Alpine corridors reflect rail's struggle for modal share

Photo: Hupac

Anchored in Italy, three north-south Rail Freight Corridors provide significant opportunities for modal shift in line with the European Commission's Green deal objectives. However, the transalpine routes still face many challenges that need to be addressed, suggests Reinhard Christeller.

On July 11, the European Commission issued its Greening Freight proposals, which are aimed at making freight transport across the European Union more efficient and more sustainable, in line with its Green Deal policy objectives (RG 8.23 p5). The package is multimodal, but among the rail measures set out by the Commission is a proposal to rethink the management of the transcontinental Rail Freight Corridors. These would be merged into the TEN-T core network in order to link infrastructure investment and utilisation more closely.

The Green Deal aims to make the EU climate neutral by 2050. Despite a forecast 1% decrease in population over the intervening period, the bloc's economic activity is projected to grow by about 50% by 2050, with a corresponding increase in the demand for freight transport.

Today, freight is responsible for more than 30% of the EU's greenhouse gas emissions from transport, and these would grow in line with volumes unless suitable decarbonisation measures are put in place. According to the European Environment Agency, freight transport by road generates almost nine times as much CO_2 per tonne-km as rail. In its Sustainable & Smart Mobility Strategy the Commission set a target of doubling rail freight volumes by 2050 as part of a package aimed at reducing transport emissions by 90%.

However, even a doubling of rail freight would not balance the projected increase in demand. A quick calculation suggests that modal shift might reduce today's GHG emissions by about 30%, but that projected 50% growth in demand would see total emissions rise to 120% unless steps are taken to decarbonise other modes — notably road haulage. Hence the Greening Freight proposals.

Other measures under way for making rail freight more efficient, reliable and cost-effective include the proposed migration to the digital automatic coupler. Along with the installation of electro-pneumatic brakes, this would facilitate the automation of brake testing and other processes, together with the transmission of operational train data. It could also potentially support the partial automation of 'last mile' collection and delivery services. Meanwhile, real-time digital monitoring of wagons is seen as the basis for condition-based maintenance.

Hauled by an SBB Cargo locomotive, a Hupac intermodal train enters the Lötschberg base tunnel.

Corridors rethought

The trans-European Rail Freight Corridors were established under Regulation 913/2010. That set out the rules for the co-ordination of traffic management on selected corridors — originally nine but now 11, each of which has its own management structure.

Under the Regulation, the RFCs were specified to be suitable for 740 m

long trains with a maximum axleload of 22·5 tonnes. They should be cleared to the P400 loading gauge able to accommodate 4 m high road semi-trailers and high-cube containers, and equipped with ETCS Level 2 to provide interoperable train control.

Yet few of the routes reach those standards throughout, and investment has been required to upgrade them. Much of this has been funded through the Connecting Europe Facility, although the RFCs and TEN-T core corridors are not necessarily congruent — one of the reasons for the current proposal to merge them. It is worth noting that the CEF 2 Regulation, which provides funding for the 2021-27 budget period, was accompanied by a Smart TEN-T Directive aimed at streamlining measures to reduce delays in project implementation.

Linking the Blue Banana

Among the most important of the rail freight corridors serving Italy are the Rhine – Alpine RFC1, which embraces two routes through Switzerland and RFC3, Scandinavia – Mediterranean, while Italy is also served by the north-south RFC2 North Sea – Mediterranean and east-west RFC6 Mediterranean.

RFC1 and RFC2 are the backbones of the so-called Blue Banana, a densely populated metropolitan area that stretches from northwest England, the Midlands and Greater London across the Channel to the European metropolis of Lille, the Benelux states with Brussels and the Dutch Randstad region, along the Rhein to southern Germany and the Grand Est region in France, through Basel, Zürich and Genève in Switzerland and across the Alps to Milano, Torino, and Genova in northern Italy. This is one of the world's most economically active mega-regions with around 110 million inhabitants.

Much of the seaborne cargo coming from Asia to Europe through the Suez Canal continues to the North Sea ports such as Rotterdam, Hamburg and Antwerpen, even though this typically incurs an extra five days transit time compared with using the smaller Mediterranean ports.

The big North Sea ports have a combined handling capacity of about 1 100 million tonnes a year. Much of this freight then moves inland by lorry or train, even as far as Italy and the south of France. By comparison, the ports of Marseille, Genova and Trieste together cannot handle more than 300 million tonnes, and their hinterland links are not so well developed.

The northern tunnel portal of the Fehmarn Belt Fixed Link at Rødbyhavn in Denmark taking shape in December 2022.

Photo: Femern A/S

Aerial view of part of the port of Rotterdam, the biggest in Europe that handles about 500 million tonnes of freight per year.

Photo: Danny Cornelissen / Port of Rotterdam Authority

Getting through the Alps

The Alpine mountain range forms a formidable barrier for north-south trade in western Europe, stretching for more than 1 200 km from Monaco to Slovenia via France, Italy, Switzerland, Germany and Austria. The principal road and rail links connecting Italy with the northern and western parts of the continent are thus concentrated into four main corridors — from west to east these are the Mont Cenis/Fréjus, Lötschberg/Simplon, Gotthard and Brenner passes.

Most important from a rail perspective is the Gotthard line through central Switzerland, completed in 1882. Despite a 15 km summit tunnel, this winding route had to overcome a height difference of around 850 m, requiring gradients of up to 2·8%, while curves of 300 m radius limited speeds to no more than 80 km/h.

The opening of a 57 km base tunnel in 2016 shortened the route by 30 km, as well as reducing the height difference to just 250 m. This cuts SBB's overall traction energy of 2 300 GWh by an estimated 3% and allows for easy gradients of just 0·7% and generous curve radii laid out for 250 km/h operation of passenger trains. Freight trains can now run at speeds of between 100 and 160 km/h. While the old line never carried more than 16 million tonnes per year, the base tunnel provides capacity for up to 50 million.

However, a freight train derailment in the base tunnel on August 10 caused substantial damage to both the slab track and the doors at one of the crossover connections between the two bores; the initial cause was thought to be a fractured wagon wheel. According to an SBB statement issued on August 16, the tunnel will be partially closed for several months for repairs to at least 8 km of track. The infrastructure manager hoped

to have the eastern bore available for some freight traffic from late August, but other services will continue to be diverted because of the limited capacity available. Pasenger trains will have to continue using the legacy Gotthard pass line due to the lack of adequate escape routes from the base tunnel.

By contrast, the double track Simplon corridor linking Italy with western Switzerland was completed in 1906 with a base tunnel from the outset. However, the connecting Lötschberg route to northern Switzerland was steeply graded. This route was upgraded in 2007 by the opening of a 34·6 km base tunnel, but for the time being part of the twin-bore tunnel is still single track.

Switzerland's decision to invest in the Alpine base tunnels was primarily motivated by a desire to facilitate a shift of transit freight from road to rail — as well as improving passenger journey times. Enhanced capacity and speed were key measures to boost the attractiveness of rail. Residents along the principal road axes were suffering, because noise reverberates three times louder in the mountains than in the lowlands. Environmental pressure was also growing to reduce the high levels of pollution from exhaust gases and microplastics from tyre wear, which were being blown into the narrow Alpine gorges and even into the remotest upland valleys.

The first ideas for a base tunnel were floated in 1947, but it was not until 1992 that the Swiss voters gave the green light for both the Gotthard and Lötschberg corridors, followed in 1994 by further legislation to protect the Alps. The legal and financial instruments to shift freight from road to rail came into effect in 2001. These included lorry taxes on the basis of weight, distance travelled and emissions category, as well as subsidies for combined transport by rail until 2028. Since 2000, total traffic on the corridors has increased by around 15%, but despite these measures rail's share has only increased slightly.

To the east, another 55 km base tunnel is being built on the Brenner corridor, linking Italy, Austria and Germany, where the current railway dates from 1867 (p34). This will reduce the gradient on that route to 12·5%. The base tunnel is currently expected to open by 2032, but there is still no concrete plan for upgrading the route through southern Germany from München to the Austrian border.

In the west, work is also under way on the Lyon – Torino line between Italy and France, including a 57·5 km base tunnel, augmenting the existing Frejus line completed in 1871. A challenging schedule envisages that the tunnel should be ready to open by 2032, but as with the Brenner there are many uncertainties over the proposed connecting routes (p44).

Bottlenecks on RFC1

The Rhine-Alpine corridor is one of Europe's busiest freight routes. Much of the liquid and bulk goods, as well as some containers, are shipped in barges on the Rhein, which is navigable as far as Basel. Around 120 million tonnes a year currently uses the river, moving both up and downstream, of which about 6 million tonnes reaches Switzerland. This compares to 52 million moving by road and just 13 million by rail.

However, the river is subject to disruption in times of extremely high or low water levels, despite dredging and innovative vessel designs. When navigation is reduced from time to time, traffic is displaced to both road and rail.

RFC1 offers a network of parallel and diversionary routes in both the north and south, but the core section between Köln and Basel forms a real bottleneck, as there is only one main route and no realistic alternatives offering adequate capacity. This vulnerability was highlighted in 2017 when the corridor was closed for seven weeks due to the collapse of a tunnel under construction at Rastatt (RG 11.17 p8).

> 'Switzerland's decision to invest in the Alpine base tunnels was primarily motivated by a desire to facilitate a shift of transit freight from road to rail'

Ironically, this was being built as part of a long-running upgrading of the route, but the work has dragged on for decades. Germany committed as long ago as 1996 to upgrade the corridor between Karlsruhe and Basel to four tracks to provide sufficient capacity on the links to Switzerland's new trans-Alpine tunnels. However, DB does not now expect to complete the work until 2035, while Swiss sources fear it may even run on until 2040 or later.

In addition, poor co-ordination of engineering works conspires to reduce capacity, with frequent closures of one track on different sections. Another month-long total blockade of the core section is currently planned for September 2024, with SNCF being asked to provide a temporary alternative route through France to take part of the traffic via Strasbourg.

Logistics experts report that the situation on the corridor is becoming desperate. Between 15% and 20% of all planned freight trains are being cancelled for lack of capacity, and scheduled journeys are out of the question. DB is reportedly offering 225 train paths in total per day, which is significantly less than the 300+ paths normally available on the various routes through Switzerland. However, some traffic can be routed via RFC2 as an alternative.

At the southern end of RFC1, work is in progress to enhance the various Mediterranean ports. However, these efforts are limited because the mountainous hinterland in Italy reaches close to the shore. Even so, it is estimated that in the longer term about 4·5 million tonnes more traffic for Italy could be unloaded locally, with a corresponding reduction in the traffic flow from the

Photo: Reinhard Christeller

The Brenner Base Tunnel linking Austria with Italy forms a core element in the enhancement of RFC3.

north. Conversely, an extra 2·8 million tonnes would travel in the opposite direction, helping to balance volumes moving over the corridor.

This investment is not just focused on the ports. Following studies as long ago as 1991, work started in 2012 to upgrade the rail links between the port of Genova and the lines to the north. The so-called Terzo Valico project to build a third line between Genova and Milano forms part of RFC1. From 2026 there should be two parallel routes between the port and the Alpine base tunnels, part of which will be four-tracked, and with flexibility to switch the traffic from one route to the other.

The corridors are being upgraded to take 740 m long trains carrying both high cube containers and semi-trailers, while ETCS Level 2 will provide interoperable train control. The 90 km Terzo Valico line will have a maximum gradient of 1·25% and 70% of the line will run in tunnel, including the twin-bore 27 km Galeria di Valico. The connection link to the Gotthard line is already cleared to the P400 intermodal loading gauge while the Simplon route is due to be modified by 2028.

RFC2 saturated in part

The North Sea – Mediterranean RFC2 serves the Dutch and Belgian ports linked to RFC1, but also includes the French ports of Dunkerque and Calais. The corridor originally started from the UK, but since Brexit, sea freight volumes have dropped by about 10% to 123 million tonnes while about 22 million tonnes use the Channel Tunnel rail option. RFC2 has therefore been realigned to integrate the rapidly growing maritime connections from Ireland.

Heading south, the corridor has three branches: one serving Paris; one running to Strasbourg and Basel, with a connection to the Rhein port and RFC1; and the main trunk running down the Rhône valley to the French Mediterranean ports of Marseille and Fos. This meets RFC6 at Lyon, which is a critical hub for both passenger and freight traffic.

The corridor is already saturated in parts, and the situation is expected to worsen following the opening of the Lyon – Torino base tunnel. Long-term studies had envisaged the construction of additional tracks in the Lyon area, along with the expansion of Part-Dieu station and further development of the city's rail bypass, but the final plans for the French side of the tunnel remain uncertain.

The French rail freight strategy published in 2021 set a target of increasing rail's modal share from the current 9% to 25% by 2050. Initiatives to achieve that include the development of terminals and the creation of a network of intermodal 'rail motorways' covering the whole country by 2030.

The Swiss authorities would like to see the line via Strasbourg upgraded to provide a freight corridor along the left side of the Rhein, helping to relieve the bottleneck on RFC1 between Karlsruhe and Basel.

At the southern end of RFC2, the ports of Marseille and Fos have a combined capacity of close to 90 million tonnes a year. The port authority is developing its own plan, with the aim of improving long-distance rail connections to Lyon, the Grand Est *région*, Switzerland, Germany and beyond.

The whole corridor would be cleared to the P400 loading gauge. This is currently available in Belgium, the Netherlands and Luxembourg, but there are issues in France, most notably between Metz and Strasbourg, which creates an obstacle for the route towards Switzerland and Italy. Studies are under way to look at the options for dealing with the six tunnels along this section.

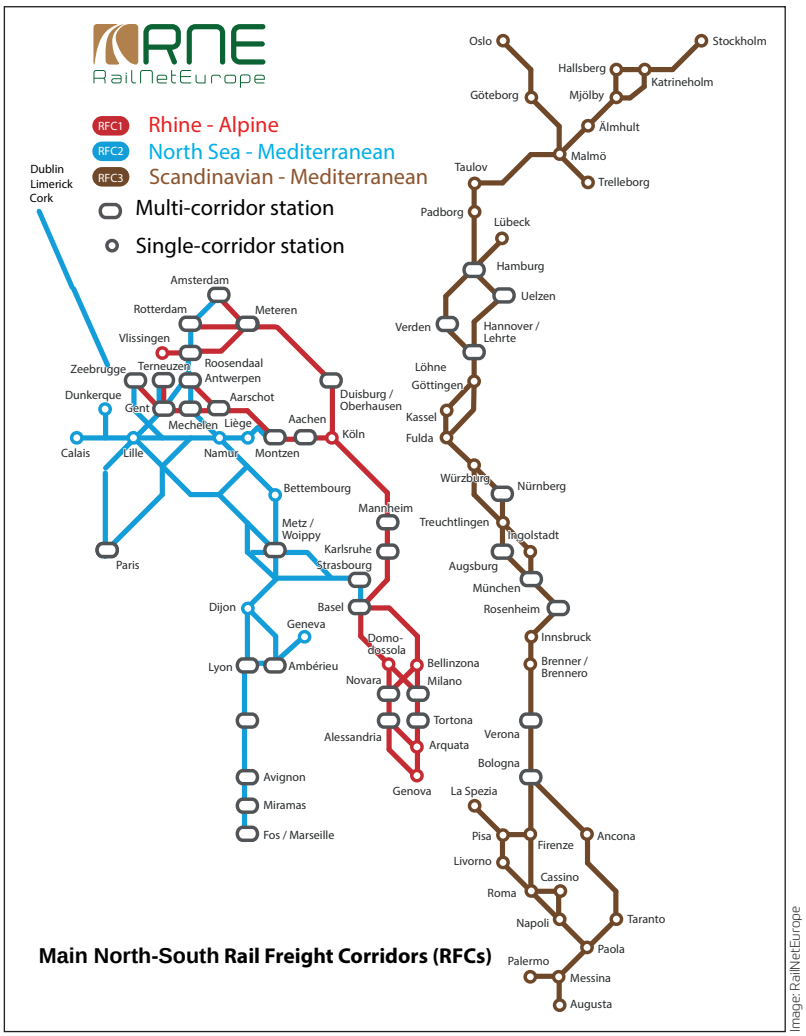
Two more tunnels need to be upgraded on the short stretch between the French border and Basel; this work may start in 2026 for completion in 2029. There are further loading gauge complications near Marseille.

Belgium is making significant progress with the installation of ETCS, which is expected to be implemented fully on the routes between the North Sea and Basel. However, little of the French main line network will be equipped with ERTMS before 2030 at the earliest. Speeds of 100 km/h and 22·5 tonne axleloads are possible on most of RFC2, but the 740 m train length requirement remains a challenge, notably in Belgium and on the Strasbourg – Basel connection. However, the Dutch government recently allocated funds to adapt the ProRail network by 2030.

Missing links on RFC3

RFC3 represents a crucial axis for the European economy, crossing almost the whole continent from north to south. Linking Scandinavia with Sicily, it serves cities and ports such as Oslo, København and Stockholm with

The three main European North-south Rail Freight Corridors RFC 1, 2 and 3, which form part of the recently updated TEN-T network that encompasses all transport modes.



Main North-South Rail Freight Corridors (RFCs)

Image: RailNetEurope

70%

of the 90 km Terzo Valico line will run in tunnel

Hamburg and München in Germany, passing through Innsbruck in Austria and over the Brenner pass to Bologna, Roma and Napoli in Italy, as well as serving the Mediterranean ports such as La Spezia and Palermo.

However, there are two major missing links along this corridor. In the north, the Fehmarn Belt fixed link now under construction between Denmark and Germany is expected to be operational by 2029. Germany's Federal Ministry of Digital & Transport expects the completion of the link to increase road and rail freight between the two countries from 22·5 million tonnes in 2010 to 34·5 million tonnes by 2030.

Further south, the Brenner base tunnel is now expected to be completed in 2032. The Brenner route is currently the most heavily used transalpine freight corridor, with road and rail carrying a total of 54·5 million tonnes per year, compared to about 37 million tonnes moving via the two routes through Switzerland.

There have been discussions whether the reduction in the transalpine road traffic through Switzerland observed since the introduction of road pricing is the result of lorries being displaced to the Brenner route, rather than modal shift to rail. However, studies have proven that this is not the case. The strong growth in traffic over the Brenner has been driven mainly from sources or destinations in Bayern or countries in central and eastern Europe, notably Poland, the Czech Republic and Slovakia.

Traffic forecasts by the Brenner Corridor Platform suggest an increase in freight volumes of between 53% and 95% by 2030 and up to 215% by 2040. Rail's current 25% modal share is predicted to increase substantially once the base tunnel and feeder lines have been completed.

Train lengths of 740 m are permitted on almost all of RFC3, with some limitations in Sweden and Italy, and on the Brenner route pending completion of the base tunnel. The P400 loading gauge is available throughout, except between Hof and Regensburg in Germany and south of Firenze. Most lines allow speeds of 100 km/h and axleloads of 22·5 tonnes. However, there are questions about the rate of deployment of ETCS, mainly in Germany but also in Italy.

Missing the target

All the work being undertaken on these three corridors is necessary, but it may not be sufficient to generate the massive shift from road to rail for which the EU is looking. The political, legislative and planning procedures take far too long, not to mention the lengthy delays in project execution. As well as the major works along the corridors themselves, many rail nodes, transhipment terminals and siding facilities need to be built or upgraded, many more than can be listed in this article.

A far stronger political will is needed to make the decisive push to achieve the desired transition to rail, with the aim of reducing energy consumption and CO_2 emissions. It has been frustrating to see the long-term trends in Switzerland: in 1984, four years after the opening of the Gotthard road tunnel meant that lorries no longer had to drive over the pass, rail's share of freight movement in the corridor still amounted to 86%. Despite the various legal and financial measures designed to limit road traffic, rail's share declined to 61% in 2007. The opening of the base tunnel has improved the position slightly, but rail's share seems to have plateaued at 72%.

This suggests that more will be needed than simply infrastructure and operational improvements and soft financial incentives. Road competition remains a significant issue, with continued investment in more and better roads and increasingly efficient and less polluting lorries that erode some of rail's competitive and environmental advantages.

Rail freight is essentially only competitive for the movement of block trains, yet the market for low-value bulk and liquid cargoes is declining. Rail can only win a substantial share in other market segments such as containers, semi-trailers, swap bodies, general cargo, pallets and parcels if it is attractive, forecasting and adapting to changing market needs. Adequate logistics hubs and sidings are needed for single wagonload traffic that has been virtually abandoned in many regions, while transhipment facilities need to be promoted. Much more market-oriented thinking is clearly needed.

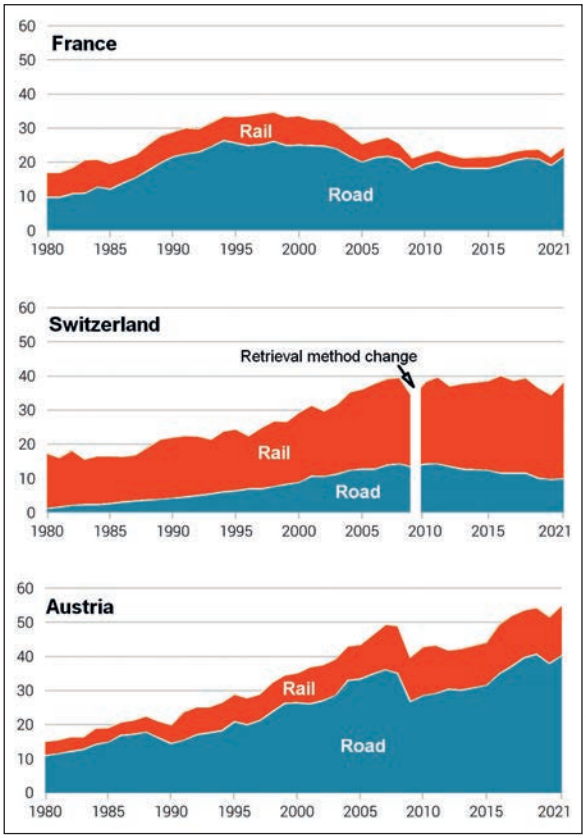


Image: Bundesamt für Statistik

Modal split trends for freight transport on the three major alpine crossings.

Photo: LKW Walter

Austrian transport company LKW Walter loads semi-trailers on railway pocket wagons to form complete trains for the trunk hauls.

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