green in motion

III European Conference on Sustainable Mobility at Universities

The academic migration **towards electrification of road transport**: restrains and benefits, from the analysis to the action

prof. Bruno DALLA CHIARA
POLITECNICO DI TORINO (I) – *Transport systems, Mobility manager of the Atheneum, Green Team*

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SINTHESIS

During 2020, within the **Italian Academic network** (nearly 80 universities) for the **sustainable development** named "**RUS**", which includes a sub-group devoted to **Mobility and Transport** ("MOB"), a **shared analysis** was carried out - at academic level - in order to identify the **pros and cons of road electrification**, with particular reference to universities and related seats:

- how far pursuing electrification
- with which kind of electric grids
- how may recharging spots
- with attention to modal shift and MaaS: best practices.

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GUIDELINES ON ELECTRIFICATION FOR UNIVERSITY MOTORISED MOBILITY

➲ Active participation of **11 universities**, coordinated by the Politecnico di Torino.

a) Academic objectives regarding the electrification (this does not mean "electric vehicles") of vehicles (University or Departmental cars, their actual use, recharging possibilities, shared vehicles, accompanying measures)

b) **Co-modality** for travel to and from the universities - **MaaS** (Mobility as a Service); includes: integrated academic cards, electronic ways of using services, public and shared transport, platforms, modal integration).

RUS
Rete delle Università per lo Sviluppo sostenibile

MOBILITA'

WP4_Innovazione e tecnologie

LINEE GUIDA SULLA ELETTRIFICAZIONE PER LA MOBILITÀ MOTORIZZATA UNIVERSITARIA.

V 11.0 conclusiva, 7.3.2021

Obiettivi del documento

Con il presente documento si pongono i seguenti obiettivi.

1. Richiamare i **motivi generali** che spingono verso l'**elettrificazione** – ma non necessariamente verso la trazione elettrica - e l'indipendenza graduale dal petrolio nel trasporto su strada.
2. Sintetizzare i **punti di forza e di debolezza** sia dei combustibili derivati dal petrolio per la propulsione sia delle batterie, accoppiabili a motori elettrici, per la trazione dei veicoli terrestri.
3. Fare emergere il **ruolo** dell'elettrificazione per le **sedi universitarie**, specie se collocate nelle aree urbane.
4. Proporre i punti essenziali di *policy* sull'elettrificazione per le università: **soluzioni pratiche, sostenibili** e d'**interesse economico**.
5. Proporre **azioni attuative** frutto dei passaggi precedenti e condivise dalle varie sedi aderenti alla RUS per le relative applicazioni, adottabili nel caso dagli Organi di Governo delle medesime università.

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RUSmobilità

Who collaborated

Università degli Studi di Bergamo, Prof. Maria Rosa RONZONI
Università degli Studi di Brescia, Prof. Giulio MATERNINI, Ing. Benedetto BARABINO
Università degli Studi di Catania, Prof. Giuseppe INTURRI
Università degli Studi di Cagliari, Prof. Italo MELONI
Università degli Studi di Firenze, Prof. Francesco ALBERTI
Università degli Studi dell'Insubria, Prof. Elena MAGGI, Prof. Andrea VEZZULLI
Università degli Studi di Milano-Bicocca, Prof. Alessandro ABBOTTO, Dott. Massimiliano ROSSETTI
Università degli Studi di Udine, prof. Salvatore AMADUZZI
Università degli Studi di Messina
Università degli Studi "G. D'Annunzio" Chieti Pescara
Università degli Studi di Urbino
besides the Politecnico di Torino (coordination and editing)

RUS mobilità

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Aims of these Guidelines on electrification

1. Recall the general reasons for moving towards electrification - not necessarily towards purely electric traction - and gradual independence from oil in road transport.
2. Summarise the strengths and weaknesses of both petroleum-based fuels for propulsion and batteries that can be coupled to electric motors for ground vehicle traction.
3. To highlight the role of electrification for universities, especially those located in urban areas.
4. Propose essential policy points on electrification for universities: practical, sustainable and economically interesting solutions.
5. Propose implementation actions shared by the various RUS member campuses for their applications; can be adopted by the governing bodies of universities.

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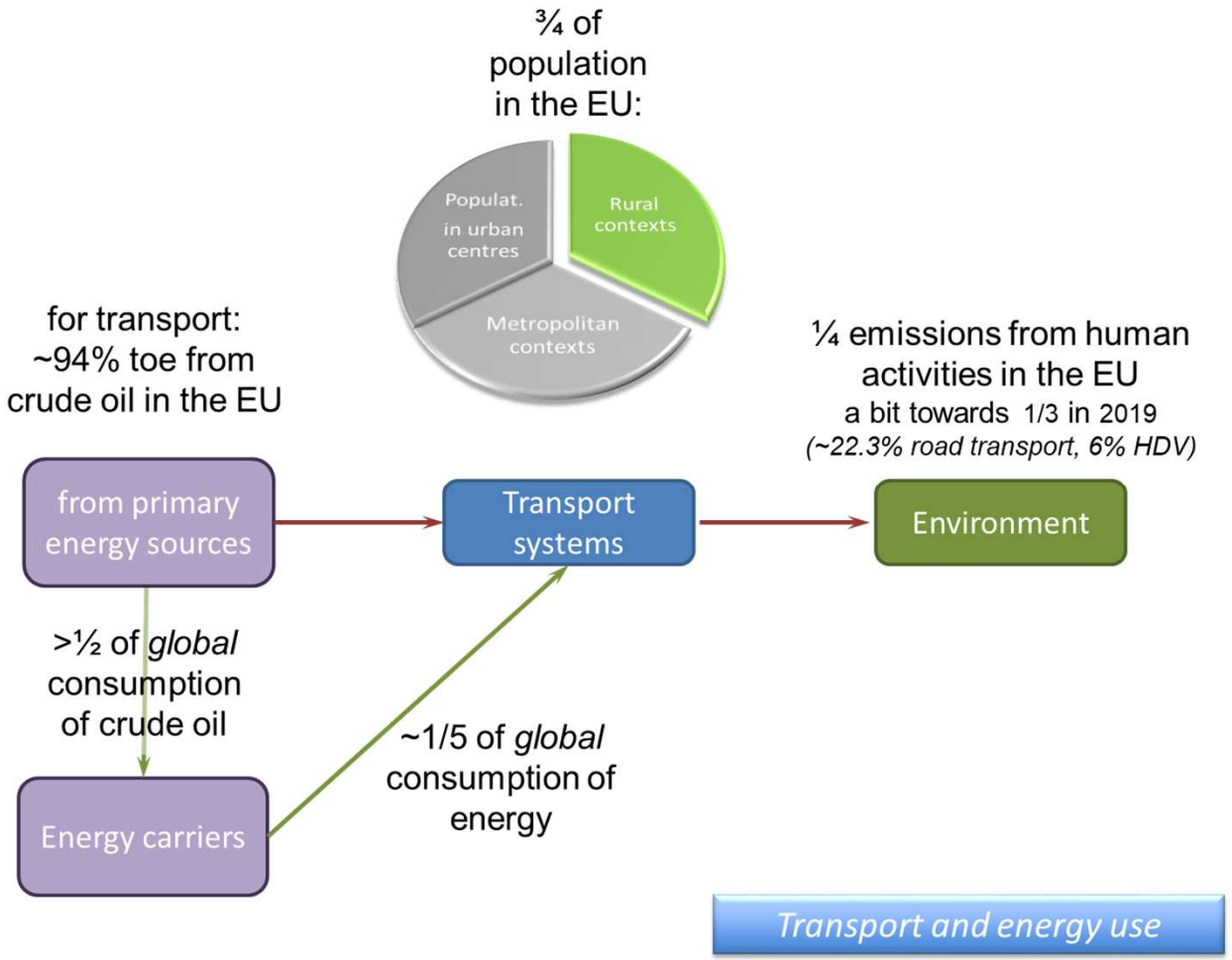
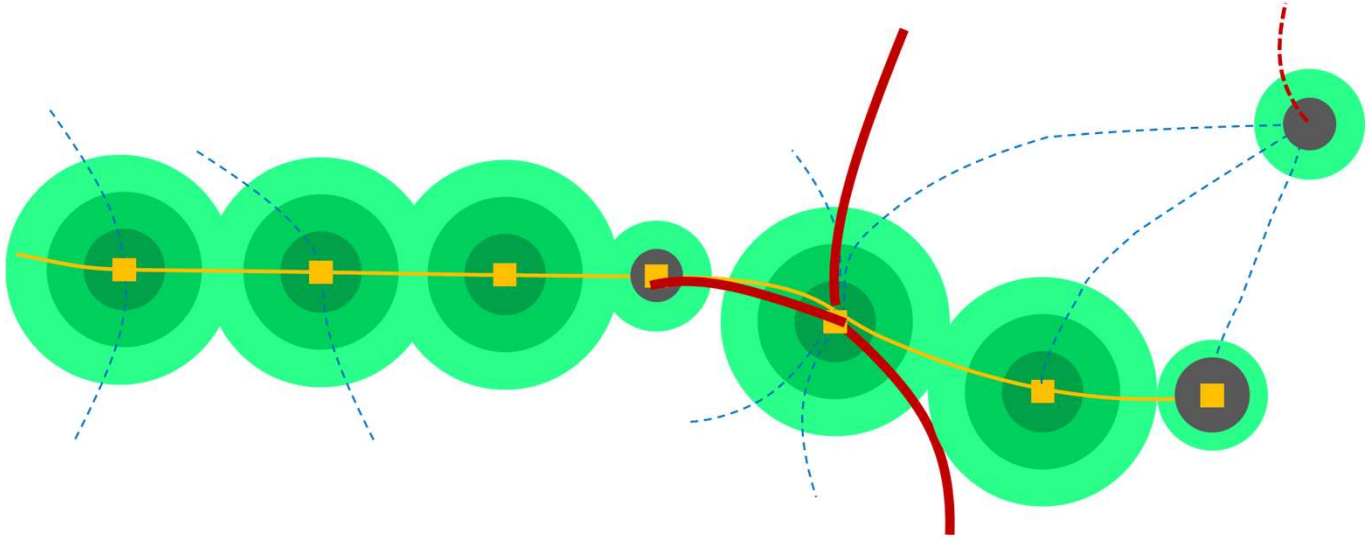
Energy chain, transport and environment



Common goals among universities

The offices of the Universities in the RUS network, with their **mission groups** (Green Teams,...) and Mobility Managers generally pursue a **multimodal approach** in home-work/study travel (**hierarchical**), with the containment of the use of private cars used autonomously and a **flexible approach** in the mode choice as much as possible.



H.S./H.C. Lines (**TEN-T in EU**)

Railways and undergrounds (PT)

Interchange area for modal shift

Local Public Transport by road (TP)

Covered area with route by *car*, *on foot* or *micro-mobility*

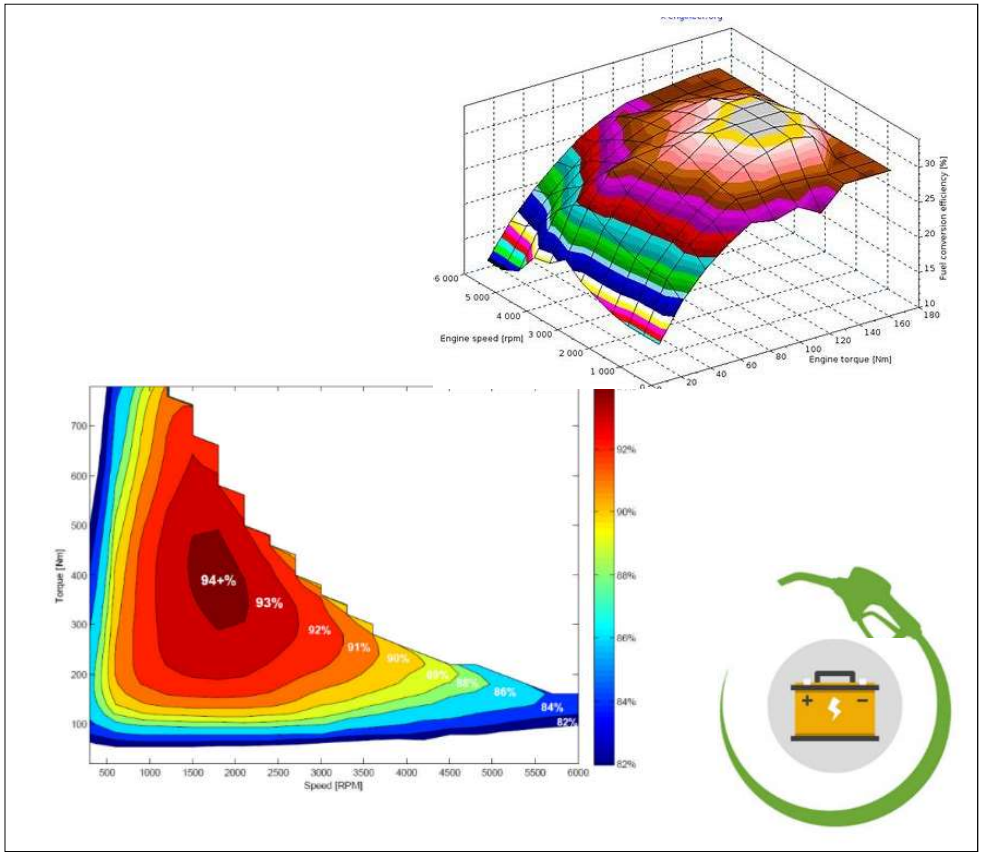
Contents of the Guidelines

"Decarbonisation' seems logical; however, the goal of electrification does not find an easy and immediate solution,
either technically or economically, especially if we consider the real accessibility of recharging networks, the transportability of the energy carrier, the historical consolidation of technologies and economies associated with the use of oil derived fuels, the energy resource chosen ***over a century*** *ago as the main one for means of transport.*

- Crude-oil relations and implications
- Local and global emissions
- Local and global constraints and targets
- Energy chain (WTW)
- Energy sources
- Freedom of movement and mode choice
- White Paper (EU)
- Infrastructure

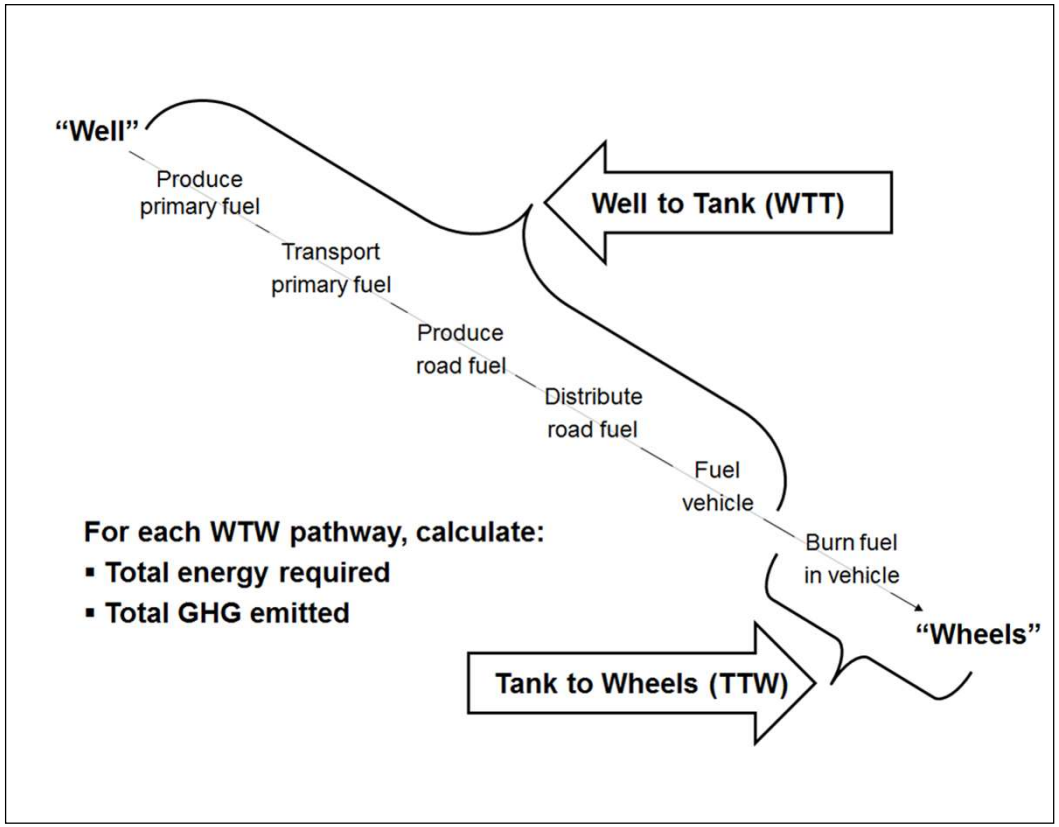
Contents of the Guidelines

- Energy density
- Spill and recharge times
- Distribution networks
- Economies of scale
- Skills
- Standards
- Oil wells
- Pollutant emissions
- Overall energy yields



Contents of the Guidelines

- Autonomy
- Mass
- SOC
- Charging locations
- E-Fuel
- Comparison with Norway
- WTW



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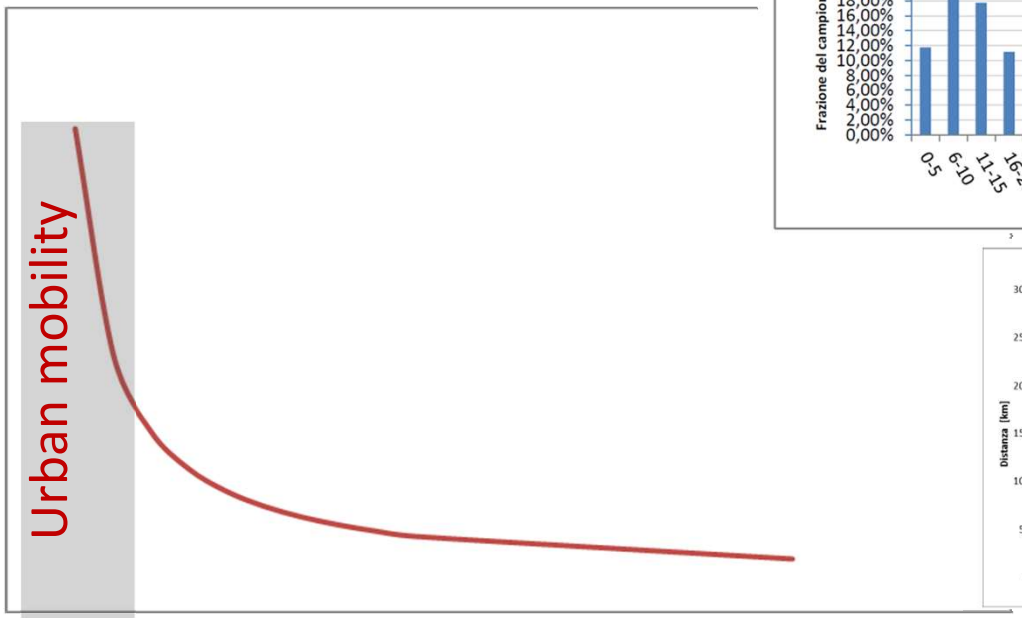
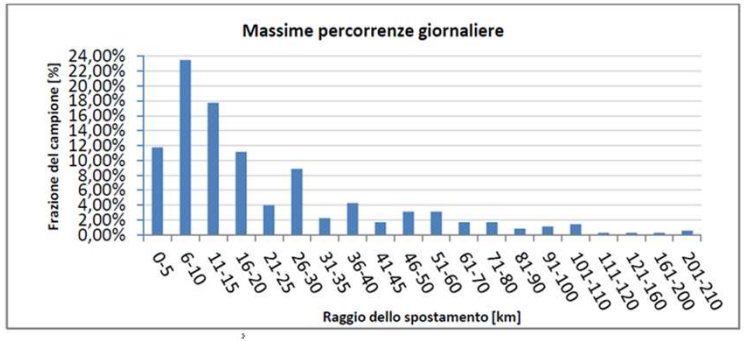
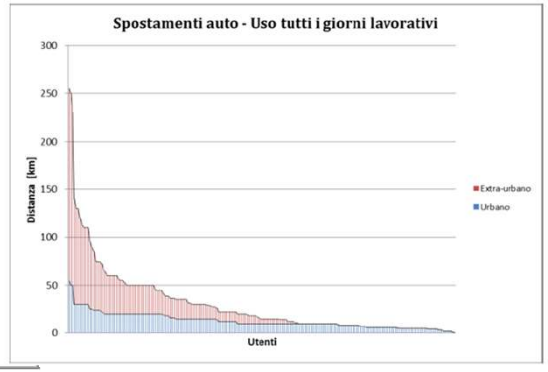
Characteristics of university trips (from surveys of Italian academies)

FREQUENCY



Few km





DISTANCE

Recharging type		Provided power	Autonomy reintegrated in		Time required for integrating 10 km
			1h	15 min	
AC	Slow	3,3 kW	13-15 km	3-5 km	40-45 min
	Rapid	22 kW	90-100 km	23-30 km	6-7 min
		43 kW	Complete	50-60 km	3-4 min
DC		50 kW	Complete	60-70 km	2-3 min

Charging times for a medium-sized car [Source: CEI 2017].

RUSmobilità

Tipology	Tax of use (hypothesis)	Fare
At university	60% (alternative to domestic)	**0,18-0,25 €/kWh**
Domestic	60%	0,25 €/kWh
Points of interest	25%	- €/kWh
Public, slow charging	10%	0,51 €/kWh
Public, fast	5%	0,53 €/kWh

Consumer habits and public charging tariffs, Smart mobility report data processing, 2019

Public slow		Public fast	
Duferco	0,46 €/kWh	Ionity	0,79 €/kWh
Enel x	0,45 €/kWh	Enel x	0,50 €/kWh
Route 220	0,61 €/kWh	Tesla supercharger	0,30 €/kWh

Public charging fares, May 2020

[Sources: Duferco, Enel x, Route 220, Ionity, Tesla].

RUSmobilità

Academic aspects and practical implications

1) Electricity supply: free market
2) Charging points for approximately all (generally small) University-owned or Departmental cars by 2030 or at least 60% of them
3) Sizing the number of charging points by 2030 according to potential demand on the basis of available data, including those from university surveys
4) Smart charging network, preferably slow or semi-slow mode (e.g. single-phase up to 7.2 kW or three-phase at 11-22 kW), based on time spent in the car park, pre-settable on arrival on a wall box
5) Better to have a wide range of slow-charging offerings than fast-charging or quick-charging ones
6) Evaluate actions for micro-mobility tools

7) Multi-purpose cabinet for micro-mobility tools
8) Provision of racks and charging points for pedelecs, especially for cities and university campuses in difficult orographic contexts
9) Regular current-absorbing wall-boxes, capacity 8-12 kWh
10) With wall-boxes or charging points for PHEVs or BEVs, some wall-boxes can operate plug-and-play without modification using a simple schuko: it should be noted that power is limited to 2.2 kW or 10 A, which allows up to 20 kWh to be recharged in 10 hours; it can reach up to 3.6 kW if the sockets are of the right size and the cables are compliant (standard for cars).
11) If more power is needed to charge an electric car, some wall-boxes or charging stations can operate up to 7.4 kW in single-phase and 22 kW in three-phase, but no longer on the shuko socket. This requires a connection to the existing line or an installation adapted to the new power; cost per kWh

Sinthesis

Basically, the full electric vehicle (BEV) can be associated with certain types of use;
the plug-in hybrid vehicle (PHEV) is much more flexible and convenient from the point of view of operation in its entirety, with respect for the environment and whose slow recharging at home or in the university is the most appropriate solution, especially if the recharging (university) station is not in rotation with other users.

BEST PRACTICES

In relation to these objectives, some **best practices** have been implemented at the Politecnico di Torino (2020/2021) through concrete actions:

1. reduction of parking spaces for automobiles from indicatively 1200 to 630 in the last years,
2. renouncement to the **access tag** to the internal car parking as an exchange for the free yearly subscription to **public transport**,
3. call for tenders for an **underground car park** with an entire floor equipped with a smart grid for adequately recharging plug-in vehicles,
4. installation of **black boxes** and their monitoring for controlling the energy consumption of shared cars besides their management, when used by the university staff,
5. development of **apps for internal sharing** of lab-vehicles.

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Reduction of parking spaces

72% → 60% → 54% → 34%

% of parking stalls on staff, from **2013** and **2021**

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Reduction of parking spaces

MaaS

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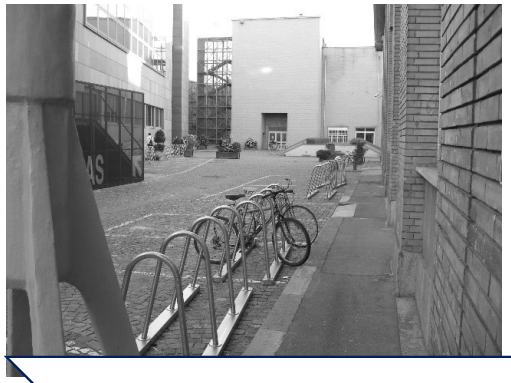
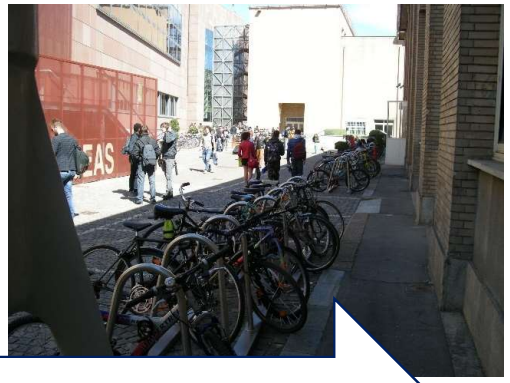
Increase of racks for bicycles





Same place, April, sunny, h 7.45 (l.s.), at 8.33 (centre), at 11.50, one of several locations

~200

~1000

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An entire floor of a parking area with plug-in spots

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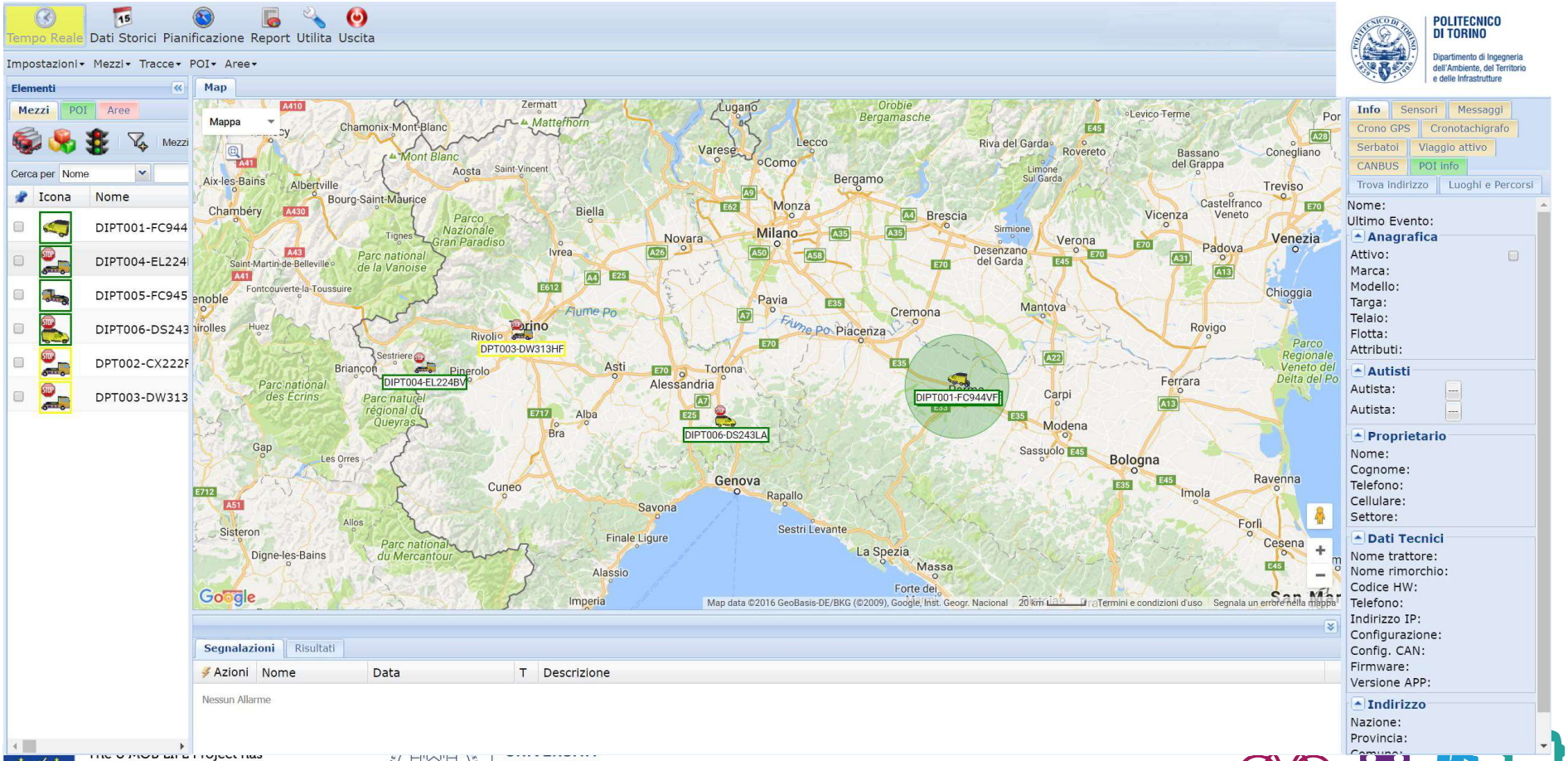
Monitored shared vehicles (black boxes)



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Conclusions

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1) Co-modal, hierarchical approach

2) Pure electric will probably not win, electrification may win

3) Study demand (plug-in) and trend

4) Better not to generate competition and constraints on people's daily schedules for using parking spaces with recharging, so better to have a wide range of recharging facilities, but to be commensurate with a quantitative estimate of plug-in users by 2030, using data from internal surveys and national and European estimates

5) Priority to slow recharging, to avoid ageing batteries, the cost of recharging, not to oversize installations (think of the scalability of the plug-in market) and to reduce the impact of fire regulations if the parking spaces are in a covered structure.

6) MaaS; there is an EU standard in progress: NEXT, for BIPforMaaS

prof. eng. Bruno DALLA CHIARA

POLITECNICO DI TORINO

Mobility management
Green Team
Rete delle Università per lo Sviluppo sostenibile (RUS)
(Italian) Network of Universities for Sustainable Development (RUS)
bruno.dallachiara@polito.it
greenteamoffice@polito.it

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