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# Investment in rail: the economic benefits

Note prepared for Rail Delivery Group

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## Summary of key points

- £50bn+ of investment to improve Britain's railway into the early 2020s by building new lines, upgrading existing track and manufacturing new trains will deliver £82bn–£84bn of extra economic benefits.<sup>1</sup>
  - Enhancement projects; investment to improve the existing rail network, carried out by Network Rail over Control Period 5 (CP5, between 2014 and 2019) alongside new trains (also called rolling stock) will generate around £52bn of benefits, including benefits to rail users, reduced congestion, and wider impacts on the economy over the lifetime of the schemes.<sup>2</sup>
  - Investments in new lines to complete Crossrail in CP5 and start HS2 Phase 1 between 2015 and 2019 will proportionally produce economic benefits of £27bn over their lifetimes.
  - In addition to enabling benefits from several enhancement projects, further investment in new trains will create benefits from improved quality as well as incremental service-level improvements. These economic benefits are expected to be between £3bn and £5bn.<sup>3</sup>
- The increases in spending by the rail industry associated with the enhancements delivered by Network Rail in CP5 could help to create up to 11,000 jobs in the rail sector and its supply chain.
- Network Rail will also deliver renewals investment, which will help the rail network to continue delivering economic benefits of up to £31bn per year, over and above the £82bn–£84bn. These will take the form of benefits to

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<sup>1</sup> In 2016 prices and values. The components of this overall figure have been assessed over their individual asset lives.

<sup>2</sup> It is important to note that these figures cannot be used in a benefit–cost ratio, owing to omissions from the figures. Specifically, the costs quoted here do not include the full capital costs of the schemes or any operating expenditure and revenue impacts. The benefits do not include indirect taxation or other benefits.

<sup>3</sup> Over an appraisal period of 30 years.

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users, reductions in congestion on the road network and wider impacts on the economy. These benefits amount to around £21 per passenger journey.

## 1 Introduction

Reflecting recent and planned investments in rail, the Rail Delivery Group asked Oxera to analyse the economic benefits of the following investments, building on our previous analysis of the benefits of the rail network:<sup>4</sup>

- renewals and enhancements to the railway infrastructure by Network Rail between 2014 and 2019;
- spending to complete the Crossrail project between 2014 and 2019;
- investment in HS2 from 2015 to 2019;
- nearly 5,700 new carriages being rolled out between 2014 and 2021.

For the purposes of this report we focus on the benefits of the planned investments in the rail network. Our analysis is not intended to provide a value for money assessment of the investments, though we do draw on existing value for money analysis where it is available.

### Box 1.1 Composition of recent and planned investment in rail

A total of £53.1bn will have been invested between 2014 and 2021.<sup>1</sup> This amount is composed of the following elements:

- around £12.7bn in **renewals** works during CP5. This represents on average over £2.5bn per annum invested in the existing infrastructure;
- £15.1bn in **enhancement** investment to the rail network which is substantively taking place in CP5, supported by investment in CP4 (approx. £5bn) and CP6 (approx. £6.5bn);
- £7.7bn in spending on **HS2** between 2015 and 2019;<sup>5</sup>
- almost £6bn planned investment in **Crossrail** during CP5;<sup>6</sup>
- £11.6bn of investment in new **rolling stock** and upgrades to existing vehicles by 2021.

Note: <sup>1</sup> All amounts are given in 2015/16 prices.

Source: Rail Delivery Group, Network Rail and DfT.

This report is structured as follows:

- section 2 describes the economic benefits of **renewals investments**;
- section 3 outlines the benefits of the **enhancement investments** being carried out by Network Rail and our estimate of the impact of these schemes on rail sector employment. We also consider the economic impacts of HS2 and Crossrail;
- section 4 outlines Oxera's estimates of the benefits of **rolling stock investments** in terms of capacity and rolling stock quality.

<sup>4</sup> Oxera (2014), '[What is the contribution of rail to the UK economy?](#)' July.

<sup>5</sup> In nominal terms. Source: Department for Transport, '[HS2: Outline Business Case Section 4: Financial Case](#)'.

<sup>6</sup> Department for Transport and Claire Perry MP (2015), '[Annual update on Crossrail 2015, Written statement to Parliament](#)', 2 July.

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## 2 Economic benefits of renewals investments

### 2.1 Benefits of renewals

As a part of ongoing investment in rail, renewals investments in the existing infrastructure, alongside ongoing expenditure on operations and maintenance, will allow the network to continue delivering economic benefits to Great Britain.

In a previous piece of analysis for the Rail Delivery Group, we estimated the value of the rail sector compared to a scenario where there is no rail network. It is worth noting that this 'no rail sector' scenario has been created to provide valuable insights into the size of the sector in the economy and is not a judgement on what would happen if this decision were ever made.

We then value the benefits using principles from the DfT's appraisal guidance. Our analysis suggested this could be up to £31bn per year including the following elements:

- user benefits of the network, for freight and passenger services (up to £17bn per year): these benefits accrue from passenger journeys and freight transport being made faster and less costly to users compared to the alternative of road travel;
- non-user benefits through reduction of congestion on the roads (up to £12bn per year);
- wider economic impacts (up to £2bn per year): rail contributes to the wider economy by increasing the productivity of firms through agglomeration economies, the benefits from closer links between businesses and easier access to current and potential employees, and by making production less costly for firms (increased output).

### 2.2 Apportionment of existing rail benefits by sector

We have apportioned the following impacts across industry sectors. This represents a sub-set of the overall benefits of rail, focusing on benefits that can be linked directly to businesses.

- business passenger user benefits;
- freight user benefits;
- road congestion relief for business travellers and road freight users;
- wider economic impacts.

For business travel and freight user benefits, we have assumed that benefits accrue to different sectors in proportion to each sector's spending on rail travel services based on the Office for National Statistics' (ONS) Input-Output tables.

The remaining benefits would not be captured by the ONS data as it does not involve direct purchases by businesses from the rail sector. As an approximation, we have apportioned commuting travel, congestion relief and wider economic impacts under the assumption that the use of rail services varies simply in proportion to gross value added (GVA) by sector.

We began by distributing rail benefits across sectors according to each sector's share of GVA at the regional level using ONS data on regional GVA by sector. We then summed across all regions to give an estimate of rail benefits by sector.

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The results, totalling an estimated £8bn of the up to £31bn annual benefit, are shown in the table below.

For agglomeration benefits, we have weighted the distribution of benefits based on sector-level parameters recommended by the DfT.<sup>7</sup> This is to reflect the fact that service sectors tend to benefit more from agglomeration economies.

**Table 2.1 Estimated sectoral distribution of rail benefits (£m)**

Sector	Estimated benefit from rail
Agriculture, mining and utilities	300
Manufacturing	800
Construction	200
Distribution, transport, accommodation and food	2600
Information and communication	700
Finance	500
Real estate	500
Professional and business support services	1900
Public services	600
Recreation and other services	200

Source: Oxera analysis of ONS data.

### 3 Economic benefits of enhancement investments

Spending on enhancements will include a range of projects across the country. We have considered the economic benefits of these projects based on existing appraisals conducted by Network Rail and the DfT. For HS2 and Crossrail there are publicly available appraisals published as part of the business cases for these schemes.

#### 3.1 Benefits of enhancement investments

The enhancement investments delivered by Network Rail will generate £52bn in benefits to users, reduced road congestion and wider economic impacts.

Over the lifetime of these schemes, appraisals conducted by the DfT and Network Rail for these schemes suggest benefits of:<sup>8</sup>

- around £33bn in user benefits for both passenger and freight users. These benefits include the value of time saved due to quicker journeys;
- £10bn in non-user benefits, which accrue to those who are not directly using the rail network. We understand that in these appraisals, non-user benefits come primarily from congestion relief on the road network and do not include wider economic impacts.

We have conducted a high-level estimate of the potential wider economic impacts of these schemes.

##### 3.1.1 Top-down estimate of wider economic impacts

The user and non-user benefits quantified in Network Rail and the DfT's appraisals of the enhancement schemes do not include wider economic impacts.

<sup>7</sup> See Department for Transport (2014), 'TAG UNIT A2.1 Wider Impacts'.

<sup>8</sup> All numbers expressed in 2016 prices.

We have produced an order-of-magnitude estimate of these benefits for the enhancement schemes being delivered through the planned investment in rail. For each of the wider economic impacts, we have surveyed the literature to derive a percentage uplift of each wider economic impact over user benefits.

- **Agglomeration:** a 2014 Centre for Cities study<sup>9</sup> suggests an agglomeration uplift of 12% over user benefits for schemes in Leeds. However, London's much higher firm density suggests that it experiences significantly higher agglomeration benefits—for example, the government's appraisal of Crossrail suggested that agglomeration benefits would be 24% of user benefits. We have applied an uplift of 18% based on a study conducted by Steer Davies Gleave (SDG), which reviewed a number of studies drawn from a range of countries.<sup>10</sup>
- **Increased output:** as for existing benefits, we have uplifted business user benefits directly, employing the assumption that user benefits from these enhancement schemes arise in a similar proportion to benefits of the network as a whole.
- **Labour force participation:** based on the SDG study cited above, we have applied a fixed percentage uplift of 6.7% to user benefits.

Applying these figures to the enhancement projects, we find that if the wider economic impacts generated by the enhancement schemes were similar in size to those observed in other transport schemes,<sup>11</sup> they would increase the total benefits by around £9bn. We would caution that this is a broad estimate. The DfT's suggested methodology for estimating wider economic impacts involves a detailed assessment on a scheme-by-scheme basis, which has not been conducted for the purposes of this report. However, including this figure, the total benefit of the enhancement programme would amount to around £52bn.<sup>12</sup>

### 3.1.2 Employment impact of enhancement schemes

The spending delivered by Network Rail's enhancement schemes will also result in an increase in operating expenditure, which could in turn generate additional employment in the rail sector and its supply chain. Previous analysis by Oxera suggests that around 240,000 workers are employed either directly in the rail industry or in the rail supply chain.<sup>13</sup>

It is possible to make a broad estimate of the impact on employment by assuming that an increase in operating costs would result in an increase in wages (i.e. direct new employment for the sector) or intermediate consumption (which would generate indirect employment from the rail supply chain) in line with their current proportions within the sector. We have applied this ratio to the uplift in operating expenditures associated with the investment in enhancements delivered by Network Rail.<sup>14</sup>

On this basis, we have calculated that direct and indirect employment would increase by around 11,000. It is important to note that this would not necessarily

<sup>9</sup> Marshall, A. and Webber, C. (2014), 'The case for better transport investment: Agglomeration and growth in the Leeds City Region', Centre for Cities.

<sup>10</sup> Kernohan, D and Rognlion, L. (2011), 'Wider economic impacts of transport investment in New Zealand', Steer Davis Gleave, September.

<sup>11</sup> Kernohan and Rognlion (2011) found that the wider economic impacts added a percentage uplift of 33% over user benefits. This is in line with the numbers obtained by Oxera.

<sup>12</sup> Expressed on a yearly basis, the total benefits are around £1.43bn per annum.

<sup>13</sup> Oxera (2014), 'What is the contribution of rail to the UK economy?', July.

<sup>14</sup> This increase has been annualised assuming a constant profile of expenditure over the appraisal periods covered.

mean an overall increase in the economy as a whole due to the likelihood of displacement of activity elsewhere.

### 3.2 High Speed 2 and Crossrail investments

Current investment in rail also includes spending on new routes including the HS2 and Crossrail projects.

Both of these projects have been subject to value-for-money assessments. We can therefore use these assessments to estimate the benefits of the investment into these projects detailed in the Plan.

The most recent economic appraisal for HS2 comes from the October 2013 Business Case. The benefits of HS2 Phase 1 included both user benefits to passengers and wider economic impacts.<sup>15</sup> We have not included any consideration of the potential benefits of HS2 Phase 2, which is currently under consideration. For Crossrail, the 2011 Business Case Update provides the most up-to-date economic assessment. Again, this assessment considered both user benefits to passengers and wider economic impacts. Furthermore, the Crossrail appraisal quantified congestion relief to users of the existing transport network.

A summary of the two appraisals is shown in Table 3.1.

**Table 3.1 Total appraisal benefits for HS2 and Crossrail (2016 £bn)**

	HS2 (Phase 1)	Crossrail
Transport user benefits	31	14
Public transport crowding relief	Not assessed separately	11
Wider economic impacts	6	13
Other*	-2	-2
Present value of benefits	35	36

Notes: \* 'Other' primarily consists of lost indirect tax revenue.

Source: HS2 Business Case Update; Crossrail Business Case.

The investments included in CP5 represent a significant proportion of the total investments in both projects but do not account for the entire cost of either. We also note that wider economic impacts make a significantly larger contribution to the overall benefits for Crossrail than would typically be expected for a transport investment. This might be the case because of, for example, the higher levels of employment density and productivity seen in the Crossrail service area, both of which could drive higher wider economic impacts.

We have calculated the benefits associated with the spending on these projects between 2015 and 2019 by multiplying the benefits by the share of the total costs being incurred over this period. The results suggest that this phase of spending will be worth £15bn of benefit for HS2 and £12bn for Crossrail.

## 4 Rolling stock investments

As part of the investment programme, there will be a significant package of investment in new rolling stock and upgrades to existing vehicles.

The benefits from some of these rolling stock investments have been appraised by Network Rail and DfT as a part of the enhancement investments analysed

<sup>15</sup> Consistent with the DfT definition.

above. The rolling stock investments, along with other improvements, will help generate £52bn in economic benefits, as noted above. However, the rolling stock included in these appraisals represents around 60% of the planned increases. Moreover, some of the appraisals included benefits just from increased capacity, and not from improved comfort and quality of rolling stock.

We have therefore conducted an indicative assessment of:

- capacity benefits from the remaining investments in rolling stock not already appraised by Network Rail or the DfT;
- benefits from improved on-board passenger experience due to better quality, for the investments not already appraised and those for which only capacity benefits had been taken into account.

Overall, our order-of-magnitude estimation finds that these investments would add a further £3bn–£5bn in benefits to users of rail services in the UK, assuming a rolling stock asset life of 30 years.<sup>16</sup>

Furthermore, in some cases, investments in new rolling stock constitute a form of renewal thereby allowing existing benefits of the network described in section 2 to continue, on top of bringing improvements to capacity and quality of the network. The impacts quantified in this section capture only incremental improvements (and only those improvements not already included in the assessments by Network Rail or the DfT).

#### 4.1 Benefits from increased capacity

We have received high-level information from train operating companies (TOCs) on the rolling stock investments that had not been appraised before.<sup>17</sup> Based on this information, we have determined for each TOC a percentage uplift to capacity resulting from new purchases and upgrades. This increase in capacity has been assumed to materialise through two channels: reduced crowding of existing services and increased frequency.<sup>18</sup>

For **frequency**, we have used the average waiting time computed from the National Travel Survey (NTS). For each TOC, the increase in frequency from this baseline has been converted to monetary terms through generalised journey time (GJT) service interval penalties based on coefficients from the Passenger Demand Forecasting Handbook (PDFH).<sup>19</sup>

For **crowding**, we have used data from the DfT to map crowding levels to TOCs through the stations they operate. Based on this information and the average proportion of journeys during peak times (computed using NTS data), we have calculated the equivalent impact on GJT from reduced crowding, consistent with the PDFH. This reduction in GJT and its impact on passenger demand have then been converted to monetary terms using values from WebTAG.<sup>20</sup>

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<sup>16</sup> In practice, the asset life of rolling stock can be considerably higher than 30 years. In this sense, our estimate could be viewed as being conservative.

<sup>17</sup> See Appendix A2 for details of the schemes considered here.

<sup>18</sup> When the information received did not allow for a more refined breakdown, an indicative split between capacity resulting in reduced crowding or increased frequency has been assumed.

<sup>19</sup> Average baseline GJT values have been taken for different types of lines (London South East, regional, long-distance). A national average of value of time (VoT) has been used.

<sup>20</sup> Using an appraisal horizon of 30 years.

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Given the high-level nature of our assessment and the uncertainty around the effects of certain investments, we have assessed the benefits from increased capacity as a range.

#### **4.2 Benefits from improved quality**

Purchases of new—and upgrades to existing—rolling stock also generate benefits by improving the on-board passenger experience of train service users. These benefits had not been previously quantified for all schemes, hence we conducted an indicative assessment based on information from TOCs on the nature of improvements.<sup>21</sup>

In the absence of more precise information, we have estimated the benefits as a range based on different assumptions regarding the magnitude of the improvements. To this effect, we have applied the methodology set out in the PDFH, using updated coefficients estimated for the Passenger Demand Forecasting Council by Systra in 2016.<sup>22</sup>

We have estimated a range of benefits based on national average values for GJT, value of time and other WebTAG parameters. We have considered key aspects of rolling stock quality based on broad patterns in improvements described by the TOCs. However, we have not conducted a detailed assessment of the different schemes. As such, our estimates should be treated as indicative. To reflect the uncertainty associated with these judgements, we have produced a range of estimates for this aspect of the improvements.

The lower and upper ends of the range rest on different assumptions regarding the magnitude of the improvements—respectively, more modest changes and step changes to some train features.<sup>23</sup>

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<sup>21</sup> Due to the absence of information on cascading from most TOCs, we have not specifically quantified the impact of cascading existing vehicles.

<sup>22</sup> Systra and ITS Leeds (2016), 'Valuations of rolling stock improvements', October.

<sup>23</sup> These include Wi-Fi provision, availability of power sockets, quality and temperature of the air, and passenger information system.

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## A1 Evaluated enhancement schemes

Table A1.1 lists the enhancement schemes included in our analysis, based on information provided by Network Rail and the DfT.

**Table A1.1 Enhancement schemes**

	<b>Project name</b>	<b>Appraisal source</b>
1	Chiltern Main Line train lengthening	NR
2	Uckfield line train lengthening	NR
3	Stafford area improvement scheme	NR
4	Gospel Oak to Barking electrification	NR
5	Gordon Hill turnback	NR
6	Anglia Traction Power Supply Upgrade – Brimsdown traction power feed	NR
7	Chesterton Station	NR
8	East Kent Resignalling Phase 2: Enhancements	NR
9	CP5 Freight Schemes funded via Strategic Freight Network funding	NR
10	Tram Train Pilot	NR
11	Waterloo	NR
12	Sussex traction power supply upgrade	NR
13	West of England DMU capability works	NR
14	Western Route Resilience	NR
15	Acton (Great Western Main Line) to Willesden (West Coast Main Line) electrification	NR
16	Walsall to Rugeley electrification	NR
17	Northern Hub & North West Electrification	NR
18	Western Route Modernisation (excluding Reading to Basingstoke and Cardiff to Swansea)	DfT
19	Midland Mainline KO1	DfT
20	East Coast Enhancements	DfT
21	Thameslink KO1+ KO2	DfT
22	Borders Railway	Transport Scotland
23	Edinburgh Glasgow Improvement Programme	Transport Scotland

Note: NR, Network Rail.

Source: Network Rail; Department for Transport.

## A2 Rolling stock purchases included

Table A2.1 lists the rolling stock purchases based on information provided by RDG and Network Rail.

**Table A2.1 Rolling stock projects**

TOC/project	Description	Carriages	Appraised by NR/DfT <sup>1</sup>
Great Western Railway/ Virgin Trains East Coast	Intercity trains	866	Yes
Great Western Railway	Intercity trains	208	No
Hull Trains	Intercity trains	25	No
Transport for London's Elizabeth line	Electric trains	594	Yes <sup>1</sup>
Thameslink route	Electric trains	1,140	Yes
Gatwick Express	Electric trains	108	No
ScotRail	Electric commuter trains	234	No
London Overground	Electric commuter trains	180	No
Great Western Railway	Electric commuter trains	180	Yes
Thameslink	New trains	116	No
South Western Railway	Electric trains	150	Yes <sup>1</sup>
Caledonian Sleeper	New carriages	75	No
c2c	Electric commuter trains	24	No
c2c <sup>2</sup>	Further electric trains	68	No
Northern	Electric and diesel trains	281	No
TransPennine Express	Electric and diesel trains	220	No
Great Northern Route	Electric trains	150	No
Greater Anglia	Replacement of fleet	1,043	No

Note: <sup>1</sup> For some projects appraised by Network Rail, we have quantified quality benefits. Capacity benefits for these projects are included in appraisals of corresponding enhancement schemes. <sup>2</sup> c2c is undergoing a procurement process so the quality benefits have not been assessed.

Source: Rail Delivery Group; Network Rail.