

Pre-feasibility study Stockholm - Helsinki using Hyperloop One technology

Short summary

July 2016

Executive summary

The pre-feasibility study has analyzed the Stockholm-Helsinki fixed link from three different aspects:

- Cost and benefit
- Technical
- Legal

The Stockholm – Helsinki corridor is estimated to 500 km, with 11 stations spread out along the route – and with Hyperloop One technology, journey times between the two capital cities will be dramatically reduced. It will only take approximately 28 minutes to travel between Stockholm and Helsinki, in effect creating a new Nordic super-region, where it will be possible to live in Sweden and work in Finland – and commute on a daily basis.

Preliminary calculations of the Stockholm-Helsinki corridor, including Hyperloop One system, is estimated to cost 13 EUR Billion (CAPEX), whereas the total CAPEX, including gliding stock, risk, overhead and allowances is estimated to 19 EUR Billion.

First indications show that the Stockholm – Helsinki corridor has a strong potential to result in a positive economic case. Preliminary transport economics modeling show that Value of Time benefits will add almost 25 Million hours per annum saved due to substantial reduced travel times.

The corridor consists of three main technical solutions – tube dug down, on pylons and sub sea tunnel depending on geotechnical prerequisites.

There are many legal aspects that need to be further addressed. Permission, the right of way and taxation and social benefits are some examples. However, regarding legal obstacles, no insurmountable barriers can be identified at this stage.

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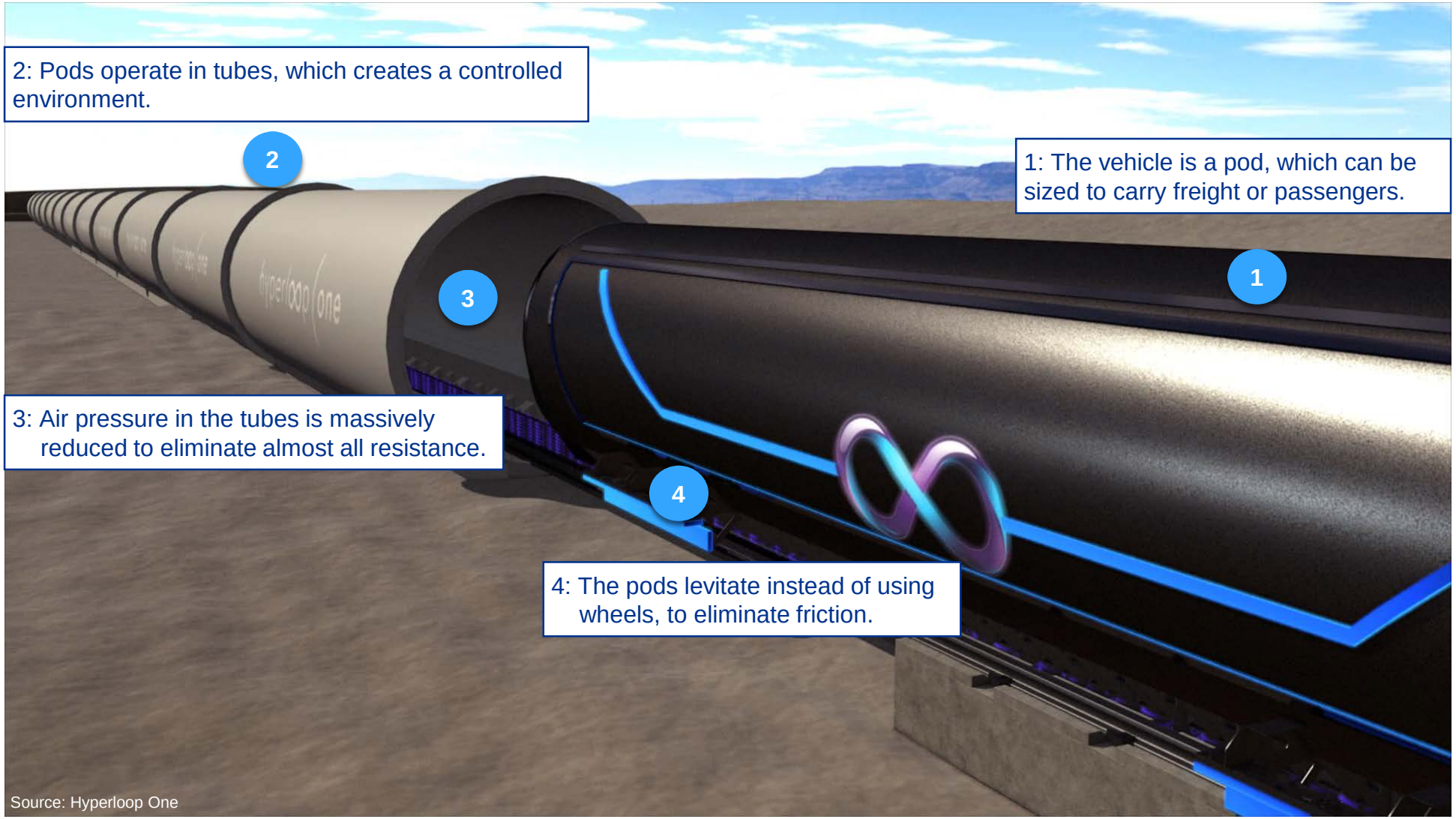
What is Hyperloop One?



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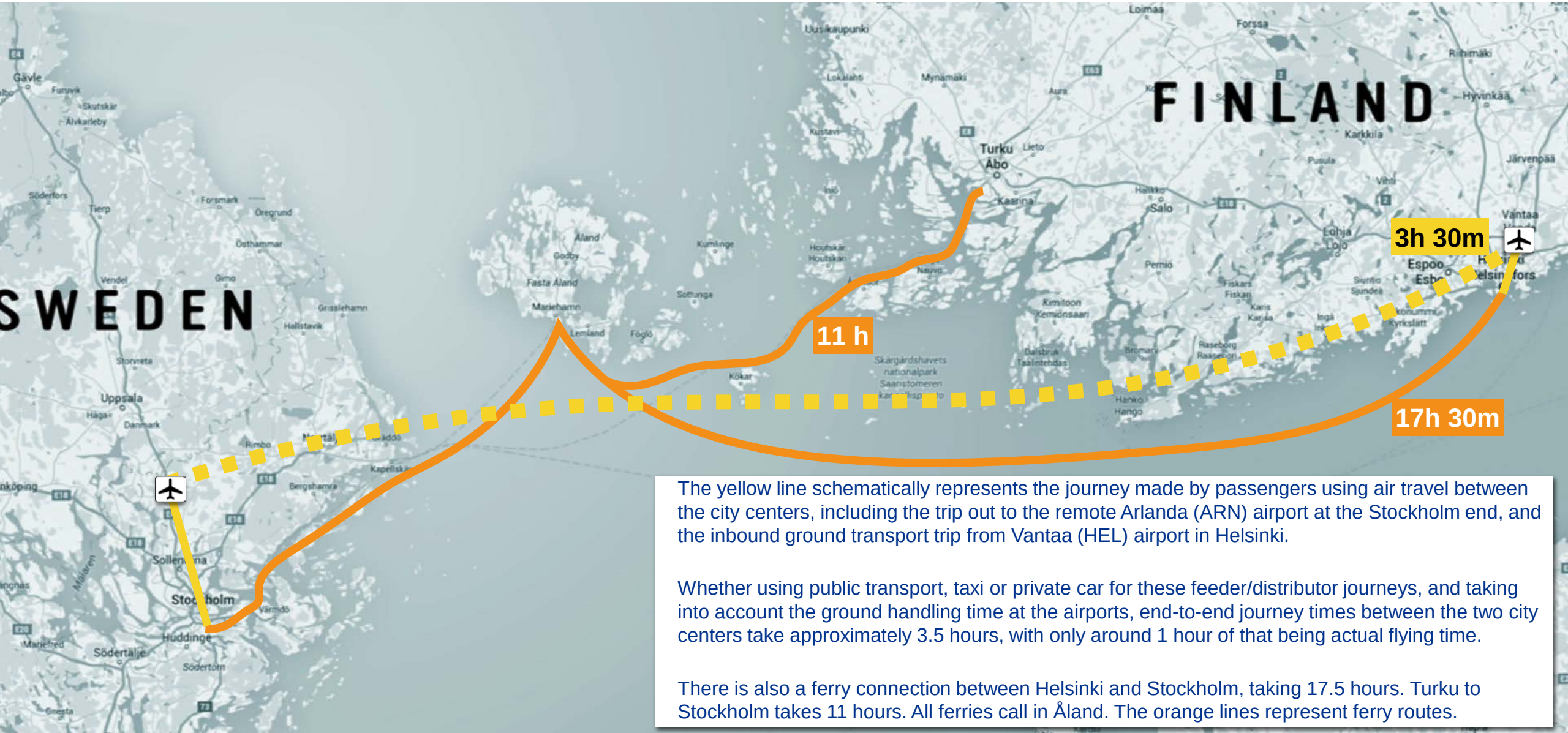
Current travel times between city centers are extensive



The yellow line schematically represents the journey made by passengers using air travel between the city centers, including the trip out to the remote Arlanda (ARN) airport at the Stockholm end, and the inbound ground transport trip from Vantaa (HEL) airport in Helsinki.

Whether using public transport, taxi or private car for these feeder/distributor journeys, and taking into account the ground handling time at the airports, end-to-end journey times between the two city centers take approximately 3.5 hours, with only around 1 hour of that being actual flying time.

There is also a ferry connection between Helsinki and Stockholm, taking 17.5 hours. Turku to Stockholm takes 11 hours. All ferries call in Åland. The orange lines represent ferry routes.

Substantially reduced travel times will change the future landscape



This schematic shows the potential trip times achievable by Hyperloop One over the FS Links route.

All Hyperloop One trips are non-stop between any departure point and any other arrival point. Hyperloop One pods do not make stops at intermediate stations.

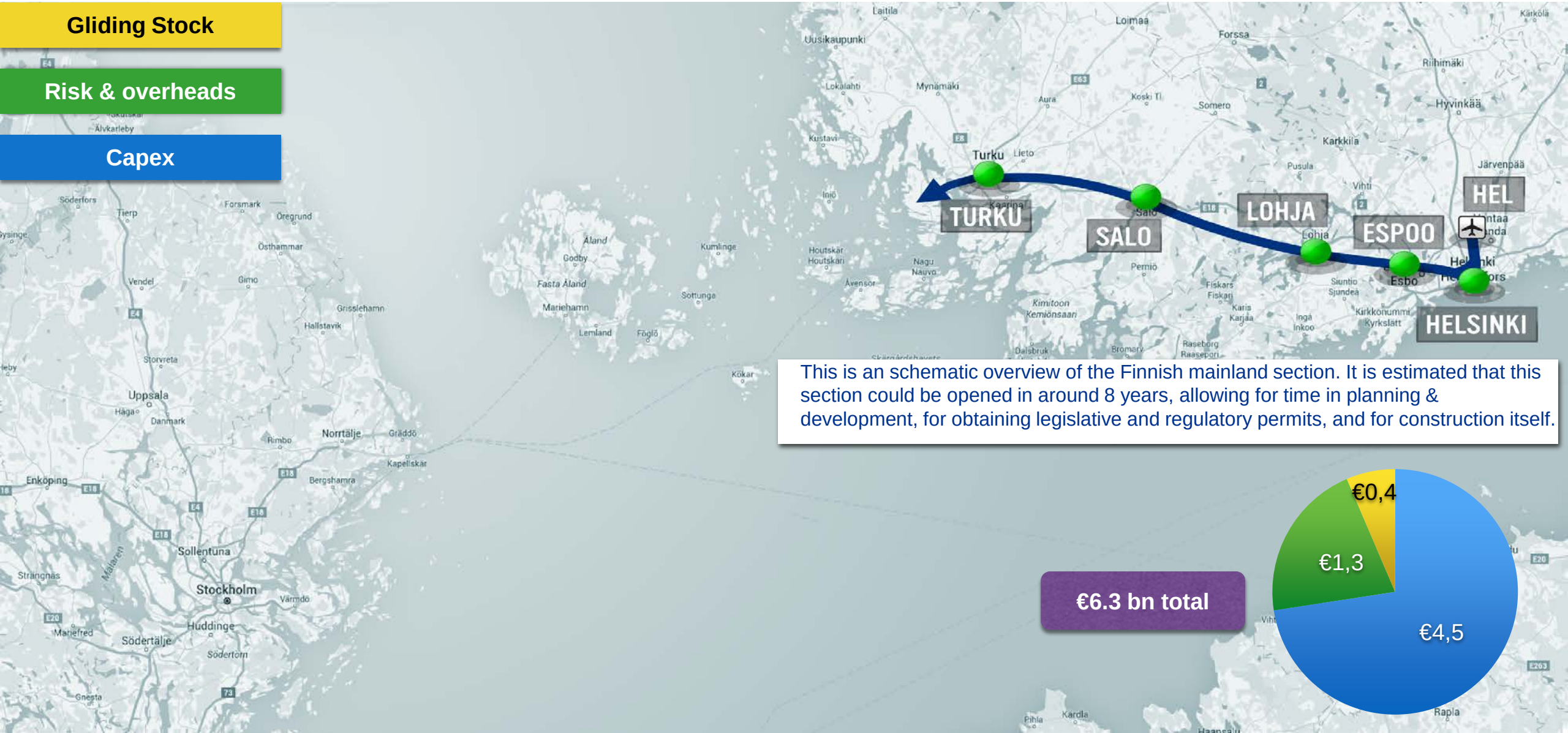
All trip times stated allow for acceleration and deceleration.

The Stockholm – Helsinki corridor can be built in stages (1/3)

Gliding Stock

Risk & overheads

Capex



This is an schematic overview of the Finnish mainland section. It is estimated that this section could be opened in around 8 years, allowing for time in planning & development, for obtaining legislative and regulatory permits, and for construction itself.

€6.3 bn total

The Stockholm – Helsinki corridor can be built in stages (2/3)

Gliding Stock

Risk & overheads

Capex



This schematic adds the Swedish mainland section. Again, this section could be opened in around 8 years. All trips on the Swedish section take less than 10 minutes. The network design will be evolved to incorporate Hyperloop One stations at all locations where major development will take place. With such short commutes, these places will effectively become part of Stockholm itself. Major property value uplift can be expected, and should, in that case, be captured to part-fund the infrastructure.

€4.5 bn total

The Stockholm – Helsinki corridor can be built in stages (3/3)

Gliding Stock

Risk & overheads

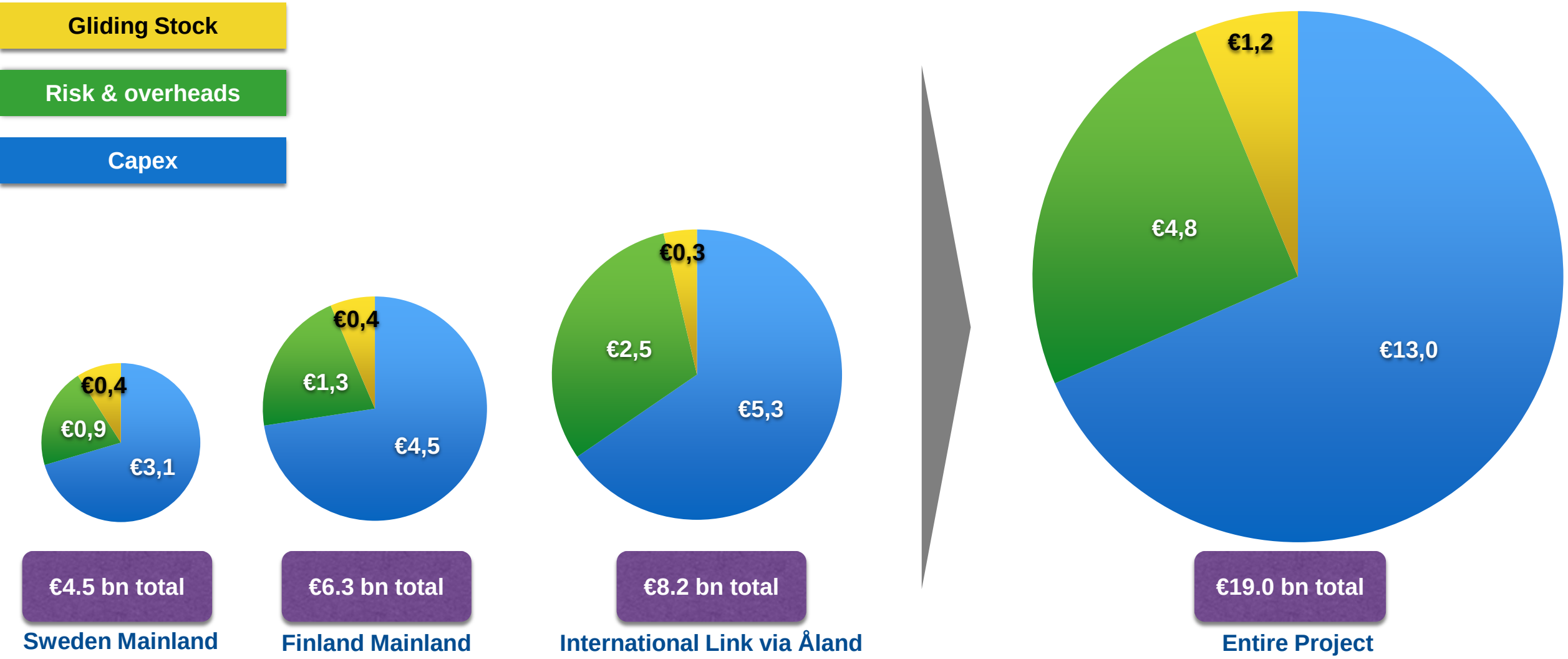
Capex



This schematic adds the International Link, which is a sub-sea tunnel between the Finnish to the Swedish coasts, with a terminal in Åland. This section could open for traffic approximately four years after the mainland sections. The mainland sections are thus generating revenue and delivering strategic benefit before the International Link enters service. Completion of the International Link enables the entire Stockholm to Helsinki super-region to function as a single economy. It becomes possible to live in Sweden, work in Finland – and easily commute on a daily basis.

€8.2 bn total

The complete Stockholm – Helsinki corridor is estimated to €19 bn



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Estimated Opex, Revenue & Value of Time benefits

This table summarizes the main commercial results forecast for each of the two mainland sections as standalone projects, and for the entire project when the International Link tunnel is completed and joins the two mainland sections together.

The strong ridership on the Swedish mainland section is a result of converting many existing commuters to Hyperloop One and also capturing a major part of the new commuter homes that will be enabled by Hyperloop One stations along the Swedish mainland route*.

Note also the low average fare levels, using conservative uplifts on current fares on other modes. This strategy maximizes ridership.

Øresund precedent suggests that a massive increase in international commuting will take place. We expect the scenario shown here to prove conservative, with significant upside to be expected.

Value of Time benefits are based on Swedish and Finnish national guidance for transport economics modelling. VoT will be a key factor in economic benefits appraisal.

Operating Profit and Value of Time Overview

All monetary values in Euro All data at Stabilised Year of Operation per sector	Sweden Mainland	Finland Mainland	Entire Project Finland & Sweden
Total corridor length (route km)	136	158	500
Ridership: passenger trips per annum	21 994 420	13 373 500	42 706 038
Total revenue	**€394 554 226**	**€246 887 375**	**€1 071 189 255**
Average revenue per single Hyperloop trip	*€17,94*	*€18,46*	*€25,08*
Operating costs	€95 009 619	€91 318 594	€217 887 400
Maintenance costs	€23 256 265	€29 358 178	€38 543 198
Total O&M Costs	€118 265 884	€120 676 772	€256 430 598
Operating Profit	**€276 288 342**	**€126 210 603**	**€814 758 657**
Time savings per annum (hours)	13 140 115	8 481 446	25 380 982
Value of Time benefit	€140 552 197	€103 755 664	€321 713 481
Total Operating Profit and VOT savings	**€416 840 539**	**€229 966 267**	**€1 136 472 138**

*Source: SvD Näringsliv Debatt (30th of May 2016), KMPG Analysis

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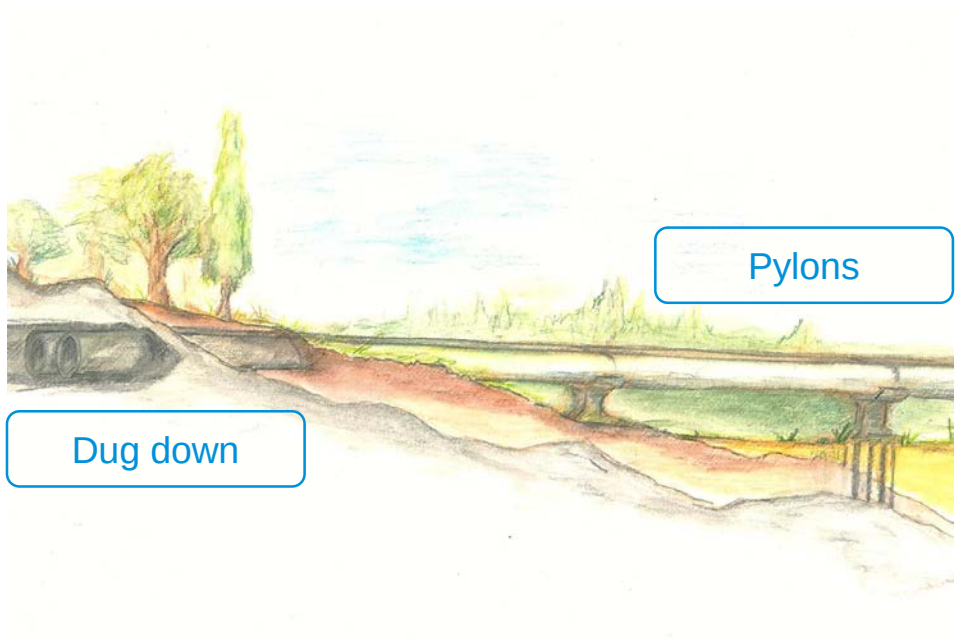
The 500 km and 11 station corridor will consist of three main technical solutions





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Summary of legal considerations

To enable the building of the link we see many different legal considerations and questions that have to be solved

- The link will most likely be built in two phases, the Swedish and Finnish corridors and the International corridor. This means that most of the international legal questions have to be considered in phase two. Before the second phase can begin, agreements between the two states and Åland are needed.
- There are various ways to finance the project and different models are possible. However, since legal considerations, government approvals and other governmental interactions are needed throughout the project, we are preliminary of the opinion that the best way forward is a cooperative alternative between Sweden/Finland, Hyperloop One and maybe other parties as well.
- In order to structure the link as a cooperative project and to enable different investors in the project, procurement legislation and conflict of interest questions need to be considered.
- It is also crucial to start discussions with the governments at an early stage since adjustments to existing legislation most likely are needed. Hyperloop One is the 5th mode of transportation which means that there is, neither in Sweden nor in Finland, any legislation regarding this type of transportation. However, implementation of new legislation is complex and time consuming. We would therefore be inclined to propose adjustments to existing Railway Acts.
- To enable the building of the fixed link several permissions are needed. A thorough impact assessment on nature is needed and has to be approved in both Sweden and Finland. In the second phase, when the tunnel under the Baltic Sea is built, the same assessment has to be done off shore.
- The right of way needs to be discussed with land owners. Expropriation can be a way forward.
- Taxation and social benefits are also major question in this project. Åland has a special tax exemption in the EU.

As a whole, many different legal aspects and new questions will be added in the different phases of this case. However, regarding legal obstacles, no insurmountable barriers can be identified at this stage.

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The time, from feasibility study to completed construction, is estimated to 12-15 years (incl. construction time of 8 years)

High-level time plan from feasibility study to completed construction

- Detailed design, Legal and Procurement: 3 – 4 years.
- Environmental permits, land take: 3 years.
- Construction: 8 years.
  - Tunnel boring 2 parallel tunnels diameter 6,5 m.
  - Pylon production and Hyperloop tube logistics: in parallel with tunnel boring.
- Total: 12-15 years.

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