*This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 314125*

# Public Summary of

# D3.1 COMMON METHODOLOGY FOR SCENARIOS DATA GATHERING AND ASSESSMENT

### What is MERLIN?

**MERLIN** is a collaborative project funded under the European Commission's 7th Framework Programme on Research and Development. MERLIN started on 1st October 2012 and will last 36 months.

**MERLIN's** main aim and purpose is to investigate and demonstrate the viability of an integrated management system to achieve a more sustainable and optimised energy usage in European electric mainline railway systems.

### What are the issues at stake?

Energy management is a key issue for railway systems and this situation will continue to be prominent for the foreseeable future. Multiple operational scenarios add complexity to the development of suitable and appropriate energy management solutions. Moreover, existing assessment tools lack an integrated approach, and tend to omit the variation in emission levels, energy usage and associated costs resulting from differing traffic peaks.

Given that the railway system is a complex and interconnected system, a single supplier, operator or infrastructure manager (as large as they may be) cannot tackle the energy management issue for the entire network alone. Hence, only through a collaborative approach such as **MERLIN** can effective solutions for this issue be developed. Appropriately, the **MERLIN** consortium brings together the key rail stakeholders from across Europe.

### What are MERLIN's main achievements?

- Proposals for technical recommendations (UIC/UNIFE TecRec) on Specification and verification of energy and power consumptions of railwaysystemsand on Energy and power related information protocols at operational level;
- Future business models & recommendations (smart energy management, cost saving);
- Optimised solutions for current and future business models;
- Reference architecture and interfaces related to a strategic support tool and operational energy management tool which supports real time suggestions to network actors.

**Public summary:**

***WARNING**: This document is a synthesis of a confidential document. Access to the full content of the deliverable is restricted to the members of the MERLIN consortium and to the European Commission's services.*

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In D3.1 "Common Methodology for Scenarios Data Gathering and Assessment" as part of the methodology are defined a categorization of the input data, output data, key performance indicators, information from various subsystems that can interact with the REM-S and SDMT subsystems for the validation of them.

In order to compare scenarios, evaluate improvements in energy savings and perform simulations in equal conditions it is necessary to gather data in a common way. This is the baseline for the methodology that has been used to describe the scenarios. The procedure includes the definition of traffic information on the railway lines, types of electrification and operation conditions.

By defining these scenarios, other key points have been considered. One of them have to do with the description of the network considering topology, location, characteristics of substations and other consumption points along the network such as fixed installations and signalling devices. Connections with other rail networks have also been considered, as well as fixed accumulations devices along the network (connection type and characteristics).

In order to define the scenarios and to properly analyse the results to be obtained, a description of the traffic type as well as an indication of the characteristics of the trains, their progress on their routes and the distribution of delays probability have been given as inputs. Additional inputs such as indications of automatic driving and storage devices on board have also been needed.

Other parameters have been taking into account as the legal and economic framework on the power purchasing, considering aspects related to advance purchasing, historical hourly price of energy imported and exported, as well as losses coefficients and the way to pay for power.

Then, the different scenarios, which will validate the developed tools and the proposed solutions in each, are collected.

**Scenario 1. High Speed Rail on 25kV 50Hz AC networks**

This scenario will be studied by SDMT tool and will focus on the aspects of networks design of High-Speed lines running on 25kV 50Hz AC, performing at HSL 1 line from RFF between Paris and Lyon. The main aim is the increase of the capacity of the line taking into account the limited capacity of the public power network that feeds substations, smoothing power needs during peak hours:

- a better management of available energy
- a better use of energy.

In both case, those improvements will need smart operational tools able to forecast the energy needed according to the infrastructure (geography of the line but maybe also weather) and the trains (position, speed,...).

**Scenario 2. Intercity service on 15KV 16.7Hz AC network**

This line of Swedish Railway network on 15KV 16,7Hz AC will use the SDMT tool, for validating the results with the measurements of energy on trains. Trains should be simulated in normal traffic which then is

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compared to optimized traffic with different driving modes in various operational scenarios. Two issues will be studied:

- Reduction of losses by controlling voltage angles and voltage levels in order to eliminate undesirable flows of active and reactive power.
- Reduction of power peaks by controlling the demand of the trains to not exceed the nominal power of substations.

**Scenario 3. Suburban services on 3kV DC network**

This scenario is focused on the potential benefits of integrating the energy dispatcher component of the REM-S in conjunction with the use of infrastructure-based energy storage systems that allow harnessing the energy of braking trains and reducing power peaks in substations. First the SDMT tool is used to determine the location and optimal characteristics of the storage system (ESS), minimizing the time of the return of investment (ROI) and quantifying the risks that could experiment: schedule change of trains, modification of rolling stock, including other technical systems such as driver assistance systems (DAS), degraded situations of exploitation, etc. In a second phase at the operational stage, the normal operation use case and degraded use case will be analyzed. Finally, at field tests all systems will be integrated (reversible substation, ESS, REM and DAS) to demonstrate the achievement of the objectives by the REM-S. The scenario simulations and its comparison with real data in field tests, will determine the energy effectiveness of the REM system.

**Scenario 4. Mixed passenger and freight traffic on 25kV 50Hz AC network**

The purpose of this scenario is to investigate a dynamic DAS for traffic management of a mixed-traffic railway, in conjunction with the REM-S for energy management, analyzing only operational aspects, with no strategic input.

Different service recovery strategies for different operating scenarios will be analyzed, by determining the energy consumption in relation to the capacity of normal service replacement.

**Scenario 5. Real Time Energy Management for 25kV 50Hz AC network**

This scenario will be based upon two areas. The first is a 100 km DC (750 $V_{DC}$) electrified network in the south of England, between Weymouth and Bournemouth, with regional traffic. The second area to be looked at will be the 25 kV electrified line between Lichfield and Redditch. This is a 57 km stretch of suburban railway services with electric trains and some regional diesel services.

The objective of the scenario is to investigate the potential of new contractual arrangements to buy electrical energy, and whether this can offer significant cost savings when energy is managed by the REM-S.

It is expected that in the case of Network Rail, an energy market with 30 minute periods is chosen as the basis for simulation, since it is the standard market for the UK.

**More information**

To know more on the MERLIN project, please visit http://www.merlin-rail.eu.