JASPERS

Guidance Note N-2

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0. Background

The basic operational principles of the Czech high speed rail (HSR) network were examined/defined in a strategic document developed by the MoT in 2016/2017 called "Analysis of the potential of development of high speed lines in the Czech Republic". The intention is to fast track the most important elements of this programme to implementation in the next few years, starting during the 2021-2027 funding period.

In order to further develop and inform the pipeline, a number of co-ordinated feasibility studies are on-going covering what are considered to be the most important connected high speed (TEN-T) lines between Dresden – Prague, Prague – Brno – Breclav and (Brno) – Přerov - Ostrava.

JASPERS was requested to review the pipeline and individual studies providing advice on :

- the study inputs/assumptions, methodology and outputs primarily in the areas of demand, operational solutions, technical solutions (including investment costs), environmental, climate, economic, financial, risk and options analysis,
- development and prioritisation of the project pipeline arising from these lines based on study outcomes in the context of the wider railway investment pipeline.

The following Guidance Note reviews the Prague – Dresden Feasibility Study (FS) focusing on the concept and options of the main HS corridor between Prague and Dresden i.e. Stage I ("etapa I") of the consultant work and the second SŽ update of this from December 2020 :

We note that Stage II outcomes of the study (developing further sub-projects such as the branch line to Most) were not accepted by SŽ and the contract with the consultant was terminated. Therefore JASPERS has not considered the outputs of Stage II in any depth[1].

SŽ has prepared a final in-house updated version of Stage I of the FS (in two iterations), focused on the main Prague-Dresden corridor, with some amendments to the operational model, technical solution, demand assessment and economic analysis.

JASPERS guidance note has a number of separate chapters :

1. Options considered and further development of Option 2 (page 4-6)
2. Demand analysis (page 7-9)
3. Costs and other technical and operational issues (page 9-13)
4. CBA (page 13-14)
5. Environmental analysis (page 15)
6. Climate resilience and adaptation assessment (page 15)
7. Main conclusions and recommendations (pages 15-17)

Our comments are intended to provide a final opinion on the assumptions, methodology and outcomes of the study (mainly Stage I outcomes and the final SŽ update) as well as recommendations for further preparation.

[1] However, information about technical details available only in the Stage 2 documentation has been taken into account.

1. Options considered and further development of Option 2

1.1 Options analysis (options 1 and 2) and sub-projects

1.1.1 During Stage I of the FS, a "No project" option and two HSR options were developed and evaluated:

- **"No project" (BP)** assuming maintenance of the existing network and beyond that modernisation projects already ongoing, planned or envisaged;
- **Option 1** with the HSR line starting at Praha-Vysočany (Kbely tunnel), further to the new Roudnice HSR line station, then – after a bi-directional connection to the existing line 090[2] just before Lovosice – crossing the Central Bohemian Montains with long tunnels, and avoiding Usti nad Labem – reaching the south portal of the Krušnohorský base tunnel at the western end of Chabařovice station on line Usti n.L. – Teplice – Most, with connections from direction Dresden into both directions of this line;
- **Option 2** with the HS line branching off at odb. Balabenka (Střížkov tunnel), further to the new Roudnice HS line station, then – after crossing the existing line 090 but without connection, and the river Elbe – connected to the existing line 072[3] at an extensive complex of bridges and tunnels[4], followed by the Litoměřice tunnel underpassing Central Bohemian Montains and the Elbe river, to the new (partly underground) station Usti n.L. centrum. This finally reaches the south portal of the Krušnohorský base tunnel at the eastern end of Chabařovice station, with connections from direction Dresden into both directions of this line.

1.1.2 Both options lead to very substantial improvements in rail travel time and service frequency on the main relations, often reducing travel times and service intervals by 50 % or more. See annex 1 and figure 1 below for more graphical and tabular details of the two options.

1.1.3 Based on the results of the CBA, but also with reference to other aspects such as territorial development, environment and fulfilment of project objectives, at the end of Stage I the consultant recommended (and a decision was made) to select Option 2 as the preferred one.

1.1.4 We note however that :

- That there was no substantial (modular) comparison of the costs, benefits and climate impacts of different design speed options on a modular basis for different sections of the line.
- There is no substantial documented qualitative environmental comparison of options 1 and 2, therefore it is not clear how the different environmental impacts and risks of the two options have been considered in judging the decision between options 1 and 2.
- No comparison regarding climate (change) resilience of the two options has been undertaken.

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[2] Praha – Kralupy n.V. – Lovosice – Usti n.L. – Děčín

[3] Kolín – Lysá n.L. – Všetaty – Litoměřice – Usti n.L.

[4] "Labský Kříž", connecting all directions

1.1.5 A number of sub-projects ("stage II project options" according to Vol. A.II.1 chapter 7) were also developed in Stage II of the study.

1.1.6 The operating programmes for both Options assumed implementation of the additional new lines : above all the Most branch, but also a new connection to Neratovice. However, no investment costs for these additional lines were included in the final CBA.

1.1.7 Except for some comparatively small investments such as the "Žernosecká spojka", implementation of the HS line does not depend on any of the sub-projects. But the consultant developed an implementation strategy assuming realisation of sub-projects, in particular through using the Kbely tunnel and connecting the HS line at Vysočany at the first phase.

1.2 Further development of Option 2

1.2.1 In an approach to shorten travelling times and further optimise Option 2, the client (SŽ) disagreed with the consultant’s proposal and proposed the following modifications:

- At Prague, to connect the HSR at Balabenka through the Střížkov tunnel from the very beginning rather than using the Vysočany (Kbely) tunnel in the first phase;
- To connect the HSR at approx. km 51 (odb. Židovice) to route No. 090 towards Lovosice;
- To replace the extensive “Labský Kříž” (partly situated in the tunnel) through a more comprehensive odb. near Křešice; and
- To redesign the station Ústí nad Labem Centrum, considering a surface alternative (also for the Elbe crossing).

1.2.2 After JASPERS and other stakeholders provided comments and after subsequent discussions, SŽ further developed and refined this solution through :

- Redesign of odb. Balabenka by adding a connection towards Liběn, thus providing the possibility of bypassing Praha hl.n. towards Praha-Východ, and in a way allowing reconstruction under full Corridor I operations (route 090 towards Holešovice);
- Double-tracking of the 3.8 km connection odb. Židovice – odb. Oleško (on route 090, “sjezd do Lovosic”);
- Redesign of station and odb. Polepy on route 072;
- Including crossover connections;
- Applying an implementation strategy independent from any sub-projects, though leaving the possibility of their implementation;
- Revising the cost estimate; and
- Defining a consolidated operating programme for both passenger and freight traffic.

1.2.3 An overview of the network for Options 1 and 2 and the final option 2 modification proposed by SŽDC is provided at Fig. 1 below.

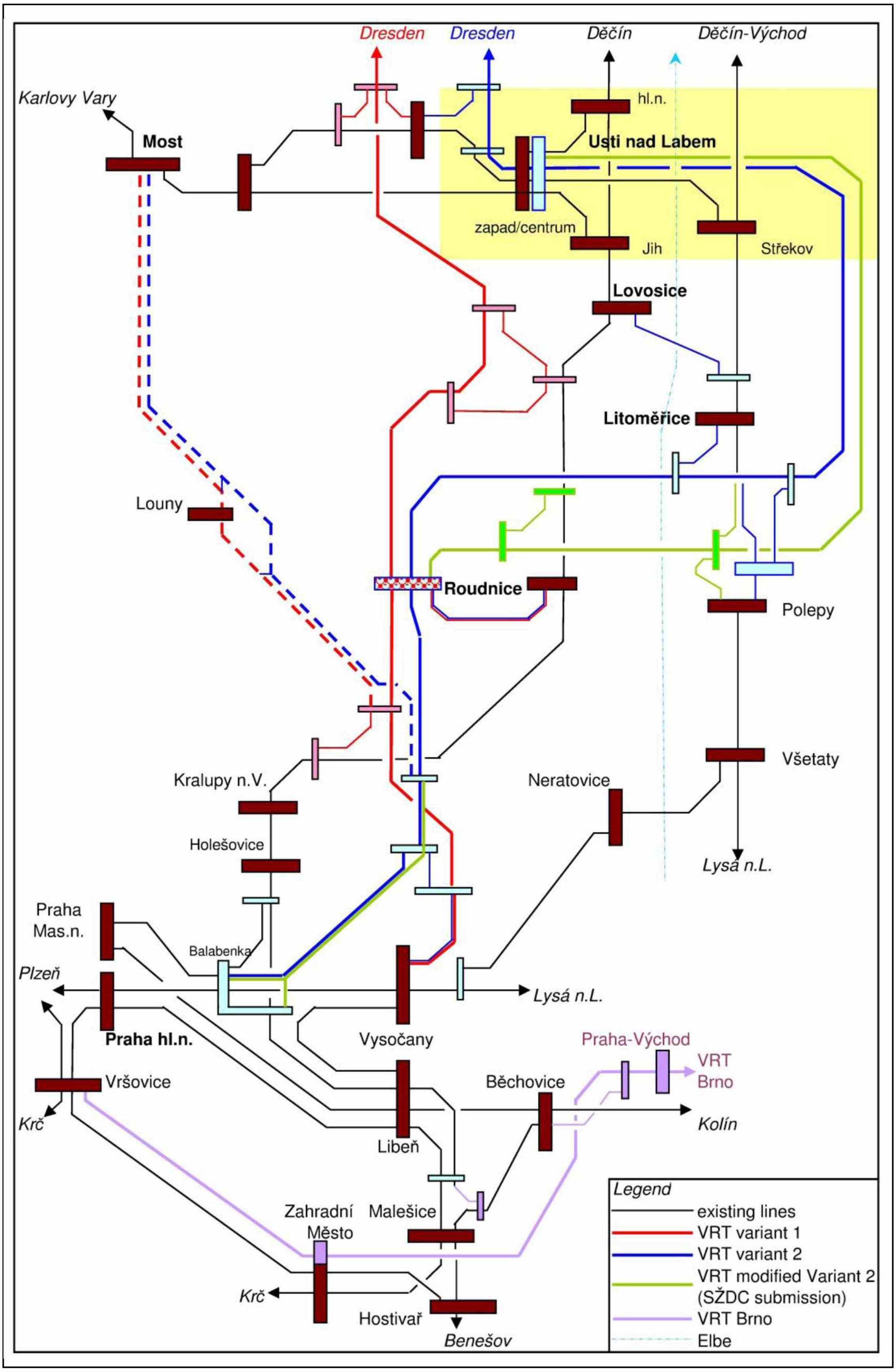


Fig. 1 – Network overview

2. Demand analysis

2.1 Passenger demand

2.1.1 Since the first draft of the feasibility study for Stage I, where the demand assessment and its outputs were not very transparently documented, the Ministry of Transport itself has audited and amended the version of the national transport model used as a basis for the study demand assessment and has recalculated the outputs from the model into the CBA.

2.1.2 The following table shows the levels of modelled traffic growth on three selected sections of the railway line (in the with project case just high speed line traffic, which almost fully displaces traffic on the existing line):

Rail passengers per day	2020	2050		Index : Base growth 2050/2020	Index : Project Impact : with/without project
		without project	with project		
CZ-DE border	4,694	6,691	15,010	143%	224%
South of Usti nad Labem	11,332	12,325	39,094	109%	317%
South of Roudnice	10,348	12,155	40,765	117%	335%

Table 1 – Passenger traffic volumes forecast

2.1.3 Base growth between 2020 and 2050 seems reasonable and in line with national transport model assumptions. Growth due to the project is very high, however the project does provide high levels of time savings and increases in service frequency, often reducing travel times by 50 % or more on the main relations and at least doubling service frequencies.

2.1.4 We have prepared the following table considering the % make-up of traffic sources of the HSR line (based on cartograms provided) in comparison to other reference sets from other countries (based on ex-post assessment) :

Comparsion of HSR rail traffic forecast breakdown	Prague-Dresden rail section traffic breakdown 2050 HSR project				Chinese HSR lines World Bank review 2015 : 1-200 km length	Chinese HSR lines World Bank review 2015 : 200-300 km length	Madrid - Zaragosa (Rus 2012, Rus and Roman 2005)
Source	*Usti-Dresden*	*Roudnice*	*Roudnice-Prague*	Average			
Existing conventional rail passengers	*45%*	*32%*	*30%*	35%	41%	44%	49%
Bus-rail shift	*6%*	*1%*	*3%*	4%	22%	19%	1%
Car-rail shift	*19%*	*21%*	*27%*	22%	16%	15%	20%
Air-rail shift	*0%*	*0%*	*0%*	0%	0%	0%	3%
Induced and generated	*31%*	*46%*	*40%*	39%	22%	25%	27%

Table 2 – Breakdown of Project rail traffic and comparison to international reference cases

2.1.5 The project ratios of induced and car-rail mode shift to existing rail traffic are both significantly higher on average than the reference cases (by over 100 % and 50 % respectively) despite the fact that in most HSR cases, substantial rail traffic (not included here) also remains on the existing alignments. We note however that the social tariff policy proposed and modelled in the Czech case will support more mode shift and induced traffic than in typical HS models with premium fares.

2.1.6 JASPERS own approximate assessment of the project data and previous JASPERS assessments of use of the national passenger transport model (e.g. for the Brno-Přerov FS) however also indicate that it probably has rather optimistic parameters regarding car mode shift and induced transport compared with similar national passenger models.

2.1.7 If project car-rail mode shift was reduced by 33 % and induced traffic reduced by 50 %, total project rail traffic volumes would be approximately 30 % lower than forecast. We have performed demand related downward sensitivity calculations in the CBA using these assumptions and others in chapter 4 below.

2.1.8 Implementation of other Czech high speed lines is not considered in the model and no impacts on air transport are calculated (e.g. Prague-Berlin, Berlin-Vienna potential), which are both conservative assumptions once a high-speed line from Dresden through Prague to Vienna is considered.

2.1.9 JASPERS does not have sufficient information to make any further detailed assessment of the national model at this point.

2.2 Freight demand assessment

2.2.1 The Stage I modelling did not address any shift in freight from road to rail, which is a very conservative assumption considering that one of the primary objectives of the project is to facilitate increased freight traffic between CZ and Dresden. In the Stage II report, mode shift was calculated but the data used were not explained or justified and it therefore could not be considered.

2.2.2 Due to the lack of an active consultant or in-house experience readily available, the Ministry of Transport and SŽ exceptionally requested experienced JASPERS experts to prepare a simplified international freight demand impact assessment.

2.2.3 To do this, JASPERS used its own published methodology (Guidance on Appraising the Economic Impacts of Rail Freight Measures, 2017), key parameters from similar international models (mainly a logit sensitivity factor of -0.154 eur/tonne-1) and base international freight forecast volume data from the ongoing feasibility study update for the Right Bank Freight corridor modernisation. For the latter we assumed the approval of option Z1 from that study, which does not include the impacts of Krušnohorský tunnel.

2.2.4 The resulting logit model shows average elasticity between rail freight demand and rail transport costs of -1.6, which is at the high end of values found in the literature but probably to be expected for international transport flows of the type found on this corridor.

2.2.5 No capacity restrictions are considered in the model :

- It is assumed that any technical capacity issues further in the direction of Dresden, in Dresden node and beyond will be resolved in the time-frame of the project.

- In the valley towards Dresden on the German side there is not yet clarity on any real limits to accommodating expected freight growth in the without project case. Technically, the existing line can comfortably accommodate more than the SŽ projected 2055 freight traffic of approx. 166 trains per day (approximately double the existing volume).
- However, the real without project capacity in the valley may be lower once noise limits and the potential of various noise reduction measures become clearer. This situation might lead to substantially higher potential relative mode-shift as the project would remove this effective bottleneck once the without project capacity limit is reached.

2.2.6 Due to the lack of clarity on the capacity issues, the freight model instead just calculates the positive mode shift potential of the Krušnohorský tunnel to attract road freight traffic to the railways (through time saving and a logit model for 15 main international freight origin-destination directions). The impact of the Středohorský tunnel is not taken into account as the operating concept is not fully stabilised in our view, although if used as expected for up to 50 freight trains, it would improve the truck-rail mode shift performance.

2.2.7 The outcome of the exercise shows a base growth potential of cross-border rail traffic by approx. 100 % between 2019 and 2050 to over 150 trains per day (circa 36 million net tonnes per year). Potential project mode shift from truck to rail in 2050 is estimated at 0.87 million tonnes of goods per year (approximately 3.65 freight trains a day) with a corresponding mode shift of 730 million tonne kms per year.

Daily trains / section with project	Rok	2050
	Lovosice - Ústí n. L.	96
	Litoměřice - Ústí n. L. mimo Středohorský tunel	98
	Litoměřice - Ústí n. L. Středohorským tunelem	50
	Ústí n. L. - Děčín - Dresden	15
	Ústí n. L. - Stradov - Dresden	145
	Transferred trains / day from road	3.65

Daily trains / section with project without project	Rok	2050
	Lovosice - Ústí n. L.	94
	Litoměřice - Ústí n. L. mimo Středohorský tunel	147
	Litoměřice - Ústí n. L. Středohorským tunelem	0
	Ústí n. L. - Děčín - Dresden	156
	Ústí n. L. - Stradov - Dresden	0

Table 3 – Outcome of rail freight forecast with and without project

2.2.8 This outcome was then transferred into the final CBA sheet by SŽ.

3. Costs and other technical and operational issues

3.1 Investment cost estimate

3.1.1 Investment costs on Czech territory are estimated at 142 billion CZK including reserve and excluding VAT. A further circa 40 billion CZK investment is currently expected on German territory, the latter however is approximate as the solution and cost estimate is not yet stabilised on the German side.

3.1.2 Investment costs are calculated according to the new CZ national SPOŹES method leading to higher average unit costs with larger risk cushion than the previous MOPIN system. This means that the investment cost estimate is no longer a median value, rather closer to the high end 80th percentile of outturn costs.

3.1.3 *Bill of quantities and unit costs used seem basically plausible* though some details – such as connecting track lengths between turnouts including catenary and special requirements for the traction system - may still need to be considered. In general, the technical details provided are not sufficient for a deeper analysis of the cost estimate.

3.1.4 The estimated investment costs also seem to cover only the final stages, thus ignoring the possibly numerous interim stages of construction wherever the new lines have to be connected to the existing network, or existing stations modified.

3.2 Dependency on route design on the German side

3.2.1 The spatial planning procedure finalised in August 2020 still allows several options including possible lengthening of the base tunnel from 24 to up to 32 km, and according to a DB Netze press release of 21st August a final decision cannot be expected before 2024. Due to abandoning the proposed Goes station, lengthening the base tunnel would have considerable impact on the feasibility of the proposed operating programme.

3.2.2 It is therefore recommended in further planning for now to assume the worst case i.e. the long tunnel without the Goes station for the final operating programme.

3.3 Operating programme and capacity considerations

3.3.1 The operating programme has been developed for three stages of implementation i.e.

- Prague – Lovosice / Polepy (- Litoměřice) in 2031;
- Ústí nad Labem – state border – Heidenau in 2038; and
- Polepy - Ústí nad Labem in 2046

3.3.2 Due to capacity constraints in the Prague Node, the 1-hour-frequency for EC trains between Prague and Dresden cannot be realised before 2038 for which implementation of the "new connection II" or an equivalent measure is assumed.

3.3.3 For the R20 line Prague - Děčín, two branches are proposed, one on the left bank via Lovosice - Ústí nad Labem hl.n. (R20A), the other one right bank via Litoměřice – Děčín-Východ (R20B). Optionally (from 2046, Scenarios C and D), R20B shall return after Litoměřice to the left bank (via "Žernosecká spojka" to Lovosice); rendering the "Žernosecká spojka" thus obsolete until 2046 and in Scenarios A and B.

It is recommended to generally review this proposal and assess it with demand analysis.

3.3.4 The maximum number of freight trains on the HSR line is assumed according to assumed capacity limits i.e. 150 trains (both directions) on section Heidenau – Ústí nad Labem and 50 trains between Ústí nad Labem and Polepy.

3.3.5 In addition to the EC trains, on section Heidenau – Stradov every two hours an R train Dresden – Teplice is proposed from 2038. However, from 2046 this shall be optionally replaced through a Sprinter (SPR) Dresden – Prague on MD's demand. This might be feasible if the same time slot (directly attached to the EC) is used, will without implementation of Goes station however otherwise result in a limitation of freight capacity as illustrated in Fig. 2 below:

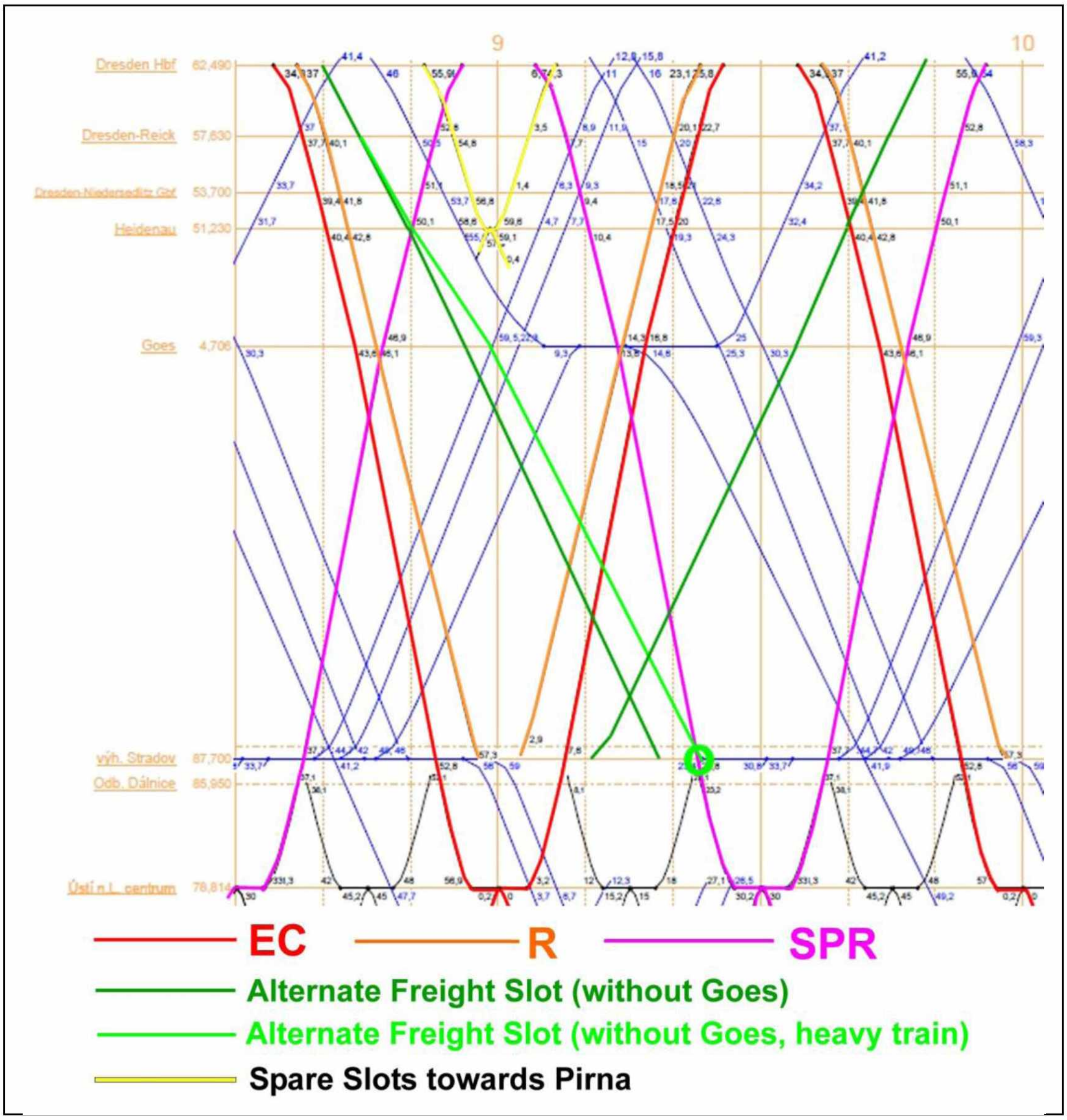


Fig. 2 – Conflict of SPR and freight trains between Goes and Stradov

It is recommended to base the relevant decision on a detailed time table study to be carried out jointly with DB Netze.

3.3.6 Chapter 8 of Vol. A_01 includes some summary tables on capacity but does neither provide any source data nor evaluate on details. We note that for section Heidenau – Stradov the optimum capacity value will used to 100% under the assumption that Goes station can be implemented. For the existing line Děčín – Schöna usage may exceed the optimum (but not the critical) value before the new line is put into operation. For section odb. Oleško – Lovosice on the existing line 090, a usage of 109% of the optimum value is assumed before the Litoměřice tunnel is operational. For some sections, calculations are yet to be completed. No station capacity has been investigated so far.

Detailed capacity assessment should be completed at an early stage, and operating programme and/or infrastructure adapted accordingly. In particular, such assessment based on final design and operating programme is required for HRS section Polepy - Ústí nad Labem (Litoměřice Tunnel) as basis for review or justification for the considerable investments at Polepy[5].

3.4 Crossovers and diversion possibilities

3.4.1 The study does not evaluate permeability during exclusion of one track from operation due to irregularities or for maintenance. Locations of proposed crossover connections and the resulting length of single-line operated sections can be seen from Fig. 3 and Fig. 4 below.

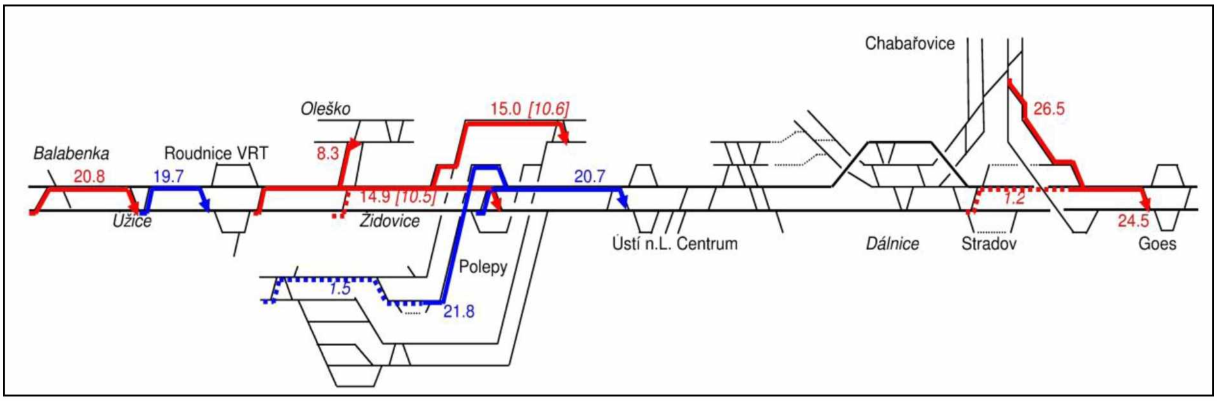
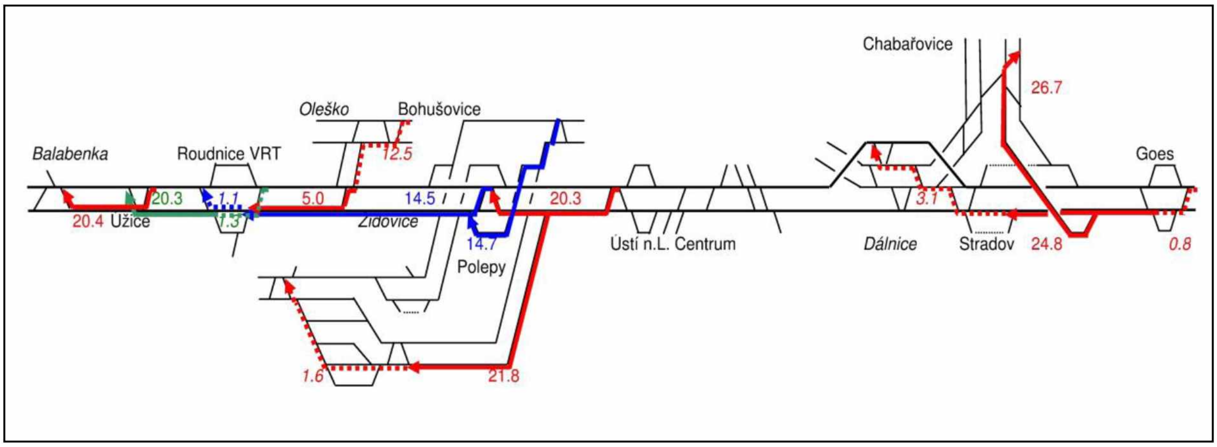


Fig. 3 - Single-line operation lengths direction Praha - Dresden



[5] 5049 mCZK (including risk component)

3.4.2 With resulting single-line operation lengths of about 20 kilometres, the arrangement of crossovers seems appropriate though diversion of part of the trains will be required at least during peak hours. One should be aware that at Polepy and Stradov track groups of the opposite direction will have to be used also within stations.

During further planning stages, lockout permeability should be compiled and crossover arrangement be optimised as far as required.

3.4.3 Diversion possibilities are not evaluated at all. Both crossovers and diversion possibilities are essential for major maintenance or renewal works (in particular if fixed track instead of a gravel bed is used), as well as in case of major emergencies, as occurred in the past within the European high speed network in several cases.

It is recommended to further address the issue accordingly.

4. CBA assumptions and outcomes

4.1 Basic assumptions and outcomes in the final SŽ CBA

4.1.1 According to the final updated SŽ model (including correct inclusion JASPERS freight modelling outcomes), EIRR is 7.9 % and NPV +46 billion CZK with a benefit to cost ratio (BCR) of 1.58. Net CO2 reductions over the project life-time are 2.2 million tonnes.

4.1.2 The largest share of project benefits are related to saved car and truck travel vehicle costs and time savings, followed by saved external cost (of mode-shifted car and truck traffic). The largest share of time savings value are related to existing public transport traffic (rail and shifted bus), followed by induced passengers and then mode shift of passengers transferred from car. The latter 2 form a substantial part of the time savings.

4.1.3 If passenger mode shift from rail to car is eliminated from the SŽ final CBA, the resulting NPV is -33.7 billion CZK with a BCR of just 0.6. The economic outcome is therefore highly dependent on the volume of car-rail mode shift as the critical assumption.

4.1.4 SŽ in its updated final CBA output has made the following notable assumptions :

- Investment and operational costs scope on Czech territory only, excluding the part of the tunnel on the German side (cost estimate circa 40 billion CZK).
- Benefits calculated for the whole project to Dresden, however with reduction of time and externality benefits to take into account the Czech side only technical scope by a factor of 0.902 (related to relative time savings and traffic volumes).

4.1.5 The project as conceived is however clearly an indivisible economic unit between Prague and Dresden and the only valid approach is to make a complete assessment of this including all costs and benefits.

4.1.6 We note that any economic analysis to be presented for EU funding for example EIB loans will certainly require a CBA covering the Czech and German side of the project together both in terms of costs and benefits.

4.1.7 Regarding electric rail traction and CO2 emissions as previously reported for other recent studies, the Czech national CBA methodology massively underestimates the real unit GHG emissions of electric trains (which should include emissions related to electricity production), in the case of HS trains probably by two orders of magnitude (Czech national methodology states 77 gCO2 / train km).

4.1.8 The following values, which we have calculated based on the Czech electrical energy production mix and estimates of traction requirements of high speed trains for Prague-Brno and other international literature, would be closer to the reality of the Prague-Dresden case.

Czech train				
Train 6	Train 8 200	Train 8 250	Train 8 320	
160	200	250	320	speed km/hr
12.1	14.7	18.2	25.4	kWh/trainkm
6,183	7,523	9,275	12,985	gCO2/trainkm
29	35	44	61	Traction cost CZK/trainkm

Table 4 – realistic electric traction and CO2 emissions for electric passenger trains

4.2 JASPERS own sensitivity assessment of CBA outcomes

4.2.1 JASPERS has made a sensitivity analysis of the SŽ final economic CBA using the following alternative values reflecting our comments above and in the chapter 2 on demand and with a couple of further corrections :

- use of a reduction factor (0.77) of calculated benefits equal to the (SŽ) estimated proportion of Czech territory investments with respect to total Prague-Dresden investment costs,
- reduction of car-rail mode shift volume by 1/3 (see chapter 2.1),
- reduction of induced rail traffic by 1/2 (see chapter 2.1),
- use of correct C02 emissions values for passenger electric traction approx. as above (increase factor between 80-120 compared to the national methodology),
- use of correct C02 emission values for freight electric traction (increase factor of approx. 30 compared to the national methodology),
- perceived time savings increased by factor of 1.3 to include uncounted perceived impacts of planned increased service frequency, which are significant in this project.

The EIRR in this case is now just over 5 %, BCR = 1.026 and NPV 2 billion CZ, while project life-time net CO2 emissions reductions are reduced from 2.2 to 0.7 million tonnes.

4.2.2 A further scenario building on the one above was also considered with :

- freight truck-rail mode shift tripled to 11 trains per day due e.g. to capacity limitations becoming clear on the existing alignment on the German side of the line,
- passenger car-rail mode shift and induced traffic is further halved to 1/3 of the model estimate and 1/4 of the model estimate respectively in a more pessimistic but still plausible outcome.

The EIRR in this case is still just over 5 %, BCR at 1.03 and net CO2 emissions reductions increase to 0.9 million tonnes. Passenger traffic volumes fall to 50-60 % of the model forecast estimates.

5. Environmental analysis

5.1.1 Cumulative impacts with other plans/projects were not considered and assessed in the study, which in case of such a major investment is an important task.

5.1.2 Transboundary issues together with the German part of the plan are not discussed/considered/taken into account in the study.

5.1.3 We recommend that cumulative impacts and transboundary issues are carefully addressed going forward with project preparation.

6. Climate (change) resilience and adaptation assessment

6.1.1 We note that the climate resilience assessment is not prepared in line with a recognized international methodology. *We recommend the climate assessment should be updated going forward to ensure that the final design has sufficient adaptation to future climate risk.*

7. Main outcomes, conclusions and recommendations

The following chapter summarizes the content and outcomes of the study and provides clear recommendations for further action related to the project development and more generally. Recommendations are aimed at various stakeholders including SZ, MoT and SFDI, corresponding to areas of responsibility.

7.1 Main conclusions

Technical, operations, cost and options analysis

7.1.1 The technical solution and operating programmes for the preferred Option 2 appear to be basically sound and consistent and the main critical design issues identified by JASPERS and other stakeholders in the October version of the study have been addressed (see chapter 1). However, a number of key details still need to be addressed. See chapters 3.4-3.6 and recommendation 7.2.3 below.

7.1.2 However, the scope of options analysis prepared in this study does not allow us full assessment of whether the optimal option has been chosen by considering all relevant criteria and plausible sub-options (see chapter 1.1).

7.1.3 The investment and operations costs estimates appear to be reasonable based on the limited information provided. Investment costs at circa 140 billion CZK (Czech territory part) however may represent a major challenge of affordability even in the medium-term considering other commitments already made for the railway sector.

Demand forecasting and project impacts

7.1.4 The passenger demand assessment and its outputs to the CBA are now clearly and consistently related to the Czech national transport model after some recalibration based on data collected for the study. Forecast traffic on the line for 2050 varies from circa 15-40 000 passengers per day, which is almost 4 times the current level of rail traffic with a large proportion of induced rail traffic and car-rail mode shift (see chapter 2).

7.1.5 In line with previous assessments and concerns expressed by JASPERS, the national passenger transport model is probably however somewhat systematically over-optimistic in its calculations of car-rail mode shift and induced transport forecasts, which is also apparent when the outcome is compared with reference high speed line cases from other countries. We addressed this concern with sensitivity analysis of the SŽ CBA (see chapter 4).

7.1.6 The study now correctly includes a documented model of potential for freight mode shift from truck to rail, indicating a potential to add circa 4 trains a day by 2050 just based on the increased attractiveness of the line due to the Krušnohorský tunnel. This forecast was, exceptionally, prepared by JASPERS using its own methodology and experience based on base case input data from the new Right Bank corridor study freight model prepared by SUMP.

7.1.7 In the case an objective freight capacity limitation (e.g. related to noise limits) is proven on the existing alignment on the German side of the corridor, the freight mode shift impact could be significantly higher.

Socio-economic justification

7.1.8 The socio-economic case for the project is shown in the final CBA by SŽ to be positive with a nearly 8 % socio-economic internal rate of return. However the result is highly dependent on passenger mode-shift from car, does not take into account the full investment and operations costs of the project through to Dresden and highly underestimates the CO2 impacts of the project itself (see chapter 4).

7.1.9 Based on the assessment of inputs, JASPERS has made a sensitivity analysis of the SŽ final CBA with a 1/3 reduction of car-rail mode shift compared to the model and a 1/2 reduction of induced traffic, correct treatment of CO2 and a reduction of benefits to proportionately reflect the missing German estimated investment costs.

This led to an economic performance just over the 5 % discount rate with total passenger rail traffic volumes approximately 70 % of the modelled traffic estimate.

7.1.10 Further building on this sensitivity test : if freight mode shift is tripled to 11 trains per day in the case of a proven capacity bottleneck on the existing alignment but mode shifted car traffic and induced transport are both further halved (a more pessimistic but plausible scenario), the project remains with a rate of return just above the discount rate but with passenger traffic now closer to 50-60 % of the modelled traffic.

7.2 Recommendations

7.2.1 Considering the critical roles of passenger car-rail mode shift and freight truck-rail mode shift in justifying the project, consolidated and focused effort should be made to maximise both in further project preparation:

- Optimise the car-rail mode shift potential by preparing a comprehensive P+R concept and national level soft mobility management (e.g. with targeted marketing and educational campaigns aimed towards current car travellers).
- Protect the key affordable tariff policy for Czech high speed lines, which will maximise project use and thus benefits (ideally by legislation).
- Maximise usability of the project for freight transport both for the Krušnohorský and Středohorský tunnels. Substantial costs are included to enable freight transport and its potential should not be compromised by overly maximalist passenger operations proposals.
- Fully engage in making international rail freight more attractive for customers on the corridor including operational and organisational policy interventions to improve the whole door-to-door freight chain.

7.2.2 Demand modelling and CBA considerations :

- Complete the ongoing review and update of the national passenger model based on the national mobility survey already performed and the national freight transport models including review/inclusion of developments such as the international freight model used for recent feasibility studies.
- Include the Středohorský tunnel in the freight mode shift assessment once the operating concept is stabilised.
- Once all costs are known with more precision on the whole line, change the perspective of the CBA to all European costs and benefits. The project is European cross-border in nature and is basically indivisible to the national level.

- It is advised to update the national transport CBA methodology (general update process is ongoing) to, inter alia, correctly take into account green-house gas emissions and include an extended section on assessment of freight transport.
- Recalculate the CBA at a later date in accordance with these revised assumptions.

7.2.3 Although the technical solution and operating programmes seems now basically sound and consistent after changes based on comments of JASPERS and other stakeholders, a number of conceptual tasks remain to be completed in further project development : in particular the conceptual operational and technical uncertainties and risks described in points 3.4-3.6 of this note should be addressed as soon as possible :

- Remaining dependencies on the solution on the German side of the border
- Adaptation to the final chosen solution for the Prague node (after the Prague node study ?)
- Review/assess the R20 proposal and "Žernosecká spojka"
- Develop a final operating programme for Dresden - Ústí nad Labem on the basis of a detailed time table study to be carried out jointly with DB Netze
- Detailed capacity assessment for all lines concerned (HSR and existing)
- Assess and develop lockout permeability, crossover arrangement and diversions possibilities

7.2.4 Prepare a climate change resilience assessment in accordance with an internationally recognised methodology. This assessment could still provide design and operational climate adaptation measures going forward.

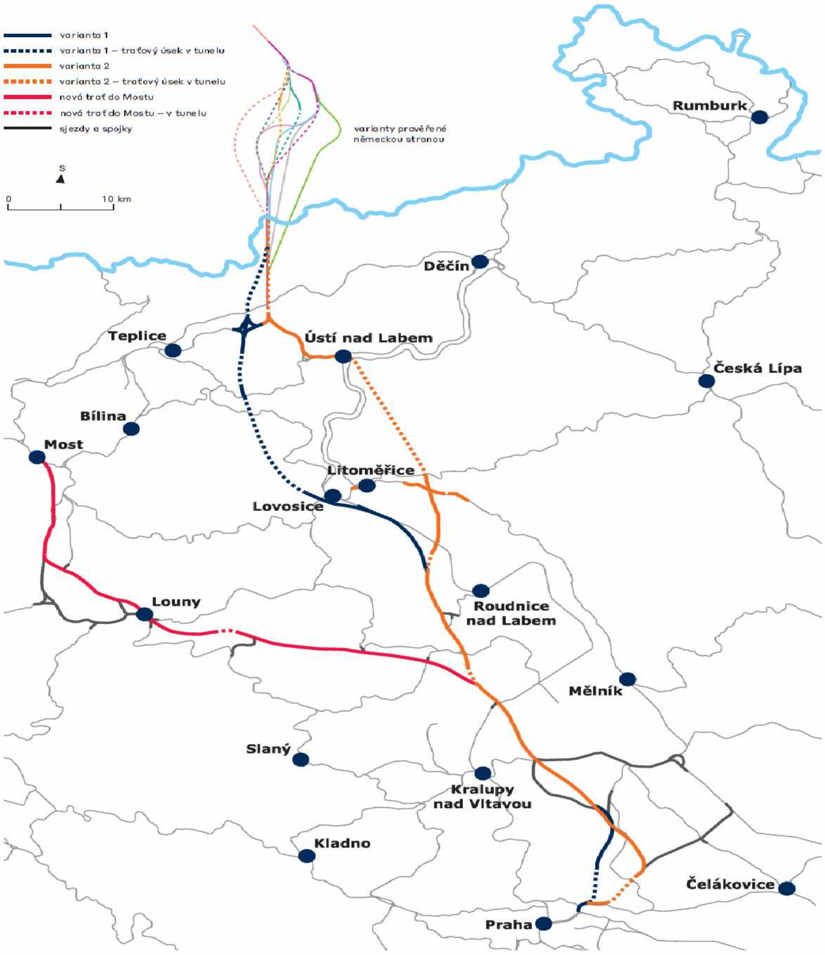
7.2.5 The following key environmental issues should be addressed carefully going forward :

- Cumulative impacts with other plans/projects.
- Transboundary issues together with the German part of the project.

7.2.6 We recommend generally in future studies at conceptual stage to improve the approach to considering potential environmental issues in options analysis by including an identification and more in-depth assessment of the key environmental issues per option rather than just counting the number of potential conflicts as a basis for option comparison.

Annex I : Options considered in Stage I of the feasibility study

A conceptual scheme of the options and table of trip time savings per option (variant) on key relations can be seen below (bez project = without project option).



Jízdní doby mezi důležitými zastávkami jsou zobrazeny v následující tabulce

Relace	Bez projektu	Varianta 1	Varianta 2
Praha – Ustí nad Labem	1 :05	0 :37	0 :25
Praha – Drážďany	2 :00	0 :47	0 :51
Praha – Decin	1 :21	1 :05	1 :10
Praha - Teplice	1 :23	0 :53	0 :39
Praha – Roudnice nad Labem	0 :49	0 :23	0 :18
Praha – Litoměřice	1 :08*	0 :50*	0 :28
Praha – Lovosice	1 :01	0 :35	0 :36
Drážďany – Teplice	1 :30	0 :28	0 :29
Drážďany – Usti nad Labem	0 :53	0 :29	0 :24

* není přímé spojení

Tabulka 6-1 Jízdní doby mezi důležitými zastávkami pro všechny varianty