

Innovation technologies towards energy efficiency and high performances in the Italian DC railway system

TECHNICAL DEPARTMENT
TECHNOLOGY STANDARDS
ENERGY

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RFI: The infrastructure manager



- RFI, a company of Ferrovie dello Stato Group, has been established on July 1st 2001, at the conclusion of a restructuring process of the whole Group.
- RFI is the company responsible for the management and maintenance of the rail infrastructure.
- RFI manages the control and safety systems connected with train operations, defines the criteria for the use of the network and enters into contracts with railway companies for the access to the rail infrastructure.



RFI: National railway infrastructure

... a big network

Network	16.742	km
<i>Double track</i>	7.536	km
<i>Single track</i>	9.206	km

Power supplied lines 11.932 km (71%)

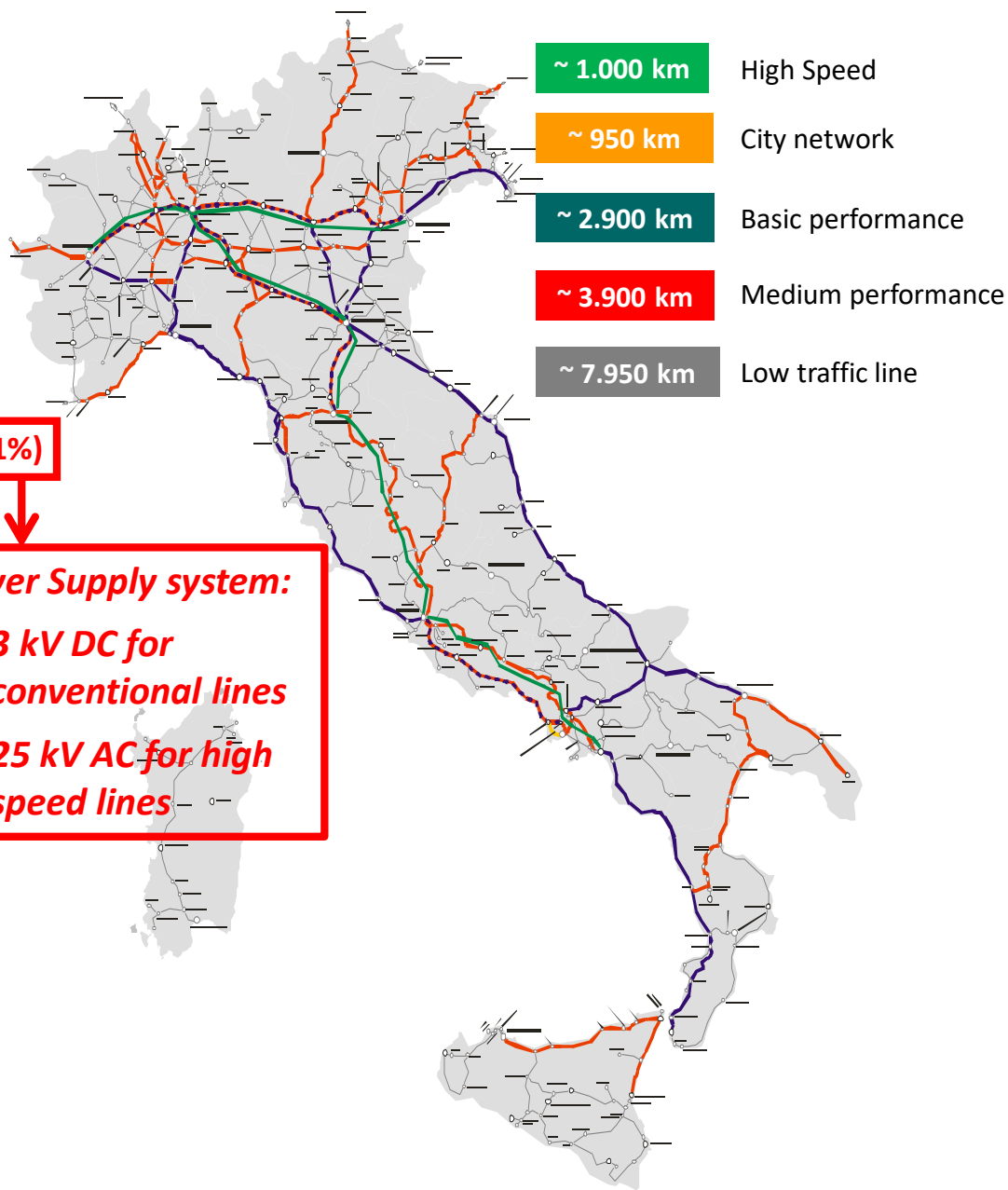
Tunnels and bridges	1.980	km
Stations	2.260	

Signalling technologies

SSC – SCMT	16.742	km
ERTMS	671	km
GSM-R	9.000	km

Power Supply system:

- 3 kV DC for conventional lines
- 25 kV AC for high speed lines



RFI projects towards energy efficiency

RFI is involved in the research and the development of the following projects in the energy efficiency field:

- ☐ On-board energy measurements (MyRails)
- ☐ On-board energy efficiency: implementation of the eco-driving technique realized by optimization algorithms
- ☐ Energy recovery and voltage control systems in ESSs

RFI on-going energy efficiency projects

❖ Project presently being developed in Italy:

ERTMS High
Density

ERTMS level 2 on city railway
network with ATO (Automatic
Train Operation)

*Integrated
with
ERTMS*

Test of a DAS
prototype

on a regional train (in co-
operation with Trenitalia) –
Driver Auxiliary System

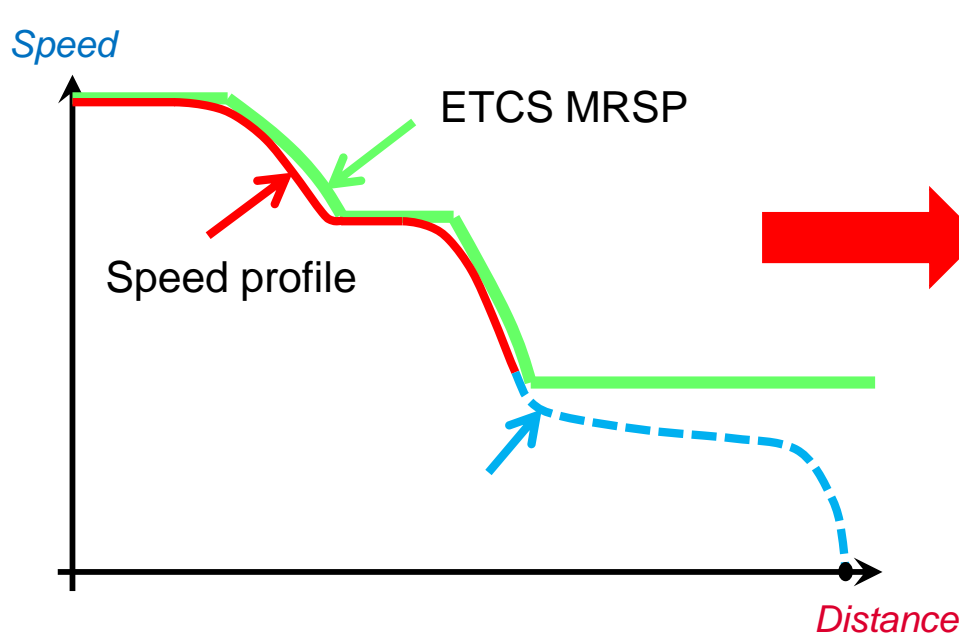
External
supporting
device

The **main advantages** are:

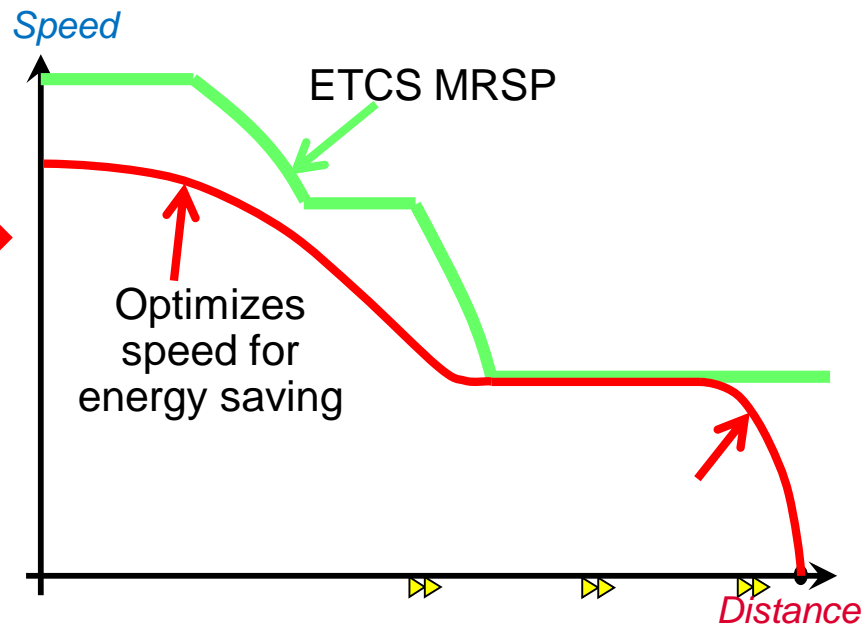
- ☐ punctuality improvement;
- ☐ carbon footprint reduction;
- ☐ energy costs decrease.

Speed profiles

Current speed profile:



Final goal:



Energy recovery and voltage control system in ESSs

The **energy recovery and voltage control system** is an innovative system designed for the 3 kV DC power supply system.



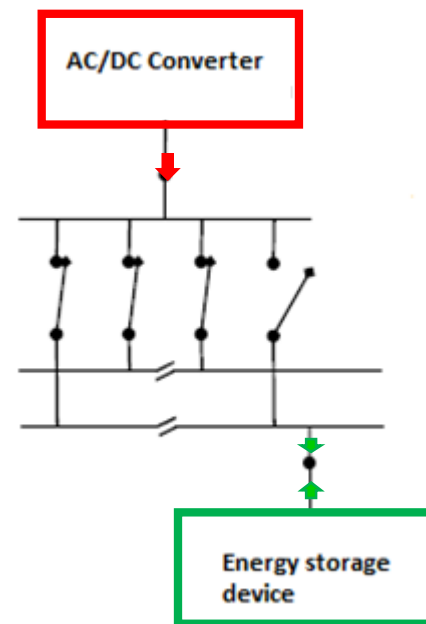
The **innovative ESSs** are composed by:

- ☐ Supply transformer for interconnection of HV and MV supply systems
- ☐ AC/DC converter for the power conversion and for the voltage control in the DC railway system
- ☐ DC/DC converter for conversion of rolling-stock braking electrical energy
- ☐ Energy storage device to storage the braking energy

Energy recovery and voltage control system in ESSs

The **main characteristics** of the components are:

- ❑ The AC/DC converter in active rectifier mode behaves as a traditional converter and shall provide maximum **10 MW** overload capability
- ❑ The DC/DC converter is bidirectional in order to store the rolling-stock braking electrical energy and reuse it into 3 kV DC line



Energy recovery and voltage control system in ESSs

The energy storage device is realized by a supercapacitors bank that can be connected directly to the contact line:

- ❖ Near the ESS during the experimental phase

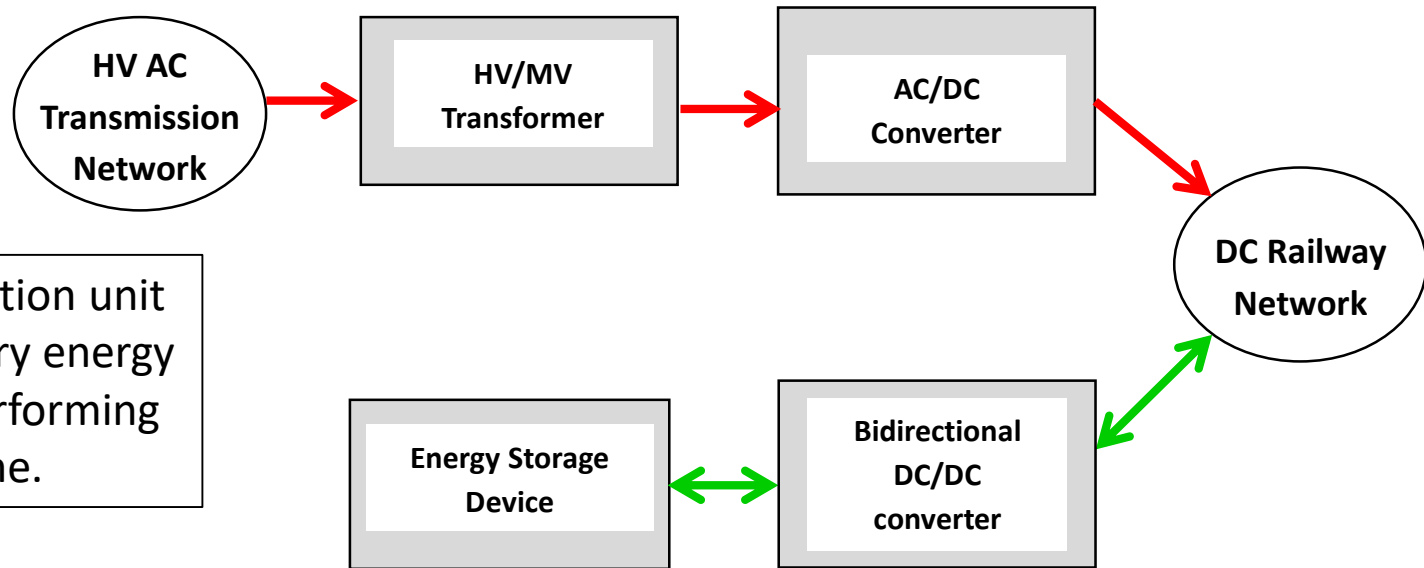
Or

- ❖ Between two ESSs

The supercapacitors are designed to handle the power peaks caused by the rolling-stock braking and to store the related energy.

This energy will be given back to the rolling-stock during the traction phase.

Energy recovery and voltage control system in ESSs



Energy recovery and voltage control system in ESSs

The main advantages of the innovative ESSs in 3 kV DC system are:

- ☐ Improvement of the energy saving by recovering the rolling-stock braking energy
- ☐ Regulation of the contact line voltage and the increase of the operational advantages

Energy recovery and voltage control system in ESSs

- ❖ The increase of system performances in terms of power supply voltage according with the load conditions in compliance with power quality requirements defined by European standards (EN 50388, EN 50163) especially when:
 - ☐ there are high slopes;
 - ☐ there is high distance between two ESSs.
- ❖ The improvement of system behaviour in case of short circuit:
 - ☐ for maximum short circuit current (near the Electrical Substation) the voltage could be decreased by the AC/DC converter in order to preserve the electrical equipment;
 - ☐ for minimum short circuit current (far from the Electrical Substation) the voltage could be increased in order to change the settings of OCL protection systems improving the performance of power supply system.

**Thank you for your
attention**

