## HS2 Summary comment and data

**May 2010**
**Updated September 2010**

**The update** relates to (a) "Incremental fares": item (3) under the heading "Economic analysis" and the associated end note suggests that the DfT cannot sustain the subtraction of incremental fares from costs within the economic analysis. The consequence is that no railway scheme is ever likely to pass the cost benefit test (b) Emissions: an additional paragraph under that heading shows that, far from HS2 being carbon neutral, it will increase emissions (c) frequency of use: an additional paragraph following the first under the heading "Other comment" shows that only one person in 70 people is likely to use HS2 more than once a year.

We also note that one reason now being advanced for proceeding with this project is that, if it were abandoned, the £9 million alleged to be spent on studies would be wasted. That seems to be one of the worst possible reasons that can be imagined. After all the £9 million amounts to only one two-thousandth part of the proposed capital expenditure.

**Sources:** The data in this note is from the reports by HS2 Ltd or their references. The main source is the report with the title High Speed Rail London to the West Midlands and Beyond: A Report to Government, dated 11th March 2010, here referred to as the main report and available at http://www.dft.gov.uk/pgr/rail/pi/highspeedrail/hs2ltd/hs2report/

**Dates and price base:** The earliest start date for the construction of HS2 is 2019. That provides an opening year of 2026. The main report suggests 2008 is the base year for flows but the base line forecasting report refers to 2007/8. The present value year for discounted values is 2009. The price base for costs is also 2009. The forecast year is 2033 after which no further passenger growth is assumed.

**The proposals:** HS2 proposal is the solid line in the diagram opposite (figure 6.1f of the main report). It provides a double track connecting Euston to the WCML north of Birmingham. The line length is 180 km and the cost £16.5 bn, including optimism bias. The aspiration is to:

(a) Extend to Manchester and Leeds creating a Y-shaped, core network at a further cost of £11.4 bn, providing £28 bn in total and a line length of 500km.
(b) Further extend from Manchester to Glasgow and Edinburgh and from Leeds to Newcastle with the addition of a trans-Pennine link from Manchester to Leeds at a cost of £24 bn, providing a total of £52 billion and a line length of circa 1100 km.
(c) Further extend from Newcastle to East Scotland at a cost of £12.7 bn providing a total cost of circa £65 bn and a line length of 1360 km. Adding rolling stock yields £68 bn.

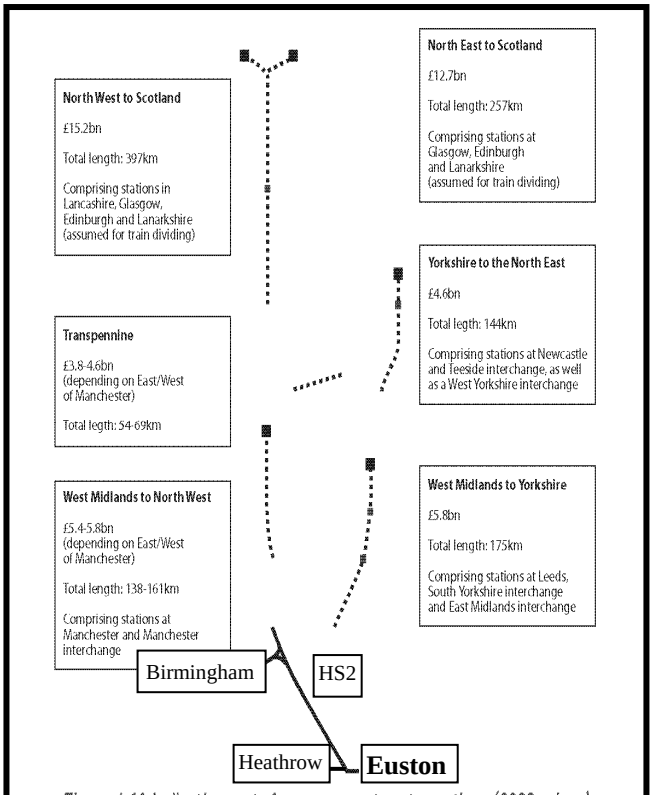

*Figure 6.1f Indicative costs for component route sections (2009 prices)*

**The trains:** The trains would be 207 metres long and contain 550 seats. They may be coupled together so as to provide double length trains with 1,100 seats (main report paragraph 3.10.8). The line speed is to be 400 kph or 250 mph.

There would be 16 trains capable of operating only on the high speed line. Those trains would cost £30 million each, or circa £55,000 per seat. In addition there would be 45 trains

that could run on both the high speed lines and classic rail. Those trains would be more complex and may cost £52.5 million each, or £95,000 per seat. These costs include allowances for risk (or optimism bias) of 17% and 40% respectively. The trains are said to have a life of 35 years. The total capital for the rolling stock is £2.835 bn.

**Passenger forecasts:**

The forecasts for HS2 are extraordinarily high, amounting to 145,000 (arrivals plus departures) per weekday at Euston in 2033. In the base year (2007/8) there were some 33,000 who would have transferred to the HS2 line if it had existed. By 2033 wealth and population growth would increase that to 83,000, or by a factor of 2.5, corresponding to exponential growth of 3.6% per year, or to 42% per decade. By 2033 the higher speed would generate a further 39,000 passengers and attract 11,600 from cars and the same from air, providing a total of some 145,000, 4.4 times the 33,000 base year flow. References for and the derivation of these flow are in Appendix 2.

Table 11.5a of the Demand Model Analysis, http://www.dft.gov.uk/pgr/rail/pi/highspeedrail/hs2ltd/demandandappraisal/pdf/report.pdf, provides that if the rest of the network were built there would be 219,000 passengers per day at Euston. Of those 136,000, or 62%, would be generated or attracted from car and air.

**Service frequency:** The technical appendices at http://www.dft.gov.uk/pgr/rail/pi/highspeedrail/hs2ltd/technicalappendix/pdf/report.pdf claim that the 145,000 passengers per day at Euston would be satisfied by 9 trains per hour in each direction (one every 6 minutes 40 seconds) plus two trains per hour at peak times. If that is conceived as operating for 16 hours there would be 146 trains per day in each direction, each carrying an average of nearly 500 passengers. Alternatively, if we conceive demand being met by trains carrying 400 passengers for 12 hours then 15 trains per hour in each direction would be required, or 180 per day.

If the aspirational network were built, so that there would be 219,000 passengers per day at Euston, the demand would require 13 trains per hour in each direction for 16 hours, each with 500 passengers aboard. That implies a train every four and a half minutes.

**Economic analysis:** The claim is that HS2 will return £2 for every £1 spent. The detail is in figure 4.3a of the main report, reproduced below.

| Quantified Costs and Benefits of HS2 (PV 2009 discount year and prices) | | | |
|---|---|---|---|
| Item | | Business | Other |
| (1) | Transport User Benefits | £17.6bn | £11.1bn |
| (2) | Other Benefits (excl. Carbon) | less than £0.1bn | |
| (3) | Net Transport Benefits (PVB) = (1) + (2) | £28.7bn | |
| (4) | Wider Economic Impacts **(WEIs)** | £3.6bn | |
| (5) | Net Benefits incl WEIs = (3) + (4) | £32.3bn | |
| (6) | Capital Costs | £17.8bn | |
| (7) | Operating Costs | £7.6bn | |
| (8) | Total Costs = (6) + (7) | £25.5bn | |
| (9) | **Revenues** (Alias incremental fares) | £15bn | |
| (10) | Indirect Taxes | -£1.5bn | |
| (11) | Net Costs to Government (PVC) = (8) – (9) – (10) | £11.9bn | |
| (12) | NATA BCR = (3)/(11) | 2.4 | |
| (13) | BCR with WEIs = (5)/(9) | 2.7 | |

The benefit to cost ratios (BCR) of 2.4 and 2.7, at rows (12) and (13), in this table are substantially above the minimum value of 1.5 at which the scheme would be accepted. The BCR for wider network excluding the link from Newcastle to Edinburgh is 2.3, which is similarly encouraging. However:

(1) (Obviously) the benefits depend on the very high forecasts cited above.

(2) Sensitivity tests (main report paragraphs 4.4.5 and 4.4.8) show that if the annual growth in demand were reduced by 25%, from 3.6% to 2.7%, or if the demand were curtailed at the 2026 level then the benefit to cost ratio would fall below the necessary value of 1.5.

(3) Revenues or incremental fares of £15 bn are subtracted from costs. Those fares depend on where the economic boundary is drawn. Network Rail was selected, so as to represent the costs as the cost to the Government. However, we are interested in the cost to the nation. Hence, the correct place for the boundary is not round "the Government" but round the economy as a whole. If the latter is selected incremental fares fall to zero. Likewise the Indirect Taxes of minus £1.5 bn should be struck out. The BCRs then falls to 1.125, with no WEIs and to 1.27 with the WEIs, both far below the desired value of 1.5.
Since first publishing this note, May 2010, the DfT has effectively thown in the sponge on this issue, see the note below. The consequence is that no railway scheme is ever likely to pass the cost benefit test.

(4) The value of time is assumed to grow exponentially for ever at circa 1.8% per year (different rates apply to different periods and for work and leisure time, see the WEBTAG). We estimate that if that is set to zero the benefits would be halved.

(5) Likewise fares, in so far as they are relevant, are inflated at 1% above inflation (paragraph 2.14 of the base line forecasting report) and GDP growth is set to 2%. That introduces two other contentious factors.

(6) Our calculations (see spread sheet) show that about 40% of the benefits are derived from the later 30 years of the 60 year evaluation period ending in 2085. Many people believe that benefits from such a remote future should not be included. If they are not the benefit to cost ratio would again fall below the desired value of 1.5.

Any one of the above factors may destroy the economic case for the proposal. Taken together they are overwhelming.

**Costs:** Appendix 1 provides more detail and identifies anomalies that we have not resolved.

In any event the costs and benefits in the cost-benefit table above do not represent the actual expenditures. Instead they represent the values at the 2009 price base, which, if invested at the Treasury Discount rates would generate the cash flows that will arise. Hence, if for simplicity we view all capital expenditure as arising in the mid construction year of 2022, 13 years after 2009, then, since the Discount rate for that period is 3.5%, the sum required will be £27.8 at billion at 2009 prices rather than a mere 17.8 billion . £27.8 billion is equivalent to £1,100 for every household in the land.

**Fares:** These would be the same as for conventional rail and are to inflate at 1% above inflation annually.

**Emissions:** The net CO2 emission attributable to HS2 has the range minus 25 to plus 26.6 Mega Tonnes. Paragraph 4.2.33 of the main report concludes that HS2 "would not be a major factor in managing carbon in the transport sector".

However, that presumes the generating industry's emissions will be cut from its current value of 550 gms of CO2 per KWh to 385. More importantly, because large scale increases in demand will prolong the life of coal fired generation, or increase coal fired generation above the value that may otherwise arise, it is not the industry average that should be used in calculations but, subject to the distant prospect of carbon capture, the emissions from the coal fired. That is double the current industry average or nearly three times the value that the HS2 report uses. Hence, rather than being carbon neutral this project, along with other electrification schemes will increase the UK's emissions unless all coal fired generation is capped or abandoned.

**Eddington:** The HS2 reports refer to the Eddington Report as though it provided support. In fact it does not. Instead it says "The principal task of the UK transport system is not, in comparison to the needs of France or Spain, to put in place very high speed networks to bring distant cities and regions closer together..... Instead, because the UK's economic activity is in

fact densely located in and around urban areas, ... the greater task is to deal with the resulting density of transport demand".

**Other comment:** Richard Bowker, when Chairman of the Strategic Rail Authority, boasted, in Everyone's Railway (2003), that "nearly half the population of Britain uses a train at least once a year". He appears to have overlooked the corollary, namely, that over of us half used a train less than once a year, let alone a high speed one.

Taking that point forward, (a) today 56% of us use rail at least once a year (b) only circa 5% of rail trips are longer than 100 miles and (c) the proportion of those long distance trips that lie in the HS2 corridor is unlikely to be above 50%. Hence, only one person in 70, or 1.4% of us, is likely to use HS2 more than once a year [(56% x 5% x 50%) = 1.4%].

Those from the top quintile of household income travel five times as much by rail as do those from either of the bottom two quintiles. One of the reasons put forward in support of the proposal is that the existing line is running out of capacity. Since the railways make a massive loss the obvious solution is to balance supply and demand by raising fares but that has not been considered.

**Conclusion:** The passenger forecasts are unbelievably high. Despite that the lifetime cost of this project is nearly double the projected fares income.

The underlying theory adopted by the Treasury for evaluating such projects appears flawed in that instead of the cost relating to the cost to the nation as a whole the value used is the cost to the Government. Consequently incremental fares are subtracted from costs. That inflates the HS2 Benefit to Cost Ratios by a factor of two.

The analysis also assumes that GDP and the value of time will grow exponentially throughout a 60 year evaluation period ending in 2086. Without those assumptions the economic case for the scheme would collapse. Furthermore, sensitivity tests carried out by the proposers show that, despite the extravagant assumptions made, reducing the extraordinary passenger growth by 25% or curtailing it in 2026 instead of in 2033 would lead to the project failing the cost benefit test.

Taken together those issues destroy the credibility of the analysis. Instead of benefiting the nation the taxes required to finance this project will almost certainly destroy profitable jobs in the real economy, and contribute to our impoverishment.

**……..**

**Note on incremental fares**

As in the text above, incremental fares are subtracted from scheme costs so as to find the net cost to the Government. However, it is the cost to the nation that should be of concern. If the economic boundary is widened to embrace the economy as a whole the incremental fares fall to zero. We put it to the DfT as follows:

> "Let us call those services which would lose revenue to HS2 the 'liquorice all-sorts industry'. Why should we exclude that industry's loss from the analysis upon finding that the services are "liquorice" whilst including the loss on finding that the "all-sorts" are buses and trains? There is, of course, no rational answer, and the economic case underpinning HS2, and all other rail projects, collapses".

The response opens with the paragraph:

"Your letter of 08 June suggested that rail services were in principle no different from any other goods and services. If this were the case, we would leave the provision of such services and the networks on which they operated entirely to the private sector".

We comment, by claiming rail is a special case, when it is not, and by ignoring the point being made, the DfT has effectively thrown in the sponge on this issue. The implication is that Incremental fares should indeed be struck out, in which case projects such as Crossrail and HS2 fail the cost benefit test by wide margins.

# APPENDIX 1: COST DATA

This appendix (a) provides details of costs and (b) draws attention to anomalies that we cannot explain.

**Construction costs:** Paragraph 2.4.1 of the Cost and Risk Model, available at http://www.dft.gov.uk/pgr/rail/pi/highspeedrail/hs2ltd/riskmodel/pdf/report.pdf, provides the tabulation below, where the costs relate to HS2 only. There is a small but worrying discrepancy (10%) between the construction risk of £1.12.bn and the 18% in paragraph 2.3.3.

**TABLE A1: Construction costs**

| **Item** | **Cost £** |
|---|---|
| Permanent Way | 313,539,394 |
| Switches and crossings | 35,000,000 |
| OHLE and power supply | 251,746,953 |
| Signalling and communications | 200,310,127 |
| Stations | 1,630,000,000 |
| Earthworks | 634,526,481 |
| Retaining walls | 51,598,350 |
| Structures | 560,785,050 |
| Tunnel | 1,466,087,500 |
| Road | 90,010,600 |
| Utilities | 171,203,009 |
| Additional items (construction) | 473,162,500 |
| **Base construction** | **5,877,969,963** |
| Contractor administration on-costs | |
| Preliminaries and General items | 587,796,996 |
| Site Supervision | 293,898,498 |
| Testing and commissioning, training and spares | 56,041,753 |
| **Base construction + on-costs** | **6,815,707,211** |
| Construction risk (location-specific) | 1,120,941,122 |
| Ancillary Items (additional environmental mitigation) | 215,231,818 |
| Land compensation | 930,000,000 |
| **Total Construction Cost** | **9,081,880,151** |
| HS2 costs | |
| HS2 project management | 726,550,412 |
| Design including consultancy charges (legal, advisory etc.) | 726,550,412 |
| Rail interface costs (possessions, isolations, TOC compensation) | 174,674,328 |
| Topographical/ground investigation surveys | 31,000,000 |
| Statutory charges | 200,000,000 |
| Depot/stabling | 250,000,000 |
| Programme construction risk allowance | 1,104,916,667 |
| Cost escalation allowance (all prices at Q3, 2009) | – |
| **Estimated Total Scheme Cost inc. QRA risk** | **12,295,571,9** |

The total in the table is £12.3 bn. However that excludes optimism bias, amounting to an additional 34%, yielding a total of **£16.5 bn**, see section 7 of the Cost and Risk Model report..

**Rolling stock costs:** Para 4 1.20 of the main report provides the following data table. The capital of £2.835 bn is inclusive of risk, which is confirmed as optimism bias in section 4 of the Cost and Risk Model report.

**TABLE A2 Rolling stock capital costs**

| Rolling stock type | £m | Comments |
|---|---|---|
| HS captive fleet (16 sets) | 472 | Includes risk provision of 18% (standard, off-the-shelf, European designs; relatively low risk) |
| HS classic-compatible fleet (45 sets) | 2,363 | Includes risk provision of 40% (higher risk reflecting greater complexity and commercial viability of UK-specific design and development) |
| Total | 2,835 | At 2009 prices |

Figure 4.1j Rolling stock capital cost estimates (2009 prices).

**Present value costs:** Table 10.3 of the Demand Model Analysis, available at http://www.dft.gov.uk/pgr/rail/pi/highspeedrail/hs2ltd/demandandappraisal/pdf/report.pdf is reproduced below**.** The totals were taken forward to the economic analysis:

**TABLE A3 Present values for costs**

| **Capital Expenditure** | £ billion |
|---|---|
| Construction | 13.7 |
| Rolling Stock | 3.0 |
| Renewals | 1.1 |
| **TOTAL Capital Costs** | **17.8** |
| **Operating & Maintenance** | |
| Track | 0.8 |
| Stations | 0.4 |
| Train Maintenance | 3.3 |
| Train Operation | 4.0 |
| Classic Line Savings | -1.0 |
| **Total Operating & Maintenance Costs** | 7.6 |
| **TOTAL COSTS (PVC)** | 25.5 |

**Operating costs:** Paragraph 5.1.1 of the Cost and Risk Model report at http://www.dft.gov.uk/pgr/rail/pi/highspeedrail/hs2ltd/riskmodel/pdf/report.pdfb provides the following:

**TAPLE A4 Operating cots**

| Item | Cost |
|---|---|
| HS2 Infrastructure Operations & Maintenance | £180,000/route-km/year |
| Rolling stock maintenance HS captive | £2.80/km |
| Rolling stock maintenance HS classic compatible | £3.50/km |
| Traction Power (**See note**) | £2.80/km |
| Train crew – driver | £0.78/km |
| Train crew – conductor | £0.56/km |
| Station staffing 10 platform terminus | £5,626,000/year |
| Station staffing 6 platform through | £2,089,000/year |
| Station staffing 4 platform through | £1,649,000/year |
| Station staffing 6 platform terminus | £2,931,000/year |
| Station maintenance and utilities (4 platforms) | £474,000/year |

**Note.** Report para 5.2.4. provides "For a 200m train set, the model calculates energy consumption of 28 kWh/km. Assuming a cost of 10p/kWh, the traction power cost is £2.80/km".

In paragraph 5.3 we read "For modelling purposes, an uplift of 41% **has been applied** to the opex costs reflecting the early stage of development of these costs and absence of QRA". We comment, it is not clear whether the uplift has been applied to data in the table or whether it is to be applied subsequently. Probably it is the later.

**Anomalies:** Reference table A3 above:

(1) The present value for construction of £13.7 bn is inconsistent with the £16.5 from the text below Table A1 in that if we discount the £16.5 bn at 3.5% from the mid construction year of 2022 to the present value year of 2009 we get £10.55 bn, not £13.7 bn. Conversely, if we inflate £13.7 bn at 3.5% from 2009 to 2022 we get £21.54 bn, not £16.5 bn.

(2) The present value of £3 bn for rolling stock is inconsistent with the of £2.835 bn from Table A2 in that if the £2.835 bn is discounted from 2022 to 2009 it yields 1.8 million, not £3 bn.

We have sought an explanation from HS2 Ltd but without success.

# APPENDIX 2: PASSENGER FORECASTS

The table below provides the weekday HS2 passenger flows to the north of Euston. The main reports do not provide the same data directly. Instead we have made the best estimates we can by interpreting various of the HS2 data as explained below the tabulation.

| | Weekday long distance arrivals plus departure at Euston | | | | | |
|---|---|---|---|---|---|---|
| | Remaining On the WCML | HS2 High speed rail Trips | | | | |
| | | From classic rail | Generated trips | Ex Air | Ex Road | Totals |
| HS2 2007/8 (a) | 8,714 | 33,160 | 15,720 | 4,172 | 8,055 | 61,107 |
| HS2 2033 (b) | 21,785 | 82,900 | 39,300 | 11,600 | 11,600 | 145,391 |

(a) Except for the generated trips we have estimated the 2007/8 trips by dividing the 2033 values by the study growth factors apparent from the Forecasts report at http://www.dft.gov.uk/pgr/rail/pi/highspeedrail/hs2ltd/appraisalmaterial/pdf/baselinereport.pdf. Paragraphs 1.22 to 1.31 provides a factor of 2.5 for rail, 1.44 for car, and 2.78 for air. These are attributed to GDP and population growth. Generated trips are due to reductions in journey times and in overcrowding. The reports appear silent as to the factor that may apply to them so we have assumed 2.5, the same as for rail.

(b) See main report at http://www.dft.gov.uk/pgr/rail/pi/highspeedrail/hs2ltd/demandandappraisal/pdf/report.pd. Fig 4.1e provides 145,391 on HS2 north of Euston and 84,326 removed from Classic Rail. Fig 4.1b shows 106,111 originally on classic rail, hence by difference the long distance passengers remaining on classic rail number 21,785. Fig 4.1d provides 57% from classic rail, 27% new trips, 8% from each of car and air. Those percentages yield 82,873 from classic rail (compared with the 84,326 from Figure 4.1e), 39,238 generated trips, and 11,626 from each of air and car. The slight anomalies will be due to rounding errors or inconsistencies in the locations of the flows on the source diagrams. Fig 4.1a of the main report provides 45,260 long distance trips in 2007/8 whereas the above provides (8,714 + 33,160) = 41,874.

We have sought confirmation of the above from HS2 Ltd but without success. Instead the organisation referred us to its endless, and often seemingly self contradictory, reports.

## THE SPREAD SHEET

In the working spread sheet attached the flow factors, if applied to base year (2007/8) flows, would generate estimates of future year flows. The PVB factors assume benefits are proportional to flow. Hence the PVB values are the flow factors multiplied by the appropriate discount factor etc.

The Excel version enables the reader to test the effect of changes in assumptions upon the flows and benefits. E.g. changing the growth in the value of time from 1.018 to 1.00 provides new benefits that are less than half the initial value.

The spread sheet also provides (a) the effect on benefits if lower growth rates are assumed and (b) the proportions of benefits attributable to successive decades. Hence, looking at the bottom and emboldened set of numbers in the sheet, 79.6% of the full benefits arise if decadal growth is reduced from the study value of 42% to 30% and 59.6% of the 60 year benefits arise from the first 30 years after opening, leaving circa 40% from the later 30 years.

## SPREAD SHEET HS2 Flow and Present Value (PVB) Factors

| Growth | | 42% / decade | | 30% / decade | | 20% / decade | | 15% / decade | | 10 % / decade | | Forecast | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Row | Year | Flow | PVB | Flow | PVB | Flow | PVB | Flow | PVB | Flow | PVB | reduction | |
| 1 | 2026 | 1.953 | 1.474 | 1.646 | 1.242 | 1.414 | 1.067 | 1.304 | 0.984 | 1.199 | 0.904 | 0% | Greengage used values of 20, 10, 5 and 0% here. The same may be tested now. |
| 2 | 2027 | 2.024 | 1.502 | 1.690 | 1.254 | 1.440 | 1.069 | 1.323 | 0.982 | 1.210 | 0.898 | 0% | |
| 3 | 2028 | 2.096 | 1.530 | 1.735 | 1.267 | 1.466 | 1.071 | 1.341 | 0.979 | 1.222 | 0.892 | 0% | |
| 4 | 2029 | 2.171 | 1.559 | 1.781 | 1.279 | 1.493 | 1.072 | 1.360 | 0.977 | 1.233 | 0.886 | 0% | |
| 5 | 2030 | 2.249 | 1.588 | 1.828 | 1.291 | 1.521 | 1.074 | 1.379 | 0.974 | 1.245 | 0.879 | | |
| 6 | 2031 | 2.330 | 1.618 | 1.877 | 1.304 | 1.549 | 1.076 | 1.399 | 0.971 | 1.257 | 0.873 | | |
| 7 | 2032 | 2.413 | 1.649 | 1.927 | 1.317 | 1.577 | 1.078 | 1.418 | 0.969 | 1.269 | 0.867 | | |
| 8 | 2033 | 2.500 | 1.680 | 1.978 | 1.329 | 1.606 | 1.080 | 1.438 | 0.966 | 1.281 | 0.861 | **Note:** the totals and decadal totals are compared at the foot of the table where 60yrs and forecast growth provides 100% of benefits.M60 | |
| 9 | 2034 | 2.500 | 1.652 | 1.978 | 1.307 | 1.606 | 1.062 | 1.438 | 0.951 | 1.281 | 0.847 | | |
| 10 | 2035 | 2.500 | 1.625 | 1.978 | 1.286 | 1.606 | 1.044 | 1.438 | 0.935 | 1.281 | 0.833 | | |
| 11 | 2036 | 2.500 | 1.599 | 1.978 | 1.265 | 1.606 | 1.027 | 1.438 | 0.920 | 1.281 | 0.819 | | |
| 12 | 2037 | 2.500 | 1.572 | 1.978 | 1.244 | 1.606 | 1.010 | 1.438 | 0.905 | 1.281 | 0.806 | | |
| 13 | 2038 | 2.500 | 1.547 | 1.978 | 1.224 | 1.606 | 0.994 | 1.438 | 0.890 | 1.281 | 0.793 | Base "flow" | 1.00 |
| 14 | 2039 | 2.500 | 1.521 | 1.978 | 1.204 | 1.606 | 0.977 | 1.438 | 0.875 | 1.281 | 0.780 | Base year for forecasts | 2007 |
| 15 | 2040 | 2.500 | 1.496 | 1.978 | 1.184 | 1.606 | 0.961 | 1.438 | 0.861 | 1.281 | 0.767 | Present Value year | 2009 |
| 16 | 2041 | 2.500 | 1.472 | 1.978 | 1.164 | 1.606 | 0.946 | 1.438 | 0.847 | 1.281 | 0.754 | | |
| 17 | 2042 | 2.500 | 1.447 | 1.978 | 1.145 | 1.606 | 0.930 | 1.438 | 0.833 | 1.281 | 0.742 | | G/yr |
| 18 | 2043 | 2.500 | 1.424 | 1.978 | 1.126 | 1.606 | 0.915 | 1.438 | 0.819 | 1.281 | 0.730 | Forecast growth 150% to 2033** | 1.036 |
| 19 | 2044 | 2.500 | 1.400 | 1.978 | 1.108 | 1.606 | 0.900 | 1.438 | 0.806 | 1.281 | 0.718 | 30% in 10 years | 1.0266 |
| 20 | 2045 | 2.500 | 1.377 | 1.978 | 1.090 | 1.606 | 0.885 | 1.438 | 0.792 | 1.281 | 0.706 | 20% in 10 years | 1.018 |
| 21 | 2046 | 2.500 | 1.355 | 1.978 | 1.072 | 1.606 | 0.870 | 1.438 | 0.779 | 1.281 | 0.694 | 15% in 10 years | 1.014 |
| 22 | 2047 | 2.500 | 1.332 | 1.978 | 1.054 | 1.606 | 0.856 | 1.438 | 0.766 | 1.281 | 0.683 | 10% in 10 years | 1.010 |
| 23 | 2048 | 2.500 | 1.310 | 1.978 | 1.037 | 1.606 | 0.842 | 1.438 | 0.754 | 1.281 | 0.672 | **Growth factor over 26 years providing 42% per decade | 2.5 |
| 24 | 2049 | 2.500 | 1.289 | 1.978 | 1.020 | 1.606 | 0.828 | 1.438 | 0.742 | 1.281 | 0.661 | | |
| 25 | 2050 | 2.500 | 1.268 | 1.978 | 1.003 | 1.606 | 0.815 | 1.438 | 0.729 | 1.281 | 0.650 | | |
| 26 | 2051 | 2.500 | 1.247 | 1.978 | 0.987 | 1.606 | 0.801 | 1.438 | 0.717 | 1.281 | 0.639 | Discount rate first 30 yrs | 0.035 |
| 27 | 2052 | 2.500 | 1.226 | 1.978 | 0.970 | 1.606 | 0.788 | 1.438 | 0.706 | 1.281 | 0.629 | Discount rate second 30 yrs | 0.03 |
| 28 | 2053 | 2.500 | 1.206 | 1.978 | 0.955 | 1.606 | 0.775 | 1.438 | 0.694 | 1.281 | 0.618 | | |
| 29 | 2054 | 2.500 | 1.187 | 1.978 | 0.939 | 1.606 | 0.762 | 1.438 | 0.683 | 1.281 | 0.608 | | |
| 30 | 2055 | 2.500 | 1.167 | 1.978 | 0.923 | 1.606 | 0.750 | 1.438 | 0.671 | 1.281 | 0.598 | | |
| 31 | 2056 | 2.500 | 1.153 | 1.978 | 0.913 | 1.606 | 0.741 | 1.438 | 0.664 | 1.281 | 0.591 | | |
| 32 | 2057 | 2.500 | 1.140 | 1.978 | 0.902 | 1.606 | 0.733 | 1.438 | 0.656 | 1.281 | 0.584 | | |
| 33 | 2058 | 2.500 | 1.127 | 1.978 | 0.892 | 1.606 | 0.724 | 1.438 | 0.648 | 1.281 | 0.577 | | |
| 34 | 2059 | 2.500 | 1.114 | 1.978 | 0.881 | 1.606 | 0.716 | 1.438 | 0.641 | 1.281 | 0.571 | | |
| 35 | 2060 | 2.500 | 1.101 | 1.978 | 0.871 | 1.606 | 0.707 | 1.438 | 0.633 | 1.281 | 0.564 | | |
| 36 | 2061 | 2.500 | 1.088 | 1.978 | 0.861 | 1.606 | 0.699 | 1.438 | 0.626 | 1.281 | 0.557 | | |
| 37 | 2062 | 2.500 | 1.075 | 1.978 | 0.851 | 1.606 | 0.691 | 1.438 | 0.618 | 1.281 | 0.551 | | |
| 38 | 2063 | 2.500 | 1.063 | 1.978 | 0.841 | 1.606 | 0.683 | 1.438 | 0.611 | 1.281 | 0.545 | | |
| 39 | 2064 | 2.500 | 1.050 | 1.978 | 0.831 | 1.606 | 0.675 | 1.438 | 0.604 | 1.281 | 0.538 | | |
| 40 | 2065 | 2.500 | 1.038 | 1.978 | 0.821 | 1.606 | 0.667 | 1.438 | 0.597 | 1.281 | 0.532 | | |
| 41 | 2066 | 2.500 | 1.026 | 1.978 | 0.812 | 1.606 | 0.659 | 1.438 | 0.590 | 1.281 | 0.526 | | |
| 42 | 2067 | 2.500 | 1.014 | 1.978 | 0.802 | 1.606 | 0.652 | 1.438 | 0.583 | 1.281 | 0.520 | | |
| 43 | 2068 | 2.500 | 1.002 | 1.978 | 0.793 | 1.606 | 0.644 | 1.438 | 0.576 | 1.281 | 0.514 | | |
| 44 | 2069 | 2.500 | 0.990 | 1.978 | 0.784 | 1.606 | 0.636 | 1.438 | 0.570 | 1.281 | 0.508 | | |
| 45 | 2070 | 2.500 | 0.979 | 1.978 | 0.775 | 1.606 | 0.629 | 1.438 | 0.563 | 1.281 | 0.502 | | |
| 46 | 2071 | 2.500 | 0.967 | 1.978 | 0.766 | 1.606 | 0.622 | 1.438 | 0.557 | 1.281 | 0.496 | | |
| 47 | 2072 | 2.500 | 0.956 | 1.978 | 0.757 | 1.606 | 0.614 | 1.438 | 0.550 | 1.281 | 0.490 | | |
| 48 | 2073 | 2.500 | 0.945 | 1.978 | 0.748 | 1.606 | 0.607 | 1.438 | 0.544 | 1.281 | 0.484 | | |
| 49 | 2074 | 2.500 | 0.934 | 1.978 | 0.739 | 1.606 | 0.600 | 1.438 | 0.537 | 1.281 | 0.479 | | |
| 50 | 2075 | 2.500 | 0.923 | 1.978 | 0.730 | 1.606 | 0.593 | 1.438 | 0.531 | 1.281 | 0.473 | | |
| 51 | 2076 | 2.500 | 0.912 | 1.978 | 0.722 | 1.606 | 0.586 | 1.438 | 0.525 | 1.281 | 0.468 | | |
| 52 | 2077 | 2.500 | 0.902 | 1.978 | 0.714 | 1.606 | 0.579 | 1.438 | 0.519 | 1.281 | 0.462 | | |
| 53 | 2078 | 2.500 | 0.891 | 1.978 | 0.705 | 1.606 | 0.573 | 1.438 | 0.513 | 1.281 | 0.457 | | |
| 54 | 2079 | 2.500 | 0.881 | 1.978 | 0.697 | 1.606 | 0.566 | 1.438 | 0.507 | 1.281 | 0.451 | | |
| 55 | 2080 | 2.500 | 0.871 | 1.978 | 0.689 | 1.606 | 0.559 | 1.438 | 0.501 | 1.281 | 0.446 | | |
| 56 | 2081 | 2.500 | 0.861 | 1.978 | 0.681 | 1.606 | 0.553 | 1.438 | 0.495 | 1.281 | 0.441 | | |
| 57 | 2082 | 2.500 | 0.850 | 1.978 | 0.673 | 1.606 | 0.547 | 1.438 | 0.489 | 1.281 | 0.436 | | |
| 58 | 2083 | 2.500 | 0.841 | 1.978 | 0.665 | 1.606 | 0.540 | 1.438 | 0.484 | 1.281 | 0.431 | | |
| 59 | 2084 | 2.500 | 0.831 | 1.978 | 0.657 | 1.606 | 0.534 | 1.438 | 0.478 | 1.281 | 0.426 | | |
| 60 | 2085 | 2.500 | 0.821 | 1.978 | 0.650 | 1.606 | 0.528 | 1.438 | 0.472 | 1.281 | 0.421 | | |

**Totals by decade**

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 year total | 15.88 | 12.88 | 10.69 | 9.69 | 8.74 |
| 20 year total | 30.73 | 24.63 | 20.24 | 18.23 | 16.35 |
| 30 year total | 43.32 | 34.59 | 28.33 | 25.47 | 22.80 |
| 40 year total | 54.27 | 43.25 | 35.36 | 31.77 | 28.41 |
| 50 year total | 64.01 | 50.96 | 41.62 | 37.37 | 33.40 |
| 60 year total | 72.67 | 57.81 | 47.18 | 42.36 | 37.84 |

**Total PVBs as % of 60 year value with 42% growth**

| | 42% / decade | 30% / decade | 20% / decade | 15% / decade | 10 % / decade |
|---|---|---|---|---|---|
| 10 yr total | **21.9%** | **17.7%** | **14.7%** | **13.3%** | **12.0%** |
| 20 yr total | **42.3%** | **33.9%** | **27.9%** | **25.1%** | **22.5%** |
| 30 yr total | **59.6%** | **47.6%** | **39.0%** | **35.1%** | **31.4%** |
| 40 yr total | **74.7%** | **59.5%** | **48.7%** | **43.7%** | **39.1%** |
| 50 yr total | **88.1%** | **70.1%** | **57.3%** | **51.4%** | **46.0%** |
| 60 yr total | **100%** | **79.6%** | **64.9%** | **58.3%** | **52.1%** |

Webtag Table 3 of unit 3.5.6 provides growth rates in the values of working and non-working time. In the light of that we inflate PVs at 1.8% annually. 1.018

The PVs are the flow values multiplied by the increase in the value of time raised to the appropriate power and divided by the discount factor raised to the appropriate power.

Note also that the growth factors relate to existing rail trips and that generated plus those attracted from air and car increase the trips by 75%. If the additional trips generate benefits at half the rate of pre-existing ones then the additional trips add 37.5% to benefits attributable to those pre-existing.