



# Energy Metering Day by ERESS

Bombardier Energy Metering System:  
Innovative Projects, Latest EMS developments,  
and EN 50463:2017 Standardization

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Energy Metering Day by ERES  
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## Bombardier Energy Metering System: Innovative Projects, Latest EMS developments, and EN 50463:2017 Standardization

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OD1	DRAFT OF FIRST DOCUMENT EDITION	2020-10-05	H MARTINEZ

# Agenda

- **BOMBARDIER ENERGY METERING SYSTEM. INTRODUCTION**

- ERESS INTERVIEWER QUESTIONS:

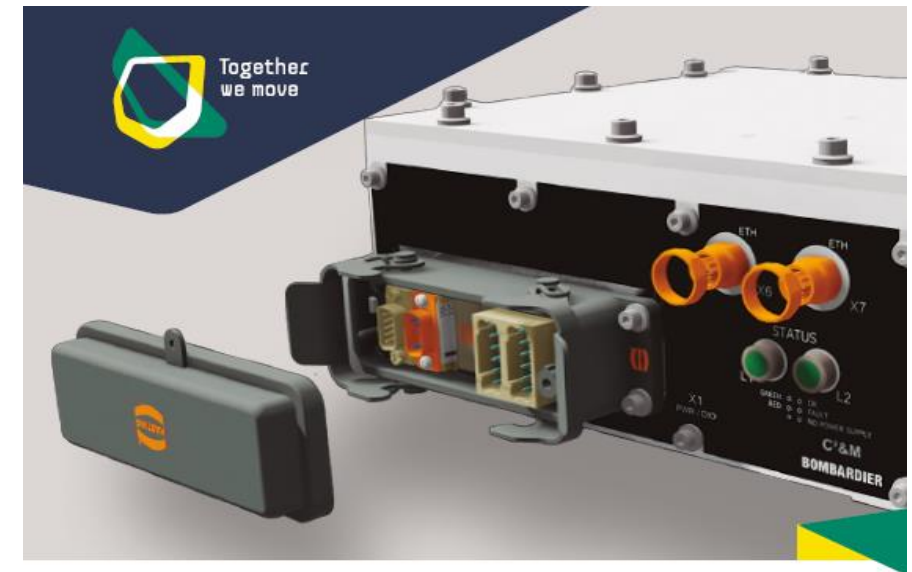
- WHICH TECHNICAL INNOVATION IS BT WORKING WITH CURRENTLY?
- BT REMARKABLE PROJECTS, DELIVERED OR WORKING CURRENTLY ON. WHY DO YOU CONSIDER REMARKABLE?
- WHAT IS THE STATUS OF YOUR COMPANY IN REGARDS WITH THE EN 50463:2017?
- WHAT IS THE EXPECTED LIFETIME OF BT METERS AND WHAT ARE THE MAINTENANCE ROUTINES DURING THE EMS LIFETIME? DO THEY INVOLVE RE-VERIFICATION OR OTHER ACTIVITIES?

- CONCLUSIONS

# BOMBARDIER ENERGY METERING SYSTEM. INTRODUCTION

## What is EMS (Energy Metering System) and DCS (Data Collecting System)?

- Bombardier's EMS follows the **standard EN-50463:2017**, "Energy Metering for Railway applications".
- Product composed by two main parts: Onboard and Wayside Server.
- According to the norm: The **onboard EMS** (mainly launched in C2&M module):
  - EMF: Measures primary current and voltage (AC and DC).
  - ECF: Calculates consumed and regenerated Energy.
  - DHS: Packs and compiles the calculated energy to be sent and stored at server level.
- Bombardier's EMS onboard is complemented with its **DCS (Data Collection Service)**, a wayside **server application**.
  - Receives and manages Energy data from onboard units according to the **standard EN50463:2017**.
  - Allows Operator to know fleet energy consumption for billing purposes.
  - Offers reporting functions, fleet consumption analysis and detect saving opportunities.



First step for managing energy is measuring it

## Energy Measurement System

As part of Bombardier's commitment to find innovative solutions to save energy and reduce costs, we continue improving our Energy Measurement System (EMS).

Bombardier in Spain has developed an onboard Energy Measurement System (EMS). This EMS is fully operative and certified with the latest standard: EN - 50463, "Railway applications - Energy Measurement on board trains" and Technical Specification of Interoperability (TSI). EMS has a double functionality:

- 1) Energy measurement for billing
- 2) Easy analysis to identify new energy saving alternatives

Additionally, the integration of the EMS within the vehicle allows the operator to only pay for the real energy consumption.

EMS can be provided with additional functionalities depending on each customer's requirements, such as smart stabling and/or efficient driving system for energy consumption reduction, diagnostic applications and web interface for maintenance purposes.

Customer	Project / platform
RENFE	High speed
FGC	Commuter EMUs
SNCF	M7 double-deck
SNCF	Regio2N (BOMBARDIER* CIMNEO*)
	NAT EMUs
Crossrail	
LOTrain	BOMBARDIER*
East Anglia	AVENTRA*
South Western	EMUs
West Midlands	

Energy Measurement System

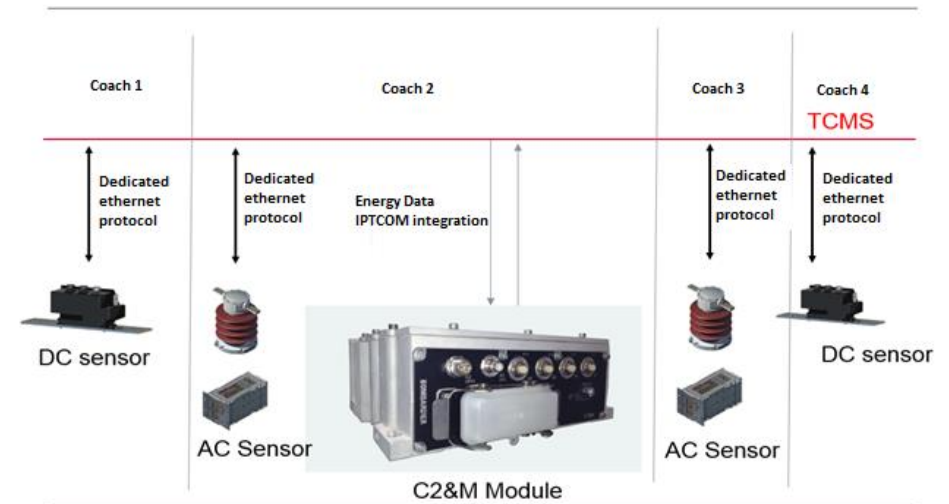
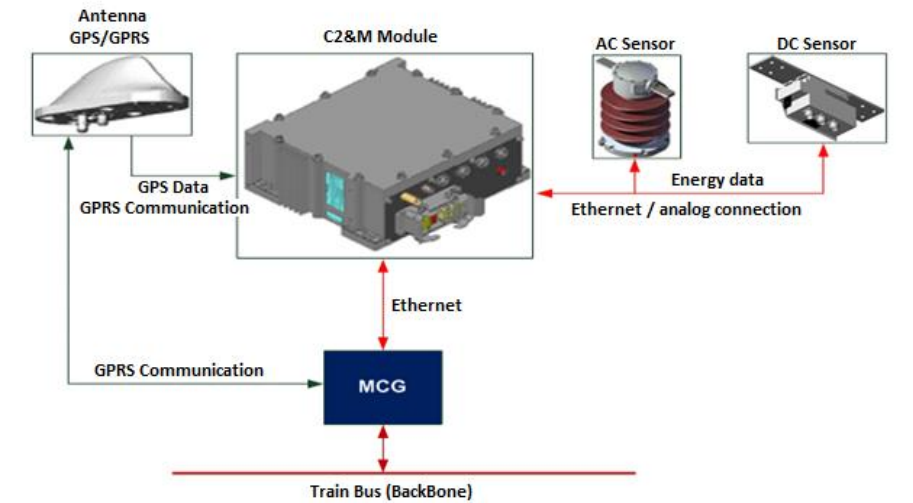
**BOMBARDIER**

**BOMBARDIER**

# BOMBARDIER ENERGY METERING SYSTEM. INTRODUCTION

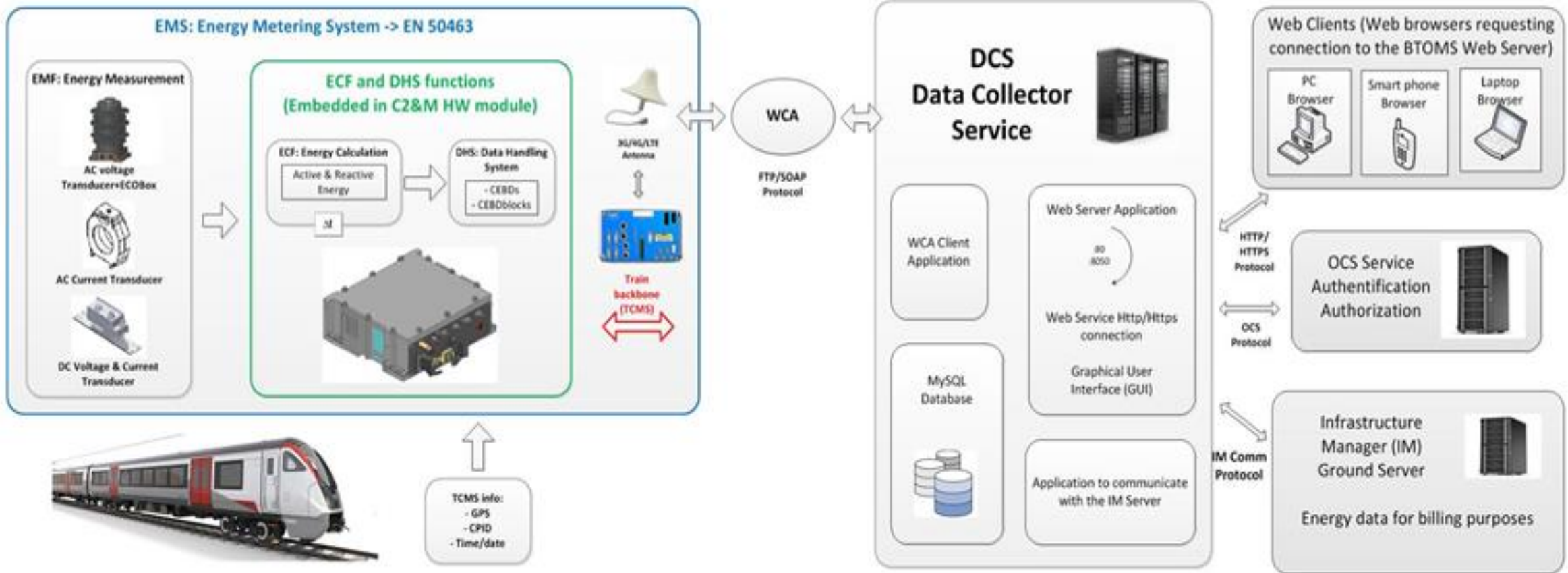
## What is EMS (Energy Metering System) and DCS (Data Collecting System)?

- The onboard Bombardier EMS offers **high flexibility and compatibility with any type of onboard architecture.**
- Onboard EMS can be integrated in the TCMS or be a totally independent subsystem in the train.
  - Fully Integrated EMS in Train Backbone:
    - Exchanges Voltage and Current measurements with the transducers.
    - Uses resources and exchanges information with the TCMS: GPS signal, GSM/GPRS communication
  - Stand Alone EMS:
    - No interaction with the Train TCMS.
    - Dedicated EMS bus among the EMS devices.
    - Dedicated peripheral to gather every piece of needed information: Voltage and Current measurements, GPS position and Train to Wayside (T2W) data communication.



# BOMBARDIER ENERGY METERING SYSTEM. INTRODUCTION

## Architecture Overview of Bombardier's EMS and DCS communication

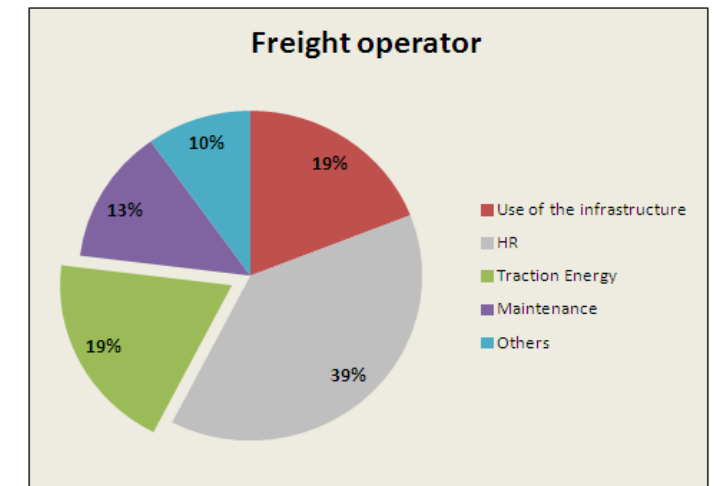
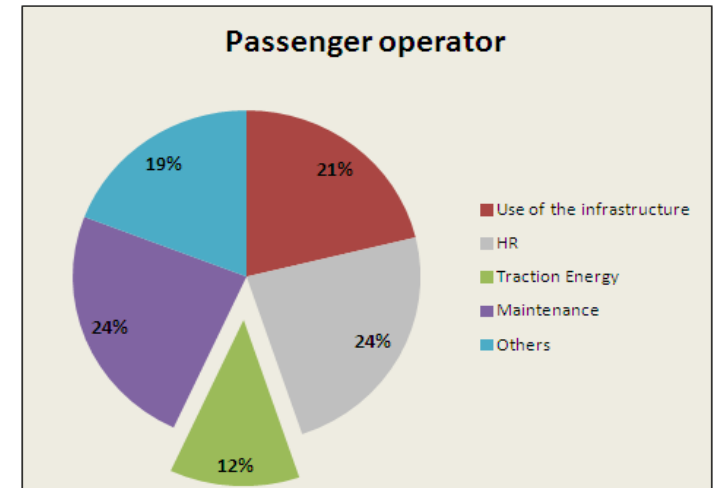




# BOMBARDIER ENERGY METERING SYSTEM. INTRODUCTION

## BOMBARDIER ENERGY MANAGEMENT SYSTEM AS A COMPLETE PROJECT THAT INCLUDES:

- Related with the Energy Metering System (EMS), **Bombardier 's innovative BEDS Solution, the Bombardier Efficiency Driving System.**
- Both applications (EMS and BEDS) are launched and run simultaneously in the same onboard C2&M HW device.
  - EMS measures, calculates and packs the consumed operation energy according to the **last standard: EN – 50463:2017.**
  - BEDS optimizes the operation in revenue service, so the energy consumption is minimized.
- The development and combination of both applications within the same onboard units is part of the **Bombardier Energy Management System.**
- Indeed, optimizing Energy consumption while Rolling Stock is in Revenue is an increasing concern in Railroad Operators:
  - Reduce Energy bills
  - Reduce Operation and Traction costs
  - Reduce equipment wear down
  - Reduce Maintenance Costs
  - Enhance “green transport” label



# Agenda

- BOMBARDIER ENERGY METERING SYSTEM INTRODUCTION
- **ERESS INTERVIEWER QUESTIONS:**
  - **WHICH TECHNICAL INNOVATION IS BT CURRENTLY WORKING WITH?**
  - BT REMARKABLE PROJECTS, DELIVERED OR WORKING CURRENTLY ON. WHY DO YOU CONSIDER REMARKABLE?
  - WHAT IS THE STATUS OF YOUR COMPANY IN REGARDS WITH THE EN 50463:2017?
  - WHAT IS THE EXPECTED LIFETIME OF BT METERS AND WHAT ARE THE MAINTENANCE ROUTINES DURING THE EMS LIFETIME? DO THEY INVOLVE RE-VERIFICATION OR OTHER ACTIVITIES?
- CONCLUSIONS



# ERESS INTERVIEWER QUESTIONS:

## WHICH TECHNICAL INNOVATIONS IS BT CURRENTLY WORKING WITH?

- **Bombardier Energy Management System**, which combines other applications with the EMS.
- **EMS**: Fully operative and certified EMS with the last standard: **EN – 50463:2017**, “Energy Metering for Railway applications”.
- **DCS**: Fully developed and **ready to receive and manage energy data** from on board units that follow the **standard EN50463:2017**.
- **BEDS** which is a Driving Advisory System (DAS) in charge of minimizing the onboard Energy consumption while train is in revenue service. **Proven 11% Energy Savings in High Speed Trains**.
- BEDS is also composed by 2 main parts: Onboard units and BEDS Wayside Server which is in constant T2W communication with the different train units in order to keep them updated with the latest traffic schedule and Infrastructure revenue service planification.
- **C-DAS** functionality:
  - Constantly interaction between BEDS and Traffic Management System (TMS)
  - Constant “Real Time” exchange of operation event and updates in timing constrains
  - Enhance Energy Saving possibilities at fleet level based on the CURRENT Network Traffic Evolution.
- **SMST**: Smart Stabling Technology: Increase Energy Savings while train is in Stand Still (ACU, Passenger Doors, Ventilation and other subsystem Management when train is in standstill based on passenger load and other TCMS information as part of the Integrated EMS/BEDS solution).
- **Expected up to 30% Energy Savings with combination of the different functionalities.**

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# ERESS INTERVIEWER QUESTIONS:

## BOMBARDIER REMARKABLE PROJECTS, DELIVERED OR WORKING CURRENTLY ON. WHY DO YOU CONSIDER REMARKABLE?

- The **Bombardier EMS** offers **HIGH flexibility and compatibility** with any type of onboard architecture. Proof of that are the different project the BT EMS has been deployed in.
- **PMGE RENFE: Management of Energy Improvement Project for Renfe Fleets in SPAIN.**
  - Fully EMS **Integrated** solution in the TCMS
  - **Multi-fleet:** High Speed Trains and Freight TRAXX Locomotives.
  - **Multisystem** AC and DC
  - Total amount of EMS: **280 uds**
  - Management Data Collecting System (**DCS**) with **“Real time” Monitoring** of the fleet status.
  - Deployment of **BEDS** (DAS System)
- **EMS and Monitoring Ground Server for BT Omneo Platform (Regio2N and NAT) in France and M7DD in Belgium:**
  - **Stand-Alone** EMS System & **Integrated**
  - Multi-fleet: **Commute** Electro-Mechanic Train Units (**EMUs**)
  - **Multisystem** AC and DC
  - Total amount of EMS: Over **690 uds**
  - Management and **Fleet monitoring** performed with a dedicated SOCLE Ground Server for the Multi-fleet EMUs operated by SNCF and **DCS for SNCF (standard: EN – 50463:2017).**

# ERESS INTERVIEWER QUESTIONS:

## BOMBARDIER REMARKABLE PROJECTS, DELIVERED OR WORKING CURRENTLY ON. WHY DO YOU CONSIDER REMARKABLE?

- **PMGE RENFE: Management of Energy Improvement Project for Renfe Fleets in SPAIN.**
  - **Fully EMS integrated solution** into the train TCMS at onboard level
  - High EMS flexibility and compatibility to be installed in a Multi-fleet project. Total EMS units (280 uds):
    - High Speed S102/S112: 46 trains – 92 EMS units (DELIVERED)
    - High Speed S130/S730: 44 trains - 88 EMS units (DELIVERED)
    - Freight S253: 100 TRAXX Locomotives – 100 EMS units (WORKING CURRENTLY ON)
  - **Multisystem Energy Measurement (AC and DC)**
  - Multi-fleet and **Multisystem Management Data Collecting System (DCS)** with “Real time” Monitoring of the fleet status and **introduction of BEDS** system to optimize energy consumption.
  - Remarkable Project for its **complexity**.
    - Considered as a challenge with such a **broad different rolling Stock types** operating under several Overhead Voltage Systems (AC and DC) including the deployment of a **DAS system (BEDS)**.
    - Challenging Project that has **been already successfully completed in over 2/3 of its execution**.

# ERESS INTERVIEWER QUESTIONS:

## BOMBARDIER REMARKABLE PROJECTS, DELIVERED OR WORKING CURRENTLY ON. WHY DO YOU CONSIDER REMARKABLE?

### ➤ EMS and Ground Server for BT Omneo Platform (Regio2N and NAT) in France and DCS for M7DD in Belgic:

- **Stand-Alone** and Integrated EMS Solution based on the fleet.
- **Multisystem** Energy Measurement (AC and DC pantographs)
- EMS installed in **Commuter Electro-Mechanic Train Units (EMUs)**
- Energy Management and remote Monitoring performed with a dedicated SOCLE Ground Server for the Multi-fleet EMUs operated by SNCF.
- Total **amount of EMS units**:
  - R2N: 420 Trains – 420 EMS units
  - NAT: 189 Trains – 184 EMS units
  - M7DD: 91 Trains – 91 EMS units (**standard: EN – 50463:2017**)
- Remarkable Project because of:
  - Amount of onboard EMS systems installed (**over 690 uds**)
  - Proven EMS **system flexibility and adaption capability**, as a Stand-Alone subsystem, to operate in AC and DC multi-fleet EMU's.

# Agenda

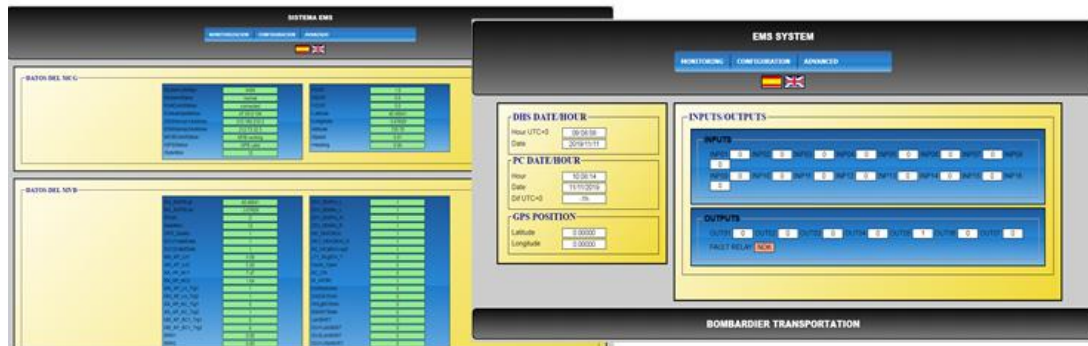
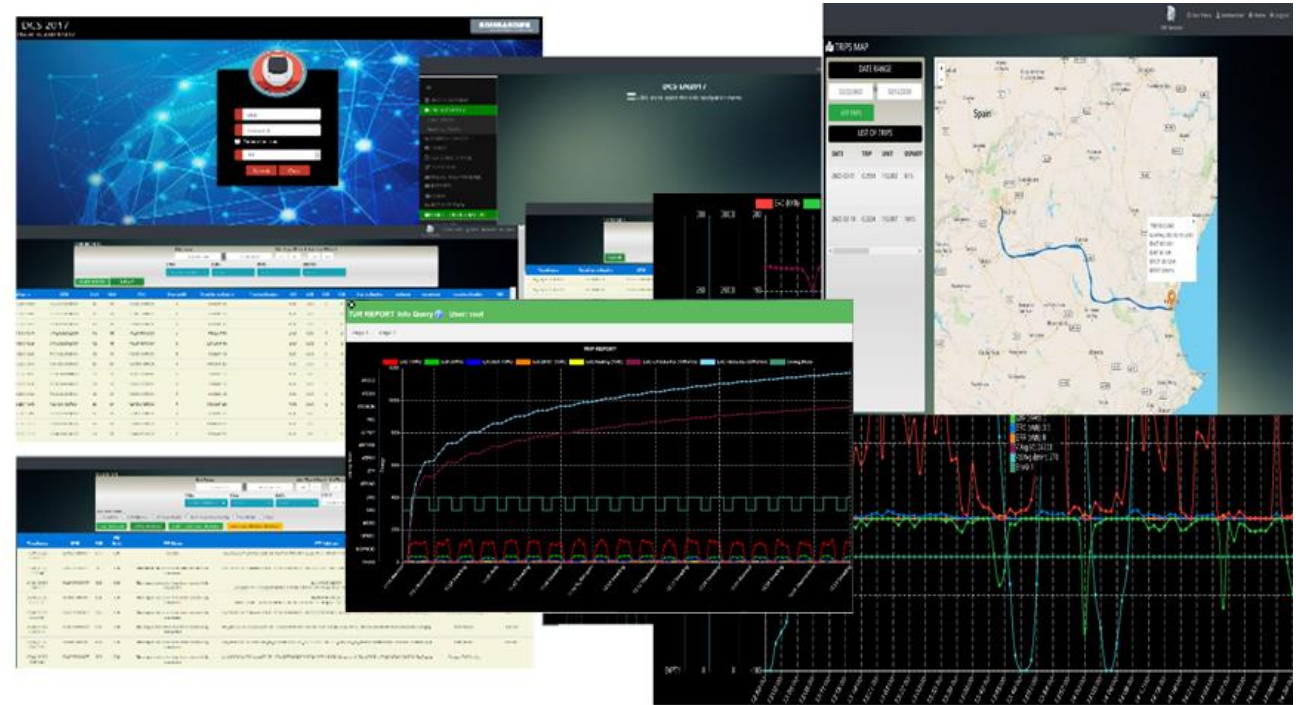
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# ERESS INTERVIEWER QUESTIONS:

## WHAT IS THE STATUS OF YOUR COMPANY IN REGARDS WITH THE EN 50463:2017?

- Bombardier EMS solution is fully operative and certified EMS with the last standard: EN – 50463:2017, “Energy Metering for Railway applications”.
- DCS is already developed and ready to receive and manage energy data from on board units that follow the standard EN50463:2017. The DCS solution offers an interactive and friendly user interface with several reporting and analysis possibilities.



- Onboard EMS functionality complements the **EN – 50463:2017 certification** with an internal SW maintenance tool. This GUI allows users to:
  - Perform different monitoring activities (Transducers)
  - System commissioning and service
  - Journey report analysis.

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# ERESS INTERVIEWER QUESTIONS:

## EXPECTED LIFETIME OF BOMBARDIER METERS AND MAINTENANCE ROUTINES DURING THE EMS LIFETIME. DO THEY INVOLVE RE-VERIFICATION OR OTHER ACTIVITIES?

- Lifetime of Bombardier Energy Meters (C2&M module) is expected to be the **same lifetime than the train consist where it has been deployed** as soon as:
  - System verification and re-calibration activities are performed as defined in system documentation and
  - Based on the Experimental field data of its FPMH and
- EMS system **verification** and **Re-calibration** if it proceed, recommended **every 10-year period**.
- Maintenance tasks **do not require any re-configuration** of the EMS system. The onboard EMS unit is configured, according to EN-50463:2017, with Train Identification, EVN and CPID data, which are stored in a E2PRROM memory (Hard key terminal).
- **MTBF**: Calculated operation duty cycle =1, during 24 h, 365 days.
- **FPMH**: Based on field data complementing technical analysis.
- Measurement **Accuracy**:
  - ECF: 0.5R
  - DHS: negligible (tends to zero)
  - **Total EMS accuracy: 0.5R**

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# CONCLUSIONS

## Energy Metering Day by ERESS

- **BOMBARDIER Energy Metering Solution is a success.** Currently deployed in over **1700 train units**.
- Standardized solution totally certified with the **EN-50463:2017** and compliant with the Quality standard **UNE-EN ISO 9001:2015**.
- Expansion of the EMS solution is granted and ongoing not only within Bombardier new build equipment but also among other train manufacturers.
- Perfectly complemented with the BEDS Innovative solution to ensure maximum Energy Savings and Rolling Stock Efficiency.

### BOMBARDIER



#### BEDS brings significant savings in energy and cost

The Bombardier Efficient Driving System (BEDS) reduces energy consumption by more than 11 per cent for RENFE's high-speed trains (HST), which is well above the contractual target of four per cent. This ultimately amounts to more than 1 million euro operation savings per annum



### Bombardier Spain renews quality certificate for its railway maintenance division

Awarded by Chamber Certifica according to the UNE-EN ISO 9001: 2015 standard

Bombardier Transportation, has obtained quality management certification for its rail maintenance services division. The auditing company was **Cámara Certifica**. An independent and impartial environmental certification and verification entity with recognition of its certifications at the national and international level and accredited by the National Accreditation Entity (ENAC).

Specifically, Certificación y Confianza Cámara, SLU accredited that the quality management system implemented by Bombardier European Holdings, SLU Services for its maintenance and modernization activities of railway vehicles, as well as repair and revision of components, meets the requirements of the UNE-EN ISO 9001: 2015 standard.

The processes of maintenance, procurement, quality assurance, resource management, risk and opportunity analysis, stakeholders, continuous improvement and quality objectives, are some of the fundamental aspects that have been evaluated.

Obtaining this certification strengthens Bombardier's competitiveness and contributes to increasing the efficiency of its maintenance services division's processes.

From the Services division of Bombardier Spain, the supply of energy consumption measurement and management equipment (EMS - *Energy Management System*) is carried out, which allow a continuous record of your energy expenditure, with real-time data exchange between the rolling stock and workshops. This represents an important leap in quality and sustainability for the railway sector, since through this system it is possible to avoid the emission of thousands of tons of carbon dioxide per year.

The objective of this on-board energy metering system is to provide reports that enable rail operators to improve the energy efficiency and performance of their rolling stock, making it possible to reduce operating costs during commercial service.



# Questions & answers





# Thank you very much!

Héctor Martínez Cabañes & Diego Aguilar Pérez  
BEDS Possibilities for CrossRail Project  
Confidentiality level Internal