Railway Related Impacts: the Turin-Lyon High-Speed Rail Case

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ABSTRACT

One of the best known cases of struggle for the commons in Italy, characterized by bitter controversies over the last 20 years, is the popular opposition to the construction of the High Speed Railway line (HSR, “TAV” in Italian) between Turin and Lyon, designed to cross the Susa Valley (at the Italian-French border) and the Alps. This HSR project still carries, in spite of twenty years of continuous updating and reworking, a great deal of unsolved environmental and economic issues. An issue of insufficient cost-benefit balance has recently come to clear evidence, especially in view of the non-negligible passenger and freight traffic decrease along the Turin-Lyon direction. The most important aspects dealing with economic costs and claimed benefits, energetic considerations, legal constraints, environmental impact, health impact potential, and the negative experience of other projects, are discussed.

1. Introduction

The Susa Valley situated between Maurienne, France and Turin, Italy, has been urbanized by the economic development of the region. The construction of infrastructures like the Frejus highway, an international railway, and a large number of dams, tunnels and industries, has generated significant environmental and social impacts. The proposed high-speed train line (Treno Alta Velocità in Italian, or TAV) between Turin and Lyon would pass cross the Susa Valley, via 2 main tunnels and several shorter ones across the Alps. The "No TAV" movement is a grass-roots movement of the Susa Valley population against the new line construction. The Turin-Lyon High Speed Railway (HSR) in the Susa Valley (Italy) has long been surrounded by bitter controversies about the most significant and technical aspects of the proposed project. The HSR project carries, after more than twenty years of strenuous and continuous redesigning, a large number of still unsolved environmental issues. Main pollution problems dealing with the railway construction have been put into evidence by several studies and official reports. For instance, the presence in the Susa Valley of geological formations with asbestos and uranium is of particular concern, also considering the final destination of the extracted inert [1]. Aspects related to local hydrogeology and its perturbations, and noise, are also of huge concern [2].

The insufficient cost-benefit balance, especially in view of the significant passenger and freight traffic decrease along the Turin-Lyon direction [3], has come to better evidence when the French Government (as of July 2012) announced a spending review that could stop the construction of the HSR Turin-Lyon and other ones on the French side [4].

Last but not least, the concept itself of this type of investment is under deep review, since the huge amount of public money invested or planned in support of such development does not appear to be justified by sufficient economic benefits associated to the investment [5]. In other words, not only a sequestration and degradation of the environment is going to take place, but also there is no advantage at all in economic terms, except probably for the companies involved in the construction business and, more likely, the banking system.

Getting back to the technical questions, we believe that the usual appeal to the Precautionary Principle [6,7] in the case of HSR project is not even necessary. Economic data, energetic considerations, legal questions, environmental impact, the health impact potential, the negative experience of other projects, and especially the common sense, suggest that the High-Speed Train Turin-Lyon is not an actual priority for Italy and Europe, and its construction should be immediately stopped.

2. Materials and Methods

2.1 The Susa Valley. Nature and history.

The Susa Valley is located in Northwest Italy at the border with France, from which it is separated by the Alps, 3600 meters high. It is the widest valley in the Western Alps; in fact, it is a natural corridor stretching from East to West. The two sides of the valley benefit from different sun exposure and this makes them quite different from one another. The left side is dry, while the right side is humid, shady and cold. The natural environment, and particularly the flora, are deeply affected by this peculiarity, resulting in a valley with extremely
diverse and interesting sites and habitats. In particular, the Susa Valley is defined as a Site of Community Importance (SCI) according to the so-called European Commission "Habitats Directive" (92/43/EEC), within the Natura 2000 Network. The Dora Riparia River runs through the valley, and there are abundant springs and superficial aquifers. Large pastures are located in the high part of the valley, while at lower heights (1300–1800 meters) it is possible to find steep crevasses. The Susa Valley is among the most developed alpine valleys from economic and infrastructural points of view. It is crossed by two main roads through the passes Monginevro and Moncenisio. Moreover, a motorway and an international railway reach France through the Frejus tunnel. The Valley hosts three hydroelectric dams and is crossed by two electric lines. Many tourist and sport resorts make the valley a tourist attraction (it also was the base of the 2006 Winter Olympics). There are many industries, including mining, and many military roads built in previous centuries that are currently international tourist attractions for walkers and cyclists.

The valley has about 90,000 inhabitants, and it is divided into 39 Municipalities. There is a well-established tourist industry, as it is evident by the presence of “second homes”, hotels and motorway traffic. Notwithstanding the heavy human presence, the Susa Valley features wide semi-natural and wild areas, which host many examples of alpine fauna (deer, chamois, roe deer, wild boar, eagles, hawk, partridges and wolves) and a very rich diversity of flower species; there are four natural parks, two natural reserves, and many areas of European interest. Livestock rearing, which was very intense until the end of World War II and subsequently declined, is now in a new phase of growth, albeit slow, and consists of about 8000 cattle, 12000 sheep and 800 goats.

2.2 The new Turin-Lyon railway.

In the year 2005 the Rome-Naples HSR line came into operation, the first one in Italy, followed by the Milano-Turin line in the year 2006, the Milan-Bologna line in 2008, the Bologna-Florence and a high-speed technological improvement of the Florence-Roma in 2009. Further line extensions (the Naples-Salerno and other minor lines) completed the first Italian high-speed network in the following years until 2011. The Salerno-Milan line is part of the North-South high speed European corridor, while the Milano-Turin-Lyon was designed to be part of a more ambitious project linking Kiev (Ukraine) to Lisboa (Portugal). The project, not included by European Union among its priority high-speed projects, has lost potential partners on the way (Spain, Portugal, Ukraine, Slovenia) due to the huge financial investments needed, low traffic forecasts, low economic returns expected. As a consequence, it became a France-Italy bilateral project, still under debate and waiting for final approval and further funding. Its completion requires a new tunnel 57 km long and other rail works to link to the existing network. The entire Turin-Lyon line would be approximately 270 km long across the Susa Valley (Northern Italy) which originated heated debate and opposition by the local population over more than 20 years (and still pending). Supporters claim the new line to be able to transfer large fractions of freight traffic from road to rail, with consequent environmental advantages. The Governmental cost-benefits analysis [9], claims that by the year 2035 about 39.9 Mt/yr of freight will be traded through the new line across the Susa and Maurienne Valleys, accounting for about 55% of total freight traffic. Such amount translates into a ten times higher freight trade than in the year 2010, in contrast with the present trend of decreasing commercial traffic between Italy and France [8]. A residual 45% of traffic (1.6 times the 2010 traffic) would have to be transferred via road by trucks through the Mount Blanc tunnel, translating into about 2 million trucks, about 800,000 more than the 2010 circulating vehicles. Not a road traffic decrease, indeed, but a potential reduction of the planned increase [8].

2.3 Economic Cost-Benefits Assessment

Estimates about the needed investment and expected benefits have been very uncertain until recently (June 2012), when a Governmental cost-benefit analysis was finally presented [9] and published. The foreseen investment was so large that a plan B was put forward: instead of a 270 km line Turin-Lyon, a cheaper solution (only the 57 km base-tunnel and related links to the existing line) was designed, translating into a 60% cost abatement. Economic estimates have always been uncertain and subject to exponential increase due to real costs occurred and the consequences of organized crime and corruption, during the construction of the Salerno-Milan High Speed Rail, as clearly pointed out by the Italian Court of Auditors1 by the results of a public audit performed by a special committee of the Italian Parliament [10] and other academic studies [11]. Some of these sources have strongly questioned the validity of the HSR investment and the possibility of a return on the invested capital.

2.4 Environmental and energy costs

A comparison between different transport modalities is presented, based on published literature [13-20] among others) and previous evaluations carried out by the Authors, referring to the Naples-Milan HSR as a case study [8,16]. In particular, the following Environmental Impact Categories are compared: Abiotic Resource Depletion, Cumulative Energy Demand, CO2 emissions (Global Warming), SO2 emissions (acidification).

Three passenger transport modalities (road car, intercity train and high speed train) and three freight transport modalities (heavy transport lorry, regular freight train, and an hypothetical use of high capacity/high speed freight train) are compared.

All calculated impacts refer to the functional units of 1 p-km and 1 t-km respectively for passengers and freight.

Other kinds of impacts (extraction of radioactive and asbestos materials and hydrological risk) are also assessed, based on Val Susa site-specific information.

3. Results

3.1 Economic Costs-Benefits Assessment

Concerning freight, the central problem is that rail freight transport in Italy occurs at an average speed of 19 km per hour [3], since trains are often diverted and parked in transit stations, to provide priority to passenger trains. This is the main bottleneck requiring improvement. It’s a nonsense for commodities to arrive from France at a speed of 150 kilometres per hour and have to stop and spend most of their time in a transit station when they arrive in Italy.

1 http://trisikel182.wordpress.com/2012/03/06/tav-corte-deiconti-costi-assardi-paolo-m-ruggiero/
Concerning passengers, it makes sense to talk of High Speed Rail when the journeys are longer than 250-300 km. In Italy, if we look closely at the rail transport statistics [3,7], we can see that 80% of the demand for passenger transport is for short journeys, less than 100 Km. It’s true that Italian trains are overloaded with passengers on certain routes but only very few people go from one end of the country to the other, taking real advantage of the high speed (also in consideration of the growing offer for low-cost airfares, competing with high prices of HSR tickets).

Official costs estimates refer to the entire line (270 km), not just to the basic tunnel (57 km). Foreseen investments are around 22 billion euro, but previous experience shows that forecasts result much lower than final real costs. The Italian Milano-Salerno high speed train line, already implemented, costed three times more than the forecasts [12]: the benefits for long-distance passengers in terms of train line, already implemented, costed three times more than the lower than final real costs. The Italian Milano-Salerno high speed to the basic tunnel (57 km). Foreseen investments are around 22 Km. It’s true that Italian trains are overloaded with passengers on demand for passenger transport is for short journeys, less than 100 Km. in Italy, if we look closely at the rail transport statistics [3,7], we can see that 80% of the demand for passenger transport is for short journeys, less than 100 Km.

Environmental results are very sensitive to factors such as ridership (load factor), a country’s electric mix, extent of use by passenger and by freight traffic (very uncertain at present), allocation of infrastructure costs to passenger and freight transport, site-specific aspects. As a consequence, all studies and estimates carried out up-to-date are rich with uncertainties and depend on sometimes arbitrary assumptions. We have personally identified very arbitrary assumptions in LCA and impact assessment studies performed within LCA commercial software as well as in official reports published in support of HSR. However, published peer-reviewed studies [11-16] allow at least a gross estimates of impacts (Tables 1 and 2).

Table 1. Average load factors and selected LCA impact categories for passenger road and rail transport modalities [16]

<table>
<thead>
<tr>
<th>Mode</th>
<th>Load factor (passengers per trip)</th>
<th>Abiotic material depletion (kg/p-km)</th>
<th>Cumulative Energy Demand (MJ/p-km)</th>
<th>CO₂ emissions (g CO₂/p-km)</th>
<th>SO₂ emissions (g SO₂/p-km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>1.8</td>
<td>0.53</td>
<td>1.87</td>
<td>89.40</td>
<td>0.24</td>
</tr>
<tr>
<td>IC train</td>
<td>400</td>
<td>0.85</td>
<td>0.77</td>
<td>30.30</td>
<td>0.34</td>
</tr>
<tr>
<td>HS train</td>
<td>250</td>
<td>1.40</td>
<td>1.44</td>
<td>48.20</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Table 2. Average load factors and selected LCA impact categories for freight road and rail transport modalities [16]

<table>
<thead>
<tr>
<th>Mode</th>
<th>Load factor (ton per trip)</th>
<th>Abiotic material depletion (kg/t-km)</th>
<th>Cumulative energy Demand (MJ/t-km)</th>
<th>CO₂ emissions (g CO₂/t-km)</th>
<th>SO₂ emissions (g SO₂/p-km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lorry (average)</td>
<td>8.8</td>
<td>0.60</td>
<td>1.25</td>
<td>72.10</td>
<td>0.21</td>
</tr>
<tr>
<td>Regular freight train</td>
<td>350</td>
<td>7.65</td>
<td>2.50</td>
<td>150.00</td>
<td>0.85</td>
</tr>
<tr>
<td>HS train</td>
<td>350</td>
<td>8.65</td>
<td>3.09</td>
<td>189.00</td>
<td>1.05</td>
</tr>
</tbody>
</table>

As far as employment is concerned, nowadays, the massive projects have a modest multiplier effect: manual workers are not employed as they were in the 1800’s. Moreover, the well known tourist value of Italian landscape (with expected increase of visitors from recently developed countries) should prevent from implementing further landscape degrading infrastructures, calling for much better ways to invest public and private money, for higher return in terms of revenues and jobs.
The claimed virtuosity of the train is not always
emissions are so high as to entirely offset the claimed advantage of
only a few aspects, and the energy necessary to keep it working, then
construction work, tens of thousands of truck journeys, excavated
new line with about 70 kilometers of tunnel, 10-20 years of
but only if we use or improve on an existing network. If we build a
transport, less versatile than road transport, may cause less pollution,
required for a careful analysis of the life cycle of the project. Rail
construction, including the energy incorporated into the materials and
fuels, but also on the energy investment for the infrastructure
although valuable in principle, cannot be given for granted, and
trucks and private cars) to electricity driven railway. This result,
of a fraction of freight and passenger traffic from road (fuel driven
the expected decrease of pollutant emissions, associated to the shift
a main ecological justifications of projects, the energy savings and
released by the engines of trucks. Supporters of HSR put forward, as
importance: in the presence of a small or decreasing traffic, the
entire infrastructure life cycle. The ridership is also of paramount
2
/ p - km for road car traffic (load factor 36%). Preston's values did
allocated to a much larger amount of freight transported. It would
decrease the impact of infrastructure costs, in that this latter would be
values are affected to some extent by ridership: increased use may
desire of seeing a more competitive environment for HSR compared to
the Lyon-Turin line between France and Italy, energy and
environmental costs require a special attention and a careful analysis of
the energy and material flows involved over the entire project life
cycle.

The environmental impact of any new construction project is
high; a project may be justified, however, if its usefulness compensates the environmental burden from construction and
operation. Given the serious doubts about its usefulness under the
perspective of declining freight traffic, the HSR project runs the risk that the shift in traffic from road to rail would not occur or be very
low, and thus the benefits in the reduction of the environment, on
impact would also be very low. Planners forecast fourteen trains per
day, while the capacity of the line is for 250 vehicles. Freight traffic
on rail lines is in decline throughout Europe, with very few
exceptions. Even in France, rail traffic is declining because in the last
two centuries production has shifted away from raw materials
traditionally carried by rail such as bricks, wood and coal. It would
be much better from the environmental standpoint to invest in
technologies that cost much less and can do a better job at dealing
with any likely increases in demand.

4 Discussion

One of the main environmental justifications of HSR projects is
the transfer of goods and passengers from road to rail modality,
resulting in a reduction of the greenhouse gas and other pollutants
released by the engines of trucks. Supporters of HSR put forward, as
a main ecological justifications of projects, the energy savings and
the expected decrease of pollutant emissions, associated to the shift
of a fraction of freight and passenger traffic from road (fuel driven
trucks and private cars) to electricity driven railway. This result,
although valuable in principle, cannot be given for granted, and
heavily depends not only on direct consumption of electricity and
fuels, but also on the energy investment for the infrastructure
construction, including the energy incorporated into the materials and
their necessary management and maintenance. In the case of a big
infrastructure project, such as HSR, this is a particularly important
requirement for a careful analysis of the life cycle of the project. Rail
transport, less versatile than road transport, may cause less pollution,
but only if we use or improve on an existing network. If we build a
new line with about 70 kilometers of tunnel, 10-20 years of
construction work, tens of thousands of truck journeys, excavated
material to dispose of, drills, thousands of tons of iron and concrete,
heavy interference with underground and surface water, to mention
only a few aspects, and the energy necessary to keep it working, then
the consumption of raw materials and energy and the related
emissions are so high as to entirely offset the claimed advantage of the
hypothetical partial transfer of freight from road to rail
[13,16,17]. The claimed virtuosity of the train is not always
confirmed in real cases, and heavily depends on the energy
investment for infrastructure, including the energy embodied in the
materials and the necessary management and maintenance over the
entire infrastructure life cycle. The ridership is also of paramount
importance: in the presence of a small or decreasing traffic, the
investment per unit of passenger and commodity transported would
never be competitive with other transport modalities (or with a
decreased transport demand driven by more local consumption, when
such option exists). In the case of a big infrastructure project, such as
the Lyon-Turin line between France and Italy, energy and
environmental costs require a special attention and a careful analysis of
the energy and material flows involved over the entire project life
cycle.

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with any likely increases in demand.

4.1 Energy cost-benefit analysis

Energy intensity indicators for construction and operation listed in
Table 1 for passenger traffic and Table 2 for freight traffic clearly
show a much higher energy expenditure of HSR compared to
Intercity rail as far as passenger traffic is concerned. The hypothetical
use of HSR for freight transport is also very energy intensive
compared to both regular freight trains and trucks. Only passenger
transport by car is more energy expensive than any other modality.
As already pointed out, results may depend on a variety of factors,
including assumptions on vehicle load, on electric mix, on
infrastructure allocation to transport modalities. Energy intensity
values are affected to some extent by ridership: increased use may
decrease the impact of infrastructure costs, in that this latter would be
allocated to a much larger amount of freight transported. It would
not, however, affect too much the operational energy costs, because
of a proportional increase of electric use and commodities
transported.

Calculations from [16,17] are based on present load factors from
official statistics. A decreasing traffic would only have the effect of
increasing the unit transportation costs and emissions. Claims of HSR
proposers foresee increasing traffic in the next 30-50 years, which is
not supported by present trend data and may rather be ascribed to
fairy tales books. By the way, the present offer by the Italian railway
companies (FS and NTV) is towards improving comfort for a limited
category of users (business and executive class coaches), with about
40% decreased number of seats. Decreasing ridership inversely
affects energy and environmental costs.

It should be noted from Tables 1 and 2 that cumulative energy
demand for Intercity and HSR passenger transport are respectively
59% and 23% lower than for road vehicles, while the opposite is true
for freight transport (respectively 2 and 2.4 time higher for IC and
HSR than cars), due to higher loading factors for trucks compared to
railway carriages.
4.2 Carbon emissions

Train transportation modalities are claimed a priori to be carbon free or, at least, less carbon intensive. It is certainly true that a train does not directly release any CO₂ during its operation. However, the construction of the infrastructure (excavations, tracks, viaducts, concrete for tunnel walls reinforcement, electric lines) and vehicles, maintenance operations, and the provision of electric power all require huge amounts of energy that are in Italy mainly based on fossil fuels. Considering the non-linear increase of energy consumption of a running vehicle up to more than 3-4 times when speed increases from 100 to 300 km/yr [24], due to the kinetic energy loss while braking and aerodynamic resistance; considering also the need for strong, complex, and much more sophisticated HSR infrastructures compared with regular IC trains, and finally considering the much lower occupancy per trip, CO₂ emissions per p-km and t-km come out to be more than 30% higher for HSR than for IC train (Tables 1 and 2) and likely to be even higher than highway track transport in times of increased decline of traffic along the Turin-Lyon corridor. Infrastructure-related energy costs and emissions account for about 40-45% of total life cycle [14,16], depending on the electric and energy mix of a country.

Calculations from the Italian Government’s cost-benefit assessment [23] point out – for the entire, not yet existing, East-West EU Corridor 5 - an annual decrease of CO₂ emissions equal to 3 million tons/year reached by the year 2035 with a net release in 2038; in that year the foreseen (although not supported by any present real traffic data) increase of traffic and related savings on road transport should offset the emissions associated to the infrastructure and operation of HSR. Surprising it may appear, these calculations do not include the emissions related to infrastructure construction, which means that about 40% of total life cycle emissions are not accounted for, thus making the break-even point (if any) much beyond than the claimed year 2038.

The Frejus highway in the Susa Valley is presently used by approximately 3300 big transport trucks per day. The foreseen increase of freight traffic by ten times via railway and by 1.6 times via road by the year 2035 [23] must be combined to the almost certain decision to implement as a cheaper solution only the construction of the base tunnel (57 km) and links to the old line: this means that, considering the limited capacity of the latter (20 Mton/yr), additional 19.9 Mton/yr will have to flow through the Frejus highway instead of being transported via rail, thus totaling about 52.3 Mton/yr by truck. This translates into 3,300,000 truck trips per year, about 2.75 times the road traffic in the year 2010, a significant increase of freight traffic by ten times via railway and by 1.6 times via road by the year 2035 [23]. Particularly alarming is that the planned tunnel, which will be more than 100 kilometers long (a double tunnel, 57 km each one), will pass through zones with a high concentration of asbestos and uranium. For example, concerning uranium, it is planned that the resulting material from excavations will also be disposed of in two open-pit mines in the Susa Valley, Meana and Caprie. Thus, about 3.3 10⁵ becquerels of radioactivity from uranium would be dispersed into the environment, with possible water and soil contamination. Due to weather conditions, resuspension of polluted dust is quite likely, and such a dispersion of pollutants would expose the local population to collective doses of several thousands of sievert per person: this represents a hazard for public health in the zones surrounding the mines, where hundreds of persons are living.

Radioactive excavation materials

Concerning Uranium, it is foreseen that a fraction of the resulting material from excavations will be disposed of in two open-pit mines in the Valsusa, Meana and Caprie [27]. This would imply the dispersion into the environment of about 3.3 10⁵ Bq of radioactivity, with likely water and soil contamination. Due to the action of meteorological agents, resuspension, and wind, such a dispersion of radioactive pollutants would expose the local population to collective doses of several thousands of Sv/person [27].

Concerning excavation of tunnels in uranium-bearing rocks, even with quite low concentration, the main source of radiation exposure is radon (²²²Rn), a radioactive gas, and radon decay products. Radon is colorless, odorless, and chemically inert; it is formed by the radioactive decay of uranium in rock, soil, and water, and has a half-life of about four days. When radon undergoes radioactive decay, it emits ionizing radiation in the form of alpha particles. It also produces metallic short-lived decay products, like: ²¹⁸Po, ²¹⁴Po, ²¹⁴Bi, ²¹⁴Pb, ²¹⁹Bi, ²¹⁹Pb. Their chemical reactivity and electric properties make them stick to dust and other tiny particles in air. These dust particles can easily be inhaled into the lung and fixed to pulmonary...

http://www.odyssee-indicators.org/
mucosae. The deposited atoms decay and eventually damage cells in the lung. A considerable amount of evidence has established that prolonged exposure to the α-emitting decay products of radon increases the risk of lung cancer [1]. Accurate measurements of concentration are mandatory by law in workplaces, and, in some cases, adequate countermeasures too. Compliance with dose constraints must be demonstrated by gas measurements and may be verified or predicted with dose assessments. The dose received by an individual working for the excavation of the HSR Tunnel is estimated, using the code RESRAD-BUILD [1].

Natural radionuclide concentrations in the Susa Valley can reach quite high concentrations in some selected locations, due to the presence of several uranium-rich geological formations and even some former sample uranium mines dating from the fifties. For instance, the Regional Agency for the Environment of Piedmont, Italy (ARPA) measure concentrations up to 100 Bq/g in samples of rock collected in Venas (Susa Valley) [28]. We however refer to more moderate values, far from the above peak values. In particular, the world average concentration of U in rocks is estimated to be 0.025 Bq/g, while worldwide mean values for other natural radioactive species are: 0.028 Bq/g (226Ra) and 0.37 Bq/g (232Th). We, therefore, assume a concentration equal to 0.0265 Bq/g, that is around 3800 times lower than the peak values above. This value is in agreement with measurements conducted by ARPA during the excavation of a service tunnel, carried out by the Italian Energy Authority AEM, not far from the village of Exilles in the Susa Valley [29].

According to these values, the absorbed dose for workers due to the permanence inside the tunnel exceeds the lowest threshold (1 mSv/h) imposed by the Italian law [30] in the absence of adequate ventilation: in particular, the dose equivalent value of about 197 mSv/yr without any ventilation can be reduced to 1 mSv/h with an air exchange rate of 0.87 (1/h), i.e., all the air content of the tunnel must be completely changed almost every hour. It is an amazing result, considering that we assumed a quite moderate concentration of uranium just slightly superior to the world average: in presence of real uranium-rich formations that can be found in many places in Valsusa [31]; these values would scale up to unsustainable levels.

**Asbestos excavation materials**

Concerning asbestos, HSR proposers claim that about 170,000 m³ of asbestos-bearing rock with “relevant concentrations” [32] can be found 500 m from the base tunnel. This assumption can be proved to be a huge underestimate of the real case, by at least a factor 10. First of all, let’s note that “very low levels” are defined in [32] as “the ones under a 5% concentration of asbestos in rocks encountered during excavation”, while the legal limit is about 0.1% according to the Italian Law; the latter banned asbestos from any use since 1992 [33], since even a few fibers can cause serious health damages: if such more appropriate threshold concentration is assumed for asbestos then the estimated amount of asbestos-bearing rocks in excavation material would be much higher than 170,000 m³. Moreover, in 1995-1998 the Turin University [34] performed evaluations in the Susa Valley showing the presence of chrysotile and tremolite, both asbestos minerals. It is important to point out that the study was commissioned by Alpetunnel, the first company responsible for the design of the Tunnel. The most recent surveys carried out by the HSR proponents [32] and claiming the absence of asbestos are instead questionable. The sampling activities were carried out in points where no asbestos presence was expected: the tectonics structure of the Western Alps in the Susa Valley zone is very complex, having been involved in various geological events; as a consequence, sampling results would have been very different in the surrounding areas. Surveys of the University of Siena found asbestos fibers “with high tendency to defibrillation” [34] in 20 out of 39 rock samples tested in the Susa Valley. Further studies [35] concerning the presence of chrysotile veins identified non-negligible asbestos concentrations in many serpentine rocks in Val Susa. Tremolite veins are common in small masses of serpentine schists in the Piedmont area, especially in the upper Val Susa. Rocks are potentially asbestos-rich also in other lithological contexts, the serpentinized peridotites of the “Mount Musiné” in Susa Valley [36] and in the ultrabasic complex in Lanzo between Almese and Caselette in lower Susa Valley. The same rocks form the mountains above Chiusa San Michele, Sant’Ambrogio and Avigliana, municipalities included in the route of the international and domestic tracks of the HSR.

**Hydrological risk**

An assessment of hydrological risks connected with the HSR construction may be summarized as follows. In 2006, about 30 superficial water springs have been identified by the HSR proponents [36] along the old version of track of the national segment rail line, in many villages in the Susa Valley. Same situation appears in the Municipalities impacted by the international segment, where the number of water sources and creeks is quite high, with the complication that several of them are used as drinkable water supply. Therefore, two kinds of problems emerge:

- The excavation activities can drain or divert the springs leaving population without water
- The sources can be polluted, becoming undrinkable and unusable.

In the presence of very deep tunnel design, sampling surveys are not so easy because of the depth of some sites and because of the difficulty to reach the surface sampling sites located in mountain. Just to mention an example related to the Susa Valley, during the activities for the construction of the “Pont Ventoux” hydroelectric power plant, a large number of high pressure water jets have been found, together with an underground lake of hundreds of thousand cubic meters. Moreover, the artificial lake of the Mont Cenis, a 333 million cubic meters water reservoir at 2000 meters of altitude, supplying power plants in France and in Italy, is located in the area. Interception of very high-pressure jets cannot be excluded a priori during excavations.

**4.4 Economic cost-benefit**

Finally, Preston’s review at European level [19] points out that “the dominant benefits are time savings to HSR users and the net revenue to the rail industry. Other benefits, such as reduced overcrowding, the benefits of released capacity on the classic rail network and on parallel roads, and of reduced emissions of greenhouse gases are much smaller but are positive”.

This author underlines that benefits are estimated based on the claimed existence of increased strong demand for passenger rail services. Preston’s report warns that operating and maintenance costs might be covered by revenues from passenger traffic, but also states that the latter are unlikely to contribute to more than a small fraction of capital costs, thus requiring non-negligible public support. In conclusion, Preston states that “the limited reviews of high speed rail projects elsewhere in Europe indicate that they have been affected by...
appraisal optimism and that out-turn results suggest Benefit Cost Ratios much lower than those being forecast in Britain”.

5 Conclusion

Recently, a down-sized project was presented by the Italian Government [37], costing one third of the original one, and limited to the base tunnel, i.e. without any improvement of the existing line outside it (“Low-Cost Solution”). In practice, this makes the overall time savings very modest, eliminating any possible relevance for the passenger traffic. No analysis has been presented yet, but for sure this down sizing is the consequence of the local opposition, the lack of public funds, and the widespread skepticism of the academic world. For sure, all the relevant impacts will also be proportionally reduced, although this “success” does not make the expenditure any more justified.

Can the opposition against HSR be defined as “against Progress”? Results suggest the opposite to be true. Progress and wellbeing must not be confused with infinite growth. The territory of Italy is small and over-populated. Natural resources (water, agricultural land, forests, minerals) are limited. Pollution and waste are increasing. Fossil energy supplies are coming to an end. Progress means understanding that physical limits exist to our mania to construct and transform the face of the planet. Progress means optimizing, increasing the efficiency and durability of already existing infrastructures and built environment, cutting out what is superfluous and investing in intellectual and cultural growth more than material one, using minds more than muscles. The HSR represents the exact opposite of this idea: wasting resources for no benefit.

6 References

[5] Donald Gray, Laura Colucci-Gray and Elena Camino: Science, society and sustainability, Routledge (USA-UK), 2009 (see particularly cap. 3 Active Citizenship, a Case Study. The Controversy of High-Speed Rail in the Susa Valley)


[25] Travoli Dall’alta Voracità (Claudio Cancelli, Giuseppe Sergi, Massimo Zucchetti, ed. 2006)


