

Promoting **clean** public transport

Trolley

On-board storage systems -

“supercaps” evaluation of first results
and foreseen performances for
“supercaps” in Parma

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TROLLEY Transferability Conference

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Introducing TEP S.p.A

TEP S.p.A. is a joint stock company:

- Municipality of Parma (50%)
- Province of Parma (50%)

TEP has run public transport since 1948:

- 1948 **Tranvie Elettriche Parmensi**
- 2012 **37Mil Passengers/year**



Introducing TEP S.p.A

- 530 workers (**450 drivers**)
- **400 buses:** diesel, CNG, trolley
- Services: **Local Public Transport 13Mil Km/year**



Trolleybus network

- network: 4 lines
- vehicles required: 21
- 1 Mil Km/year
- **2 Mil KWh/year**
- overhead voltage: 650V
- overhead length: 20 km



Trolleybus fleet of Parma



10 Menarini F201 LU
(1981, **RESISTORS**)



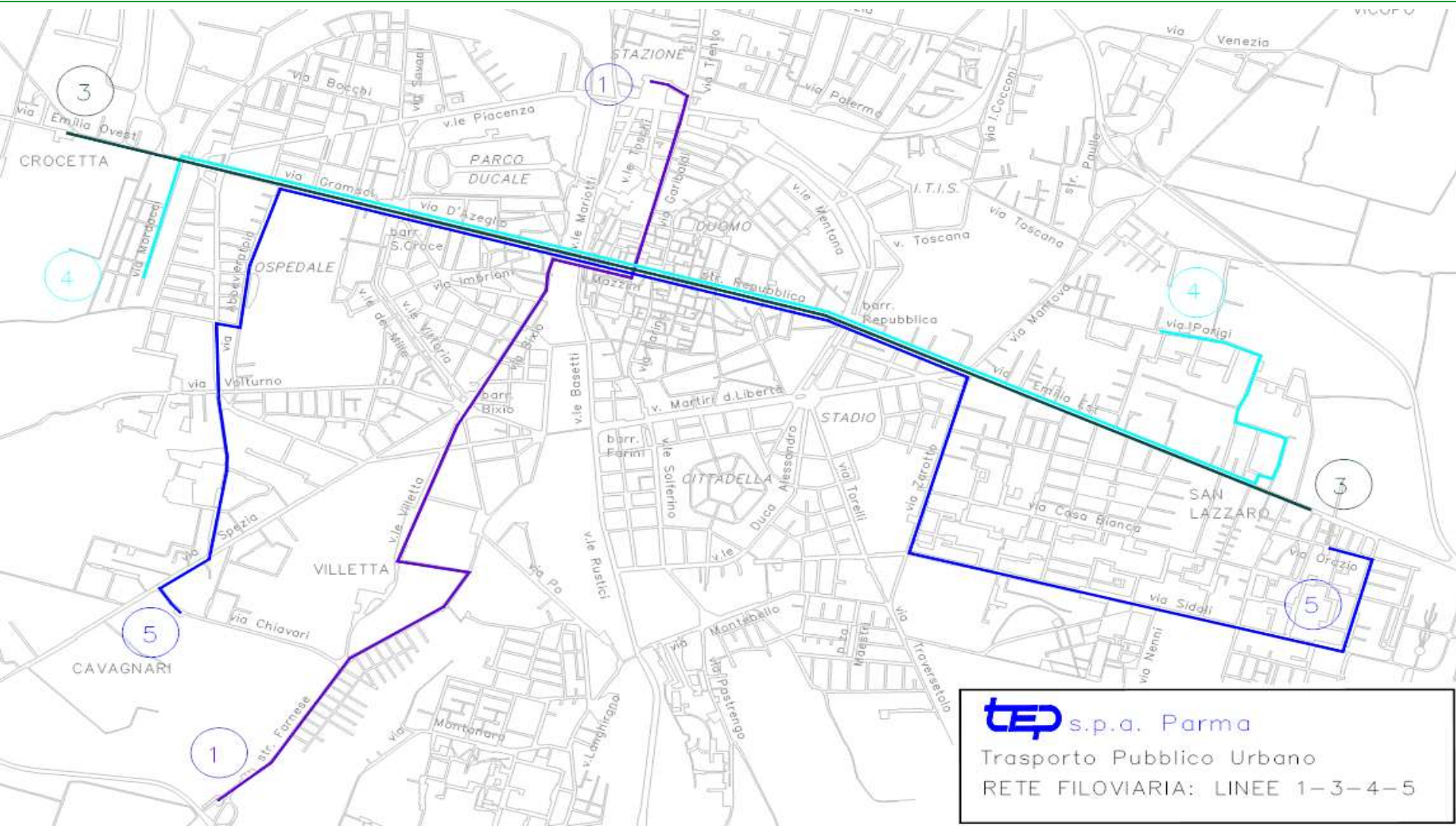
10 Menarini F201/2 LU
(1986, **CHOPPER**)



14 MAN 204F CAM
(1997, **INVERTER**)

Expertise in trolleybus systems *Trolley*

Promoting electric public transport



The goal of the trolleybus

Veliche	Direct energy consumption	Direct CO ₂ emissions
	[MJ/km]	[g]
Diesel bus	15.3	1135
Trolleybus	7.5	0



Low noise level



Comfortable



Zero direct emissions

The new trolleybus of Parma

Trolley
Promoting *electric* public transport

VAN HOO + **vossloh**
KIEPE



The new trolleybus of Parma

Trolley
Promoting *electric* public transport

AG300T TRL **VANHOOL** EXQUI.CITY

Length: 18m - Capacity: 149 passenger - Design: Tram Look

Electric engine: 240 KW (SKODA 24ML3550K4)

Electric equipment: **vossloh**
KIEPE

Supercaps: Maxwell Double Layer HTM Power

Diesel engine: 120 KW (IVECO N 40 ENT.C)



KINETIC ENERGY RECOVERY SYSTEM on ebus

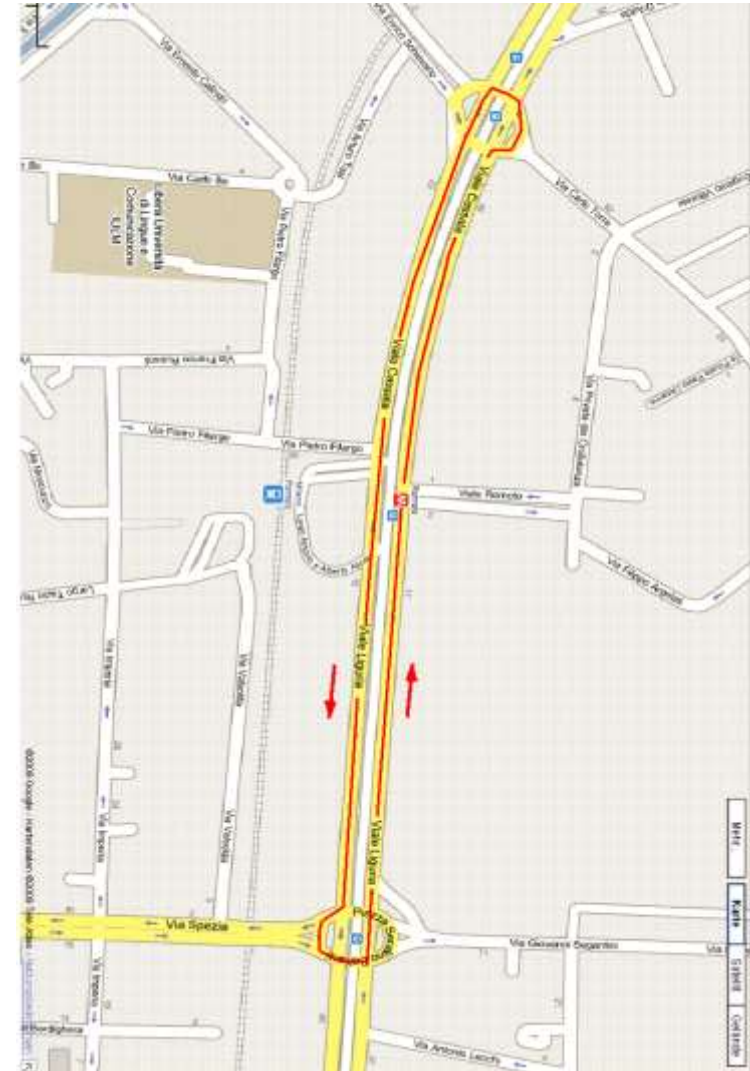
- KERS based on super-capacitors technology
- 4 modules (300Kg)
- life time : 11 years



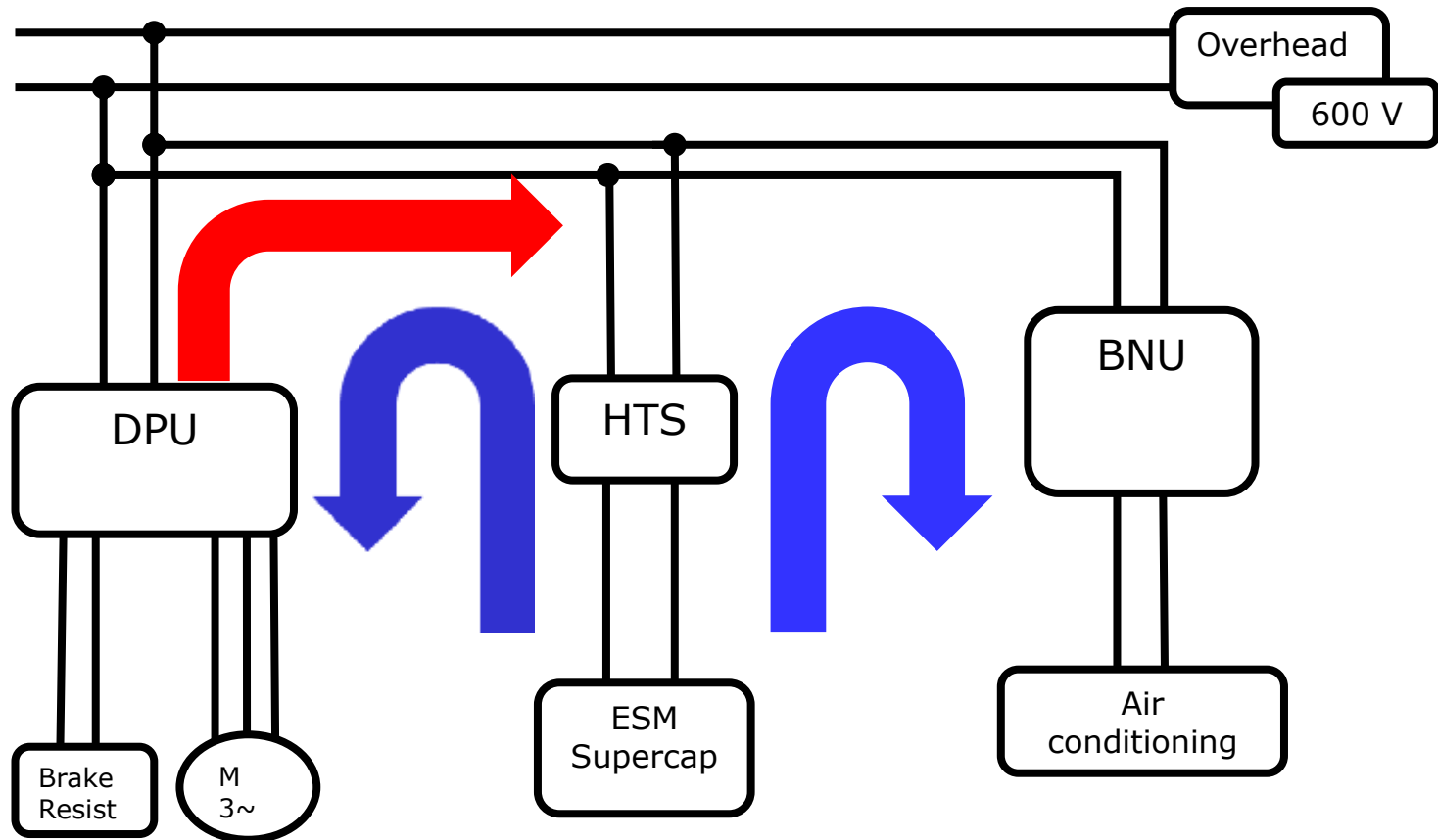


Operative conditions:

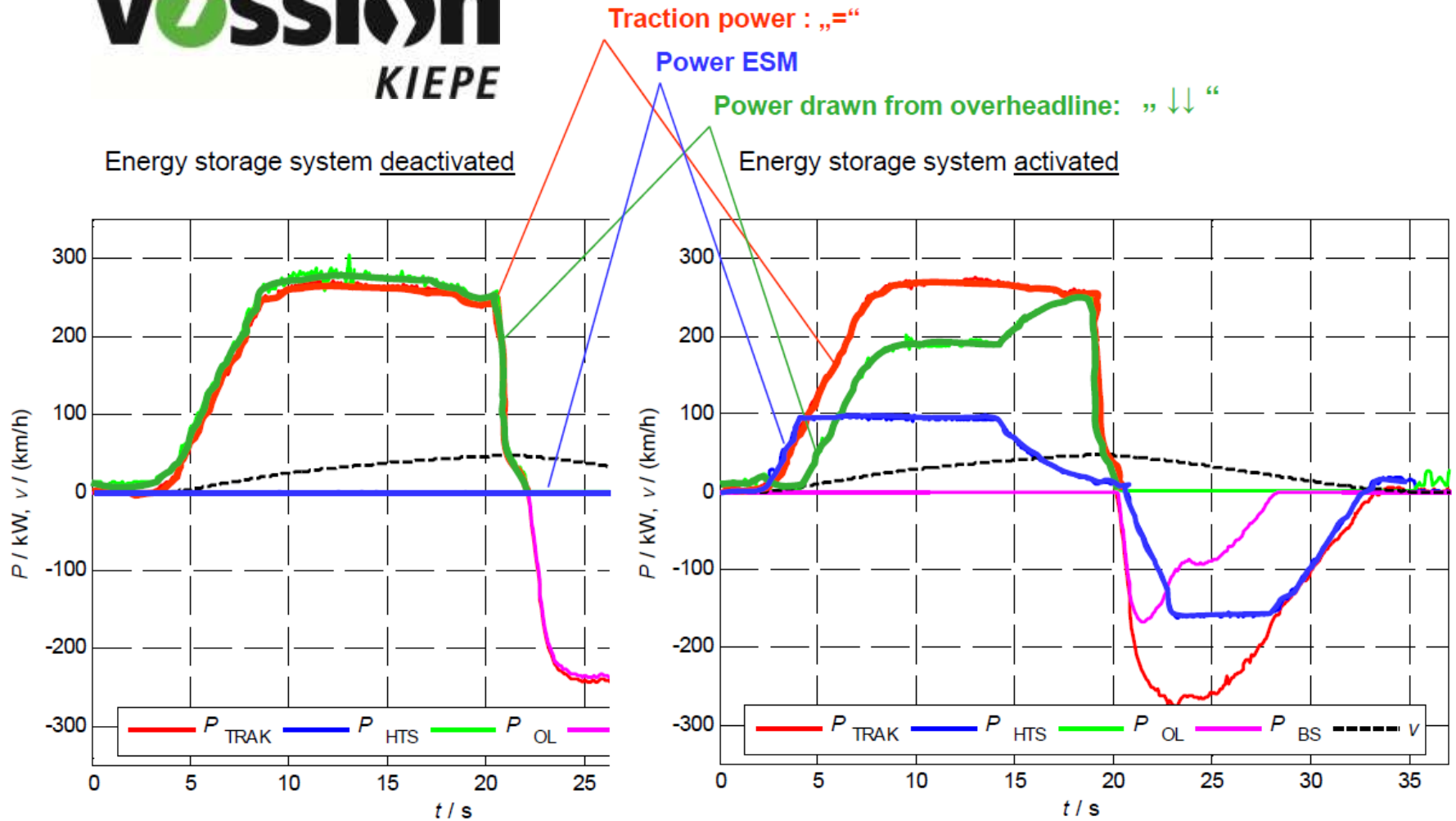
- total weight = 28500 Kg
- overhead voltage = 600V÷650V
- gradient = 0%
- route = 250 m
- stopping time = 10 s
- air-conditioning system = active
- temperature = 30°C
- n° repetitions = 10



Supercaps charge/discharge



Power consumption



SUPERCAPS deactivated

Test Nr..	power drawn from overhead line E_{OL} [Wh/t*km]	route [m]
1	172	233
2	155	246
3	167	227
4	167	238
5	171	224
average value	166,4	

SUPERCAPS activated

Test Nr.	power drawn from overhead line E_{OL} [Wh/t*km]	route [m]
1	109	257
2	120	234
3	115	235
4	124	221
5	126	223
average value	118,8	

$$\Delta = (166,4 - 118,8) \left[\frac{Wh}{t * km} \right] * 28,5[t] * 0,250[km] = 339,15Wh$$

$$\Delta\% = \left(1 - \frac{118,8}{166,4} \right) * 100 = (1 - 71,39) = \mathbf{28,61\%}$$


Trolleybus line 5

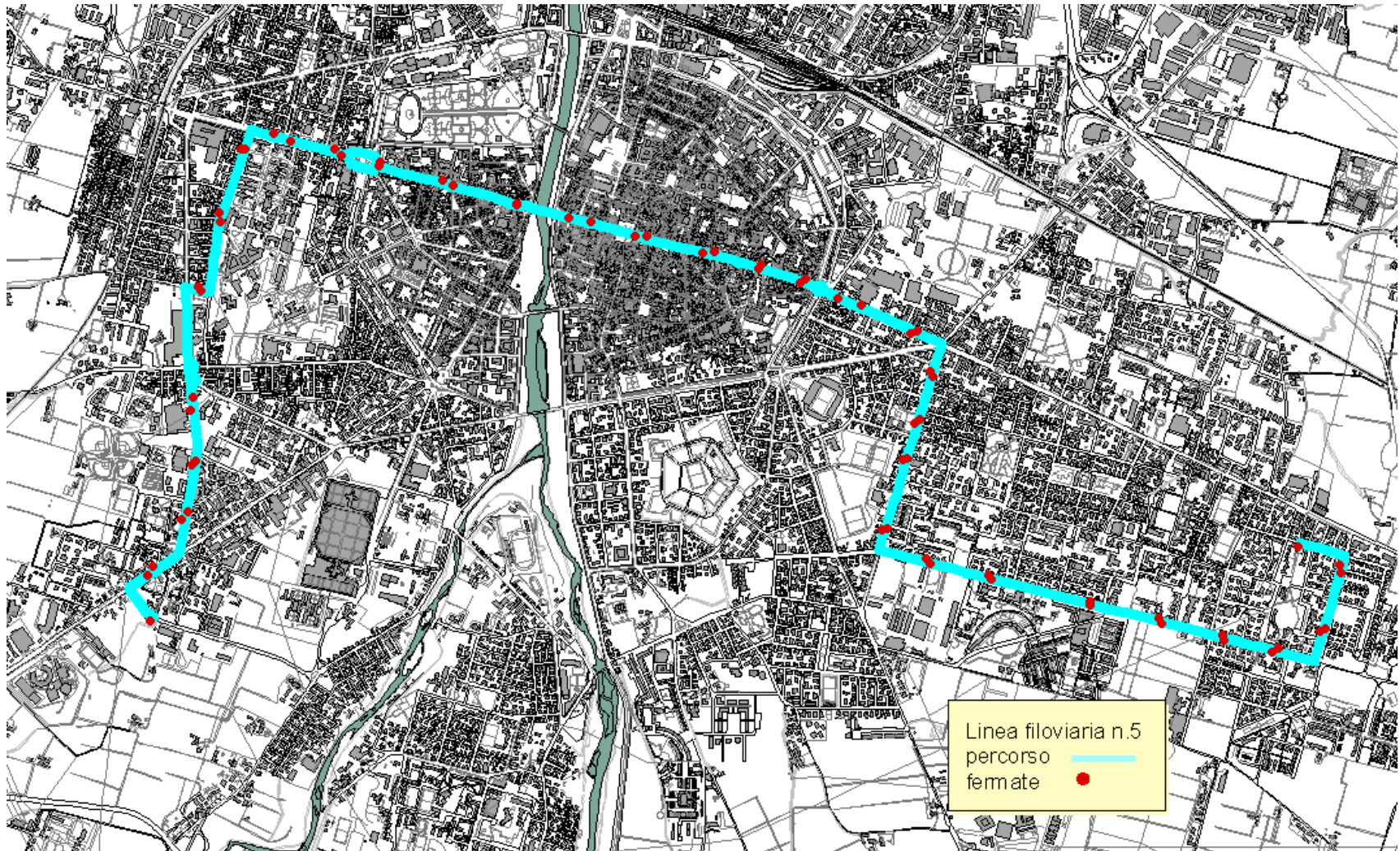
5



- a main Line
- EAST to WEST across Parma



Trolleybus line 5



Line 5 with “ebus”

- Frequency: every 10 minutes
 - vehicles required: 8
 - Route Length: 9 km
 - 415000 Km/year
 - Max n°Passengers/hour: 1700
 - **power consumed:
1.1 Mil KWh/year**
- (power saved with SUPERCAPS:
350000 KWh/year)



- Ecological
- Economical
- Electrical



and the ride goes on...

Trolley
Promoting *electric* public transport

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