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East West Rail Central Section – Option Comparison Results

V0.8

Economic Analysis, Network Rail

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1.0 Introduction

The purpose of this study is to appraise various route options for East West Rail Central Section (EWRCS). Previous Atkins work[1] considered a range of routing options for EWRCS within two broad corridors, and recommended further development should focus on the corridor between Bletchley and Cambridge via the Bedford and Sandy areas. Four route options (A1, A3, C1 and C3) have been developed within that corridor for economic analysis in this phase of the project.

This report discusses the methodology used to appraise value for money of each corridor, as well as key assumptions. It then sets out socioeconomic appraisal results, including for variations such as line speed improvements, electrification scenarios, and other sensitivities. This will help inform a decision on whether further development work should be undertaken, and on which route options.

[1] East West Rail Central Section Phase 2B Final Report, 26 Apr 2016

2.0 Methodology

Twelve options were defined for the purposes of this analysis, each with specific characteristics including journey times, mileages, station calls and capital costs. These service options were input to two demand models – a spreadsheet based model for local demand, and MOIRA for longer-distance journeys. The models calculate the difference in benefits between our Do Minimum and Do Something[2] scenarios. The demand and revenue outputs from these two models were fed into a Discounted Cash Flow (DCF) appraisal template, along with capital and operational costs, to produce value-for-money assessments of each option. Further details on the methodology are given below.

2.1 Modelling local journeys

The local demand model used by Atkins in previous East West Rail Central Section (EWR CS) work was adapted for use in modelling local journeys. 'Local' here refers to journeys between 104 stations on and around the potential EWR CS routes; all flows[3] fully or partially outside this local area were modelled in MOIRA. The following changes were made to the Atkins model for this value-for-money assessment:

- Previous service options replaced with twelve options set out in this report, with defined journey times, calling patterns, and mileages for each
- Revenue, demand, and mileage outputs by year used to calculate present value over appraisal period, in accordance with WebTAG guidance
- Station population and employment catchments updated to account for potential new stations and station relocations

Forecasts are made by one of two methods; a Generalised Journey Time (GJT)[4] elasticity approach, or a gravity model approach. The choice between these two forecasting methods is based on the change in GJT on a flow as a result of adding EWR CS services. GJTs for flows, split by business, commute and leisure journey purposes, were obtained from the MOIRA work on long distance journeys. Where the GJT was 30% or more lower with than without EWR CS, the gravity model was used; if the GJT reduction was less than 30% then the GJT elasticity model was used.

[2] Do Minimum scenario is the current timetabled services, with committed improvements and known service changes added. Do Something scenario is the Do Minimum scenario plus the EWR CS services. There are different Do Something scenarios for each of our 12 options, but the Do Minimum scenario remains the same.
[3] A flow refers to journeys between any specific pair of stations
[4] Generalised Journey Time is a measure incorporating the total station-to-station journey times, plus time penalties based on the frequency of service and the number of interchanges required to make the journey. It is expressed in minutes of journey time.

The model outputs revenue benefits, user time benefits, user fare benefits[5], and rail mileage change, all split by business, commute, and leisure users, and various categories of externalities[6].

Gravity Approach

The gravity model is a method used to forecast demand where changes in GJT are significant; these are situations where the standard GJT elasticity approach tends to under-forecast. The gravity model forecasts a Do Something demand by considering the attraction between origin-destination pairs, based on their relative population and employment and the level of rail service provided between them. The Do Minimum demand and Do Minimum GJT do not factor into this calculation.

GJT elasticity approach

The GJT elasticity approach calculates the Do Something demand by applying an uplift to the Do Minimum demand. The uplift is based on the change in GJT between the Do Minimum and Do Something scenarios, and GJT elasticities from the Passenger Demand Forecasting Handbook (PDFH). The elasticity measures how the demand for a journey is expected to change in response to a change in GJT (in this case, a reduction in GJT as a result of adding EWR CS services). An elasticity of -1.25 is used, sourced from PDFH 5.1 table B4.3. This means that a reduction in GJT of 10% is expected to increase demand by 12.5%.

This method is only considered accurate for relatively small, incremental changes in GJT, hence why it is only used here when the reduction in GJT is relatively small (less than 30%.)

Methodological Issues

- We retained the gravity model formulation that Atkins previously used, which has no parameter for road journey time. This may mean it is over-forecasting rail journeys by not taking account how competitive the alternate mode (road) is. However, assuming the model was well calibrated we believe it is an accurate tool to forecast the rail demand, even with no direct parameter for competing modes– especially as this stage of analysis is focused on the comparative performance of various options. In future stages of analysis, we would recommend explicitly considering competition by road, especially given the proposed Oxford-Cambridge Expressway road scheme which would make road more competitive than currently in peak hours.
- The model uses one station in Bedford and one in Bicester, instead of modelling each town's two stations separately. In order to obtain GJTs for

[5] User fare benefits refer to the cost savings to users of a lower fare. In many cases the fare for a journey via EWRCS will be cheaper than the fare for that same journey if made currently, for example via London.
[6] Externalities refers to the benefits of reducing the number of car miles as a result of increased rail demand. It includes things like reductions in road congestion and negative environmental impacts of driving.

these combined stations, we take smallest of the two stations' GJTs from MOIRA, and add a 10 minute access penalty. This is in line with the approach used by Atkins previously. Future analysis may wish to model stations at Bedford separately, given that our options call at different combinations of Bedford stations.

- Marginal External Costs of Car Use benefits (MECs) are calculated based on an estimated reduction in car miles. As the model only provides the change in rail miles, a diversion factor of 35% has been used - that is, an assumption that 35% of the new rail miles were previously travelled by car and are now removed from the roads, driving MECs benefits. This figure is taken from the July 2017 WebTAG databook for South-East non-London journeys.
- To avoid significant demand changes if a station pair moved between different sides of the 30% GJT threshold for different options, the gravity/GJT elasticity choice was calculated for option 1, and the same model used for that station pair in all other options. We also compared the demand forecast by the two different methods for a selection of flows, to check whether there were any significant changes in demand on either side of the 30% threshold.
- Note that no crowding-related benefits are calculated for local journeys. Atkins' Phase 2B Final Report concluded that the level of crowding relief as a result of diverting existing passengers from London radial routes onto EWR services would be very limited.
- The 'rule of a half' is a formula used to calculate user time benefits for both new and existing users as a result of a service change. The rule of a half assumes a linear demand curve, but previous Atkins work on EWR Western Section suggested a concave demand curve for EWR, which would lead to the rule of a half overestimating benefits. Atkins previously calculated that a further adjustment of 75% should be applied to benefits calculated by the rule of a half to adjust for this overestimation, which we have also applied.

2.2 Modelling longer distance journeys

Benefits accruing to long distance flows were calculated using MOIRA, the rail industry's standard rail forecasting tool. The model looks at journey time improvements arising from interventions to a base timetable on a flow by flow basis. If there are improvements to a flow then an uplift is applied to demand, using journey time elasticities taken from PDFH v5.1. A bespoke station zoning structure (OR44) developed for EWR was used - this included all stations within Central and Western sections. Stations outside of the study area were grouped together with the nearest major station e.g. Salford station is included within Manchester BR station. Revenue and journey data were from the December 2016 timetable update to MOIRA.

A Do Minimum base timetable was coded into MOIRA including East West Rail services on the Western Section. The Do Something Central Section options were then coded incremental to the base timetable. Non-EWR services that would interact with EWR stations (with the exception of the West Coast Mainline) have been updated to best reflect their likely assumed service pattern at the opening of the Central section. HS2 and WCML services have been assumed as per Atkins in their Central Section Phase 2B Final Report.

MOIRA outputs changes in revenue, value of time saved, and mileage as a result of altering the base timetable. Revenue is based on LENNON ticket data, and values of time are based upon PDFH v5.1 valuations when output from MOIRA. They are subsequently converted to WebTAG values of time.

Revenue, mileage and value of time data were grown to take into account future passenger growth. To maintain WebTAG compliance, rail demand growth rates were only applied for 20 years until 2037; after this date, benefits from MOIRA are grown in line with UK population growth forecasts. Growth rates were taken from Network Rails Regional Urban Market study, which gives passenger demand growth of 3.7% until 2023 and 2.5% onwards until 2037.

Methodology Issues

- MOIRA is not capable of calculating crowding relief benefits and hence an uplift was applied based on prior work by Atkins (Central Section Phase 2B Final Report). Crowding benefits are assumed to be ~75% of Value of Time benefits.
- HS2 and WCML service assumptions on opening of Central section should be updated in the next iteration of analysis to reflect best knowledge at the time.
- We believe that demand is underestimated for some long distance pairs, which experience a significant decrease in GJT but have a small number of journeys in the Do Minimum case – in this case, a large proportional uplift in demand is applied to a small number of existing passengers. Leigh Fisher work for the DfT counteracts some of this underestimation by expanding the geographical scope of the gravity model.
- We believe the disbenefit of relocating Sandy station is not adequately captured by MOIRA. Several options involve building a new station on the East Coast Mainline to the north or south of the existing Sandy station site. We believe this may have a net negative impact on passengers starting their journey at Sandy, including the large Sandy-London commuter market. This is because, while MOIRA can account for the change in travel time on the rail network, it does not take into consideration any change in time taken to access the station in order to begin the rail journey. Moving the station further from the existing population centre will disbenefit any passengers starting or ending their journeys at Sandy, and MOIRA modelling does not capture this aspect. This should be taken as a qualitative consideration until modelling can be improved.

2.3 Socio-economic appraisal of options

A socio-economic appraisal estimated the value for money of delivering each option. Demand and revenue data was taken from the local demand model outputs and from MOIRA, and the benefits were appraised over a 60-year period using the Department for Transport's (DfT) WebTAG[7]-consistent methodology. The benefits appraised were:

- Changes in rail revenue
- Value of journey time savings to new and existing users
- Fare savings to existing users
- Monetised non-user benefits relating to a decrease in car miles, such as reduced road congestion and environmental externalities. Marginal External Costs of car use (MECs) values were taken from the WebTAG Databook for the East Anglia region.

Note that in 2037, 20 years from the current year, rail demand growth is constrained to grow in line with UK population, in accordance with WebTAG guidance.

These benefits were appraised against the costs of delivering the services in each option:

- Capital costs of construction
- Renewal costs of infrastructure within the appraisal period
- Operational costs, including leasing and running rolling stock, and ongoing infrastructure maintenance

The costs and benefits were incremental to a 'Do Minimum' scenario, which included current services and committed improvements, including EWR Western Section services.

[7] Web Transport Appraisal Guidance

3.0 Assumptions

Key assumptions used in the value-for-money assessment are detailed below.

3.1 EWR CS rail services

The services appraised in this report are 3tph central section services:

- 1tph OXF-CBG fast, calling at Oxford, Bletchley, a Bedford station, an East Coast Mainline (ECML) interchange station, and Cambridge.
- 1tph OXF-CBG stopping (an extension of Western Section service EW3), originally calling at Oxford, Oxford Parkway, Bicester Village, Winslow, Bletchley, Woburn Sands, Ridgmont, Bedford St Johns and Bedford Midland in the base. As a result of central section, the Bedford calls are replaced with one call at the Central Section Bedford station, and the service additionally calls at an ECML interchange station and Cambridge.
- 1tph MKC-CBG, calling at Milton Keynes, Bletchley, a Bedford station, an ECML interchange station, and Cambridge.

3.2 Do Minimum rail services

The Do Minimum scenario was based on Atkins' previous work[8], including assumptions for HS2 and WCML stations. Non-EWR services that would interact with EWR stations (with the exception of the West Coast Mainline) were updated to best reflect their likely assumed service pattern at the opening of the Central Section. This includes the following updates from Atkin's Do Minimum:

- Western section service assumptions as per CS2 option 3.0 ITSS
- Thameslink 2018 timetable provided by GTR
- One additional St Pancras-Kettering/Corby train per hour on the Midland Mainline

3.3 Route options

Two main routes, A1 and C1, and four variations, A3, E3, C3, and E1, were considered in this analysis. An overview of these routes is laid out below, and diagrams can be found in the engineering report.

- **Route A1**. Routing up the Marston Vale line from Bletchley, diverging north of Lidlington to a new Bedford South station, on eastwards to a new Sandy

[8] East West Rail Central Section Phase 2B Final Report, 26 Apr 2016

South station which replaces the existing Sandy station, and to Cambridge via Shepreth Junction.

- **Route A3**. Routing up the Marston Vale line from Bletchley, diverging north of Lidlington to a new Bedford South station, on eastwards to a new Sandy North station which replaces the existing Sandy station, and to Cambridge via Shepreth Junction.
- **Route E3**. Routing up the Marston Vale line from Bletchley, diverging north of Lidlington to a new Bedford South station, on eastwards to existing Sandy station, and to Cambridge via Shepreth Junction.
- **Route C1**. Routing up the Marston Vale line from Bletchley to the existing Bedford Midland station, on eastwards to a new Sandy South station which replaces the existing Sandy station, and to Cambridge via Shepreth Junction.
- **Route C3**. Routing up the Marston Vale line from Bletchley to the existing Bedford Midland station, on eastwards to a new Tempsford[9] station which replaces the existing Sandy station, and to Cambridge via Shepreth Junction.
- **Route E1**. Routing up the Marston Vale line from Bletchley to the existing Bedford Midland station, on eastwards to existing Sandy station, and to Cambridge via Shepreth Junction.

3.4 Journey time assumptions

Different journey times are assessed for different options. The following journey times were used for each route:

		Route					
		A1	A3	C1	C3	E1	E3
Diesel journey time (mins) by service	OXF-CBG fast	77	78	83	81	82	80
	OXF-CBG stopping	96	97	102	100	101	99
	MKC-CBG	52	53	58	56	57	55

Table 1 - Diesel journey times by route and service

These times include a one minute dwell at every station stop, with an additional four minute allowance for reversing at Bletchley (applicable to the Milton Keynes service only).

Variations of some routes were run with reduced journey times, including a diesel line speed improvement (LSI) scenario and electrification scenarios:

[9] Previously referred to as St Neots South

		Route			
		A1 Diesel LSI	A1 electrified	C1 Diesel LSI	C1 electrified
Journey time (mins) by service	OXF-CBG fast	74	75	81	81
	OXF-CBG stopping	93	94	100	100
	MKC-CBG	49	50	56	56

Table 2 - Journey times by route option and service

These are indicative journey times and may be understated, as we were provided with running times only. Running times make no allowance for other services operating on the existing part of the route (for example, the hourly Marston Vale line stopping service), or pathing times, etc. Where there is interaction with existing lines and stations, this analysis assumes that EWRCS trains could be timetabled to meet their running times without impacting other services. Options which require more interaction with existing network are more likely to see increased journey times when detailed timetabling work is done, hence are more at risk of a reduction in value for money.

3.5 Capital cost assumptions

All costs shown in this section are GRIP 1 costs in 2015 prices and are shown without risk and without optimism bias. The capex spend profile covers 2018-2030, with the bulk of costs incurred from 2026 onwards and an opening year of 2031.

The first is for a diesel railway, which is the only cost presented for most routes, and is the central case in this analysis. The diesel costs include the costs of passive provision for electrification. We also appraised several variants of routes A1 and C1:

- **Diesel + LSI** is a scenario with line speed improvements on the Marston Vale line between Lidlington and Bedford.
- **Electrified (pre)** is a variation where the route is electrified as part of the initial construction.
- **Electrified (post)** is a variation where the route is electrified after the opening year. It uses a representative electrification year of 2041, ten years after opening.

Table 3 – Capital Cost Estimates by Option (2015 prices)

Variant	Cost £m	MVL Capacity £m	Total £m	Excluding 40% risk £m
A1 Elec	2,071	344	2,415	1,725
A1 Diesel	1,983	344	2,327	1,662
A1 Diesel + LSI	2,086	344	2,430	1,736
E3	1,621	344	1,965	1,404
A3	2,355	344	2,699	1,928

C1 Elec	2,531	344	2,875	2,053
C1 Diesel	2,432	344	2,776	1,983
C1 Diesel + LSI	2,527	344	2,871	2,051
E1	2,109	344	2,453	1,752
C3	2,930	344	3,274	2,339

Note that the above costs are not fully inclusive at this stage. Some costs, including those for depots and stabling, have not been assessed and are not included in the value-for-money assessment process. These items will need to be considered in more detail at the next stage of development and their impact on the business case reviewed.

Also note that the capital costs include infrastructure designed to accommodate 9-car IEP formations, although the rolling stock requirements assumed to operate for the purposes of appraisal are often shorter formations.

3.6 Operating cost assumptions

The majority of our operating costs are taken from Atkins' Phase 2a report[10], section 2.3, which sets out rolling stock, staff, and station cost assumptions used in their earlier appraisal of corridor options. For each option the operating costs that vary include the number of diagrams required, determining the vehicle requirement and the staffing requirement and the vehicle mileage, which determines the mileage costs of operating the services. Infrastructure maintenance costs vary depending on the length of new track delivered under each option.

Rolling stock assumptions

Our central case options assume IEP-type rolling stock, using costs from the Atkins Phase 2a report. The formations are dependent on the level of forecast demand, and increase from a 5-car formation at opening to a 9-car formation towards the end of the appraisal period. We have assumed that the shortest possible IEP formation is 5-car, but actually fewer than 5 cars would be needed to meet demand for some years upon opening. Considering the feasibility of shorter rolling stock formations has the potential to reduce operational costs.

Our 90mph running sensitivity assumes a lower cost type rolling stock, for which we used generic Network Rail cost assumptions. The formation is again dependent on forecast demand, but is a 5-car formation throughout the whole appraisal period for most 90mph running options.

Diagram assumptions

[10] East West Rail Central Section Phase 2A Final Report, 5 Oct 2015

The number of diagrams (sets of rolling stock) required is calculated at a high level for this initial appraisal, based on the known mileages and journey times for each option, plus a small allowance for empty coaching stock moves.

Increases in journey time of just a couple of minutes can trigger the need for an additional diagram in this high level modelling, adding substantial operational costs. Detailed diagramming work may conclude that longer journey times were achievable without the increase in number of diagrams.

The diagram requirement is calculated separately for each of the three hourly Central Section services. There is an opportunity to reduce costs if more detailed diagramming work is done, considering the potential to optimise diagrams across both all three central section services, or across East West Rail as a whole especially for shared Western and Central section services.

Staff assumptions

We have assumed that each diagram requires three teams of a guard plus driver. The staff costs are taken from the Atkins report above. There is opportunity to lower staff costs if more detailed diagramming work is undertaken as described above.

Station costs

Some of the route options result in a net increase of the number of stations on the network, for example those which go via a new Bedford South Parkway station. Operational costs for these options include an annual station running cost as per the Atkins Phase 2a report. This is assumed to consist of the operational, maintenance, and staff costs associated with the new station.

3.7 Other assumptions

- Fares on EWR CS services are calculated from an average fare per mile (2013 prices) of:
    - £0.19 per mile for season journeys (commuting trips)
    - £0.26 per mile for non-season journeys (business and leisure trips)

  Note that these figures, while similar, are not consistent with those assumed for the Western Section
- EWR CS services operate for 16 hours a day, 364 days a year. Note that there is no implied lower service level at the weekends. This is to match stated western section operating hours.
- All central section services are assumed to terminate at Cambridge in this appraisal. The eventual service pattern may have these trains running onwards through Cambridge to the east, dependent on Eastern Section work.

Benefits for the extension of these services would accrue to an Eastern Section business case.

- Our central case costs include the full cost of constructing the Platinum option at Cambridge station. One of our sensitivities considers the case where the Central Section is only required to pay for the increment between the Gold and Platinum options at Cambridge[11].
  Also note that the Platinum option at Cambridge provides capacity and may provide benefits for projects other than East West Rail. Benefits to these other projects have not been included in the appraisal.
- The population and employment growth rates in our demand models are taken from TEMPRO 6.2 (from NTEM 7, originally from local plans). We are aware that these figures do not include significant developments proposed by local authorities in the area – this appraisal includes only confirmed development as per TEMPRO.

4.0 Value-for-Money Assessment

For all results presented here, Present Values (PVs) are in 2010 market prices and are discounted to 2010 using Social Time Preference discount rates from WebTAG. The appraisal is in accordance with the DfT's WebTAG appraisal guidance.

Note that these results include no wider economic benefits and no freight benefits.

Key routes

[11] The key difference between the Gold and Platinum options at Cambridge is that platinum includes grade separation of Shepreth Branch Junction.

Results of socio-economic appraisal	A1 diesel	E3 diesel	A3 diesel	C1 diesel	E1 diesel	C3 diesel
	£m PV	£m PV	£m PV	£m PV	£m PV	£m PV
Net benefits to consumers and private sector (plus tax impacts)						
Rail user journey time benefits (local journeys)	2,216	2,051	2,103	2,029	1,973	2,021
Rail user journey time benefits (long-distance journeys)	226	234	201	272	296	250
Rail user fare benefits (local journeys)	1,229	1,161	1,190	1,138	1,127	1,116
Non user benefits - road decongestion, noise, air quality, greenhouse gases & accident benefits	704	644	662	640	630	643
Rail user and non user disruption disbenefits during possessions	-143	-120	-165	-170	-150	-201
Indirect taxation impact on government	-256	-232	-240	-229	-217	-235
Private sector investment contribution	0	0	0	0	0	0
sub-total (a)	**3,976**	**3,738**	**3,751**	**3,680**	**3,658**	**3,595**
Costs to government (broad transport budget)						
Initial capital costs (c')	1,893	1,598	2,195	2,258	1,995	2,663
Renewal costs (c'')	284	103	329	335	312	373
Non user benefits - road infrastructure cost changes	-6	-6	-6	-6	-6	-6
Revenue transfer (all journeys)	-825	-742	-751	-754	-723	-778
NR operating costs and TOC operating costs transfer**	999	1,084	1,064	1,069	1,079	1,056
sub-total (b)	**2,345**	**2,039**	**2,831**	**2,902**	**2,658**	**3,309**
Net Present Value (NPV) (a-b)	**1,631**	**1,699**	**919**	**778**	**1,001**	**286**
Benefit Cost Ratio to Government (BCR) (a/b)	**1.70**	**1.83**	**1.32**	**1.27**	**1.38**	**1.09**

These results show:

- There is a range of value for money results between the various options, from low to medium value for money.
- Routes E3 and A1 perform best, representing medium value for money. These two routes provide some of the highest PV benefits for the lowest PV costs.
- There is a relatively small range of PV benefits between options, but a significant range in the PV costs. Options A3, C1, E1 and E3 have notably higher costs than options A1 and E3 – this is driven mainly by variance in capital costs.

Diesel linespeed improvements

We tested the impact of additional works to improve the linespeed along the Marston Vale line for diesel options, shown below alongside the standard diesel results for options A1 and C1.

Results of socio-economic appraisal	A1 diesel	A1 diesel LSI	C1 diesel	C1 diesel LSI
	£m PV	£m PV	£m PV	£m PV
Net benefits to consumers and private sector (plus tax impacts)				
Rail user journey time benefits (local journeys)	2,216	2,289	2,029	2,096
Rail user journey time benefits (long-distance journeys)	226	245	272	287
Rail user fare benefits (local journeys)	1,229	1,244	1,138	1,164
Non user benefits - road decongestion, noise, air quality, greenhouse gases & accident benefits	704	736	640	668
Rail user and non user disruption disbenefits during possessions	-143	-149	-170	-176
Indirect taxation impact on government	-256	-272	-229	-240
Private sector investment contribution	0	0	0	0
sub-total (a)	**3,976**	**4,093**	**3,680**	**3,800**
Costs to government (broad transport budget)				
Initial capital costs (c')	1,893	1,977	2,258	2,335
Renewal costs (c")	284	293	335	343
Non user benefits - road infrastructure cost changes	-6	-6	-6	-6
Revenue transfer (all journeys)	-825	-897	-754	-802
NR operating costs and TOC operating costs transfer**	999	963	1,069	1,069
sub-total (b)	**2,345**	**2,329**	**2,902**	**2,940**
Net Present Value (NPV) (a-b)	**1,631**	**1,764**	**778**	**860**
Benefit Cost Ratio to Government (BCR) (a/b)	**1.70**	**1.76**	**1.27**	**1.29**

These results show that the costs of improving the linespeed for diesel options are more than matched by the benefits of doing so, slightly improving the value for money. The benefits are a combination of higher demand and lower operating costs.

Electrification

We tested the impact of electrifying the route, both as part of the initial construction and at a representative post-construction date (2041). The results are shown below alongside the standard diesel results for options A1 and C1.

Results of socio-economic appraisal	A1 diesel	A1 elec	A1 elec post	C1 diesel	C1 elec	C1 elec post
	£m PV	£m PV	£m PV	£m PV	£m PV	£m PV
Net benefits to consumers and private sector (plus tax impacts)						
Rail user journey time benefits (local journeys)	2,216	2,238	2,221	2,029	2,110	2,110
Rail user journey time benefits (long-distance journeys)	226	237	235	272	279	278
Rail user fare benefits (local journeys)	1,229	1,236	1,235	1,138	1,165	1,165
Non user benefits - road decongestion, noise, air quality, greenhouse gases & accident benefits	704	769	752	640	729	718
Rail user and non user disruption disbenefits during possessions	-143	-148	-147	-170	-176	-175
Indirect taxation impact on government	-256	-244	-244	-229	-225	-231
Private sector investment contribution	0	0	0	0	0	0
sub-total (a)	**3,976**	**4,089**	**4,051**	**3,680**	**3,881**	**3,864**
Costs to government (broad transport budget)						
Initial capital costs (c')	1,893	1,964	1,952	2,258	2,338	2,328
Renewal costs (c")	284	292	291	335	344	344
Non user benefits - road infrastructure cost changes	-6	-6	-6	-6	-6	-6
Revenue transfer (all journeys)	-825	-850	-832	-754	-812	-811
NR operating costs and TOC operating costs transfer**	999	819	869	1,069	938	979
sub-total (b)	**2,345**	**2,219**	**2,274**	**2,902**	**2,803**	**2,834**
Net Present Value (NPV) (a-b)	**1,631**	**1,870**	**1,777**	**778**	**1,078**	**1,030**
Benefit Cost Ratio to Government (BCR) (a/b)	**1.70**	**1.84**	**1.78**	**1.27**	**1.38**	**1.36**

These results show that the costs of electrifying the route are exceeded by the benefits of doing so. Electrifying the route during initial construction has a higher PV capital cost than electrifying later (due to discounting, inflation, etc.), but also enables the benefits of electrification (lower journey times leading to higher demand, and also lower operational costs) to be experienced for longer. Overall, an electrified route provides better value for money than a diesel route, and it is better value for money to electrify the route from the start than to electrify the route later.

90mph sensitivities

The central case was for a 125mph railway using IEP-type rolling stock. We tested the impact of reducing linespeed to 90mph and using a cheaper type of rolling stock. The results are shown below alongside the standard diesel results for options A1 and C1.

Note that we did not update the capital costs to reflect potential infrastructure cost savings of the lower running speed. This analysis reflects only the lower operational costs of the reduction in running speed.

Results of socio-economic appraisal	A1 Diesel	SENS A1 90	C1 Diesel	SENS C1 90
	£m PV	£m PV	£m PV	£m PV
Net benefits to consumers and private sector (plus tax impacts)				
Rail user journey time benefits (local journeys)	2,216	2,063	2,029	1,543
Rail user journey time benefits (long-distance journeys)	226	195	272	242
Rail user fare benefits (local journeys)	1,229	1,180	1,138	905
Non user benefits - road decongestion, noise, air quality, greenhouse gases & accident benefits	704	635	640	483
Rail user and non user disruption disbenefits during possessions	-143	-143	-170	-170
Indirect taxation impact on government	-256	-231	-229	-172
Private sector investment contribution	0	0	0	0
sub-total (a)	**3,976**	**3,699**	**3,680**	**2,830**
Costs to government (broad transport budget)				
Initial capital costs (c')	1,893	1,893	2,258	2,258
Renewal costs (c")	284	284	335	335
Non user benefits - road infrastructure cost changes	-6	-6	-6	-4
Revenue transfer (all journeys)	-825	-707	-754	-556
NR operating costs and TOC operating costs transfer**	999	832	1,069	787
sub-total (b)	**2,345**	**2,296**	**2,902**	**2,820**
Net Present Value (NPV) (a-b)	**1,631**	**1,403**	**778**	**10**
Benefit Cost Ratio to Government (BCR) (a/b)	**1.70**	**1.61**	**1.27**	**1.00**

These results show that, in this case, the operational cost savings do not make up for the reduced revenue and reduced user benefits that a lower linespeed provides. The value for money of option A1 falls remains medium, and of C1 remains low. However, this does not include the benefit from any potential capital cost savings.

Other sensitivities

The following sensitivity tests were also run:

- A sensitivity test on a 40% increase in capital costs reduces the value for money for option A1 from 1.7 (medium value for money) to 1.4 (low value for money).
- A sensitivity test on a reduced cost at Cambridge increased the BCR for option A1 from 1.7 to 1.9. This test assumed that EWRCS would only bear the incremental cost between the Gold and Platinum options at Cambridge, rather than the full cost for the Platinum option that is assumed in the central case here[12].
- A sensitivity test with reduced maintenance assumptions had a very small positive impact on the BCR of option A1, which remained at 1.7. This test reduced maintenance cost assumptions by 25% compared to the central case.
- A sensitivity test on the impact of a third party funding contribution (illustrative value of 30% of capital costs) increased the BCR for option A1 from 1.7 to 1.9. Note that this is in strict accordance with WebTAG guidelines which require that the funding contribution be reported not only as a negative cost but also as a negative benefit.

[12] The key difference between the Gold and Platinum options at Cambridge is that platinum includes grade separation of Shepreth Branch Junction.

5.0 Summary

There is a wide range of value for money results within the options appraised here. Within the six central case options, the best value for money is provided by route E3, which routes EWRCS services via a new Bedford South Parkway station and the existing Sandy station. This option has a BCR of 1.8, and demonstrates medium value for money. Route A1 also demonstrates medium value for money, with a BCR of 1.7. Route A1 serves a new Bedford South Parkway station, and then routes EWRCS services via a relocated Sandy South station. Other route options, which look at serving the existing Bedford Midland station and/or a relocated Sandy North station, provide medium or low value for money.

Note that this is in the context of a traditional transport appraisal, with the benefits mainly driven by variance in journey times between the options. These results do not include any assessment of wider economic benefits or freight benefits.

A series of sensitivities suggest that there is potential to improve the value for money of routes. Electrification as part of initial construction provides the largest increase in value, followed by electrification 10 years after opening, or, if a diesel option is chosen, a series of works to improve linespeed on the Marston Vale line. Further sensitivities suggest the value of reducing costs via a selection of measures, including cost-sharing at Cambridge, a potential third-party funding contribution, a more detailed understanding of the maintenance requirements of a new-build railway. Future development of any of these options, in a standard transport benefit context, should also consider detailed diagramming work and rolling stock decisions, both of which could reduce operating costs.