FREIGHT 21

INTEGRATING FREIGHT WITH RAIL

Freight to and from Felixstowe and the East Coast in 2044.

February 2023

This note uses predictions from the Department for Transport's document about future port freight:

[1] UK Port Freight Traffic: 2019 Forecasts which can be downloaded from here.

The forecasts date from 2019, so need to be treated with caution as they do not include the effects of the war in Ukraine and increasing tension between the West and China. The report also assumes there will be no capacity constraints on growth.

Information about GHG emissions is from the spreadsheet:

[2] Conversion Factors 2022: condensed set of UK Government GHG conversion factors, obtainable here.

There is also a Network Rail report about future volumes of rail freight:

[3] Rail Freight Forecasts: Scenarios for 2033-34 and 2043-44 which can be downloaded from here.

UK Port Freight Forecasts.

On p21 of [1], there is a summary table which shows:

Year	2020	2025	2030	2035	2040	2050
Million TEU	10.59	11.69	13.42	15.43	17.34	21.89

These forecasts are close to constant growth rate, so that would yield 19.03M TEU in 2044 and 11.46M TEU in 2024. This gives the growth factor from 2024 to 2044 to be 1.66.

The present situation.

Information about the volume of container (Lo-Lo) traffic through Felixstowe comes from the Department for Transport's maritime statistics dashboard. This source gives the volumes in both tonnes and TEU1, for inbound and outbound freight separately. We learn that on average over the period 2010-2021 there are 1.89M TEU inbound and 1.82M TEU outbound through Felixstowe each year, and that the average load of a TEU inbound is 7.61t and outbound is 4.83t, so the average load per TEU is 6.22t. *(TEU = Twenty-foot Equivalent Unit; a standard maritime container is 40 feet long, so is 2 TEUs, though 20-foot containers are also quite common)*.

Information about container sizes, weights and capacities is obtained from this website. A 20-foot container weighs 2.23t and will carry up to 28.2t, a 40-foot container weighs 3.68t and will carry up to 29.8t. Based on this, we suppose that the weight of a TEU is 2t; in view of the average load of a container, the weight limit is unlikely ever to be reached in practice. Combining these sources, we arrive at an average gross weight for a loaded TEU to be 8.22t. Table 12 in [3] says that the average total load of a container train is 507t (this is gross weight), so this would be about 62 TEU. For later calculations, we need to specify what we take as a standard container train. Based on the information just summarized, we shall suppose that our standard container train will consist of:

eleven 3-wagon VTG Ecofret 2 units, each unit carrying 6 TEU, with each TEU weighing 8.22t.

Currently, container trains are hauled by diesel-electric locomotives, such as the Class 66, but when we consider possible future upgrades, we will suppose that the lines have been electrified (as they eventually will be), and the trains will be hauled by electric Class 90s.

To fix ideas, we will focus on the journey from Felixstowe to Nuneaton (or in the reverse direction). This is because if we were to try to send freight to the North West by the proposed new East West Rail (EWR) route, or via the Freight21 study route, the place where it would meet the existing route via Ely would be Nuneaton (See the report Rail Freight in the East: Cost and Performance Analysis on the Freight21 website).

The distance by road is 240km, by the existing rail route via Ely and Peterborough it is 265km, by the EWR proposed route it is 275km, and by the Freight21 study route it is 255km. About 25% of the container traffic through Felixstowe is carried by rail, so at present rates, 0.9275M TEU annually. The remaining 2.7825M TEU goes by road.

We will estimate the GHG emissions associated with these journeys, and the daily numbers of rail and of HGV journeys:

For the road journeys, this is quite straightforward. We know how many TEUs are transported in a year, how far they travel, and how much they weigh. Consulting the spreadsheet [2] for a half-laden articulated truck of over 33t, we find the GHG emissions per tonne-km are 0.09617 kg. Multiplying these factors together gives an annual GHG emission of 529,000t. Daily HGV movements average out to be 3975 (or about 8,000 TEUs daily).

For the rail journeys, we rely on the sophisticated analysis of the Freight21 report Rail Freight in the East: Cost and Performance Analysis, which computes the dynamics of the train along the entire route chosen, deduces the energy required, and converts this into GHG depending on the type of traction in use. Diesel-electric is considerably dirtier than electric, and as electricity generation gets cleaner, the difference will only increase. From these calculations, we find that the annual GHG emissions from the current rail transport via Ely of Felixstowe container traffic is 59,000t, with about 40 trains per day on average. *(In February 2023 there were on average 26 trains daily arriving, 26 trains daily leaving. This actual count of 52 trains is higher than the calculated figure of 40, but trains are often only partly loaded, so might not be carrying as many as the assumed 66 TEU).*

*Thus, the present annual GHG emissions are about **587,000t**.*

The situation in 2044.

We shall suppose that the volume of container traffic in 2044 is 66% higher than it is presently, in line with the forecasts of [1]. We have considered four possible scenarios, depending on what improvements to rail infrastructure are made in the next twenty years:

1. With no change to the existing rail provision, there would be about 7,500 HGV journeys daily on the A14 (more than 5 HGVs per minute entering or leaving the port, around the clock), and an overall GHG emission of 1,051,000t pa;
2. If the line through Ely were upgraded and electrified to double its present capacity, there would be about 6,200 HGV journeys daily, 80 trains a day, and overall GHG emissions of 845,000t pa;

3. If the Ely line were upgraded and electrified to double its capacity, and the Freight21 study route past Cambridge and Bedford to Bletchley were built and carrying the same volume as the Ely line, then there would be about 3,500 HGV journeys daily, 80 trains per day via each of Ely and Bletchley, with overall GHG emissions of 520,000t;
4. If the improvements of the previous scenario were made and 90% of container traffic were directed equally via Ely or Bletchley by rail, total GHG emissions would be about 197,000t annually. There would be 900 HGV movements a day, and there would be 240 trains a day, a train entering or leaving the port every 6 minutes.

From this, we see that by 2044 the annual GHG emissions will be substantially higher than at present unless additional rail capacity (such as the Freight21 study route) is built to take more traffic off the road; and this conclusion holds even if the existing Ely route is improved. The proposed EWR route is incapable of delivering the necessary additional freight capacity because of bottlenecks passing through Cambridge and Bedford, and the poor-quality line between Newmarket and Cambridge. Moreover, the current route via Ely does not well serve Wales or the South West.

By 2040, all sales of new diesel HGVs will end. At present, there are only experimental technologies that might replace diesel HGVs, but **we cannot be certain that there will be any viable road alternative to diesel HGVs**. This is perhaps an even more compelling reason to accelerate the modal shift of long-distance overland freight from road to rail. Even if a viable road alternative to diesel HGVs is developed, the GHG emissions per t-km from road transport are about 4 times those of rail transport due to the much higher rolling resistance of tyres, so consideration of emissions always prefers rail to road transport.

Appendix.

For a single journey between Felixstowe and Nuneaton the GHG emissions for various routes are as follows:

Route	In	Out	Locomotive
Freight21, 1 stop	1.01t	0.80t	Class 90
Ely, 3 stops	1.12t	0.89t	Class 90
Ely, 5 stops	1.15t	0.93t	Class 90
Ely, 3 stops	4.66t	3.77t	Class 66
Ely, 5 stops	4.76t	3.90t	Class 66