# A Comparative Analysis of Short Sea Import and Export Routes to and from the UK

**Conducted by the University of Hull Logistics Institute**
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UNIVERSITY OF HULL | LOGISTICS INSTITUTE

# Contents

# 1. Introduction

This report is an analysis of the import and export routes to and from logistics hubs situated in the central East-West corridor of the UK (roughly North of Derby and South of York) to outline the advantages of using the ABP Humber ports (specifically Hull and Immingham) in terms of distance, journey times and CO2 equivalent emissions. Associated British Ports (ABP) commissioned the Logistics Institute (University of Hull) to compile this report in April 2019.

To transport goods and products between the UK and mainland Europe, short sea services play a vital role. A number of short sea services are operated between ports located on the East coast of the UK and mainland ports such as Rotterdam and Amsterdam. These include both Roll On/Roll Off ferry services (Ro-Ro) and Lift On/Lift Off container vessel services (Lo-Lo).

The report is a comparative analysis of the routes between selected industrial sites in the UK and Europe for Ro-Ro and Lo-Lo services through the East Coast ports. The routes are compared by looking at the journey distance (miles), the times taken for the full journey (hrs/mins) and the carbon dioxide equivalent[1] ($CO_2e$) emissions incurred. $CO_2e$ (as opposed to $CO_2$) is used as an emissions measure due to it accounting for all greenhouse gas emissions based on their global warming potential (GWP). A selected sample of routes are compared and the report concludes with a comparison of the Humber ports verses other UK ports. A comprehensive comparison of freight routes between sites, comparing ports and mode of sea transport (accompanied/unaccompanied, Ro-Ro/Lo-Lo), is contained in the appendixes to this report. A downloadable spreadsheet and an on-line search feature for these tables can be found at https://lido.hull.ac.uk/routes.

[1] https://www.gov.uk/guidance/calculate-the-carbon-dioxide-equivalent-quantity-of-an-f-gas

# 2. Methodology

This section outlines how the data used for the analysis was collected and formatted in order for the comparisons of the different routes and ports to take place.

For this study we use a sample selection of sites and routes to compare.

All calculations are based on a sample load of an articulated HGV diesel lorry with capacity greater than 33 tonnes. This is the vehicle weight plus the maximum load. For this study, the average load weight of 20 tonnes is used, based on data published by Defra[2].

## 2.1 Sites an Routes

To compare the various routes, a representative sample of origin and destination points were selected. The points in the UK were selected from the areas of high density manufacturing and warehousing on the northern East-West corridor, in a band bordered by York to the north and Derby to the south. The industrial locations selected are Melton, Leeds, Doncaster, Bradford, Manchester, Wigan, Derby and Stoke-on-Trent.

| Location | Postcode |
|---|---|
| Armthorpe Industrial Park (Doncaster) | DN3 3GW |
| Euroway Industrial Estate (Bradford) | BD4 6SF |
| Melton Business Park (Melton) | HU14 3HB |
| Waterside Industrial Park (Leeds) | LS10 1RW |
| Trafford Point (Manchester) | M17 1SH |
| Marsh Green (Wigan) | WN5 0JL |
| Sinfin Central Business Park (Derby) | DE24 9GJ |
| Stanley Matthews Way (Stoke-on-Trent) | ST4 8GR |

*Table 1: The locations of UK industrial estates.*

Figure 1 maps the UK locations selected and the band in which these locations are.

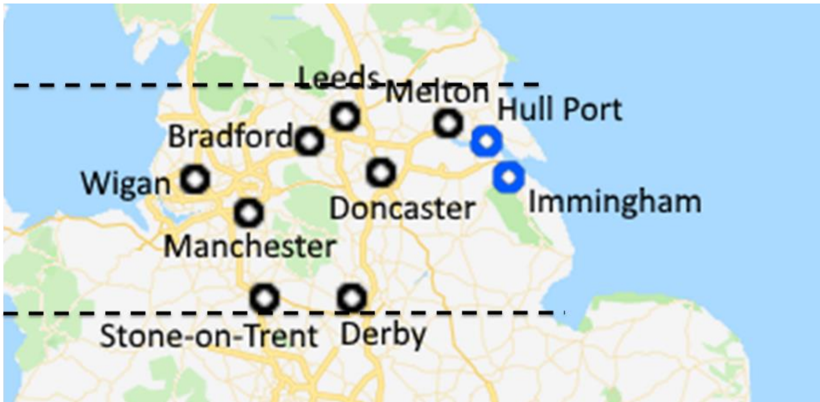



*Figure 1: UK Industrial concentration sites selected for route analysis*

A simplistic Voronoi diagram (*Figure 2*) illustrates the area for which the Humber ports (Hull or Immingham) are the closest mainland Europe connected port. The Voronoi indicates the closest

[2] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018

mainland Europe connected port from any point on the map. This does not consider factors such as physical barriers (e.g. rivers or mountain ranges), historic factors, road conditions and congestion, logistics service availability and capacity etc. and therefore does not necessarily indicate the "best" port to ship through, but is a good indicator as a starting position. All the UK sites we selected are within the central coloured band where Hull or Immingham are closest. It is worth noting that the indicated area represents 29.3% of the national Gross Value Added (GVA), based on income generated.

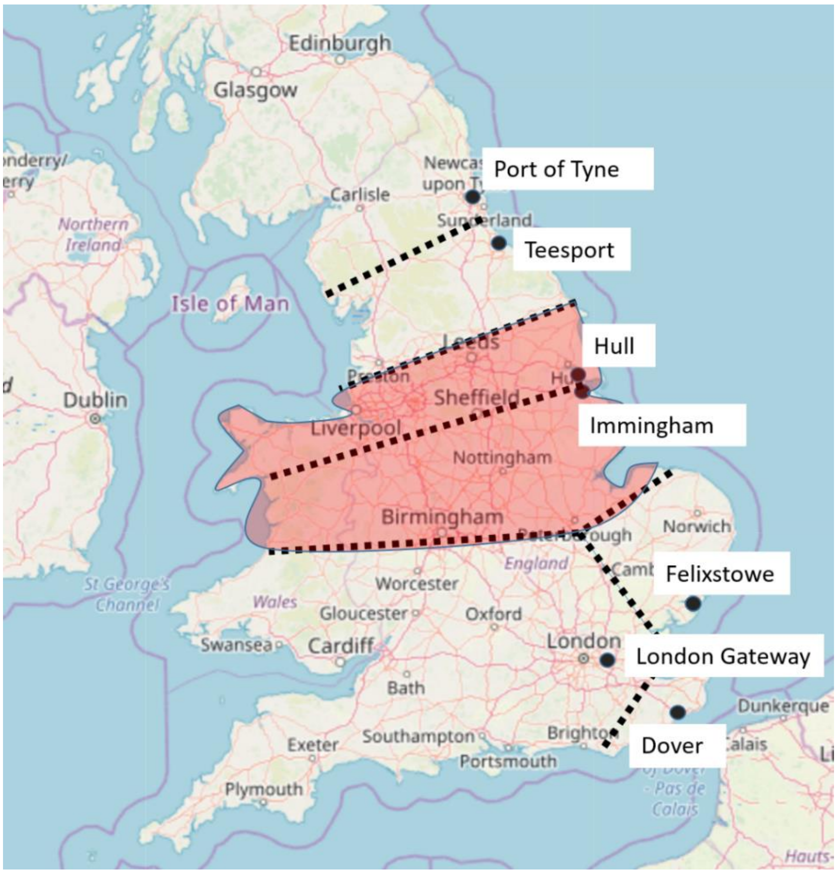



*Figure 2: Voronoi diagram segmenting the UK according to the closest mainland Europe (short sea) trading port*

The locations in Europe were selected from a publication by Savills Investment Management called 'European Logistics: Warehousing the Future'[3]. This document looks at industrial and logistics corridors in Europe and categorizes locations based on warehouse capacity. These are broken down into tiers defined by volume in square metres (sqm).

[3] https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/regionalgvanuts3

[4] http://www.savillsim.com/documents/2017-sim-european-logistics-warehousing-the-future-final.pdf

| Tier 1 | Tier 2 | Tier 3 | Tier 4 | Tier 5 |
|---|---|---|---|---|
| **> 5 million m²** | **4 - 5 million m²** | **2.75 - 4 million m²** | **2 - 2.75 million m²** | **<2 million m²** |
| London | Barcelona | Berlin | Amsterdam | Budapest |
| Madrid | Birmingham | Brussels/Antwerp | Dusseldorf | Dublin |
| Milan | Frankfurt | Copenhagen | Lille | Luxembourg |
| Paris | Hamburg | Stockholm | Lisbon | Munich |
| | Lyon | Warsaw | Manchester | Rome |
| | | | Marseilles | Edinburgh/Glasgow |
| | | | Prague | |
| | | | Rotterdam | |

*Table 2: Cities across Europe and how much warehousing each location has in square metres.*

In the scope of the research, locations from this list were selected to reflect a large area of the mainland Europe so the report is not  biased to one location. The map in Figure 1 shows the locations of the cities in the above table and outlines logistics corridors across Europe.

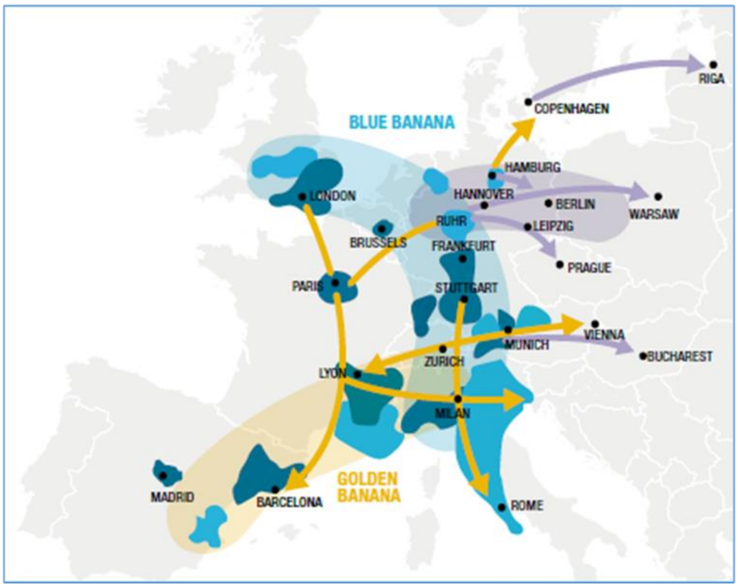



*Figure 3: Sources: Bulwiengesa, Savills Investment Management*

| Location | Country | Postcode |
|---|---|---|
| Madrid | Spain | 28906 |
| Frankfurt | Germany | 60386 |
| Copenhagen | Denmark | 2650 |
| Paris | France | 94380 |
| Warsaw | Poland | 03-786 |
| Munich | Germany | 80331 |
| Barcelona | Spain | 08040 |
| Hanover | Germany | 30419 |
| Milan | Italy | 20060 |

*Table 3: European logistics locations included in study scope.*

## 2.2 Calculating Distance, Time and CO2e

**Land Journeys**

In order to calculate the land journey distances and times we cross-referenced a number of route planners including Freight Journey Planner[4], Google Maps[5], The AA[6], The RAC[7] and Impargo[8] to validate the results. Having done so it was concluded that the most accurate results were provided by Freight Journey Planner for the UK, which is a UK only tool, and Impargo for Europe. The fact that these are logistics specific route planners ensures that the route calculations are appropriate for freight vehicles. Based on calibration tests between Impargo and Freight Journey Planner on UK routes, a correction factor was applied to the European journey times calculated by Impargo. As an example, using the 3 journey planners for the trip from Wigan to Hull were as follows:

| Wigan WN5 0JL to Hull HU9 5NS | |
|---|---|
| Freight Journey Planner | 3h 38m |
| Google Maps | 3h 24m |
| Impargo | 2h 28 |

*Table 4: Journey time comparisons for 3 route planners.*

The Freight Journey Planner website calculates routes by using Smart Road Routing which is a dynamic algorithm that considers time and day specific restrictions on the route. These include road closures due to events, road works and night-time restrictions. For consistency to allow comparison, all journey times were calculated with a departure time of 10.30am on 13/05/2019.

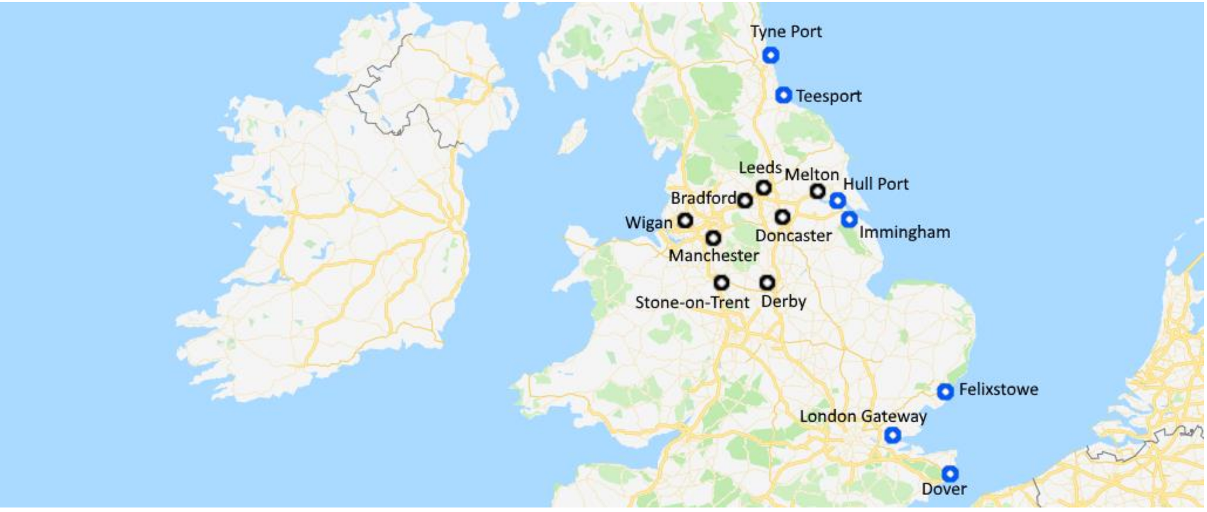



*Figure 2: Sample UK industrial/warehouse locations and mainland Europe connected ports*

**Sea Journey**

4 www.freightjourneyplanner.co.uk
5 https://maps.google.com
6 http://www.theaa.com/route-planner/index.jsp
7 https://www.rac.co.uk/route-planner/
8 apps.impargo.de

For the sea journeys we used a route planner designed specifically for maritime traffic[9]. This website returns distance values in Nautical Miles which were converted to miles so that a total journey could be calculated in one unit of measure. Ro-Ro services cover both accompanied and unaccompanied trailers. The $CO_2$e data is based on Ro-Ro ferries with a capacity of 2000+ Lane Metres and container ships built to carry 0-999 Twenty-Foot Equivalent Units (TEUs)[10]. All routes were calculated on an average speed of 17 knots.

Below is a table of postcodes of ports that were used to calculate both the sea and land routes:

| Location | Postcode |
|---|---|
| The Port of Hull | HU9 5NS |
| The Port of Immingham | DN40 2LZ |
| The Port of Dover | CT16 1JA |
| Teesport | TS6 6UD |
| The Port of Tyne | NE34 0PT |
| London Gateway | SS17 9NA |
| The Port of Felixstowe | IP11 3TA |
| The Port of Rotterdam | 3029 AP |
| The Port of Calais | 62100 |
| The Port of Zeebrugge | 8380 |
| The Port of Hamburg | 20457 |
| The Port of Lisbon | 1900-264 |
| The Port of Amsterdam | 1011 |
| The Port of Bremerhaven | 27568 |
| The Port of Antwerp | 2000 |

*Table 5: The locations of ports across Europe used.*

## 2.3 $CO_2$e Calculations

All the $CO_2$e values were calculated by using the Defra Conversion Factors 2018[11]. The road calculation was based on an articulated HGV (>33t). The Defra Conversion Factors are different depending on the exact mode of transport.

The following Defra conversion factors were used for calculations:

| Transport mode | Defra classification | $CO_2$e tonne.km |
|---|---|---|
| Road | Articulated (>33t) – Average Laden | 0.08348 kg |
| Sea (Ro-Ro) | RoRo-Ferry - 2000+ LM | 0.05019 kg |
| Sea (Lo-Lo) | Container ship - 0–999 TEU | 0.03681 kg |

*Table 6: Defra conversion factors used for CO2e calculations*

The classifications used are representative of the type of vehicles and vessels used for unitised freight movement between the UK and mainland Europe.

[9] www.searoutes.com
[10] https://dedola.com/2011/10/what-is-a-teu/
[11] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018

During road legs, for each tonne travelling a kilometre, 0.08348 kg of $CO_2e$ were emitted. For the sea legs two options were calculated to cover both Ro-Ro and Lo-Lo ferries. For Ro-Ro, a ferry with a capacity of 2000 plus Lane Metres (LM) emits 0.05 kg of CO2e for each tonne carried per kilometre. For Lo-Lo, a container ship 0-1999 TEU emits 0.03 kg of CO2e for each tonne carried per kilometre.

## 2.4 Driver Rest Breaks

The total journey times we calculated do not include driver rest breaks or overnight stops. This is due to the legislation being complex and the variables involved having an extremely wide range of scenarios. These variables include previous working patterns of drivers, weather, road works and accidents. Due to there being so many variables, it doesn't make sense for the purposes of this study to include them in the calculations.

The basic driver rest break regulations[12] dictate that a mandatory 45 minute break must be taken every 4 hours and 30 minutes. These regulations allow for a certain amount of flexibility based on the driver's recent working pattern. Although the times in the report don't include rest breaks, it must be taken into consideration that for every road journey that exceeds 9 hours (this can be extended to 10 hours twice a week), the driver must take at least 11 hours rest every day – this can be reduced to 9 hours rest 3 times between any 2 weekly rest periods.

## 2.5 Waiting and Loading/Unloading Times

The data includes the vessel loading and unloading times for each sea journey. This has been included to show the variations with the different types of vessels and how it impacts on the total journey time. The data was arrived at after a number of discussions with various hauliers about their experience of loading and unloading times. For this report it is assumed all the ports have the same loading and unloading times.

| Type | Unload time (hrs) | Load time (hrs) | Total time (hrs) |
|---|---|---|---|
| **Ro-Ro Unaccompanied** | 1.5 | 3 | 4.5 |
| **Ro-Ro Accompanied** | 1.5 | 1.5 | 3 |
| **Lo-Lo Containers** | 2 | 4 | 6 |

*Table 6: Loading and Unloading for different ship types.*

Note that we have not included any waiting time where trucks arrive early to wait for a vessel. Do consider though that at ports where there are more frequent services (e.g. hourly), the waiting times are likely to be less where there are less frequent services (e.g. daily) because drivers will plan their arrival times more conservative for infrequent services to avoid the consequences of missing it.

[12] www.gov.uk/drivers-hours/eu-rules

# 3. Route Comparisons

Here we highlight 3 example route comparisons. Note that there are not necessarily current direct LO-LO and RO-RO services active on all the calculated routes. The time and CO2 calculations are theoretical values assuming the types of vessels and speeds that would be used on these routes if there were active direct Ro-Ro or Lo-Lo services.

## 3.1 Derby to Hanover

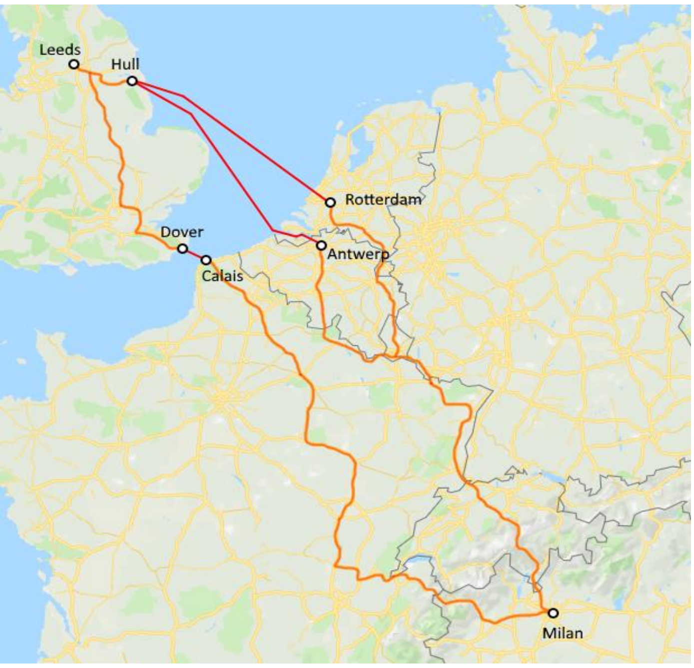
The map and data below show that for Hanover to Derby the most efficient route for both mileage and CO2e is shipping from Immingham to Hamburg. There is a 27% saving on CO2e for the Humber route. The total distances are very similar, but the Immingham route takes 10 hours longer due to the longer sea journey.


| Sea Leg | Total Miles | Road Miles | Sea Miles | Time (hh:mm) | Total Kg CO2e | Road Kg CO2e | Sea Kg CO2e |
|---|---|---|---|---|---|---|---|
| Dover – Calais (Ro-Ro) | **634** | **609** | **25** | **22:34** | **1677** | **1637** | **40** |
| Immingham –Hamburg (Ro-Ro) | **626** | **193** | **433** | **32:42** | **1217** | **518** | **699** |

*Table 7: Breakdown of journey from Derby to Hanover.*

## 3.2 Leeds to Milan

The map and data below compared a journey between Leeds and Milan. There are two possible Humber routes considered in this example, one via Rotterdam (Ro-Ro) and one via Antwerp (Lo-Lo). There is a 13% saving on CO2e for the Humber-Antwerp route compared to the Calais-Dover route. Notably the road journey between Milan and the port is not much different between the port options, which is contrary to what may be expected. On the Rotterdam route, the travel time is actually less than the Dover route due to the shorter road journey from Milan.




| Sea Leg | Total Miles | Road Miles | Sea Miles | Time (hh:mm) | Total Kg CO2e | Road Kg CO2e | Sea Kg CO2e |
|---|---|---|---|---|---|---|---|
| **Dover-Calais (Ro-Ro)** | 936 | 911 | 25 | 32:56 | 2,487 | 2,447 | 40 |
| **Hull – Antwerp (Lo-Lo)** | 957 | 680 | 277 | 40:47 | 2,156 | 1,709 | 447 |
| **Hull – Rotterdam (Ro-Ro)** | 946 | 704 | 242 | 29:35 | 2,282 | 1,891 | 391 |

*Table 8: Breakdown of journey from Leeds to Milan.*

## 3.3 Manchester to Warsaw

The map and data below show that for a journey between Manchester and Warsaw, the Immingham-Hamburg route is the best route for mileage and CO2e. For CO2e there is a 25% saving if using the Immingham-Hamburg route instead of the Dover-Calais and it only takes an extra 6 hours on journey time.


| Sea Leg Accompanied | Total Miles | Road Miles | Sea Miles | Total Time (hh:mm) | Total Kg CO2e | Road Kg CO2e | Sea Kg CO2e |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Dover – Calais (Ro-Ro) | **1,229** | **1,204** | **25** | **40:25** | **3,273** | **3,233** | **40** |
| Immingham – Hamburg (Ro-Ro) | **1,091** | **658** | **433** | **46:39** | **2,466** | **1,766** | **699** |
| Tyne – Bremerhaven (Ro-Ro) | **1,202** | **770** | **432** | **49:05** | **2,765** | **2,067** | **698** |

*Table 9: Breakdown of journey from Manchester to Warsaw.*

# 4. Benefits of Humber Ports

## 4.1 Environmental Benefits

There is a clear environmental benefit in reducing land-based miles for goods shipped between the UK and mainland Europe. This is because the $CO_2$e emissions for water-based transport is significantly lower per mile per tonne, than land-based transport using HGVs. It is therefore to be expected that, for the UK sites we evaluated in this study, the shipping routes through the northern ports will have lower emission values resulting from the larger percentage water-based transport legs.

Comparing the current share of unitised freight attracted by the Humber ports (12.7%)[14] with the GVA generated by the region that has the Humber as closest port (as per the Voronoi diagram in *Figure 2*), 29.3%, it is clear that this potential for being environmentally efficient has not been fully harnessed. As an example, we know that there are currently 2.6 million HGV loads per year that moves through Dover, on Ro-Ro ferries, representing 15.7%[14] of all unitised freight imports and exports. We have calculated that for every 1% percent of the 2.6 million HGV loads that can be rerouted to use a Humber port instead, there will be a reduction of 10,407 tonnes of $CO_2$e, which is equivalent to the $CO_2$ absorbed by 1,868 acres of woodland or more than twice the size of Central Park in New York. If 10% of the annual loads are rerouted via the Humber ports, this equates to a $CO_2$ reduction equivalent of trees covering more than 20 times the size of Central Park, and this is only for Dover. (If you are interested these calculations are explained in Appendix 3 of this report)

Research done as part of the Innovate UK funded LHOFT (Liverpool Humber Optimisation of Freight Transport) project indicates a full potential for rerouting 4,000,000 units of unitised freight per annum from ports in the south to ports in the north (including the Humber ports), with a realistic target in the medium term of 165,000 units.

## 4.2 Distance and Time Benefits

For all the UK sites that we have selected the Humber ports are closer than any of the other east coast ports. For example, compared to Dover, the average reduction in distance for the sample 6 UK locations is 178 miles, average journey time is cut by 5 hours and 10 minutes and also for CO2e, there is an average saving of 458Kg per load.

Table 17 shows the miles, travel time and Kg of CO2e emissions per load that are incurred when travelling between the 6 industrial sites in the UK and the Humber and Dover and the reductions in distance, time and Kg CO2e when using Humber ports as opposed to Dover.

| | Miles | | | Time (h:mm) | | | Kg CO2e | | |
|---|---|---|---|---|---|---|---|---|---|
| | Hull | Dover | Diff | Hull | Dover | Diff | Hull | Dover | Diff |
| Doncaster | 43 | 240 | 197 | 01:21 | 06:58 | 5:37 | 116 | 644 | 528 |
| Bradford | 67 | 271 | 204 | 02:02 | 07:52 | 5:50 | 181 | 728 | 547 |
| Melton | 11 | 255 | 244 | 00:25 | 07:39 | 7:14 | 29 | 685 | 656 |
| Leeds | 60 | 263 | 203 | 01:48 | 07:37 | 5:49 | 160 | 707 | 547 |
| Manchester | 104 | 285 | 181 | 03:03 | 08:23 | 5:20 | 278 | 764 | 486 |
| Wigan | 118 | 288 | 170 | 03:35 | 08:28 | 4:53 | 316 | 773 | 457 |
| Derby | 99 | 211 | 112 | 02:59 | 06:19 | 3:20 | 266 | 567 | 300 |
| Stoke-on-Trent | 129 | 241 | 112 | 03:51 | 4.01 | 3:19 | 346 | 648 | 302 |

*Table 10: Comparison of the statistics between the Humber ports and Dover.*

The data shows on average the Humber is 5 hours and 10 minutes nearer to the 8 UK industrial locations than Dover. The closest location to Dover is Stoke-on-Trent which is still 112 mile further than travelling to the Humber. This illustrates that any industrial location on the Northern East-West corridor (as per *figure 1*) will always be closer in miles and time travelled than Dover. Also, on a $CO_2e$ perspective, the Humber ports are more environmentally friendly with an average saving of 478Kg of CO2e for the 6 industrial sites.

## 4.3 Risk and Resilience Benefits

Within logistics, minimising risk is important to make sure there is reliability in the supply chain. For the period between July 2017 and June 2018, 3.5 million roads goods vehicles travelled from Great Britain to the continent. 56% of these went through the Dover Strait (this includes Dover, Folkestone, Ramsgate and the Channel Tunnel). Only 938,000 went through the North Sea routes (everything North of and including the Thames). This is 26.8% and shows that Great Britain is heavily reliant on the Dover Strait for Ro-Ro freight[13]. However, according to 'EEF The Manufacturers' Organisation'[14], their latest 2018/2019 statistics of industrial output shows that 49% of all manufacturing (and therefore laden exports as an approximation) originate from the locations nearer the Humber ports than the Dover Strait in miles. This shows although nearly 50% of manufacturing originates nearer to the Humber ports, there is 26.8% of road goods vehicles exploiting the North Sea routes.

For any supply chain to only have one route between the UK and Europe means that if there are any problems and delays on that route, the supply chain could face considerable disruption. To have a supply chain that is resilient and to minimise risk, there should be a number of different routes using different ports on either side of the sea crossings. By using multiple ports in a supply chain, the risk

[13] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/756077/roro-july-2017-to-june-2018.pdf
[14] https://cms.eef.co.uk/campaigning/campaigns-and-issues/manufacturing-facts-and-figures

of a major disruption at one port is mitigated. For example, if a company shipping to the UK from the EU needs to ship 300 trailers a day, ideally 3 routes with 3 different combinations of ports should be used, with 100 trailers on each route. This would mean if there was disruption on one of the routes then at least part of the shipment would be unaffected. Disruption is not only limited to the ports, the road networks can have disruptions like an accident so by using multiple ports and roads the risk of one single disruption on the roads is minimised due to a number of routes being used.

An example of the port of Dover being severely disrupted was in June 2015 when French ferry workers took strike action. The disruption lasted 4 days, caused a 30-mile queue of 4,600 lorries on the M20 and cost the UK economy £1 billion[15,16].

A second example of disruption at Dover is in July 2016 when understaffing at French border posts led to delays of up to 14 hours through Kent and queues of up to 12 miles[17].

Brexit could also add lots of delays to the heavily used ports for European freight such as Dover.

By using the Humber ports instead of Dover, the distance travelled by road, which is the most expensive mode of travel, is reduced. According to the latest Department for Transport figures, HGVs represent 5.2% of total miles travelled per annum in Great Britain[18] and 2% of road traffic accidents involve an HGV[19]. However, 15% of fatalities caused by road traffic accidents in the UK involved an HGV[20]. This shows there is a disproportionate number of deaths involving an HGV.. This demonstrates that if the number of miles travelled by HGVs are reduced, the number of deaths on roads in Great Britain should also reduce.

## 4.4 Driver and Asset Utilisation Benefits

With a worsening HGV driver shortage in the UK[26] hauliers are under increased pressure to maximise the efficient use of drivers and improve working conditions for drivers. Maximum utilisation of tractor units (as the most significant capital investment) is also key for profitability. In this regard we see some advantages to using the Humber ports for our selected industrial areas. The higher percentage of unaccompanied freight on the Humber routes results in HGV drivers not spending unproductive time on the ferries. Drivers can do more, shorter shuttle type routes between customers and the port and is more likely to end the day at home. The utilisation of the tractor unit can also be very high in this case.

15 https://www.bbc.co.uk/news/uk-england-kent-33359337
16 https://www.cips.org/en/supply-management/news/2015/july/calais-disruption-cost-uk-1-billion-says-dover-port-chief/
17 https://www.bbc.co.uk/news/uk-england-kent-36873632
18 https://www.gov.uk/government/statistical-data-sets/road-traffic-statistics-tra#traffic-volume-in-miles-tra01
19 https://www.gov.uk/government/statistical-data-sets/ras40-reported-accidents-vehicles-and-casualties
20 https://www.gov.uk/government/statistical-data-sets/ras40-reported-accidents-vehicles-and-casualties
26 https://fta.co.uk/getattachment/Compliance-and-Advice/Economy/Skills-Shortage/Skills-Shortage/Skills-Shortage-report-2018.pdf?lang=en-GB

The table below indicate the number of shuttle trips a HGV driver can complete from the location to the port in a working day.

| UK Industrial Location | Time for round trip to Humber Ports (Hull/Immingham) | Number of trips per day (9 hours) | Time for round trip to Port of Dover | Number of trips per day (9hours) |
|---|---|---|---|---|
| **Doncaster** | 3:42 | 2 | 14:56 | <1 |
| **Bradford** | 5:04 | 1 | 16:44 | <1 |
| **Hull** | 1:50 | 4 | 16:18 | <1 |
| **Leeds** | 4:36 | 1 | 16:20 | <1 |
| **Manchester** | 7:06 | 1 | 17:46 | <1 |
| **Wigan** | 8:10 | 1 | 17:54 | <1 |
| **Derby** | 6:58 | 1 | 13:40 | <1 |
| **Stoke-on-Trent** | 8:42 | 1 | 15:22 | <1 |

*Table 18: Round trips per day*

Where accompanied freight options are used on the Humber routes, the longer sea journey time could actually be an advantage if the planning is such that the driver can use the time on the ferry as his required daily rest period. Of course it is not always possible to accurately schedule in this way, but where possible (especially on regular routes), this could be positive for driver utilisation.

# 5. Conclusion

Reducing freight related greenhouse gasses (GHG)[21] and increasing driver utilisation[22] and supply chain resilience[23] are increasingly important consideration factors in logistics planning and we expect the future development of freight services and infrastructure to reflect this. For industrial sites that are located roughly north of Derby and south of York, the use of the Humber ports (Hull and Immingham) for unitised freight trade with mainland Europe is an attractive option. The road journeys are generally significantly shorter due to the closer distance on the UK side, with a resulting very significant reduction in $CO_2$ and related greenhouse gasses (GHGs). For the routes we analysed, the Humber ports, on average, delivers a 15.3% better CO2e performance compared to the southern port routes. It also provides good opportunities for better truck and driver utilisation, especially using unaccompanied freight options.

On the import and export routes via the Humber ports, the sea journeys are longer and road journeys are shorter (at least on the UK side) compared to route via the ports in the South (e.g. London Gateway or Dover). This mostly results in a longer total journey time, given that trucks on land move significantly faster than ships. For the journeys we analysed, on average, it results in less than three hours longer journey times compared to the total journey times through the southern ports, on an average 34 hours total journey time. This is 6.4% additional time. In certain special cases this time difference may be significant, but for most freight journeys this will not be considered significant, with time reliability probably more important. Where unaccompanied or container freight options are used, the longer total journey time should not have any negative impact on driver or asset utilisation as the driver and tractor is only used for the shorter road journeys. For accompanied freight options, if the timing is right, the longer sea journey can be coordinated with the driver mandatory rest periods, although admittedly this is not always easy to achieve. While total journey times between UK industrial to European industrial site may be longer, the shorter journeys between UK industrial site to UK port has the advantage of shorter lead times from production to sailing for export or vessel arrival to warehouse for imports). This is an advantage where the UK party is responsible for this leg. It has to be added though that the higher frequency of sailings from the Dover Strait ports possibly cancels out this advantage to some degree as it provides more flexibility for sailing time.

In the time of Brexit uncertainty, there is a great awareness of the importance of resilience in supply chains. The unbalanced high reliance on the southern Dover Strait routes is a vulnerability for supply chains exclusively using these routes. Disturbances or delays on this route can (and have on several occasions in the past) result in problems for time critical and low inventory supply chains. A better balance between the northern and southern ports will result in more resilient supply chains for the UK in general or for individual organisations that split their volume between the routes.

[21] https://www.eea.europa.eu/data-and-maps/indicators/transport-emissions-of-greenhouse-gases/transport-emissions-of-greenhouse-gases-11
[22] https://fta.co.uk/campaigns/driver-shortage
[23] Meriton, R and Graham, G, *International Supply Chain Resilience: a Big Data Perspective*. In: Proceedings of the 21st Cambridge International Manufacturing Symposium. 21st Cambridge International Manufacturing Symposium - Globalisation 2.0, 28-29 Sep 2017, Cambridge, UK. Institute for Manufacturing, University of Cambridge, pp. 158-164.

Environmental, resilience and utilisation benefits can be gained from using the Humber ports for the analysed UK industrial locations. This for a relatively small price in total journey times and resulting in fewer freight miles on UK roads. Cost comparisons are difficult to make because there are so many factors contributing to the negotiated prices of freight services. However, at price parity or near price parity, there is a convincing case to consider the Humber ports as a favourable alternative to other routes, especially in a world where environmental and resilience factors are of increasing importance.

# Appendix 1: Distance, Time and CO2e tables: UK Location to UK Port

| | PORTS | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hull | | | Immingham | | | Dover | | | Teesport | | | Tyne | | | London Gateway | | | Felixstowe | | |
| **UK Site Name** | Miles | Time (hh:mm) | Kg CO2e | Miles | Time (hh:mm) | Kg CO2e | Miles | Time (hh:mm) | Kg CO2e | Miles | Time (hh:mm) | Kg CO2e | Miles | Time (hh:mm) | Kg CO2e | Miles | Time (hh:mm) | Kg CO2e | Miles | Time (hh:mm) | Kg CO2e |
| Doncaster - (Armthorpe Industrial Park) | 44 | 1:21 | 117 | 43 | 1:21 | 116 | 240 | 6:58 | 644 | 98 | 2:44 | 264 | 124 | 3:29 | 332 | 184 | 5:29 | 494 | 189 | 5:25 | 509 |
| Bradford - (Euroway Industrial Estate) | 67 | 2:02 | 181 | 80 | 2:23 | 215 | 271 | 7:52 | 728 | 87 | 2:28 | 224 | 112 | 3:14 | 301 | 215 | 6:23 | 578 | 221 | 6:18 | 593 |
| Hull - (Melton Business Park) | 11 | 0:25 | 29 | 26 | 0:54 | 70 | 255 | 7:39 | 685 | 109 | 3:00 | 279 | 134 | 3:46 | 359 | 199 | 6:10 | 535 | 205 | 6:06 | 550 |
| Leeds - (Waterside Industrial Park) | 60 | 1:48 | 160 | 72 | 2:10 | 194 | 263 | 7:37 | 707 | 74 | 2:05 | 190 | 99 | 3:49 | 266 | 208 | 6:08 | 557 | 213 | 6:04 | 572 |
| Manchester - (Trafford Point) | 104 | 3:03 | 278 | 117 | 3:26 | 313 | 285 | 8:23 | 764 | 123 | 3:31 | 317 | 149 | 4:17 | 399 | 229 | 6:54 | 614 | 249 | 7:17 | 669 |
| Wigan - (Marsh Green) | 118 | 3:35 | 316 | 131 | 3:57 | 351 | 288 | 8:28 | 773 | 137 | 4:03 | 353 | 163 | 4:47 | 437 | 232 | 6:59 | 624 | 253 | 7:19 | 679 |
| Derby - (Sinfin Central Business Park) | 99 | 2:59 | 266 | 99 | 3:00 | 266 | 211 | 6:19 | 567 | 140 | 4:00 | 360 | 165 | 4:45 | 444 | 155 | 4:48 | 417 | 176 | 5:07 | 471 |
| Stoke-on-Trent - (Stanley Matthews Way) | 129 | 3:51 | 347 | 129 | 3:51 | 346 | 241 | 7:10 | 648 | 171 | 4:51 | 441 | 197 | 5:41 | 528 | 185 | 5:40 | 498 | 206 | 6:04 | 553 |

# Appendix 2: Distance, Time and CO2e Tables: UK Location to Mainland European Locations

A spreadsheet containing the detailed tables per route (UK site to Mainland Europe site) and freight format (e.g. Ro-Ro, Accompanied) can be downloaded from the site https://lido.hull.ac.uk/routes

This site also contains a search tool where you can enter an UK and mainland Europe site and the alternative route options will be displayed for information and comparison.

## Appendix 3: Converting $CO_2e$ benefits into forest equivalent

For every 1,000 HGV journeys split equally between the 6 EU locations (Paris, Frankfurt, Warsaw, Munich, Hanover and Milan) travelling from Manchester that use the Humber instead of the Dover ferry routes, there is a resultant 400.26 tonnes of $CO_2e$ reduction.

There are 2.6 million HGV loads travelling through Dover each year[27]. If 1% of those (26,000) were diverted through the Humber ports, based on the above calculation, 10,407 tonnes (10.4 million kg) of $CO_2e$ would be saved each year.

A mature tree absorbs on average 22Kg of $CO_2$ per annum[24]. According to Welsh Woodland Organisation[25], an acre of woodland with trees spaced at 4 metres apart would contain approximately 253 trees. Taking this into consideration, if the 1% of HGVs using Dover annually were not diverted through the Humber ports, it would take a woodland the size of 1,868 acres to absorb the same amount of $CO_2$. This is the same area of 1,245 football pitches[26], or more than two Central Parks in New York[27].

The tables below are a breakdown of the $CO_2e$ savings by journey from Manchester to each of the 6 EU locations. These are the parameters used to arrive at the total $CO_2e$ savings.

The below numbers are based on accompanied Ro-Ro services. This was chosen due to Dover only handling accompanied Ro-Ro services at present and to give the current scenario. For the first section below, 1,000 HGVs have been divide between the six EU industrial locations. It was decided to divide 1,000 HGV journeys over the 6 EU locations to show no bias to a particular location that heavily favoured the Humber ports. The second section will show the $CO_2e$ savings in 1,000 HGV journeys per EU location. The data below is based on Manchester being the UK industrial location.

| EU Industrial location | Kg CO2e Savings | Tonnes of CO2e Savings | Equivalent number of trees needed to absorb CO2 | Acres of woodland |
|---|---|---|---|---|
| **Frankfurt** | **66,038** | 66.04 | 3,002 | 12 |
| **Paris** | **18,370** | 18.37 | 835 | 3 |
| **Warsaw** | **134,769** | 134.77 | 6,126 | 24 |
| **Munich** | **47,595** | 47.60 | 2,163 | 9 |
| **Hanover** | **102,037** | 102.04 | 4,638 | 18 |
| **Milan** | **31,416** | 31.42 | 1,428 | 6 |
| ***Total*** | **400,225** | **400.26** | **18,192** | **72** |

*Table 11: A summary of CO2e savings per 1000 loads between Manchester and Mainland Europe.*

[27] http://www.urbanforestrynetwork.org/benefits/air%20quality.htm

[28] www.coed.cymru/index.html

[29] https://www.woodlands.co.uk/blog/woodland-activities/how-big-is-an-acre-measuring-your-woodland/

[30] https://www.britannica.com/place/Central-Park-New-York-City

| Manchester to Frankfurt | | | | | |
|---|---|---|---|---|---|
| UK Port | EU Port | Miles | Time (hh:mm) | Kg CO2e | Kg CO2e for 167 HGVs |
| **Hull** | Rotterdam | 635 | 28:36 | 1,413 | 235,731 |
| **Dover** | Calais | 683 | 24:00 | 1,807 | 301,769 |
| | | | | ***Saving in CO2e*** | **66,038** |

*Table 12: Breakdown of Manchester to Frankfurt using either Hull or Dover.*

| Manchester to Paris | | | | | |
|---|---|---|---|---|---|
| UK Port | EU Port | Miles | Time (hh:mm) | Kg CO2e | Kg CO2e for 167 HGVs |
| **Hull** | Zeebrugge | 538 | 28:30 | 1,189 | 198,563 |
| **Dover** | Calais | 494 | 18:27 | 1,299 | 216,933 |
| | | | | ***Saving in CO2e*** | **18,370** |

*Table 13: Breakdown of Manchester to Paris using either Hull or Dover.*

| Manchester to Warsaw | | | | | |
|---|---|---|---|---|---|
| UK Port | EU Port | Miles | Time (hh:mm) | Kg CO2e | Kg CO2e for 167 HGVs |
| **Immingham** | Hamburg | 1,091 | 46:39 | 2,466 | 411,822 |
| **Dover** | Calais | 1,229 | 40:20 | 3,273 | 546,591 |
| | | | | ***Saving in CO2e*** | **134,769** |

*Table 14: Breakdown of Manchester to Warsaw using either Hull or Dover.*

| Manchester to Munich | | | | | |
|---|---|---|---|---|---|
| UK Port | EU Port | Miles | Time (hh:mm) | Kg CO2e | Kg CO2e for 167 HGVs |
| **Hull** | Zeebrugge | 866 | 33:33 | 2,070 | 345,690 |
| **Dover** | Calais | 887 | 30:18 | 2,355 | 393,285 |
| | | | | ***Saving in CO2e*** | **47,595** |

*Table 15: Breakdown of Manchester to Munich using either Hull or Dover.*

| Manchester to Hanover | | | | | |
|---|---|---|---|---|---|
| UK Port | EU Port | Miles | Time (hh:mm) | Kg CO2e | Kg CO2e for 167 HGVs |
| **Immingham** | Hamburg | 643 | 33:08 | 1,264 | 211,088 |
| **Dover** | Calais | 708 | 24:38 | 1,875 | 313,125 |
| | | | | ***Saving in CO2e*** | **102,037** |

*Table 16: Breakdown of Manchester to Hanover using either Hull or Dover.*

| Manchester to Milan | | | | | |
|---|---|---|---|---|---|
| UK Port | EU Port | Miles | Time (hh:mm) | Kg CO2e | Kg CO2e for 168 HGVs |
| **Hull** | Zeebrugge | 972 | 36:48 | 2,357 | 395,976 |
| **Dover** | Calais | 957 | 33:42 | 2,544 | 427,392 |
| | | | | ***Saving in CO2e*** | **31,416** |

*Table 17: Breakdown of Manchester to Milan using either Hull or Dover.*