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

D4.4. ENERGY PURCHASE DECISION MAKER ALGORITHM DEFINITION (EBDM)

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.*

The scope of the fourth work package (WP4) is to develop the holistic railway energy management in terms of new smart grid structures, new controllable components or new intelligent devices for energy management at infrastructure grid level or at vehicle level. Task 4.1 of WP4 is specifically committed to design and develop the Operational Railway Energy Management System (REM-S) to make best use of the available energy in the railway system. That means that different agents involved in energy uses are not isolated players anymore but players of the global energy game.

The REM-S developed in this WP, especially in Task 4.1 will be composed of different subsystems that will work coordinated bringing higher amounts of savings and makes economically feasible the investment in new technologies. Amongst these subsystems are: the mobile part on board of the vehicles (DOEM), the Day Ahead Optimization (DAO) Application or the electricity buyer decision maker (EBDM). The latter subsystem, indicated Electricity Buyer Decision Maker (EBDM), and the optimization of the electricity procurement are the aim of the deliverable 4.4.

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The EBDM is a module of the REM-S that determines the best way to purchase/sell the energy consumed/generated by the railway system managed by the REM-S, based on:

- The power and energy consumption/generation forecasted by the DAO Application for the following 1-2 days (the actual number of hours will depend on the spot of the electricity market), which takes into account all the managed generation and consumption (trains, railways infrastructure, local energy sources, external consumers, etc.). To take into account the uncertainty, the forecast includes several energy estimations with the corresponding likelihood.
- The forecast of the prices in the different electricity spot markets (day-ahead, intraday, etc.) for the following hours. To take into account the uncertainty, the forecast includes several price estimations with the corresponding probability.
- The set of purchasing/selling constraints, derived from the long-term contractual arrangements as well as from other long-term markets, if any.

Because the EBDM is part of the REM System, which manages the operation of the smart railway system in the 1-2 days term, only the shorter term (1-2 days) electricity procurement is addressed by this module. In this timeframe, the EBDM determines for each hour:

- which amount of energy is purchased/sold by means of the contractual agreements, which typically introduce some constraints (minimum and maximum amount of energy, price, etc.) and
- which amount of the energy is negotiated at each session of the spot market.

More specifically the deliverable 4.4 addresses the following two topics:

- Analysis of the organization of the different types of electricity spot markets and its implications for electricity procurement in railways smart grids in the short term.
- Design of a general algorithm to buy/sell the electricity in the 1-2 days term. This procedure has to anticipate mechanisms to correct the deviations that occur both in railways operation (for instance, due to traffic congestions) and in the local generation sources (for instance, due to the stochasticity of the primary energy in the case of wind power plants), for example by buying/selling the missing/exceeding energy in the most profitable way.

Finally, to validate the architecture and the formulation of the optimization problem, a study case has been analysed. A real network (the Spanish ADIF railway network) has been used and the energy procurement has been optimized for a specific day.

More information

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