The Lyon-Turin Project: general overview

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The Lyon-Turin rail link project, also known as the Lyon-Turin tunnel, was initiated more than 25 years ago by elected representatives of the Northern Alps. Following several agreements between the Italian and French governments, the work of drilling the base tunnel (54km), the central part of the project, could start soon. The European Union (EU) wants to speed things up as it has committed to finance 40% of the costs of this tunnel. But the French and Italian states, while renewing their interest in the project, seem to be hesitant about the magnitude of the costs that will remain with them. An attitude that is understandable when we know that these two countries have persistent budget deficits.

As we will show in the first part, the fact that the implementation of the project has been regularly postponed is mainly due to questions about financing and not to constraints resulting from environmental problems. On the contrary, environmental gains are one of the main motivations for this project to be realized, although many questions remain about its real impact. We will address them by reminding in a second part that rail freight has collapsed in France since the beginning of the 2000s and that it remains at a low level in Europe. This will lead us in the third part to consider that the traffic forecasts of the Lyon-Turin tunnel are overestimated, whereas they are the ones who justify the project, from the environmental point of view.

1) 25 years of national and European lobbying

As the chronology below shows, the first evocations of a new rail tunnel between France and Italy emerge in the wake of the success of the first French high speed line (HSL), between Paris and Lyon (1981). The importance of the time gains offered by high-speed rail made local elected officials dream about everywhere in France. At the end of the 1980s and the beginning of the 1990s, it was passenger traffic that was put forward by the promoters of the Lyon-Turin project. But, very quickly, the scientific works will show that there is a "border effect"[1].

Economists and geographers have for a long time analyzed the demand for transport through so-called gravity models. Inspired by the laws of physics, they establish that flows between two cities depend on the size of these cities and the square of distance, which can be measured in kilometers or travel time. But as soon as a rail service crosses a border, traffic is much lower than between two cities located within the national territory. Thus, in France as in Italy, the main reasons for travel have to do with the national character of the activities: meeting at the ministry or head office of a company, visit to family or friends ... Only tourist trips, statistically part of business travel, are strongly attracted by foreign destinations. Studies of passenger traffic between France and Italy, between Rhône-Alpes and

[1] Alain Bonnafous et alii, Les effets frontières. Rapport final, LET - Laboratoire d'économie des transports, https://halshs.archives-ouvertes.fr/halshs-00817850

Piedmont, quickly showed that there was little to hope for that side. Nothing that can justify an infrastructure of several billion euros just for passenger traffic.

Short chronology

September 1981: Opening of the first high-speed rail link between Paris and Lyon
1987: Meeting between elected representatives from Rhône-Alpes, Piedmont and Catalonia to evoke a new relationship across the Alps.
1991: In Salzburg, signature of the Alpine Convention which aims to reduce the nuisances and risks of transport in the Alps. Creation of the French and Italian Committees to promote the European rail link
1994: The Lyon - Turin project is listed among the 14 priority transport projects of the U.E.
January 1996: 1st Franco-Italian agreement.
January 2001: 2nd Franco-Italian agreement.
2002: beginning of the preparatory work on the cross-border tunnel of the international section on the French side.
2006: beginning of the consultation on the Italian part.
December 2007: declaration of public utility of the French part of the tunnel.
2011: approval of the layout of the Italian part and start of the preparatory work on the Italian side of the tunnel.
January 2012: 3rd Franco-Italian agreement.
January to March 2012: public inquiry of the French part of the tunnel access lines.
August 2013: declaration of public utility of the French part of the access lines to the tunnel.
February 2015: approval of the "progetto definitivo" of the Italian part of the cross-border section worthy of declaration of public utility and 4th Franco-Italian agreement, an additional protocol has been signed on March 8, 2016.
July 2016: beginning of the digging of a reconnaissance tunnel of 8,737 m and 11, 26 m of diameter in the axis and the gauge of the south tube of the tunnel on the French side.
December 2016: the Italian Parliament and the French National Assembly approve the law ratifying the international treaty that allows the launch of the final works of Lyon-Turin.

The promoters of the project turned to the freight traffic. Its progression was so strong in the late 1980s and early 1990s (see Figure 4) that it was possible to consider the saturation of existing tunnels, road and rail. A new tunnel had to be programmed to anticipate such a situation. This reasoning was the basis of the Alpine Convention, signed in 1991 in Salzburg. Its objective was to stop the sharp rise in truck traffic at all crossing points from Tarvisio to Ventimiglia. On this basis, it has been possible in 1994 to include this project in the "short list" of 14 priority European projects.

The French and Italian governments then worked on this project by creating an *ad hoc* binational structure. The latter launched traffic studies, but also looked for ways to finance them. The PPP options was examined in particular but it will be gradually abandoned in the face of the impossibility for private capital to yield any profit from the construction of such a project. The turpitude of Eurotunnel being on the front of the scene in the early 2000s, it was obvious, only 100% public funding could be mobilized. This constraint strongly slowed down the ardor on both sides of the Alps. Especially since at the same time, several expert reports pointed out, on the French side, the low utility of the project.

In 1998, a report of the General Council of Bridges and Roads (CGPC)[2] wrote "*It is extremely difficult to find a profitability to the project*". In 2003, with the General Inspectorate of Finance, the same CGPC wrote: "*Although based on questionable methodological presuppositions, the results currently available show that it is clearly not its socio-economic profitability that can justify this project*". The French Court of Auditors has several times repeated the same observation. But the French passion for big projects won. Lyon-Turin has been protected by an international treaty with Italy and supported by the European Union by 40% of the cost of the base tunnel (estimated at around 9 billion euros).

But France's commitments are not limited to 2.2 billion euros for the base tunnel. If France pays less than Italy (3.3 billion) for this tunnel, it is because it is committed to achieving access French side. In Article 1 of the agreement of 29 January 2001, it is only a question of committing to the basic tunnel. But the "common part" was redefined by Article 4 of the agreement of January 30, 2012. It now includes, in addition, 33 kilometers on the French side with double-tube tunnels for Belledonne and Glandon. Not to mention the necessary modernization between Savoie and the Lyon region. More than ten billion euros (see box)!
The importance of the amounts at stake explains, on the French side, the ministerial decision (November 10, 2011) which provides for four phases for the French side of access to the base tunnel[3].

• A first section would aim at constructing a 78 km new mixed line bringing together passengers and freight from the Lyonnais region to Chambéry, supplemented by a punctual adaptation of the existing line from Chambéry to Montmélian.

• A second phase would aim to create a second section dedicated to freight only, 62 km between Avressieux and Saint-Jean-de-Maurienne, by making only one of the two large-scale tubes of the Chartreuse and Belledonne / Glandon tunnels.

• the third phase consists of doubling the works of the second phase, to increase the freight capacity from Avressieux and allow the continuity of passenger traffic on the new line from La Combe de Savoie to Saint-Jean-de-Maurienne.

• the fourth phase plans, in the long term, to split the mixed line of the first phase, by reserving it for freight and at the same time creating a new high-speed line for passengers from the Lyons region to Chambéry.

Given the scope of the work envisaged, we can better understand the hesitations of successive governments. Concretely, everything happened as if, between France and Italy on the one hand, and the European Union on the other hand, we were in the presence of a kind of "liar poker". The important thing for both states is to protect European funding while delaying the start of such a costly project as much as possible[4]. The EU is obviously not fooled by this maneuver and calls for real implementation. But where to find money in times of growing scarcity of public funds?

It is to answer this difficulty that elected officials propose to introduce regional taxes on the circulation of heavy goods vehicles. But after the failure of the tax on Heavy Good Vehicles (HGV) in France in 2014, the subject is sensitive, especially at a time when the movement of “yellow vests” has made the

[2] Brossier C. and Blanchet J.D., La politique française des transports terrestres dans les Alpes, CGPC Juillet 1998
[3] The public inquiry of the first two sections took place from January 16th to March 19th, 2012. They were declared of public utility by decree in council of State of August 23rd, 2013.
[4] In the decree of 4 September 2014, following the 2012 agreement, Article 16 stipulates "The availability of funding will be a prerequisite for launching the work of the various phases of the Franco-Italian common part of the international section".

government cautious in terms of compulsory levies. It is therefore very likely that if the work is launched, it will be necessary to find the money in the state budget, probably to the detriment of other projects. We will then be in the presence of a zero sum game. But is such arbitration relevant at a time when, in France and more widely in Europe, rail freight traffic is far below expectations?

A cost estimation

In the agreement of January 31, 2012, the international section on which France has committed (Article 2) starts around Saint-Didier-de-la-Tour (40km east of Lyon) and goes to on the outskirts of Turin. As detailed in Article 4, it includes "a section of about 33 km crossing the Belledonne Massif and including the Belledonne and Glandon double tube tunnels". In the 2012 Public Inquiry Document, costs are estimated as follows (2009 millions).

Lignes	Coût
Lignes d'accès côté français	**11 378**
CFAL (part concernée par les trafics transalpins)[2]	**997**
Grenay - Chambéry par Dullin L'Epine	**4 145**
1er tube Chartreuse et belledonne	**2 952**
2ème tube Chartreuse et belledonne	**2 129**
Travaux LGV entre Grenay et Avressieux	**1 155**
Section internationale	**10 480**
Lignes d'accès côté italien	**2 220**
TOTAL	**24 078**

More than 11 billion (probably much more today) for the only French part of the international section, which has this originality to provide a section to Chambéry (4.1 billion!). Why this detour, why spend such a sum to temporarily move freight trains into urban areas? The answer is simple, the city of Chambéry wants to take advantage of this project to get closer to Paris.

2) Rail freight disappointments in France and Europe

After having reached a peak of 57 billion tkm in 2001, rail freight traffic dropped steadily in France in the years that followed. Even before the financial crisis of 2008, traffic had already fallen by 29% in France while they had increased by 52% in Germany.

This French counter-performance is all the more curious as it is unique in Europe. It does not find its origin in the economic situation, rather favorable once passed the hole of air of 2001. The GDP increases regularly until 2008 and the industrial production was stable. The fall in rail traffic can therefore be explained by causes internal to the sector and more specifically internal to SNCF, which enjoyed, until 2006, a monopoly on rail freight traffic in France, including for transit. The problem was

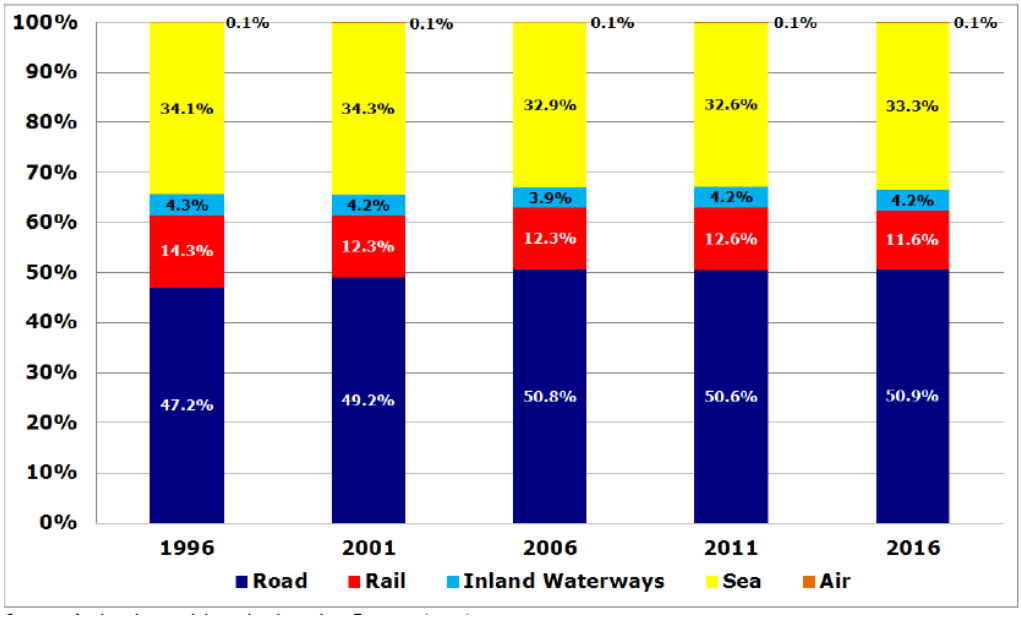
that despite this monopoly, or rather because of it, the SNCF-Freight branch of the incumbent accumulated losses: several hundred million euros a year in the early 2000s.

To limit them, it was necessary to eliminate unprofitable activities such as the single wagons or the transport of wood. Many small freight stations have been closed. This helped reduce deficits but they have not disappeared. In 2018 Fret-SNCF lost another 100 million euros while its traffic is only 21 billion tkm (-62% in 17 years). The opening to competition, effective in 2007, helped stabilize French rail freight traffic at around 32 billion tkm. As a consequence the modal share of road transport has increased.

The importance of the modal share of road freight transport is a reality in all EU countries as shown in Figure 1. Contrary to the ambitions of the 2001 and 2011 white papers, the rebound in European rail freight did not take place. Even in Germany, the country that has seen the largest increase in rail freight since 2000, its market share has increased very little and its gains have been fully taken on the waterway. The market share of road transport has not decreased.

The attractiveness of road transport is due to the changing nature of the products transported and the transformation of supply chains where warehouses now play a key role. The goods rarely make a direct trace of several hundred kilometers from the manufacturer to the customer. For reasons of massification, they make flea jumps of a few hundred kilometers from one warehouse to another before reaching the final recipient. All of this leads to modes of transportation not playing in the same yard. The attributes specific to road transport (speed, flexibility, reliability, adaptability of batch sizes, frequency of shipments, no breakage of loads ...) make this mode simply become unavoidable and will remain so. Even for journeys of more than 300 km, the market share of the road in Europe (58% in 2016) remains much higher than that of rail (36% in 2010).

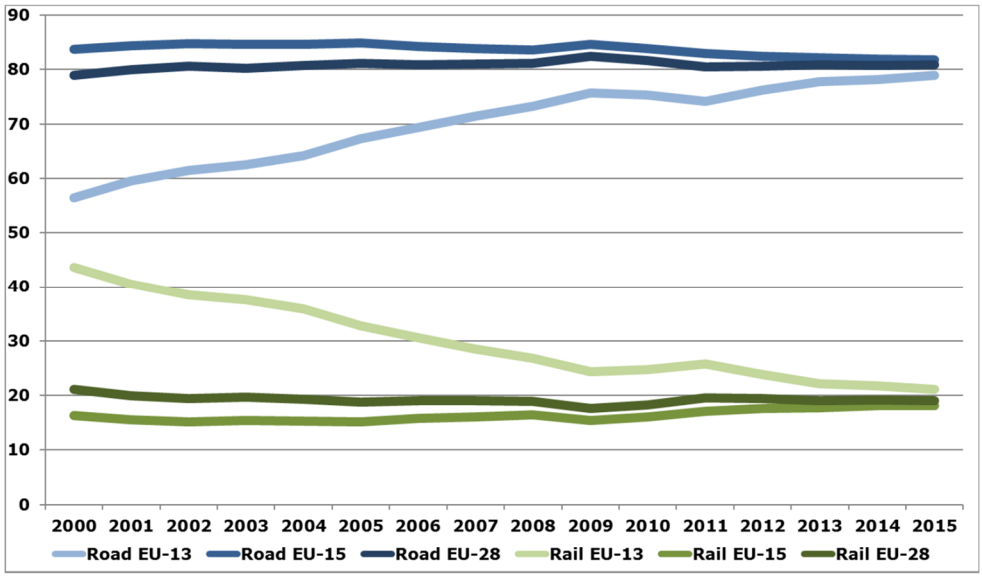
Figure 1: Evolution of modal shares for freight transport in Europe



Source: Modal shift in Europe, a way forward p.29

It is noticeable that many countries in Central and Eastern Europe (EU-13) have experienced a sharp decline in rail traffic as they transition to a market economy. But it is possible to dissociate them from Western European countries (EU 15).

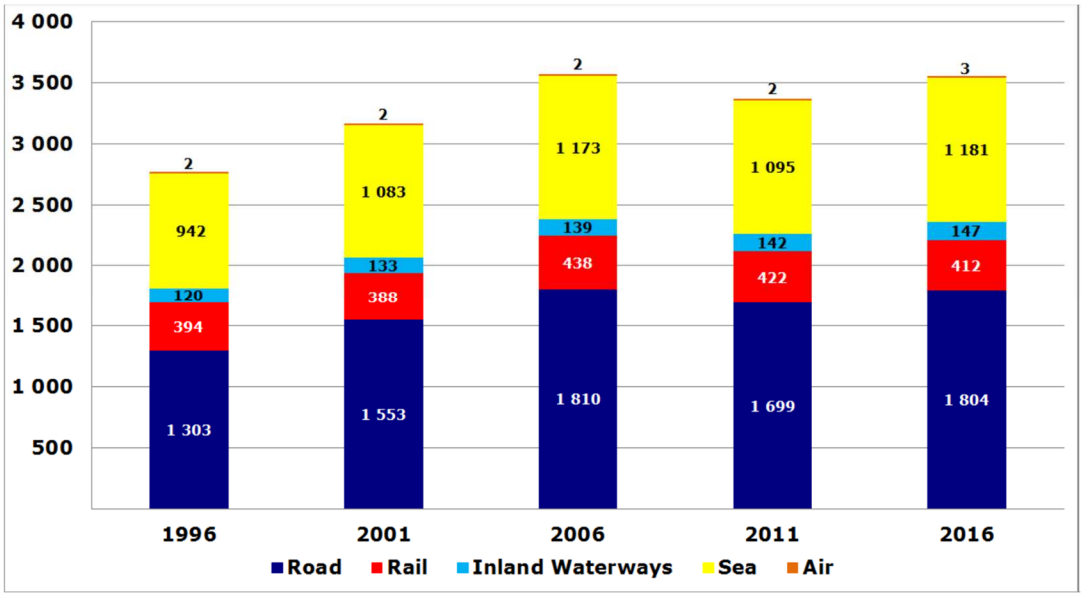
Figure 2: Comparative developments in road and rail traffic in Europe



Source: Modal shift in Europe, a way forward p.31

Figure 2 shows that in the old EU member states, the status quo prevails. The market share of the road decreased very slightly in 15 years, while that of rail increased very moderately. The railway is therefore faced with its intrinsic limits and the fact that it cannot easily replace road transport. To this structural weakness of the railway, it is necessary to add another difficulty, the trend stagnation of the freight traffic, whatever the modes of transport used. As shown in Figure 3. During the 2008-2009 crisis, goods traffic everywhere fell. But the recovery that followed does not correspond to a catch-up. The evolution of freight traffic has not regained the dynamism of previous years. The decline of industry has played an important role here, as has the growth of service activities.

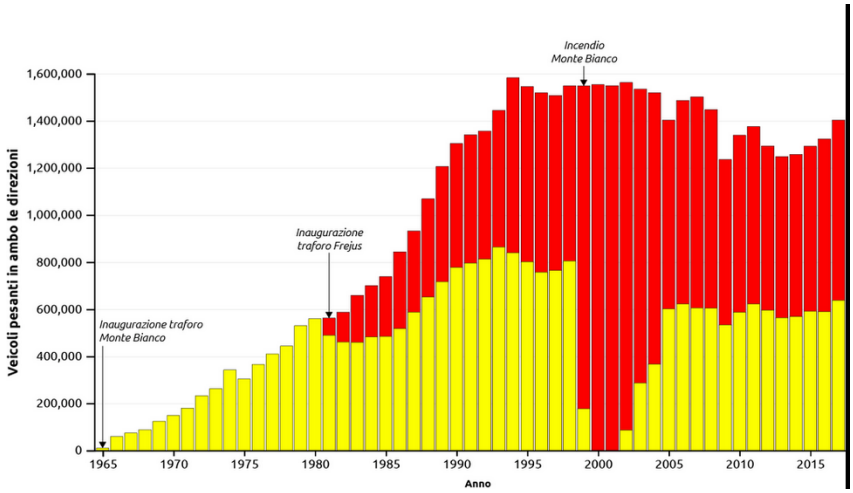
Figure 3: Freight moved in the EU between 1996 and 2016 (billion t-km)



Source: Modal shift in Europe, a way forward p.28

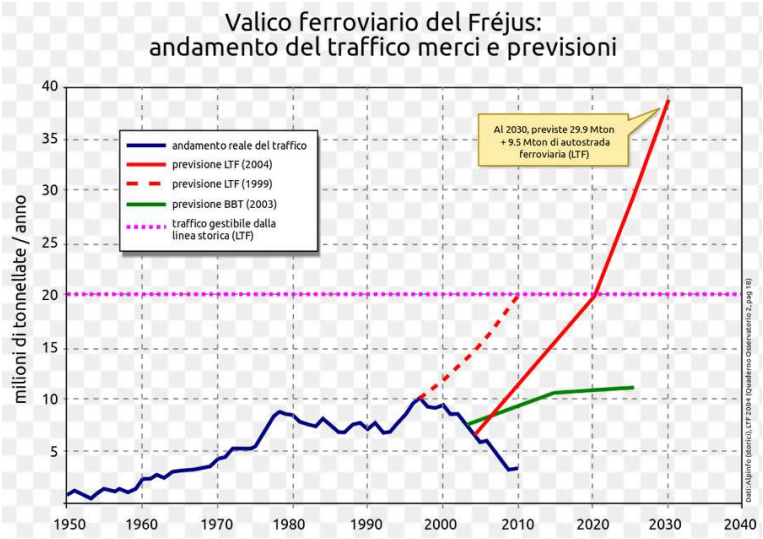
Figure 3 shows the virtual stagnation of freight flows in Europe from 2006 to 2016. The recovery of road freight in 2017 is much less clear than after the recessions of 1991 or 2003. Infrastructure saturation scenarios transport are less and less realistic, which raises the question of the usefulness of very expensive projects such as the Lyon-Turin tunnel. Trafficking between France and Italy is a good example of the double structural weakness of rail freight: one that comes from its low competitiveness compared to the road, the other resulting from the general slowdown in transport. The growth in merchandise traffic, which is now weakly correlated with growth in gross domestic product. Figure 4 shows that heavy-weight traffic reached in 1993 a maximum on all the road tunnels of Mont Blanc and Fréjus. After the sharp fall of 2009, a recovery took place, but in 2017, we were still 12% below the level reached in 1993.

Figure 4: Heavy Good vehicles in Mont-Blanc and Fréjus tunnels



In addition to this trend, there is a structural weakness in rail freight between France and Italy. Figure 5 is without appeal. The blue curve shows the evolutions of traffic in the old Frejus tunnel. The traffic of the mid 1990s has been divided by 3 in 20 years, from 10 to 3 million tons.

Figure 5: Actual and planned rail traffic between France and Italy



Based on the evolutions observed in the old tunnel, which has been set to the European size and would be able to absorb an annual traffic of 15 million tons, we can see that the 1999 and 2004 traffic forecasts are simply fanciful. More serious, although still very optimistic, appear the forecasts established in 2003 by an independent Swiss organization (BBT). If traffic could return to 1995 levels, it would already be an extraordinary result. But this last would not be enough to justify the project because the environmental gains would then be too weak as we will show it.

3) The overestimation of environmental gains

The promoters of large infrastructure projects must produce data to convince decision-makers and funders. For this reason, when it comes to private financing, they generally tend to inflate the traffic forecasts on the one hand and to underestimate the costs of realization on the other hand. The ex-post analysis conducted on Eurotunnel showed that in order to increase the potential profitability of the operation, the traffic was inflated with flows expected to come from all over Europe, in addition to the expected flows between London and Paris.
In the case of projects that have no financial profitability but are justified for environmental reasons the estimated socio-economic profitability is inflated by the project promoters. It is indeed necessary to convince the public financier that there is an interest for the community to finance the operation. The Lyon-Turin tunnel offers a typical example of this manipulation of the economic calculation where, to the overestimation of the traffics, are added fanciful evaluations of the gains in terms of CO2 emissions and road safety. Once revised, the economic calculation data give the project a completely different image.

Traffic overestimation

An independent synthetic study (L. Clément) showed that transit traffic collapsed in the Franco-Italian tunnels. France-Italy flows remain, but the flows between Italy on the one hand and the United Kingdom, Benelux or Germany have turned to other relations via Switzerland or Austria. The first question that arises is to ask whether it is desirable to attract these flows back to our territory. The second question is whether we can do it. In other words, can we believe the traffic forecasts of the project promoters as presented below?

Table 1: Official traffic forecasts (Public inquiry 2012, pièce C, page 14)

	2004	2020			2025			2030			2035		
		Référence	Projet	Gain de trafic	Référence	Projet	Gain de trafic	Référence	Projet	Gain de trafic	Référence	Projet	Gain de trafic
Route (Fréjus + Mt Blanc)													
Mt par an	22,0	28,6	27,7	-0,9	33,1	28,1	-5,0	39,0	30,6	-8,4	46,8	33,1	-13,7
Milliers de PL	1 485,0	1 906,0	1 847,0	-59,0	2 217,0	1 874,0	-343,0	2 604,0	2 034,0	-570,0	3 124,0	2 206,0	-918,0
Fer classique													
Mt par an	8,0	10,8	11,1	0,3	11,4	15,4	4,0	11,8	24,1	12,3	9,9	28,5	18,6
Autoroute ferroviaire													
Mt par an	0,2	2,2	2,7	0,5	2,6	7,2	4,6	2,7	10,1	7,4	2,7	13,1	10,4
Milliers de PL	16,0	141,0	175,0	34,0	165,0	432,0	267,0	175,0	599,0	424,0	176,0	775,0	599,0
Total rail													
Mt par an	8,2	13,0	13,8	0,8	14,0	22,6	8,6	14,5	34,2	19,7	12,6	41,6	29,0

Trafics marchandises sur le corridor Lyon-Turin (scénario « Décennie perdue)

By 2035, rail freight traffic would exceed 41 million tons a year, nearly 14 times the current traffic! How to take such data seriously as they are based on an unrealistic baseline scenario. Traffic in 2004 is estimated at 8.2 million tons, with an upward trend leading to a level of 13 million tons in 2020, four times the level seen in 2016. From 2020 to 2035, rail traffic is thus expected to grow by 7.6% per year. A figure to compare with the growth of 2.6% per year of road and rail traffic through the Alps from 1984 to 2014 (L. Clément). How to do three times better than the trend of the last 30 years, even though since 2008 freight transport is only weakly correlated to GDP growth?

• Table 1 counts on an increase in conventional rail traffic, which would reach 28 million tons, nearly 10 times the current traffic! By which magic wand could we achieve this goal while from 2000 to 2016, rail freight traffic has fallen in France by 40%?

• Table 1 also mentions the development of the rail motorway, whose 2035 traffic is 65 times higher than in 2004! A figure that seems more than optimistic, but is justified by the fact that it would bring significant security gains.

Road fatalities

Among the environmental gains, in the broadest sense, of the Lyon-Turin project, is the reduction of road fatalities estimated at 6,000 as a result of the decline in road traffic. But where does this figure of 6,000 fatalities come from? It is difficult to consider that this comes from the only drop in traffic on the Maurienne motorway (A43). The ex-post evaluation carried out on the motorway A43 tells us that from 2002 to 2006 there were no fatality on this highway. The opening of the motorway was accompanied by a significant drop in fatalities on the classical road (RD 1006), parallel to the motorway. Before the opening of the motorway, there were nearly 10 fatalities per year on the RD 1006. Since the opening of the motorway, this figure has been divided by 5. And the accidents at the origin of these deaths mainly concern automobiles or motorcycles, not heavy goods vehicles.

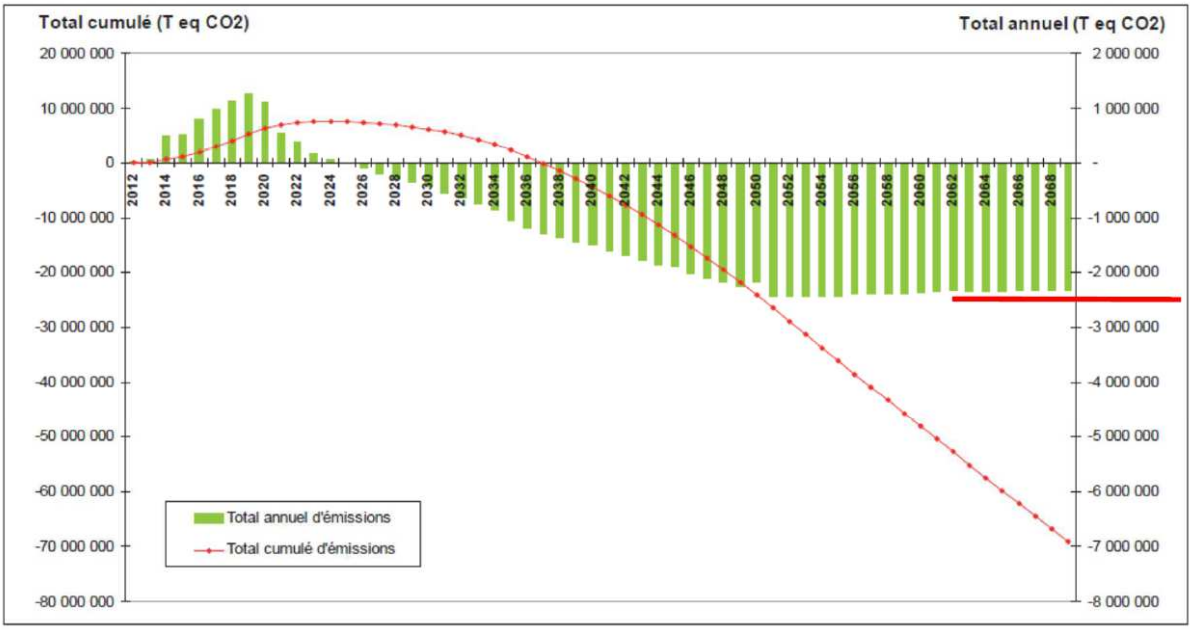
The 6,000 avoided fatalities must therefore be sought elsewhere than on the A43 and RD 1006. We could consider that the railway is supposed to reduce very serious accidents like that of the Mont Blanc tunnel in 1999. But it seems difficult to consider that road tunnels could be responsible for 6,000 fatalities in a few decades. The only plausible explanation for these 6,000 avoided fatalities is therefore to be found on the side of a general decline in road fatalities in France and in Europe due to a massive modal shift from road to rail, not just to cross the Alps, but on the whole territory.

In 2016, 14% of those killed on the roads were in a car accident involving 493 deaths. To save 6,000 deaths in 40 years, it would be necessary to reduce the number of deaths involving heavy goods vehicles by 150 per year. With constant traffic conditions (quality of the infrastructure, traffic, speed, road code, etc.), this 30% drop in mortality would imply a 30% drop in HGV traffic on the national territory. A figure obviously unreasonable but which informs us on the backdrop of the project Lyon-Turin: a belief in the possibility of massively postponing road traffic to the rail by the magic of a new tunnel of 54 km.

CO_2 emissions

The overestimation of traffic is also at the origine of the gains that the community could draw in terms of CO_2 emissions. The promoters of the project produce the following figures for this purpose.

Figure 6: Expected carbon balance sheet of the project (Public inquiry 2012 Pièce G – Page 78)



The interest of this graph is to recall that the construction of the tunnel is initially at the origin of an increase of CO_2 emissions. Then, the development of rail traffic, if it replaces road traffic, makes it possible to offset initial emissions by reducing emissions. According to the project's promoters, it is in 2037, nearly 25 years after the start of the works, that the carbon footprint becomes positive. 30 years later, nearly 70 million tons of CO_2 equivalent were saved (left scale) thanks to an annual saving of around 2.5 million tons per year (red line, right scale). But this figure depends a lot on traffic. If they are not up to expectations, then the results are much less favorable.

It is sufficient to show it to look at the data provided in the 2012 public inquiry. The latter estimates that, in the Mont-Blanc-Fréjus perimeter, 900,000 PLs will be carried over annually from the road to rail and it is indicated that this allows an annual saving of 2.5 million tons of CO_2. But arithmetic does not confirm this figure if we apply the methods recommended by the official methodological framework of 2014[5].

Assuming very optimistically that the distances saved by HGV are 300 km for each HGV reported. Knowing that the loading of a HGV of 40 tons is on this type of axis of approximately 16.2 tons (pages 58 and 60, chapter 8, socio-economic evaluation) one obtains an emission of 84 gr of CO_2 per ton kilometer (Table 19 methodological guide page 78), giving a total of 1,344 kg of CO2 per HGV-km, or 403 kg of CO_2 per HGV over a 300 km journey. Let's apply this economy to the 900,000 HGVs supposed to refer to the railway, this gives us a saving of 362,700 tons per year, 6.9 times lower than the 2.5 million annual tons mentioned in the public inquiry. On this basis, the 70 million tons of CO_2 saved are vanishing. Because with 362,700 tons saved per year, 25 years are needed to offset the 9 million tons related to the construction of the tunnel. CO_2 savings do not appear until the middle of the 21st century. And 20 years later, they are only about 7 million tons, 20 times lower than what is announced by the promoters of the project. And yet, here we have kept the more than optimistic assumptions about traffic. If they were to be only half of what is announced (450 000 HGV carried over instead of 900 000), it would take almost 50 years of traffic to only offset the emissions related to the construction of the tunnel. Here again, the studies envisage that by the magic of a tunnel, it is the

[5] (https://www.ecologiquesolidaire.gouv.fr/sites/default/files/Guide_Information_CO2-2.pdf)

whole road traffic of goods which would fall significantly in France. To be reasonable, we must reverse the reasoning of the proponents of the project. It is not the tunnel that will make a massive modal shift from the road to the rail, the relationship is the other way. As the report of Mr. Brossier and Mr. Blanchet already said in 1998, if a massive transfer to the railroad were to take place, then this project would make sense. But as long as nothing happens on this side, this tunnel would be of no use.

Conclusion

A brief analysis of the figures put forward by the promoters of the Lyon-Turin project reveals, on the one hand, a strong overestimation of potential traffic and, as a result, a huge overestimate of environmental gains. The reasoning is biased by implicit assumptions about a massive modal shift, from the road to the rail, not only on the Alpine cross section, but on all freight traffic in France and Europe.

For both safety gains and CO_2 savings, even adopting the highly optimistic traffic assumptions of the project's promoters lead to figures much lower than what is advanced. The only way to find the figures indicated in the public inquiry is to consider that the realization of Lyon-Turin would alone.

- On the one hand to reduce by 30%, on the national territory, all the fatalities in road accidents involving a HGV!
- On the other hand, to reduce by 10% per year all CO_2 emissions from road freight traffic in France.

How can a railway tunnel, 54 km long, have such effects on all traffic, it is a mystery that can be likened to wishful thinking. Do not we say that joining major projects is an act of faith!

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