

A Report for
Network Rail and the ORR
from
Asset Management Consulting
Limited (AMCL)

Version 1.0
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**Electric Current for Traction
Energy Efficiency Review
Report Executive Summary**

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AMENDMENT HISTORY		
Version	Sections	Amendment Details
Draft A	All	Initial document
Draft B	All	Incorporation of Network Rail and ORR comments
Draft C	All	Incorporation of final Network Rail and ORR comments
1.0	All	Incorporation of 'Industry Review' comments

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Executive Summary

Train operators on Great Britain's national rail network spend between £200m and £250m on electricity for traction every year. The consumption and associated electrical losses of traction energy are complex and dependent upon many factors, including train formation and design, driving styles, infrastructure configuration and timetabling of trains. A key factor is that the train operators, as system users, pay for any system losses. System losses are currently not fully understood or quantified and there is a lack of confidence in the end of year reconciliation process. For example, the magnitude of the year end cost reconciliation for West Coast Main Line (WCML) train operators has recently varied between plus 10% and minus 5%.

This brings into focus the questions of whether energy efficiency is being managed effectively across the industry and the potential benefits of more effectively managing energy consumption. These benefits include potentially significant contributions towards central Government carbon reduction targets and plans.

The Office of Rail Regulation (ORR) remitted Asset Management Consulting Limited (AMCL), the Independent Reporter (Part B - Asset Management), to undertake an independent review to assist the ORR in its understanding of energy efficiency and identification of potential efficiency improvement options. To provide specific knowledge and experience of railway electrification engineering AMCL worked with Peter Williment (BSc Hons, CEng, FIET) of Green Leader Ltd. on the project.

The key stated objective of the work was to assess the effectiveness of energy efficiency management across the industry and to provide an independent report to assist the ORR in its understanding and identification of potential improvement options.

The review was limited to Network Rail managed infrastructure and the infrastructure/train interface and did not directly consider the potential benefits to be gained via train operator initiatives. Specifically the review was limited to Network Rail 25kV AC electrification systems and the Southern 660V/750V DC electrification system

The overall scope was a review of the current EC4T electrical energy efficiency situation to address the following:

- Technical background;
- What can industry do to improve energy efficiency;
- What can be learned from best practice elsewhere;

- Non-traction uses of EC4T;
- Are industry incentives appropriate; and
- Identify, where appropriate, any recommendations to improve industry energy efficiency.

The review was constrained by predefined timescales to support the requirements of the ORR and Network Rail and undertaken as a desktop exercise in consultation with representatives from industry-wide stakeholders.

The review undertook an investigation of the issues, focused on Network Rail managed infrastructure and the infrastructure / train interface, and considered benchmarking to form a series of conclusions and recommendations captured in this report. The report also outlines a range of cross-industry efficiency improvement options for further consideration by the ORR, where appropriate.

The review found that the use of train borne energy metering should provide a means to effectively measure and manage energy consumption:

- Train metering will enable train operator energy efficiency initiatives to be monitored and directly rewarded and, together with further enabling of rolling stock regenerative braking, should enable significant cost savings to be made. Train operators have the potential to achieve the greatest proportion of EC4T efficiencies, although this was not a direct part of the scope of this review.
- Train metering will also enable Network Rail to quantify the electrification system losses, which when fed into cost / benefit studies, will enable the quantification of those electrification system changes which can be justified on system losses alone. However, it is expected that most changes will not be justifiable by system losses alone and will need to be linked to growth or renewal.

In conclusion, full traction energy metering in the longer-term will be beneficial to the industry as a whole and will help drive the industry towards greater efficiency as well as improved cost savings and reduced carbon emissions in line with Government targets. As a result it is concluded that full traction energy metering should be implemented as soon as is practicable to support further improvements in energy efficiency.

However, some short-term difficulties are presented by the transition phase between the current status quo and future full traction metering, such as the need for new business processes and changes to the apportionment of EC4T costs. This transition phase has now been initiated by

Virgin Trains seeking to be the first train operator to opt in to the metered billing option mandated by the ORR in 2009. Although the transition phase will be difficult it is critical to achieving industry wide traction energy metering and it is recognised that a good start has been made.

The issues associated with the transition phase are further compounded by the complexity of modelling and quantifying electrification system losses, prior to the availability of data from full metering. Based on Network Rail's modelling to date and the associated assumptions, the following observations can be made:

- The annual % 25kV AC electrification system loss factor of 5% provisionally agreed by Network Rail with Virgin Trains would appear to be of the right order. However, it should be noted that the ORR retains reservations over the losses estimate and is still requesting further information from Network Rail to validate the estimate.; and
- The annual % 750V DC electrification system loss factor is likely to be lower than the 22.5% median of the 10% to 35% range currently identified by Network Rail.

It is also noted that there are currently no direct incentives on Network Rail, as Network Manager, to improve or even consider these losses in its Asset Management activities. Network Rail has, however, been positive in its approach to regenerative braking, which can also provide significant energy efficiencies.

Although the magnitude and accuracy of electrification system losses was found to be important for train operators' business cases for meter fitting during the transition phase, particularly for DC operators, it was also established that they will never be 100% accurate and an end of year reconciliation of the energy costs will still be required in the long-term.

The key recommendations identified in this review are:

- 1) Network Rail should propose and technically justify an estimated annual % electrification system loss factor for each major traction type for each ESTA (Electricity Supply Tariff Area), or appropriate ESTA groupings during the transition phase, with specified confidence limits by April 2011. This should be based on modelling work completed to date, the results of the trials currently being undertaken and should be cognisant of any short-term technically and economically viable improvements in efficient network management achieved in accordance with Recommendation 2) below.
- 2) Network Rail should revise relevant electrification fixed equipment asset policies to include a requirement for the consideration of industry wide electrification system efficiency in all

aspects of electrification system maintenance, renewals, enhancements and new works, and in the manner in which electrification systems are managed and operated. The practice should be implemented immediately and the revised policies should be in place by April 2011.

- 3) Starting immediately, Network Rail should identify or establish an appropriate forum to work more closely with the wider industry to identify and progress efficiency improvement options. This should include ensuring full transparency of relevant cost-benefit analyses and any relevant technical, economic and risk factors.
- 4) Network Rail should be incentivised from CP5 onwards to consistently reduce AC and DC annual ESTA % electrification system loss factors via one of the following options:
 - a. An Ofgem 'style' allowable losses threshold for each ESTA with appropriate pain/gain regulatory mechanisms for not achieving or exceeding the threshold; or
 - b. Network Rail being responsible for all or a portion of the losses costs identified.

Note 1: These reductions should be based on real increases in infrastructure efficiency, not on a reduction in losses bought about by train operator efficiencies, achieved by improved driving styles, depot management, etc.

Note 2: If option a. is utilised, the allowable losses threshold should be managed to ensure Network Rail moves towards challenging electrical efficiency targets whilst assuring no impact on other business deliverables.

- 5) Network Rail should formally document a plan to implement appropriate metering for all non-traction uses of the AC and DC electrification systems by January 2011. The metering implementation should be complete by April 2013.
- 6) Network Rail should revise the timetable planning process for all traffic to include a requirement for the consideration of energy consumption and should propose, by April 2011, a date from which the revised process will be completed and the practice implemented. This work should be cognisant of the Next Generation Traffic Management work commissioned by the cross-industry Technical Strategy Advisory Group, which will consider energy efficiency timetabling.
- 7) Appropriate end-of-year 'wash-up' processes should be retained during the transition period and in the longer term to ensure that all costs are accounted for and allocated appropriately and fairly between users.

- 8) There should be only one date per year when train operators can opt to start to be billed for traction energy consumption based on train metering rather than on modelling, nominally 1st April each year.
- 9) Train operators, including freight operators, should be further incentivised to install on-board energy metering on all electric trains when this is permissible under the regulatory and contractual regime. This could consist of one or both of the following options:
 - a. Further funding, in addition to the existing Network Rail fund to provide approximately £4k per unit, to normalise the installation costs of train meters; and / or
 - b. Penalty mechanisms for non-fitment of meters by an agreed date.
- 10) Future train operator franchise arrangements should set and monitor consistently reducing normalised energy consumption targets for train operators whilst maintaining timetable requirements.

Note 1: These reductions should be based on real increases in operating efficiency, not on a reduction in consumption bought about by increased journey times, reduced passenger loading, etc.

AMCL would like to take this opportunity to thank the industry stakeholders who have contributed to this study.

Appendix A: Glossary of Abbreviations

Abbreviation/Acronym	Description
AC	Alternating Current
AMCL	Asset Management Consulting Limited
ASC	Aluminium/Steel Conductor Rail
ATOC	Association of Train Operating Companies
CCR	Composite Conductor Rail
COTS	Commercial of the Shelf
CP4	Control Period 4
DC	Direct Current
DfT	Department for Transport
DNO	Distribution Network Operator
DPCR5	Distribution Price Control Review 5
EC4T	Electric Current for Traction
ERESS	European Railway Energy Settlement System
ESI	Electricity Supply Industry
ESTA	Electricity Supply Tariff Area
GB	Great Britain
GRP	Glass Reinforced Plastic
LUL	London Underground Limited
NPV	Net Present Value
NG	National Grid
Ofgem	Office of Gas and Electricity Market
ORR	Office of Rail Regulation
PABS	Passenger Access Billing System
TAA	Track Access Agreement(s)
TABS	Train Access Billing System
TMS	Train Management System
tph	Trains Per Hour
TPH	Track Paralleling Hut
TRATIM	Train Timing Model System
WCML	West Coast Main Line

Table 1 Glossary