Report highlights opportunities to improve rail diesel efficiency

A report published today highlights the results of research work carried out by Ricardo and TRL on behalf of the UK Department for Transport, exploring the means by which improvements in diesel fuel efficiency could be realized within the rail network of Great Britain.

The potential fuel saving improvements investigated in the study focused upon diesel powertrain technologies available for retrofit to the existing rolling stock of passenger diesel multiple units (DMUs) and freight locomotives, as well as those that can be incorporated into new rolling stock both to improve fuel economy while also meeting the latest Stage IIIB emissions limits.

Key findings of the report included a number of technically viable solutions that are available to improve rail diesel powertrain efficiency, many of which are commercially attractive in terms of their projected return on investment. The solutions identified by the study were based on well-proven packages of powertrain technologies that have been demonstrated in other industrial sectors, drawing upon Ricardo’s experience in other markets including the on- and off-highway heavy duty automotive, marine and power generation sectors. Owing to the complex nature and age profile of the diesel rail vehicle fleet, the study showed that smaller and more incremental changes applied to a large proportion of the fleet would deliver significantly greater fuel saving benefits than more radical innovations applied to a smaller number of vehicles.

Discussions with key rail industry stakeholders demonstrated that operators working within finite franchise periods will prioritize technologies with low capital costs, proven benefits and the shortest payback periods. However, economic and environmental benefits can be improved by cross-industry collaboration, enabling initiatives that can be deployed across as many vehicles as possible and development costs to be shared more widely.
The report and its conclusions and recommendations are now in the process of being shared with a range of industry stakeholders including rolling stock leasing companies, train operating companies, fleet maintenance and overhaul firms and rail freight operators.

“We have been extremely encouraged by the results and recommendations of this study, which was carried out on behalf of the Department for Transport by Ricardo and TRL,” said a Department for Transport spokesperson. “The rail industry has made significant improvements in fuel consumption at an operational level in recent years, but this report highlights further technology-led initiatives that could also be considered with the aim of reducing fuel costs as well as delivering environmental benefits in terms of reduced fuel consumption and carbon emissions.”

DETAILS OF THE RESEARCH PROJECT

Background – the need to reduce fuel consumption on the railway

Over the last 15 years the rail network in Great Britain (GB) has experienced significant growth in passenger and freight traffic, with demand for services in both sectors expected to continue to rise over the foreseeable future. The GB rail network is unique amongst similarly developed nations, especially those of Western Europe, in terms of its relative geographical isolation and the high proportion of diesel traction that it uses; over two-thirds of the GB rail network is not electrified, thus requiring diesel traction services. It is also unusual by international comparison in the separation between the rolling stock leasing companies, passenger service and freight operators, and the ownership of the infrastructure and permanent way. In addition, the very restricted nature of its loading gauge limits the available opportunities for the adoption of internationally generic vehicle solutions as well as limiting the packaging space for more complex on-board powertrain systems.

While significant achievements have been made by the country’s rail industry in reducing vehicle fuel consumption – particularly in terms of consumption per passenger mile – as a result of technical and operational efficiencies, the UK Government Department for Transport is keen to explore the further practical and commercially attractive options that could be deployed in order to further improve fuel efficiency. The objective in so doing is both to help reduce the operating cost-base of diesel powered rail services, while also helping to meet the country’s commitments on greenhouse gas emissions.
Assessing technology packages

The primary focus of Ricardo in the study was to review existing diesel traction technologies in use on the railway and to assess the levels of efficiency currently achieved in comparison with state-of-the-art diesel powertrain system efficiencies in other sectors, such as commercial vehicles and off-highway equipment. This enabled direct like-for-like comparisons to be drawn between rail and non-rail sectors, enabling the identification of a series of possible improvements to both new and existing rolling stock that could be made in rail using existing, cost-effective and readily available technologies.

Owing to the limitations of the study it was not possible to evaluate all classes and types of diesel rail vehicle and to provide specific recommendations for each. Instead, the country's DMU and diesel locomotive fleet was analysed in order to identify the most commercially and environmentally attractive improvement opportunities. The DMU fleet is comprised of in excess of twenty individual classes of vehicle. These were grouped into three categories based on engine type, and the largest group – consisting of the oldest engines with the greatest potential for improvements in fuel efficiency, and representing 55 percent of the DMU fleet and 57 percent of total vehicle mileage – was selected for in-depth research. To provide a basis for comparison of both existing and new technologies, operating duty cycle data was used to represent both a typical inter-city route and a local route with lower speeds and more frequent stopping.

The Class 66 vehicle was selected as the focus of the research for freight locomotives as this forms the backbone of the country's rail freight network, representing 48 percent of the freight locomotive fleet, and 87 percent of overall freight distance travelled. The duty cycle used for the evaluation of new technologies on freight locomotives was based on 103,600 hours of test data recorded from a study published in 2006.

In order to evaluate the potential costs and fuel consumption benefits of applying new technologies both to the existing fleet as well as to new vehicles, Ricardo evaluated the effects of engine enhancements, parasitic loss reduction measures, waste heat recovery innovations, transmission and driveline system improvements, energy storage technologies and various hybridization measures. These were grouped into practical ‘technology packages’ for each vehicle type, in order that their respective costs, benefits and investment payback periods could be calculated.
Stakeholder engagement – the importance of collaboration

In parallel with Ricardo’s research on powertrain technologies, TRL evaluated previous efficiency improvement initiatives through stakeholder engagement with rolling stock leasing companies, freight and train operating companies (franchise holders) and engine suppliers. This research was used to identify case studies in which such initiatives have been successful and where lessons could be learned in terms of likely technical and operational incentives and obstacles.

Opportunities to improve efficiency

“The results of this research have highlighted a range of practical technology packages that can be readily implemented in order to improve the operational fuel efficiency of diesel rolling stock,” said Ricardo director of rail vehicle technology, Jim Buchanan. “The challenge of identifying the optimal technology solution for a given fleet of vehicles is complicated by the business parameters within which each operator and rolling stock owner is operating. However, as the study has indicated, there are a number of technology packages applicable to new vehicles, as well as for retrofitting to existing fleets, some of which offer the prospect of very tangible fuel consumption savings as well as commercial returns.”

“The structure of the GB rail industry provides a challenging environment for fleet-wide improvement initiatives,” said Vijay Ramdas of TRL. “The stakeholder engagement aspects of this research highlighted clearly that when the rail industry forms coalitions of common interest between companies representing its many different sectors, significant benefits are possible. Through collaborative working by operators, maintenance providers and fleet owners, it should be possible to realize significant environmental and economic benefits from the application of new, fuel-efficient technology packages.”

“Many opportunities for improving GB rail diesel powertrain efficiency have been identified in this study, with seven technology packages suggested for initial comparison,” added Buchanan. “A large number of further synergistic technology combinations are possible, which Ricardo is actively investigating in order to implement these changes with the key stakeholders in GB rail.”

Ends
PRESS RELEASE

NOTES TO EDITORS:

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