PROJECT

ELECRAIL

Systematic analysis of energy consumption in metropolitan, suburban and high speed trains, with assessment of the energy impact and the economic result, including the development of models and parametrical simulators

Análisis sistemático del consumo energético en líneas ferroviarias metropolitanas, cercanías y alta velocidad, valorando el impacto energético y el resultado económico, el desarrollo de modelos y simuladores

Funding: National (Spain)
Duration: Jan 2007 - Dec 2011
Status: Complete with results

Background & policy context:

The use of energy generated by braking systems is very useful in railways. In fact, in Metro and suburban trains, it reaches percentages of use between 15 and 30%.

However, in order to make this energy usage possible, another train claiming energy on the same electric rail track is needed at the same moment the train brakes. For this reason, this system is useful when electrified rail tracks are long and with high traffic density. It can be estimated that on the overall Spanish railway network, the annual benefit is of about 520 GWh, which represents about 15% of the total railway energy consumption.

Objectives:

The main aim of this project was to analyse how to increase the percentage of recovered energy use, either from schedule coordination, variation of the network topology or from on board unit storage or on track. The definition of energy usage priorities in each specific moment was also explored.

Other specific objectives within the ElecRail project were:

- To analyse theoretically and test the required actions to reduce railway energy consumption;
- To analyse the interrelations between actions and to study in detail the results obtained in past research projects and in on-going ones about railway energy efficiency;
- To develop simulation models for the analysis of strategies of energy consumption reduction for an efficient design of railway schedules and specific train driving for high speed lines and metros.

The interest and opportunity are in the convenience of using efficient designs for investments to be made in infrastructures and trains in Spain. Also, in the modernisation of management methods of railway traffic which include energy efficiency criteria.

Methodology:

The project was organised around the following key activities:

- Analysis of general and common aspects and presentation of an inventory of energy consumption;
- Study of the main features of the vehicle (i.e. mass, aerodynamic shape, auxiliary services and on board storage);
• Analysis of the electric power network, co-generation, in ground storage and design of the feeding network;
• Design of train schedules and driving ways applied to a high speed and metro line.

Parent Programmes:
PEIT - Strategic Plan of Infrastructures and Transport

Institute type: Public institution
Institute name: CEDEX (Centro de Estudios y Experimentación de Obras Públicas)1; part of the Ministry of Public Works and Infrastructures
Funding type: Public (national/regional/local)

Partners:
• Universidad Pontificia de Comillas (Project Co-ordinator);
• Fundación de los Ferrocarriles Españoles;
• Universidad Complutense de Madrid;
• ADIF - Administrador de Infraestructuras ferroviarias;
• Renfe Operadora;
• Metro de Madrid;
• Ferrocarriles Generalitat de Catalunya;
• Dimetronic; Patentes Talgo;
• CAF - Construcción y Auxiliar de Ferrocarriles;
• M Torres Disaeños Industriales;
• SAU;
• TEAM;
• DETREN;
• TMB - Ferrocarril Metropolitano Barcelona

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Key Results:
The recovery of electricity by using train braking systems and its return to the public grid has the following advantages:

1. No emissions or energy consumption from non-renewable sources;
2. The Energy supplied to the public network can be known with a reasonable degree of approximation;
3. The Marginal cost of this generation is null;

The combination of the elimination of skating wheel with compensation weight transfer provided the AC drive system, an adhesion of between 37% and 39% against 18% 20% of the old DC system. Therefore, AC traction chains can ensure the same effort that DC tractor chains with half adherent or in other
words with the same axle load weight, can offer twice the traction effort.

New railway vehicles should be equipped with three-phase AC traction equipment.

The advantages of an energy storage system on the railway infrastructure concerned the substations, which can lower their dimensions and those of their connections, helping to improve the stability of the electricity grid in vulnerable zones and reduce the cost of operating the train traffic since it is likely to decrease the amount devoted to electricity production.

Furthermore, the indirect impact was also considerable: the need for energy storage is closely linked to improved quality of electricity service and increased stability of weak power grids.

Documents:

STRIA Roadmaps: Transport electrification, Infrastructure
Transport mode: Rail transport
Transport sectors: Passenger transport, Freight transport
Transport policies: Environmental/Emissions aspects
Geo-spatial type: Network corridors