



GREENGAUGE 21

High Speed Rail for Bristol/South Wales

A Vision on HSR for Wales

Greengauge 21 for
Welsh Assembly Government

April 2009



Context

GREENGAUGE 21

- In January 2009, government-owned company 'HS2' established to develop a high-speed rail proposal for London – West Midlands
- In March 09, 'HS2' asked also to look beyond Birmingham (to Greater Manchester, West Yorkshire, North East and Scotland) on 'a corridor basis'
- 'HS2' says it will look to Greengauge 21 to provide guidance on wider national HSR strategy
- Cross-party support for HSR, but differing views over Heathrow, its development and how to serve it by HSR
- Theresa Villiers for the Conservatives has said that she wants to see Heathrow connected to HS1 (the channel tunnel rail link), HS2, the Great Western (GW) main line and the 'south west'.



This Assignment

GREENGAUGE21

- Wales Assembly Government commissioned Greengauge 21 to give preliminary advice on high-speed rail for Wales
- Aim to establish a vision for HSR for (South) Wales and identify incremental investment needs, their costs and outcomes
- Greengauge 21 engaged technical experts on the GW corridor and drew upon cost data from its main work programme which is funded by a broadly drawn Public Interest Group



How does HSR to Bristol/South Wales fit in to studies already in-hand?

GREENGAUGE 21

- Network Rail identify GWML as the second most congested corridor after the WCML, which they see as a priority for HSR
- There are plenty of options to extend HSR northwards beyond the London – West Midlands proposition, and this is where Lord Adonis' political attention is set
- There are two avenues into government when thinking about HSR for Wales:
 - *via* Greengauge 21's wider remit which now includes producing evidence and guidance on longer term HSR strategy for 'HS2'
 - through the interest that exists in connecting Heathrow into HS1/2 and GW main line.



Outline of this report

GREENGAUGE21

- Key issues and HSR objectives
- Base-lining the existing railway & its expected development over the next 10 years
- Identification of the incremental steps to full HSR
 - Journey times?
 - Capacity and other impacts?
 - Broad estimate of costs?
- Heathrow access and related issues
- Vision statement and conclusions



GREENGAUGE21

Issues and Objectives



Government Company (HS2) Objectives for HSR (in London – West Midlands context)

GREENGAUGE21

Government company HS2's objectives for HSR in broad priority order	Comment
Passenger capacity	'Driving consideration', but no reference to capacity of transport modes other than rail
Optimised Speed	Expects at least 300km/h
Land use and development	Focus on providing capacity in West Coast corridor to deliver additional housing Economic regeneration in West Midlands mentioned but nothing on role in relieving development pressure in wider south-east
Freight	HSR should be freight capable ('German approach')
Modal shift from car	Key gain expected Heathrow/Thames Valley from Heathrow Interchange (somewhere between Heathrow and London) No specific requirements from HS2 – will emerge from appraisals Parkways may be acceptable
Modal shift from air	Not expected from HS2 Consideration of West Midlands – Europe HSR services

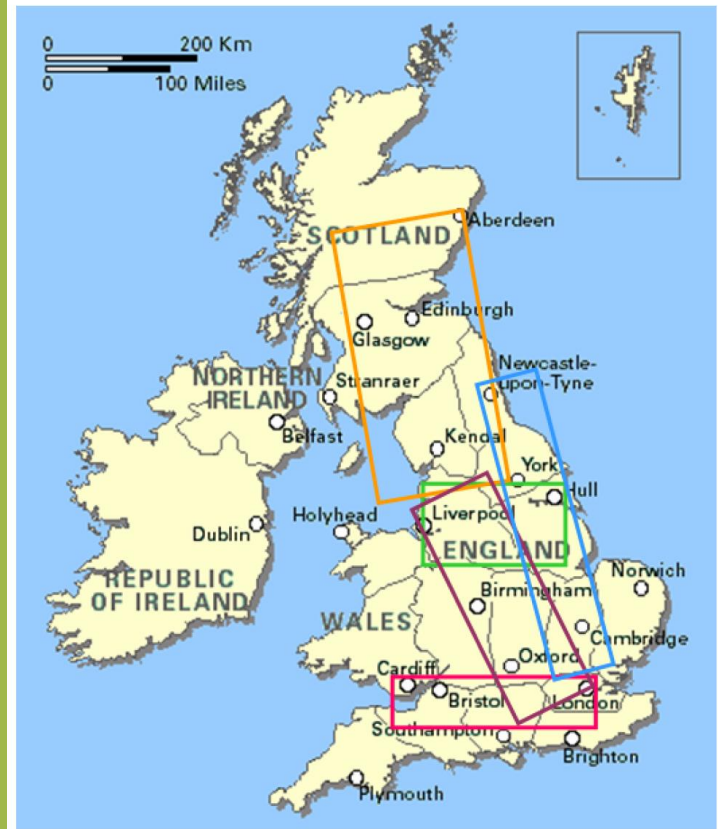


Greengauge 21's HSR Development Programme, reporting Summer 2009, looks beyond the London – Birmingham Corridor

GREENGAUGE21

- Strategies for high-speed rail in each of five corridors, integrated into a network strategy, and subject to consultation
- One of the five corridors is London – Bristol – Cardiff
- Economic & environmental impacts
- Potential role of private sector in project delivery and operation.

Route Corridors





Greengauge 21 Guiding Principles for HSR *approved by its Public Interest Group, January 2009*

GREENGAUGE21

1. Capacity

- where there is unmet demand, for the national transport system
- relief to the existing rail network

2. Economic Regeneration

- growth, regeneration and wider productivity benefits
- sustainable pattern of development

3. Alternative to Car Use

- address the whole journey; an attractive, lower carbon, alternative to car use

4. Modal Switch from Aviation

- attract demand from short-haul aviation to free-up runway capacity and/or reduce carbon emissions

5. Nationwide Benefits

- phased national network, reducing carbon emissions from the transport sector.



Five Key Issues to consider in London – Bristol/South Wales Corridor

GREENGAUGE21

- Capacity
 - is there a problem to solve?
 - is there value in the capacity created on the existing network?
- Journey time
 - is there enough advantage to deliver the wider benefits of modal switch?
- Connectivity to Heathrow
 - available potentially even before HSR to South Wales as a 'by-product'?
- Connectivity to Continental Europe
 - also available potentially as a 'by-product' if GWML is connected to HS1?
- Taken together, will these gains support economic regeneration in South Wales? *Which features matter most will determine the 'Vision'.*



HSR Objectives in summary

GREENGAUGE21

- Capacity is a key driver of the business case for HSR
- There are also important objectives:
 - To support a sustainable pattern of growth and economic development
 - To contribute to de-carbonising the transport sector
- To achieve the second and third objectives above, it is necessary that HSR offers a more attractive, and lower carbon, form of transport than air and car modes of transport



GREENGAUGE21

Base-lining



Existing Pattern of Passenger Services

GREENGAUGE21

The Great Western Main Line GWML) has an integrated service pattern, largely based on a repeating interval each hour with two trains each hour between Cardiff and London

Main groups of 'high speed' services from Paddington are:

- South Wales –
 - 1 train each hour Paddington, Reading, Swindon, Bristol Parkway, Newport, Cardiff Central and principal stations to Swansea
 - 1 train to Cardiff, also serving Didcot (for Oxford)
- Bristol – 2 trains each hour
- West of England via Newbury – 1 or 2 trains each hour
- Cheltenham via Kemble – alternate hours
- Oxford and Worcester – 2 trains each hour

Other services (Heathrow and Thames Valley) also run on the Main lines.



Existing Pattern of Freight by Rail

GREENGAUGE21

Freight consumes capacity and has a complex, limiting effect on passenger services:

- London to South Wales trains share tracks with heavy freight flows
- Providing capacity for freight is an important consideration on 2-track sections and Relief lines between Didcot / Reading and Paddington and in South Wales
- Freight 'crossroads' at Reading where north-south flows between the ports of Southampton and the Midlands / north of England and Scotland cross flows from South Wales / Bristol / west of England to London
- Growth from Southampton ports expected of six trains per day in each direction
- Bristol's Avonmouth and Portbury terminals handle imported coal for Didcot, Aberthaw and the West Midlands and there is a plan to expand these ports' automotive product throughput (with rail distribution)
- Petroleum traffic between South Wales and England is now greatly reduced, but a daily train remains, as well as flows of automotive products and coal from Avonmouth to Aberthaw.



Relative Journey Times – Freight and Passenger: a major capacity constraint

GREENGAUGE21

- On 2-track routes shared between passenger and freight, lower speeds and longer running times for freight trains constrain capacity
- Between Bristol Parkway and Swindon, limited passing facilities and gradients restrict passenger service to 2-3/h when freight path provided
- Between Swindon and Didcot, long 'dynamic' loops are provided, but not centrally located, leaving 12 mile long 2-track section
- In South Wales, 4-track route between Severn Tunnel and Cardiff provides opportunity for separation of freight and passenger services

Route Section	Running Time Freight	Running Time Passenger
Bristol Parkway - Swindon	53 min	25 min
Swindon - Didcot	32 min	15 min



Current Journey Times (and 20 years ago)

GREENGAUGE21

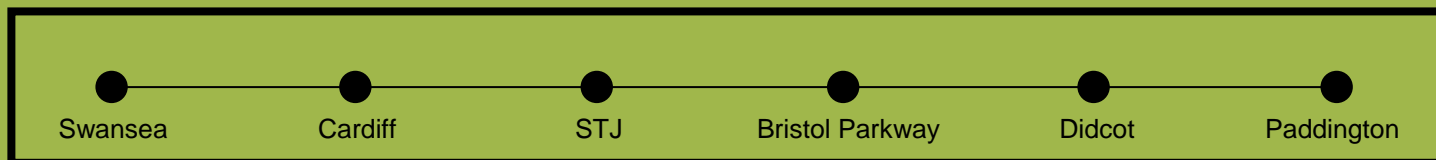
- As the network has become busier, journey times have lengthened

Journey time from London to	1989 Standard / Fastest	Current
Swindon	51m / 47m	55m
Bristol Parkway	1h15 / 1h11	1h24
Newport	1h 37 / 1h33	1h46
Cardiff	1h53 / 1h49	2h03
Swansea	2h46 / 2h44	2h58
Bath	1h23 / 1h02	1h25
Bristol TM	1h38 / 1h17	1h42
Exeter	2h13 / 1h55	2h03



Existing Network Constraints

GREENGAUGE21



Swansea – Cardiff	Cardiff – Severn Tunnel Jn	Severn Tunnel Jn – Bristol Parkway	Bristol Parkway – Didcot	Didcot to Paddington	Paddington
Close to capacity with current mix of freight and fast and stopping passenger services over mostly 2-track route	4-track route with theoretically spare capacity, but restricted by unsuitability of Relief lines for passenger use because of low speed (45mph)	Constrained by 7 min headway through Severn Tunnel, gradients though tunnel and on approaches and operating rules for freight trains	Close to capacity with current mix of freight and fast passenger services over mostly 2-track route	Didcot East – conflicting moves. Reading's platforms at capacity, flat junctions and freight 'crossroads'. Airport Jn into Paddington congested	Platforms at capacity in peaks, near capacity off-peak



Baselining – Current Infrastructure Plans for GWML

GREENGAUGE21

- 1. Crossrail (now – 2017):**
 - Better accessibility to City, Canary Wharf
 - Releases some platform capacity at Paddington
- 2. Reading station redevelopment and re-modelling (to 2015)**
 - removes bottleneck at Reading
- 3. Resignalling provides opportunity to reduce headways**
 - between Reading and Didcot, from 4min to 3min
- 4. Bristol Parkway 4th platform**
- 5. Speed increases**
 - between Severn Tunnel Junction and Cardiff
- 6. Newport area resignalling**
- 7. Cardiff area resignalling.**



Baselining: Potential for Change post - 2014/longer term

GREENGAUGE21

1. Paddington station Span 4 development

- provides more platforms – up to 15 full length

2. ERTMS

- may enable small increase in capacity

3. Swindon – Kemble redoubling and Kemble – Standish Junction headway improvement

- allowing enhanced passenger service and development of a freight route via Gloucester (unsuitable for Avonmouth – Didcot traffics)

4. Electrification of GWML

- New trains
- Faster acceleration, but still 125 mph maximum speed
- Crossrail extension becomes possible



Baselining – Rolling Stock & Electrification

GREENGAUGE21

1. Crossrail, planned to open in 2017

- 10-car trains compared with current 6-car/2-car trains transform capacity on local services in Thames Valley

2. IEP / SET, planned to be introduced on GWML from 2016

- 125 mph (200 km/h) maximum speed
- Diesel, bi-mode and electric forms offer progressive capacity increases as electrification spreads (respectively, 8%, 19% and 25% more seats than the diesel HSTs to be replaced)
- Power / weight ratio c 42% higher than HST which, combined with higher tractive effort, enables higher rate of acceleration
- Shorter journey times should result

3. Electrification opens way for re-equipment of local trains on main lines

- replacing sluggish diesels with new high acceleration EMUs



Impact of Current Plans?

GREENGAUGE21

- IEPs increase unit train capacity by up to 25%; (context: 31% demand growth South Wales – London between 2000 and 2007)
- Other projects will release some capacity for extra train paths to deliver further capacity increments
- Crossrail may release peak paths from Paddington on main lines,
- Journey times will improve but only a little (back to the future)
- There are *no plans* to enhance the section of route between Didcot and the Severn Tunnel – a major constraint on improved services between London and South Wales, as we have identified
- Accommodating the requirements for rail freight with those for developing the rail passenger business is a critical issue
- Electrification of GWML is under examination right now and is critical to any plan for a progressive introduction of HSR services in this corridor



GRENGAUGE21

Incremental Investment Options



Options for Further Development in the London – South Wales Corridor

GREENGAUGE21

There are four strategic options:

- Develop **improved services** over existing infrastructure with or without already planned upgrades and new trains
- **Enhance existing infrastructure** to allow further improvements to services to exploit additional capacity available between Paddington and Didcot, but retaining 125mph maximum speed
- **Staged route upgrade**, including additional tracks, to extend planned capacity benefits in Thames Valley further west and allow higher speeds
- **New route at high speed**

The Severn Tunnel/Severn barrier is a special issue.



Improved Services over Existing Infrastructure

GREENGAUGE 2.1

Already planned upgrades and new trains

- Additional Main line paths through Reading
- Paddington – Cheltenham service could run hourly, covers Didcot and Swindon
- **One of the two hourly South Wales services (Service 1) could run non-stop between Paddington and Bristol Parkway**
- Downside is reduced connectivity between South Wales / Bristol Parkway and Swindon, Didcot (for Oxford) and Reading and some loss of capacity at those stations
- Speed increases between Severn Tunnel Junction and Cardiff assumed to save 2min
- Introduction of SET estimated to save further 5 min
- Total journey time savings compared with the time of the current fast service and subject to being able to path the faster services are shown

Journey time from London to	Current	Estimated time, service 1 at 125 mph	Estimated time, service 2 at 125 mph
Newport	1h46	1h30	1h39
Cardiff	2h03	1h47	1h56
Swansea	2h58	2h42	2h51

	Service 1	Service 2
Omitting station calls	9 min	
Introduction of SET	5 min	5 min
Raising line speed	2 min	2 min
Total reduction	16 min	7 min



Improved Services over Enhanced Infrastructure

GREENGAUGE 2.1

Already planned upgrades and new trains

- **Provide limited additional infrastructure capacity west of Didcot**
- **125 mph maximum**
- **Allows regular 6th path for passenger trains with 3 South Wales services per hour**
- **Maintains current connectivity, but no further journey time reductions**
- Existing 4-track between Didcot and Swindon extended from Challow to Shrivenham;
- Reduces 2-track section between Swindon and Challow from 12½ miles to 4½ miles;
- Upgrade freight loops between Wootton Bassett and Bristol Parkway.

Journey time from London to	Current	Estimated time, service 1 at 125 mph	Estimated time, service 2 at 125 mph
Newport	1h46	1h30	1h39
Cardiff	2h03	1h47	1h56
Swansea	2h58	2h42	2h51

	Service 1	Service 2
Omitting station calls	9 min	
Introduction of SET	5 min	5 min
Raising line speed	2 min	2 min
Total reduction	16 min	7 min



Route Upgrade

GREENGAUGE21

Partial new route and new faster trains:

- **A new line alongside the existing route from Didcot to west of Wootton Bassett;**
- **High speed alignment with 186 mph (300 km/h) potential, but assumed lower initially**
- Upgrade west of Wootton Bassett, but tunnel sections as now
- Bristol Parkway - 4th platform and parallel moves from South Wales and Bristol TM
- Severn Tunnel - options
- 110 mph on fast lines west of the Severn to Newport and Cardiff
- Difficult to achieve line speed improvements west of Cardiff
- 4-track route between London and Bristol, via Bath and Parkway routes, will enable good late night and weekend services all year.
- Separate longer distance services ensure capacity benefits for all, including Reading – London and new local stations.

Journey time from London to	Current	Estimated time, at 140 mph	Estimated time, at 155 mph
Newport	1h46	1h23	1h21
Cardiff	2h03	1h40	1h38
Swansea	2h58	2h35	2h33

	140 mph	155 mph
Omitting Reading and Swindon station calls	9 min	9 min
New trains with better performance	5 min	5 min
Upgraded route east of River Severn	7 min	9 min
Raising line speed from 90 to 110 mph		
S Tnl Jn – Cardiff	2 min	2 min
Total reduction	23 min	25 min



Extended Route Upgrade

GREENGAUGE21

Extends new route to Bristol Parkway / Severn Tunnel:

- **Provides 4-track route throughout from Paddington to Bristol Parkway / Severn Tunnel** (times shown assume Bristol Parkway);
- Duplicates Alderton and Chipping Sodbury tunnels;
- Options for joining existing route at Bristol Parkway or extending new route to Severn Tunnel to by-pass Patchway tunnels;
- Bristol Parkway - 4th platform and possible new high speed station
- Severn Tunnel – options including link with new Severn rail crossing
- 110 mph on fast lines west of the Severn to Newport and Cardiff;
- Difficult to achieve line speed improvements west of Cardiff.

Journey time from London to	Current	Estimated time, at 140 mph	Estimated time, at 155 mph
Newport	1h46	1h20	1h18
Cardiff	2h03	1h37	1h35
Swansea	2h58	2h32	2h30

	140 mph	155 mph
Omitting Reading and Swindon station calls	9 min	9 min
New trains with better performance	5 min	5 min
Upgraded route east of River Severn	10 min	12 min
Raising line speed from 90 to 110 mph		
S Tnl Jn – Cardiff	2 min	2 min
Total reduction	26 min	28 min



New High Speed Line

GREENGAUGE21

A new high speed line between London and the Severn Tunnel:

- Three potential routes, mostly following existing transport corridors
- 186 mph (300 kph) assumed speed
- Fast trains from London, with a call at Bristol Parkway, take more than half an hour off current London – Cardiff journey times to reduce it to below 90 min
- Potential for non-stop Cardiff – London services saving further 7 min
- Newport by-pass would allow further 6 min reduction
- Further journey time reductions from a replacement Severn crossing
- If a Heathrow (or other) station is included, it would add 10 mins to journey times
- Freight benefits from fewer passenger services on conventional lines.

Journey time from London to	Current	Estimated time, with Bristol Parkway call	Estimated time, non-stop Cardiff
Newport	1hr46	1hr09	1hr09
Cardiff	2h03	1hr26	1hr19
Swansea	2h58	2hr21	2hr14

With Newport by-pass

London – Cardiff 1hr 13min

London – Swansea 2hr 8min



New Severn Crossing

GREENGAUGE21

1. **A number of options**
2. **New rail bridge**
 - parallel to the new M4 road bridge
 - not linked to a barrage
3. **125 mph assumed to be maximum speed** over such a structure;
4. **Journey time saving of 2 – 3 mins** compared with route via Severn Tunnel;
5. **Principal benefits would be:**
 - Increased capacity
 - Infrastructure resilience through not having to rely on tunnel
 - Weekend services direct to Bristol and London, all year
 - May avoid need for freight train diversions and allow additional freight capacity through the tunnel
6. **Rail route could be incorporated into a Shoots barrage** but not into other options such as the Cardiff – Weston-super-Mare barrage
7. **Could be progressed independently and in advance of** options between London and Severn Tunnel



Bristol and West of England

GREENGAUGE21

1. **Report has not considered options for Devon and Cornwall to London**
2. **Additional tracks to Bristol**, either route upgrade or HSL, however, build towards a solution for West of England
3. **Bristol potentially benefits directly from South Wales proposals**
 - Shorter journey times and more frequent services between Bristol Parkway and London
 - Improved services to South Wales if new Severn crossing provided
 - Shorter journey times and improved frequency between Bristol Temple Meads and London
4. **Infrastructure upgrades to support operation of West of England services via HSL could include:**
 - Upgrade between Filton and Bristol Temple Meads, including re-instatement of four tracks (would also benefit South Wales – Bristol services)
 - Upgrade Bristol – Exeter for 125 mph and additional capacity, particularly to allow longer distance services to pass local services, which would enable higher frequencies
5. **However, HSL as described does not offer a faster route to the west of England without further route investment west of Bristol**



Cost Assumptions

GREENGAUGE21

Key cost assumptions

- Costs option have been built up from GG21 unit costs and assume 66% optimism bias
- Costs estimates cover capital costs of infrastructure and land
- Costs of HSL stations at Reading South, Swindon and Bristol Parkway are included as appropriate in the Upgrade and HSL options
- No costs for new stations at Heathrow or London are included
- New Severn Crossing is costed as a bridge / viaduct alongside the new M4 road crossing and parallel to the existing railway through the Severn Tunnel.
- Span 4 scheme assumed to cover terminal costs at Paddington to deliver 15 long (IEP length) platforms
- Upgrade of Severn Tunnel to reduce headways is undertaken in advance as a scheme in its own right

Option	Assumed Between	Distance
Route Upgrade	Didcot – Alderton Tunnel	46 miles
Extended Upgrade	Didcot – Severn Tunnel	67 miles
HSL to Severn	London – Severn Tunnel	111 miles



Option Summary

GREENGAUGE21

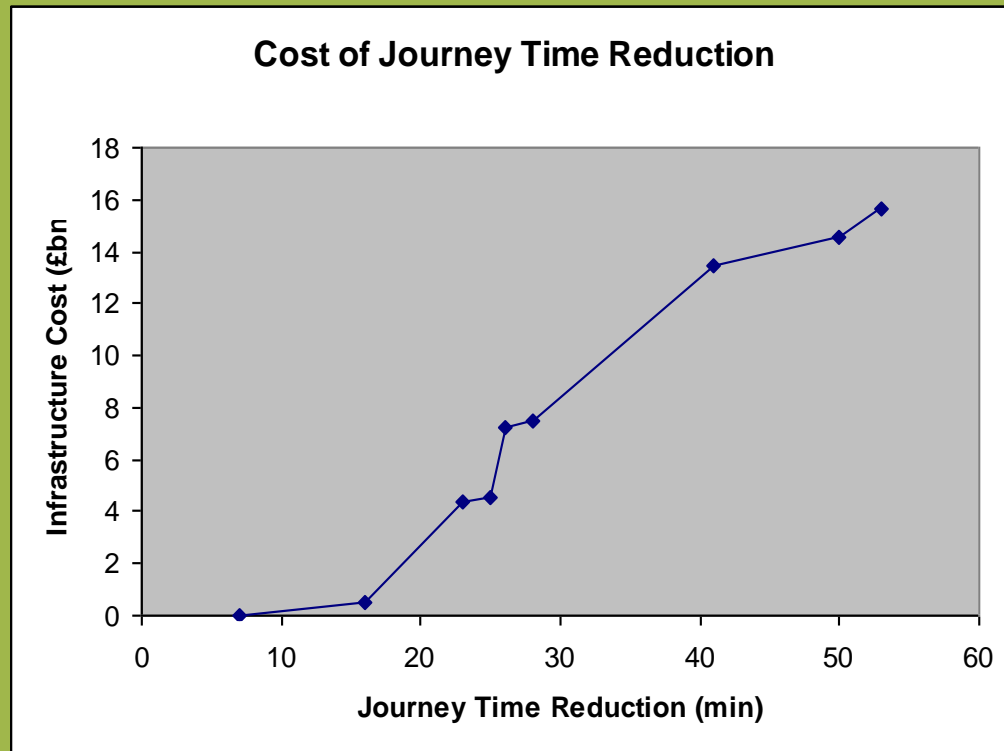
Progressive journey time and capacity gains....

	Journey time (Cardiff)	Frequency (tph)	Ball-park capital cost (£bn)
Existing plans (IEP, Crossrail, Reading, ERTMS) and electrification	1h 56min	2 GWML	Substantial (but in base)
<i>And</i> HSL route section Didcot – Wootton Bassett	1h 38min	2 HS 1 GWML	4.6
Extended HSL route section Didcot – Bristol Parkway / Severn Tunnel	1h 35min	2 HS 2 GWML	7.5
<i>And</i> new Severn Crossing to extend HSL route section to South Wales	1h 32min	2 HS 2 GWML	8.6
New HSL London – Bristol Parkway	1h 19min	4 HS 1 GWML	13.4+
New HSL throughout London – South Wales including Severn and Usk crossings	1h 10min	4 HS 2 GWML	15.6+



Summary of costs vs journey time savings

GREENGAUGE21





Where have we got to?

GREENGAUGE21

- Key issues and HSR objectives
- Base-lining the existing railway & its expected development over the next 10 years
- Identification of the incremental steps to full HSR
 - Journey times?
 - Capacity and other impacts?
 - Broad estimate of costs?
- **Heathrow access and related issues**
- Vision statement & conclusions



Heathrow

GREENGAUGE 21

- Today's travel choice involve interchange, hassle and expense:
 - Coach from Reading to terminal door
 - Heathrow Express from Paddington
- Heathrow 'Hub' Protagonists:
 - 'HS2' has identified Old Oak in West London
 - Arup: Iver/West Drayton on GWML
 - 2M: Cricklewood
 - Greengauge 21 (with BAA) will consider these, but is also looking at a new HSR station at Heathrow itself
- There is a Western Connection scheme from the mid 1990s, now being reconsidered



Heathrow direct (western) connection to the GWML

GRENGAUGE21

- Saves 20 minutes travel time and removes the need to interchange (and pay a fares premium)
- Station locations at Heathrow under discussion with BAA
- Greengauge 21 planning:
 - on both a 2R and a 3R case
 - Looking for high levels of direct network connectivity, with routes to the west (GWML), the north & east (HS2 and HS1) and to the south (SWML)

in order to facilitate services operating across the airport (as is achieved at Paris CDG by a national network of TGV services)

- Greengauge 21 has now got evidence that the Bristol/Cardiff corridor is by far the most important long distance rail opportunity for Heathrow



What this offers South Wales

GREENGAUGE21

- Either using the GWML (electrified) or, by incorporating LHR into a new high-speed line, the opportunity for:
 - direct hourly services to Heathrow
 - extended beyond the airport to serve a choice of Stratford/Kent or European destinations (Paris/Brussels)
- There are constraints and issues with operating direct European services via Heathrow to Cardiff:
 - Eurostar has found no case for beyond London services without suitable infrastructure so far
 - Cannot use European-standard high-speed trains
 - But could use Eurostars
 - Clearly, requires GWML to have been electrified



Implications

GREENGAUGE21

- An east-west cross-Heathrow link offers not just Heathrow connectivity, but potentially, valuable access to London Docklands and to Europe
- The addition of the western connection to a new access to Heathrow from the east that might be contemplated as part of HS2 could be a reasonable cost increment (£00ms) and bring large benefits
- Although described here as a direct service to Heathrow, the same tie up is theoretically available with the Arup Hub proposal, but any scheme with a station on the GWML has drawbacks
- GWML investment needs to form part of a coherent strategy integrated with thinking on HSR nationally.



GREENGAUGE21

Vision and Conclusion



A Vision for South Wales: achieve early progress and a flexible step-by-step upgrade

GREENGAUGE21

1. Ensuring that the GWML is connected into HS1 as HS2 is developed and that GWML is electrified
2. (related to this) getting a direct western access to Heathrow Airport
3. Expanding the capacity of the central part of the GWML, allowing for speeds in the 225km/h – 300km/h range possible
4. Creating new high-speed route capacity between Bristol Parkway and South Wales
5. Add high-speed capacity at the eastern end of the route as needed

This provides the earliest possible introduction of high-speed trains to South Wales on upgraded route infrastructure offering valuable new connectivity as well as speed and quality gains.



Answering the key questions (as posed earlier)

GREENGAUGE21

- Capacity
 - is there a problem to solve? ***Yes, there are capacity and connectivity shortfalls***
 - is there value in the capacity created on the existing network? ***Yes, for freight and for regional passenger services such as Cardiff - Bristol***
- Journey time
 - is there enough advantage to deliver the wider benefits of modal switch? ***Ultimately 1h15 London - Cardiff***
- Connectivity to Heathrow
 - available potentially even before HSR to South Wales as a 'by-product'? ***Yes, with a phased strategy provided GWML is electrified***
- Connectivity to Continental Europe
 - also available potentially as a 'by-product' if GWML is connected to HS1? ***Yes, provided HS2 planned appropriately***



Conclusions

GREENGAUGE21

- Network Rail have advised that Great Western Main Line does not have the same capacity problems as the West Coast Main Line, but is next in line for more 'new line' capacity
- Currently identified schemes tackle the immediate capacity pressures at the east end of the route (Reading to London)
- But we have identified capacity between Bristol Parkway and Didcot as a constraint that the first stage of HSR for Wales could tackle
- This points towards a value for money staged approach that gives extra benefits from the investments already committed:

STEP 1 connections created at Heathrow

STEP 2 a partial upgrade to Bristol and South Wales, with new faster tracks from Didcot westwards alongside the existing line

STEPS 3/4 etc. High speed lines built to add capacity (west of Bristol Parkway and east of Didcot) – including a new Severn Crossing, which could always be brought forward in the programme and which offers particularly wide benefits.