Long Term Passenger Rolling Stock Strategy for the Rail Industry

February 2014

This Long Term Passenger Rolling Stock Strategy has been produced by a Steering Group chaired by Richard Brown, and comprising senior representatives of:

- Angel Trains
- ATOC Engineering Council
- Eversholt Rail Group
- Network Rail
- Porterbrook Leasing
- Rail Delivery Group Executive Team
- Train Operating Company Owner Groups

Evolution of Type D and E EMU design and development: A BR-procured Merseyrail class 508 of 1979; an Alstom SWT class 458/5 'Juniper' of 1998, recently re-configured from 4-car to 5-car length; and a Siemens class 700 'Desiro City' to be introduced on the Thameslink routes from 2015

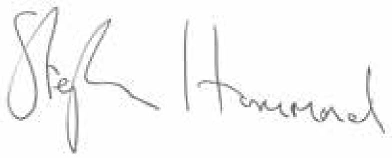
Foreword by Stephen Hammond MP, Parliamentary Under Secretary of State for Transport

I would like to thank the rail industry for developing this second Long Term Passenger Rolling Stock Strategy, which highlights possible future rolling stock requirements. Our railways are a success story with increasing levels of passenger demand. To meet that demand we are investing record amounts into transforming our railways, including £12 billion to electrify and upgrade the network and a further £5 billion for new rolling stock on the Great Western, East Coast, Thameslink, Crossrail and other routes.

This strategy will help industry partners understand the long term implications of these investments. It has already been warmly welcomed by train builders and their suppliers, and will provide a valuable resource for the recently established Rail Supply Group.

The new generation of rolling stock, when delivered, will allow the existing stock to be made available to train operators, which will lead to more choice about how they resource their train services than at any time in the last 20 years. In addition to this, we are overhauling our franchising process and have published a long term franchising schedule. In assessing new franchise bids we are giving greater credit to committed quality enhancements offered by bidders and will actively seek market recommendations on new rolling stock and refurbishments. We recognise that a successful franchising programme is essential for the delivery of the rolling stock strategy, and will ensure value for money for passengers and taxpayers.

The strategy is right to note the pressures faced by the Department for Transport regarding railway operating costs, including subsidies and grants paid to train operating companies and Network Rail. However, I am confident that with continued strong partnership working between the Department and industry we can meet these challenges and ensure that our massive programme of rail improvements remains on course.



Stephen Hammond MP

Contents

This report is structured as follows:

A BR-procured Northern Rail Type A class 144 ‘Pacer’ DMU of 1986

Executive Summary

This report updates the Long Term Passenger Rolling Stock Strategy (RSS), first published in February 2013. Like its predecessor it sets out a range of forecasts for the likely size and mix of the national rolling stock fleet to accommodate future passenger numbers over a 30-year timeframe. It assumes Government's commitment in principle to continue to invest in expanding, enhancing and electrifying the national railway network. Around £12 billion is being invested in such enhancements in the five years to April 2019 (Control Period 5 (CP5)). The RSS is firmly linked into the rail industry's Long Term Planning Process, and has been welcomed by train builders, rolling stock owners and their suppliers.

Government policy is that rolling stock procurement should, other than in exceptional cases, be franchise-led and the RSS fully supports this principle. The re-shaping of the franchising programme in March 2013 has offered the opportunity to put this approach into action, but in the short term this has been affected by the need to let short contracts to some existing franchisees, and by limitations on DfT's operating expenditure budget. Against this background, the analysis undertaken for the February 2013 RSS has been reviewed and rolled forward. The long term conclusions are largely unchanged, being demand-led. Passenger growth across all market segments continues and it is necessary to expand the rolling stock fleet to address crowding. It is important that short term factors do not adversely affect long term value for money. A constructive dialogue has been established with Government on these issues.

The total passenger fleet is forecast to grow by between 53% and 99% over the next 30 years, and the proportion that will use electric traction is forecast to rise from 69% today to over 90% in all scenarios. These scenarios indicate that between 13,000 and 19,000 new electric vehicles will be required over this period. Electrification will in many cases permit longer trains, and will enable diesel trains to be transferred to non-electrified routes, where growth has been constrained by lack of sufficient vehicles. These changes will produce significant benefits for the national economy, local communities and the environment.

The updated analysis has given greater focus to fleet requirements in the next five to ten years. The central forecast of the RSS indicates that around 3,050 new electric vehicles (for England, Wales and Scotland, including TfL's rail concessions) will be delivered in CP5, over 80% of which have already been ordered. This includes around 2,250 for three major projects – the new intercity Super Express trains, and the trains for the Thameslink and the Crossrail projects - which are being procured by the public sector. The forecast of 3,050 new vehicles represents a capital cost of more than £5 billion, and requires an average build rate of 12 vehicles per week. This compares with an average of just four vehicles per week in the current five years to April 2014 (CP4).

The total net increase in fleet size is forecast to be lower in CP6 (2019 to 2024) than in CP5, following completion of the major projects listed above. Britain's rail industry and its suppliers have several times experienced large fluctuations of demand for new vehicles, and it is important that this is avoided so far as possible in future if the confidence of investors and the supply chain is to be increased. This would be helped by early Government commitment to a specific programme of electrification in CP6. Life extension of existing vehicles will be a major feature of both CP5 and CP6.

The modelling of scenarios for electrification and growth produces a reduction in rolling stock unit costs of more than 30% in all scenarios. The Rail Delivery Group (RDG) is assessing the potential for additional short-term savings that can be achieved in CP5. The RSS also contains new information relating to standardisation and to depot requirements, and high level timeline charts showing the linkages between infrastructure enhancements, rolling stock requirements, and franchising timescales.

A. Introduction – Goals and Scope

1. This report updates the Long Term Passenger Rolling Stock Strategy (RSS), first published in February 2013. The earlier document marked the first time since privatisation that the industry had committed to develop a collaborative, industry-led strategy for passenger rolling stock. It was also the first time that the long term rolling stock implications of growth, electrification, HS2 and other major projects had been modelled and considered together. The work was and is being led by a Steering Group (RSSSG) comprising senior representatives of Train Operating Company (TOC) Owner Groups, Network Rail and the three principal rolling stock owners (ROSCOs), all of whom jointly have funded the work, together with members of the recently-created RDG executive team. RSSSG is chaired by Richard Brown. The Department for Transport (DfT) has attended meetings of RSSSG as an observer.

2. The need for a high-level, long term RSS as a way of helping to forecast future requirements for fleet size and composition was originally articulated by the Association of Train Operating Companies (ATOC) in its discussion paper 'Rolling Stock and Value for Money' published in December 2011. That paper set out a number of proposals for delivering better value for money from rolling stock and was welcomed in the March 2012 Government Command Paper 'Reforming our Railways'. Among the recommendations of the Command Paper were that putting train operators (TOCs) and ROSCOs, rather than DfT, in the lead for planning and delivering rolling stock through a market-based approach is the best way forward, and that development of a long term RSS would help shape expectations, giving more visibility to the supply chain, and thereby achieving long term, whole-system benefits. RSSSG has been encouraged by ministerial endorsement of this approach.

3. The fundamental aim of the RSS is as follows:

Set out the dimensions of industry-wide rolling stock requirements over a 30-year horizon in the context of growth, committed and likely network developments and the direction of government policy, without imposing constraints on the market to deliver appropriate solutions.

A key objective of the Strategy must be to promote better value for money from the rail industry. The Strategy should therefore as a minimum indicate the manner in which it might reduce not only rolling stock unit costs and wider industry costs, but also increase train capacity, route capacity and industry revenues.

4. The RSS is intended to add value by:
   - providing a backdrop for longer term planning, in particular by train builders and their suppliers, ROSCOs, and Network Rail;
   - identifying opportunities to smooth peaks and troughs of workload;
   - highlighting priorities for further Value for Money (VfM) work;
   - facilitating a whole-system approach to strategy, bringing together infrastructure, demand growth, train services and fleet scenarios; and
   - assisting investors to understand the longer term prospects and opportunities for the industry.

5. The approach behind the RSS has been to work from the perspective of long term peak period passenger demand and its implications for each TOC and for different types of rolling stock. This in turn has enabled RSSSG to develop a number of scenarios for future fleet size. The emerging work has been discussed regularly with the train builders that are members of the Rail Industry Association (RIA), and this is continuing. It has also fed into the Industry Strategic Business Plans (ISBPs), published in January 2013, and links to the industry's Long Term Planning Process (LTPP), which will review the infrastructure and service implications of the factors outlined in this report. The combination of this RSS and the LTPP work – together with HS2's plans for a new North-South Y-shaped high speed rail network - will provide the overall picture for rail development over the next thirty years.

6. Since publication of the first RSS the Steering Group has reviewed and updated the initial work by:
   - considering the implications of the recent changes to the franchising programme and the DfT's role in negotiating franchise extensions in the form of Single Tender Actions (STAs) with incumbent TOCs (see Section B below);
   - updating and rolling forward the forecasts for the size and composition of the national passenger fleet, now covering the period 2013 to 2043, in the light of forecasts of peak passenger demand over 10 years and 30 years as included in the Market Studies published by Network Rail in October 2013 (see Sections D, G and H below);
   - considering how standardisation of rolling stock, subsystems and/or their key outputs can help to optimise route capacity and provide other benefits (see Section I below); and
   - producing a high level estimate of incremental depot and berthing requirements that will be required over 10-year and 30-year horizons, as an input to the industry's Long Term Planning Process (see Section J below).

Chiltern Railways diesel trains: A BR-procured Type A class 165 'Network Turbo' DMU of 1991, and an Alstom/General Motors Type B Class 67 locomotive of 1999

B. Impact of Changes to the Franchising Programme

7. In the first RSS published in February 2013, RSSSG set out the key principles which should apply with regard to the provision of rolling stock. Alongside government's important role in setting out the strategic direction and the desired outcomes, these were that:
   - the franchising model is the best mechanism to deliver value for money rail services;
   - rolling stock provision should be the result of market-driven solutions, procured in a competitive environment; and
   - optimisation of the whole-life, whole-system costs and benefits of rolling stock must be achieved.

8. We were encouraged by ministerial endorsement of the RSS, reflecting previous support for the broad approach set out in the March 2012 Command Paper. Since then there has been limited opportunity to put the principles into practice, notwithstanding the re-shaping of the franchising programme in March 2013 following the cancellation of the West Coast franchise competition.

9. Two of the three franchises currently being let in England and Wales are heavily shaped by the large centrally-procured contracts for Intercity Express Programme (IEP) and the trains for the Thameslink project respectively. The scope for adopting the above principles has been further curtailed by the DfT's need to negotiate STAs with some existing franchisees, limitations on the DfT's operating expenditure budget, and the need for the DfT to rebuild its resources, staff numbers and capabilities. The start dates of all planned new franchises, new concessions and STAs are shown in the Timelines in Appendices 1 to 3 of this RSS.

10. Against this background, the analysis undertaken for the February 2013 RSS has been reviewed and rolled forward. Despite the factors highlighted above, the long term conclusions about the size and composition of the fleet are largely unchanged, being demand-led and based on a range of assumptions and scenarios for growth in peak passenger demand and for future railway electrification.

11. While we recognise the short term pressures currently faced by the Department, we believe the principles of our approach still hold true and that it is important to mitigate the risks which those pressures pose to securing long term value for money.

12. In particular, care must be taken that:
    - guidance from DfT is not interpreted as, nor does it become (however inadvertently), the specification of inputs;
    - short term savings in rolling stock costs to meet budget constraints over the next 2-3 years are not made at the expense of whole-life, whole-system value. (For example, the business case for some enhancements such as re-tractioning for some older fleets will become progressively weaker, the longer that they are deferred); and
    - the need for short term action does not constrain competitive tension and innovation.

13. RSSSG has begun a constructive dialogue that has been initiated with the DfT on these issues. We look forward to seeing signals in the negotiation of STAs and future franchise Invitations to Tender of practical recognition by the DfT of the longer-term opportunities to secure value for money from rolling stock.

C. The Approach Adopted for the Strategy

14. Scenarios for fleet size have been modelled by five-yearly Control Period for the whole of the 'main line' passenger fleet including Scotland, LOROL, Crossrail, and HS2 but not the light rail, tram-train, LUL, or international fleets.

15. Each of the existing fleets has been categorised by one of seven generic types of train:
A. Shorter Distance Self-Powered (diesel, generally with 75 mph maximum speed);
B. Middle Distance Self-Powered (diesel, with 90/ 100 mph capability);
C. Long Distance Self-Powered (diesel, with 100/ 110/ 125 mph capability);
D. Shorter Distance Electric (generally with 75 mph maximum speed);
E. Middle Distance Electric (with 90/ 100/ 110 mph capability. Some future trains may require 115 or 125 mph capability);
F. Long Distance Electric (with 100/ 110/ 125/ 140 mph capability); and
G. Very High Speed (140 mph and above, for domestic services on HS1 and HS2).

16. Individual class numbers have not been used in the associated analysis. The RSS is not a 'cascade plan' for the deployment of rolling stock, nor is it in any way prescriptive. Consistent with RSSSG's support for market-based approaches, it is in no sense intended to constrain TOCs and funders from making the best possible decisions about rolling stock procurement, maintenance, enhancement, life extension and replacement based on thorough business case analysis at the time.

17. To develop these scenarios, we have started with expectations for growth in peak period passenger demand, using the long term forecasts contained in the 'Generation 2' Route Utilisation Strategies (RUSs) published by Network Rail in 2011. These forecasts are consistent with those in the recent Industry Strategic Business Plans (ISBPs). As outlined in Section D below, we have subsequently tested our projections using forecasts of peak passenger demand over ten years and 30 years as included in the Market Studies published by Network Rail in October 2013. We have then incorporated the effect of electrification scenarios by examining the various options listed in the 2009 Electrification RUS and prioritising them. To do this, we have drawn on the methodology used in that RUS and concentrated principally (but not solely) on those route sections where electrification would permit more efficient operation of passenger trains.

18. Using these inputs three composite scenarios have been defined and modelled as follows.
    - 'Low' - Low growth combined with a good level of capacity utilisation efficiency growth (this is the relationship between peak passenger demand growth and fleet size growth, see paragraphs 24 and 28 below) and a low level of future electrification.
    - 'Medium' - Medium growth combined with a medium level of capacity utilisation efficiency growth and a medium level of future electrification.
    - 'High' - High growth combined with a poor level of capacity utilisation efficiency growth and a high level of future electrification.

19. At the heart of the RSS, and facilitating its future updating, is a spreadsheet model. The RUS-based peak period passenger demand forecasts for growth and the selected electrification scenarios are route-specific, and these have been used to provide bottom-up inputs to the spreadsheet model using the existing franchise map for convenience (with the addition of Crossrail and HS2). For each TOC, the total fleet size has been determined for each of the three composite scenarios in the year 2043, and the implications for each of Control Periods CP5 to CP8 have then been determined by working backwards from that date.

20. These forecasts and scenarios for long term passenger growth, fleet utilisation efficiency growth and electrification cannot, of course, quantify unpredictable external factors (e.g. oil/energy shortages), or options for future government policy e.g. in relation to fares policy, investment in rail infrastructure, policies on crowding, road pricing etc. The RSS has taken some account of such uncertainties by developing the three composite scenarios and by treating the RSS as a living entity. The intention is that the RSS will be updated annually to reflect industry developments including the franchising programme and emerging government policy.

21. The electrification programmes considered and modelled are illustrative. Since publication of the first RSS in February 2013, Network Rail has commenced its refresh of the Electrification RUS that was published in 2009 - see Section E below - and has published more details of the CP5 programme through its draft Enhancements Delivery Plan.

22. The 2011 RUSs contain many route-specific infrastructure and timetable options for increasing capacity over the next 15-20 years, and the CP5 Strategic Business Plan, Thameslink, Crossrail and HS2 projects will provide additional capacity well beyond these timescales. On many routes it will be possible to lengthen trains or run more trains within the existing infrastructure. On others, schemes beyond those proposed for CP5 or included in the RUSs would be needed to provide sufficient paths, stations capacity and depots. The costs and benefits of such schemes have not been established. The industry's Long Term Planning Process, through successive HLOSs, Route Studies and franchise bids will address these issues progressively, route by route. Train operators, ROSCOs and Network Rail work through these processes to help find good value for money outcomes and develop an overall rail development strategy, mindful of the need to improve industry efficiency and to reduce total levels of subsidy. Further information about incremental infrastructure, maintenance depots and berthing capacity is contained in Section J below.

An Alstom FGW Type C class 180 'Adelante' DMU of 2000

D. Planning for Growth – Sources of the Assumptions Adopted

23. Total passenger miles grew by 102% in the 18 years between 1994 and 2012, an average compound rate per year of 4.0%. Even in the five years of lower economic growth after 2007, the average annual growth in passenger miles was 3.8%, significantly out-performing other transport modes in Great Britain and other railways in Europe. (See 'Growth and Prosperity' published by ATOC in July 2013). This indicates that the rail industry has successfully increased volumes through actions such as capacity improvement, marketing and new trains. This generates more revenue, which helps pay for the very substantial investment programme that the industry is undertaking in CP4 and CP5. The same opportunity exists in future to help pay for capacity investment.

24. To assess the implications for the number of vehicles needed in future, we have looked at the long term relationship between demand and passenger fleet size. The 102% increase in passenger miles to 2012 was achieved with an increase of just 11% in the total national passenger fleet size. This major increase in fleet utilisation efficiency since privatisation has resulted from the following factors:
    - replacement of Mark 1 EMUs and DMUs and Mark 2 coaching stock with sliding-door vehicles, which provided more capacity for peak period passengers;
    - introduction of trains with metro-style interiors for some inner suburban services south of the River Thames;
    - elimination of most locomotives and non-passenger carrying vehicles for the Virgin West Coast and CrossCountry TOCs (meaning that more of the train is available for carrying passengers);
    - achievement of higher levels of fleet availability, and of higher average train speeds on some routes;
    - introduction of automatic passenger load weighing and counting technology on many fleets (which has led to more efficient utilisation of rolling stock); and
    - achievement of higher off-peak load factors, through marketing, yield management and internet sales.

25. The RUS-based growth forecasting methodology adopted focuses primarily on route-specific peak period passenger volumes and peak capacity, since that is what determines strategic level planning of railway infrastructure, rolling stock and timetables.

26. The fleet size growth forecasts in the Medium scenario of the RSS are based directly on the route-specific forecasts of long term growth in peak period rail passenger demand that are included in the 2011 RUS documents, extrapolated to 2043. Our resulting forecasts of fleet size growth for individual routes in the Medium scenario range from +132% for the longer distance routes into London Paddington and +104% for the principal cities served by Northern Rail, to +23% for the routes served by Southeastern (excluding HS1). In the case of peak flows to and from London, the L&SE RUS methodology has the merit of taking account of present levels of peak crowding.

27. The Low and High growth forecasts represent a range of possible outcomes for future rolling stock capacity requirements. For all routes, these Low and High forecasts of future fleet capacity have been modelled as 0.7 and 1.3 respectively (i.e. ± 30%) of the Medium forecast of the required fleet capacity in 2043, this being judged to be a reasonable range of likely outcomes making allowance both for uncertainties in future peak growth and in future capacity utilisation efficiencies.

28. Growth in peak demand of higher than the Medium case may occur, as each additional (presently uncommitted) future route enhancement or service enhancement may well itself produce some additional peak period growth leading to fleet growth. Conversely, the franchise bidding process can unlock opportunities to improve capacity utilisation further (for example through further improvements in fleet availability or fleet utilisation). This would be facilitated by flexibility in franchise specifications and change mechanisms in franchise contracts, and by TOCs continuing to adopt and improve the range of ideas listed in paragraph 24 above. The easiest of such opportunities have already been implemented, but more can be achieved through the effective specification and management of franchises. This can be facilitated by:
- continuing improvements in timetable patterns;
- introduction of more vehicles with 'metro'-style interiors for short-distance services for which the DfT has for some time permitted higher levels of standing, coupled with greater route-specific flexibility in franchise specifications regarding standing in peak periods for middle distance services;
- introduction of new industry-wide metrics for and benchmarking of peak capacity utilisation, as an aid to effective management of capacity;
- changing the profile of peak demand; and
- replacement over time of many or most of the remaining trains formed of Mark 3 and Mark 4 rolling stock which have non-passenger carrying vehicles (locomotives, power cars and driving trailer vehicles).

29. Network Rail published three new Market Studies in October 2013, for the L&SE, Long-Distance and Regional Urban markets respectively which are being fed into the LTPP.

30. These are of interest in that:
- they provide forecasts of peak passenger demand by main route (and for the principal regional cities) in 2023 and 2043, whereas the previous 2011 RUS documents covered a period of around 20 years only; and
- they incorporate four alternative composite long term demand scenarios comprising a wide range of macro-economic and micro-economic factors, demographics, 'consumer tastes', and 'the supply of travel opportunities'.

31. The demand forecasting methodology used in the Market Studies is very close to that used in the 2011 RUS documents. We have checked the 30-year forecasts contained in the Market Studies and have identified a high degree of consistency with the national fleet size forecasts for 2043 as published in Table 3 of this RSS.

32. Useful new data is provided in the Market Studies in the form of 10-year forecasts for peak passenger demand growth for all of the principal routes to London, for ten regional cities in England and Wales, and for all-day flows between pairs of 13 British cities. The degree of overall correlation with the RSS Table 3 figures for fleet sizes in 2024 is again good. This has provided a stronger 10-year focus on future fleet sizes, as described in Sections G and H below.

33. We have also included estimates of fleet requirements for HS2 based on publicly available information from HS2 Ltd and a discussion with them about options for growth after initial service introduction. We have adopted a range of assumptions in the three scenarios for the rolling stock volumes that will be required to operate high speed and intermediate services on the existing long-distance routes after capacity has been released by HS2.

E. Electrification – Prioritisation and Analysis

34. As outlined in this RSS, route electrification offers major new opportunities to reduce unit costs of rolling stock operation and to provide additional capacity and environmental benefits as the network progressively shifts from relying heavily on diesel trains on many of the nation's principal long-distance and commuter routes to one in which diesels are in future used only on the more lightly used secondary routes.

35. The present total national Network Rail track mileage is 19,309 single track miles (excluding depots and sidings, referred to in this RSS as 'track miles' - source Network Rail Annual Return 2013). Of this, 7,960 track miles (41%) are electrified and 11,349 track miles (59%) are non-electrified. With completion of the 1,900 track miles to be electrified in CP4 and CP5, 51% of total track miles will be electrified. The currently assumed completion dates for all of the committed electrification schemes are shown in the Timelines contained in Appendices 1 to 3, based on Network Rail's draft CP5 Enhancements Delivery Plan published in December 2013.

36. Although the DfT cannot yet commit to a rolling programme of electrification beyond CP5, the direction of government policy is to continue such a programme into CP6 and beyond. Views have been sought by the DfT on this in response to the 2012 High Level Output Specification (HLOS), who have suggested that the programme should include the Derby – Birmingham – Bristol route as well as freight connectivity in South Yorkshire and elsewhere. A joint Network Rail – DfT taskforce (also involving TOCs, local authorities and other parties) is to explore opportunities for further electrification in the North of England. Transport Scotland's CP5 HLOS already contains a specific objective of a rolling programme of electrification amounting to approximately 60 single track miles per annum, following the completion of the Edinburgh to Glasgow Improvements Programme (EGIP) electrification.

37. The 2009 Electrification RUS listed 131 route sections as candidates for future electrification. Each route was rated by Network Rail in the RUS in relation to four separate criteria.
A. Facilitating efficient operation of passenger services.
B. Facilitating efficient operation of freight services.
C. Providing diversionary routes for electric trains.
D. Facilitating new electrified passenger services.

38. For ranking in terms of ability to facilitate efficient operation of passenger services, Network Rail calculated a metric for each route section of the total number of annual passenger vehicle-miles which might be converted from diesel to electric operation, divided by the number of track miles requiring electrification in that route section (with a higher number indicating a probable better case in that the cost of electrification does not greatly increase with usage of the route).

39. Taking account of this data, and the extent to which electrification would release good mid-life diesel units to increase capacity where needed on other non-electrified routes, and also taking some regard of the other ranking factors in paragraph 37 above, we have produced an indicative ranking of route sections that might be electrified in CP6 and beyond (subject to business case development, affordability and negotiation of satisfactory commercial terms).

40. Low, Medium and High scenarios for electrification have been constructed as shown in Table 1 below. This is a strategic view only, designed to give a potential sense of scale for the electrification programme beyond CP5. The timing and phasing of electrification of individual routes are clearly subject to further refinement. The scoping of electrification schemes provides a pool of possible projects from which a long term rolling programme could be constructed.

This RSS is intended to illustrate and quantify the implications which such a rolling programme might have for the national passenger rolling stock fleets.

Table 1 – Illustrative Electrification Scenarios (Track Miles that might be Electrified)

Control Period	Low	Medium	High
CP4 & CP5	1,900	1,900	1,900
CP6	2,100	2,100	2,100
CP7	0	1,800	1,800
CP8	0	0	1,100
TOTAL	**4,000**	**5,800**	**6,900**
% Electrified	**62%**	**71%**	**77%**

Source – Analysis based on data provided by Network Rail

41. The capital cost of the CP5 electrification programme is estimated to be in the region of £3.2 billion (source: ORR CP5 Final Determination), and it is likely that similar expenditure would be required in CP6 and CP7, to achieve the Medium scenario forecast, although no detailed costing work has yet been undertaken.

42. Conversion of DC-electrified routes to AC or to dual-voltage capability has not been included in the above table as this does not affect the total electrified mileage. There is one such scheme that will be evaluated by Network Rail in CP5, this being between Basingstoke and Southampton as part of the 'Electric Spine' route. Such conversion here or elsewhere, if and where there is a business case, is likely to lead to replacement of the existing BR-procured DC rolling stock and/or retrofit of existing post-privatisation EMUs. Given that examination of the business case for more widespread DC to AC conversion is still at an early stage, we have not made specific allowance for any replacement or modification of these fleets. Our analysis assumes that DC to AC conversion will not lead to an increase in total vehicle numbers beyond that which would be required for growth.

43. Since publication of the first RSS in February 2013, Network Rail has begun its refresh of the Electrification RUS published in 2009, with inputs from an industry-wide working group and from RSSSG. Network Rail is undertaking appraisals of the business case for electrification of many routes. All of the routes contained in our scenario modelling have been included in the Network Rail appraisals. We are still some way from the Government underwriting a specific electrification programme for England and Wales in CP6 and beyond, but the scenarios contained in our own modelling for the RSS are consistent with the direction of government policy. These scenarios have therefore not been changed from those used for the RSS published in February 2013, except that it has now been confirmed that Gospel Oak to Barking, Barnt Green to Bromsgrove and several other short route sections will be electrified in CP5.

A BR-procured East Coast Type F 'IC225' electric trainset of 1989

F. The Present Fleets and Future Capability Requirements

44. Details of the composition of all of the existing fleets (in use, rather than stored), and of committed changes to the end of CP4, are summarised in Table 2 below, using the definitions set out in paragraphs 14 and 15 above. The totals here and elsewhere in the RSS include both passenger-carrying and associated non-passenger carrying vehicles in passenger trains (the latter including locomotives, power cars and driving trailer vehicles). These are not rigid categorisations: it is possible that, for example, existing Long Distance DMUs cascaded from routes to be electrified could in some cases be used on services currently operated by Middle Distance DMUs if their operating characteristics are suitable and if there is a business case to do this.

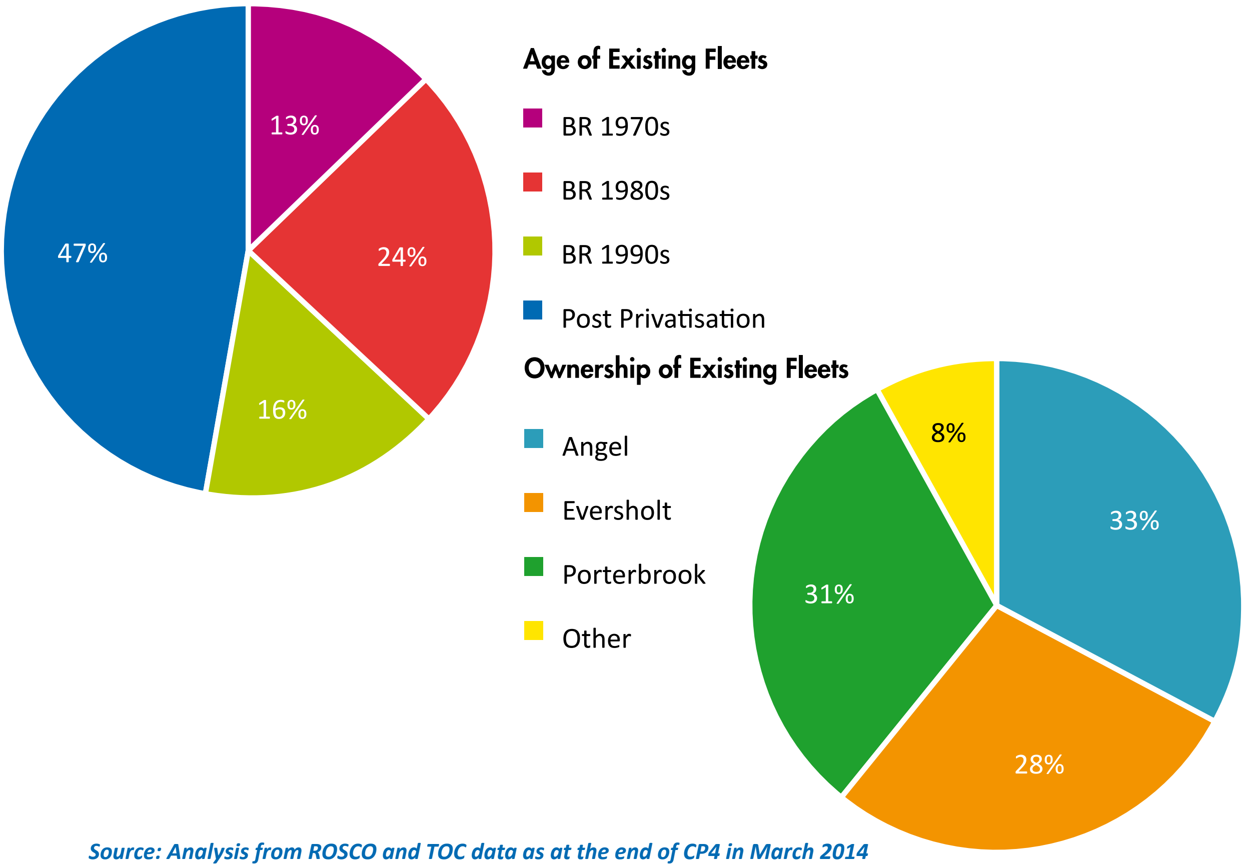
Table 2 – Present Fleet Composition (including Committed Changes to the End of CP4)

Generic Type	Total Vehicles, March 2014
A. Shorter Distance Self-Powered (diesel, generally with 75 mph maximum speed);	1,055
B. Middle Distance Self-Powered (diesel, with 90/ 100 mph capability);	1,348
C. Long Distance Self-Powered (diesel, with 100/ 110/ 125 mph capability);	1,493
D. Shorter Distance Electric (generally with 75 mph maximum speed);	2,336
E. Middle Distance Electric (with 90/ 100/ 110/ 115/ 125 mph capability);	5,098
F. Long Distance Electric (with 100/ 110/ 125/ 140 mph capability);	1,143
G. Very High Speed Electric (140 mph and above, for domestic services on HS1 and HS2).	174
TOTALS	**12,647**

Source: Analysis from ROSCO and ATOC data as at the end of CP4 in March 2014

45. Figure 1 overleaf shows that, of the 12,647 vehicles:
- 5,988 (47%) have been built since privatisation, and the remaining 6,659 (53%) during the BR era prior 1994; and
- 966 (8%) are owned by parties other than the three ROSCOs (e.g Voyager Leasing), principally in categories C, D and E.

Figure 1 Present Age and Ownership of the National Passenger Rolling Stock Fleet



Source: Analysis from ROSCO and TOC data as at the end of CP4 in March 2014

46. For the future, 'Self-Powered' units will include any type of train which cannot collect electrical power when in motion, from an overhead or third rail source. This may include classic diesel-powered units and also 'hybrid' units incorporating an internal combustion engine or fuel cell with some form of electrical or mechanical energy storage. 'Electric' units include not only straight-electric but also 'bi-mode' trains (such as Hitachi's IEP Trains) which can both collect power when in motion from an overhead or third rail source, and also generate power from an on-board source. Some electric units may in future include some form of electricity storage for operation away from overhead or third rail power sources, subject to a satisfactory business case and continuing development of power storage technology.

47. It is widely expected that present and future EU legislation regarding emissions from diesel engines (Directive 97/68/EC and its subsequent amendments, implemented in Great Britain as the Non-Road Mobile Machinery (Emission of Gaseous and Particulate Pollutants) Regulations 1999 and 2013, known as NRMM) will increasingly make it difficult to procure and operate new DMUs having underfloor diesel engines, with an affordable business case. Indeed, EU consultation on further tightening of the rules is now underway. Our present understanding of the associated issues is as follows.
   - Existing EU and UK legislation does not prevent the continued operation of any of the present British DMU fleets, thanks to an amendment agreed in 2011.
   - None of the present British DMU fleets are at any risk of being unable to operate as a result of non-availability of diesel engines or spare parts for diesel engines.
   - Legislation prevents any more engines of the present types being manufactured for these fleets, but engine components can be manufactured and in addition a float of additional spare engines will become available for the older DMUs when electrification starts to reduce the size of these fleets over the next ten years.
   - The NRMM 2013 Directive contains an Extended Flexibility Scheme which allows engines on existing trains to be replaced with new Stage IIIA compliant engines (rather than with the

later standard Stage IIIB compliant engines). The only Stage IIIA compliant engine currently fitted to a British DMU is the MTU 1800 series engine fitted to the Class 172 DMUs built by Bombardier in 2010-11. No TOC or ROSCO has to date needed to consider whether this or any other Stage IIIA compliant engine might one day have to be fitted to any existing British DMU.

- It is widely considered that it would be impossible to fit a Stage IIIB compliant engine of adequate power to any of the existing British DMU types.
- Further stages of EC emission legislation may one day prohibit the operation of pre-Stage IIIA or pre-Stage IIIB engines, and this might be the trigger for further electrification and/or for a relatively small build of new self-powered rolling stock (see paragraphs 54 and 55 below).

48. Some overlap is already occurring in the distinction between Categories E and F. On the south end of the West Coast Main Line, and on other principal electrified (and to be electrified) long distance main lines, maximum route capacity and revenues will most probably be achieved if high capacity, high performance electric trains (in some cases with a maximum speed of 110, 115 or 125 mph) are introduced for middle distance flows. There are trade offs to be made between track capacity and the capacity of individual trains. Trains with a top speed of more than 117 mph lose passenger capacity because of the EC's Technical Specification for Interoperability (TSI) requirements relating to passengers in the leading vehicles of higher speed trains. (See Sections I and J below).

A Siemens FTPE Type B class 185 'Desiro' DMU of 2005

G. Fleet Sizes and Compositions Calculated for each Scenario

49. As described in paragraph 18 above, the three growth and capacity utilisation scenarios have been combined with the three electrification scenarios to obtain three composite scenarios within the spreadsheet model, for each TOC, for each Control Period to 2043. The aggregated results are summarised in Table 3 on the next page.

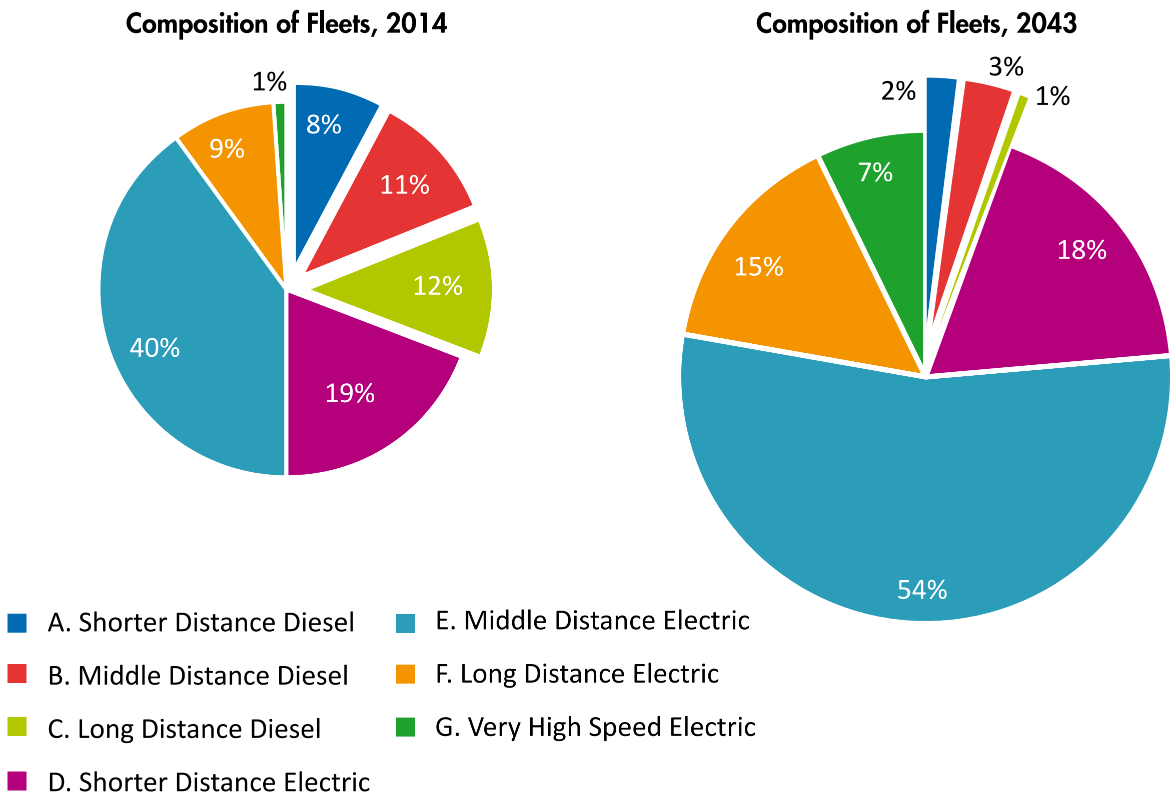
50. The key developments over 30 years highlighted in Table 3 are:
- total national passenger fleet, overall increase of 53-99%;
- electric fleets, rising from 69% of the national fleet today to 92-95%; and
- self-powered fleets, falling from 31% of the national fleet today to 5-8%.

51. It can be deduced that in the Low scenario, a minimum of 13,000 new electric vehicles would be required by 2043, from today's base position. This figure comprises the sum of:
- 9,000 which is the net increase in electric vehicles over 30 years, in the Low scenario; and
- 4,000 to replace most of the BR-procured electric fleets (all of which will be a minimum of 49 years old in 2043).

52. In the Medium and High scenarios, this minimum total of 13,000 new electric vehicles to be constructed by 2043 would rise to 16,000 and 19,000 respectively. This equates to a construction requirement for electric trains averaging approximately 8, 10 or 12 vehicles per week respectively in the three scenarios over 30 years. This would be a significant increase over the average rate of construction of new electric and diesel vehicles during CP4 of just 4 vehicles per week.

53. The projected changes in the size and composition of the national passenger fleet for the Medium Scenario are shown in Figure 2.

Figure 2 – Change in National Passenger Fleet Size and Composition (Medium Scenario)



Source: The figures are as in Table 3. The two circles are approximately to scale, with the reduction in the diesel fleets being shown highlighted.

Table 3 – Aggregated Results of Fleet Size Changes for the National Passenger Fleets to 2043 (Low, Medium and High Scenarios)

	Committed CP4	Forecast CP5 to 2019			Forecast CP6 to 2024			Forecast CP7 to 2029			Forecast CP8 to 2034			Forecast CP9/10 to 2043		
Sub-Group	Total Vehicles	Total Vehicles			Total Vehicles			Total Vehicles			Total Vehicles			Total Vehicles		
	March 2014	Low	Med.	High	Low	Med.	High	Low	Med.	High	Low	Med.	High	Low	Med.	High
A. Shorter Distance Diesel	1,055	768	779	794	527	516	512	514	484	467	503	457	392	488	422	337
B. Middle Distance Diesel	1,348	1,305	1,331	1,362	891	971	1,035	870	574	682	850	561	645	880	607	729
C. Long Distance Diesel	1,493	888	873	951	318	378	429	73	137	188	73	137	188	73	137	188
D. Shorter Distance Electric	2,336	3,079	3,144	3,267	3,212	3,289	3,576	3,324	3,460	3,941	3,559	3,764	4,060	3,677	3,930	4,282
E. Middle Distance Electric	5,098	6,070	6,325	6,516	7,464	7,945	8,395	8,173	9,185	9,898	8,952	10,323	11,492	9,893	11,774	13,432
F. Long Distance Electric & Bi-Mode	1,143	1,802	1,935	1,981	2,354	2,500	2,601	2,492	2,907	3,322	2,229	2,947	3,684	2,483	3,327	4,201
G. Very High Speed Electric	174	174	174	174	174	174	174	654	662	686	1,397	1,436	1,507	1,469	1,516	1,587
TOTALS	**12,647**	**14,086**	**14,561**	**15,045**	**14,940**	**15,774**	**16,722**	**16,100**	**17,408**	**19,183**	**17,563**	**19,625**	**21,968**	**18,964**	**21,713**	**24,756**
Effective Capacity Growth on Period 6 2013/14	2%	13%	17%	21%	20%	27%	35%	30%	40%	55%	41%	58%	77%	53%	75%	99%
Diesel Totals	3,896	2,961	2,983	3,107	1,735	1,866	1,976	1,457	1,195	1,337	1,426	1,155	1,225	1,441	1,166	1,254
Electric & Bi-Mode Totals	8,751	11,125	11,578	11,938	13,204	13,908	14,746	14,643	16,213	17,846	16,137	18,470	20,743	17,523	20,548	23,502
Electric & Bi-Mode %	69%	79%	80%	79%	88%	88%	88%	91%	93%	93%	92%	94%	94%	92%	95%	95%

Source: Analysis using TOC-specific and route-specific peak period growth forecasts and illustrative electrification scenarios as described in this RSS.

54. Electrification will produce a steady flow of mid-life DMUs for use on non-electrified routes, (subject to commercial terms). Based on the electrification scenarios in this RSS and the figures in Table 3 it can be assumed that there will be no requirement for any new diesel or other self-powered rolling stock on a significant scale unless or until hybrid technology matures and the business case becomes sufficiently strong, or until such time as new environmental legislation makes the operation of the present diesel-engined vehicles non-viable (see paragraph 47 above). Small orders of growth stock as part of franchise bids remain possible.

55. All of the Type A short-distance DMUs and many of the Type B DMUs were procured by British Rail between 1985 and 1992. It can be expected that all or most of these will have been withdrawn by 2043, all being more than 50 years old at this time. A total of 1,350 Type B and Type C diesel vehicles have been built since privatisation, these being built between 1997 and 2011. Most of these could still be operating in 2043, if environmental legislation and the supply of engines permit this, and subject to adequate commercial leasing terms. Based on the figures in Table 3, a total of between 1,150 and 1,450 self-powered vehicles will be required in 2043. It is possible therefore that no more than 100 new self-powered vehicles may be required to be built in the 30 years to 2043. Alternatively if environmental legislation were to be strengthened, then up to 1,500 new self-powered vehicles may be required. This is a small figure compared with the 13,000 to 19,000 new electric vehicles forecast to be required over this period. The self-powered totals shown could potentially include some diesel or bi-mode locomotives to haul electric trains beyond the limits of electrification on some routes. More generally, should for whatever reason the electrification programme in CP6, CP7 and CP8 not advance as fast or as extensively as assumed in paragraph 40 above, then a higher number of new diesels may be needed to cater for growth on non-electrified routes

56. RSSSG has been actively engaged with the RIA and with the train builders and other suppliers who are members of the RIA during the development of this strategy. The implications of the RSS for the manufacturing and maintenance communities are clear and either directly or indirectly should have a positive impact. The involvement of all parties in these discussions has been extremely constructive, sharing key data and emphasising the most beneficial direction of travel for UK rail. This approach has developed RSSSG's thinking, further demonstrating the value of collaborative working.

57. The train builders have emphasised that the short, medium and long term forecasts stretching out 30 years which are provided in the RSS, far from being of merely theoretical interest, are of great value to their future business strategies, and have in specific cases been discussed in some detail with their parent companies. There is agreement between all parties that the regular meetings with RSSSG members should continue. As the role of the recently established Rail Supply Group becomes clear, RSSSG members will develop a similar relationship with this body.

58. The train builders and RIA have emphasised their firm belief that:
- the procurement of new rolling stock is normally best undertaken by TOCs with ROSCOs;
- the ROSCOs' role is crucially importance for addressing residual value;
- procurement decisions should be based on optimisation of whole-system life-cycle value ;
- procurement evaluation criteria and weighting for rolling stock investments must be transparent and proportionate;
- DfT's approach to deliverability is important e.g. for 'new' vs 'life extended' rolling stock decisions, and in franchise bid evaluation;
- batch sizes and continuity of 'beat rates' (i.e. the rate of production) for new rolling stock have major impacts on build efficiency, cost and ability to innovate; and

- full service maintenance provision by the manufacturer can in their view produce a better train, but typically needs a maintenance contract period of around 10 years to justify the investment required.

Type E EMUs: A Bombardier Southern class 377/6 'Electrostar' of 2013, and a Siemens ScotRail class 380 'Desiro' of 2009

H. Rolling Stock Requirements in the Next Ten Years

59. For this update of the RSS, we felt it important in particular to review the impact of our assumptions for the fleet over the next two Control Periods (CP5 and CP6), covering ten years. RSSSG had already checked its fleet size forecasts derived for 2019 for consistency with work done on rolling stock specifically, as an input to the Industry Strategic Business Plan (ISBP) for CP5 which was published in January 2013.

60. Section 5.2.6 of the ISBP for England & Wales (but containing in this instance rolling stock data for Scotland also) stated that the total of new vehicles in CP5 could be "up to 4,150", including a nominal 2,400 vehicles for Thameslink, Crossrail and IEP. The figure was expressed in this way to reflect a range of potential options, depending on which routes might best be able to make the business case for new vehicles as opposed to cascaded vehicles, and/or around the strength of the business case for enhancement or life extension of existing and cascaded vehicles.

61. RSSSG has continued to review the emerging intelligence on such business cases. The ISBP forecast of up to 4,150 new vehicles to be delivered in CP5 is still consistent with the High scenario of Table 3 of this RSS, but this figure should be looked at as very much an upside case in terms of the number of existing electric vehicles to be replaced by new electric vehicles in CP5 given the likely relative attractiveness of continued operation and life extension of existing vehicles.

62. It is now known that the following will occur beyond the end of CP5, rather than during CP5.
    - Completion of deliveries of the Crossrail fleet will occur in the early months of CP6 because full implementation of the Crossrail timetable will not occur until December 2019.
    - The East Coast phase 2 IEP trains will be delivered in the first year of CP6.
    - Full implementation of electrification of the MML is now proposed by Network Rail for December 2020.

    Our updated central forecast for fleet sizes at the end of CP5 indicates that approximately 800 new EMU vehicles will be required in CP5 (for England, Wales and Scotland, and including TfL's rail concessions), in addition to the orders for the Thameslink, Crossrail and IEP projects. Orders have already been placed for 210 of this total of 800 vehicles. This represents a total requirement of around 3,050 new vehicles in CP5, assuming that 2,250 will be delivered for the three major projects. This is a very large requirement for new vehicles in a single five-year period. The forecast delivery dates of committed rolling stock orders (and of some other fleet requirements) in CP5 and early CP6 are shown in the Timelines contained in Appendices 1 to 3 of this RSS.

63. The numbers of new electric vehicles required (in addition to those for the three major projects) could be further increased beyond those noted in paragraph 62 if the costs and capabilities of new electric trains can justify replacement of older electric trains. Conversely the total could be lower if the DfT's short term affordability constraints were to dominate procurement decisions. None of the present electric fleets has a fixed or absolute technical life. The ability of fleet owners to offer life extension and other enhancements to their TOC customers means that the TOCs will have a greater range of options for fleet expansion in the future than was the case in the past. New fleets will have the greatest advantages where they offer additional functionality and therefore greater overall value for money.

64. Our updated fleet size forecasts contained in Table 3 of this RSS show the 'Electric and Bi-mode' fleet totals increasing by between 2,100 and 2,800 over the course of CP6, in the three scenarios. This compares with an increase of between 2,400 and 3,200 over the course of CP5. It is not possible to predict how many older electric vehicles and electrically-hauled vehicles

will be permanently retired during these control periods, and also how many EMUs which may temporarily be off-lease at the end of 2019 may move back into operational use during CP6. Nevertheless, it appears highly likely on the basis of the assumptions contained in this analysis that the total number of new vehicles required to be delivered in CP6 will be less than in CP5.

65. The over-riding reason for this is that the Thameslink and Crossrail projects, and replacement of HSTs built in the 1970s, all represent major investments which had long gestation periods and are due to come to fruition in CP5. No similar rolling stock procurements of 600+ new vehicles are likely to occur in CP6. Even HS2 is forecast to require only around 500 new vehicles in CP7, with a further 700 to 800 in CP8.

66. This analysis illustrates that a completely steady new build programme for rolling stock is unlikely ever to occur. Further peaks in demand for new build vehicles will occur as a direct consequence of refranchising timescales, where decisions to procure new rolling stock will, in many cases, be triggered by franchise award. Nevertheless, the forward projections of rolling stock fleet sizes offered by the RSS, combined with an early commitment to a continuing programme of electrification, should provide a greater degree of predictability about orders for new electric vehicles beyond CP5. This can help manufacturers to optimise production capacity and associated costs.

67. Assuming that the current policy of a rolling electrification programme continues in CP6, the analysis suggests that no new diesel vehicles (or other self-powered vehicles) would be required to be built in either CP5 or CP6. Many older diesel vehicles would be withdrawn over this period, firstly those HSTs which are being replaced by IEP (although some might be used on other TOCs including open access operators), and then by 2024 around 500 (50%) of the shorter-distance Type A 75 mph DMUs procured by British Rail in the 1980s. This might include many of the Class 14x 'Pacer' vehicles which will be replaced by electrification in the North of England and in South Wales. There will be a smaller percentage reduction in the number of 90 mph and 100 mph Type B DMUs. These were built after 1989, and many of these will be redeployed to provide additional capacity on non-electrified routes.

Hitachi Type F class 800 electric and bi-mode 'Super Express Trains' to be introduced on the Great Western and East Coast routes from 2017

I. Standardisation Issues

68. RSSSG has discussed, at a strategic level, the potential advantages and drawbacks of increasing the degree of standardisation of trains and their subsystems in future. On the one hand, greater standardisation could potentially make it easier to move trains around the network at franchise re-let points, to achieve economies of scale in production, technical support and maintenance, to increase infrastructure cost efficiency and, potentially, to increase the number of suppliers of important train subsystems. On the other, it could inhibit technical innovation and significantly constrain the options open to bidders for franchises, which is an important means to promote efficiency. RSSSG's experience is that, in this area as well as others, the industry (working through the processes that it already has, such as the Systems Interface Committees) can effectively address many of the issues where the DfT might otherwise feel it needs to intervene, provided that the industry is left to operate and explore the full range of options itself.

69. There are number of areas in which the industry – mostly with suppliers and manufacturers - is working together, in the UK and at EU level, to address this issue as a means of improving value for money. These are described in the following paragraphs 70 to 76.

70. The **Vehicle/Vehicle Systems Interface Committee (V/V SIC),** on which the whole industry including suppliers is represented, has agreed a series of Key Technical Requirements for new rolling stock. These are distilled from experience of procuring new trains by TOCs and ROSCOs over the years and are a series of guidelines for those procuring new trains which the whole industry is expected to follow. Although, formally, they are not obligatory from a contractual or a standards perspective, they do form a valuable set of experience sharing and the industry, through the V/V SIC, has come together to endorse them.

71. A similar process has been used by the **Vehicle/Track Systems Interface Committee (V/T SIC)** to develop a better understanding of the interaction between train and track represented in the Vehicle Track Interaction Strategic Model (VTISM), which has been used to support a number of recent train procurements; and by the **Vehicle/Structures Systems Interface Committee (V/S SIC)** which is currently looking at options around standardised gauges and train-platform clearances.

72. It is not always recognised that the operation of the normal commercial process in franchising, train procurement and leasing that was set up at privatisation has, in practice, naturally led to the evolution of several families of train, most particularly:
    - Siemens' Desiro EMU (10% of the present national fleet, and still under construction);
    - Bombardier's Electrostar EMU (18% of the present national fleet, and still under construction); and
    - Bombardier's Turbostar DMU (4% of the present national fleet).

73. This has happened because, once a manufacturer has developed a train type and it has successfully been proved in service by achieving the high levels of safety and reliability required on the UK network, there are natural commercial advantages in ordering more of those train types rather than incur the expense and uncertainty of developing wholly new ones.

74. As route capacity has become more constrained, the **Route Planning Process** is playing an increasingly important role in setting expectations for the kind of rolling stock that should be used on busy routes. The process effectively sets high-level output requirements (e.g. for speed, acceleration, train length and door positions) for the rolling stock that might be deployed on each route, reflecting the fact that capacity on a route is maximised when the various train types that use it have similar path-occupancy characteristics. For example, the fast pair of tracks on the Great Western, West Coast, Midland and East Coast Main Line routes are now (or will be) used by modern electric trains operating at 125mph (or above), all with very rapid acceleration.

Similarly, on the dense commuter routes, assumptions about door positions and widths, as well as train acceleration/de-acceleration, underpin route plans to increase capacity, facilitate passenger access and egress from trains, and reduce crowding. In each case, de facto, an output 'standard' for the kind of train that can operate on each busy route is being defined and there is an opportunity to address this more strategically as the strategy for each route is developed over the next three years through the LTPP.

75. **European TSIs,** which apply to new vehicles and to significant modifications of existing ones, will progressively introduce standards that are designed to remove country-based technical differences to allow suppliers to achieve economies of scale and to make it easier to operate and move trains across international borders. This process may be further facilitated by the **Shift^{2}Rail** Joint Technology Initiative in which €450 million of EC funding will be matched by a similar sum from the rail industry for rail research and innovation in rolling stock, infrastructure, and traffic management and control systems. Alstom, Bombardier, Siemens and Network Rail are all founding members of Shift2Rail.

76. ATOC's policy document **'Rolling Stock and Value for Money',** published in December 2011 indicated that there may be opportunities to develop common interface approaches that the rail industry could, by way of guidance, use when procuring key subsystems such as train management and braking systems, although it left open how (if at all) these might be specified and enforced. These could be of particular benefit for train subsystems where there is currently little competition, as a means of expanding the number of suppliers. ATOC continues to participate in a Europe-wide project named 'Euro-spec' with this objective, under which a group of the major railways are developing output specifications for a number of systems and sub-systems in order to open up the market.

77. The industry is therefore investigating, and implementing, ways of making more use of standardisation where this can be done without inhibiting the normal commercial process of train procurement and leasing that RSSSG regards is the linchpin to improving overall cost effectiveness in rolling stock provision.

Bombardier CrossCountry Type B class 170 'Turbostar' DMU of 1998

J. Depot and Infrastructure Requirements

78. Plans for the additional maintenance depot capacity and berthing sites required for the large expansion of fleet sizes in CP5 are already well advanced.
    - Some new depots and berthing sites have already been constructed or adapted (e.g. Reading and Liverpool (Allerton) respectively).
    - The ORR has included a figure of £182 million for depot and stabling enhancements associated with electrification schemes in England and Wales, and £10 million for stabling at Motherwell in Scotland, in its final determination of Network Rail's funding requirements in CP5.
    - The new and reconfigured depots required for the large new Thameslink, Crossrail, and IEP (GW and ICEC) fleets are already designed and committed, and construction has in many cases begun.
    - The additional maintenance depot capacity that will be required for electrification and growth in Scotland will be delivered by the next franchisee; and options for depot and berthing capacity for EMUs in South Wales are being developed for the Welsh Government in discussion with the incumbent TOC and Network Rail.
    - Further work still needs to be done to appraise the optimum depot and berthing strategy for some of the routes to be electrified where there will be incumbent TOCs with STAs. Examples include the MML and NTPE routes.

79. The requirements for increases in depot and berthing capacity in CP5 will be compensated in part by the reduced servicing and maintenance requirements of electric trains compared with diesel trains, and in some cases of new or re-tractioned electric trains compared with older electric trains. The business case for re-tractioning of SWT's Class 455 trains was assisted by quantification of the benefits generated by reduced scheduled maintenance, and the resulting release of depot capacity for fleet enlargement. Furthermore, the new depots being built for the Crossrail and IEP fleets will release some capacity for future fleet size expansion at locations such as Ilford and Bristol St. Philip's Marsh.

80. On the basis that plans for berthing and maintenance of the large increases in fleet sizes to the end of CP5 are now largely committed, we have carried out a preliminary analysis of the requirements for additional berthing to the end of CP6 in 2024, and then to 2043, for each of the 10 devolved Network Rail Routes plus HS2. This is based on the TOC-specific and in some cases route-specific analysis which underpins the spreadsheet model for the RSS. It takes no account of spare berthing capacity which may exist at some locations today, by day or by night.

81. The overall increases from 2019 to 2024 and from 2019 to 2043 are around 10% and 50% respectively in the Medium scenario. Apart from HS2 (for which plans for berthing and new maintenance depots are already being developed), the largest percentage increases are in the LNW and Western Routes and in Scotland. The growth percentages are driven principally by the forecast high increases in passenger demand for regional services.

82. The absolute forecast increases in berthing required over the next 30 years for L&SE routes are also large, because these routes have large absolute fleet sizes. Depot and stabling capacity is already an issue in the London area and the scale of fleet expansion required to serve the South East means that it may be prudent to attempt a higher level strategic review of possible sites, for the next round of Route Studies. Some Network Rail-owned sites could be safeguarded for future depot and berthing uses in the longer-term, e.g. at Feltham. Conversely, there could be some opportunities to rationalise (or possibly build over) depot and berthing capacity in some locations, particularly close into London, given high land values.

83. A critical factor not considered in this high level analysis is the maximum length of trains to be stabled or maintained at existing locations and how this compares with the current capability. Increases in train length have a big impact on the siding space required and on alterations required to depots. Additionally, understanding the eventual maximum train length for a given route will enable trains and depots to be procured with provision from the outset for 'future proofing', e.g. a 5-car unit could be introduced with the capability of being extended to a 6-car easily, provided that the depots and berthing sites have passive provision for the longer trains. There have been past examples of train lengthening that have taken place or have been attempted that have incurred higher costs than necessary and where a depot's physical constraints have restricted the TOC's or maintainer's ability to achieve the optimal fleet availability and maintenance regime.

84. Furthermore, the need for safe working with 25kV EMUs will necessitate substantial modification to some existing DMU depots if these are to remain in use following electrification. In some locations it will be more cost-effective to construct a new depot on a new site.

85. Outside London, various large brownfield sites adjacent to railway lines (and often with present or past rail connections) exist outside railway ownership. Some of these could potentially be suitable for new depots or berthing locations. It is important that future depot planning addresses not only forecast growth and the shift toward more and longer electric trains, but also considers depots that are already known to pose significant operational constraints for one or more TOCs.

86. As regards who should provide new and manage new or existing maintenance depot sites, TOCs or manufacturers, there is no single correct answer, and both are likely to have a long term role going forward. Such decisions should be market-led rather than centrally-imposed.
    - Crossrail, Thameslink and IEP will increase the extent of manufacturer involvement.
    - Some TOCs who procure new fleets are likely to prefer to be largely responsible for maintenance themselves, especially where these are generic trains with limited technical risk.
    - Where a greater degree of innovation is offered with new fleets, some TOCs may prefer to involve the manufacturer in a medium-term or long term relationship.
    - In some cases, TOCs may choose to let a maintenance contract to the manufacturer, but with defined future break-points.

87. People issues are critical to the success of the railway industry, and this is certainly true for rolling stock maintenance issues. Short term franchises may not give sufficient incentive for TOCs to invest in recruitment, training and development of engineering staff at all levels, and there is a risk that STAs will compound this further if the risk is not fully understood and acted upon. The introduction of new fleet types, new technology, larger fleets and electrification must be accompanied by adequate long term investment to provide the skills necessary to underpin the required business results.

88. The National Skills Academy for Railway Engineering (NSARE) has an important role in helping to identify potential future gaps in engineering skills, and in developing new tools such as 'skills passports' to enable railway staff to work across the industry. There will also be a need for a more systematic approach to career development across the industry to ensure that sufficient numbers of high quality engineering managers are available with the leadership and technical skills required for future years. The Rail Systems Academy established by Siemens for the industry at Northampton is a positive step forward.

89. The scale of future additional berthing required for each devolved Network Rail Route is also indicative of the scale of infrastructure investments that will be required on each of the routes. This will be explored through the industry's LTPP over the next three years, and specifically through the next series of Route Studies, which potentially could identify solutions such as:

- longer trains, in particular (but not solely) where electrification occurs;
- increases in the number of trains per hour, produced by:
  - more homogeneity in the performance characteristics of rolling stock types on specific routes (see Section I above);
  - shorter headways between trains produced by changes to signalling, driver advisory systems, ERTMS, intelligent automated traffic management and centralised train control systems;
- incremental infrastructure – elimination of bottlenecks and provision of additional running lines; and
- totally new infrastructure.

90. Most of these solutions are already being adopted in the investment programmes now committed and being delivered for CP5. All funders have to face strategic options of affordability and value for money in their infrastructure investment programmes. The scale of growth anticipated in this RSS and outlined in the Network Rail Market Studies indicates the need not only for HS2 plus ongoing incremental investment in many routes, but potentially also for additional completely new infrastructure (e.g. the proposed 'Crossrail 2' scheme, and other major enhancements likely to include the GW Main Line and routes to the South Coast), where such investments may provide the only feasible solution, provided that they can demonstrate a robust long term business case.

Hitachi Southeastern Type G class 395 HS1 EMUs of 2006

K. Improving Value for Money from the Rolling Stock Fleets

91. In this Section K, the same costs and price levels have been used as in Section G of the RSS published in February 2013. New analysis is being undertaken as part of the refresh of the Electrification RUS (see Section E above and specifically paragraph 43).

92. According to the McNulty 'Rail Value for Money Study', the annual cost of maintenance and financing of rolling stock in the UK is £1.9 billion (at 2009/10 price levels), approximately 15% of total railway operating costs. The total cost of traction energy (electric power and diesel fuel) for the passenger TOCs has been estimated from ATOC data to be £0.55 billion. These costs totalling £2.45 billion p.a. are defined as Rolling Stock Related Base Costs in this Section.

93. The RSS will, as it develops, quantify many different kinds of opportunity by which costs can be reduced in the short term and over time. The RDG is currently reviewing various options by which rolling stock cost efficiency could be improved, initially during CP5.

94. The growth projections quantified in this RSS mean that a reduction in absolute costs is highly unlikely (given the likely increase in total fleet size), but taken together with the electrification scenarios there is significant scope to reduce unit costs for rolling stock, as outlined in this Section.

95. The requirement for subsidy per passenger-mile can be reduced through this combination of growth, electrification and other changes, provided that the electrification projects are prioritised in respect of their business case, and taking account of incremental revenues and other benefits as well as incremental costs.

96. Typical rolling stock costs (i.e. total maintenance costs, and capital leasing costs) per vehicle-mile of diesel and electric vehicles are compared in Table 4:

Table 4 – Comparison of Diesel and Electric Rolling Stock Costs per Vehicle Mile

Cost per Vehicle Mile (£)	Diesel	Electric	Saving (£)	Saving (%)
Maintenance Cost	£0.80	£0.44	£0.36	45%
Capital Lease Cost	£1.43	£0.97	£0.47	32%
Maintenance and Leasing Costs Total	**£2.23**	**£1.41**	**£0.83**	**37%**

Source: TOC and ROSCO sources, for new EMU and DMU vehicles, assuming similar annual mileages, at February 2013 price levels

97. In general terms, the maintenance costs of diesel vehicles are higher than those of similar electric vehicles because of the additional costs of fuelling, servicing, maintenance and repair of the engines and transmissions of the diesel vehicles.

98. Capital lease costs are higher for new diesel vehicles than for similar new electric vehicles because of the higher initial capital cost, and also because of lessors' concerns about their ability to lease diesel vehicles in the medium to longer term when financial and environmental factors are expected to increase the benefits of electrification as outlined in this RSS.

99. Other costs for diesel and electric vehicles are compared in Table 5.

Table 5 – Comparison of Other Diesel and Electric Costs per Vehicle Mile

Cost per Vehicle Mile	Diesel	Electric	Saving (£)	Saving (%)
Energy Cost	£0.47	£0.25	£0.22	47%
Track Maintenance Cost	£0.071	£0.068	£0.003	4%
Electrification Fixed Equipment Maintenance Cost	£0.00	£0.012	-£0.012	n/a
'Other Costs' Total	**£0.54**	**£0.33**	**£0.21**	**39%**

Source: TOC and ROSCO sources, for new EMU and DMU vehicles at February 2013 price levels

100. Future energy costs are very difficult to forecast. Diesel fuel costs may in future rise faster than electricity costs, but the reverse is also possible. Electricity costs are currently rising to help pay for lower carbon sources. It is possible that the cost of fossil fuels used in generation may fall from their current, relatively high, levels.

101. When the annual vehicle miles that might be electrified in each of the illustrative scenarios of this RSS are combined with the rolling stock related cost savings per vehicle mile from Tables 4 and 5, the gross rolling stock related savings that would result are as shown in Table 6:

Table 6 – Projected Annual Rolling Stock Related Cost Savings from Electrification, by 2043

Annual Rolling Stock Savings from Electrification	£ pa (millions)	% of Total Rolling Stock Related Costs
Annual Saving by 2043 (Low Scenario)	£346	14%
Annual Saving by 2043 (Medium Scenario)	£438	18%
Annual Saving by 2043 (High Scenario)	£479	20%

Notes: These savings have been calculated from the data in Tables 4 and 5 above, at February 2013 price levels. The annual savings have been presented as a % of the total annual Rolling Stock Related Base Costs for maintenance, capital lease and energy quoted in paragraph 92 above.

102. To get a fuller sense of the future impact on fleet unit costs, the savings in rolling stock related costs from electrification, and the costs of greater fleet sizes, have been combined with estimates of total increases in passenger miles to 2043. The results for the total national fleet are shown in Table 7 for the Medium scenario.

Table 7 – Estimated Reduction in Total Rolling Stock Related Unit Costs in 2043 (Medium Scenario)

	2011/12 (Base)	2043 (Medium Scenario)	Change
Rolling Stock Related Costs pa (£ millions)	£2,450	£3,520	44%
Passenger Miles p.a. (billions)	36	80	125%
Rolling Stock Related Costs (£ per thousand Passenger Miles)	£69	£44	-36%

Notes: The Rolling Stock Related Costs quoted for maintenance, leasing and energy in 2043 have been calculated as (Base Cost – RS Savings from Electrification (from Table 6)) x Increase in Fleet Size (from Table 3).
The Passenger Miles quoted for 2043 have been conservatively assumed to be the 2011/12 actual (from ORR) plus 125%, this being derived from industry data increased for non-committed electrification and non-committed capacity enhancements after CP5, plus the impact of HS2, TOC marketing etc.

103. Similar analysis for the Low and High scenarios to 2043 produces a reduction in rolling stock related costs per thousand passenger miles of 39% and 33% respectively; and similar analysis for the Medium scenario to the end of CP6 in 2024 produces a saving of 20%.

104. Observations relating to Tables 4 to 7 are as follows.
- These estimated operating cost savings, though material, would not in general be sufficient on their own to justify the capital cost of electrification. The business case for electrification is generally founded on a combination of operating cost reductions, revenue increases, capacity benefits, carbon-related benefits and socio-economic benefits. Each such business case is route-specific.
- There is potentially a large range in the values of some of these estimates, affected by the type of service being electrified and the annual mileages of the fleets.
- It is difficult to be precise about the lease costs of new DMUs since no TOC or ROSCO has ordered any new DMU vehicles since 2008, since which time residual value concerns about such trains have arisen following the Government's change of policy regarding electrification, and EU emissions legislation has become more demanding.
- The estimated rolling stock savings ignore real cost increases for the capital leasing costs of new electric rolling stock compared with life-extended diesel rolling stock, on the basis that all or most of the BR-procured fleets will have been withdrawn by 2043.
- The estimated savings in Table 7 do not include the potential cost savings from other rolling stock related initiatives being assessed by the RDG for possible implementation in CP5.
- The estimated savings do not include potential incremental depot costs (see Section J above).

L. Conclusions

The Principle of Franchise-Led Procurement

105. Government policy is that rolling stock procurement should in most cases be franchise-led and the RSS fully supports this principle. The re-shaping of the franchising programme in March 2013 has offered the opportunity to put this approach into action, but in the short term this has been affected by the need to let short contracts to some existing franchisees, and by limitations on DfT's operating expenditure budget.

106. In applying this approach, care must moreover be taken that:
- guidance from the DfT is not interpreted as, nor does it become the specification of inputs;
- short term savings in leasing costs and other rolling stock related costs to meet budget constraints over the next 2-3 years are not made at the expense of whole-life, whole-system value. For example, the business case for some enhancements such as re-tractioning for some older fleets will become progressively weaker, the longer that they are deferred; and
- the need for short term action does not constrain competitive tension and innovation.

107. RSSSG welcomes the constructive dialogue that has been initiated with the DfT on these issues, and this is continuing. We recognise and understand the DfT's financial pressures and will develop innovative options to improve short term affordability.

108. Articulating the required outputs and allowing the market to decide the optimal means of delivering these would produce the following benefits.
- Optimised long term, whole-system benefits from investment in and deployment of rolling stock.
- A spur to investment in innovation.
- A strengthened supply chain with greater production capacity for both new and life-extended fleets.
- Reduction in the overall costs of enhancements (e.g. where these can be combined with PRM-TSI modifications, ERTMS fitment and/or heavy maintenance).
- Lower cost of capital and improved value for money.
- Earlier delivery of passenger benefits, revenue increases, and carbon reduction benefits.
- Greater value for DfT from future franchise bids.

The Size and Composition of the Future National Fleet

109. The analysis undertaken for the February 2013 RSS has been reviewed and rolled forward. The long term conclusions are largely unchanged, being demand-led. The combination of exogenous growth, growth resulting from investment in new and electrified and upgraded railway infrastructure, and growth stimulated by TOC initiatives will require a major change in the size and composition of the national passenger fleet over the next three decades. With the assumptions and scenarios modelled in this RSS, the total size of the national fleet could grow by between 53% and 99% over 30 years, while the proportion of electric (and bi-mode) vehicles could rise from 69% today to more than 90% over the same period.

110. The consequence of the modelled scenarios is that between 13,000 and 19,000 new electric vehicles would be required over the next 30 years, taking account of growth, electrification, replacement by 2043 of most BR-procured vehicles, and HS2. This equates to a build rate of between 8 and 12 electric vehicles per week and may be compared with an average build rate of just four (diesel and electric) vehicles per week in CP4.

111. This requirement for new electric vehicles is front-loaded. Our updated central forecast for fleet sizes at the end of CP5 indicates that it is probable that approximately 800 new EMU vehicles will be required in CP5 (for England, Wales and Scotland, including TfL's rail concessions), in addition to the orders for the Thameslink, Crossrail and IEP projects. Orders have already been placed for 210 of this total of 800 vehicles. This represents a total requirement of around 3,050 new vehicles in CP5, assuming that 2,250 will be delivered for the three major projects. This is a very large requirement for new vehicles in a single five-year period. The numbers of new electric vehicles required could be further increased beyond those noted above if the costs and capabilities of new electric trains can justify replacement of electric trains built since privatisation, or could be lower if the DfT's short term affordability constraints were to dominate procurement decisions.

112. Our updated fleet size forecasts show the 'Electric and Bi-mode' fleet totals increasing by between 2,100 and 2,800 over the course of CP6 in the three scenarios. This compares with an increase of between 2,400 and 3,200 over the course of CP5. It is not possible to predict how many older electric vehicles and electrically-hauled vehicles will be permanently retired during these control periods, and also how many EMUs which may temporarily be off-lease at the end of 2019 may move back into operational use during CP6. Nevertheless, it appears highly likely on the basis of the assumptions contained in this analysis that the total number of new vehicles required to be delivered in CP6 will be less than in CP5.

113. This analysis illustrates that a completely steady new build programme for rolling stock is unlikely ever to occur. Further peaks in demand for new build vehicles will occur as a direct consequence of refranchising timescales, where decisions to procure new rolling stock will, in many cases be triggered by franchise award. Nevertheless the forward projections of rolling stock fleet sizes offered by this RSS, combined with an early commitment to a continuing programme of electrification, should provide a greater degree of predictability about orders for new electric vehicles beyond CP5. This can help manufacturers to optimise production capacity.

114. It is probable that there will be a business case for many of the older BR-procured electric and diesel fleets to receive life extension in CP5 and CP6.

115. On many routes, the growth projections of this RSS would also require potential enhancements to permit the operation of longer trains, to permit shorter headways between trains, or to provide additional infrastructure. The industry's Long Term Planning Process will progressively shape what schemes might need to be considered for funding in future control periods to support this. Equally, changes in areas such as timetable structure, train utilisation and fares policy could additionally affect infrastructure and rolling stock requirements.

116. Assuming that the current policy of a rolling electrification programme continues in CP6 and remains affordable to the Government, the work to date suggests that no new diesel vehicles (or other self-powered vehicles) would be required to be built in either CP5 or CP6. Many older diesel vehicles would be withdrawn over time, firstly those HSTs which are being replaced by IEP (although some might be used by other TOCs including open access operators), and then by 2024 potentially 500 (50%) of the shorter-distance 75 mph DMUs procured by British Rail in the 1980s. There would be a smaller reduction in the number of 90 mph and 100 mph DMUs which were built after 1989, as many of these would be redeployed to provide additional capacity on non-electrified routes.

117. The RSS forecasts that there would be no requirement for any new diesel or hybrid rolling stock whilst a long term electrification programme proceeds. It is possible that no more than 100 new self-powered vehicles may be required to be built in the 30 years to 2043 - probably in the

second half of this period, and principally to serve routes that are unlikely ever to be electrified - if legislation permits the continued operation of DMUs built in the post-privatisation period. Alternatively, further strengthening of emissions legislation might require up to 1,500 new self-powered vehicles over this 30 year period.

Electrification, Cost Reduction and Value for Money

118. Rolling stock-related costs per vehicle mile can be reduced in real terms as a result of these changes because the cost of leasing, maintenance and energy for new electric vehicles are substantially lower than the costs for comparable new diesel vehicles; also the costs of older electric vehicles are significantly less than for comparable older diesel vehicles. The committed programme of electrification in CP4 and CP5 will take the proportion of track mileage that is electrified from 41% to 51% by 2019. The Low, Medium and High scenarios in this RSS, based on some initial ranking, illustrate the potential to increase this figure to 62%, 71% or 77% in subsequent years. The capital cost of the CP5 electrification programme has been calculated by the ORR to be £3.2 billion and our current working assumption is that similar expenditure would be needed in CP6 and CP7 in the Medium scenario.

119. Investor and supply chain confidence would be enhanced, and costs potentially reduced, if funders could make early commitments to a future electrification programme beyond CP5. Ministerial and departmental commitment to a specific programme of electrification in CP6, of a similar quantum to that of CP5, would greatly help Network Rail and the suppliers of both electrification and rolling stock to optimise production capacity and associated costs. This would also give confidence to TOCs and stakeholders that a steady flow of good quality diesel trains will become available to meet growth in demand on non-electrified routes, so reducing the need for expensive new diesel vehicles. It would also help Network Rail to combine synergies of electrification with other major route infrastructure renewals and enhancements.

120. All owners, maintainers, operators and funders of rolling stock and infrastructure should be incentivised to cooperate in working together to adopt a whole-life, whole-system approach to cost reduction and optimisation, as is best practice in other asset based industries. One way in which this could be encouraged would be for the DfT (and Transport Scotland) to insist that rolling stock plans in franchise bids should contain explicit forecasts of whole-life, whole-system costs and benefits, and to give credit in the franchise bid evaluation process for such costs and benefits for the lives of these rolling stock assets (i.e. beyond the end of the franchise being let).

121. At present, no single party is able to calculate or compare the whole-life whole-system rolling stock-related costs (i.e. including maintenance, leasing, energy and track maintenance) of individual rolling stock fleets. As the industry matures one option would be to introduce anonymised benchmarking of whole-life whole-system rolling stock related costs for individual fleets.

122. In each of the three scenarios outlined in this RSS, our work to date indicates that total rolling stock costs per passenger mile could fall in real terms by more than 30% by 2043. Electrification will also produce journey time improvements, route capacity benefits, revenue increases, and substantial carbon reduction advantages. The impact of the RSS is potentially good news for the economy and could offer additional employment and business opportunities – in manufacturing, maintenance, installation and the associated supply chains, for vehicles and electrification; and in programmes for cost-effective life extension and re-tractioning of older vehicles, for achieving compliance with the PRM-TSI regulations for passengers of reduced mobility, and for the fitting of ETCS. Additional production capacity will be required in order to provide sufficient capacity for all of these programmes.

123. The industry is investigating, and implementing, ways of making more use of standardisation where this can be done without inhibiting the normal commercial process of train procurement and leasing that RSSSG regards is the linchpin to improving overall cost effectiveness in rolling stock provision. Established UK and European industry processes and the market are already leading to increased standardisation in rolling stock. Therefore, there is no pressing need for a new DfT initiative in this area.

124. RDG is also currently reviewing options to improve rolling stock cost efficiency during CP5.

Depots and Berthing

125. The scale of increase in fleet sizes outlined in this RSS will require additional berthing locations and some new maintenance depots. Provision of this capacity for CP5 is already well advanced. Our analysis shows that a further increase in berthing capacity of around 10% will be required to 2024, and 50% to 2043, these increases being relative to total capacity at the end of CP5 in 2019.

126. Apart from HS2 (for which plans for berthing and for new maintenance depots are already being developed), the largest percentage increases for berthing capacity are forecast to be in the LNW and Western Routes and in Scotland. The growth percentages are driven principally by the forecast high increases in passenger demand for regional services. Percentage increases in berthing required for L&SE TOCs will be smaller, but are likely to be more challenging to achieve so requiring advanced planning.

127. As regards who should provide new and manage new or existing depot sites, TOCs or manufacturers, there is no single correct answer, and both are likely to have a long term role going forward. Such decisions should be market-led rather than centrally-imposed.

128. People issues are critical to the success of the railway industry, and this is certainly true for rolling stock maintenance issues. The introduction of new fleet types, new technology, larger fleets and electrification must be accompanied by adequate long term investment to provide the leadership and skills necessary to underpin the required business results.

BR-procured EMT Type C 'IC125' HST built in the late 1970s

APPENDIX 1, TIMELINE OF KEY ACTIVITIES RELATING TO LONDON & SOUTH EAST FRANCHISES

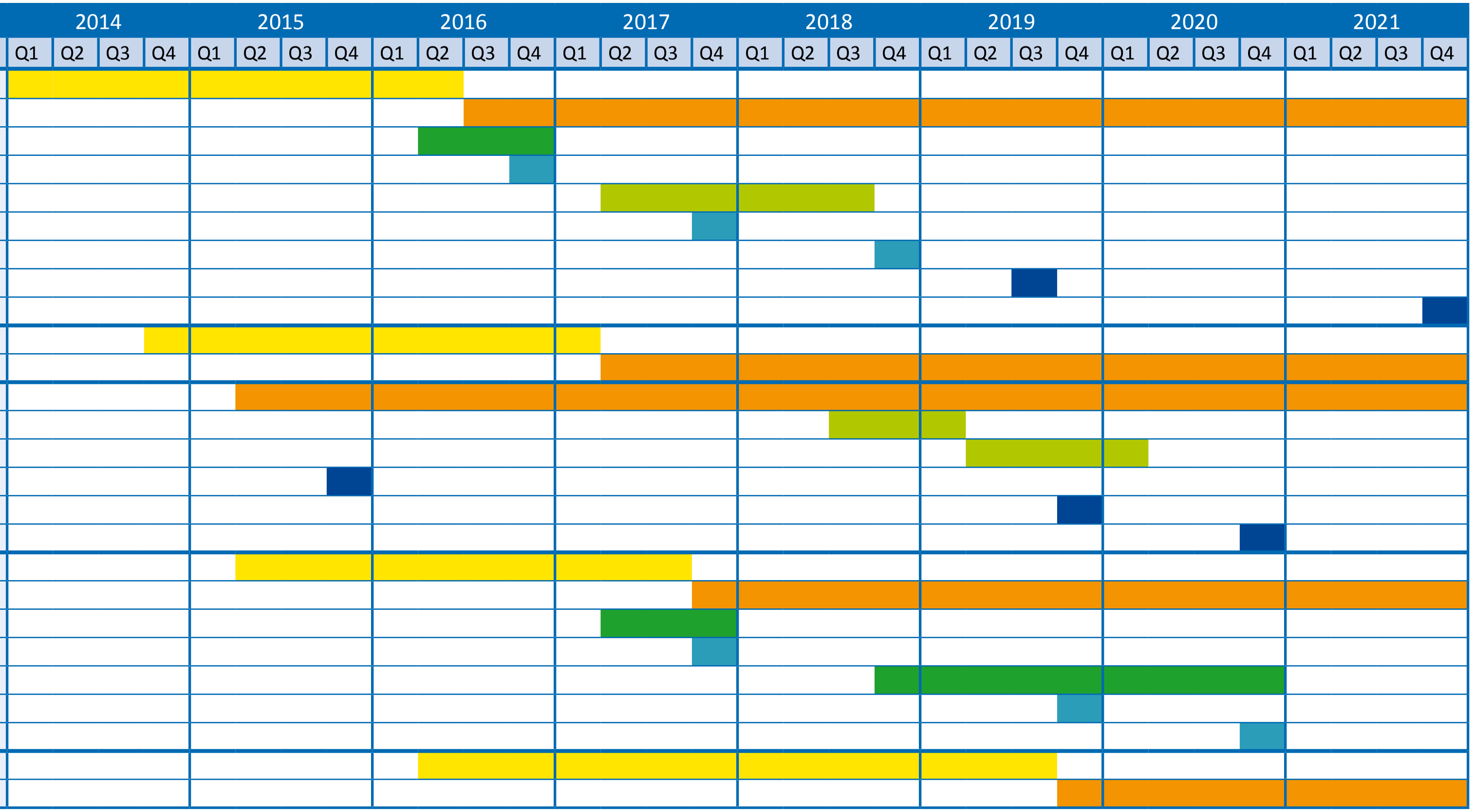
Item	Start	Finish
SE Franchise STAs	4/2014	6/2018
100 Class 377 vehicles sub-leased from TSGN to SE		12/2017
IKF New Franchise	6/2018	
Kent Train Lengthening Complete	5/2014	3/2019
ET New Franchise	9/2014	
Southern New Class 377 EMUs (170 cars)	9/2013	3/2014
TSGN Franchise	9/2014	9/2021
TSGN New Class 387 EMUs (up to 256 cars)	5/2015	11/2015
Southern merged into TSGN	7/2015	7/2015
TSGN New Class 700 EMUs (1,140 cars)	12/2015	6/2018
Thameslink Key Output 2 incl ERTMS		12/2018
Crossrail Concession	5/2015	
Crossrail, new Class 345 EMUs (up to 747 cars)	5/2017	6/2019
Crossrail Core and Abbey Wood Services		12/2018
Crossrail to Shenfield		5/2019
Crossrail to Maidenhead		12/2019
GA Franchise STA	7/2014	10/2016
GA new Franchise	10/2016	
GE and West Anglia Capacity Enhancements		3/2019
LOROL Concession Extension	11/2014	11/2016
LOROL New Class 378 EMUs (57 cars)	10/2014	8/2015
Overground Full 5-car Operation		12/2015
Overground New Concession	11/2016	
EMUs for TFL's West Anglia train services	12/2017	12/2018
EMUs for Gospel Oak - Barking Electrification	12/2017	12/2018
Gospel Oak - Barking Electrification		12/2018
SWT Class 458/5 conversion (180 cars)	11/2013	12/2014
SWT Class 455 re-powering (364 cars)	11/2014	1/2016
SWT, new or cascaded EMUs (up to 250 cars)	7/2016	7/2017
SWT Full 10-car Operation (Inners & Reading)		3/2019
SWT Franchise STA	1/2015	3/2019
SWT New Franchise	4/2019	
Chiltern Services to Oxford		6/2016
East West Rail, Oxford - Bletchley/ Bedford		3/2019
East West Rail Electrification, Oxford to Bletchley		3/2019
Chiltern New Franchise	12/2021	

Franchise STAs · New Franchises · Electrification Complete · Other Infrastructure Complete · Committed New Rolling Stock · Other Rolling Stock

Network Rail dates are as in the draft CP5 Enhancements Delivery Plan

APPENDIX 2, TIMELINE OF KEY ACTIVITIES RELATING TO INTERCITY FRANCHISES

Item	Start	Finish
FGW Franchise STAs	10/2013	7/2016
GW New Franchise	7/2016	
Rolling Stock for Thames Valley Electrification	3/2016	12/2016
GWML Electrification, Oxford and Newbury		12/2016
GW New Class 800 IEP trains (369 cars)	5/2017	7/2018
GWML Electrification, Bristol and Cardiff		12/2017
GWML Electrification, Swansea and Full Timetable		12/2018
GWML ERTMS		9/2019
Western Rail Access to Heathrow		12/2021
VT Franchise STA	11/2014	4/2017
ICWC New Franchise	4/2017	
ICEC New Franchise		2/2015
ICEC New Class 800 IEP trains, Phase 1 (227 cars)	8/2018	4/2019
ICEC New Class 800 IEP trains, Phase 2 (270 cars)	5/2019	2/2020
ICEC ERTMS, Hertford Loop Overlay		12/2015
ICEC ERTMS, KX/ Moorgate to Peterborough		12/2019
ICEC ERTMS, Peterborough to Doncaster		12/2020
EMT Franchise STA	4/2015	10/2017
EM New Franchise	10/2017	
Rolling Stock for MML Phase 1 Electrification	4/2017	12/2017
MML Electrification, Kettering and Corby		12/2017
Rolling Stock for MML Phases 2&3 Electrification	12/2018	12/2020
MML Electrification, Derby and Nottingham		12/2019
MML Electrification, Sheffield		12/2020
XC Franchise STAs	4/2016	11/2019
XC New Franchise	11/2019	

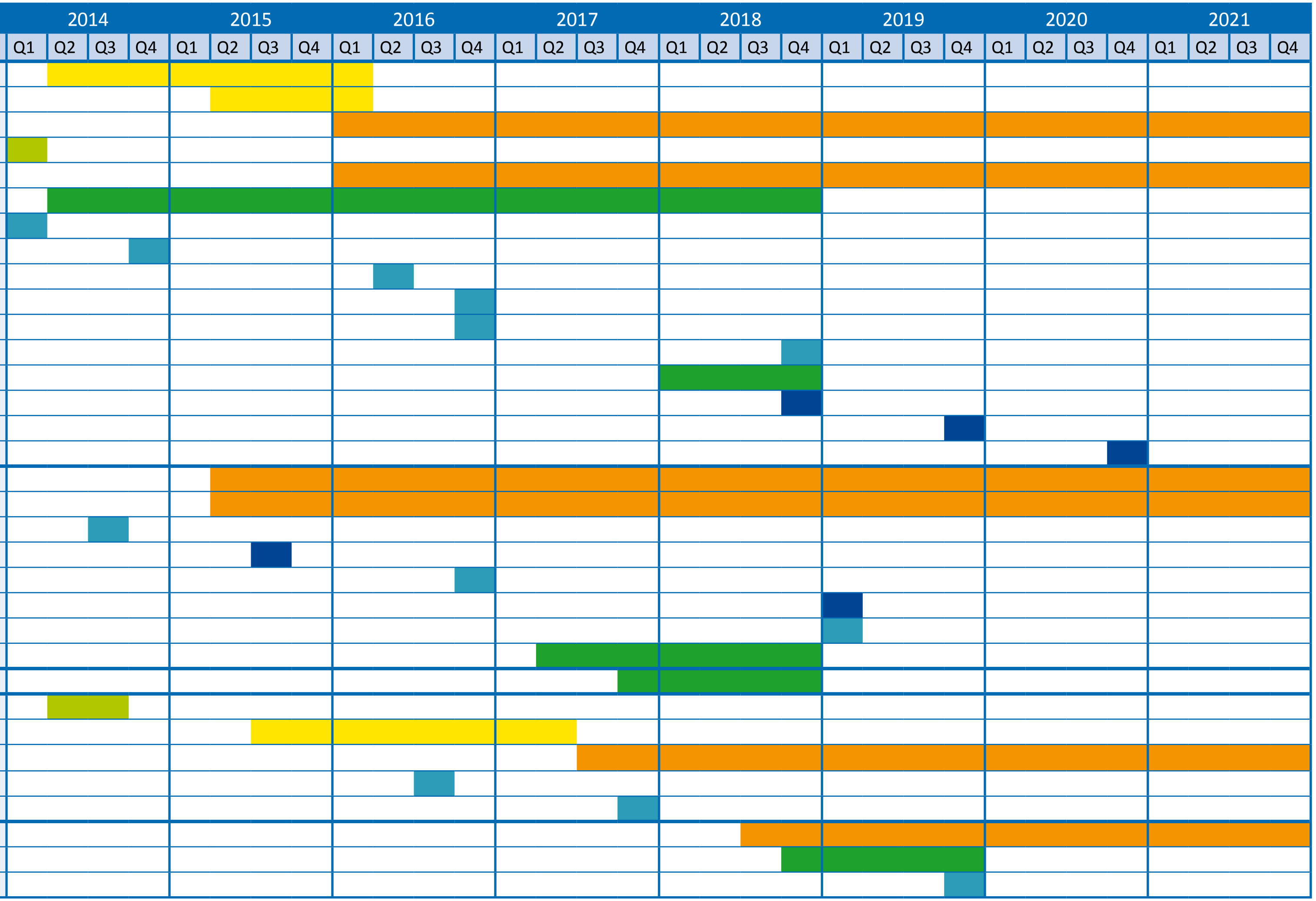


Franchise STAs · New Franchises · Electrification Complete · Other Infrastructure Complete · Committed New Rolling Stock · Other Rolling Stock

Network Rail dates are as in the draft CP5 Enhancements Delivery Plan

APPENDIX 3, TIMELINE OF KEY ACTIVITIES RELATING TO REGIONAL FRANCHISES

Item	Start	Finish
Northern Franchise STA	4/2014	2/2016
FTPE Franchise STA	4/2015	2/2016
Northern New Franchise	2/2016	
FTPE New Class 350 EMUs (40 cars)	12/2013	3/2014
TPE New Franchise	2/2016	
EMUs for NW and NE Electrification schemes	5/2014	12/2018
NW Electrification, Manchester to WCML		12/2013
NW Electrification, Liverpool to WCML		12/2014
NW Electrification, Preston to Blackpool		5/2016
NW Electrification, Manchester to Preston		12/2016
Windermere Electrification (tbc)		12/2016
NTPE Electrification, Leeds and York/Selby		12/2018
EMUs for NTPE Electrification	1/2018	12/2018
Northern Hub Programme, Full Timetable		12/2018
ERTMS Cumbria Coast		12/2019
ERTMS Carlisle - Hexham		12/2020
ScotRail New Franchise	4/2015	
Caledonian Sleeper Franchise	4/2015	
ScotRail Electrification, Cumbernauld/Whifflet		7/2014
Borders Railway Reopening		9/2015
Edinburgh-Glasgow Electrification, Initial Service		12/2016
Edinburgh-Glasgow Electrification, 8x23m trains		3/2019
ScotRail Electrification, Alloa, Dunblane, Shotts		3/2019
ScotRail, new EMUs (EGIP etc)	4/2017	12/2018
New EMUs for Merseyrail	12/2017	12/2018
LMR New Class 350 EMUs (40 cars)	4/2014	8/2014
LMR Franchise STA	9/2015	6/2017
WM New Franchise	6/2017	
Barnt Green - Bromsgrove Electrification		7/2016
Walsall - Rugeley Electrification		12/2017
W&B New Franchise	10/2018	
EMUs for Valleys Electrification	12/2018	12/2019
South Wales Valleys Electrification		12/2019



Franchise STAs | New Franchises | Electrification Complete | Other Infrastructure Complete | Committed New Rolling Stock | Other Rolling Stock

Network Rail dates are as in the draft CP5 Enhancements Delivery Plan

GLOSSARY

AC	Alternating Current
ATOC	Association of Train Operating Companies
BR	British Rail
CP	A five-year regulatory Control Period
CP4	1/4/2009 to 31/3/2014
CP5	1/4/2014 to 31/3/2019
CP6	1/4/2019 to 31/3/2024
CP7	1/4/2024 to 31/3/2029
CP8	1/4/2029 to 31/3/2034
C6	A Code 6 vehicle overhaul
DC	Direct Current
DfT	Department for Transport
DMU	Diesel Multiple Unit
Electric Spine	The route to be electrified between Southampton, Bedford and the West Midlands
EMT	The East Midlands Trains TOC
EMU	Electric Multiple Unit
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
EU	European Union
FGW	The First Great Western TOC
FTPE	The First TransPennine Express TOC
GA	The Greater Anglia TOC
GW	Great Western
GWML	Great Western Main Line
HLOS	High Level Output Specification
HS1	The High Speed line from London to the Channel Tunnel
HS2	The proposed High Speed line from London to Birmingham, Manchester and Leeds
ICEC	The Intercity East Coast franchise
ICWC	The Intercity West Coast franchise
IC225	The intercity electric trains operated by the East Coast TOC
IEP	The Intercity Express Programme (and 'Super Express Trains' to be built by Hitachi)
IKF	The Integrated Kent Franchise
ISBP	Industry Strategic Business Plan
kV	Kilovolts
LMR	The London Midland TOC
LNE	Network Rail's London North Eastern Route
LNW	Network Rail's London North Western Route
LTPP	The rail industry's Long Term Planning Process
LOROL	London Overground Rail Operations Ltd.
LUL	London Underground Ltd.
Mark 1	20-metre slam-door rolling stock built by BR, now all withdrawn
Mark 2	Later 20-metre slam-door rolling stock built by BR, now almost all withdrawn
Mark 3	23-metre rolling stock built by BR, built from the mid-1970s and still in operation
Mark 4	Rolling stock operating in the IC225 trains
MML	Midland Main Line
MP	Member of Parliament
Northern Hub	Infrastructure capacity enhancements in the Manchester area
NRMM	Non-Road Mobile Machinery emissions legislation (see paragraph 47)
NSARE	The National Skills Academy for Railway Engineering
NTPE	The North TransPennine route to be electrified from Manchester to Leeds etc.
NW	North West
ORR	Office of Rail Regulation
PRM-TSI	Technical Specification for Interoperability, for Passengers of Reduced Mobility
RDG	Rail Delivery Group
RfP	Request for Proposals
RIA	Rail Industry Association
ROSCO	A company that owns and leases rolling stock
RSS	The Long Term Passenger Rolling Stock Strategy
RSSSG	Rolling Stock Strategy Steering Group (see paragraph 1)
RUS	Route Utilisation Strategy
SE	South East
SET	The Southeastern TOC
SoFA	Statement of Funds Available
STA	Single Tender Action i.e. a short franchise awarded to an incumbent TOC
SWT	The South West Trains TOC
TfL	Transport for London
TOC	Train Operating Company
TPE	The TransPennine Express franchise
TS	Transport Scotland
TSGN	The Thameslink, Southern and Great Northern franchise
TSI	Technical Specification for Interoperability
UK	United Kingdom
VfM	Value for Money
V/S SIC	Vehicle/ Structures Systems Interface Committee
VTISM	Vehicle Track Interaction Strategic Model
V/T SIC	Vehicle/ Track Systems Interface Committee
V/V SIC	Vehicle/ Vehicle Systems Interface Committee
W&B	The Wales and Borders franchise
WM	The West Midlands franchise
XC	The CrossCountry franchise

A Bombardier Type D Class 345 'Aventra' EMU to be introduced on the Crossrail routes from 2017