

THE HIGH-SPEED RAIL HANDBOOK: A TECHNICAL GUIDE¹

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ABSTRACT

The project of the new railway line Turin Lyon is an exemplary case of unnecessary work. It should overlap a railway tunnel and an international railway line with modern features; traffic data show since 2000 a collapse of road and rail movements along the corridor Italian French interested; after 14 years of experimentation its modal transfer capacity has always given negative results; the new line would not be interoperable with the rest of the Italian and French network because it has its own, even different, links between the Italian and the French of the same line. The studies carried out on the energy consumption and CO₂ production of the Turin Lyon in the construction phase, which requires the excavation of 42 million cubic meters of rock, and the management of energy consumption of the ventilation and refrigeration of the base tunnel, give a negative energy balance for the new work. Finally, because the size of the necessary works and their enormous cost would have very heavy effects on the environment and on the resources to be dedicated to the critical issues of the remaining national network and to the real needs of citizens.

Keywords: High Speed Rail, Turin-Lyon, Environmental Impact, Cost-Benefit Assessment.

INTRODUCTION

This paper is a kind of detailed summary on the High-Speed Rail (HSR) Turin-Lyon construction question. It is mainly derived from the new edition of a booklet [1] that explains, in Italian, “150 reasons against the Turin-Lyon HSR”. It is completed with some in-deep assessments on the environmental and health question [2-3] and will briefly deal with the socio-economical aspects too [4]. It will try to explain the apparently unexplainable reasons why the worst “Big Project” (In Italian: Grande Opera) ever proposed in Italy must be “urgently” built since the end of the eighties, that is, since thirty years. A short history of this “steady-state emergency” can be found in [4], while the complete history, in Italian, is reported in the books in [5].

¹This paper is dedicated to Ivan Cicconi.

The HSR Turin Lyon (in Italian: Treno Alta Velocità, TAV) survives as a project, and has been constantly reaffirmed to be “strategic” by all the past Italian Governments, despite tons and tons of fact checking indicate the only rationale solution: to archive the whole project and use public funds better. This paper – we hope – could be useful to the decision-makers of the new Italian Administration. Many further useful references and directly downloadable material can be found in [6-7].

"The new tunnel for the TGV and the railway highway on the Turin-Lyon are not a priority and it is better to intervene on the existing line".

These were the conclusions of the expertise commissioned by the French Minister of Transport to Christian Brossier, and two other experts of the *Conseil General des Ponts et Chaussées*, published in May 1998 [8]. According to the Brossier report, *"we need to wait for the evolution of the international context, and particularly in Switzerland and Austria, before embarking on a new tunnel under the Alps "*.

However, all the former Italian Governments strongly wanted the TAV. Then, their insistence on the term "strategic" given as a magic word. The term "strategic" has been used by bad politics for questions on which it refuses the comparison and which fails to show that they are necessary works. However, if the facts are not certain enough, no action can be strategic in itself. The state should not borrow with bonds, and pay interest 20 or 30 years before the need, or indefinitely, just to satisfy the ambitions of political liars.

We will examine instead the main “strategic” points that all show how financing and constructing the TAV is a wrong choice.

The Exploring Tunnel And The Project: a summary of the main controversial points

The exploratory tunnel of La Maddalena in Chiomonte, excavated in the recent years as a “test” for the actual TAV tunnel, was a contradiction: this type of work has to be carried out as close as possible to the tunnel planned, to have a better knowledge of its geological characteristics. Here, however, on 7,540 meters of excavation, 4,080 meters were excavated in very distant rocks, perpendicular to the axis of the base tunnel. The exploratory tunnel has followed the route of the main tunnel only in the last 3,460 meters, 520 of which have not been more excavated. On the actual results of this work, however, weighs this question: what was in the 500-meter rocks that were not excavated? The application for authorization sent to the Ministry speaks only of "useless work" because of "results already achieved". On the sidelines, it can be noted that the measurements of radon, which is one of the main risk elements of this rocky massif (see following sections), had been officially suspended in 2014.

The project, presented by LTF on 10 August 2010 [9] includes 12 kilometers of the tunnel of 57.3 kilometers, which go from the French-Italian border to the entrance of Susa, then the crossing of 3 kilometers of the Susa plain, the new tunnel of 18.8 kilometers of the Orsiera, and the underground section with the interconnection of Chiusa S. Michele, for a total of 35.4 kilometers, including the last two tunnels sent back to a second phase and no longer detailed in the final design. In Susa it would be installed the huge construction site of 290,000 square meters, equal to 80 football pitches, which would serve, on one hand for the excavation of the section of competence of the base tunnel and, on the other hand, for the excavation of half of the Orsiera tunnel. At the end of the latter, in the municipality of Chiusa S. M., a new area of 180,000 square meters of construction sites is planned, and part of the interconnections with the current line that would then continue underground in Avigliana. The project plans to bury the new line under the village of Chiusa through the excavation of trenches of 10-20 meters deep in the middle of the inhabited center. The possibility that this interconnection is suppressed is practically zero, because here it allows you to skip the 10 km detour on Orbassano and to directly access the north railway gutter [9].

One of the most disturbing points of the 2017 revised project [10] is the hydrogeological risk in the Salbertrand area, which is probably the highest in Piedmont. The construction site was designed in the Dora riverbed, right where in 1957 a flood event happened. In that occasion, on the right of the river, a landslide occurred that affected the slope for 1,000 meters of altitude and for 800 meters of width and, on the left, were eroded 500 meters of the highway that had to be rebuilt 100 meters higher. On that occasion, the area now chosen for the new site was submerged by 3- 4 meters of water. Nevertheless, above all, there is a historical documentation that shows that, in the case of a new riverbed, which could now be facilitated by the presence of three kilometers of double fencing nets and the materials and structures of the construction site, the released water would invest the city of Susa. The Upper Susa Valley Community had often

supported the Turin Lyon HSR, since all the impacts seemed to be in the Lower Valley. Their representatives, by majority, have continued to participate in the Osservatorio Torino-Lione (The "Observatory", a puppet committee where no objection on the project is admitted). Now the Upper Susa Valley citizens find themselves to have the construction site of the base tunnel in-house: interference on the road, pollution, and damage to image due to this presence will be a fault of their quite short-minded representatives and local administrators. [10]

RFI envisages as a landfill site, for 4.5 million cubic meters of excess excavation material, a site close to the Montanaro village, which has not yet been authorized [11]. According to data provided by the Piedmont Region for additions to the LTF project, the location indicated in the document has a real capacity of only 4 million cubic meters. But the study of RFI tries to minimize the volumes by providing them as cubic meters of rock "in situ", rather than in crushed rock, that is "in cumulus", which is obtained by multiplying them for 1.6 and overestimating the reuse and the possibility of exploiting the material extracted from the moraine hill. Therefore, in the most predictable situation, a site is missing to accommodate all the product waste. In the overlapping of the LTF / TELT and RFI studies for management and landfill, the embarrassment of a problem that, born in 2003, has not yet arrived at a solution. There is no doubt that, as environmentalists claimed, the calculations are to be revised up. [11].

The materials of the Rivoli hill where the 15 km tunnel will be excavated contain asbestos, and the data was incorrectly minimized by RFI. In the documents for the current VIA (Environmental Impact Assessment, EIA = VIA), RFI provides a study on 4 samples of the moraine material of which the hill is formed, which results in an average presence of 42% green rocks. Another study, completely separate and with an ambiguous title, reports the analysis on 9 samples of erratic boulders, in which it is noted that 4 samples out of 9 contain asbestos fibers, even if they are declared non-hazardous due to the very long exposure to open. Based on these data, the presence of asbestos would be similar to that of the old Dora project in 2003. This highlights the fact that the moraine deposits of the Susa valley are not different from the corresponding rocks of the valley. The seriousness of the problem is however different: in the debris of the moraine hill, it is impossible to separate the green rocks from the others: therefore, the feasibility of the tunnel and of this project is still to be verified. Despite a complaints, RFI has always refused to make further analyzes and make them public. [11]

Emissions from construction sites in urban areas are particularly worrying. In a well-documented case of pollutants, which occurred in Valsusa in 2004 for dioxin, the peaks of concentration on the ground were 2.5 kilometers away, with values up to 5 times higher than those closer to the point of issue [5]. Having made the necessary corrections for a pollution that is generated close to the ground, it should be assumed that the fallout from the construction sites for the double tunnels in the urban area are much wider than the 3-400 meters indicated by the VIA studies, which seem to have wished to avoid to recognize the involvement of urban agglomerations. The action of the breezes must also be considered, because even when they are almost imperceptible, they convey microscopic particles quite well.

As far as construction sites are concerned, data for calculating emissions are missing altogether: in the EIA studies it is not indicated how many and which machinery and vehicles will be present on a construction site. The absence of these data, which would have been easily available, comparing them to the actual ones found at the Gotthard or Loetichberg base tunnels, raises the fear that the pollution values are higher than those provided by the projects. This is true especially for those provided by the hurried version released later, when the designers realized that, with the calculations of the project deposited before, an alarm had been created.

For the powders, the particular need for treatment of the excavation rocks of the moraine hill, which must be dried in order to biodegrade the surfactants they have been kneaded to strengthen the stability of the excavation face, places before an alternative between two types of pollution: that of surfactants or that from PM10 or asbestos. Turin cannot be considered safe from the dust and emissions of construction sites, because half of the metropolitan area is affected by construction sites within a radius where the dispersion of PM 10-2.5 can reasonably be significant, above all.

It must be considered that, from the point of view of air quality, Turin is already in a very critical situation compared to the big Italian and European cities and this further pollution could create insoluble problems. [12-13].

The impacts of the construction sites are linked to those of road transport. The LTF study, for the sole part up to Chiusa, calculated the need for 1,100,000 journeys [14]. For the transport of the excavated rocks and terrain only, 150,000 journeys were foreseen because, according to the initial project, the majority of the transport had to take

place with huge conveyor belts that were tens of kilometers long. For the transport of cement, 300,000 journeys were expected, for the transport of the material to the storage 650,000 journeys. These numbers give the idea of what a great HSR line construction site is. In addition, they are still only half of the total journeys, because the RFI section is longer and has not provided for alternative transport. The latest project of LTF / TELT in 2017 foresees about 400,000 journeys connecting the two semi-construction sites to transport aggregates and cement and each one taking place down the Susa junction, which implies for each trip a double path with a total distance of 54 kilometers. Moreover, these are "internal" journeys to building sites that are added to the ordinary ones. [10,14]

The example of the Chiomonte exploratory tunnel confirmed the difficulty of controlling the impact on health, even if it was a small work, practically without concrete structures and relatively isolated. Data collection was entrusted to the potential polluter itself, i.e. LTF –TELT, who chose and paid the companies responsible for the survey and, later, the professionals who drafted the final report: the so-called VIS. The ARPA has simply tabulated the data received [15], because even the power of intervention has been delegated to an official at a ministry in Rome that has never been known. In these cases, it is clear that there is a tendency towards self-absolution and reassuring proclamations. A much more reliable picture can be drawn from the comments to the data tabulation made by the ARPA itself. In the first quarter of 2015, halfway through the works, Arpa underlined that "The data concern only PM 10 because the TELT has not carried out quality campaigns on nitrogen oxides, benzene, metals and other components under examination. Furthermore, more than half of the data are late and there are omissions" [15]. In 2015, TELT has halved the very few exams on the presence of asbestos with the excuse of wanting to reduce costs. At the end of 2014 LTF / TELT, "with the favorable opinion of the control bodies", had decided to stop monitoring the concentration of radon in the air, which is essential to identify the presence of uranium, which is one of the heaviest unknowns of this construction site [15,16].

Costs

On the basis of the final costs of the high-speed sections already completed elsewhere in Italy, it does not seem out of place to forecast a further doubling of the presently estimated costs of the entire work, and to assume a charge for Italy for the Turin-Lyon TAV of 40 billion euros.

The results of the former Italian high-speed railway projects make this figure correct. Compared to 1991, until the time of commissioning, the cost of the Rome-Florence grew 6.8 times, the Florence-Bologna 4 times, the Milan-Turin 5.6 times. The final charge assumed for Turin Lyon would represent a 6-fold increase compared to the estimates of 25 years ago, and therefore would fall within the norm [5].

The first victim of the underestimation of real financial needs could be the continuity of the work. A mechanism of this type determined the duration of 65 years for the works of the doubling of the current Frejus railway line from 1919 to 1984, excluding the tunnel that was the subject of work to widen the shape in 2002-2012. The doubling of Genoa Ventimiglia railway has been under way for over 50 years.

The cost per kilometer will be around half a billion per kilometer. If we calculate that Italy has only 12 kilometers of the base tunnel, the 6.3 billion budget for Italy corresponds to this figure. However, it is interesting to note that the same values are obtained by dividing the planned 40 billion with the doubling of the estimated costs, divided by the 81 kilometers from the border to the junction in the Turin node.

By way of comparison, in the final balance, the previous High Speed Rail costs 32 million per km in Italy, 9 million per km in Spain and 10 million per kilometer in France.

The base tunnel will have very high costs even for ordinary management too. For this item, which also deals with the cooling costs to bring down the temperature to 32 ° C, Remy Prud'homme, professor emeritus of economics at the University of Paris, on the basis of the costs of the TGV North France, has calculated for the Turin Lyon an annual loss between investments and revenues, of 280 million euros a year [17].

The Turin Lyon will have a very high financial cost, however the traffic goes. A state in strong deficit, like Italy, finances large works in debt and unable to repay capital: this burden weighs forever and could weigh far more in the event of an increase in interest rates. In a symbolic distribution of expenditure, the economist Marco Ponti had calculated that - based on the only existing estimates - the Turin-Lyon would cost 1200 euros for each Italian average family of four [18].

Traffic

The "isolation" of Piedmont, which was one of the flagships of the promotion of the Lyon Lyon, is a fairy tale. Piedmont already has an excellent network of connections: to the west, it has the tunnels of the motorway and the railway of the Val di Susa, to the north, the two tunnels of the Valle d'Aosta; to the south, it is close to the three major ports of Liguria, to which it is connected by 3 highways, and to the east is joined to the Padana plain by three railways and two motorways. Moreover, all the Italian and French transalpine infrastructures, both motorways and railways, are only used at 30% capacity [19, 20].

The Turin Lyon project tackles the problem of transport from the wrong side: it would increase the capacity of the infrastructure at the crossings, where it is already abundant even for future scenarios, and would divert resources to the solution of the congestion of urban nodes. In 2011, even the CEO of RFI (Rete Ferroviaria Italiana), Moretti, admitted that *"the problem of the railway junction of Milan is worth a hundred times that of the Turin-Lyon"*. Most recently, the Italian Government itself admitted that – as we have been continuously repeated for decades – his previous assessments on costs and future traffic were wrong [21]. This however did not prevent the same Government to continue pursuing the TAV since it is "Strategic" and – after three decades – the construction of TAV has assumed a "moral value" that goes beyond the material facts. To translate this into words that can be understood: *"no matter how the TAV is a wrong choice, and no matter how it will cost, we don't want to give up since it is a sort of battle, and we don't want to lose it"*. Unfortunately, dealing with 40 billions of wasted funds that will burden the economic future of Italy and of our sons, it's not like winning or losing a football game. Let us stick to the facts: if the only reason to build the TAV is the reward (moral and most probably economic) to the proposers, we could estimate the economic reward they want and give it to them, even multiplied by two to sooth the delusion for losing "the game": the Nation would spare anyhow a lot of money.

Getting back to facts, TIR trucks floods forecasts through the Italian-French Alps proved to be completely false. The freight traffic of the Frejus and Mont Blanc freeway tunnels, which the TAV proponents were thinking to partially transfer from the road to the railroad, had a decrease of 31% between 1998 and 2014, but no revision has ever been made of the forecasts underlying the project [19].

The loss of mercantile traffic by the Italian-French Alpine tunnels is because Italy and France are two economies that exchange less than they exchanged in the past, because the global and transoceanic market has replaced the reciprocal one, and therefore it is a structural phenomenon.

In recent periods, only the Alpine passes of the north-south route have increased significantly due to the growth of Eastern European economies: in eastern Germany, Poland, Hungary and others. However, the TAV is an east-west route, and it could not benefit from it.

Things did not go better for international passenger traffic. In 1992, at the presentation of the project, the yearly passengers of the Frejus railway line were 1.5 million, and they were expected to rise to 8.5 million in 2002 thanks to a huge contribution of tourists from the Eastern countries: instead, they fell to 750,000. This trend is also seen on the German network where the € 70 billion spent on high-speed railways over the past 25 years have not prevented a 18% drop in passengers. Would the same thing have happened if, alternatively, the cost of the tickets had been greatly reduced? [5]

Traffic forecasts are the fundamental element for deciding the construction of a large transport infrastructure, because it is from these we must understand whether the intervention will be useful or will be a gigantic financial hole. By convention, the source of the transalpine historical data are the international statistics ALPINFO, processed annually at the Swiss Federal Department of Transport, which harmonizes the various national statistical surveys, to compare the goods flows of the 17 most important passes of the Alpine arc [19-20].

The whole project of the Turin Lyon was based instead on a predictive model, invented by LTF, which did not take into account Alpinfo's data, and which never agreed to discuss the failure of its forecasts, even when, since 2002 onwards, we have seen that they were going in the opposite direction to the real evolution of the traffic. The first criterion for validating a model is whether it can describe the trend of real data. Yet, even though in 2012 the Frejus railway yearly tonnage was 3.4 million, (with a downward curve substantially homogeneous from 2000 onwards),

neither LTF nor the Government have ever adjusted their forecast at 20 million tons, which had been put on for that date (2012). They only limited themselves to move the same curve of exponential growth a year or two later. [21]

The LTF model is an example of how one can construct the desired forecast to get a project approved, even if that could not be. The initial source of data was not the official statistics but an investigation of origin and destination of the TIR trucks made at the borders in 2002, on a sample that corresponded to about 0.5% of the transits of the area. Then LTF set that all existing roads and railways were a homogeneous network, so that this model could move the traffic without having to take into account any better route and, as it gradually, added capacity constraints on the other Alpine passes, for hijack their traffic on their own. To do this, a Turin-Lyon, a motivated preference condition was added with the use of Modalhor wagons while, in reality, it had been known since three years that they were a failure. In doing so, it was found that the increase in rail traffic between 2020 and 2050 over the entire Alpine arc could be transferred to Val di Susa for 80%, that is, for 37 million tons. LTF has arrived to his wrong forecast by this false and wrong trick. They also thought that a supposed growth of traffic in the central Alps could rise the entire Alpine Arc traffic, and disguise the fall of that of the Alpine passes between France and Italy [22], right there were they propose their fake “strategic work”.

The Turin-Lyon freight traffic forecasts were also calculated by the Swiss SBB, which was responsible for the Brenner railway base tunnel project. Their model, applied to Alpinfo data, provided that our railway axis, made the appropriate interventions, could stabilize just over 10 million tons of goods. For 2025 gave a traffic of 11 million tons: about a quarter of the 40 millions of tons “planned” by LTF for 2030 [23] Nevertheless, against this, LTF and the Osservatorio, instead of confronting each other, ruled that it was the SBB that had to change the calculation methods [22].

The Fairy Tale of Low-cost and other similar fakes.

The so-called “Low Cost” solution proposed for the TAV project quite recently [1], was in fact a “Double Cost” solution played on the shift of the terms of jurisdiction between the national and the common cross-border sections from Chiusa to Susa. It was presented as a cancellation of the Orsiera tunnel of 19.5 kilometers and 2.4 billion budget, but in reality, it only postponed it to a second phase. However, above all, moving it along the national route, he placed it totally in Italy, making it lose both the French and the European contribution, which amounted to 1 -1.5 billion.

For the national part, in 2016 a fake cost saving project was re-advertised, proposing to postpone the main tunnel that would connect the new line between Orbassano and Settimo. However, since this part should come into service in 2030, like the base tunnel, this means that there is no postponement and therefore no savings. The only saving that could occur, would be the 5.5 kilometers of the stretch Avigliana city -Buttigliera that, instead of underground, would be realized on the surface next to the current line, crossing the village with High Speed and High Capacity and therefore in the face of unimaginable impacts.

One of the stories most cited in the press was the existence of a “European Big Project” of a traffic corridor from Lisbon and Kiev, later modified with some variations after the renunciation of Portugal and the divestment of Ukraine.

The artificiality of the so-called Mediterranean corridor is even more evident if one considers that the traffic between Italy and the Iberian Peninsula chooses for 98% the natural route of the coastal route of Marseilles, Ventimiglia and Genoa and that quantitatively the goods traffic that crosses the pass di Ventimiglia is the same size of Frejus and Mont Blanc together. Nevertheless, it was imagined that Ventimiglia did not exist and that the “Mediterranean” traffic after Marseilles could go up the Rhone valley to get to Lyon and from here to Turin. All this only to justify a stretch of railway between Lyon and Turin. To the east of Italy, the line ceases to be High Speed / High Capacity and the failure of the new Tarvisio railway has shown the impossibility of attracting new traffic only with a new infrastructure.

Another fairy tale is that of greater safety of the base tunnel and the new line. A mixed line with very different operating speeds accentuates safety problems. The operating model of the project presented by LTF provides that every hour, for each direction of travel, and on the same track, three trains of a railway highway at 120 kilometers

per hour, two freight trains at 100 kilometers per hour, and after an appropriate interval, a TAV or a TGV, at 220 kilometers per hour. On the current railway this problem is almost non-existent because the speed differences are smaller and there are several gauge points for slow trains. Instead, in a High Capacity / High Speed line, it becomes very complex and would require facilities such as the 4-kilometer long and a couple hundred meters wide platform that was planned in the plain between Bruzolo and Borgone.

The stretch of the Susa plain cannot carry out this task, because it does not have sufficient length. In addition, on a railway of this type, a train cannot slow down on the road track, since it is necessary to always travel at the maximum speed and must discard and then re-enter on the tracks with a thrilling edge of time, having sufficient space in front of them. Even with a very modern signage system, this would increase the risk of accidents due to unforeseen circumstances. Finally, many users would be discouraged to enter a very long tunnel in those conditions. Such a situation avoided that the Eurotunnel supplanted the Channel ferries. [9,11]

Climate Change Emissions

A railway line is not always more advantageous than the road in terms of CO₂ emissions and energy consumption. This is true only if, like all other means of transport, it remains within a certain speed and size limit of infrastructure. Studies carried out at by M. Federici and S. Ulgiati, in addition to those made by M.V. Chester, A. Horvarth et al. [24-28], conclude that high-speed rail transport is worse than road transport for CO₂, particulate and SO_x emissions, while the values of other gaseous species are comparable.

The TAV shows systematically worse values than the classic rail transport due to the excessive infrastructure required and the excessive power of the trains: for these reasons, a TAV corresponds to an increase of 26% of CO₂ compared to a classic train, as with the speed increase consumes a lot more. These results, relating to the Bologna-Florence section, are also applicable to the Val di Susa project: in both cases, these works are absolutely disproportionate and unjustified compared to the transport load they may have.

As for the energy consumption due to the construction, it can be considered that the 42.5 million cubic meters of aggregates extracted for the total construction of the 270 km of new line, are equal to 42 "twin towers" each corresponding to a parallelepiped of 50 m x 50 m of base and 400 m of height. These will be dug by gigantic cutters driven by electric motors, as well as those that will shatter millions of cubic meters of rock to knead them with 15 million cubic meters of cement. [24].

Even the management of the base tunnel would not lead to energy savings because the new line would involve an energy use higher than the savings, also taking into account that the maximum altitude within the base tunnel is only 500 meters lower than that of 1300 meters above sea level of the existing line. In fact, the new line in the heart of very high mountains involves a huge energy consumption to bring to 32 ° C the warm environment of deep rock that, according to the same project, reaches 60 ° C. The 20 thermal megawatts that are needed, according to the preliminary draft of LTF of 10 August 2010, correspond to the annual consumption of 175 million kWh. These must be added to the 12-15 million kWh needed to ventilate the 120 km of tunnels [9].

Environmental impact: some initial remarks

For 50 years, the Susa Valley has been the site of construction sites for major works: first there was the international dam of Moncenisio, then the doubling of the railway tunnels, after the highway tunnel and the Frejus freeway, finally the catchments and the large hydroelectric power plant of Pont Ventoux, not counting the minor works, and those from which it has successfully defended, as the doubling of the mega power line. However, the volume of the great works has reached the point that their further growth would compromise the quality of life of the territory, characterizing it as a land of construction sites. These bring down the housing value of homes on a much larger area, because the presence of many construction sites damages the image of the whole area, regardless of the municipalities directly affected.

A large group (312) of doctors and health workers in the project area signed an appeal in 2011 [5], stating that "*From the examination of the new Turin Lyon project there are numerous problems related to health issues with possible heavy consequences on public health*". The document then examines the risks related to asbestos, nitrogen oxides, PM10 and uranium. The premise states that, for this evaluation: "*the committee used only the data submitted*

by the designers". The appeal was then posted in 43 municipalities, and distributed as leaflets in the medical offices of the areas concerned. In 2006, 103 doctors from the Susa Valley had published a similar appeal, expressing strong concerns about the health of the population with the opening of the Turin Lyon sites.

The construction yards seriously damage the health of the inhabitants: the same EIA study presented in 2010 by LTF for the common international section stated that the increases in PM10 justify hypotheses of impact on public health of significant importance, especially for the susceptible human population groups. For those susceptible to cardio circulatory and respiratory diseases, the study indicates pathological increases of 10%.

The problem is particularly serious because those ones are the two diseases that concentrate the maximum mortality in Val di Susa now. Based on these parameters, for the area of the Rivoli site the incidence was calculated in three deaths per year for the duration of the worksites. According to the WHO, in a 2006 study: "the long-term effects of PM10 concentrations exceeding 20 micrograms / mc, equate to 9% of mortality in over 30 for all causes". [1,5,9].

It would be wrong to estimate the damage only based on the increase in diseases and mortality: their presence indicates a state of health deficiency that affects the entire population, even those who do not get seriously ill. We must then consider the cumulative effect of dust, pollution and noise: each affects for its part on the health of the individual and all together create a weakening that makes the body more exposed to diseases not directly connected with these. Laying large sites on a territory is not a decision to be taken lightly, especially within a valley, that is, in a conformation where air pollutants disperse less because they recirculate, and within urban areas where the population is much more concentrated.

A separate aspect is pollutants from the building site after the construction is over. Mugello showed the vastness of the problem of the lands contaminated by hydrocarbons, used to stabilize the excavation. The government then inserted an exemption to cancel the crime. Here the volumes of cement that should have entered the construction sites for the 35 km of the Italian part of LTF up to Chiusa can be calculated in 3.5 million cubic meters. This figure is as much as 3.5 times of the old twin towers of New York that had a base of 50 meters on each side and a height of 400 meters. These facts are taken from the LTF Documentation to the TEN-T Directorate for the request of the financial contribution for the year 2008 [29].

The presence of asbestos

The asbestos fibers are like microscopic needles, with a diameter of one fiftieth of a hair that exceed the defenses of the bronchioles, penetrate deep into the pulmonary alveoli and plant themselves in the cell walls, causing inflammation conditions that can degenerate into practically irreversible diseases.

The threshold below which they can be harmless is not known and the values established at national or international level are an estimate by convention.

Asbestos risk has certainly been underestimated, especially by RFI [11]. The presence of asbestos is a widespread problem even where it did not seem to exist: just remember that due to the presence of amiantic rocks the Olympic bobslevel was moved from Sauze d'Oulx to Cesana, and that in Claviere, the construction of the 1.8 kilometers road bypass, started in 2005, lasted 10 years instead of two because the problem of disposal was very difficult to solve [5].

For the cross-border part of the section that includes the base tunnel, the presence of asbestos is admitted by the LTF / TELT project for the first 420 meters at the beginning of the base tunnel, and is referred to as "zero to low" risk for the rest of the base tunnel and for the Orsiera tunnel.

To evaluate this judgment, it should be remembered that the first 420 meters of Mompantero are those where, after the polls at the Seghino, LTF had declared that the extracted rocks had not revealed the presence of amiantic rocks: when they became the starting point of the excavation starting from entrance of the tunnel to Susa, and therefore with a very high visibility, it was decided to admit its existence [9].

But in the following phases, and in the presence of less significant volumes of less favorable rock, there may not be the courage to interrupt the excavation, make the TBM "mole" 200 meters long retreat, and then proceed substantially by hand. We would remember that, even on the basis of the 120 million per kilometer cost allowed, the value of each working day of the yard, calculated on the basis of an average progress of 8 meters per day, i.e. more than what was done at La Maddalena and St Martin La porte, would correspond to about one million euros a day. In a system of fixed costs, as it should be that of CIPE's deliberations, it is to be feared that the companies would not have the strength to stop the works rather than try to hide the presence of asbestos and uranium, if this could go unnoticed.

For the national part of RFI, the problem is even more serious since the data provided by the VIA studies of RFI show that the material of which the moraine hill is constituted consists of 42% of green stones. [9,11]]

The asbestos disposal measures proposed by LTF and RFI show a still unresolved problem. The project prior to 2017 envisaged placing the amiantic rocks in concrete containers of one cubic meter, then 12 containers per wagon to be shipped to northern Germany with trains of 11 wagons, each of which meant loading 1,000 special trains every 500 meters of double tunnel of progress. The last solution is to store it in tunnels dug specifically but those prepared are sufficient only for the first 420 meters of the base tunnel where it is known its presence. To create others would mean interrupting the excavation work for at least a year, which seems unrealistic both for the costs and for the respect of a time schedule. The RFI project is far behind because it does not take into account the consistency of the presence of asbestos and the complexity of the situation and confines itself to saying that they will remove the erratic boulders by hand through the openings of the cutter shield. Which is obviously surreal, also due to the presence of surfactant liquids in front of the shield. [9,11]

Uranium and radon hazards

The presence of uranium (pitchblende) mineralization in the base tunnel area is a reality: this presence was reported since the nineties [5, 30-33], but LTF and its consultants have long denied it. It is not true which his EIA study states "*the significance of uraniferous minerals reported in the Susa Valley are in sectors not interfered by the construction of the base tunnel*". On the contrary, the deep parts of a dozen spectrometric anomalies found on the surface could be of interest to the excavation. The study does not mention the data recorded by the French in 1980 by Minatome and, for the Italian part, in 1959 by Somiren and in 1977 by Agip Mineraria [5,34]. In his book [35] on Italian uraniferous deposits and their minerals, D. Ravagnani, an expert in the sector, publishes the sketches of the exploration galleries, and judges the Susa Valley champions very rich and very beautiful to see, because the mineral forms the distinct black veins. An important uranium ore is uraninite. It is a mixed oxide of uranium and thorium. In places of Grange della Valle, Exilles, Valle di Susa, important sites with the presence of uraninite are reported. Another famous place for the uraninite and for the pitchblende is the Monte Seguret, with its mine near Oulx. Famous as an infamous one. There have been reports of the old iron mine opened by FIAT in the 30s, in the Rio Secco area. The testimonies tell us that many workers of that mine died, and their lung disease was attributed to silicosis. However, in those black rocks, to hear the testimonies of then, "there was something that killed people". The radon, uranium emission, and the lung tumors caused by it then had not yet been discovered. What happened to the mine? Once the state contributions had ceased, Fiat suspended the research and then closed the construction site. However, in the 1960s - during the atomic energy boom - specialists from the FIAT Nuclear Research Center arrived with equipment to detect radioactivity, and polls began. A hundred meters from the former iron mine, Fiat identified a strand of pitchblende, uranium ore. Two galleries were opened, then suddenly everything was abandoned: that mineral was not economically competitive with that available abroad.

Another uranium deposit is in Salbertrand, still in the valley: here we find, besides uraninite, also the autunite, another uranium ore. In that area, other excavations were probably made by FIAT, always in the 60s, in the locality of San Romano, which is right under the vertical directrix of the Seguran uranifera vein. We could not conclude without talking about the Molaretto, the site between Chiomonte and Giaglione along the Moncensio highway. These "mines", actually test and test galleries carried out by AGIP in the 70s, are in one of the 28 outcrops of uranium that AGIP in the '70s had identified in Valle di Susa. Earlier, in 1960, Somiren SpA started a prospecting campaign between Venaus, Novalesa and Giaglione: it was discovered uraniferous outcrops consisting precisely of the Molaretto, but the company also that time was considered not convenient for industrial exploitation. New studies in 1965 by Sergio Lorenzoni and new confirmations: relevant uranium formations in the subsoil of the Ambin massif. Several scholars, in the "nuclear" age, until the 70s, defined that area of the Molaretto as "one of the most interesting uraniferous deposits in the western Piedmont valleys". [5,31,33,37].

Molaretto is just hundreds of meters away from the TAV exploratory tunnel. Despite this, the VIA study of LTF / TELT dedicates a single page to the "management of radioactive materials", with completely generic indications. The particular danger of the uranium oxides is due to the fact that they emit alpha and beta radiations which, in contrast to gamma rays (which are similar to X-rays), have a greater mass and strongly impact even the air molecules, and in normal conditions they are exhausted in distances of the order of centimeters, so they are easily detectable only at close range. However, for this same characteristic, when the dust carries uranium in direct contact

with the mucous membranes and the skin, these radiations create serious damage because the energy of their radiations does not cross but affects the organic molecules, and alters the structures of living cells. and their DNA. [31]

Radon is a radioactive element in the form of odorless and colorless gas, which is generated by the natural decay of uranium. Its dangerousness is linked to the fact that, being in a gaseous form, it is easy to reach deep into the pulmonary alveoli where it emits radiation in contact with the cells. It is heavier than air and therefore, it goes through the cracks in the rock and collects at the bottom. Above all, only those who work in the excavations are affected, because, on the outside, radon is diluted in the air. Radon accumulation can be a problem for TAV tunnel workers [31].

Noise and vibrations during construction and during operation

Noise was the first major problem of this line that has been reported by the population since the early 90s because this is not an ordinary railway but a super railroad with fast trains and particularly heavy goods trains [37,38]. A fast train emits, above 220 km / h, an aerodynamic whistle that overcomes mechanical noise. In the project, the speed has been kept to that limit, but the impact of the vibrations of the freight trains is very heavy and pushed to the maximum of their performances: also because these heavy trains do not have specific tests to refer to. The situation was then dramatically worsened by the decision to pass all the traffic of the base tunnel on the current line that crosses the countries of the Val di Susa: it is the worst possible scenario, one that nobody would have imagined, because in the only stretch of the valley, makes critical the livability of 1,150 houses between Avigliana and Bussoleno, which are located within those 150 meters away from the tracks for which, for the same line, in France the right to full compensation is recognized.

The risk is that a wide range of houses are no longer inhabited, creating urban decay. [37]

The disturbance of construction sites in the valley and in the belt of Turin, will be particularly serious: because in the metropolitan belt the works are in heavily inhabited areas, while in the valley environment, the location of the inhabitants makes them more exposed to the propagation of sound waves. The noise of the train, especially at high speeds, can cause a lot of discomfort at night, because, being impulsive, it causes awakening. [37]

Loss and compromise of water resources

The experience of the Mugello has left behind 57 km of small rivers that in summer are a desert of stones, 73 springs and 45 wells dried up, and five aqueducts today supplied with a very expensive upstream pumping system [5].

For the Consortium of construction companies that have worked in Mugello, the Court of Auditors has hypothesized damage to the Treasury of € 740 million for failures caused over the years and for having used, without authorization, public water for the plants of concrete mixing, for vehicle washing and construction activities.

The future of the territories crossed by the Turin-Lyon will certainly be worse. In the first place for technical reasons: in Mugello the tunnel was bigger, but unique, while here there will be two, one for each direction, and this doubles the drainage front; also because here the mountains are higher, with accumulations and pressures of water greater. The whole mountain is home to underground fossil lakes, the most superficial of which, of 14 million cubic meters, was intercepted in Venaus by the works of the Pont Ventoux power plant [5].

The severity of the subtraction of water resources is proportional to the low altitude at which the tunnel is made, compared to that of the overlying mountains: in this respect, the situation in the Valle di Susa is much worse than in the Mugello.

The water network of the Moncenisio group is very extensive and connected. The tracers thrown in the Giasset cave in 1970, came almost anywhere after two weeks, confirming that they had crossed large underground lakes; the last one came out a month later, a thousand meters lower. The basic tunnel project will go through it despite the fact that water inflows are the worst enemy of TBM.

The previous major construction works have already heavily affected the sources of the Susa valley: the doubling of the Turin-Modane railway has led to the disappearance of 13 springs in the territory of Gravera and 11 in the Mattie area. The tunnels of the motorway, between Exilles and the Cenischia valley, have made 16 sources of the fractions of Exilles disappear, as well as in some other places.

The works of the Pont Ventoux power plant, for a tunnel only two meters in diameter, have dried up the Pontet river, 2 springs in Venaus, 2 in Giaglione and a dozen in the Salbertrand area, including that of the Eclause aqueduct.

This project would provoke the collapse of the water resources of our mountains, also because we must consider that the valley of Susa is a dry valley with very scarce rainfall: around Susa, it is equivalent to Puglia.

Our situation, following the Turin-Lyon construction works would pale every precedent: this fact was also admitted by the COWI report, requested by the European Parliament in 2006. Although the client was the same European Commissioner for the construction of this line, the hydrogeology experts could not fail to point out that the only base tunnel would have drained from 60 to 125 million cubic meters per year, which corresponds to the needs water of a city with one million inhabitants. [39].

The experts of the COWI report have also pointed out another aspect that would make our situation much more critical than that of Mugello: the waters captured inside the mountain would be hot, and part of them will have concentrations of sulphates well beyond the acceptable limits to be introduced in surface water courses. This is a serious problem, because dumping these waters would kill rivers, and because the problem will have to be managed in perpetuity, that is, well beyond the duration and responsibility of the construction sites.

The subtraction of enormous quantities of water from the Mont Cenis massif and the Amin will also have effects on the feeding of the Lake of Mont Cenis, which supplies water to a hydroelectric plant in France and one in Italy. If the deficit induced to the sources that feed it were 25 million cubic meters a year, in energy terms this would mean the loss of about 150 million kW / h of peak energy, which should be included among the damages caused by the project.

In Lower Valle the construction of the underground line and interconnection between Chiusa and Avigliana will constitute an average 20 meters deep barrier to groundwater runoff, raising it upstream and lowering it downstream, with significant consequences on the underground parts of the homes of the concerned countries. [11]

The volumes of aggregates and the problems of finding a landfill

The problems of finding sites where landfill rocks extracted from excavations are still largely unresolved. According to a global calculation made by LTF [9], the total of rocks extracted from the Italian side for the Turin Lyon would be 18.4 million cubic meters, equal to seven pyramids of Cheops. Of these, 10.7 million cubic meters would come from the section designed by LTF, from the state border to Chiusa San Michele. After that, 7.7 million will come from the RFI section between S. Ambrogio and Settimo. A more exact calculation, which takes into account the relationship between in situ rock and accumulated rock, which RFI had ignored, would give, however, for the RFI tract, 9.5 million cubic meters that would bring the total of the Italian part to 20.2 million. The total volume extracted from the French part of the base tunnel would be another 10.7 million, plus 11.7 million for the three tunnels of its national section, which would give a total of the French part of 22.4 million cubic meters, plus to the four French descents and that of the Maddalena. The total between Italy and France would therefore be about 43 million cubic meters, equal to 17 pyramids of Cheops. The LTF and RFI designers foresee a total reuse for cement and materials of 47%: an excessively high percentage considering that, in the projects already presented, also in France, LTF had always calculated a decidedly lower share. However, even in this case, 10 million cubic meters would remain in landfills in Italy. The unpublished hypothesis of selling about half of the material, mentioned in a supplementary document of LTF, was then denied during the document itself. It was admitted that this is prevented by existing regulations, which require identifying the recipient before the excavation, and the difficulty of make the times and volumes of the excavation material coincide with the times and the volumes of any buyers. The problems of real reuse are confirmed by the explorative tunnel of La Maddalena, of which nothing has been reused. About 12 million euros have been spent, for 153,000 linear meters of foundations of a meter and a half in diameter, to create a platform necessary for the weight of the deposit of 250,000 cubic meters. Otherwise, the landfill could not make the pylons of the highway viaduct tilt more than 20 cm. [9]

The objective necessity of bringing to landfill at least 10 million cubic meters, equal to 10 "twin towers", is indirectly confirmed by the LTF project of 2011. The documents state that, alongside the new destination in Montanaro, some million cubes would be then moved to Torrazza. In the end, Montanaro would remain destined to the landfill of the aggregates of the national section of RFI. The destination of the Mont Cenis quarry was still open, estimated at 5.5 million cubic meters for which, in the project of LTF in 2010, it was planned the foolish construction

of a 70 million euro cableway, with 42 pylons of about 25 meters in height, which would have crossed for 9 kilometers the slope above the millennial Novalesa Abbey. This solution was then not permitted by the French municipality of Lanslebourg. More recently, there can certainly be doubts that, of the 4.5 million cubic meters of aggregates excavated for the project in variant of 2017, only 1,500,000 are to be taken to landfill. [9-11].

In reality, the plan of disposal by train becomes only an impact that is added to the previous one and involves the night traffic of at least 4 pairs of trains per day, per yard, which would involve territories and populations that were not previously touched. The opposition of the municipalities of Montanaro and Torrazza is still unresolved. They protested because this solution emerged outside the project originally presented and without a total, clear and in-depth plan of the whole problem, which seems to change periodically. [40]

We must not neglect the impact of about 8 million cubic meters, which would be re-used above all to make cement, which represent a mountain of 8 "twin towers" that will be crushed and sifted, with all that follows, as powders and noise. The problem of pollution is aggravated by the fact that the work will be done in inhabited areas of the valley floor, or those, even more densely inhabited, of the metropolitan belt. [40]

The illusions about employment, compensation and analysis of costs and benefits

The Turin-Lyon will not bring employment and would already be a success if the overall balance sheet were not negative: the companies of the big construction sites are set up as an autonomous country in all and, for supplies, depend on large contracts. There are few places and few initial jobs left to the locals. In the San Gottardo base yard in Bodio, only about twenty of the 700 people in the Canton of Ticino and, from the testimony of the mayors concerned, the effects on the territory were non-existent.

In Mugello the main occupational fallout was that of a group of women who had consortium for the cleaning of the rooms and the kitchen and had started a modest catering business. In important contracts, it is not possible to set recruitment conditions because they are at European level and companies do not lay off workers who have had previous experience, to hire others to be trained and followed up.

The number of employees for civil works, however, remains decidedly modest, in relation to the size of investment, in Italy the LTF and RFI projects give a quantity of working days corresponding, respectively, to 1,020 people and 1,320 people for 7 years. If you think about how many industrial companies with equal employment are disappearing due to lack of support initiatives, you can evaluate the negative impact that would have the Turin Lyon through the removal of public resources [9,11].

Even if we would not consider that with the same investment of the TAV we could create 100,000 / 150,000 decent and clean jobs, we need to calculate the places that would be lost due to the incompatibility with other activities. For instance, agriculture, which loses at least 4 million square meters of fertile soils by direct subtraction, and for the fractionation that make them unusable, or loss due to lack of various forms of tourism. However, the damage would also affect other sectors, because no industry and no quality laboratory would settle in an area perpetually congested with construction vehicles and polluted by dust. Moreover, the uncertainty of the financing plan entails the heavy uncertainty of the continuity of employment. The great works that are faced with technical and economic uncertainties superior to their strengths are subject to abandonment, dissolution of consortia, and blocking of work due to lack of government appropriations, and risk offering unsecured places.

The compensations and mitigations are not managed by those who ask for them, but by those who build the work. The fundamental question of compensations is that the local administrators must accept them before they know the real extent of the damage, which will happen at the end, when it will no longer be possible to reopen the negotiation. The offers, which anticipate the time of municipal works still due from the State, have a certain attraction only because for the promoters it is easy to minimize the final picture in terms of harmfulness, damage to health, distortion of the territory during and after the end of construction sites.

Another problem is that compensation works are generally sanctioned in documents signed by the Region, and not by those directly involved. Consequently, as we have seen in the case of the Frejus motorway, in case of non-compliance due to bad intent or economic crisis of the building society, the municipalities are not entitled to request them from anyone, because they are not one of the contracting parties. In this way, initially the municipalities are made to believe they can have everything, but, after they have accepted, they will be forced to take what is given, because they have lost all bargaining power.

It is worth to hear the experience of the mayors of Mugello in the spring 2010 survey: "From planning to implementation, the costs can grow even by 400 percent. If this money is not covered by the State, it happens that, of the 53 million euro planned to urgently repair the first environmental damage, ten years after the works, there are still 15 million euro missing and yet they told us that we should not complain ". "There is a lack of money to heal environmental damage and many of the promised works are still missing: and the mayors, who had put their faces against the citizens, cannot even say they brought home the gym or the asylum that had been promised". [41]

Among the illusory promises is worth mentioning the so-called Strategic Plan [42], released in 2009, with the ambition to be a stratospheric offer for the Susa valley and then ended up in oblivion: it was just a game of administrative illusionism in order to gather subscriptions to spend on other tables. In fact, it had been drawn up by the Province, which had no power to decide the addresses or define economic resources, and essentially asked the mayors to sign a document without commitments before knowing the extent and quality of the damages. It did not allocate funds and did not provide any resources from the construction of the Turin-Lyon. In practice, it was limited only to suggest the management of resources deriving from sectoral projects, from the various development plans and from what Region and municipalities could find with ordinary requests. 60% of the projects concerned Turin and it is significant that the Valle di Susa lacked strong and truly strategic interventions, as could be the industrial reconversion of steel mills. The script was the usual one to promise everything by pretending to have unlimited resources.

An independent body should have done the cost benefit analysis: and when it was, as for the audit commissioned in 2003 by the French government [43], it was disastrous for Turin-Lyon. The same analysis, made by the proponent and without the possibility of a contradictory, was a farce [44]. The highest benefit item was 8.3 billion euros saved in 50 years due to the lower number of accidents. But making a calculation based on the average cost of settlement of accidents involving weighed means, developed by insurance companies, this figure corresponded to 83,000 accidents a year on the actual stretch of about 300 kilometers which is the length of the roads subtended by the new line: an absurd and exaggerate figure. In a context of limited public resources, it is not only necessary to ascertain whether the construction of a work has a positive cost-benefit assessment. It is also necessary to evaluate how much this work will worsen the Italian state's deficit increase, and vice versa how well it would do to use these enormous amounts differently for the improvement of the remaining railway network, for the transport of commuters and for the revival of the economy through technological innovation and support for research.

CONCLUSIONS

Concerning the TAV project:

The tricks to mask the real cost, such as quotes without financial burdens,
the deception of baptizing Low Cost a project that increases the total real costs of at least one billion euros,
the unrealistic forecasts on the total European funding,
the failure to calculate the charges related to the hundreds of CIPE requirements, of installations, tests and extra costs and financial burdens,

hide an insurmountable financing problem in the current and future management of public accounts.

Italy has managed to allocate 2.6 billion euros, but the CIPE, in the following 15 months, with two decisions in 2017 and one in February 2018, has increased costs by two and a half times. France has not made any appropriations for future years or even reliable financing hypotheses. As far as the UE is concerned, after Brexit its budget has been reduced by 12 billion and the latest CIPE calculations have no longer taken into account its future contribution.

Given the real trend of freight traffic along the Italian-French Alps, revenues would not even pay off and the high running costs and, after having been a pit of money for construction, the TAV Turin Lyon would be a continuous problem because of a budget that is always at a loss.

The cost of the toll, which could not be light, makes it unrealistic that it can attract traffic from the coastal itinerary. This is the only one to which we have always looked to hypothesize a substantial increase because, as already mentioned, for TIR trucks coming from Spain and the south of France would mean diverting for 200 km into the busy Rhone valley to take a railway section with specific characteristics for only 270 km. However, this would be even less convenient with the competition of the new Genoa -Ventimiglia railway. As far as the other goods are

concerned, it is useless to envisage longer trains if the goods are also missing even for ordinary ones, and to expect miraculous solutions to be disavowed in any way by experience. As far as passenger traffic is concerned, the new line could offer a shorter travel time, but with an impression on the safety of the journey in the base tunnel that would weigh on the approval by the public. The current line could compete offering lower cost tickets able to face the competition of the fastest route, as happened for the Channel ferries in the competition with the Eurotunnel. Therefore, after having requested, for the Italian part only, 20 million cubic meters of extracted rocks, 20 or 40 billion of cost, and having caused enormous environmental damage, TAV will miss the objectives, and it will be a catastrophe. An unuseful and expensive great work is not preferable to a plan of small works or a modernization of the existing line. The actual project is not useful and is highly detrimental.

Glossary

LTF = Lyon-Turin Ferroviare, RFI = Rete Ferroviaria Italiana, TAV = Treno Alta Velocità, TELT = Tunnel Europeo Lione-Torino, TIR = Transport Internationale Routiere, HSR = High Speed Rail

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