

## ERESS event: EMS & DAS Day

How EMS application may help to improve energy efficiency and sustainability

## Trenord ETR522 Specific Application

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# AGENDA

- Introduction
- EMS ETR522 specific application
- About Trenord
- Trenord approach towards efficiency and sustainability

# Introduction

## Why does a Railway Operator like Trenord need to monitor train consumption?

- The billing assures an accurate energy cost allocation
- The continuous measurement of energy consumption at train level, together with the other available operational data may foster the energy efficiency improvement
- The fleet operational service monitoring may help to highlight any unplanned train stop due to not rolling stock issues
- The commercial services data may be used to build up reference models, which will form the basis for increasing driver motivation towards an "efficiency style".

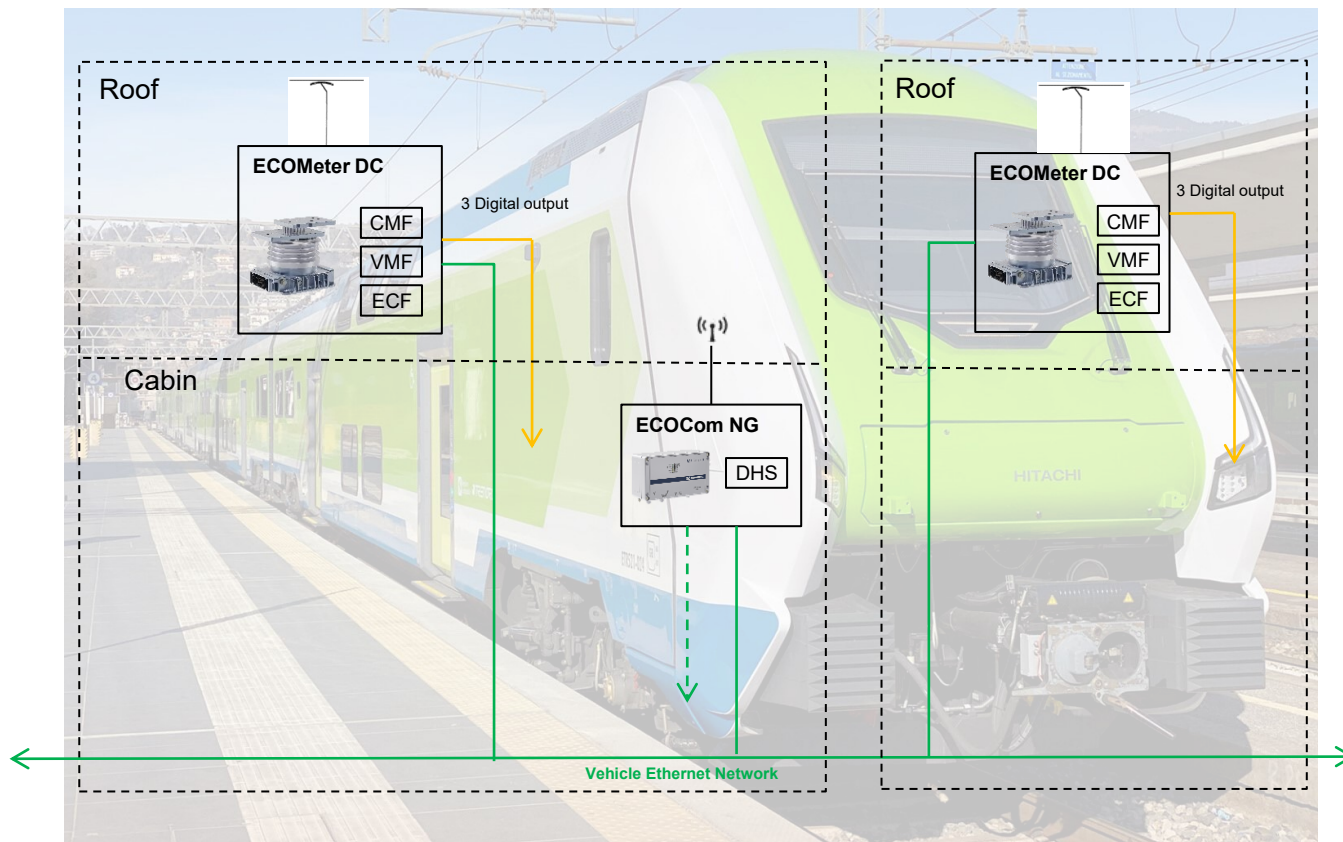


**ETR522 – Caravaggio (Hitachi)**

# EMS architecture for ETR522/ETR421 (Caravaggio trainset)

- Slow serial diagnostic communication
- Fast serial communication or O.F.
- Ethernet TCMS Communication
- - - Ethernet for local service communication
- Digital output switch Clean contacts
- RS485 communication to TCMS

- CMF** Current Measurement Function
- VMF** Voltage Measurement Function
- ECF** Energy Measurement Function
- CAO** Current Analog Output
- DHS** Data Handling System
- DO** Digital Outputs



# EMS components



- Build in GPS for train position)
- 2+1 digital output, 4 digital input
- UMTS/GSM/GPRS (In alternative GSM-R )
- WLAN: IEEE 802.11b/g (option)
- 2 ports LAN Ethernet (Energy Data from sensor / Service interface)
- Serial communication RS485/232 (CAN; MVB)



**Universal solution for DC Catenary**  
Fully compliant and certified according reference standard EN50463-2:2017 for measurement under each DC catenary type



**Advance functionalities**  
Harmonics detection  
Overvoltage  
Overcurrent



**High accuracy**  
0.5R according to EN 50463:2017



**15 years**  
Without re-calibration

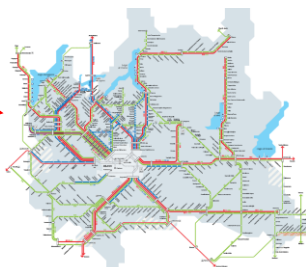
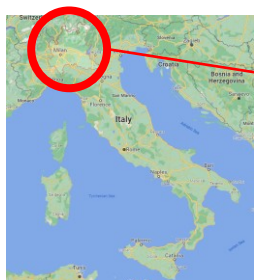


**Customization**  
Ad hoc setting through SW





## Railway undertaking completely dedicated to the regional railway transport of Lombardy



**400**

Rolling stock

**6**

Maintenance plants

**4.600**

Employees

**2.000**

Services provided every day

**> 700.000**

Passengers per day





## Fleets equipped with energy meter



ETR 421-ETR 522  
(Hitachi)



ETR 204  
(Alstom)



R-TAF  
(Aditranz, AnsaldoBreda, Firema)

ETR 425-ETR 526  
(Alstom)



ETR 245  
(Alstom)

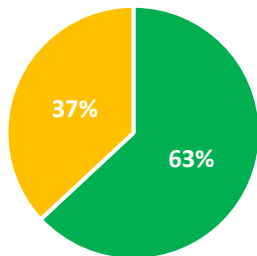
## Fleets without energy meter



TSR  
(Keller, AnsaldoBreda, Firema)



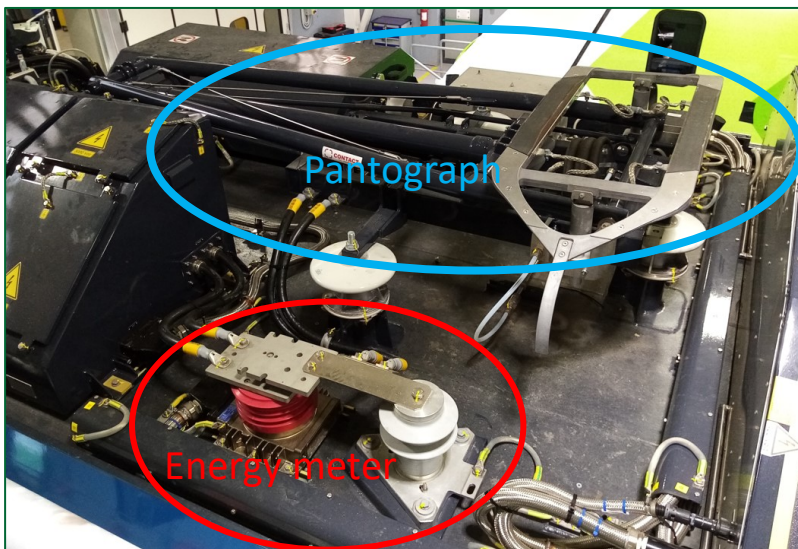
E464  
(Bombardier)



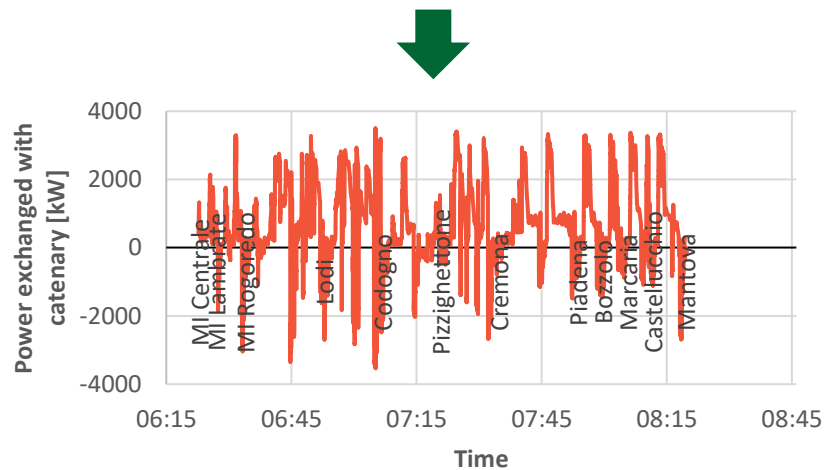
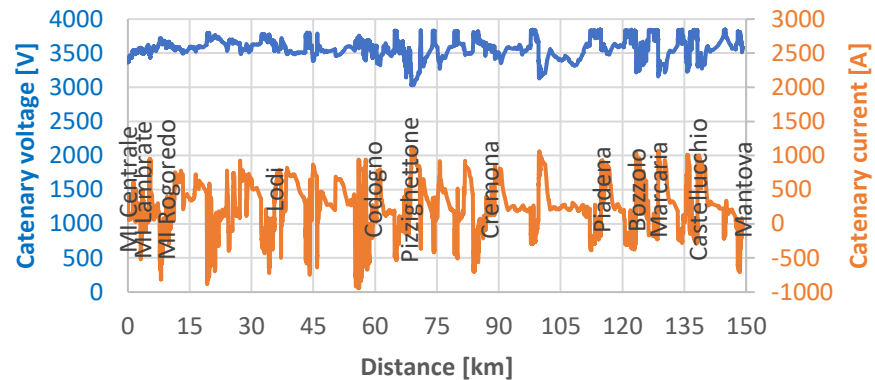
■ Fleet with energy meter ■ Fleet without energy meter

In 2025 more than 60% of electric rolling stock will be equipped with energy measurement system compliant with the EN 50463 standard

# Energy measurement system: ETR 522 specific application



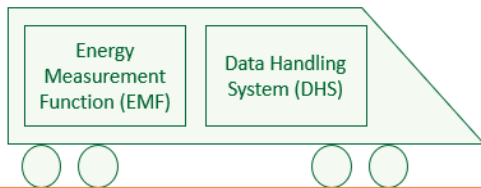
Energy measurement function



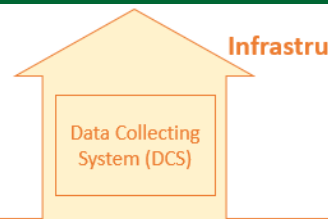




Rolling stock



Infrastructure



Rolling stock

Energy Measurement Function

Measurement of catenary voltage and current



Computation of power and energy exchanged with the catenary



Data Handling System



Energy exchanged with the catenary  
 +  
 Spatial reference (GPS)  
 +  
 Time reference



Compiled Energy Billing Data



Infrastructure



Data Collecting System

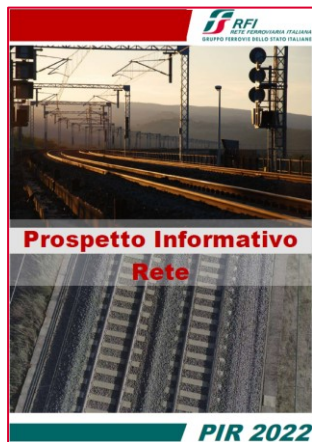
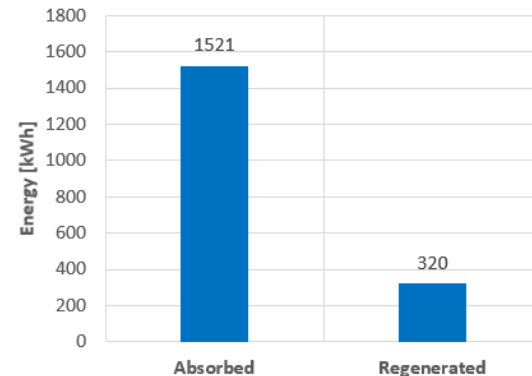
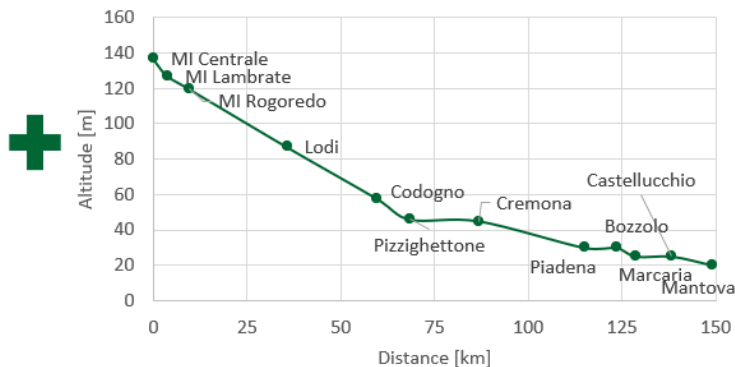


Billing

Rolling stock: ETR 522



Line: Milano Centrale → Mantova



From 1<sup>st</sup> January 2022 RFI (Italian national infrastructure manager) allows a billing system based on real consumption metered by energy measurement systems compliant with EN50463:2017 standard.

Trenord is the first railway undertaking interested in using the new billing system: two ETR 421 rolling stock are already interfaced to the RFI data collecting system and are ready to start the billing service.



## INPUT

### ROLLING STOCK TECHNICAL DATA:



- Rolling stock mechanical features
- Engines technical data
- Energy meter data



### INFRASTRUCTURE TECHNICAL DATA:

- Features of the line (slope, curves, speed)
- Features of the service
- Electrical substation features

## SIMULATION MODEL

### DEVELOPMENT OF A DYNAMIC MODEL OF THE TRAIN RUNNING WITH A FIXED BLOCK SIGNALLING

The objective function will be the minimization of energy consumption keeping the timetable. In case of traffic disruptions, the goal will be the minimization of delay.

### 2 types of services

Regio-Express  
(long line with few stops)



Suburban  
(service with several stops)



## OUTPUT



### DEFINITION OF THE DRIVING BEHAVIOUR THAT MINIMIZE THE ROLLING STOCK ENERGY CONSUMPTION KEEPING THE TIMETABLE.

The final goal is to have training indications for the train drivers

## CONCLUSION

The specific application seen today is a small example of how collaboration between different stakeholders acting in the same context can produce benefits for everyone, in terms of improving efficiency at every level and above all towards concrete and real sustainability.

Thanks for your attention



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