

Promoting **clean** public transport

Trolley

TROLLEY
on-board energy storage systems:
install and test "Supercaps"

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TROLLEY Final 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**)



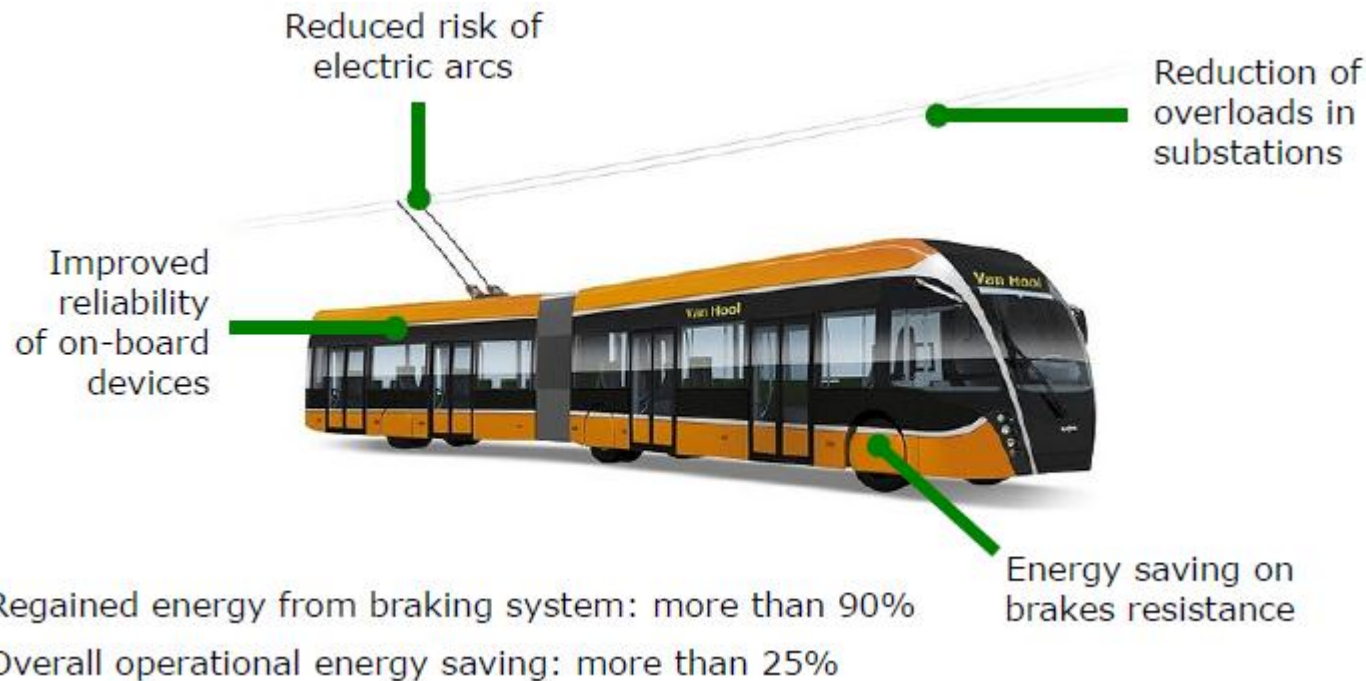
10 Menarini F201/2 LU
(1986, **CHOPPER**)



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

KERS ON TROLLEYBUSES

- test a Kinetic Energy Recovery System
- optimize the energy use
- test and spread the use of the new KERS



The new trolleybus of Parma

VanHool ExquiCity 18 (AG300T TRL)

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

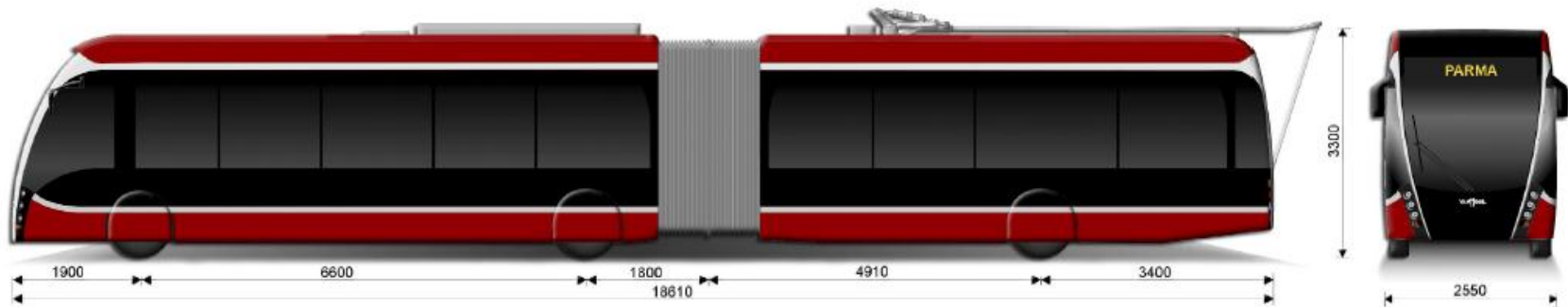
Electric engine: 240 KW (SKODA 24ML3550K4)

Electric equipment: Vossloh Kiepe

Supercaps: Maxwell Double Layer HTM Power

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

AG300T TRL



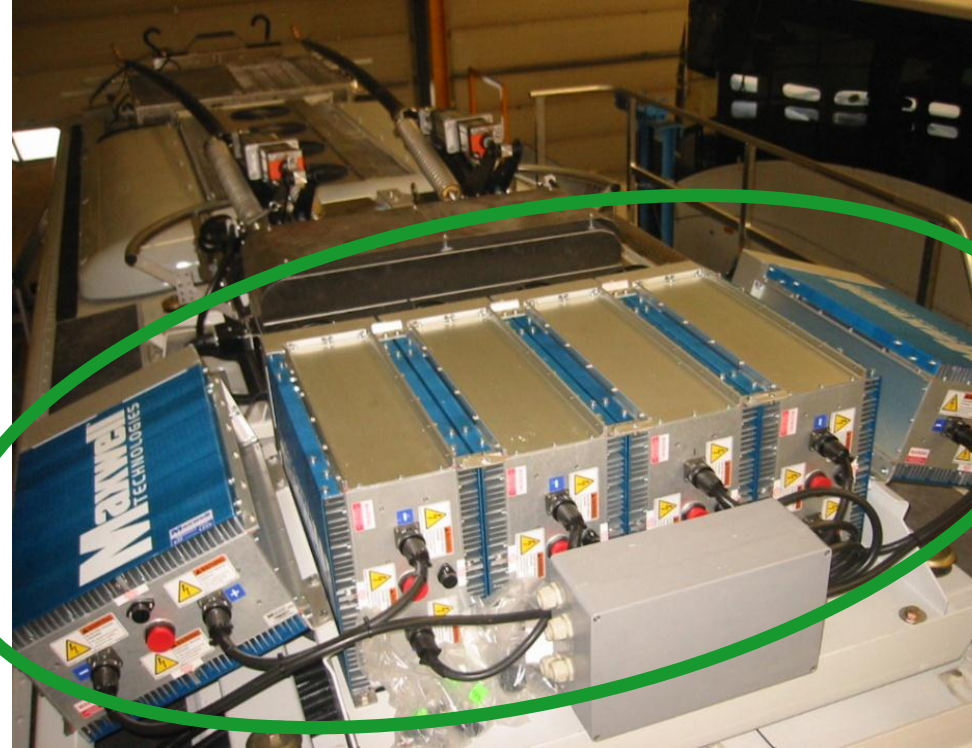
The new trolleybus of Parma

Trolley
Promoting *electric* public transport



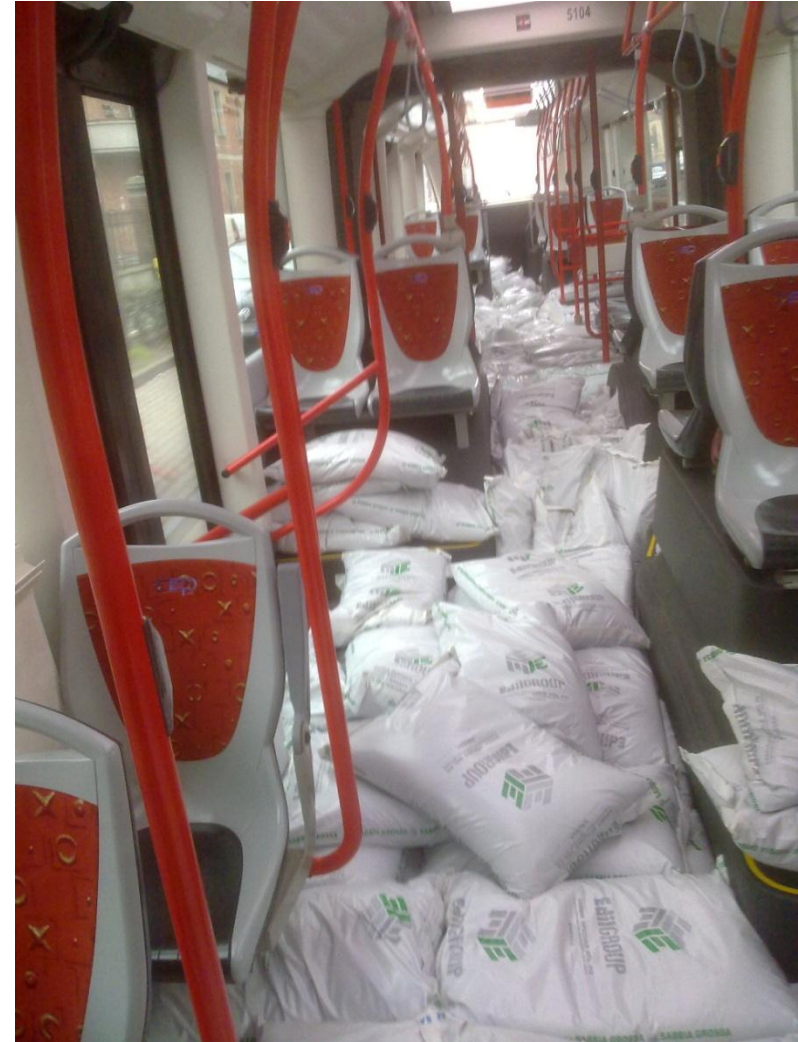
KINETIC ENERGY RECOVERY SYSTEM on ebus

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

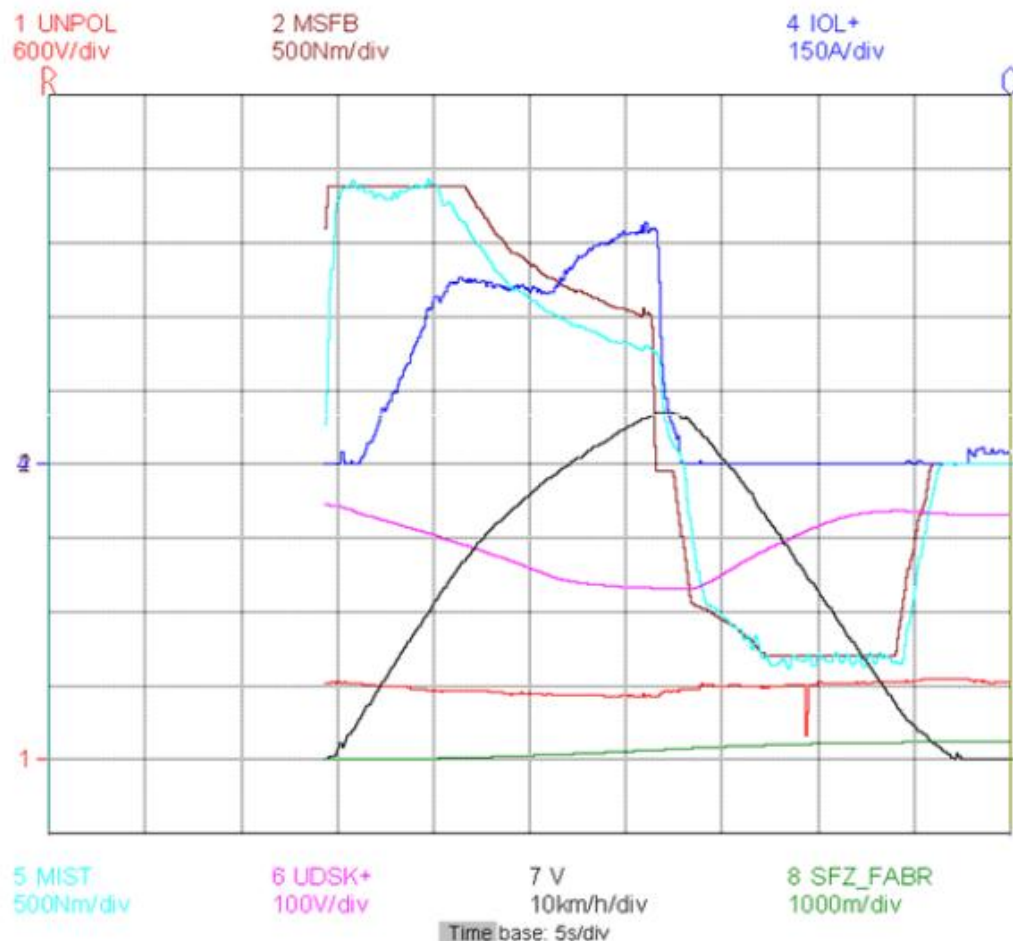


Operative conditions:

- total weight = 30000 Kg
- overhead voltage = 600V÷650V
- gradient = 0%
- route = 250 m
- Max speed = 50 Km/h
- temperature = 3°C
- n° repetitions = 6



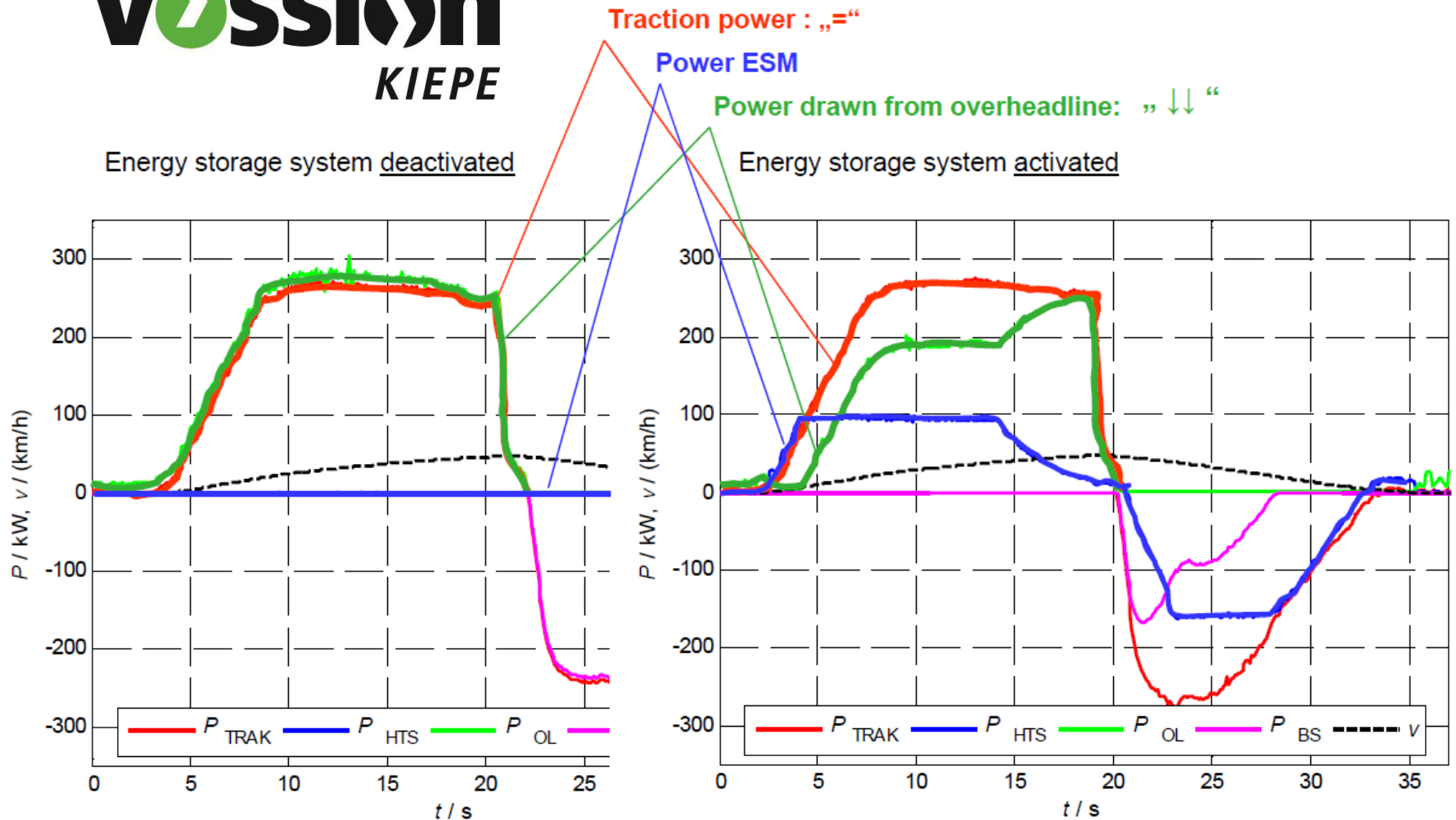
Test



Key to colours

- Overhead voltage
- Acceleration and braking moment
- Line current
- IST couple
- Supercap voltage
- Speed
- Distance

Power consumption



SUPERCAPS deactivated

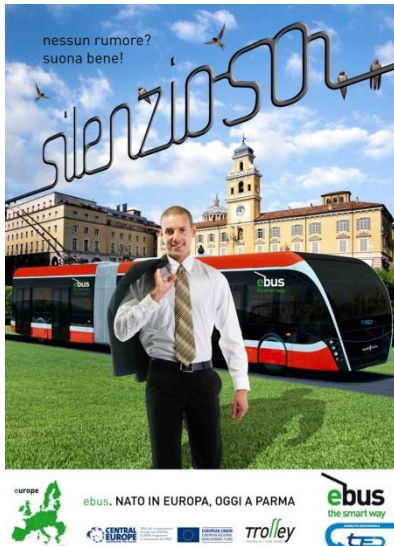
Test Nr..	power drawn from overhead line E _{OL} [Wh/t*km]	route [m]
1	147,0	233
2	164,6	246
3	152,7	227
average value	154,7	

SUPERCAPS activated

Test Nr.	power drawn from overhead line E _{OL} [Wh/t*km]	route [m]
1	117,7	256
2	119,2	278
3	105,4	245
average value	114,1	

$$\Delta\% = \left(1 - \frac{114,1}{154,7}\right) * 100 = \mathbf{26,24\%}$$

How can others benefit?



Low noise level



Comfortable



Zero direct emissions

A model for the spread of trolleybuses in Europe

what is the way forward after Trolley...

... advanced training
for safe eco-driving
of clean vehicles

actuate



and the ride goes on...

Trolley

Promoting *electric* public transport

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