

# THE SWISSRAPIDE EXPRESS:

## ON TRACK TO EUROPE'S FIRST INTERCITY MAGLEV LINE

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**ABSTRACT:** With the SwissRapide Express, Europe's first Maglev inter-city line has entered the planning phase with the start of operations expected for December 2017. The new line will connect the cities of Berne and Zurich in **20 minutes every 5 minutes in peak times**. Planned as Switzerland's first ever Public Private Partnership (PPP) transport project, the total costs for planning and construction are estimated at € 6.72 billion. This paper will present the newest developments in this innovative, exciting project.

### 1 INTRODUCTION

A recent study showed that the number one factor reducing the quality of life for the Swiss was too long travel times to and from work. In addition, the classical intercity railway line between Zurich and Berne has already reached the limit of its capacity. With the aim to meet the intercity transport needs of Switzerland in the coming decades, SwissRapide AG is actively planning and promoting the realisation of the *SwissRapide Express* project.

The 114 km high-speed line linking Berne and Zurich, with an optional 8 km link to the Zurich International Airport is to be built using the Transrapid maglev technology, connecting the cities of Berne and Zurich in **20 minutes** (today: 57 min.) with departures every **5 minutes** in peak times and offering 24 hour service. The start of commercial operations of the *SwissRapide Express* is planned for the December of 2017 with building costs, including the complete infrastructure, vehicles, new subterranean stations in the Berne and Zurich main train stations as well as power supply systems, estimated at € 6.72 billion.



Figure 1. Design study of the *SwissRapide Express*

SwissRapide AG based in Zurich is responsible for project management as well as for planning, marketing, business case development, public affairs and promotion activities in the project. In addition, the project is also being supported by the SwissRapide Consortium, made up of various national and international companies and universities.

Figure 2. Design study of the *SwissRapide Express*

## 2 POTENTIAL MARKET

Already today intercity traffic in Switzerland is facing crowded trains, regular delays and missed connections as well as traffic jams on the main motorways – valuable time which is lost when commuting between the two main cities of Bern and Zurich.

The principal reason for these public transport issues is that the railway infrastructure between Bern and Zurich, the most frequently used railway line in Switzerland, has reached its capacity limit. Crucial improvements could only be achieved with considerable investments in railway and road infrastructure.

Moreover, during the coming years demand in mobility will increase further. As an example the number of travelers during the years 2005 and 2007 has increased by more than 21% so that today already 9.5 million passengers travel between Bern and Zurich. With a forecasted growth of just 4% p.a., there would be an increase of 50% in number of passengers traveling between the two major cities in 2018. The Swiss government is aware of the problem but does not see a solution before 2030 in its official “ZEB Paper” (Future development of railway infrastructure until 2030).

For this reason the project SwissRapide Express has been launched – a new and innovative solution



for the creation of new intercity public transport capacities.

Based on the Transrapid maglev technology, which has been developed in Germany and has been successfully in operation in Shanghai over the past 5 years, SwissRapide Express opens up a new era for Inter-City public transport in Switzerland:

- Bern – Zurich in 20 minutes
- 5-minute departures during peak times
- 4-fold Intercity capacity for the line Bern-Zurich

## 3 PROJECT APPROACH

From the beginning, it was clear that SwissRapide was not a technical project but that the primary focus is in the areas of marketing and public affairs. To summarise, in order to be successful the concept of SwissRapide must find broad public acceptance in the country as well as the political backing necessary for the realisation for such an endeavour.

For this reason, the following tasks were given first priority for completion:

- Project Marketing Plan
- Establishment of the SwissRapide Consortium
- SwissRapide Business Case
- SwissRapide Financial Model
- Detailed Financial Plan
- Detailed design of the SwissRapide line between Bern and Zurich

By September 2008, these documents had been completed.

In addition, close work with Shanghai Maglev Transportation (SMT) has been confirmed on the side of both SwissRapide and SMT. The aim is to use and promote the developments of the Transrapid technology and gain from the experiences from the Maglev operations in Shanghai.

## 4 THE BUSINESS CASE

The SwissRapide Business Model is based on a public private partnership (PPP) model, a cooperative financing of cities, cantons, the federal government and private investors. The PPP model has already been utilized successfully in several large transport projects (e.g. HSL Zuid in The Netherlands).

This section presents a short summary of the SwissRapide Business Case, which was completed in August 2008.

Taking into account the forecasted growth of 4% p.a. (a conservative estimate considering that the overall SBB network is at the moment growing at 7% p.a.) the total number of intercity passengers in 2018 will amount to 14 million. If, moreover, an average ticket price of CHF 40 is assumed the potential revenue during the first year of operation in 2018 amounts to CHF 570 million. Deducting operating costs of CHF 95 million, the line can generate a before tax profit (EBITDA) of CHF 475 million. As a comparison, one USD is worth approximately 1.10 CHF (Swiss franc).

Further predicting a constant growth in passengers of 4% p.a. and an increase in ticket prices of 2% p.a. revenue would amount to CHF 1.15 billion by 2030 which corresponds to a before tax profit (EBITDA) of CHF 1.04 billion.

The following chart illustrates the development of revenue and before tax profit for SwissRapide on the basis of the current finance plan:

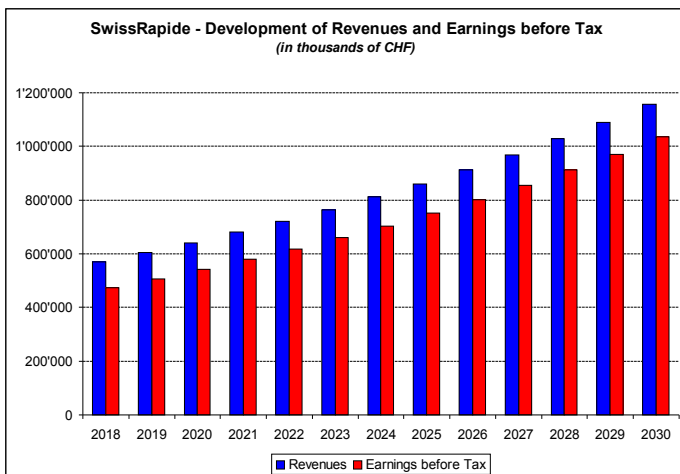


Figure 3. Turnover and EBITDA

At the point of going into operation with the line in 2018 equity holdings of early investors in SwissRapide AG could be sold at a profit to institutional investors, for example within the scope of an infrastructure fund. SwissRapide meets the needs of institutional investors for long term, steady income streams.

## 5 ROUTE PLANNING

Together with the Swiss Federal Technical University (ETH) in Zurich, studies were carried out concerning possible routes between Zurich and Bern

for the *SwissRapide Express*. Alternative variations for a connection between Basel and Zurich were also investigated since SwissRapide could offer travel times of 15 minutes between these two cities opposed to 55 minutes today. However, since the potential market for passengers is about 30 % lower than for Bern-Zurich and construction costs per kilometre would be high since the route is very hilly, this variation has been planned for a second phase of the project (see section 7).

After discussions with various experts in Switzerland, it became evident that a route closely following the A1 freeway between Zurich and Bern was not only the route that would cost the least to construct but it was also the route that would find the most political acceptance in Switzerland.

For operational reasons, the line is also planned as an **endless loop**, allowing vehicles to continue their journey in the same direction back to the neighbouring city after loading passengers in the Zurich or Bern main train stations.

This design also reduced the **length of the route** from the 127 km originally estimated to **114 km**, thus significantly reducing the estimated construction costs.

It is interesting to note that in meetings held this autumn with Commander Wu Xiangming, President of Shanghai Maglev Transportation, it was confirmed that the new extension of the Maglev line in Shanghai from Longyang Road to Hangzhou (199 km) will also be constructed largely along the freeway after leaving Shanghai city.

This route was designed with the following key requirements:

- The radius of curves was to be designed for speeds up to 450 km/h.
- Once reaching top speed after departure, no braking or acceleration should be necessary until reaching the destination.
- The guideway length in tunnels was to be kept to a minimum.

These requirements were met with the present route design and result in the following speed-distance profile:

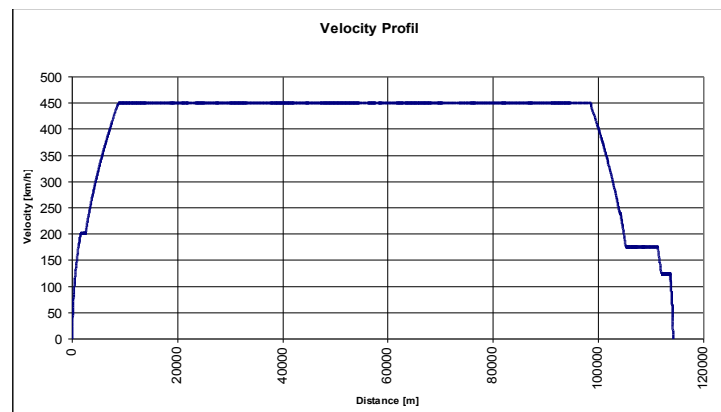


Figure 4. Velocity profile Bern - Zurich

With this, the **journey time between Bern and Zurich** will be just over **19 minutes**, as can be seen from the following time-distance graph.

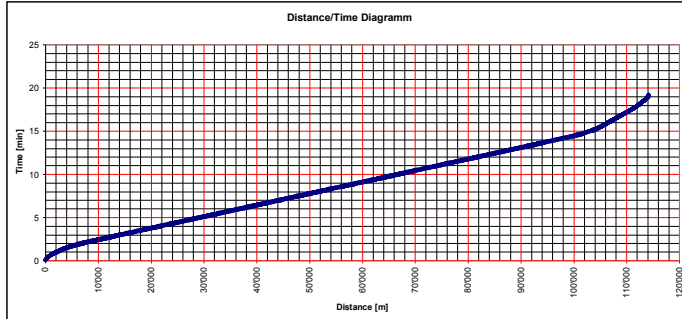


Figure 5. Journey time Bern - Zurich

This one minute of reserve journey time is very practical since it allows the following:

- Reduce the top speed in order to save energy costs
- Allows slight delays in departure time to be compensated so that planned arrival times can be met accurately (within 30 s.) for the customers

## 6 SWISSRAPIDE ENERGY

In Switzerland, more than 60 % of the electrical energy needs are covered by renewable energy sources within the country. In talks and presentations concerning *SwissRapide Express*, many questions were raised concerning the energy needs and sources



for the line. It became evident that this would quickly become a major political issue for the project.

For this reason, SwissRapide AG founded the SwissRapide Energy subproject with the following aim:

- SwissRapide Energy will ensure that the energy needs of SwissRapide Express will be provided to 100 % from renewable energy sources.

This concept has since attracted a high degree of support from organisations within Switzerland familiar with the SwissRapide project and its aims.

## 7 THE LONG-TERM PERSPECTIVE

Given that there are further needs for faster travel times between cities in Switzerland as well as more intercity capacity, the long-term plans of SwissRapide AG are to construct a complete corridor from Geneva to St. Gallen, thus reducing travel time from western to eastern Switzerland from 4 hours (2008) to just over 60 minutes. A triangular connection between Zurich, Basel and Bern is also planned, shortening travel times from Zurich to Basel to 15 minutes, as previously mentioned.

The priority for the additional SwissRapide lines will be based both on business case studies as well as priorities set and possible financing provided by various levels of government in Switzerland.