UK Ultraspeed
Response to High Speed 2 Consultation

Purpose of this document.
This document is the comprehensive response by UK Ultraspeed to the Government’s consultation on the proposed High Speed Two railway. It outlines the case for a strategic North - South maglev system which is faster, better, cheaper and greener than conventional high speed rail.

This document is made up of three sections.

1) A letter from the UK Ultraspeed CEO to the Secretary of State for Transport presenting a high level summary of the proposition and questioning the bias against maglev in the HS2 development process, dated 01/07/2010. A response to this letter is still awaited.

2) A more detailed letter, dated 15/05/2010. A response to this letter is still awaited.


As per instructions on the DfT website, this document was submitted by email on 28 July 2011 to highspeedrail@dt.fs1.gov.uk
Rt Hon Philip Hammond MP  
Secretary of State for Transport  
Great Minister House  
76 Marsham Street  
London  
SW1P 4DR

01 July 2010

High speed transport - maglev

Dear Secretary of State,

I refer to my previous letter of 15 May, and its attachment which summarised the case for selecting 500 km/h maglev to provide Britain’s high speed transport at a capital cost of around £30m per km, as opposed to the 330 km/h railway, costing £60m per km, proposed by High Speed Two. With maglev whole-life costs as little as 50% those of rail, with up to 10x less land take, with maglev effectively silent in urban operations, and with maglev energy consumption lower than rail on any like-for-like measure, the case is compelling. I await your reply and, with my team, look forward to constructive engagement with your officials in the near future, notably to present and discuss the evidence underpinning the maglev case.

I draw your attention to the statement of commitments and intentions made by Stephen Hammond, as the then Shadow Rail Minister, in his letter to me of 26/11/2008 (copy attached). Amongst other things, the letter stated that “should a Conservative Government be elected at the next General Election […] we intend to open a competition to select the optimum system ‘immediately on taking office, to enable construction to start by 2015’.” It also stated that “I confirm that Conservative Government will, if elected, welcome bids to deliver the high speed link by consortia proposing all relevant technologies, including maglev.”

Turning now to recent developments, I note your letter to Sir Brian Briscoe of 11 June, authorising HS2 to continue work on the wheel-on-rail scheme, both further developing the southern section and advancing the planning for the Manchester and Leeds links. I further note your Written Answer of 28 June, which confirmed HS2’s budget for 2010-11 budget of £21.1m – this sum being in addition to the 2009-10 budget already spent on producing HS2’s March 2010 reports, which I understand to be around £5m.

So the position is now that substantial Government funding has been made available to only one of the two possible contenders to prepare its case for the procurement competition. The rail proponents at HS2 are receiving multi-million pound Government funding, whereas the maglev team has received nothing.

Given that maglev has the potential to offer a solution which is an order of magnitude faster, less expensive and more efficient than HS2’s proposed railway, the public interest clearly requires both rail and maglev cases to be developed on an equal footing. This not only serves the interests of the taxpayer by supporting the development of a potentially better value solution, but also keeps open a genuinely competitive strategic procurement process, with the Government investing in advancing the business cases for both potential solutions to a similar level of detail.

To rectify the current situation, which would remain prejudicial to fair competition unless remedied, UK Ultraspeed proposes the following course of action, building on the substantial amount of work already conducted at our own risk.

• We would assemble a lead an expert team to produce a detailed study of a maglev high speed link from London and Heathrow and the HS1 Channel Tunnel Rail Link to the Midlands, Manchester and Leeds, having regard also to enabling extension to the English North East and Scotland in due course.

• By leveraging work already done, and subject to agreement of remit, the maglev study would require DfT funding of only 50% of the total 2009-2011 budget allocated by Government to HS2 for its rail work.

This equitable and balanced approach would empower both rail and maglev to compete on their respective merits when, in due course, Britain’s high speed ground transport is procured.

From consistent experience of work to date, we would expect the maglev system defined by such a study to:
UK Ultraspeed

- be faster than HS2 (e.g., saving up to 74 mins London - Manchester, compared to 23 mins for HS2);
- provide capacity similar to, or higher than, HS2;
- consume less energy than HS2 on any like-for-like comparison basis;
- require lower land-take than HS2;
- produce lower noise emissions than HS2;
- have substantially lower up-front capital costs than HS2;
- be capable of connecting more Northern English cities at substantially lower capital cost than rail (the optimum North:South maglev is 100–200 km shorter than HS2's 'Big Y' plan, it also does not require the expensive under-Pennine tunnel which HS2 would require if a high speed rail link between Leeds and Manchester is to be provided);
- be capable of more intensive and more automated operation than HS2; and
- require less intensive maintenance than HS2, and thus
- have lower whole-life costs than HS2;
- offer more direct connection to LHR than HS2's Old Oak plan;
- be capable of extension to the English North East and Scotland over a more efficient single route offering lower capital costs and better whole-life economics than rail;
- offer air-beating journey times all the way from London to Scotland;
- offer faster journey times to/from the Continent to/from any point beyond the Midlands than any 'simple' connection of the existing HS1 to HS2's proposed railway;
- release capacity on the existing rail network and avoid the risk of creating capacity bottlenecks at existing rail stations as any proposal to 'run-off' TGVs on to classic rail lines could do.

Given these fundamental strengths of the maglev business case, we are robustly confident of being able to bring substantial private sector funding to the table when the time comes to build the system.

Finally, the maglev solution will comply fully with the stated intention that “a route should be constructed linking London (and ideally LHR) to Birmingham, Manchester and Leeds. Such a route would be entirely segregated from the existing rail network and would be new build.” It is worth noting that HS2's scheme is not compliant. It relies on half-length, undersized and non-tilting trains running slower than today's Pendolinos on the gauge-constrained infrastructure of the West Coast Main Line; and because they are non-standard, HS2 itself states that these trains would be more expensive too.

For ease of reference I attach a one-page summary of key comparators between Ultraspeed maglev and HS2's March 2010 Stage 1 railway proposals.

I look forward to your response to our offer and to meeting with you in the near future. I reiterate that we would be delighted to host a meeting at the Transrapid test track in Germany so that you can experience Ultraspeed maglev for yourself.

Yours sincerely,

Dr Alan James
Chief Executive

Attachments
1) Copy of letter from Stephen Hammond of 15/11/2008
2) Summary maglev/rail comparison
Dr Alan James
Chief Executive, UK Ultraspeed
Warksburn House
Wark, Hexham
Northumberland NE48 3LS

26 November 2008

Dear Alan,

Thank you for your submissions to date, which we have found very helpful.

We have recently made a number of commitments regarding the development of high speed intercity links in Britain, should a Conservative Government be elected at the next General Election. We have stated that:

- A route should be constructed linking London (and ideally LHR) to Birmingham, Manchester and Leeds. Such a route would be entirely segregated from the existing rail network and would be new build.

- Our intention is to secure best value for the taxpayer. Therefore we intend to open a competition to select the optimum system “immediately on taking office, to enable construction to start by 2015”. A key term of this competition is that we shall “require the competitors to guarantee journey times”.

- We intend the Government itself to act as project sponsor and will “make the project possible by backing hybrid legislation in Parliament”.

- We intend to “offer a fixed payment towards land and track, leaving the private sector with all construction and operating risks”.

- Our current estimate, subject to revision as the project evolves, is that the fixed payment to be made available (at 2008 values) will take the form of 12 annual tranches, each of £1.3bn

- I confirm that a Conservative Government will, if elected, welcome bids to deliver the high speed link by consortia proposing all relevant technologies, including maglev.

With best wishes.

Yours sincerely,

Stephen Hammond MP
Shadow Transport Minister

Member of Parliament for the Wimbledon Constituency
Tel: 020 7219 1029 / 3408 Fax: 020 7219 0462
# Key comparators (UKU & HS2 initial route proposals)

<table>
<thead>
<tr>
<th></th>
<th>UK Ultraspeed maglev</th>
<th>HS2 railway</th>
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<tbody>
<tr>
<td><strong>Strategic Cost:Benefit</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projected capital cost per route km</td>
<td>£30m</td>
<td>£60m</td>
</tr>
<tr>
<td>Route km (miles)</td>
<td>458 (286)</td>
<td>206 (129)</td>
</tr>
<tr>
<td>Stations served by direct high speed services</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>Direct connection to High Speed 1 (Eurostar) interchange</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Direct high speed link to Heathrow</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Other airports served by direct high speed services</td>
<td>BHX, MAN, JLA</td>
<td>BHX</td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land take (m² per linear metre of typical route)</td>
<td>2 (largely elevated)</td>
<td>25 (largely at grade)</td>
</tr>
<tr>
<td>Noise emissions dB(A) @ 25m from source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transrapid vs TGV A-Series wheel-on-rail</td>
<td></td>
<td></td>
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<tr>
<td>Note: at 200 km/h (125 mph), the speed used on city approaches, maglev is effectively silent, emitting less noise than the urban background.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speeds (km/h)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200 @ 200 km/h</td>
<td>70</td>
<td>86 @ 200 km/h</td>
</tr>
<tr>
<td>300 @ 300 km/h</td>
<td>79</td>
<td>95 @ 300 km/h</td>
</tr>
<tr>
<td>400 @ 400 km/h</td>
<td>86</td>
<td>n/a</td>
</tr>
<tr>
<td>500 @ 500 km/h</td>
<td>90</td>
<td>n/a</td>
</tr>
<tr>
<td>Energy consumption (KWh per km, steady cruise, full length units)</td>
<td>30.8 @ 350 km/h</td>
<td>53 @ 330 km/h</td>
</tr>
<tr>
<td>400 km/h</td>
<td>38.2</td>
<td>53 @ 330 km/h</td>
</tr>
<tr>
<td>450 km/h</td>
<td>46.4</td>
<td>n/a</td>
</tr>
<tr>
<td>500 km/h</td>
<td>55.8</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cruising Speed km/h (mph)</td>
<td>500 (311)</td>
<td>330 (204)</td>
</tr>
<tr>
<td>Acceleration 0 – 200 mph (seconds)</td>
<td>110</td>
<td>330</td>
</tr>
<tr>
<td>Brake-Stop-Accelerate: 200 – 0 – 200 mph (km / miles)</td>
<td>8.6 (5.4)</td>
<td>25.3 (15.8)</td>
</tr>
<tr>
<td>Maximum gradient</td>
<td>1-in-10</td>
<td>1-in-25</td>
</tr>
<tr>
<td>Curve radius at 300 km/h (metres)</td>
<td>1,600</td>
<td>3,200</td>
</tr>
<tr>
<td>Total fleet required at launch</td>
<td>27 units</td>
<td>61 units</td>
</tr>
<tr>
<td><strong>Trip times on Stage 1 routes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>London to Manchester (rail using existing line north of Midlands as HS2 propose)</td>
<td>54 min</td>
<td>1 h 44 min</td>
</tr>
<tr>
<td>Birmingham to Manchester</td>
<td>20 min</td>
<td>ruled out by HS2</td>
</tr>
<tr>
<td>Manchester to Liverpool</td>
<td>18 min</td>
<td>not possible</td>
</tr>
<tr>
<td>Leeds to Manchester</td>
<td>19 min</td>
<td>not possible</td>
</tr>
<tr>
<td>Heathrow to Birmingham</td>
<td>30 min</td>
<td>not possible</td>
</tr>
<tr>
<td>Heathrow to Manchester</td>
<td>54 min</td>
<td>not possible</td>
</tr>
<tr>
<td>Heathrow to Leeds</td>
<td>74 min</td>
<td>not possible</td>
</tr>
<tr>
<td>Heathrow to Liverpool</td>
<td>73 min</td>
<td>not possible</td>
</tr>
</tbody>
</table>
SECTION TWO LETTER TO SECRETARY OF STATE 15/05/2010

To Rt Hon Philip Hammond MP
Secretary of State for Transport

From Dr Alan James
Chief Executive
UK Ultraspeed

Date 15 May 2010

Subject High Speed Transport
Confirming Ultraspeed maglev bid for North - South high speed link

Dear Secretary of State,

Congratulations on your appointment: welcome to Transport! Congratulations also on the refreshing success in forming a coalition Government, whose pre-agreed stability and longevity will be invaluable in addressing the many pressing strategic issues, not least economic, currently bearing down upon the UK.

UK Ultraspeed notes, in Section 11 of the document (11/05/2010) Conservative Liberal Democrat coalition negotiations: agreements reached, that “[t]he parties agree to implement a full programme of measures to fulfil our joint ambitions for a low carbon and eco-friendly economy”. We are delighted to note, within this overall framework, that the parties forming the Government specifically agree to “[t]he establishment of a high-speed rail network.”

Your predecessors announced that, if elected, your Government would hold a competitive procurement process to select the best high speed system for Britain, and we warmly welcomed the assurances given by your colleagues before the election that your “Government would, if elected, welcome bids to deliver the high speed link by consortia proposing all relevant technologies, including maglev”.

Well here we are: you’ve been elected and we’re going to bid maglev. I am delighted to confirm that UK Ultraspeed intends to bid 500 km/h (311 mph) maglev into the procurement competition, when you see fit to start it.

Using the proven German Transrapid system, we will be positioning maglev as the Faster, Better, Cheaper and Greener option for Britain’s strategic high speed transport; delivering more benefit at less cost to Britain than conventional (wheel-on-rail, ’TGV-style’) high speed trains. The remainder of this note sets out the essence of the maglev case.

The Stage 1 maglev network, which could be built in phases if required, is set out in the schematic on the next page.

The key data are: 458 km route length;
500 km/h (311 mph) maximum speed;
£13.5 bn total capital cost, equating to £30m per km.
Ultraspeed is documented in depth in the business case which was prepared following our detailed pre-election discussions with your predecessors in the then Shadow team. Theresa Villiers’ appointment as Minister of State provides helpful continuity to these pre-Election discussions.

As set out in the business case, Ultraspeed is fully compliant with the requirements Ms Villiers specified when announcing your Party’s intention to hold this high speed procurement competition, including the provision of a genuine high speed link between the cities of the North, such as Manchester and Leeds, not just linking them to London.

None of the slower and more costly wheel-on-rail proposals put forward to date comply with that specification, not the scheme proposed by Network Rail, nor that devised by Greengauge 21, and certainly not the exceptionally poor High Speed Two scheme brought forward under the previous Government, which is illustrated in the schematic overleaf (p3).
In a Commons answer (29/03/2010), DfT confirmed key data for this profoundly underwhelming rail scheme as: 206 km; £12.3 billion capital cost, equating to £60m per km – **double the projected capital cost per km of maglev**.

Despite this spend, HS2 provides little more than a diversionary loop for the southern end of the West Coast Main Line. Because it uses existing WCML infrastructure beyond the Midlands, it provides no direct high speed connections to, or between, Northern cities. Links to Heathrow and HS1 (Eurostar) are also missing. HS2’s quickest London to Glasgow trip time (4h 00m) is only 8 minutes faster than today’s Pendolinos and is actually 8 minutes **slower** than the best journey achieved with the APT in 1984 (3h 52m).

On HS2’s own figures, all trips to points north of the junction near Lichfield will be only 23 minutes faster than Pendolinos running non-stop to that point on today’s WCML. Put brutally, 23 minutes isn’t worth £12.3 billion. Conventional high speed rail is simply too limited in scope and falls massively short of your own stated requirements. As the Newcastle Journal put it: “a lack of vision that would shame a pilchard in a tin”.

The UK’s ‘long & thin’ geography strongly favours maglev. A number of densely-spaced corridors (eg trans-Pennine) require outstanding acceleration and braking, and the inter-city stretches that separate them (eg London – Midlands) demand the fastest possible cruising speeds. Maglev accelerates to rail’s maximum speed in one third of the time and one third of the distance, and then goes on to cruise over 100 mph faster (see data table on p4).

HS2 demands £12.3 bn for a single 200 mph railway line, which only links London and Birmingham, and which only saves 23 minutes on trips to the North.
If Ultraspeed were only to match HS2’s scheme, maglev would cost only £6 – £7 bn.

But maglev does more: the schematic on p2 shows the comprehensive maglev network which Ultraspeed will deliver for approximately 50% the cost-per-km of rail, and with as little as 10% of the land take.

Maglev slashes trip times to all key destinations by half or more – saving up to 74 minutes to Manchester, for instance, compared to HS2’s paltry 23. Not only does maglev provide the direct connections to HS1 and Heathrow which the rail scheme lacks, it also empowers economic growth in the North by linking all the cities it serves to each other, as well as to London.

The following table summarises the case. All rail data is taken from the HS2 documentation published in March 2010; maglev data is from the UK Ultraspeed North:South business case already in your team’s possession.

<table>
<thead>
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<th>Key comparators</th>
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**Trip times on Stage 1 routes**

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*See HS2 Technical Appendix, Appendix 2, p13. “this proposal…does not form part of the core HS2 scheme at this time.”

Distilled to a single slide, the key advantages of maglev which we will be promoting are set out overleaf.
Reduced to basics, conventional high speed rail delivers a fragmented railway, using technology no better than Britain’s competitors, which only gets as far as Lancashire and Yorkshire, and then fails to link them together.
UK Ultraspeed maglev, by contrast, provides a coherent Anglo-Scottish strategic intercity system, using the world’s fastest ground transport, linking most major city-regions from London to Scotland to each other as well as to London and Heathrow.

Maglev links the key locations on both the ‘West Coast’ and ‘East Coast’ corridors with one route, using its superior gradient and curvature parameters to pass over the Pennines on the existing M62 corridor. This minimises both costs and new environmental intrusion into the National Park, whilst simultaneously maximising East-West connections across the English North as an integral part of the North–South spinal route. Constrained by adhesion technology, rail cannot provide a genuinely high speed trans-Pennine link unless an unfeasibly expensive tunnel is bored under the fells.

Ultraspeed provides journeys that are faster than flying to/from London all the way to Glasgow and Edinburgh (after taking into account travel time to/from airports and airport handling time). Indeed, at 54 minutes, maglev is actually faster gate-to-gate than flying from Heathrow to Manchester (BA schedule is 65 minutes for LHR-MAN). A London – Manchester flight produces around 60,000 Available Seat Kilometres [ASK: 200 seats x 300 km] of transport capacity. The same trip by 840-seat maglev produces 252,000 ASK. That’s a clear capacity benefit, yet the environmental equation is stacked in maglev’s favour too. The flight produces 157g of CO2 per seat-km; maglev produces only 29g on UK Ultraspeed service patterns.

Over the full length of the route, Glasgow is 2 hours 40 minutes from London by maglev, including intermediate stops. In 10-car configuration, maglev will seat twice as many passengers as the world’s largest aircraft (up to 1,196 in all-economy configuration; 840 in two-class layout). However, unlike the A380, maglev is capable of calling at Birmingham, Manchester, Leeds, Teesside, Newcastle and Edinburgh en route.

By way of comparison, conventional high speed rail, with its inferior acceleration and maximum speed, could only hypothetically match maglev’s London-Scotland journey time with a much less economically useful non-stop journey, thus failing to serve all the Midlands, North West, Yorkshire, North East and Lothians markets which maglev links, not only to each end of the route, but also to each other.

With terminals both in city centres and at airports, maglev is capable of providing an attractive, sustainable, and faster alternative to almost all UK domestic aviation from Northern England and Central Scotland. Ultraspeed thus aligns perfectly with the Coalition Agreement commitment to prohibit any new runways at Heathrow, Gatwick and Stansted, and provides a better link to Heathrow than current air feeder/distributor services.

With maglev providing domestic access, precious slot pairs at LHR which are currently wasted on inefficient and often loss-making domestic flights can be retasked for more profitable and economically beneficial international flights, which are also less environmentally damaging.

Furthermore, with every location on the Ultraspeed network between Tyneside and London being less than one hour from Manchester airport, maglev enables that airport’s two existing runways to take the load off London, empowering the growth of a major air gateway in the North. Thinking further, the journey time between Manchester and Liverpool airports is as low as eight minutes, depending on route. With maglev capable of offering secure airside transit, using segregated sections of the same stations and units which are also providing walk-on general passenger transport at the same time, the prospect opens up of creating a three runway super-hub without laying an inch of new tarmac.
Rail’s trans-Pennine engineering difficulties, as noted above, are the main reason why HS2’s proposed Stage 2 route (left hand schematic on p5) has Birmingham, Manchester and Leeds on three separate branches. This layout creates an inefficient triplicated system, with all the waste of triplicated fleet, staffing and maintenance costs which that implies over the whole-life term of the project.

With no high speed links between its Northern termini, even Stage 2 of HS2 produces a system which is, quite literally, useless for any trip which is not to/from London. HS2 Stage 2 also fails to connect North East England or Scotland. With rail, only London is linked to all of the other cities served by the route, whereas maglev links every city it serves to every other. Maglev thus helps to create strong northern and Scottish super-regional economies. By reinforcing the predominance of London, TGV-style rail actually makes the North:South divide worse, maglev cures it.

This strategic failure of HS2 clearly betrays the out-of-date TGV-era thinking of its designers. In effect, HS2 threatens to import into the UK the centriste, dirigiste methods on which the French have built their TGV system: Paris is at the heart of everything, and peripheral cities are linked primarily to the capital, not to each other.

Britain does not have to slavishly follow this French model and produce a railway that would use yesterday’s technology, to answer yesterday’s problems of railway capacity, to a design driven by yesterday’s thinking. Instead, maglev gives Britain the opportunity to leapfrog the 186 mph TGV-generation systems into which our international competitors have sunk their investment, and by which they will be constrained for the decades-to-century ahead.

Next steps and key topics for discussion.

I would appreciate a meeting with you at your earliest convenience to discuss matters in detail. If you could find a day in your diary, we would be delighted to hold that meeting at the Transrapid test track in Germany, so that you can experience maglev for yourself.

Along with my colleagues, I would be keen to discuss a number of topics at that meeting. These would include project finance (addressed in a little more detail below) and also the best means of ensuring that the competitive procurement process is genuinely fair and open, in view of the fact that rail proponents have already received significant Government funding to produce the High Speed Two proposals.

Our objective in this regard is to simply to ensure that equal consideration and support is given to the development of a possible maglev solution, given that it may offer taxpayers better value and more benefits than rail. Rail and maglev should compete fair and square on their respective technical, commercial and environmental merits. Indeed, we look forward to such a competition. Competition is in the interests of the taxpayer and good procurement practice demands a level playing field.

We would also seek to explore how best to get matters moving fast, given your manifesto pledge that “a Conservative government will begin work immediately to create a high speed rail line connecting London and Heathrow with Birmingham, Manchester and Leeds” and the pre-election announcement that this would be “immediately on taking office, to enable construction to start by 2015”.

Regarding project finance, let me affirm that UK Ultraspeed is perfectly relaxed with the proposals the then Shadow team put forward before the election, to “offer a fixed payment towards land and track, leaving the private sector with all construction and operating risks”. The estimate at the time, subject to revision as the project evolves, was that the fixed payment to be made available (at 2008 values) would be 12 annual tranches, each of £1.3bn. Alternatively, we are equally happy...
with any variant of Availability Payment or similar well-precedented PPP arrangement which takes into account the whole-life costs and revenue streams of the project.

In both of the above project finance modes, core maglev advantages enable Ultraspeed to provide a level of value for money which no comparably-scoped conventional wheel-on-rail scheme can hope to match. Not only will maglev cost significantly less to build in the UK than rail, but its friction-free and highly automated operation, coupled with exceptionally intensive utilisation of a much smaller fleet, gives whole-life operating and maintenance costs typically at least a third less than rail. Furthermore, with faster and more attractive services, connecting more places more frequently than rail, revenue generation is an order of magnitude higher too.

It is maglev’s fundamental technological advantages which underpin this superiority. Every time a TGV moves, its steel wheels grind away its steel track, until it all needs replacing – all very 19th Century. Maglev, by contrast, never physically touches its guideway, it floats 1cm above it on a magnetic cushion, and is propelled along it by surfing a rolling wave of electricity.

Naturally, we recognise that economic circumstances are currently exceptionally tight. We would therefore be keen to explore with you a radical alternative project finance proposal, which could see the project 100% privately funded, with zero new up-front input by the taxpayer.

This would be achievable by using existing assets, for which the taxpayer has already paid, essentially as collateral to underpin private sector finance for 100% of the costs of the project, with this ‘buffer’ remaining in place only up to the point when operating profitability removes the need for it. And that point will be reached more quickly with maglev than with rail: highly efficient, low-maintenance, maglev has significantly better operational economics than rail schemes of comparable scope.

To expand a little, a good example of the collateral model would be to simply set aside a slice of investment the taxpayer has already made in RBS and Lloyds shares during the banking bail-out, and to ‘recycle’ them into a ringfenced ‘High Speed Guarantee Fund’. By this means, a multi-billion pound asset the taxpayer had no wish to own, but was compelled to acquire as a result of a collapse in the arcane world of casino banking, can now be used to underpin a real-world project which delivers the real and lasting benefit of best-in-world transport to Britain. And there’s a double-plus upside too: when the collateral is no longer needed, the original asset is still intact. At the end of the process the taxpayer still owns the asset and Britain also has the fastest and most efficient strategic transport system in the world: good value, great politics.

Finally, let me address the ‘technology risk’ question. I appreciate that there is always great skepticism to overcome with anything radically new. 1830s canal owners did their best to ensure that railways were perceived as so dangerous that, at 30 mph, they could melt passengers’ eyeballs. Men with red flags once walked in front of cars. Aviation was inconceivable only just over a century ago.

With maglev, risk has already been substantially mitigated. The German taxpayer has invested billions in developing maglev from a concept to a fully operational transport system which has now carried millions of people on the first public system in Shanghai. Trips are timetabled to the second, depart every few minutes, and travel at speeds of 430 km/h (267 mph) in daily service, with 500 km/h (311 mph) proven during commissioning.

The Germans paid to develop maglev, then the Chinese bore the prototyping risk of putting it into service. It’s now time for this great British invention to come home, with all its upstream costs having already been paid by foreign Governments, to return home to give Britain an absolute competitive advantage over all our overseas rivals.
By far the best way forward would be to build a first route section to demonstrate maglev in service in UK conditions. As one of your Shadow predecessors put it: “we'll only know if we try.” He continued: “no one who has travelled on the only commercially operated Maglev route in Shanghai could fail to have been impressed. It could well be a vision for the future. Not only is it fast - it also appears to offer much more versatility than conventional rail. A Maglev line could, for example, be built above a motorway in an existing corridor, without the need for massive land take - and yet could also sit at ground level alongside an existing route where no constraints exist. That could make quite a difference on the cost front.

“If Maglev were to be the right option, my view is that it should be used initially for high speed inter-city Metro services, between cities that are linked by a congested corridor that is a few tens of miles long. Leeds and Manchester and Edinburgh and Glasgow are two obvious route options. Either could serve as a pilot for Maglev without compromising the option of a conventional North-South route.” (Chris Grayling, March 2007)

Planning for potential ‘Phase 1 Demonstrator’ corridors is already under way. Liverpool – Manchester – Leeds, for instance, is well advanced, and considerable influential support has also been expressed for a Tees-Tyne route. Edinburgh – Glasgow has already reached the level of detail required (including independent scrutiny of technical, business and funding plans) for a decision to be taken within a matter of weeks to proceed to definitive final engineering work and route layout.

On the assumption that we agree a suitable deal for a ‘demonstration line’ (using any of the project finance models mentioned above) we could deliver 300 mph maglev running in Britain within two years of permission to start construction being granted. In practical terms, given a rapid agreement to ‘get on with it’, the earliest possible start of test running on a first segment of the route, approved as a test track under an effectively-driven planning process, is 2013/2014.

This timetable would deliver a maglev system, fully operational under UK conditions, providing the evidence to demolish all the myths and misinformation about maglev before the technology choice for the North:South route needs to be made.

Thinking more about the Glasgow – Edinburgh route (which has a 14 minute trip time, or 17.5 minutes including an intermediate stop at Edinburgh Airport, compared to 75 minutes by car), your own party’s manifesto for the most recent Scottish Parliament election discussed the economic benefits of a high-speed link from Edinburgh to Glasgow and concluded “maglev technology would effectively twin the cities into a single economic powerhouse – a sensible and exciting aspiration for Scotland.”

This echoes, on a super-regional economic scale, the sentiments of your Party’s UK-wide Economic Competitiveness Review Group, which concluded: “we have looked at high speed train options for the UK, and have concluded that an incoming Conservative government should explore the feasibility and costs of implementing the new Maglev technology, which offers the opportunity of far faster inter-city travel, and hence a more effective challenge to the aeroplane.” (Freeing Britain to Compete, August 2007). Thinking macro-economically, it should also be noted that, with British companies well placed to construct, finance and operate the system, the local content percentage could be exceptional. Maglev will deliver high skill, high tech jobs and investment in and for Britain.

I note in conclusion that maglev should meet with the approval of your coalition partners. As Nick Clegg put it: “It is vital that investment is made in a high speed link, ahead of any decision to support airport expansion in the South East. The technology to be used remains to be decided. It has to be cost-effective and environmentally friendly.” Ultraspeed comprehensively meets and beats these requirements: maglev is faster, better, cheaper and greener than any conceivable railway of similar scope.
As one of the Deputy Prime Minister’s own MPs, Adrian Sanders, recently formally placed on the record (Early Day Motion 286, Dec 2008):

“This House recognises the considerable potential of Maglev technology for the United Kingdom’s rail network;

notes that it provides the most cost-effective high-speed rail solution;

further notes the substantial economic and environmental benefits that could be brought with a broad intercity maglev network in addition to substantial improvements in speed, comfort and reliability of rail services; and

calls on the Government to endorse the United Kingdom Ultraspeed Maglev project and to take practical steps towards developing a high speed rail network for the United Kingdom.”

With clarity of purpose, with factual engagement on the merits of maglev, and with decisive action, there is a real potential here to bring the world’s best transport to Britain.

With my colleagues, I look forward to meeting you.

Yours sincerely,

Dr Alan James
Chief Executive
Reality: maglev in public service.
Using the same German Transrapid maglev system as proposed for the UK Ultraspeed network, maglev technology has been proven in full public service in Shanghai since 01/01/2004.

Above, two units pass at a combined closing speed of 860 km/h [537mph]. Each of the units illustrated can convey around 500 passengers. 10-car units with capacity in excess of 1,000 passengers can be deployed in UK operations.

In Shanghai, maglev services depart every few minutes under highly automated control. Timetabling is to the second. Typical operational weeks pass with zero seconds total cumulative delays.

Extensions to the maglev system in China are actively in development. The Federally-funded Maglev Deployment Program is now also actively developing Transrapid maglev routes in the USA.

High speed ground transport is now universally agreed to be a pressing priority for Britain.

This briefing presents the strategic case for maglev: faster, better, cheaper and greener than high speed rail.
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Part 1: the strategic case for 500km/h maglev

UK Ultraspeed is the proposal to use the proven German Transrapid maglev system (pictured on title page and throughout this document), to provide ultra-high-speed connections between major cities in Britain.

The 500 km/h (311mph) Ultraspeed maglev case has been developed since 01/01/2003, with the support of the technology owners, Siemens and ThyssenKrupp, to offer the UK various advantages over 300 km/h (186mph) wheel-on-rail systems.

The primary purpose of this briefing paper is to summarise the strategic case for maglev in the UK. Its secondary purpose is to highlight a number of key exchanges of with DfT and others. Here the intention is to bring to the attention of the House of Commons Transport Select Committee accurate information about maglev, and (in Part 6) to correct on the public record various inaccuracies and misinformation which, if not addressed, could compromise informed policy-making.

This document therefore provides high level briefing on the technological, business, environmental and policy case for the proposed 500 km/h (311mph) magnetic levitation (maglev) system for strategic North:South high speed transport linking Scotland with northern England, the Midlands, London and Heathrow. It also includes examples of potential Stage One links (Glasgow – Edinburgh and Liverpool – Manchester are selected here) illustrating how initial route segments can be developed both as a stand-alone systems and as the first phases of the full North-South system.

Detailed supporting information, including video of maglev in service, is available at www.500kmh.com. Deeper briefing and business case documents – including definitive detail on cost, carbon and connectivity – will be made available to committee members to support a multimedia presentation in due course.

Maglev advantages in UK application

Maglev is not a railway. It is a new 300 mph+ system, developed from a British idea, at German taxpayers’ expense, in a sustained R&D programme covering roughly 1970 to the present. It has now been proven in public service since 2004. It is substantially faster and massively more efficient than the 20th Century, TGV-style or Shinkansen-style, wheel-on-rail systems which will constrain Britain’s overseas competitors for 100 -150 years to come.

In view of this, this evidence draws a number of distinctions between maglev, wheel-on-steel TGV-style railways and domestic air travel, to assist informed policy-making by allowing the relative merits of each to be considered. By extension of this logic, UK Ultraspeed formally requests that the Committee recommends that the generic terminology “High Speed Ground Transport” should be used in future policy debate in this field. The phrase ‘high speed rail’ risks misinterpretation as a technological pre-judgement: maglev doesn’t have rails.

On a macro-economic scale, only radical improvement of North:South transport will address structural imbalance in UK economy, where the persistent performance gap between London/SE super-region and Northern England and Scottish economies is the largest amongst major OECD countries.

In environmental terms, only 500 km/h maglev offers journeys that are faster than flying from London as far north as Glasgow and Edinburgh, whilst also stopping in every major market between London and Scotland en route, yet producing emissions around 10% those of aviation, assuming maglev draws its electric power from today’s UK-average generation-mix. If, over
time, maglev is eventually powered by 100% zero-carbon sources, maglev offers the world's absolute fastest ground transport with absolute zero emissions.

The fundamental advantages of maglev versus high speed rail are seen at their clearest on the North:South scale, illustrated by the map below. 500 km/h maglev can do with one route what 300 km/h TGV requires two routes to deliver.

Only maglev is fast enough to provide:

- a faster-than-air North:South link to all the major city-regions of both the ‘West Coast’ and ‘East Coast’; and

- East:West connections fully integrated into the same system; of which examples are
  - both a sub-15 minute Edinburgh – Glasgow non-stop trip [shown in blue]; and
  - a sub-60 minute connection from the Tyne to the Mersey [red].

Maglev reaches Glasgow, via Edinburgh in 2h 40m from London or Heathrow. This includes stops at the M25, Birmingham, Manchester, Leeds, Teesside and Tyneside en route. This maglev trip is faster, including all the stops, than using air to get from Central London to Central Glasgow or Edinburgh, once the time taken to get to/from airports, check-in and to pass through security is taken into account.

Yet maglev typically causes 10 to 12 times less CO₂ emissions per seat-km than domestic short-haul jets, even when its electric power is generated at the 2008 UK generation mix, which has only 22% of generation from non-carbon sources.

Using energy supplied from renewable sources, maglev has the potential to deliver Britain the world’s absolute fastest ground transport, with absolute zero emissions.

The growing emphasis on the environment as a ‘top three’ issue in UK politics is shifting debate firmly on to maglev territory. No plane, car or diesel train can ever achieve zero emissions. In practical terms only electrified railways and maglev are able to do so.

Maglev advantages compared to wheel-on-rail systems
And it is “rail or maglev” that is the basic choice facing Britain’s strategic transport for the decades-to-century ahead. The side-by-side map above highlights the key policy issues. Yes, it is a choice between two competing transport technologies, but the results and effects of that choice will have consequences on a much more profound geo-economic level.

- **Using TGV-style trains, only London is connected to every other city** whilst 500 km/h maglev connects every major city-region to every other city-region along route.

- **With TGV-style trains, twice the fleet is required**, yet the service is slower to all destinations. For example, 292 km Heathrow – M25 - Midlands - Manchester Airport – Central Manchester. It’s 58 minutes by maglev, but 85 minutes by TGV-style train.
The longer the system, the more maglev wins. If TGV and maglev hypothetically follow the ‘Big-S’ route shown on the Ultraspeed map, by the time a non-stop northbound TGV has reached Glasgow, a maglev has served all the stops between London and Scotland, turned round, served Edinburgh Airport on the return journey and is now travelling south at 300 mph on the way to Newcastle.

TGV-style wheel-on-rail lines cannot readily cross the Pennines without a prohibitively expensive very large diameter twin bore tunnel (say 30 km @ £62m/km = £1.86 bn just for the tunnel). However maglev tackles the gradients and curvature with ease and would closely follow the M62 corridor, thus avoiding any new corridor through the sensitive National Park.

It is this fundamental technical advantage which enables maglev to include East:West connections on a super-regional scale (eg trans-Pennine and Forth-Clyde) as an integral part of the fundamentally North:South trunk route.

In the specifically British conditions discussed above, many of the disadvantages of TGV flow from the unavoidable need for any TGV-style line to fork south at a point south of the Pennines into two routes if it is to attempt to offer air-competitive journey times to both the North West and Yorkshire, a goal which would require a proper 300 km/h alignment throughout both routes.

This result, depending on route selection and junction location, would be between 100 and 200 km more infrastructure for TGV-style rail.

With recent estimates suggesting a budget of £50m per km for TGV in the UK, that equals £5bn to £10bn more capital expenditure alone, before even beginning to take into account the year-after-year-after-year waste in additional ongoing operating costs that would be caused by these duplications of route and fleet. This wholly unnecessary waste would be entirely avoided by maglev.

Whole-life costs of maglev are significantly lower than TGV-style rail. This is due to more intensive fleet utilisation enabled by higher speed, and to lower maintenance costs (in the range 35% to 50% of rail). This latter is due in large part to the fact that maglev does not physically touch its guideway. It simply does not abrade and degrade its own infrastructure as is the case with the (frankly rather primitive) wheels-grinding-on-rails-at-186-mph TGV.

300 km/h TGV is not only of negligible competitive advantage to Britain (because all our major European competitors already have such systems) but it also risks actually exacerbating the predominance of London, for all the reasons summarised above.

By contrast, 500 km/h maglev is fast enough to empower autonomous economic growth in the economies of England’s Greater North and Scotland.

This efficiency flows through into operation. On a Glasgow – Edinburgh scale, for instance, only 3 maglev units would offer a 15 minute frequency service with a non-stop journey time under 15 minutes, or 17.5 minutes including a stop at Edinburgh Airport. 16-24 conventional rail units would be required. Largely automated operation also drives savings. For example, the full Scotland – London maglev system will require a total of only 46 Operational Control staff; Network Rail employs around 10,000 signallers.

The table overleaf presents a one page summary of maglev advantages versus TGV-style railways.
Summary of maglev versus TGV-style rail comparators

<table>
<thead>
<tr>
<th>Maglev</th>
<th>TGV-style rail</th>
</tr>
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<tbody>
<tr>
<td>500 km/h [311 mph] cruising speed</td>
<td>300 km/h [186 mph] cruising speed</td>
</tr>
<tr>
<td>Acceleration to 300 km/h: 97 sec &amp; 4.1 km</td>
<td>Acceleration to 300 km/h: ± 6 mins &amp; ± 20 km</td>
</tr>
<tr>
<td>Guideway (track) integrates guidance, power supply, propulsion motor, signalling and operational control feedback into one system</td>
<td>Rail for guidance, overhead line for power supply, motor on board train, signalling via separate ERTMS systems, feedback via track circuits etc.</td>
</tr>
<tr>
<td>Elevated guideway by default. As little as 2.1 m² per linear metre land-take. Flexible routing able to follow existing corridors and brownfields by climbing 1-in-10 gradients and exploiting tight turn radius of 1,600m @ 300 km/h.</td>
<td>Ground-level track by default. 8 - 16 m² per linear metre land-take. Less flexible routing: only 1-in-25 maximum gradients and turn radius twice as inefficient, at 3,200m @ 300 km/h.</td>
</tr>
<tr>
<td>Flexible routing enables maglev to penetrate city cores without the need for expensive tunnelling, using DLR precedent for elevated, automated, mass transit guideway.</td>
<td>Typically requires expensive tunnelling into city cores. Example CTRL, required tunnel from outer fringes of London to St Pancras to enable TGVs to maintain speed into city.</td>
</tr>
<tr>
<td>2008 average infrastructure cost estimate including land per km in UK conditions ± £30m/km.</td>
<td>CTRL out-turn costs £56.42m/km. If adjusted to directly comparable 2008 values ± £60m/km.</td>
</tr>
<tr>
<td>Does not physically touch guideway when in motion, leading to major maintenance savings. Sheer speed enables more intensive operations of a smaller fleet. Again leads to lower O&amp;M costs. O&amp;M costs typically 50% – 65% of wheel-on rail systems. Whole-life costs typically ± 50% of rail.</td>
<td>Wheel-on-rail systems physically grind down their track with every run. Schedules calling for speeds greater than 300km/h have been abandoned (eg Madrid-Barcelona) due to excessive maintenance burden. Köln–Frankfurt rails are reported to require replacement twice as quickly as predicted.</td>
</tr>
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Journey practically achievable in 2h 40m including stops:

<table>
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<tbody>
<tr>
<td>1h 45m non-stop Edinburgh – London</td>
<td>2h 40m non-stop Edinburgh – London</td>
</tr>
<tr>
<td>Energy consumption 5-car maglev (440 seats)</td>
<td>Energy consumption 8-car ICE3 (415 seats)</td>
</tr>
<tr>
<td>12.3 kwh/km @ 300 km/h</td>
<td>18.0 kwh/km @ 300 km/h</td>
</tr>
<tr>
<td>15.4 kwh/km @ 350 km/h</td>
<td>23.7 kwh/km @ 350 km/h not achievable</td>
</tr>
<tr>
<td>19.1 kwh/km @ 400 km/h</td>
<td>not achievable</td>
</tr>
<tr>
<td>23.2 kwh/km @ 450 km/h</td>
<td>not achievable</td>
</tr>
</tbody>
</table>

Noise: dB(A) measured @ 25m from pass-by

<table>
<thead>
<tr>
<th>TR08 series maglev</th>
<th>TGV A series</th>
</tr>
</thead>
<tbody>
<tr>
<td>67 – 69 (less than urban background) @ 200 km/h</td>
<td>86 @ 200 km/h (also classic rail diesel unit @ 100)</td>
</tr>
<tr>
<td>79 @ 300 km/h</td>
<td>95 @ 300 km/h not achievable</td>
</tr>
<tr>
<td>86 @ 400 km/h</td>
<td>not achievable</td>
</tr>
<tr>
<td>90 @ 500 km/h</td>
<td>not achievable</td>
</tr>
</tbody>
</table>
Overview of Transrapid maglev technology

In order to reach a maximum speed of 311 mph and to accelerate to 250 mph in less than three minutes, Transrapid maglev vehicles eliminate friction by literally floating above a fixed guideway track on an electro-magnetic ‘cushion’. They are guided, propelled and braked by variable frequency electric currents passed through the guideway. The system consists of three main elements, all of which are fully integrated with each other:

1. **A fixed guideway** (track) housing an electromagnetic linear motor. This can be built at ground level, or elevated at any height up to 20m above the ground, thus passing over existing infrastructure without complex and costly civil engineering. The linear motor is analogous to a conventional, rotating, electrical motor which has been unwound and laid along the entire length of the guideway. Electric current is passed through the motor to propel the maglev vehicles, with the frequency of the current controlling the speed at which they move. UK Ultraspeed planning calls for two tracks, one in each direction, with points at various locations – including each end – to enable switching from one track to the other. Both tracks are fully bi-directional, allowing flexibility and of operation.

2. **Maglev vehicles**, each with up to 10 cars, which are capable of seating up to 1,200 passengers in total, although 3-car to 5-car units can be used for ramp-up services a stand-alone route. The vehicles levitate above the guideway and are steered along it by magnetic ‘cushions’. Constant measurement, thousands of times a second, maintains a 1cm (0.4 inch) gap between the vehicle and the guideway. The vehicles are propelled and braked by variable electrical current passed through the linear motor. There is no engine in the vehicle, the guideway is the motor, the signalling system, the power supply and the positional feedback system all combined into one.

3. **Operational Control System [OCS]**. The power supply to the guideway, and hence the movement of all maglev vehicles upon it, is overseen by the final part of the system, a highly automated OCS.

The OCS engineers in to Transrapid levels of safety and reliability which are impossible to achieve in rail, air or road transport. The OCS constantly monitors every vehicle’s speed and position and adjusts propulsion power supplied through the guideway to ensure that every vehicle operates at the prescribed speed for each route section, maintains the correct separation from other maglev units and operates precisely to a timetable defined to the second.

Only the section of guideway through which a maglev is actually passing is powered up by the OCS. Sections in front and behind are switched off to ensure that it is physically impossible for two maglev units ever to collide.
Transrapid should not be confused with experimental Japanese MLX system

Transrapid system is the world’s only ultra-high-speed ground transport in public service. Its infrastructure costs around £30m per km to build in UK conditions, including all land costs and all technical installations.

For reference, the UK’s only 300 km/h (186mph) TGV-style wheel-on-rail line, the Channel Tunnel Rail Link, had an out-turn cost of £56.42m per km (or ± £60m/km in 2009 money).

Transrapid should not be confused with the still-experimental Japanese MLX system. The Japanese system costs around £100m per route-km, uses more complex technology, and has only operated to date under test track conditions.

The Japanese system is not scheduled to enter public service until 2025 at the earliest, although, as Lord Adonis correctly commented [in Rail Business Intelligence, 05/02/2009] “there is a lot of scepticism on whether it will actually happen, even in the higher reaches of the transport department in Tokyo”.

All figures in the above paragraph are average capital costs per double-track route km, including all stations, depots and land costs. Further detail is given in later sections.

Maglev uniquely suited to UK in both regional and intercity applications

Britain has no sunk investment in 300 km/h [186 mph] domestic TGV-style railways. Transrapid maglev is the only ground transport system in the world licensed to convey passengers at 500 km/h [311 mph]. It offers a strategic opportunity to ‘leapfrog’ all Britain’s major competitors. No rail system can match maglev’s combination of inter-city and short-sector performance, nor can rail match maglev’s efficient multi-task utilisation of fleet assets.

In Britain, put simply, there are 100s of km of long-and-thin economic geography, which include several highly-congested corridors 10s of km long. Only maglev can effectively serve in both roles (regional-scale super-metro and intercity), using the same vehicles.

On a full North:South scale, maglev largely replaces domestic aviation with a faster, more reliable and far greener alternative. A beneficial side-effect is liberation of up to tens of thousands of runway slot pairs a year at Heathrow (with proportionate releases at North England and Scottish Airports). Airport capacity can then be used for more economically beneficial, and less environmentally destructive, international services.

Maglev would largely replace rail for many longer intercity journeys, freeing up paths on Network Rail and allowing more, and more-efficient, use of existing capacity. With capacity-eating long-haul, limited-stop, intercity services removed, more rail trains, serving more intermediate communities, could use the rail network. These would also act as feeder/distributor links between maglev hubs and the city-regions along the route. Freight paths would also be liberated on rail.

Over shorter sectors, the acceleration advantages of maglev enable ultra-rapid connections to combine cities, and typically one or more airports, to create super-cities capable of competing with the world’s leading locations for investment and jobs. We illustrate the case by reference to Glasgow – Edinburgh and Northern England examples in Part 3.

Amongst the shorter links Glasgow – Edinburgh (with its throttlingly congested M8, and with rail electrification, although welcome, only able to deliver marginal journey time savings) and Liverpool – Manchester (with its dense urbanisation, two airports and major traffic generators such as the Trafford Centre) have strong business cases for maglev deployment on a stand-alone basis.

Between the Scottish cities, as over many of the shorter English corridors, TGV-style solutions are simply impossible. The routes are either too short for poorly-accelerating ‘heavy metal’ trains (eg Glasgow – Edinburgh) and/or too steep and sinuous (eg Manchester – Leeds) for adhesion-based trains, unless unfeasibly costly tunnels are bored.
Part 2: maglev business case in UK North:South application

The schematic below shows as section of the full Anglo-Scottish Ultraspeed network; the ‘Big-T’ linking the North:South spine with the East:West Liverpool – Manchester – Leeds route.

Network Overview

‘Big-T’ route
458 km total route length.

Dual guideway (double track) throughout.

Trip times per section are actual maglev-in-motion time for stopping services.

Section-by-section trip times for services not stopping at a terminal are faster, due to omission of acceleration and braking penalties.

Terminal dwell time is additional.
Capital Costs

Capex has been estimated (by Faithful & Gould / Atkins, incorporating maglev system cost estimates provided by Siemens and ThyssenKrupp) as shown in the table below. These estimates exclude maglev vehicles, to ensure ‘apples with apples’ comparison with TGV-style rail lines, which are typically quoted without the capital costs of their associated train fleets.

The cost estimate for the full ‘Big-T’ is shown on the left, with that for the system omitting the Liverpool – Manchester and Manchester – Leeds ‘cross of the T’ links shown on the right (i.e. only the route section shown green on the schematic).

The network is presented with Southern terminals at both London Heathrow Airport [LHR] and London, with the routes diverging to serve the airport and the capital proper at a P&R terminal adjacent to the M1/M25 intersection and Midland Main Line. Please note that the eastern approach to the London terminal encompasses two alternatives:

- a 38.1 km route to the primary transport hub of today’s regenerating, eastward-shifting, London at Stratford in the Lea Valley; or
- a shorter, but more complex, 29.7 km route following the M1 and Midland Mainline corridor to Cricklewood with a direct tunnel from that point to the key transport hub of ‘classic London’ at Kings Cross St Pancras.

Capital costs variation between these two alternatives is approximately £9m (or only around 0.06% of total capex) and, with maglev journey time only two minutes quicker from Kings Cross, consumer-side differences are minimal too. At the present stage of planning, therefore, it has been agreed to present the Eastern Approach to London as a single entity – effectively identical in capital terms – with final selection to be made at the next stage of planning.

<table>
<thead>
<tr>
<th>Route Description</th>
<th>Big-T route (incl Leeds &amp; Mancs)</th>
<th>London &amp; LHR – Mancs Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total route length</td>
<td>458.3 km</td>
<td>345.1 km</td>
</tr>
<tr>
<td>Kms in tunnel</td>
<td>19.8 km</td>
<td>7.9 km</td>
</tr>
<tr>
<td>Kms where land rented on wayleave principle</td>
<td>292.8 km (63.9%)</td>
<td>230.0 km (66.6%)</td>
</tr>
<tr>
<td>Kms where land purchased outright</td>
<td>145.7 km (31.8%)</td>
<td>106.9 km (31.0%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Costs (£m)</th>
<th>Total (km)</th>
<th>Per km</th>
<th>Total (km)</th>
<th>Per km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capex excl land</td>
<td>£12,329.5</td>
<td>£26.9</td>
<td>£8,604.2</td>
<td>£24.9</td>
</tr>
</tbody>
</table>

Land cost projections

- Up-front payment securing land to be rented on wayleave principle: £69.8
- Capex cost of temporary land use in construction: £572.9
- Land Purchase: £527.8

Total Capex inc land: £13,500.0

Annual Land/Air rights rental costs p.a. arising from land rented on wayleave principle: £87.2

Status of capital cost estimates

The usual caveats should first be noted. In general, all estimates at this stage are produced to ±30% and are subject to refinement by later study, as is generally the case with any major transport project. However the holistic nature of the Transrapid technology and the largely modular and/or prefabricated nature of its guideway means that the quantum, layout and cost of the entire system can be defined with far greater precision at this stage of upstream study than, say, a comparably-scoped rail or road project.
Land cost treatment: lower for maglev than for TGV-style rail

It should also be noted, that another key Transrapid advantage delivers a significant reduction to up-front capital costs. Over the Big-T route, as an example, an estimated 62.9% of route has guideway which is of elevated construction and is higher than 6m above contour (illustrated below).

Elevated guideway is treated under a wayleave rental structure as follows. An upfront payment of 10% of capital value is made to the landowner to secure:

- the land where the piers physically stand;
- access during construction; and
- Right Of Way plus Right Of Access in perpetuity.

A rental payment is then made annually thereafter in respect of land and air rights under the guideway, which remains usable for its original purpose. Based on the National Grid precedent, rentalising land costs has the benefit of saving significant upfront capital expenditure.

This is a advantage unique to largely-elevated 500 km/h Transrapid, compared to largely-at-grade 300 km/h TGV-style railways. Land-take for elevated maglev guideway is 2.1m$^2$ per linear metre compared to TGV at-grade (12-16m$^2$ per linear metre). For comparison, a linear metre of six-lane motorway consumes 96m$^2$.

A further advantage of elevated construction is that any height above ground of between at-grade and 20m can be accommodated within standard guideway parameters. This enables the route to span over most existing infrastructure and buried utilities, thus largely avoiding expensive civil engineering such as bridges, tunnels and the costs and uncertainties of utilities diversions (cf Edinburgh tram).

As Chris Grayling MP, then Shadow Secretary of State for Transport, put it in March 2007: “Not only is it fast - it also appears to offer much more versatility than conventional rail. A maglev line could, for example, be built above a motorway in an existing corridor, without the need for massive land take - and yet could also sit at ground level alongside an existing route where no constraints exist. That could make quite a difference on the cost front.”

Clearly the proportion of route ultimately capable of wayleave treatment will evolve as detailed engineering study defines the precise elevation of guideway along an surveyed physical alignment. There may be areas where local conditions require outright purchase of an entire section even where >6m elevated construction is used.

The caveat should therefore be noted that the 62.9% proportion of wayleave rented alignment will undoubtedly change. However, comfort should be taken from the following observations.

- Firstly, four studies and reviews of alignment options have always produced percentages over 60% on average in various network configurations.
Secondly, in urban areas, whilst detailed engineering and planning studies may yet find practically achievable elevated corridors, the current capital estimates allow for the much more expensive costs of tunnelling in the urban cores of London, Birmingham and Manchester.

This ‘cushion’ is significant given the large differential between the capital cost of a maglev corridor’s rural land+civils costs versus tunnelling in city centres. The difference is £13m – £17m (rural land + civils per km) versus £52m – £62m per km (city tunnelling). Every km of tunnelling saved by the use of elevated urban guideway would therefore compensate for several tens of km of rural corridor which may eventually require outright land purchase, not wayleave rental.

**Ridership, Revenue and Operating & Maintenance Costs**

Fully detailed projections for all the above key factors are contained in the North:South High Level Business Case, which is available for download from [www.500kmh.com](http://www.500kmh.com). The pertinent summary data are tabulated below, for both the Big-T and London & LHR -Manchester route options. All data is presented for Year 5 of operations, i.e. after ramp-up effects.

<table>
<thead>
<tr>
<th>Ridership &amp; Revenue Projections (Year 5 of operations)</th>
<th>Big-T route</th>
<th>London &amp; LHR – Mancs Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total route length (km)</td>
<td>458.3</td>
<td>345.1</td>
</tr>
<tr>
<td>2008 average rail fare (used as baseline)</td>
<td>£21.55</td>
<td>£25.95</td>
</tr>
<tr>
<td>Ridership upper estimate (millions p.a.)</td>
<td>41.44</td>
<td>22.72</td>
</tr>
<tr>
<td>Average fare upper estimate (figures adjusted for inflation and include a ‘speed premium’ of 25% or 21% respectively)</td>
<td>£38.01</td>
<td>£44.45</td>
</tr>
<tr>
<td>Total revenue including non-pax income (£bn p.a)</td>
<td>£1.86</td>
<td>£1.16</td>
</tr>
<tr>
<td>Ridership lower estimate (millions p.a.)</td>
<td>41.31</td>
<td>20.12</td>
</tr>
<tr>
<td>Average fare lower estimate (adj for inflation, no ‘speed premium’)</td>
<td>£30.40</td>
<td>£36.08</td>
</tr>
<tr>
<td>Total revenue including non-pax income (£bn p.a)</td>
<td>£1.46</td>
<td>£0.85</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operations &amp; Maintenance Cost Projections</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total staff (benefit of very high levels of automation and very low levels of guideway maintenance required)</td>
<td>1,141</td>
<td>863</td>
</tr>
<tr>
<td>Efficiency benchmark Fleet-km per member of staff p.a. (for comparison, WCML produces around 700 km/staff member)</td>
<td>26,849</td>
<td>28,613</td>
</tr>
<tr>
<td>Total O&amp;M costs (£m p.a. including all staff, energy, materials and land wayleave rental payments)</td>
<td>£273.7</td>
<td>£220.3</td>
</tr>
</tbody>
</table>

**Project finance**

Various project finance scenarios, ranging from full public funding, to zero up-front public sector capital grant are possible. For the purposes of financial modelling, which has been conducted to the standard required by HM Treasury, an Availability Payment model has been adopted.

Detail on the inputs to, and results from, the project finance model are presented separately and in confidence to relevant parties. This section simply presents an overview of the Availability Payment project finance structure and a summary of three critical results, namely:

- Gross Cost to HMG. This is modelled in this instance as Availability Payments over a 30-year PPP term, inflating at the modelled background rate of inflation.
- Revenue receipts received by the operator and passed to HMG over the same term, with results driven the quantum of ridership growing, and passenger fares rising, at prudently modelled rates.
UK Ultraspeed

- Net Cost to HMG, simply the gross Availability Payment minus Revenue.

The Availability Payment structure has been selected for modelling in this instance as it reflects a procurement path which enables the system to be built with zero up-front public sector contributions, but with HMG retaining control over the delivery and operation of the system to standards Government itself defines.

The Availability Payment made by HMG to the operator modelled in this instance reflects such a scenario, in which 100% private finance covers:

- all infrastructure capex;
- all maglev fleet capex;
- all finance costs;
- all O&M costs;
- all lifecycle & renewals costs.

With the exception of annual inflation adjustments on an agreed basis, the Availability Payment is fixed for the duration of the concession at Financial Close, with the ROI for participants being known in advance. Both HMG and the private sector can thus plan this strategic investment on a stable, long-term basis.

It should be noted that other modes of project finance and/or different terms can be modelled. In particular, there may be merit in developing a scenario in which HMG directly assumes a greater share of project risk in the critical early years of operation, following on from a PPP to construction handover.

This would deploy the financial power of the State at precisely point in the project’s life at which the private sector would price highest for perceived risk – Opening Day and the first period of operation.

Once stabilised operations have been achieved, and once ridership quantum and yield are known, HMG may then elect to open the operation of the system to competition.

Clearly this would potentially enable Government to extract better terms from Operators who would be able to reduce the risk-pricing in their tenders once they have praxis-proven O&M regimes and costs against which to judge them.

Additionally, precedent from previous paradigm shifts in transport (eg the arrival of Victorian rail, B747-era long haul aviation, or UK budget airlines) suggest explosive growth of new ridership far greater than any projection it is possible to make in advance. HMG might thus be well advised to hold back for a few years – again better terms from Operators should be achievable in these circumstances.

Procuring the system using an Availability Payment structure

Up to 100% of the up-front funding for the construction and operation of the proposed maglev system could be raised from the private sector, although HMG and/or its Agencies and/or other public sector bodies may elect to make an up-front funding contribution if they judge it prudent and cost-effective to do so.

HMG would empower the system by enacting appropriate legislation and will then specify:

- exactly when the system is to be delivered;
- exactly where the route will pass and where the terminals will be located;
- exactly how the system is to be designed and engineered, on the basis of a technical specification produced by UKU and Transrapid experts under which the main guideway infrastructure is specified for a minimum of an 80-year service life with minimum maintenance;
- exactly how the system is to be operated (e.g. health and safety requirements; performance regime including how often maglevs are to run; frequency and timetable; how many seats on each unit; what services are to be provided at terminals etc.).
• exactly how the system is to be maintained, upgraded and refurbished over time, so that it passes back to public ownership at the end of the concession period in optimum condition;

• exactly what fares are to be charged to passengers;

• exactly what up-front public sector project funding is made available to the project (if any) and when it will be injected.

HMG would then initiate a competitive process, inviting consortia of appropriately qualified and experienced private sector businesses to compete to build and operate the system, as follows:

• HMG commits to make regular ‘Availability Payments’ over the life of the concession to the successful consortium, on condition that the successful concessionaire builds and operates the system in accordance with the specification HMG has laid down. Penalties apply for under-performance, incentives can be built in to engender over-performance. The Availability Payment structure is akin to the ‘Usage Fee’ PFI deals done in other sectors including schools and hospitals to enable the deployment of private sector finance to deliver public benefit.

• HMG would enter into a contractual arrangement which commits Transrapid to make available all required proprietary equipment on a ‘open book’ basis to every bidder (i.e. the maglev element costs each bidder the same).

• UK Ultraspeed and Transrapid commit to provide any necessary UK rights and maglev expertise on a similar ‘level playing field’ basis to every bidder.

• The consortia compete by bidding to build and operate the system to meet or beat the required performance regime in return for the lowest level of availability payment.

• Consortia submit bids to HMG, fixing for the entire life of the concession (30 years modelled in this instance) all the requirements of the project including the following.
  • All infrastructure capital expenditure necessary to meet the required specification.
  • All maglev fleet capital expenditure necessary to meet the required specification.
  • All operations and maintenance costs necessary to meet the required specification.
  • All renewals & lifecycle costs necessary to meet the required specification.
  • All finance repayments.
  • The bidders own return on equity [expressed as Internal Rate of Return (IRR)]

On the basis of all the above, the competitors submit their bids to HMG to deliver the system in return for an Availability Payment which is fixed and certain over the entire length of the concession, with the only adjustment being an agreed inflation factor.

The winning consortium is the one requiring the lowest Availability Payment against a credible and sustainable bid to construct and operate the system.

The winning Operator is then contractually obliged to collect all revenue from the system for and on behalf of HMG. 100% of revenue is passed to HMG, where it partially offsets the Availability Payment flowing from HMG to the Operator.

Best Value for the taxpayer is assured by the competitive process.

The ‘whole life fixed’ nature of the Availability Payment and the rigorous public sector control over the specification for the construction and operation of the system ensures accurate HMG’s future fiscal obligations on behalf of the taxpayer are readily and transparently predictable. Given recent events, and the risk that tomorrow’s taxpayer exposure to banking-created risk will be both significant and unpredictable, it goes without saying that public-supported infrastructure projects should strive to offer the maximum certainty and clarity in their financial arrangements.

By the same token, the very predictability of the Availability Payment structure gives the private sector operator, and private sector finance, a sound basis for business planning over an extended timescale.
As patronage on the system grows, HMG’s commitment to the Availability Payment remains exactly as fixed at the outset (inflation adjusted), but the revenue passed to it by the Operator increases, thus reducing the net cost of the system to the taxpayer.

It can prudently be expected that the Revenue received will increase over time as ridership increases and fares level inflate (typically at a higher rate than the Government funding underpinning the Availability Payment).

There is therefore a net cost to the public for provision of the system, although there is no requirement for the taxpayer to fund the system up front. That net cost can be expected to diminish over the lifetime of the concession, as the operator passes a growing revenue to the HMG.

It can be prudently forecast that the annual costs of the system will be very significantly outweighed by the benefit to the UK economy, both in terms of investment directly in the project itself and by other businesses whose investment is attracted to, or retained in, the UK as a result of the project enhancing UK competitiveness as a business location. These macro-level effects will themselves have a beneficial effect on the project itself, as increased business activity will lead to higher patronage and revenue.

At the end of the concession period (30 years is currently modelled) the entire asset reverts to public ownership, fully paid off and fully maintained in optimal condition.

At this time, HMG becomes the unfettered owner of an asset with at least 50 further years design life in its core infrastructure. It can then elect either to operate the system directly in public ownership, or once again to go out to competition for its operation.

In either of these new scenarios, outgoings will be significantly less – all capital is now fully paid off, only operations, maintenance and lifecycle costs now have to be covered. Projected O&M and Lifecycle costs in this longer term will be more than amply covered by the revenues flowing from what will, by that time, be the well-established centrepiece of UK’s national transport system.

**Key financial results using the Availability Payment model**

The critical balance for Government and the taxpayer is that between Gross Cost to HMG (Availability Payments) and revenue received by Government offsetting that Gross cost.

The four tables below set out this key relationship for the routes from London to Liverpool, Manchester and Leeds [Big-T] and London – Manchester only, with both routes modelled in two cases, with all scenarios showing the effects of background inflation, ridership growth and farebox inflation above background, all as discussed previously.

- **Availability Payment [AP]** is the Gross Cost to Government.
- 100% of revenue is passed from the Operator to HMG. It is derived from passenger farebox, plus some high-value, high-speed freight and logistics traffic, plus some ridership-driven secondary revenues (eg on-terminal franchises, catering etc), as discussed in earlier chapters.
- Net Cost to HMG is simply (a) minus (b).
A: London & LHR to Liverpool Manchester Leeds [Big-T] Case 1

<table>
<thead>
<tr>
<th>Year</th>
<th>AP (£m)</th>
<th>Ridership (m)</th>
<th>Avg Fare</th>
<th>Farebox (£m)</th>
<th>2ndary Rev as % of Freight Mail Courier farebox (£m)</th>
<th>Rev (£m)</th>
<th>Total Rev (£m)</th>
<th>Net Cost to HMG (£m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2,979</td>
<td>20,451,921</td>
<td>£31.05</td>
<td>£639</td>
<td>£64</td>
<td>£75</td>
<td>£775</td>
<td>£2,201</td>
</tr>
<tr>
<td>2</td>
<td>3,054</td>
<td>26,827,497</td>
<td>£32.83</td>
<td>£873</td>
<td>£120</td>
<td>£77</td>
<td>£2,017</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3,130</td>
<td>34,768,265</td>
<td>£34.47</td>
<td>£1,198</td>
<td>£120</td>
<td>£79</td>
<td>£1,397</td>
<td>£2,173</td>
</tr>
<tr>
<td>4</td>
<td>3,208</td>
<td>40,953,184</td>
<td>£36.19</td>
<td>£1,480</td>
<td>£148</td>
<td>£81</td>
<td>£1,709</td>
<td>£2,499</td>
</tr>
</tbody>
</table>

5 (stabilised yr) 3,288 45,435,502 39.00 1,975 157 3,215 2,674

B: London & LHR to Liverpool Manchester Leeds [Big-T] Case 2

<table>
<thead>
<tr>
<th>Year</th>
<th>AP (£m)</th>
<th>Ridership (m)</th>
<th>Avg Fare</th>
<th>Farebox (£m)</th>
<th>2ndary Rev as % of Freight Mail Courier farebox (£m)</th>
<th>Rev (£m)</th>
<th>Total Rev (£m)</th>
<th>Net Cost to HMG (£m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tr>
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<td>£83</td>
<td>£2,674</td>
<td></td>
</tr>
</tbody>
</table>

5 (stabilised yr) 3,288 45,435,502 39.00 1,975 157 3,215 2,674
Alternative project finance structures

As mentioned above, various project finance approaches are possible. The Availability Payment structure modelled is only one of several potentially applicable scenarios.

Recently the Conservative Party introduced another project finance proposal into UK high speed debate, by committing, should they win the next General Election, to inject £15.6 bn of public funds (2008 terms) phased £1.3 bn p.a. 2015 – 2027.

Ultraspeed considers this approach also to have significant merit, again largely because it injects public funding at the point when infrastructure projects need it most: during build and revenue ramp-up. Indeed Ultraspeed has confirmed in public that we will bid maglev into the competition the Conservatives propose to hold “immediately on taking office” to select the system, should they win the forthcoming election.

Ultraspeed also offered to engage with the current Government’s High Speed Two company, and offered to explore all aspects of functional brief and project finance with Sir David Rowlands and his team. This offer was rejected by HS2.
Part 3: maglev business case for first route sections

As noted in Part 1, maglev not only delivers on the North:South scale discussed in Part 2, but also on a city-to-city scale, where its acceleration, capacity and speed advantages help combine population centres and key assets, such as airports, into internationally competitive super-regions. We offer below two illustrations of potential Stage One links (Glasgow – Edinburgh and Liverpool – Manchester) illustrating how initial route segments can be developed both as a stand-alone systems and as the first phases of the full North-South system.

Glasgow – Edinburgh case study highlights

The following graphic and table summarise.

<table>
<thead>
<tr>
<th>Item</th>
<th>Maglev Data</th>
<th>Comparator / Comments (if any)</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>66.3 km [41.5 miles]</td>
<td>311/250 mph [max/daily ops]</td>
</tr>
<tr>
<td>Stations</td>
<td>Haymarket, Edinburgh Airport &amp; Glasgow Queen Street / George Square</td>
<td>All providing tight integration with other modes of transport.</td>
</tr>
<tr>
<td>Route</td>
<td>Largely hugging M8, St Rollox brownfield into Glasgow, close to rail corridor into Edinburgh.</td>
<td>avoids the intrusion an alignment utilising a largely new corridor could entail.</td>
</tr>
<tr>
<td>Land-take</td>
<td>Elevated for approx 80% of route, as low as 2m² per linear metre. Land under guideway remains usable. Large capex savings in up-front land costs.</td>
<td>Rail 12-16m²/m M-way 96m²/m</td>
</tr>
<tr>
<td>Trip time</td>
<td>Under 15 mins non-stop</td>
<td>Rail 43 mins (source Transport Direct)</td>
</tr>
<tr>
<td></td>
<td>Under 18 mins including stop at Edinburgh Airport</td>
<td>Road 65 mins (source ditto)</td>
</tr>
<tr>
<td></td>
<td>Under 13 mins non-stop if using full 500 km/h</td>
<td></td>
</tr>
<tr>
<td>Fleet</td>
<td>3 x 3 car maglev units building to 4 x 5 car during ramp-up. 5-car unit conveys over 500 passengers. Stations and depots designed for expansion to 10-car (840 – 1,200 seat) units on Anglo-Scot system.</td>
<td>Typical rail unit seats around 250. Two units required to match capacity of one maglev. 16 – 24 rail units required to match frequency of a 3-maglev fleet offering 15 min frequency service.</td>
</tr>
<tr>
<td>Efficiency</td>
<td>1 maglev unit = 1.99 million pass-km of capacity per 20 hour day shuttle service.</td>
<td>1 rail unit = 0.33 million pass-km on identical service model.</td>
</tr>
<tr>
<td>Environment</td>
<td>1.99 – 2.38 kg CO₂ per passenger per single trip from Glasgow – Edinburgh Maglev using 100% renewable energy empowered would produce zero emissions. Effectively silent in urban areas.</td>
<td>Rail 4.10 kg (source Transport Direct) Road 5.18 – 17.70 kg (source ditto) Diesel rail and i.c. car/coach/bus transport can never achieve zero emissions, they are tied to carbon fuel source.</td>
</tr>
</tbody>
</table>
### Maglev Data

<table>
<thead>
<tr>
<th>Item</th>
<th>Maglev Data</th>
<th>Comparator / Comments (if any)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure Capex</td>
<td>£1.9 bn (£28.6m per km). Including technology, construction, included prelims, overheads and profits land purchase and up-front wayleave costs. Subsequent rentals accounted on O&amp;M.</td>
<td>Only UK figure for 300 km/h rail is CTRL: 2006 out-turn cost was £56.42m per km; over £60m at today’s values. Jacobs study indicated £7bn for TGV-style Glas-Edin link (rail needs tunnels).</td>
</tr>
<tr>
<td>O &amp; M costs</td>
<td>Approx £40m per annum including all energy purchase, staff, materials, marketing and averaged lifecycle (e.g. renewal/refurbishment) costs</td>
<td>No rail costs for Glasgow - Edinburgh comparable: (must include TOC and Network Rail). On avg maglev has approx. 35% O&amp;M costs of rail.</td>
</tr>
<tr>
<td>Ridership</td>
<td>Ridership in 1st full ops year (min) 10.3 – 10.7 m</td>
<td>Revenue 2x – 2.5x cover of O&amp;M costs: massively exceeds HM Treasury ‘Golden Rule’.</td>
</tr>
<tr>
<td>Ridership Revenue</td>
<td>Revenue in 1st full ops year (min) £126m – £133m</td>
<td></td>
</tr>
</tbody>
</table>

### Northern England case study highlights

The schematic below shows the English Stage One maglev route as developed in 2008 in a study exercise co-funded by The Mersey Partnership.

The objective of building a Stage One link is both to capture strategic advantage for the North West, by delivering a step-change in transport in the North West super-region, and to place the North West at the forefront of national project development.

A Liverpool – Manchester demonstration of maglev feasibility in UK physical, funding and environmental conditions, ensures that the North West’s key corridor is connected from the outset to the trans-North and North-South networks now in active planning and to the benefits they will bring.

![Route Schematic](image)

The table overleaf summarises the major features and benefits.
### Item | Maglev results | Comparator (rail or road)
---|---|---
**Trip time Liverpool – Manchester**  
18 minutes non-stop  
23 minutes stopping | 48 mins rail (fastest)  
± 60 mins driving |
**Max speed**  
435 km/h [272mph] daily service  
500 km/h [311mph] max | 145 km/h [90 mph] |
**Efficiency**  
4 units in service for shuttle service each way every 15 mins | 20+ units required for rail |
**Carbon**  
2.0 kg CO₂ per passenger per trip | Rail: 3.1 kg / passenger  
Car: 4.8 – 14.8 kg / passenger depending on car type & occupancy |
**Trip time benefit vs carbon cost ratio**  
Benchmark: 2008 rail = 1. [Higher numbers better.] | 2.13 - 2.66 |
**Land-take**  
2 – 12 m² per linear metre depending on local conditions. | TGV rail: 8 - 14 m²  
Motorway: 96 m² |

Capital costs for the Liverpool – Manchester section excluding land: £1.7 – £1.9 billion, depending on alignment selected. Including land, capex is £1.9 – £2.3 billion, again using elevated guideway to allow land under guideway to continue in its original use, with Right of Access and Air-Rights then rented on the same principle as National Grid.

The system is fully automated. Whole-life costs are approximately 50% those of a comparably-scoped rail system.

Operating & Maintenance costs are approximately £30m per annum, including propulsion [electrical] energy purchase and all right of way rentals. Lifecycle costs (eg mid-life vehicle renewals, refurbs etc) also accounted in the financial model.

Core guideway design life is 80+ years. Guideway has 0% of the abrasion wear and tear of wheel-on-steel railway track. Maglev units never physically touch the guideway when in motion.

Conservative revenue projections on basis of fares levels in £2.50 to £6.00 range. Prudent ridership projections produces revenues in range of £125m – £140m p.a. after three-year ramp up.

Revenue capable of cover O&M and lifecycle costs, thereby meeting the harshest possible interpretation of HM Treasury ‘Golden Rule’.

P&L is robustly sustainable on Liverpool – Manchester basis. The business case improves still further on eventual roll-out of system on trans-North and North:South scales.

**Project finance for a stand-alone Stage One maglev system**

The graph below indicatively summarises the net cost to Government from a 30 project finance case for a stand-alone system, with capital costs of ±£2bn and 15-minute frequency operation. The in-filled area between the blue and green lines represents the range of revenues a system of this scope is projected to generate.

The uppermost orange line represents the Availability Payment [AP, as discussed in Part 1] required to pay for a ±£2bn system, assuming the project receives zero up-front HMG capital grant, with all required funding coming from the private sector.

As discussed, the AP would be paid to a competitively selected Operator, on condition of full compliance with a delivery and operational regime specified by HMG. All revenues are passed to HMG by the Operator, where they are set against the AP.

To recap, AP covers the all the following items:

- All infrastructure capital expenditure necessary to meet HMG’s required specification.
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- All maglev fleet capital expenditure necessary to meet HMG's required specification.
- All operations and maintenance costs necessary to meet HMG's required specification.
- All renewals & lifecycle costs necessary to meet HMG's required specification.
- All finance repayments.
- Agreed return on equity or quasi-equity [IRR] for private sector.

The black and brown lines represent non-optimised and optimised potential ‘Non-Profit-Distributing’ variants. All plots include inflation and interest effects as appropriate.

Note that the net cost to HMG (i.e. AP minus Revenue Receipts) declines over time. Ridership growth and fares inflation – as modelled in the revenue plots – account for this. Finance options with up-front HMG inputs typically produce even stronger ratios of NPV of benefits to NPV of costs.

Availability Payment versus revenue range

Graphed results include all modelled effects of:
- ridership growth
- background inflation (on AP and revenue)
- fares inflation above background

Both Not For Profit scenarios based on:
- same project inputs as Base Case
- but 0% pure equity input
- all equity input as subordinated debt

Step-changes in business case when Stage One connected to larger network

As trans-North and national networks roll-out over time, the business case improves for the Stage One section, as the beneficial impact of network effects feeds through to the commercial case.

As an illustration, the bullets below capture the key factors which change when Liverpool – Manchester is connected to an extended system also serving London, LHR, the Midlands and Leeds.

- The 58.7 km Liverpool – Manchester section is already in existence.
- Fleet + O&M costs increase only marginally when Liverpool – Manchester section is part of a larger network.
- The required Availability Payment for the Liverpool – Manchester section would remain (indicatively, for illustration) at between £250m to £300m p.a.
- However, ridership and revenue can be expected to increase by an order of magnitude, because the Liverpool – Manchester section now generates revenue from passenger flows (in both directions) as set out below:
  - Liverpool & JLI – Manchester (as before); plus additionally
  - Liverpool & JLI – Manchester Airport

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- Liverpool & JLI – Birmingham, Northern West Midlands and BHX
- Liverpool & JLI – Leeds and M62 P&Rs
- Liverpool & JLI – M25, Central London and LHR

- Indicative revenue generated by the Liverpool – Manchester section of the larger network is projected as 2.5x to 3x that of the stand-alone system.

**Incremental roll-out built into maglev network planning from the outset**

Whether it is Glasgow – Edinburgh, Liverpool – Manchester, Tees-Tyne, or London/LHR – Birmingham which acts as Stage One, Ultraspeed and its financial structure have been designed from the outset to enable phased procurement and delivery of the larger routes now under active planning and policy development.

As an example, a logical first extension of a potential Liverpool – Manchester Stage One would be the trans-Pennine extension to Leeds. This route uses Transrapid’s flexible engineering advantages to hug the M62 corridor to West Yorkshire and Leeds, as illustrated below.

This combined route produces the journey times show above. These are typically around 3x faster than today’s rail service, as tabulated below. Driving is generally around as slow as today’s trains, and even slower during rush hours and periods of congestion on the motorway.

<table>
<thead>
<tr>
<th>Journey</th>
<th>Maglev</th>
<th>2008 best rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liverpool – Manchester – Leeds</td>
<td>00:39</td>
<td>01:45</td>
</tr>
<tr>
<td>Liverpool – all intermediate stations – Leeds</td>
<td>00:50</td>
<td>01:45</td>
</tr>
<tr>
<td>Leeds – Manchester non-stop</td>
<td>00:19</td>
<td>00:55</td>
</tr>
<tr>
<td>Liverpool – Manchester non stop</td>
<td>00:18</td>
<td>00:50</td>
</tr>
<tr>
<td>Liverpool – MAN Apt (changing maglev at Trafford C)</td>
<td>00:28</td>
<td>01:11</td>
</tr>
<tr>
<td>Liverpool – MAN Apt (direct, via Central Mancs, maglev reversing)</td>
<td>00:38</td>
<td>01:11</td>
</tr>
<tr>
<td>Leeds – MAN Airport</td>
<td>00:40</td>
<td>01:20</td>
</tr>
</tbody>
</table>

Thinking further, all Ultraspeed route design and business planning always has in mind the ultimate integration of the Stage One route into the eventual strategic national maglev network, as discussed in Part 1. Only maglev is technically feasible and financially viable across the range of potential UK applications from 50 - 100 km super-regional links to 840 km North:South strategic spine.
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Considerations re incremental build of maglev vs wheel-on-rail in UK conditions

Ultraspeed maglev has been developed with UK conditions in mind. Maglev technical advantages produce lower capital costs, in part due to maglev’s reduced land-take and to conversion of up-front capital land costs into rental payments for air-rights, right-of-way and right-of-access where land remains usable for its original purpose under the guideway. Maglev’s much lower whole-life operating and maintenance costs then also come into play. Taking this all into account, maglev works both technically and economically on a self-standing basis over shorter initial routes. Such routes are, by definition (a) more affordable, (b) capable of delivering benefit rapidly and (c) lower in risk.

After successful Stage One implementation, maglev then also offers unbeatable speed, with the same vehicles and operational control systems over the longer inter-city sectors which come into play as a strategic system extends incrementally over time.

By contrast, TGV-style systems would not be viable over, say, the Glasgow – Edinburgh Airport – Edinburgh route, where maglev delivers a 17.5 minute city-to-city journey time including the intermediate stop. Rail’s inferior performance would only produce journey times in the order of 30 minutes. Furthermore, rail’s less flexible routing parameters would either require tunnelling to access the city cores or extensive capital works to quadruple, re-gauge and resignal existing railway approaches.

- Core estimate for Glasgow – EDI – Edinburgh maglev is £1.9 bn.
- Jacobs 2007 capex estimates for a hypothetical TGV-style link range from £4 bn – £7 bn, with no airport connection.

Generically, flexibility routing enables maglev to serve the hearts of cities, in addition to edge-of-town P&Rs, airports etc, with lower costs and far shorter end-to-end trip times than TGV-style rail.

For the avoidance of doubt, UK maglev has been explicitly designed to serve city-centre transport hubs and out-of-town terminals. The objective is to maximise the attractiveness of maglev as the fastest possible, low-carbon, alternative to both the car and short-haul aviation by enabling the maximum number of passengers to link the maximum number of origin:destination pairs with the minimum number of mode changes.

On a whole-UK scale, as discussed, the fundamental flexibility of sinuous maglev routing versus TGV-style requirement for tunnels, viaducts and other large-scale civils works also comes to the fore on the traverse of the Pennines. Here, maglev can closely follow the existing M62 corridor. The both minimises new environmental intrusion and enables a single maglev main line to serve all the major catchments on both the ‘East Coast’ and ‘West Coast’ corridors. TGV-style rail, by contrast, would either require two lines splitting into ‘east and ‘west’ to the south of the Pennine chain, or would need an unfeasibly expensive ‘base tunnel’ under the mountains.

With all the above in mind, maglev in Britain is explicitly designed to work initially on city-to-city routes, then to be expanded on a super-regional scale, with the phased roll out of a full-scale national network ultimately in mind.

By contrast, French-style incremental development of TGV-type rail would not work in the UK. Under the French model, high speed trains run off partially-built dedicated high speed lines and use the classic network for (a) long-term city centre access and (b) interim journey continuation to regions not yet directly served by a high speed route.

Whilst this is indeed the policy in France and elsewhere, UK loading gauge restrictions, the capacity constraints of an already-overloaded classic network, plus Britain’s notorious signalling incompatibilities, mean that this approach will not work physically and financially in the UK. As others have put it, the ‘incremental build’ TGV rationale just does not work here: “in the case of the UK many of the railway networks around our major conurbations are so congested already that they would not be able to handle the significant extra traffic that a high speed service would generate anyway”. [Prof R Smith et al for DfT, 2006]

The Channel Tunnel Rail Link proves the point. If ever there was a case for running TGV-style trains over cheaply upgraded classic infrastructure from the edge of a city to a terminus it is CTRL. Such a French-style approach would have avoided many of the costs of working a new alignment into Central London. In the event, there simply was not the capacity to
operate at anything like TGV speeds on the classic network into London. So an expensive tunnel had to be built from the edge of East London to the platforms at St Pancras. TGV to the edge of town plus classic rail into the centre at Waterloo was a strictly temporary measure.

It is this *impossibility* of fitting ‘anything-like-high-speed’ rail onto UK classic infrastructure and the necessity of constructing expensive tunnelled access to a city centre which resulted in CTRL’s out-turn cost of £56.42m per km (or ± £60m per km in 2008 terms). This capital cost is substantially higher than typical average maglev capex of around £30m per km.
Part 4: maglev environmental advantages

Strategic advantage 1: maglev and aviation considered holistically

A non-stop maglev journey from Heathrow to Manchester Airport will take around 50 minutes, depending on precise alignment and speed profile. This is faster gate-to-gate than BA’s published 65 minute flight schedule. In the plane’s 65 minutes, the maglev could also have called at M25/M1 Parkway, Birmingham Airport and Central Birmingham, Manchester Airport, the Trafford Centre and Central Manchester and be on its way to Leeds.

 Whilst all journey times cited in this document depend on the precise alignments and speed profiles eventually adopted for final system design, these high level results are of the correct order of magnitude (± 5 mins) and already point to a number of strategic advantages when maglev is considered in the round with UK domestic aviation:

- Manchester Airport is the best practical location for the East:West Leeds – Liverpool ‘arms’ of the Big-T to join its North:South ‘spine’ to London.
  - A direct alignment from there to John Lennon Airport, as showing on the whole-island map on page 8 would permit an airport-to-airport trip of under ten minutes. This effectively creates a world-class three runway super-airport in the North and for the North, without building an inch of new runway. Clearly this would require detailed planning for segregation of (secure) airside and (walk-up) landside passengers, however the potential is obvious.
  - Alternatively, the configuration shown in Figs 1 and 3 (with the junction at Trafford Centre) permits a direction Liverpool – Manchester alignment, with all Southern destinations and all Northern cities except Liverpool having a non-reversing through service to Northern England’s key airport. Even the reversing service pattern from Liverpool to Manchester Airport on this variant is still at least twice as fast as today’s rail.

- Assuming London terminals serving both the metropolitan centre and Heathrow, maglev will effectively replace domestic short haul flights from Leeds and Manchester to Heathrow.
  - This will be welcomed by the airlines who would then replace loss-making domestic flights with code-shared maglev services producing several times less emissions, thus racking up immediate credits on the carbon trading markets. Airlines could then use liberated Heathrow domestic slots for profitable long-haul services or, in the case of BA, trade them to rivals as the price of regulatory approval for a ‘super-merger’ with one of the major US carriers.
  - Crucially, switching short haul domestic services to maglev would free up around 450-1,000 runway slot-pairs at Heathrow every week (assuming full London–Scotland maglev). Even substituting only BA and BMI services to/from Heathrow and Manchester and Leeds (21 arrival and 21 departure slots per day each way) liberates 15,330 total slots p.a. Simply on the narrow definition of operational and revenue-generating potential to the airlines, these 294 slots per week are worth an up-front capital payment of £172m at the market value established by the reported £30m March 2007 51-slots-per-week deal between BA and BMI.
  - Needless to say, on a broader view, the maglev-empowered liberation of Heathrow slots buys significant time before the capital, political and environmental costs of building the third LHR runway must be paid.

Maglev not only gets passengers to and from the major hubs much more reliably, punctually and sustainably than short haul aircraft, it also enables airlines to offer interlining services to/from Heathrow over journeys that are currently too short to serve effectively with aircraft. The most obvious example is Heathrow to Birmingham Airport. Here maglev has a 27 minute journey time. This is shorter than the average length of time aircraft spend on the ground from push-back to takeoff at Heathrow at busy periods.

Once the network reaches a total length of 250 - 300 km (comfortably exceeded by the 450 km of the Big-T route) maglev becomes attractive for the transport of freight.
Transrapid maglev units have been designed from the outset to be capable of rapid reconfiguration (as with modern aircraft) from passenger seating to freight. The units can accommodate a standard wide-body airfreight container [ULD].

Assuming one or more of the second-tier airports connected by the Big-T route (Birmingham or Liverpool, say) is used to tranship ULDs from aircraft to maglev, the inbound containers can be delivered to any suitably-equipped terminal on the 281 mile Big-T network within a maximum of 3 hours of wheels-down in the UK. This represents a strong competitive advantage for the national economy by refining Just-In-Time techniques to the ultimate possible extent.

Using the same Transrapid freight capability – primarily designed for high-speed, high-value flows – courier and Royal Mail traffic can viably transfer trunk/spine/inter-hub haulage to maglev once a total system length of around 300km is exceeded. (Below that length and maglev speed advantages are negated by transshipment time penalties). For Royal Mail, it is not only speed, but primarily reliability of service that is important. With regulatory targets to meet for prompt delivery, UKU’s ability to offer RM 99%+ availability of service, on timetables defined to the second, represents a once-a-generation transformation to their business, freeing the postal service from the fundamentally unpredictable nature of road and air freight. Taking RM and likewise-substitutable courier trunking operations together, a North:South spinal UK Ultraspeed has potential to remove several million truck journeys a year from the Motorway network. Further quantifying study is required on this aspect.

**Strategic advantage 2: speed and carbon performance versus domestic aviation**

Maglev-for-jet substitution provides a powerful strategic illustration of the substantial carbon benefits to be secured.

*Hansard: 8 Jul 2004 : Column 786W* gives a figure of 8.08 tonnes total CO₂ emissions for a single averaged Heathrow to Manchester flight. Over the 292 km journey, and assuming a typical 180-seat aircraft, the following results are produced:

- 153g per passenger km at 100% load factor; which equates to
- 275g per passenger km at 60% load factor.

Transrapid conducted power consumption simulations for a variety of journeys from Heathrow to Manchester Airport. These assumed a five car maglev unit (as in Shanghai), with a relaxed 446-seat configuration, using consumption data from both Shanghai and test track operations.

The simulations also assume an identical 292 km journey (which is achievable as an alignment ‘on the ground’).

The 2008 UK power generation mix average of 430g CO₂ emissions per kWh generated at power stations is also assumed. Results are tabulated below, expressed in grams CO₂ emitted per passenger km. It is essential to note that maglev powered by a cleaner generation mix will achieve even better results.

UKU studies in Scotland modelled power supply by BP’s 2006 proposal for carbon-capture CO₂ injection into near-exhausted North Sea aquifers, with the resultant pressure forcing out marginal oil which is then used to generate electricity. At 43g/kWh, this ‘closed cycle’ power source claims ten times less CO₂ emissions than todays 430g/kWh. Result: near-zero emissions maglev at 300mph.
Trip with 446 seat 5-car Transrapid

<table>
<thead>
<tr>
<th></th>
<th>g CO2/pass km @ 100% load factor</th>
<th>g CO2/pass km @ 60% load factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>LHR - MAN in 65 mins (same time as BA non-stop flight) but also including intermediate stops at M1/M25 Parkway, Birmingham Airport and West Midlands. Consumption including allowance for regenerative braking [7.5 MWh]</td>
<td>24.7g/pass km maglev vs 153g/pass km air travel</td>
<td>41.3g/pass km maglev vs 275g/pass km air travel</td>
</tr>
<tr>
<td>LHR - MAN non-stop in 60 minutes to enable direct comparison with the 65 minute BA non-stop flight [5.1 MWh]</td>
<td>16.8g/pass km maglev vs 153g/pass km air travel</td>
<td>28.1g/pass km maglev vs 275g/pass km air travel</td>
</tr>
</tbody>
</table>

For completeness sake, further simulation runs were performed on identical trips, but this time using a 10-car maglev in Ultraspeed’s preferred 840 seat [700 standard+140 premium] configuration. Results are tabulated below. For information, a typical Pendolino seats around 440. Its speed and carbon performance versus maglev is discussed in detail below.

Trip with 840 seat 10-car Transrapid

<table>
<thead>
<tr>
<th></th>
<th>g CO2/pass km @ 100% load factor</th>
<th>g CO2/pass km @ 60% load factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>LHR - MAN in 65 minutes 3 stops [12.9 MWh]</td>
<td>22.6g/pass km maglev vs 153g/pass km air travel</td>
<td>37.7g/pass km maglev vs 275g/pass km air travel</td>
</tr>
<tr>
<td>LHR - MAN in 55 minutes 3 stops [18 MWh]</td>
<td>33.1g/pass km maglev vs 153g/pass km air travel</td>
<td>55.2g/pass km maglev vs 275g/pass km air travel</td>
</tr>
<tr>
<td>LHR - MAN non-stop in 60 minutes [8.8 MWh]</td>
<td>15.4g/pass km maglev vs 153g/pass km air travel</td>
<td>25.7g/pass km maglev vs 275g/pass km air travel</td>
</tr>
</tbody>
</table>

Further energy consumption simulations will be performed when the precise physical parameters of the system (gradients, curvature, terminal locations and desired maximum speed and acceleration profiles) are determined by later stages of study.

In graphic terms the profiles are shown below. Note that, in gross energy terms, the first graph represents an ‘absolute worst case’: maximum energy is used to propel a unit over the distance in the shortest possible trip time. In all other cases, energy consumption is lower.
To illustrate the case that other trip profiles produce different results, the following graph provides a comparison for the same 161.5 km [100.9 mile] journey section using a softer acceleration and speed profile from Heathrow to BHX including a 2 minute stop at the M1/M25 P&R terminal.

Graph below: energy consumption for 400km/h LHR – M1/M25 – BHX trip [Profile A]
The case illustrated in the first graph is highlighted in purple; the most energy-efficient (the 10-car version of the second graph) is in green.

<table>
<thead>
<tr>
<th>LHR - M1/M25 P&amp;R (2 min stop) – BHX</th>
<th>5-car unit 446 seats</th>
<th>10-car unit 840 seats</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROFILE A: Total trip time 34.4 minutes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cruise between Hertfordshire and BHX capped at 400km/h [250 mph]. Softer acceleration profiles on both journey sectors. Max speed on short LHR-M1 section capped at 280km/h [175mph]</td>
<td>4.4 MWh</td>
<td>6.6 MWh</td>
</tr>
<tr>
<td></td>
<td>61 Wh per Seat Km</td>
<td>49 Wh per Seat Km</td>
</tr>
<tr>
<td></td>
<td>26 g / Seat km</td>
<td>21 g / Seat km</td>
</tr>
<tr>
<td><strong>Average speed 282 km/h [176 mph]</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PROFILE B: Total trip time 29.81 minutes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cruise between Hertfordshire and BHX peaking at absolute maximum 500km/h [311mph]</td>
<td>6.7 MWh</td>
<td>9.9 MWh</td>
</tr>
<tr>
<td></td>
<td>93 Wh per Seat Km</td>
<td>72 Wh per Seat Km</td>
</tr>
<tr>
<td></td>
<td>40 g / Seat km</td>
<td>31 g / Seat km</td>
</tr>
<tr>
<td><strong>Average speed 383 km/h [239 mph]</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Seat km are simply 161.5 km x total number of seats. Emissions are expressed in grams CO₂ per seat km, calculated on the UK average basis of 430g per kWh generated. As can be clearly seen, even these demanding maglev schedules – which all produce journey times quicker than air travel – do so at a cost (in grams CO₂ per seat km) of only 15% to 26% that of air travel.

As noted in the first table in this subsection, more relaxed maglev schedules, such as the 292 km from LHR to Manchester Airport non-stop in 60 minutes (average speed 292 km/h or 182.5 mph) produce as little as 15.4g [10-car] or 16.8g [5-car] per Seat-Km. That is to say 10% to 11% of air travel emissions, but with a trip time that is faster gate to gate over the Heathrow to Manchester Airport distance.

**Strategic advantage 3: speed and carbon performance versus high speed rail**

To provide as close as possible to an ‘apples with apples’ comparison with High Speed Rail, let us take the slowest of the maglev journeys outlined above and compare it with the fastest practically achievable journey using a state-of-the-art train. All rail data is validated by Siemens TS working from in-house data.

To approximate the maglev’s capacity by high speed rail, let us assume an 8-car ICE-3 high speed rail unit to give a similar seating capacity (typically around 415). This broadly compares to 5-car maglev’s 446.

- The rail unit takes longer (both in distance and time terms) to brake and accelerate to 300 km/h [186 mph] than maglev.
- The rail unit cannot practically exceed 300 km/h [186 mph] in daily service. 350 km/h [219 mph] was planned as the absolute peak speed for crack Madrid-Barcelona expresses but abandoned in practice due to prohibitive O&M and cost impacts.
- Operating at a steady 300km/h cruise, the rail unit consumes 7.271 MWh in every hour. Accelerating and braking power curves are as per industry data.
- Taking all the above performance characteristics into account, the best-practice high speed train:
  - **consumes** 4.9 MWh (identical to maglev)
  - **takes** 43.10 minutes for the same journey (maglev 27% faster at 31.64 minutes)
  - **produces** 31.5g CO₂ per seat km with 415 seats in an 8-car configuration. (17.5% worse than maglev’s 26g per seat km with 446 seats in 5-car configuration; 32% worse than 10-car maglev).
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Note: it should be borne in mind that these rail data are for a service operating at the outer limits of practically achievable day-to-day performance, on a single route assumed to be engineered for rail's maximum 300 km/h cruise, whereas this maglev schedule is well within the proven performance envelope.

This prompts two notes of caution regarding high speed rail in the UK context.

Firstly, any ‘ideal’ wheel-on-rail alignment would be significantly more capital-intensive to construct than maglev’s largely-elevated route, given rail’s inefficient gradient and curve parameters and the necessity to build most of it at-grade.

Secondly, in the UK, as previously discussed, no convincing case has been made that a TGV-style railway could serve both Manchester and Leeds without very costly civil engineering over (or, more likely, under) the Pennines.

In all cost, benefit, and value comparisons of maglev and high speed rail, policymakers must assume TGV-style wheel-on-rail will require two separate routes to the North West and Leeds, diverging at some point south and following alignments East and West of the Pennines if 300 km/h connections to all major destinations are required.

- This will only change if wheel-on-rail proponents put forward a case which demonstrates that a 300 km/h high speed trans-Pennine railway is achievable and clearly states its costs – and £62m/km for tunnelling should be assumed to enable like-for-like comparison with maglev.
- Alternatively, a TGV-style business case could acknowledge that high speed will only be offered to Manchester, with low speed over classic infrastructure onward to Leeds. Such a case should include no major revenues from Yorkshire, as the total journey will be little or no quicker than today’s ECML classic rail from Leeds.
- Even in this sub-optimal case, the heavy rail business case must include the full (and substantial) costs of the gauge, capacity and signalling enhancements and electrification that will be required to enable TGV-style trains to operate over the trans-Pennine route.
- Any two-route TGV-style rail business case must, naturally, also include the full costs of operating a duplicated fleet over a longer total network and all associated costs of maintaining such a system.

Strategic advantage 4: speed and carbon performance versus conventional rail

Expanding the comparison to include both today’s WCML and Cross Country trains draws out further maglev advantages. This is summarised graphically overleaf.

Maglev typically has a Carbon Cost : Journey Time Benefit ratio 2.4 or more times better than conventional rail, compared to both cross-country (90-100 mph) and intercity (125 mph max) rail systems. As the graphic overleaf clearly illustrates: the headline carbon cost of travel by maglev or conventional rail is broadly similar, in terms of grams of CO$_2$ emissions per passenger km alone. But the journey time by maglev is around two and half times quicker on these routes.

- That is to say, one could benchmark as 100 Virgin’s best 2 hour 10 minute London – Manchester trip at the published Pendolino fleet average of 27g CO$_2$ emissions per passenger km with Virgin’s published average 55% load factor.
- A trip over the same distance by maglev could very easily be accomplished on an extremely relaxed non-stop schedule in 60 minutes, cruising at little over 300 km/h.
- Modelling a 446-seat 5-car maglev on this trip profile, and also operating at 55% load factor, produces 29g per passenger km, assuming maglev consumption of only 5.1 MWh and an identical generation mix.
- Hence maglev scores 240 vs today’s rail benchmark of 100 when journey time benefit is weighed against carbon cost on these speed and capacity profiles.

The maglev inputs for these calculations are again Transrapid simulations for both trip time and energy use. The rail-side inputs are taken from Virgin’s “Go Greener” data, published on the Virgin Trains website. Further calculation inputs are as embedded in the graphic.
Results from the exceptionally demanding Leeds-Manchester-Liverpool route are also used above to compare with Virgin’s published data for cross-country services (now transferred to Arriva). Here again, maglev scored 242 on the carbon:time ratio, when contemporary rail performance is benchmarked as 100.

**Strategic advantage 5: speed and carbon performance versus car**

This subsection reproduces verbatim the text from a Summer 2008 Ultraspeed study into the Liverpool – Manchester – Leeds Maglev route [LM&LM]. In part this focussed on the speed and carbon advantages of maglev versus the private car, and analysed the extent to which maglev could attract car users to public transport, using commuter P&R stations.

An initial design study for such a facility (specified to accommodate full-length 10-car inter-city maglev units by the architectural practice Ryder is shown overleaf. The Ryder visual clearly illustrates a number of key features of maglev terminal design.

- Guideway is elevated, enabling circulation beneath the running lines.
- Each line has a dedicated embarkation platform (to the outer side) with a central, segregated, disembarkation platform between the two lines. This system allows for quicker stations stops. As the vehicle approaches, passengers are advised to prepare to disembark. On arrival the disembarkation-side doors open 20 - 30 seconds before the embarkation-side doors. This empties the critical circulation space around the door areas before embarking passengers join the service.
- Very precise reservation and yield-management systems, integrated with the centimetre-precise operational control of the vehicle, enable tickets to be issued (almost certainly in purely electronic form) to coordinate parking slot allocation to minimise the walk to the platform section at which a specific door on the maglev will stop. Additionally, platform-edge doors on the station – as per Jubilee Line – both prevent passengers falling on the guideway and cut down station dwell time by marshalling passengers to the correct section of maglev before the unit arrives.
- Modular design enables parking ‘silos’ to be added in phases as demand grows.
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LM&LM includes two strategic Park & Ride facilities. West Yorkshire Parkway is located close to the junction of the M62 and the M606. The eastern interchange, which is the subject of the present analysis, lies adjacent to J21 of the M62 and outside the M60 Manchester ‘motorway box’. Whilst technically it is located in Milnrow, close to Rochdale, in consumer terms it will be branded ‘East Manchester Parkway’, to convey the sheer proximity – in maglev terms – of this location to the City Centre.

Both of these facilities are designed to reinforce maglev’s high-quality station and on-board offer to ‘communicate, capture and convert’; encouraging the switch from road by making it easy, attractive and good value to use maglev.

Public transport has traditionally struggled to match the perceived ‘door-to-door’ convenience of the car for journeys to specific destinations in city centres. ‘Perceived’ because traffic management and car park location often makes it impossible to park anywhere near the actual destination.

Maglev will change that perception; finally a mode of public transport with the speed to outweigh the inconvenience. In order to capture market share and to convert drivers into P&R users, it is imperative that maglev communicates its speed and value for money advantages directly to users.

This design sketch for an M62 sign on the approach to M62 J21 Parkway essays this. The imposed economy of motorway-standard signage encapsulates the issue. Maglev enables a fundamental rethink at the very personal level at which journey choices are made.

Signs (and their dynamic offspring, SatNav) should no longer just tell us where we are going, but should give us the facts about how we can get there, empowering us to make informed choices about transport.

In this indicative example, the sign leverages DfT’s considerable sunk investment in dynamic traffic flow monitoring (eg MIDAS) to provide drivers with real time information about driving time to Liverpool and Manchester. Typical morning peak times to both city centres from J21 are shown, along with real-world information about comparative costs vs maglev.

Even without attempting to bring the full costs of depreciation, taxation and servicing into the equation – to which car drivers are notoriously oblivious – maglev defeats driving head-to-head on just the ‘hard’ costs of fuel, parking and C-charge, which drivers do habitually register.

From a strategic traffic management perspective, maglev P&R locations (along with Trafford Centre, which could use its spare weekday parking capacity for the same purpose) unload city centre roads and parking capacity.
For Manchester Airport users, to take another example, it becomes quicker, cheaper and more more pleasant to park 30 or 50 miles away from the airport and ride maglev direct to the terminal, rather than drive round the M60, park in a windswept long-term car park and wait in the rain for that euphemistic misnomer of the airline business, the ‘courtesy’ bus.

Business planning indicated that significant revenue could be derived from P&R operations. Optimisation is required to find the ‘sweet spot’ which balances maximum parking income and maximum appeal to drivers against the capital cost of providing the facilities.

Needless to say, value for money and value of time data are not, today, the only information the individual needs to make an informed transport choice. Readily-grasped facts about carbon impact are vital too.

Again using a design exercise for gantry signage at East Manchester Park & Ride as illustration, Ultraspeed would communicate, in consumer terms, rolling average information about Load Factor and Generation Mix. As shown on the (deliberately) green sign below, this would be streamed directly from the maglev operational control and yield management systems, and would enable a regularly updated carbon impact for specific maglev journeys to be communicated.

In this instance, a figure of 486g CO$_2$ results from one passenger making the 17.2 km, eight minute, maglev trip from the Park & Ride to Central Manchester. This assumes the system is operating at an (aggressive, but peak-hours typical) 70% Load Factor.

It also assumes that maglev will use its buying power as a strategic wholesale electricity consumer capable of predicting, and contracting for, its energy requirements to the kilowatt and to the second for decades ahead, to incentivise and secure an above-average proportion of its electricity from carbon-free generators.

The blue sign indicates total emissions caused by a car undertaking the same 17.2km journey, using representative figures of CO$_2$ emissions per car-km taken from DfT’s ‘Act On CO$_2$’ website for three categories of car (148g, 173g and 230g respectively). As evidenced above, single occupant car trips are between 5 and 8 times more polluting, with maglev operating reasonably capacity-effectively, powered by an energy mix seen as achievable in the medium-term.

Even with today’s generation mix (shown below; 22% from carbon-free sources) and at a Load Factor typical of today’s UK rail, maglev is still 2 to 3 times greener than the car, whose emissions remain the same. And that’s the point: as electricity generation gets cleaner, maglev gets greener. Oil-fueled cars (and planes or diesel trains for that matter) will never achieve this step change; their core technology prohibits it.
The calculation basis for the versus car comparisons presented above is:

<table>
<thead>
<tr>
<th>Source (maglev)</th>
<th>Transrapid power simulation for LM&amp;L route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>122km x 500pax = 4.96 MWh</td>
</tr>
<tr>
<td>Input</td>
<td>2007 Generation Mix @ 430kg per MWh</td>
</tr>
<tr>
<td>Produces</td>
<td>34g per pass-km @ 100% Load Factor</td>
</tr>
<tr>
<td></td>
<td>49g per pass-km @ 70% Load Factor</td>
</tr>
<tr>
<td></td>
<td>69g per pass-km @ 50% Load Factor</td>
</tr>
<tr>
<td>Calc</td>
<td>70% LF &amp; 55% electricity from zero-carbon sources</td>
</tr>
<tr>
<td>Result</td>
<td>28g per pass-km x 17.2 km = 486g</td>
</tr>
<tr>
<td>Calc</td>
<td>50% LF &amp; 22% electricity from zero-carbon sources</td>
</tr>
<tr>
<td>Result</td>
<td>69g per pkm x 17.2 km = 1,187g</td>
</tr>
</tbody>
</table>

Source (car) DfT: Act On CO2: typical emissions for each class of car:
- Small: 148g/km
- Family: 173g/km
- Large 4x4: 230g/km

Note: The base input (4.96MWh per 122km) is a basket of Transrapid simulations including very high speed, high acceleration profiles. J21 to Manchester is a low-speed stopping journey. In practice, it is likely to have energy consumption per unit-km lower than the whole system non-stop journey benchmarks used as inputs here because:

a) there are no very high speed sections involved over this urban alignment; meaning that

b) acceleration phases are shorter; and that

c) cruise phases consume less energy per km; and

d) a greater proportion of the run in question is spent braking and thus returning regenerated power to the grid. This input value is further justified on the basis that the 100% capacity figure for units on this section is likely to be in excess of the 500 passenger value used for whole-system modelling.

Further simulations will be conducted in the next round of work. In the light of all the above, we are confident that the comparative numbers presented in the ‘M62 gantry signs’ are highly conservative.
Part 5: maglev policy and business case demands balanced consideration

The business case presented in Parts 1 – 4 is supported by detailed studies which available on request. Data consistently emerges from these studies that very strongly indicates that maglev, deployed in the specific conditions of the UK, would:

- be faster than wheel-on-steel High Speed Rail [HSR];
- provide capacity similar to, or higher than, HSR;
- have lower emissions than HSR on like-for-like trip-time basis;
- have lower land-take than HSR;
- have lower noise emissions than HSR;
- have lower up-front capital costs than rail (largely as a result of lower land-take);
- be capable of extension to other Northern England and Scottish cities at substantially lower capital cost than rail (the optimum North:South maglev would be 100 – 200 km shorter than HSR and would require no expensive under-Pennine tunnel);
- be capable of more intensive and more automated operation the HSR; and
- require less intensive maintenance than HSR, and thus
- have lower whole-life costs than HSR;
- offer more direct connection to LHR than the proposed Heathrow Rail Hub;
- offer air-beating journey times all the way from London to Scotland;
- offer faster journey times to/from the Continent from Manchester and beyond than any 'simple' extension of CTRL;
- release capacity on the existing rail network, rather than create capacity bottlenecks at existing classic rail stations as any proposal to 'run-off' TGVs on to classic rail lines would do.

In the specific conditions of the UK, there is a strong probability that maglev is likely to deliver best value for the taxpayer. Hence the public interest clearly requires both rail and maglev cases to be taken forward, to enable a balanced and informed policy decision to be taken in due course. We distinctions

Lord Adonis has stated that the current Government: does not wish to see a maglev proposal considered further and is concentrating instead on the very limited High Speed 2 project to develop a TGV-style railway from London to the West Midlands. This stance is prejudicial to the interests of the taxpayer, because it makes a technology choice from the outset, without giving equal consideration to the development of a maglev solution which could potentially offer taxpayers better value. It also unnecessarily shuts down the possibility of genuinely competitive strategic procurement, under which rail and maglev would compete on merit.

Rather than closing down options, a better course would be for Government to invest instead in having the business cases for both potential solutions taken forward to the same level of detail. Both rail and maglev would thus be empowered to compete on their respective merits when Britain’s high speed ground transport is procured.

With this in mind, UK Ultraspeed on 02/03/2009 offered Sir David Rowlands to develop a detailed maglev proposal for Government’s High Speed Two company, and to do so for less taxpayers’ money HS2 will spend on developing a wheel-on-rail proposal. Regrettably this offer was rejected.

Despite the anti-competitive stance adopted by High Speed 2, Ultraspeed welcomes the increasing openness to 500 km/h maglev as a viable alternative to 300 km/h wheel-on-rail that is generally emerging across the political spectrum, now that more policymakers engaging with the robust factual and financial basis of the case for maglev. As examples:

We welcome Nick Clegg’s statement that, in the Liberal Democrat view, “It is vital that investment is made in [a North:South] high speed link, ahead of any decision to support airport expansion in the South East. [...] The technology to be used remains to be decided. It has to be cost-effective and environmentally friendly.” Again, we look forward to competing maglev versus rail competition. On the facts and on merit.
UK Ultraspeed

We welcome the evidence from the Scottish Minister for Transport, Infrastructure and Climate Change, given to the Scottish Parliament’s Inquiry into High Speed links. He stated “if we get down to the magic three-hour figure for the journey time to London, we will unambiguously have a surface transport system that fundamentally changes people’s decision about whether to fly or go by train” and then went on to state that “we certainly do not discount maglev. Ministers have had several meetings about maglev and we are fully engaged in keeping track of what is going on and of the opportunities.” [Scottish Parliament, TICC Committee, Report into High Speed Rail, published 26/02/2009.

We welcome the Conservative Party’s commitment to hold an open competition to select the optimum system and their we confirm that UK Ultraspeed will be making a maglev bid into that competition, should the Conservative Party form the next Government, largely on the basis of the competitive advantages outlined in this document.

Despite all the positive developments referenced above, however, informed and balanced policy-making is still being compromised by a number of factual inaccuracies that have been circulated about maglev. The final part of this document therefore offers a summary of pertinent excerpts from documentation and correspondence with Ministers and Officials to correct, on the public record, this incorrect information.
Part 6: correcting inaccuracies about maglev in the interests of informed policy-making

Summer 2004
UK Ultraspeed initial feasibility case presented at No 10. Requested to develop for presentation to Prime Minister.

September 2004
UK Ultraspeed present strategic maglev case to the (then) PM, who undertakes to request DfT to expedite matters.

October 2005
Initial meeting with the (then) Secretary of State for Transport granted. No follow-up by DfT.

June 2006
Some 20 months after the No 10 presentation, UK Ultraspeed is finally invited to present evidence to a technical review organised by DfT.

October 2006
Factual and financial case published in UK Ultraspeed Factbook, the underlying detail of which was also submitted to the Eddington Review. UKU presentations to DfT at this time state an overall estimated capital cost for the full London – Scotland system of ±£29 bn including all land costs. This estimate is based on the detailed breakdowns stated on p26 of the Factbook. Key amongst these were cost estimates excluding land, of between £16.0 and £19.8 bn.

July 2007
Rail White Paper published. It contained the following, provably incorrect, passage which overstated maglev capital cost by a materially prejudicial £31 bn (!).

6.27 “maglev would be sufficiently fast to provide a London–Glasgow service that could compete with air on journey time, whilst providing intermediate stops at Birmingham, Manchester, Leeds, Newcastle and Edinburgh. Its promoters, UK Ultraspeed, have estimated a cost of £29 billion (excluding land-take) for such a network…”

Compounding the error, the White Paper then doubles the already incorrectly-cited £29bn to

“suggest…that the figure could be very significantly greater in the UK (of the order of £60 billion)”

The above is provably incorrect because it simply mis-claims that Ultraspeed’s own 2006 cost estimate of £29bn, which included land, to be exclusive of land take.

27 July 2007
UK Ultraspeed writes formally to the (then) Secretary of State for Transport, pointing out this error and offering constructive engagement to rectify the situation. The letter is included verbatim below.

Rt Hon Ruth Kelly MP
Dear Secretary of State,

I am writing to you to follow up our brief discussion at Wednesday’s Transport Times conference. I welcome and appreciate your acceptance of a meeting to re-engage regarding maglev in response to my question at the conference. I also applaud your willingness to take questions, particularly so early into the job.

I regret that I had to use my question to correct the £31bn overstatement of the estimated total costs of maglev that has unfortunately been included in Section 6.27 of the White Paper. I’m sure you will understand I simply had to correct the public record regarding the misquotation of our own figures. Drawing your attention to the text, let us examine the error.
The White Paper states: “maglev would be sufficiently fast to provide a London–Glasgow service that could compete with air on journey time, whilst providing intermediate stops at Birmingham, Manchester, Leeds, Newcastle and Edinburgh. Its promoters, UK Ultraspeed, have estimated a cost of £29 billion (excluding land-take) for such a network...”

The cost estimate attributed to us is wrong. We know it to be wrong, because the White Paper is citing our figures.

In fact, the £29bn figure is itself an estimate of the order of magnitude of total capital costs for an 800km national system. It already includes land and the other risks the White Paper has loaded into its £60bn(!) figure.

The true figure (excluding land) is £20m – £24.75m per route km, giving a total cost for an 800km system (excluding land) in the order of £16bn – £19.8bn. This is set out on pp 25-26 in the UK Ultraspeed Factbook [enclosed]. The underlying detail is in the pre-feasibility work produced for No 10, which is in the Department’s possession.

Compounding the error, the White Paper then doubles the already incorrect £29bn to “suggest...that the figure could be very significantly greater in the UK (of the order of £60 billion)”.

This headline number of £60bn both misrepresents the maglev case and could, if left uncorrected, be seen to be materially prejudicial against it. This difficulty can be resolved by the production of accurate facts. I propose later in this letter a process of collaboration with the Department to achieve such a resolution.

For now, though, let us remain with the White Paper text, which concludes: “Given the balance of these considerations, the Government does not favour further development of maglev options”.

The most significant consideration in that balance is cost. With the massive overstatement now corrected, the entire balance shifts. Removing £31bn of erroneous cost has a fundamental effect on the inclination of any playing field. Maglev is now due serious consideration: balanced and informed policy-making requires it.

The fundamentals remain. UK Ultraspeed maglev has a powerful case as an exceptionally cost-effective and comprehensive answer to many of the questions of capacity, connectivity and carbon which the White Paper itself raises and which you most eloquently presented yesterday.

In addition, the sheer speed of maglev transforms the competitiveness of the regional economies of the UK. This would, in itself, help relieve the multiple stresses increasingly bearing on London and the South East.

As indicated above, I propose that we move on, by moving into a process of rigorous study which will produce a robust understanding of maglev in the UK, including accurate costs.

Things have progressed significantly since we last engaged with the Department. Studies of potential Stage One maglev routes are now being scoped or started in a number of locations in Northern England and Scotland. Various public sector partners are involved.

These studies are intended to provide hard facts and costs about specific city-to-city Transrapid maglev routes in UK-specific conditions. They will also deliver comprehensive project finance proposals, which take into account both capital expenditure and long-term operating, maintenance and lifecycle costs.

The studies will enable the whole-life costs of maglev to be compared to those of comparably scoped classic rail schemes. Preliminary work shows these to be between 35% - 50% of heavy rail; a step-change in value for money for both Government and/or private sector participants in the funding, delivery, operation and maintenance of major transport systems.

The studies will also provide robust, UK-specific data on energy consumption and will define the path which UK Ultraspeed intends to follow, from a current position of significantly lower carbon emissions than TGV-style trains, toward the ultimate target of 500km/h (311mph) transport with zero carbon emissions.
With all the above in mind at our forthcoming meeting, I would look to discuss with you how the Department could invest in these studies – collaboratively with ourselves and our other public sector partners – to produce balanced, accurate and comprehensive data on UK maglev. This data will both enable the Department to correct the numbers currently in the White Paper on the basis of new evidence and provide you with accurate facts to inform future policy decisions.

I am communicating the essence of this letter to a number of our regional and corporate stakeholders, in confidence, to appraise them of the accurate position.

I look forward to hearing from your office to set up the meeting.

Yours sincerely,

Dr ALAN JAMES

PS. I note some rather inaccurate discussion of the costs of maglev in China used at various points in the White Paper and its supporting documentation. For clarity, the total costs for the Shanghai maglev system, including all guideway, vehicles, substations, auxiliary equipment, and interest during the construction phase (again excluding land, which was provided by the State) were 9.943 billion RMB or 1.198 billion USD.

This produces an average (excl land) cost per route km of 330 million RMB (39.759 million USD), or around £20m per route km at today’s exchange rates. This is in line with our own projections and is as little as 50% of the cost of rail-based transport projects in Shanghai. I would be happy to send documentation on this subject to your officials.

28 September 2007
Secretary of State responds by letter, stating “we have no plans to participate in or fund studies into maglev” and retracting her commitment to meet with Ultraspeed, which was made in public at the Transport Times conference of 25/07/2007.

29 October 2008 Secretary of State appears before Transport Select Committee
In the following exchange, Mr Hoon confirms that Government’s mind remains open to maglev, but repeats the materially prejudicial mis-statement of costs derived from the 2007 White Paper, despite this already having been corrected on the record by letter to his predecessor.

Q27 Mr Clelland: On the high speed rail question, I was interested to see you were talking about the possibility of providing new lines. Does that mean that the Department’s mind is no longer closed to the idea, for instance, of a maglev line, or is it still closed to that idea?

Mr Hoon: It is certainly not closed to it, although I think the Committee will be aware that the track costs are something like three times as much for a maglev line as for a conventional line. We are certainly not closed to it but we have got to be realistic about what we can afford.

To recap for clarity.
Maglev: £30m/km. High Speed Rail (CTRL): £56.42m/km [± £60m/km in comparable 4Q 2008 numbers].
500 km/h maglev costs less than TGV-style rail, not 300% more as the Secretary of State had been briefed.

30 October 2008
UK Ultraspeed again writes formally to the Secretary of State for Transport, formally pointing out this error and offering constructive engagement to rectify the situation.

Rt Hon Geoff Hoon MP
Dear Secretary of State,

I am writing to you in response to your mention of maglev at Wednesday’s Transport Select Committee hearing. I was delighted with your statement in reply to David Clelland’s question that you have not ruled out maglev in Britain. In the light of your statement and of the growing political consensus that
investment in high speed ground transport is an urgent necessity, I write primarily, to affirm UK Ultraspeed’s readiness to re-engage immediately with DfT to move things forward.

I am, however, concerned that the view persists that maglev costs more than 300km/h [186 mph] TGV-style wheel-on-rail in UK application. This is inaccurate.

Regrettably, the 2007 White Paper statement on maglev costs was wrong. And we know it to be wrong, because it used our own figures and then erroneously simply double-counted major items. Please see my 27/07/07 letter to your predecessor for the detail.

But let us not revisit old ground, but rather progress matters on a robust foundation of fact. In this spirit, and to assist informed policymaking, much detailed work has since been carried out on maglev over the last year. This new evidence, which we will be happy to present to you and your senior team, now includes data on journey-time, speed, energy and CO2 performance to a very high level of accuracy: ± 1 metre, 1 second and 1 kilowatt. Detailed results versus train, plane and car are now also to hand. Project Finance modelling to the standard required to support substantive initial engagement with HM Treasury has also been completed.

Critically, detailed capital costings for a variety of UK maglev applications have been examined.

These consistently produce capital costs for maglev, including land, in the region of £30m per route km, including such complex route sections as the traverse of the Pennines and alignments into the hearts of London and other major cities including Birmingham and Manchester.

Compared to maglev’s £30m/km, your Department has published an out-turn cost for CTRL (the UK’s only TGV-style wheel-on-rail system, including the cost of Temple Mills Depot) of £56.42m/km. This would be over £60m/km in comparable 2008 terms.

On the basis of studies to date, 500 km/h maglev capital costs are less than 300 km/h TGV.

On a more fundamental level, maglev requires only one line to link all the major city-regions of the ‘West Coast’ and ‘East Coast’ corridors, whereas TGV-style rail needs two routes, yet is slower to all destinations. This means between 100 km to 200 km less infrastructure than TGV. That’s billions saved before a service has ever operated. Maglev’s single-route approach also means that only maglev can cost-effectively link the important catchments of Yorkshire, the North East and Scotland’s Central Belt to a national network.

On a whole-life basis, the maglev case is stronger still. Maglev is highly automated, and highly efficient in O&M and staff costs. It requires only half the fleet, and completely avoids TGV-style physical grinding down of its infrastructure every time a unit moves – maglev never actually touches its guideway. Taking all the above advantages into account, studies indicate that maglev will comfortably outscore any comparably-scoped TGV-style rail project on a whole life basis, whether this is expressed in terms of ‘net cost to HMG over a PPP term’ or ‘NPV of benefit outweighing NPV of cost’, or any other similar test of value.

To move matters along, I would be happy to arrange for an early presentation to you and your team. We would propose to focus on both the full-scale London – Northern England – Scotland system and, in parallel, on opportunities to rapidly progress city-to-city pilot projects. We would present comprehensive business cases for each.

I look forward with interest to your response.

Yours sincerely,

Dr ALAN JAMES

The Secretary of State did not reply to the above letter.

15 January 2009

(Then) Minister of State (Lord Adonis) contradicts Secretary of State’s statement to the Committee of 29/10/2009 (that Government’s mind remains open on maglev) by stating that Government does not wish to see maglev proposals taken forward.
UK Ultraspeed

“...the operating and building costs of the maglev are very high. By definition, it is not possible to integrate it with the existing high-speed line, and its carbon emissions are also extremely high—significantly higher than those of conventional high-speed rail lines. All those factors have meant that the Government do not wish to see a maglev proposal considered further.” [Lords, 15/01/2009. Col 1389.]

19 January 2009

UK Ultraspeed CEO writes formally to the (then) Minister (now Secretary) of State, formally correcting the mis-statements of fact, and pointing out that the cost misinformation is still being cited, despite formal correction by letters to two Secretaries of State. Once again constructive engagement is offered to rectify the situation. The letter is quoted verbatim below.

Andrew Adonis
Minister of State

Maglev

I note your comments in the House of Lords on last Thursday that “the Government do not wish to see a maglev proposal considered further.” I further note that, amongst the reasons you gave for this, are the contentions that “the operating and building cost of the maglev are very high” and that “its carbon emissions are also extremely high – significantly higher than those of conventional high-speed rail lines.”

Regrettably, I fear you have been misinformed. Let us firstly deal with cost. Maglev costs less than high-speed rail, not more.

- The average capital cost per km of twin-track Transrapid guideway in UK conditions ranges from £27m to £32m, including land and all associated infrastructure, equipment, stations and depots. Recent, independently verified, studies have produced these figures.
- Your own Department’s figure for the out-turn cost of the UK’s only TGV-style railway (CTRL, including its land, stations and Temple Mills depot) equates to £56.42m per km. This is around £60m/km on a 4Q 2008 basis directly comparable with the ± £30m/km maglev cost projection.
- Transrapid maglev’s greater flexibility in curvature and gradients, the avoidance of tunnelling this enables, and much lower land-take are the key reasons for maglev’s lower costs on a km-for-km basis. It should also be noted that a strategic UK north:south maglev network will be 100 – 200 km shorter than any TGV-style system, thus saving kms and further billions of capital costs. Finally, elevated maglev guideway allows land to remain usable for its original purpose, thus making long-term Right of Way rental deals possible, further saving up-front capital costs.
- Regarding operating costs, friction-free operation means zero abrasion of the track, more intensive use of much smaller fleets is enabled by higher speed, and full automation dispenses with many staff costs. This all results in O&M costs typically 50% to 65% of a similarly-scoped wheel-on-rail system.
- The misapprehension on maglev capital costs goes back to a curious ‘double-counting’ of maglev costs in Section 6.27 of the 2007 Rail White Paper. In essence, the White Paper explicitly quoted a UK Ultraspeed estimate for the entire 800 km London – Scotland system of £29 bn, which overtly included land and all associated infrastructure costs. However the figure was misquoted as “excluding land” and then very simply ‘doubled up’ to £60 bn. This resulted in a highly misleading £31 bn (!) overstatement of UK maglev costs.

Let us now turn to emissions. Maglev produces less carbon emissions than high speed rail, not more.

- A typical wheel-on-rail unit covering a kilometre at its cruising speed of 300 km/h will consume 18.0 kWh; a Transrapid maglev unit will cover the same kilometre, for the same energy consumption, at 400 km/h.
- If the train attempts 350 km/h, its consumption will rise to 23.7 kWh per km. For less energy consumption – 23.2 kWh per km – the maglev unit will travel at 450 km/h.

Incidentally, fyi, maglev has the upper hand over wheel/rail in noise emissions too. A TGV at 300 km/h produces 95dB(A), maglev produces only 79 at 300 km/h and 90 at 500 km/h. In city-centre operations at 200 km/h maglev is essentially silent, producing less noise than the city background.

I imagine that you will be disappointed that your Civil Servants briefed you with factually incorrect wording on such important matters, especially when many of the errors had already been drawn to their
attention by on-the-record letters to the current Secretary of State [30/10/2008] and his predecessor [27/07/2007].

This is doubly frustrating, because the factually correct and extremely detailed case for UK application of maglev is readily and publicly available at www.500kmh.com/UKU_London-North_BizCase2008.pdf. This includes, for instance, energy and carbon results, produced with empirical maglev consumption data, accurate to the second, to the metre and to the single kilowatt. It also has detailed Capex, O&M and energy cost data, along with trip-time and capacity findings.

I should also point out that the German Transrapid maglev system, which UK Ultraspeed uses and which is the only ultra-high-speed maglev in public service, should not be confused with the still-experimental Japanese MLX system. Japanese maglev costs per km are roughly three times greater than our system. Perhaps some confusion has also arisen there?

I agree strongly with your support for high speed ground transport and applaud your openly raising the question of whether Britain should “opt for next generation technology”. UK Ultraspeed is, of course, prepared to engage in any factual process to answer that question.

Maglev works uniquely well in Britain, where there is no sunk investment in domestic TGV lines. And, to address the other point you made in the Lords, maglev also offers interchange to CTRL, providing faster journeys to the continent from the Midlands and the North than extending the less efficient and more costly 300 km/h rail line.

So what now? Clearly, the Department has set the wheels in motion with the establishment of the HS2 Company. Sir David Rowlands and his team, starting from a well-rehearsed and explicitly wheel-on-rail position, will produce a wheel-on-rail answer to the question. Fine, as far as it goes. But, in the unique geo-economic conditions of the UK, maglev has a very strong case as a faster, cheaper and greener answer.

The present difficulty is that the potentially strongest solution has been prematurely excluded on the basis of statements that are provably factually inaccurate. I therefore suggest that, in the interests of balanced and informed policy-making, we resolve the situation the following manner.

1. Hold a meeting by the end of Jan 2009 in which we will update you on latest planning work, including the most recent independent validations of our cost and carbon data.
2. Clearly, the material presented at the meeting would be “new evidence”, the emergence of which would provide a sound basis for DfT to re-engage with maglev.
3. Establish a body, within an agreed and rapid time-scale, to work in parallel with HS2, to develop and deliver ‘the maglev answer’. Given the specialist knowledge required, the composition, remit and brief of this body would best be defined in dialogue between our own experts and counterparts from the Department. Its resourcing and funding should be such as to enable it to produce results of equal weight and stature to those Sir David will deliver in the wheel-on-rail interest.

In due course, this process would produce technical, commercial, macro-economic and funding cases for both maglev and wheel-on-rail which could then be duly weighed on their merits, on the facts, and on their respective abilities to create strategic value in the British economy.

A great deal of maglev work has already been done. We are significantly ahead of the point Arup and Greengauge 21 have now reached with their wheel-on-rail studies, so things could move rapidly.

I trust Points 1 – 3 above provides a satisfactory basis for moving ahead in the constructive and progressive spirit to which you will find Ultraspeed committed.

Please contact me to set things up.

Yours sincerely,
Dr ALAN JAMES

21 January 2009
Minister of State replies, stating “I have passed your comments on to Sir David Rowlands, the chairman of High Speed Two.”

23 January 2009
UK Ultraspeed writes to Sir David Rowlands, confirming happy to meet and offering constructive engagement.
30 January 2009
Sir David Rowlands replies, offering meeting.

27 February 2009
The gross overstatement of maglev costs originated by DfT in the 2007 Rail White Paper, and still uncorrected despite on-the-record letters to two Secretaries of State and a Minister of State, now misleads the Scottish Parliamentary Inquiry into High Speed Rail, whose report is published on this date.

103. The UK Government white paper Delivering a Sustainable Railway stated in July 2007 that “the Government does not favour further development of maglev options”.

104. In its January 2009 High Speed Two paper, the UK Government noted that the 2007 White Paper had found that when compared to a conventional high-speed rail line “a maglev would be some three times more expensive than the ‘rail’ options.” [www.scottish.parliament.uk/s3/committees/ticc/reports-09/trr09-01.htm#report]

02 March 2009
UK Ultraspeed CEO meets with Sir David Rowlands at High Speed Two and outlines cornerstones of maglev business case and its potential to deliver better value for the taxpayer than rail. Offers constructive engagement.

03 March 2009
UK Ultraspeed CEO writes to Sir David. The letter is quoted verbatim below.

Dear Sir David,

Many thanks for taking the time on 02 March 2009 to meet with me regarding maglev. This letter firstly summarises our discussion and then, as you requested, puts forward a proposal. This is for a maglev study, to run in parallel with, and to provide a competitive counterbalance to, the wheel-on-rail proposition already being developed by your organisation.

I welcomed the opportunity to present to you selected key points of the very robust policy and business case for maglev as a most cost-effective, comprehensive, and internationally competitive UK High Speed Ground Transport [HSGT] solution.

As we discussed, considerable work since 2003 has shown a UK maglev network using the German Transrapid system to have at least as good a case as conventional High Speed Rail [HSR] and, in specifically UK conditions, to be suited to a broader range of applications than HSR. These range from city-to-city links utilising maglev’s unbeatable acceleration, to the strategic intercity links where maglev’s unbeatable cruising speed is the key advantage. Overall, maglev’s ability to integrate both these functions into one system contributes greatly to its ability to deliver superior results in both performance and value.

Regarding the maglev technology itself, I welcomed the opportunity to discuss the distinctions between the £30m-per-km Transrapid system and the £100m-per-km Japanese MLX system. The latter, as Andrew Adonis rightly stated in the Lords, is inappropriate for Britain. Ultraspeed exclusively uses Transrapid.

Both wheel/rail and Ultraspeed maglev may be potentially applicable in the UK. As I explained, maglev has strong potential to deliver better value for the taxpayer. This arises in part because, in Britain, French-style incremental development of TGV-type rail would not work. Under the French model, high speed trains run off dedicated high speed lines and use the classic network for (a) long-term city centre access and (b) interim journey continuation to regions not yet directly served by a high speed line.

Whilst this is indeed the practice in France and elsewhere, UK loading gauge restrictions, the capacity constraints of the classic network, plus Britain’s notorious signalling incompatibilities, mean that this approach will not work physically and financially in the UK. As others have put it, the ‘incremental build’ TGV rationale just does not work here: “in the case of the UK many of the railway networks around our major conurbations are so congested already that they would not be able to handle the significant extra traffic that a high speed rail service would generate anyway”. [Prof R Smith et al for DfT, 2006]
So, as I presented, TGV-style rail costs are likely to be high. Indeed the only UK precedent for such a scheme is CTRL, where out-turn cost was £56.42m per km (± £60m/km in today’s money), largely as result of the expensive tunnelling required to provide TGV access to the city centre in UK conditions. By contrast, maglev reduces up-front capital cost to ± £30m/km, both by means of largely elevated construction, and by engineering parameters which permit tighter bundling with existing transport corridors than HSR. These maglev advantages radically reduce both land-take and environmental intrusion, whilst simultaneously enabling significant reductions in up-front capex by rentalising many land costs over time.

Further reinforcing the case, maglev O&M efficiencies produce exceptional whole-life economics. The self-evident advantages of a fully automated system, which never degrades its track (because it never physically touches it whilst in motion), and whose speed advantage enables more intensive use of a smaller fleet, all combine to deliver taxpayer whole-life value which HSR is extremely unlikely to be able to match.

Proposal

With all the above in mind, as discussed, the public interest clearly requires both rail and maglev cases to be developed. This not only serves the general interests of the taxpayer, but also keeps open a truly competitive strategic procurement process, with the Government investing in advancing the business cases for both potential solutions to the same level of detail.

On the rail side, you explained HS2’s plans for High Speed Two to fund an expert team from the rail world to develop a wheel-on-rail proposal, with the intention that this team will report to you for presentation to Government by the end of this Calendar Year 2009.

As discussed, we now propose that High Speed Two invests in a parallel study to be conducted by experts from the maglev world; a team which would ourselves assemble and lead. This equitable and balanced approach would empower both rail and maglev to compete on their respective merits when, in due course, Britain’s high speed ground transport is procured.

As I pointed out, given the work the Ultraspeed team has already undertaken for No 10 and others, the UK maglev case is already more advanced in some respects than the Greengauge 21/Arup/Network Rail data on which the HSR case will be founded. Leveraging the strength of this previously completed maglev work, I am delighted to put forward the proposal set out below.

UK Ultraspeed commits to produce a comprehensive maglev study to a scope and remit to be mutually agreed, and to do so to the same end-2009 timescale as your initial HSR outputs. Funding for this study would be provided by High Speed Two. This funding would be agreed in the light of the agreed scope and remit, but would not exceed 80% of the funding and resources invested by HS2/DfT in the 2009 HSR work.

From consistent experience of work to date, we would expect the maglev system defined by such a study to:

- be faster than HSR;
- provide capacity similar to, or higher than, HSR;
- produce lower emissions than HSR on like-for-like trip-time basis;
- require lower land-take than HSR;
- produce lower noise emissions than HSR
- have lower up-front capital costs than rail (largely as a result of lower land-take);
- be capable of extension to other Northern England and Scottish cities at substantially lower capital cost than rail (the optimum North:South maglev would be 100 – 200 km shorter than HSR and would require no expensive under-Pennine tunnel);
- be capable of more intensive and more automated operation the HSR; and
- require less intensive maintenance than HSR, and thus
- have lower whole-life costs than HSR;
- offer more direct connection to LHR than the Heathrow Rail Hub proposed for the GW main line;
- offer air-beating journey times all the way from London to Scotland;
- offer faster journey times to/from the Continent to/from any point beyond the Midlands than any ‘simple’ extension of CTRL;
- release capacity on the existing rail network and avoid the risk of creating capacity bottlenecks at existing rail stations as any proposal to ‘run-off’ TGVs on to classic rail lines could do.
UK Ultraspeed

I very much appreciated your commitment to an initial response by second-half March. Looking ahead, I look forward to agreeing terms for the maglev study proposed above as soon as possible.

Yours sincerely,
DR ALAN JAMES

19 March 2009

Sir David Rowlands replies to UK Ultraspeed rejecting the proposal for a maglev study to provide competitive counterbalance to Network Rail’s wheel on rail scheme. This response confirms that Government intends to progress only 300 km/h wheel-on-rail, to the exclusion of the 500 km/h maglev alternative and the potentially greater benefits it could deliver.

ALAN JAMES
UK ULTRASPEED

Thank you for your letter of 3rd March following up the discussion we had when we met.

I have now had an opportunity to talk to Lord Adonis about whether we should incorporate consideration of maglev in some way into HS2’s work programme. I am afraid that the answer is that we should not do so. You will appreciate that the HS2 can only work within the remit set by Government and only on the basis of what it is prepared to fund.

I realise that this will be a disappointment to you but I am grateful for you taking the time to take me through your proposition.

Yours sincerely
SIR DAVID ROWLANDS
CHAIRMAN

The exclusion of maglev by Government’s High Speed 2 Company is clearly and materially prejudicial to the interests of the taxpayer.

Taxpayer interests would be best served by balanced consideration of the whole-life costs of both systems, weighed against their potential economic, environmental, competitiveness and transport benefits.

Such consideration would ensure that eventual procurement of Britain’s high speed infrastructure could be conducted – on merit and on the facts – in a fully informed, balanced, and genuinely competitive manner.

Premature exclusion of maglev is prejudicial to competition, to Britain’s strategic transport future, and to the interests of the taxpayer.

Recommendation: that the Transport Select Committee bring its influence to bear, to ensure that, in all work undertaken by Government to study, develop or prepare high speed ground transport, maglev receives equal consideration, resources and funding to those dedicated to wheel-on-rail solutions.

June 2009