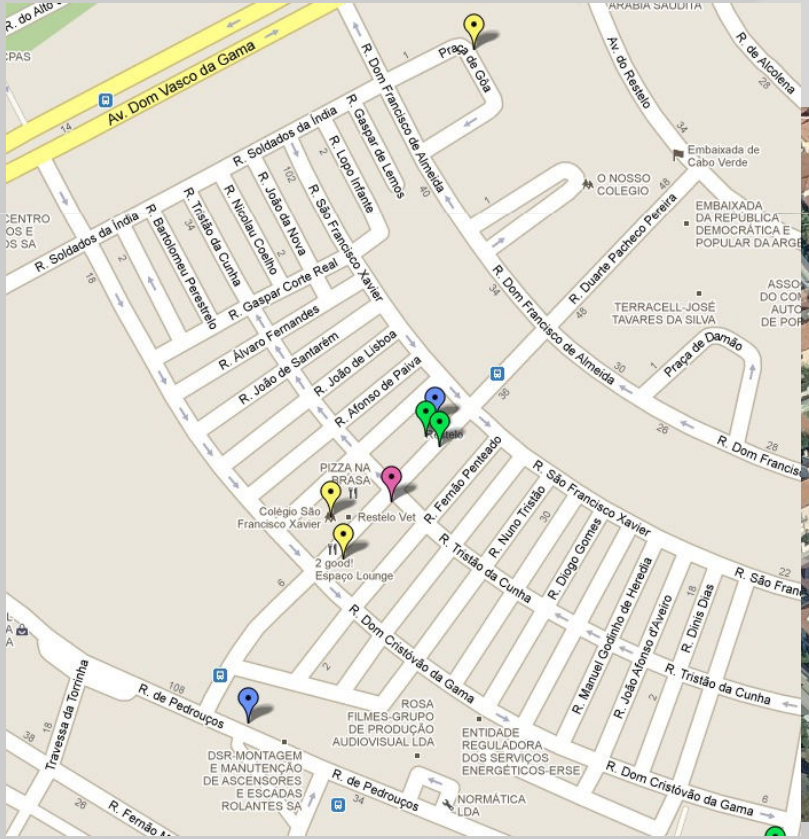


Case study areas

- Bairro de São Miguel:
  - residential neighbourhood
  - located close to one of the main commercial streets of Lisbon (Av. de Roma).

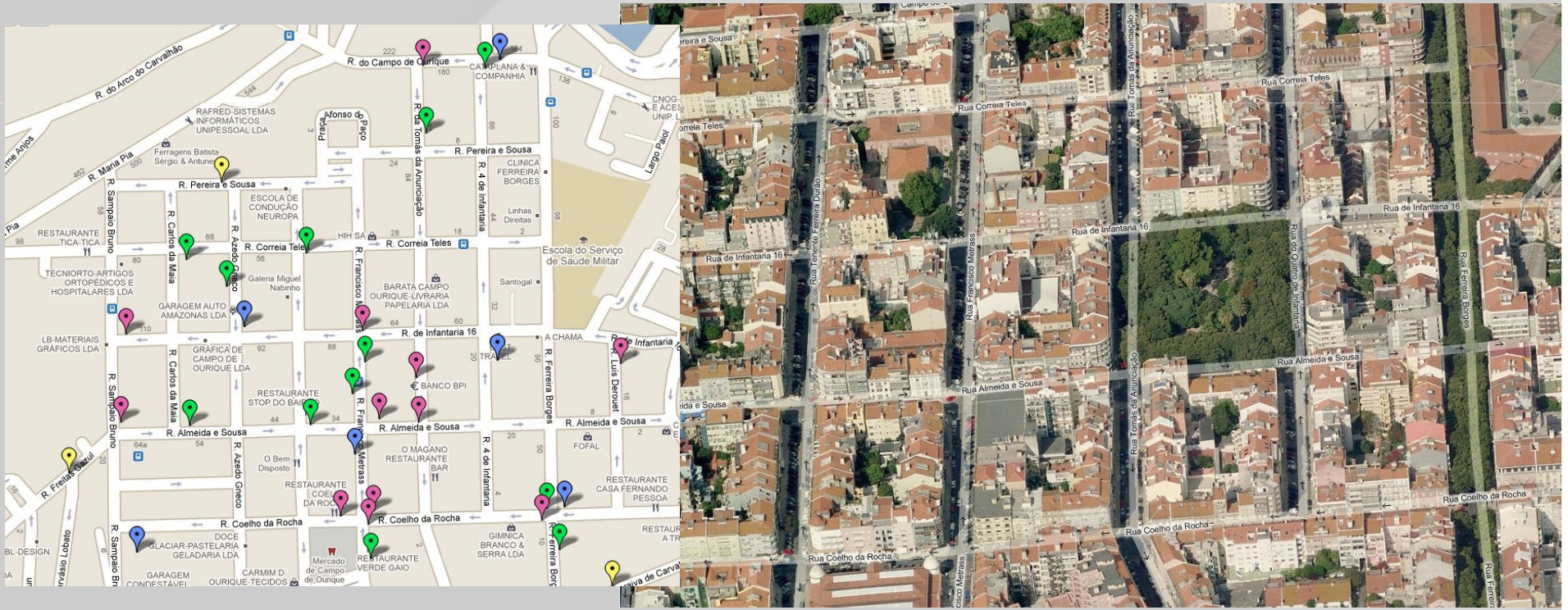
Case study areas

- Bairro do Restelo:
  - noble single-family house in a traditional neighbourhood with one single street of commerce.



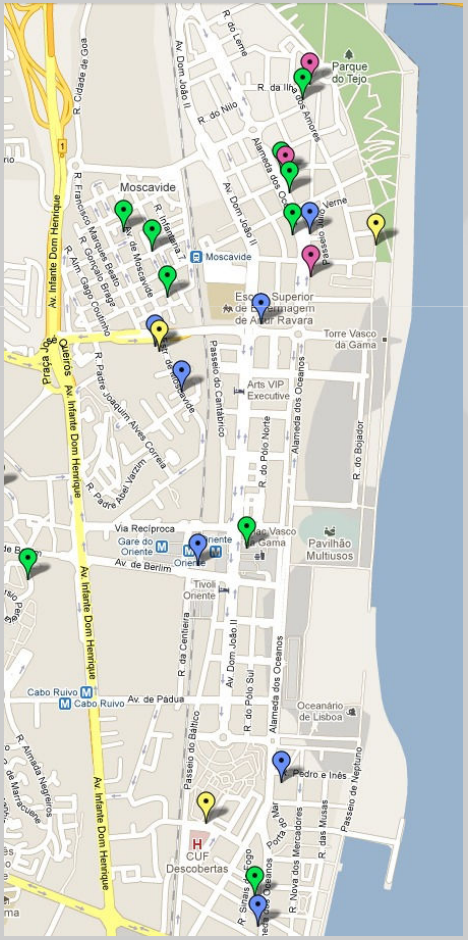
Case study areas

- Bairro de Campo de Ourique:
  - old residential neighbourhood
  - intense street commerce
  - considered a small village inside the city



Case study areas

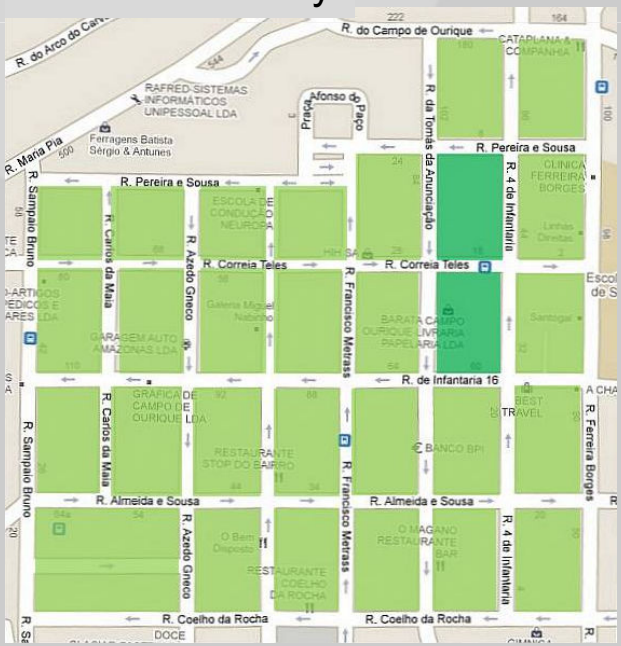
- Bairro Parque das Nações:
  - rebuilt residential, leisure and commercial area



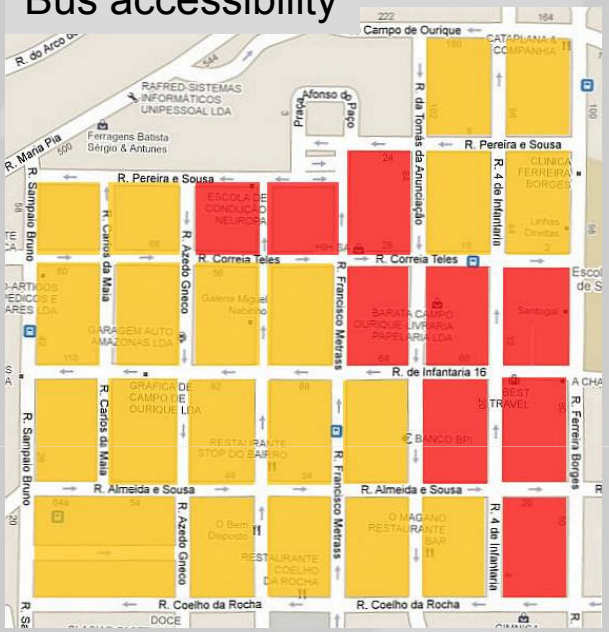
Comparison of neighborhood blocks

Walking accessibility

Car accessibility



Bus accessibility

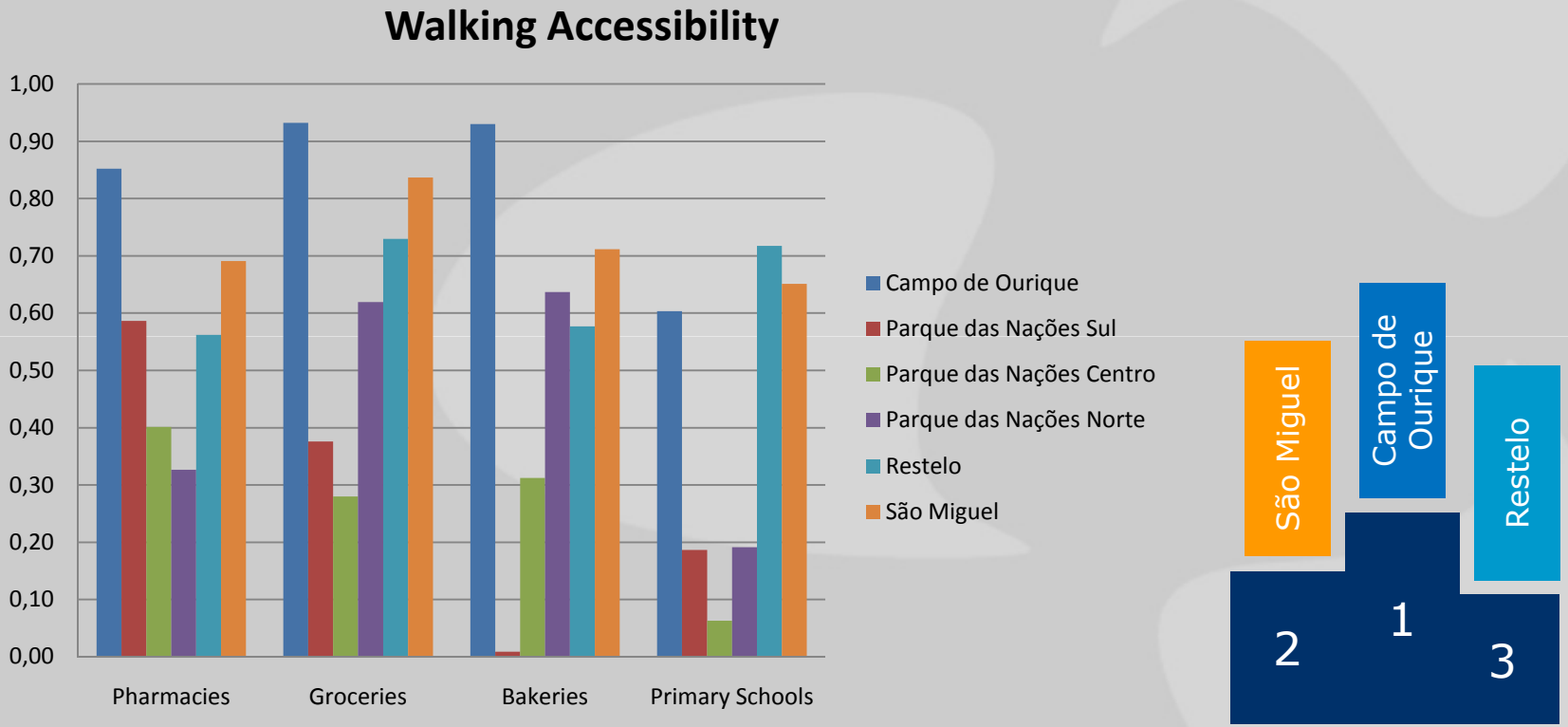


Neighborhood characterization

Campo de Ourique											
Pharmacies											
	Accessibility	Top 5 accessibility	Weighted average time (min)	Minimum time (min)	Weighted average distance (km)	FC (MJ)	CO_2 (g)	CO (g)	NOx (g)	PM (g)	HC (g)
Walk	0,85	0,84	4,2	1,9	0,33	0,00	0,00	0,00	0,00	0,00	0,00
Car	0,72	0,66	11,2	9,8	0,76	3,30	208,56	8,10	0,48	0,17	1,21
Bus	0,31	0,31*	11,1	10,0	0,54	0,14	10,48	0,05	0,12	0,01	0,02

Parque das Nações Centro											
Pharmacies											
	Accessibility	Top 5 accessibility	Weighted average time (min)	Minimum time (min)	Weighted average distance (km)	FC (MJ)	CO_2 (g)	CO (g)	NOx (g)	PM (g)	HC (g)
Walk	0,40	0,40	6,9	5,3	0,54	0,00	0,00	0,00	0,00	0,00	0,00
Car	0,81	0,79	7,5	5,5	1,09	4,49	292,66	9,45	0,70	0,22	1,39
Bus	0,32	0,32*	12,6	10,8	0,92	0,23	17,72	0,09	0,21	0,02	0,04

Different neighborhoods comparison



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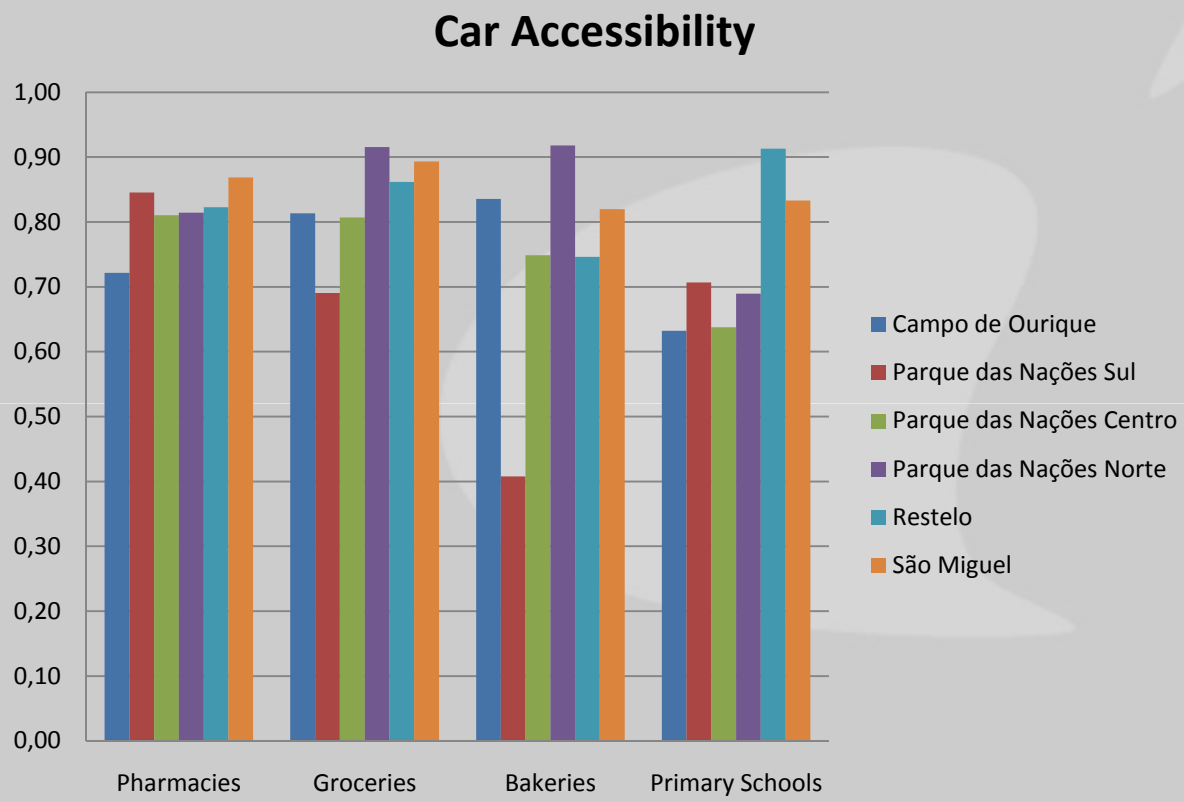
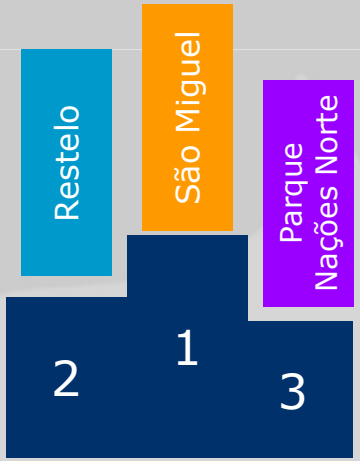
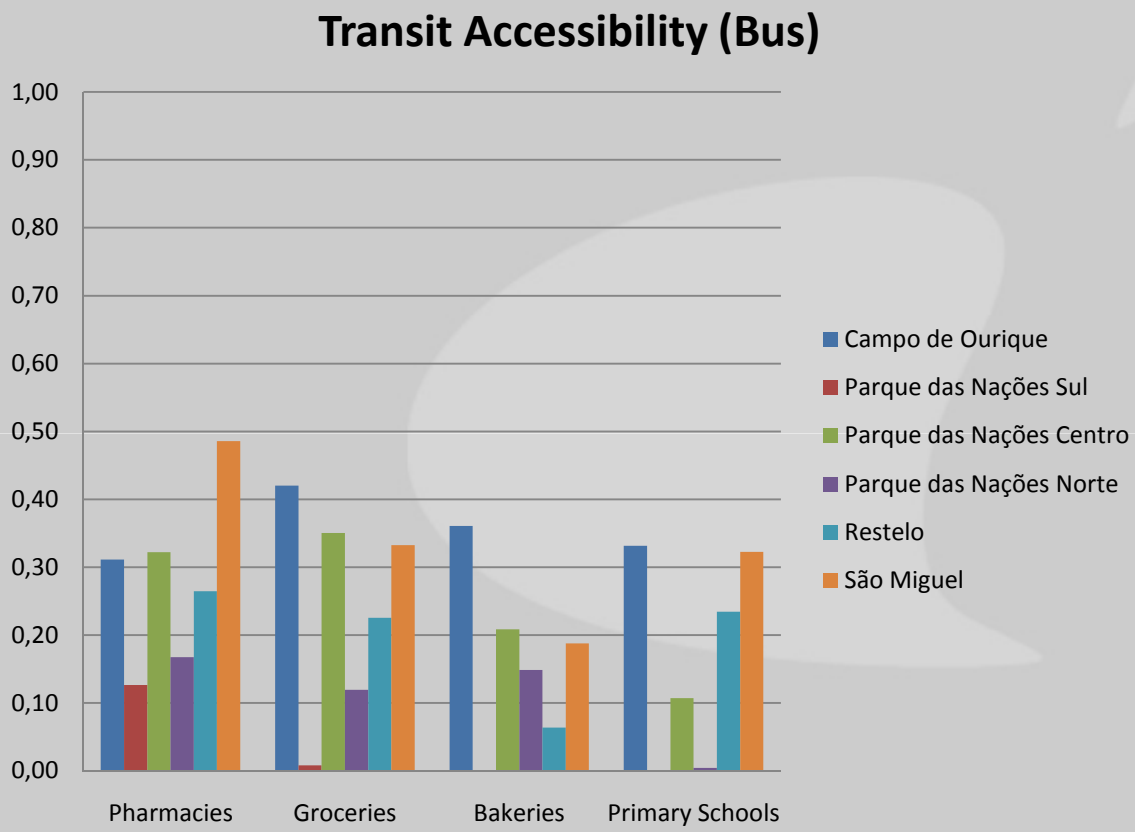
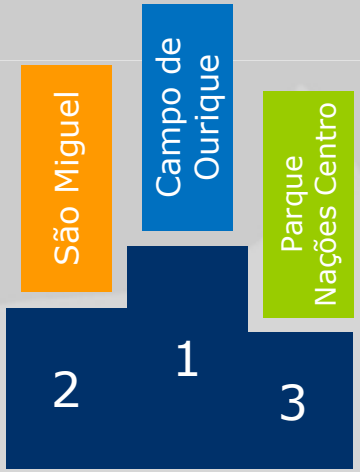




Different neighborhoods comparison





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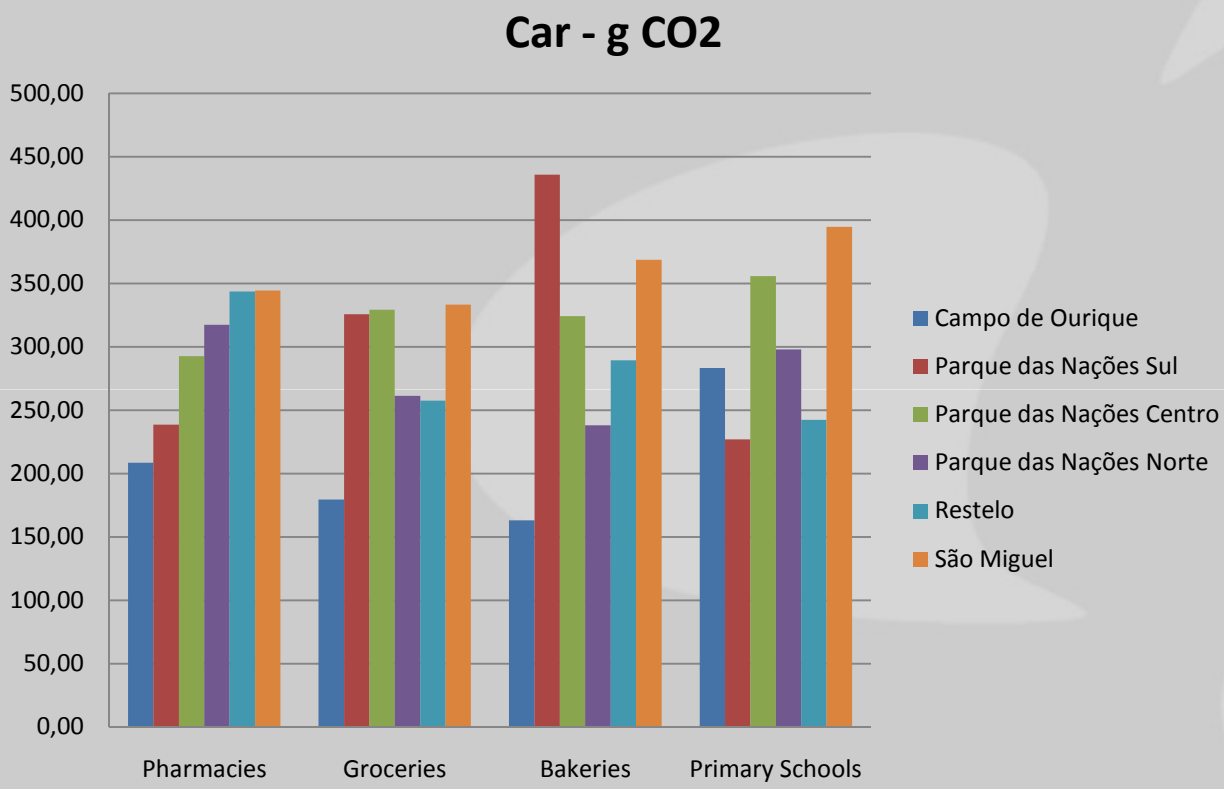
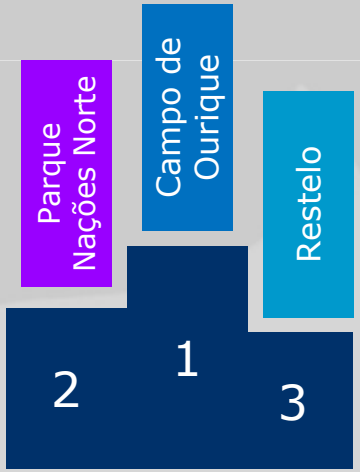
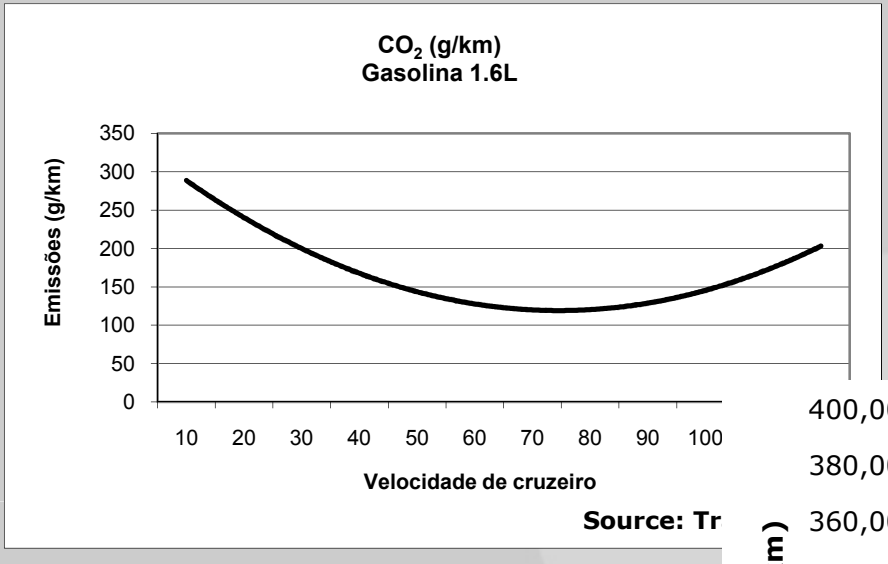
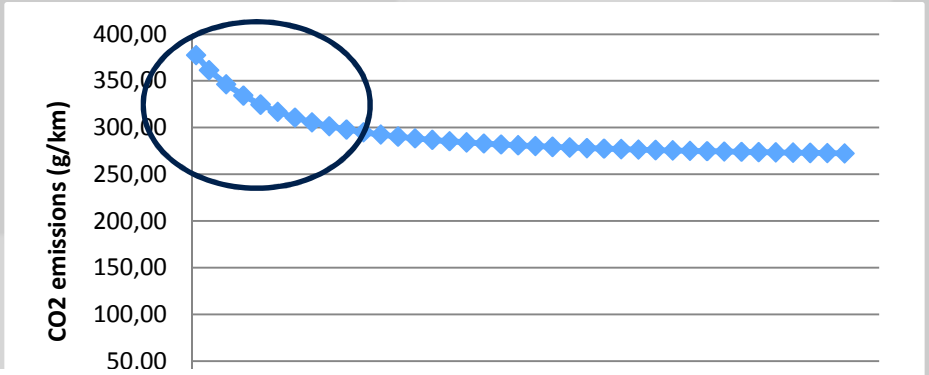
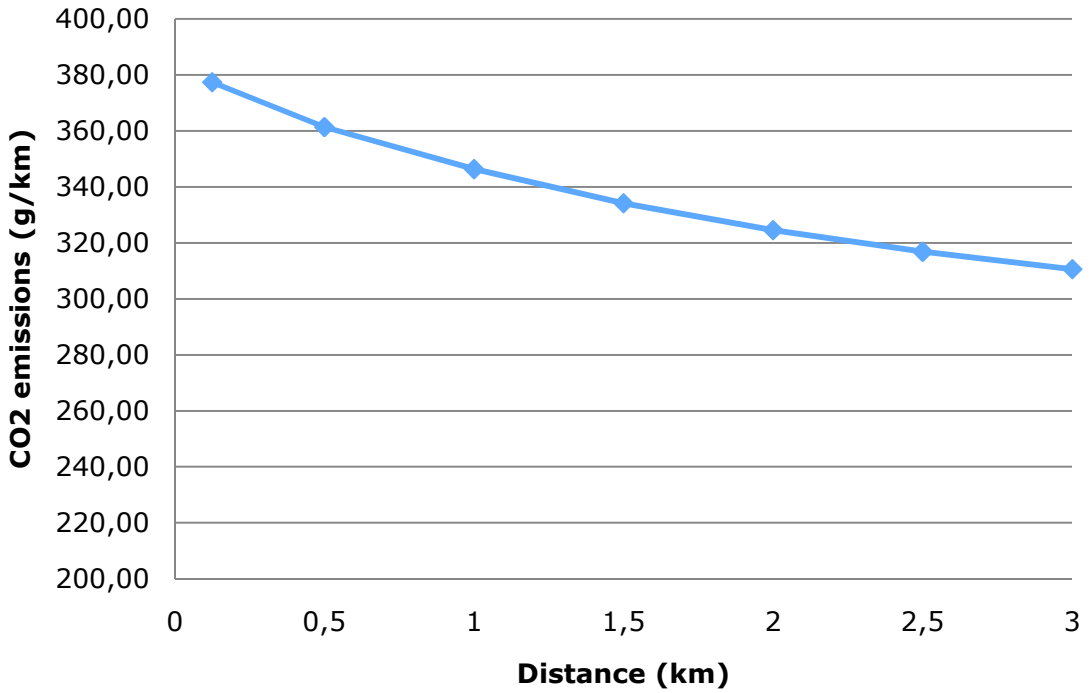




CO^2



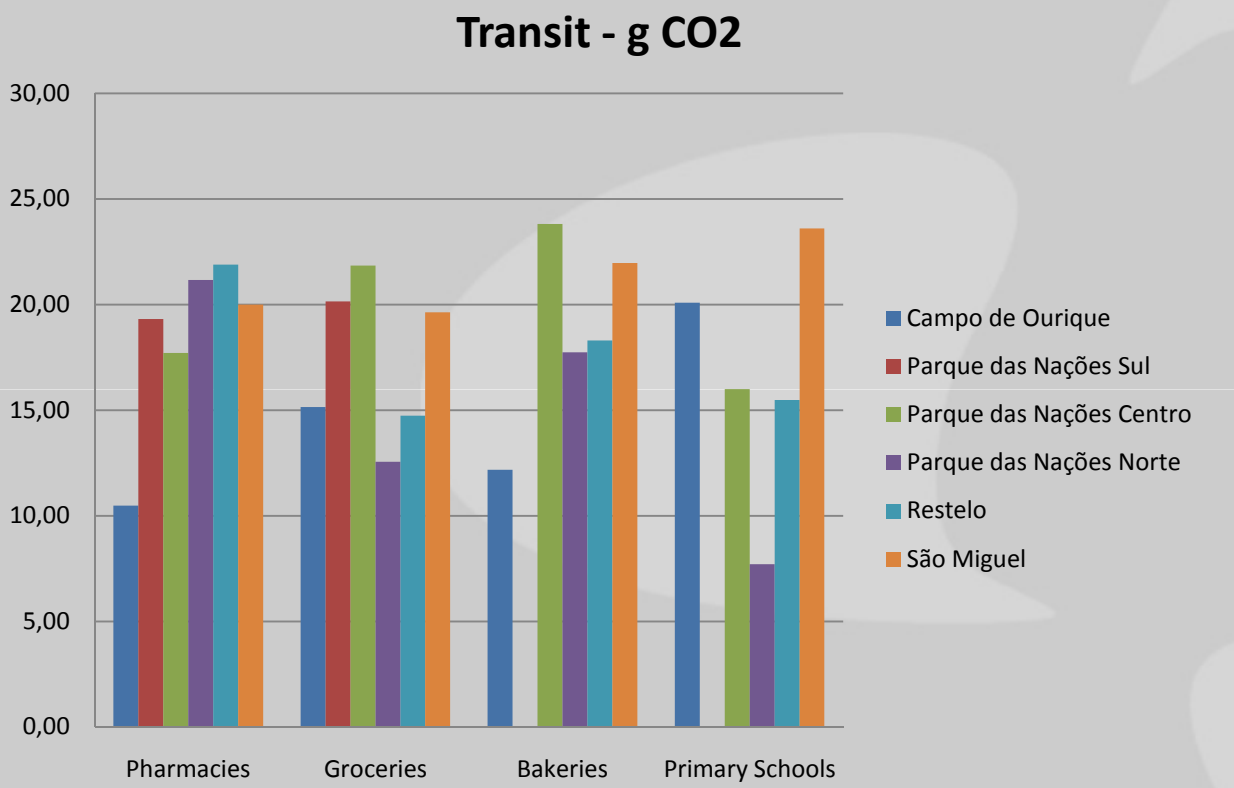


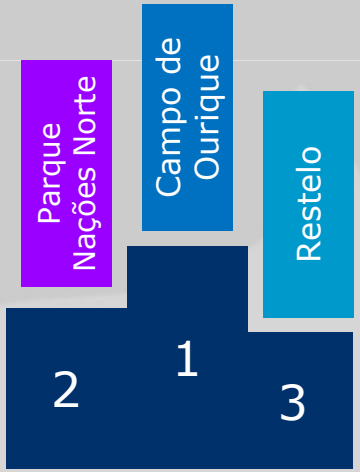


CO_2 emissions

V = 15 km/h

Different neighborhoods comparison





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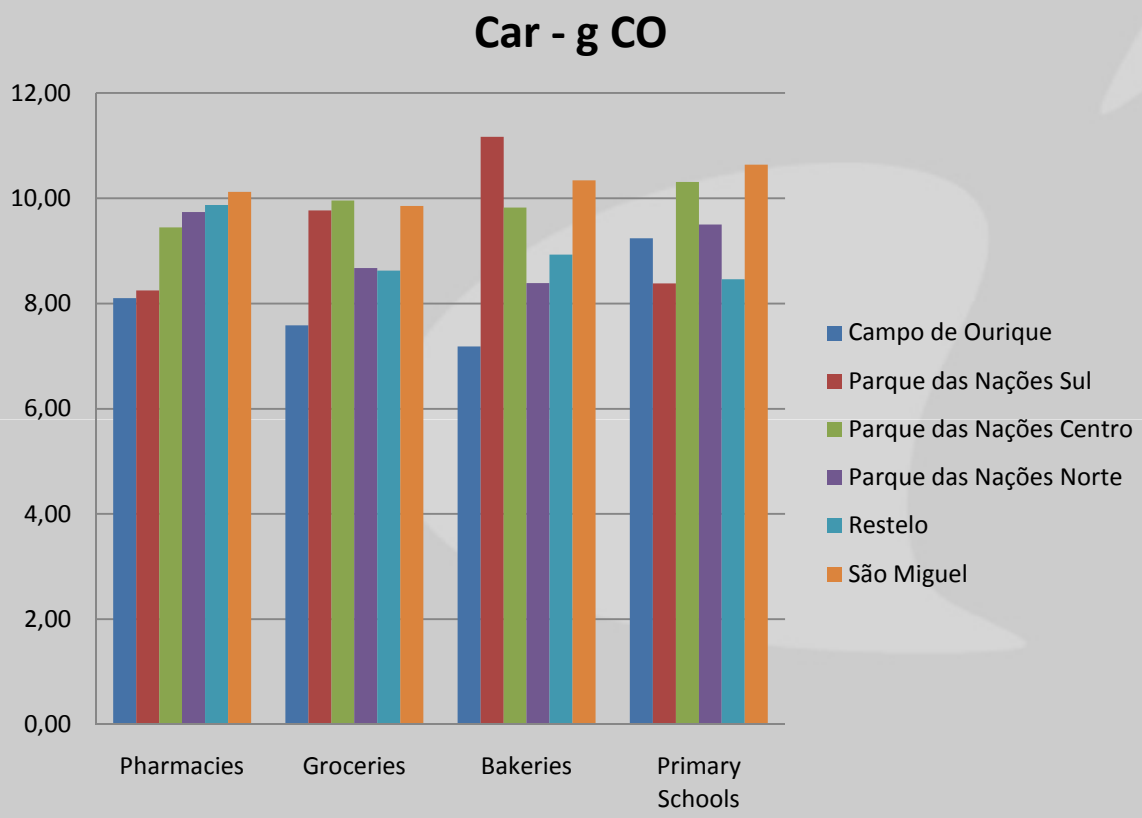
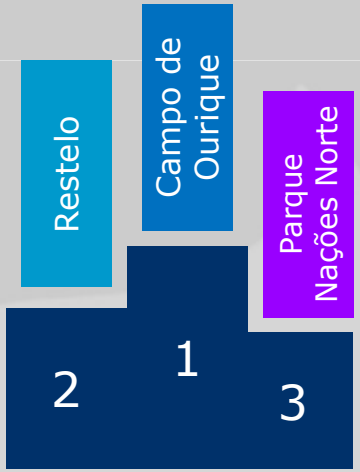
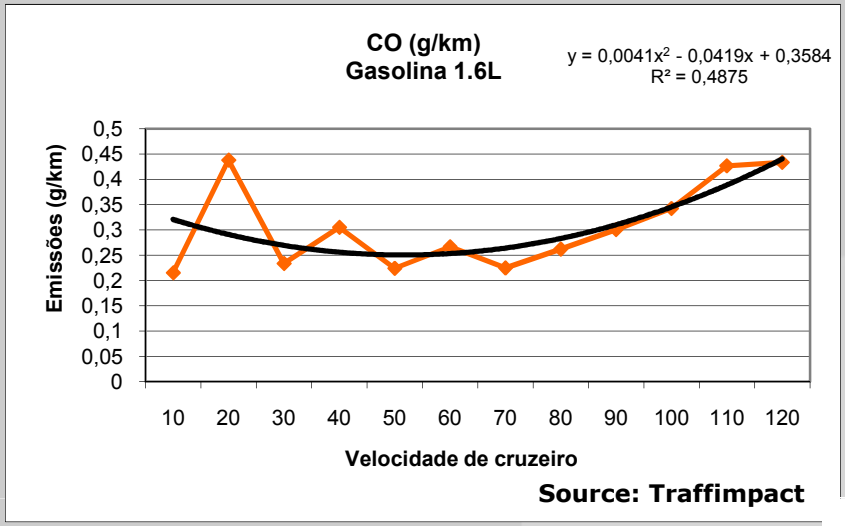
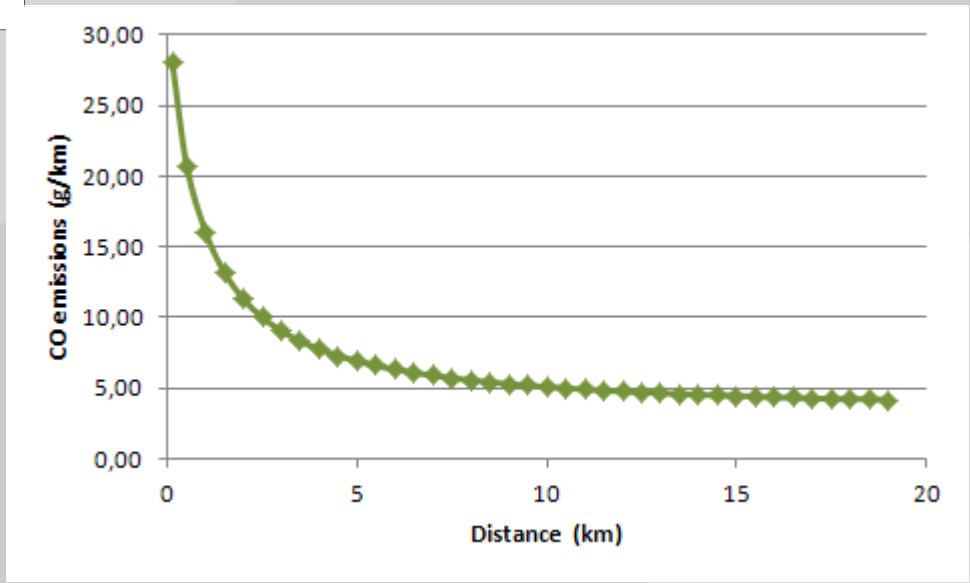




CO

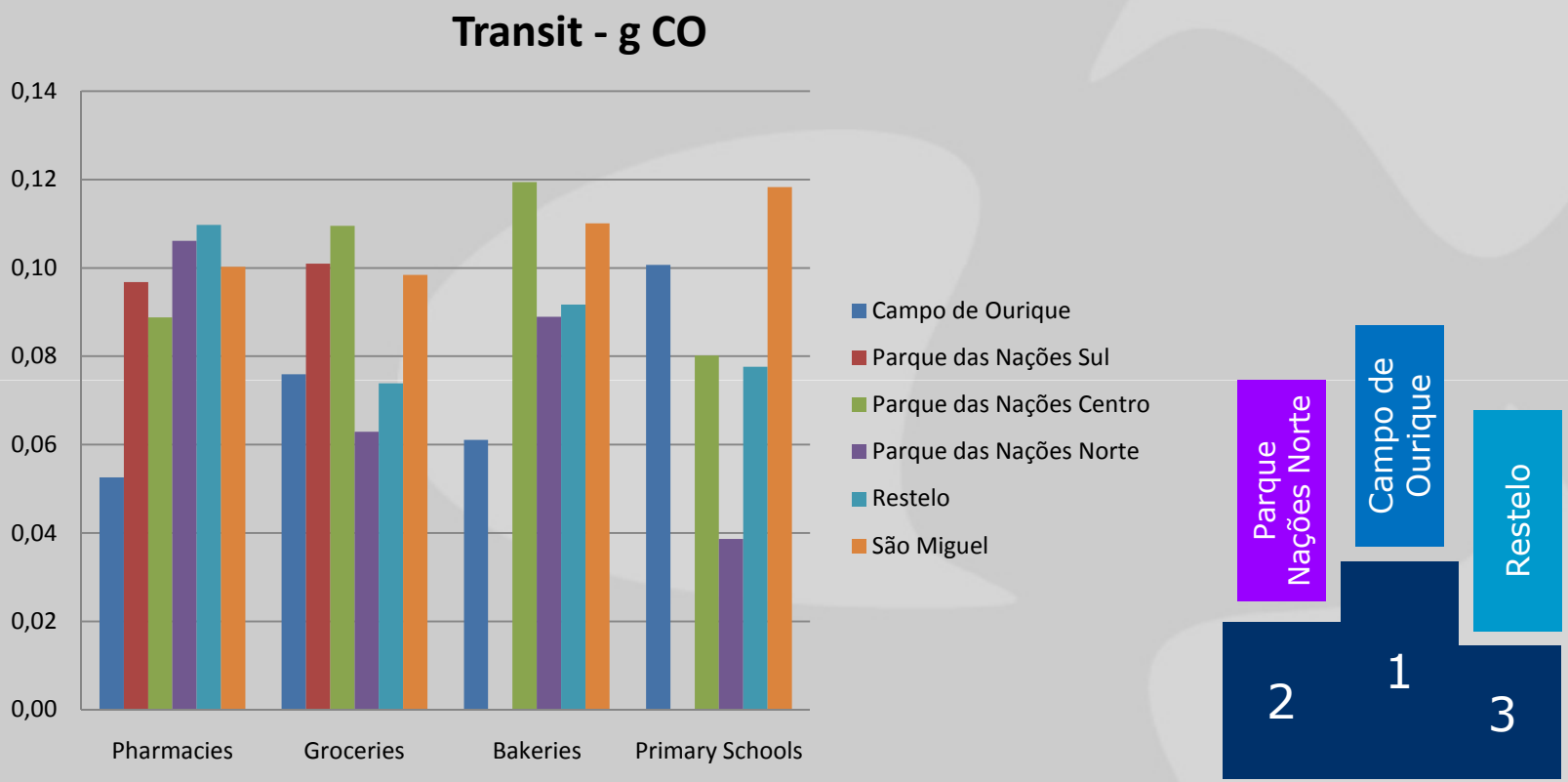


CO emissions



V = 15 km/h

Different neighborhoods comparison



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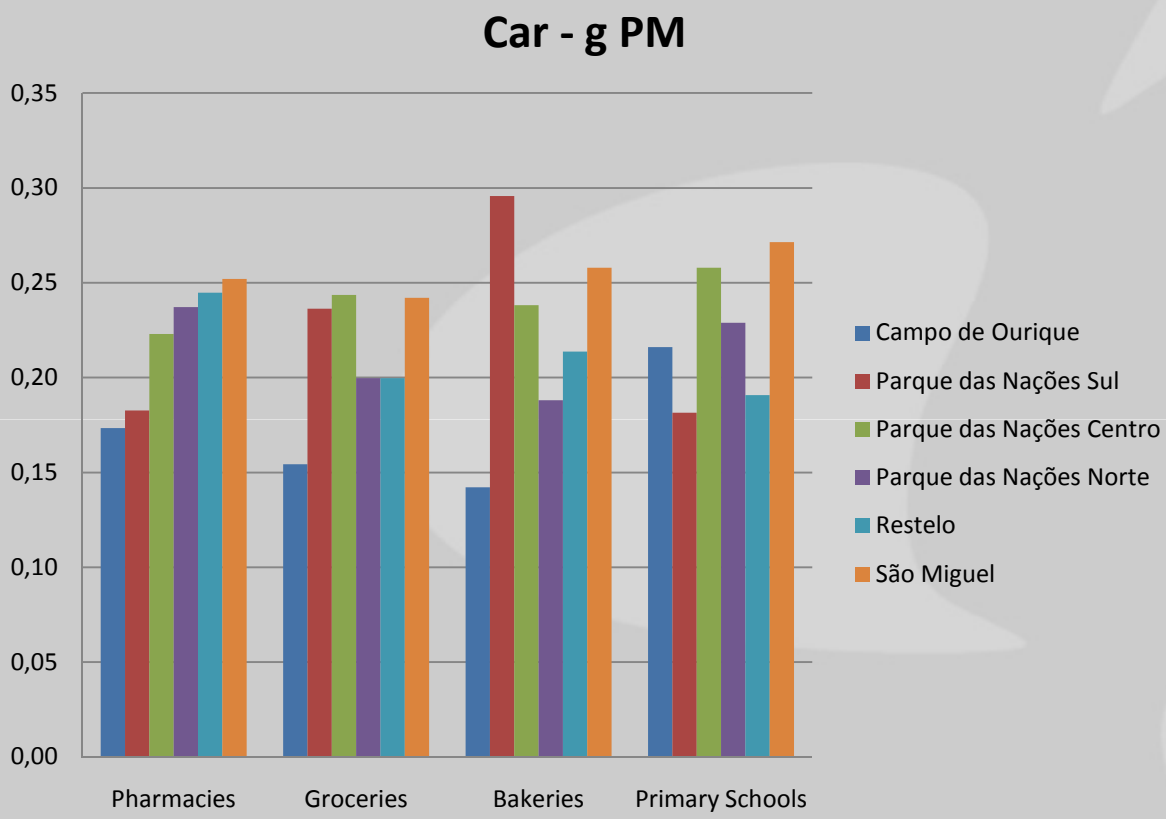

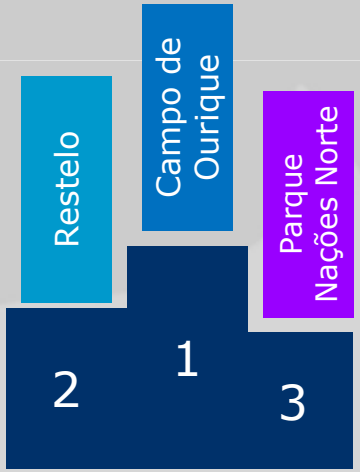

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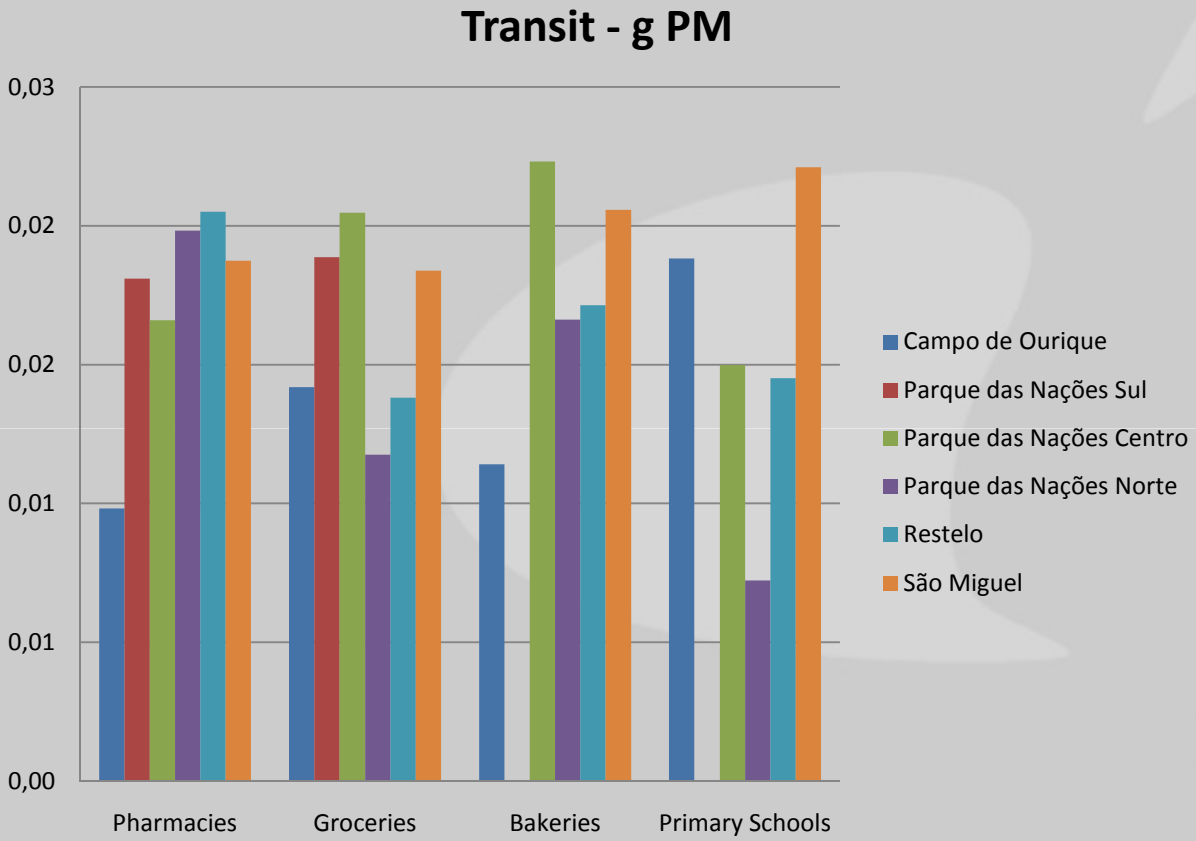

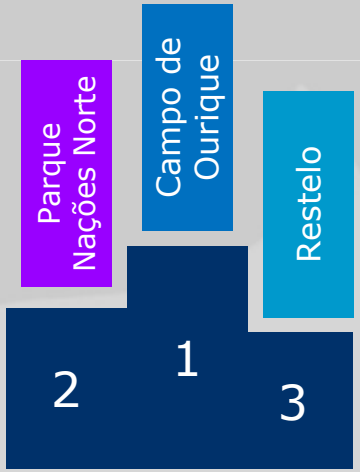

Conclusion

- Campo de Ourique is the neighborhood with better walk and transit accessibility
- São Miguel is the neighborhood with higher car accessibility

- The environmental impact of using car at low speed and with cold start emissions associated represents a significant increase in CO_2 and local pollutant emissions for short local trips