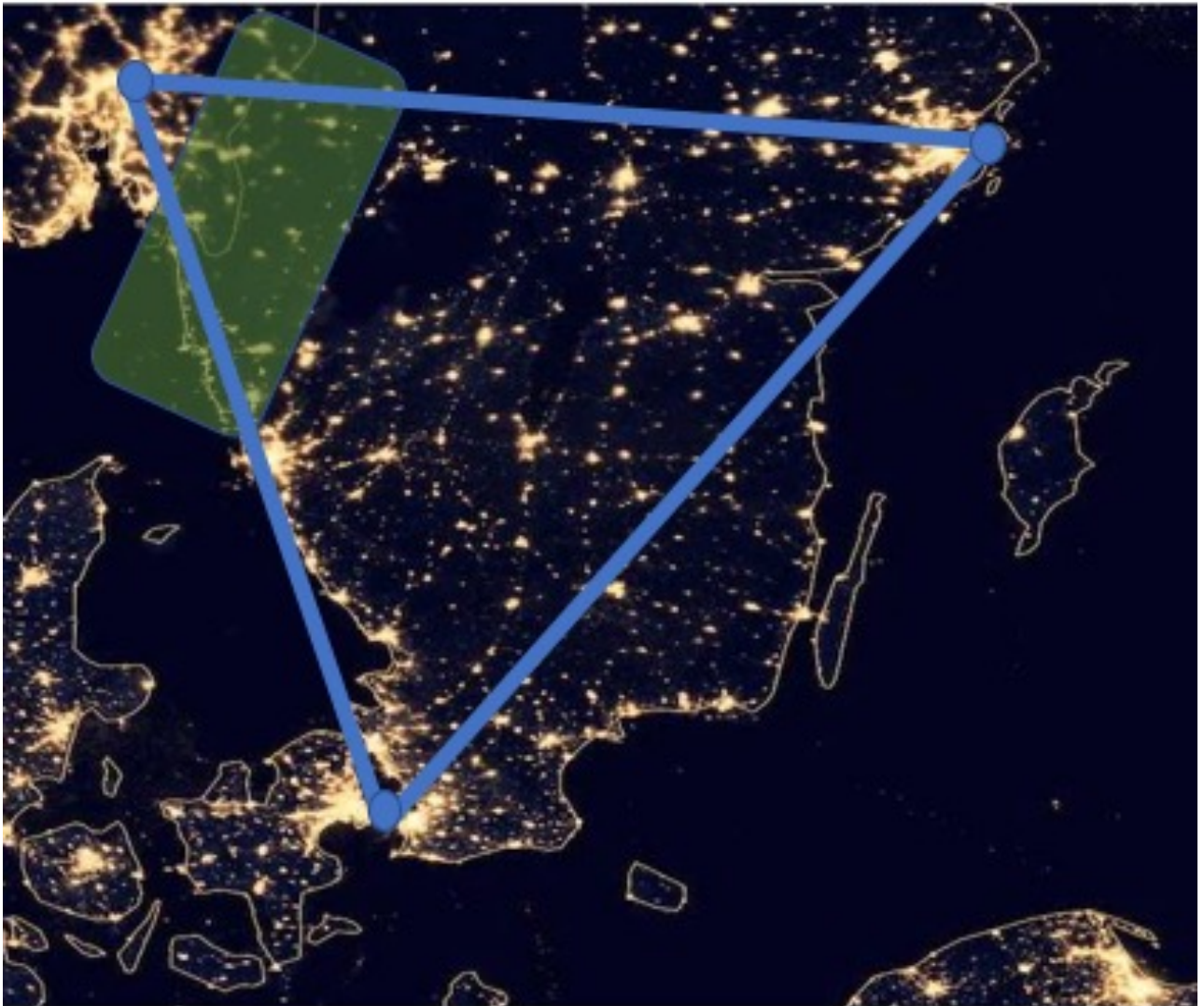


# PILOT TASK 4.1

## CENTRAL SCANDINAVIAN BORDERLAND

### FINAL REPORT



## Foreword

This report is the final summary of the TENTacle pilot task 4.1 Central Scandinavian Borderland. It contains description of the project implementation. Based on the current background, trends, challenges and opportunities, the report outlines some possible development steps which will impact not only the borderland but the Oslo region, the Nordic Triangle and beyond. There is a scenario based on improved transport infrastructure and finally a development strategy of the borderland.

The report is based on a whole range of literature studies, meetings and conference inputs. There is no overall reference list to external sources. However, the source is mentioned in the text, when relevant.

There are many people who contributed to this report and to the project result. The project management team in Blekinge region was very helpful and it was a pleasure to work with all the TENTacle partners. A special thanks to the communication team at Hafen Hamburg Marketing.

The final report is inspired by the work of Leif Lendrup and Urban Hermansson in Transnorden Sweden. They offered good cooperation and did a great job with the Karlstad Prosperity and Growth reports. Another close partner in this case was the Innovation Circle Network, which put the global perspectives in focus and helped to disseminate the findings from this task.

Without the many inputs from external experts we could not deliver this report. A range of analyses, experience and inputs were conveyed to us. We appreciated the good dialogue with politicians and others representing the government in Norway, Sweden and other countries.

Last but not least I want to express a big thanks to the Nordic cooperation, to the Nordregio research team and to my good colleagues within Nordic cross-border cooperation. Learning from each other make every region stronger. And during the last years we learned to cooperate on the Nordic territorial development, as a united team searching for sustainable ways ahead. There is still a lot to do, so this report is hopefully a contribution.

We also have to thank the many volunteers, including the think tank TGB2025, who contributed to the discussions and had valuable inputs about regional development, railways, roads, financing and governance.

March 2019

Alf S. Johansen  
Project coordinator  
Grensekomiteen Värmland-Østfold  
Vangsveien 10, 1803 Askim, Norway  
[www.varmost.net](http://www.varmost.net)

## Contents

		Page
1	Background	4
2	Actions and deliveries	5
3	The growth and development of the Central Scandinavian Borderland	7
3.1	Round table	7
3.2	Recommendations	8
4	Follow up from the round table report	9
4.1	Nordic transport cooperation	9
4.2	Research and analyses	10
4.2.1	Railways, legal framework and funding	10
4.2.2	The Karlstad region study	12
4.3	Development and planning of better railways	15
4.4.	HSR alternatives in the Nordic Triangle Perspective	15
4.4.1	HSR alternative 1, Oslo-Stockholm/Copenhagen	16
4.4.2	HSR alternative 2, Oslo-Stockholm	18
4.4.3	Slab track all the way	19
4.4.4	Flexible stop and high frequency of trains	19
4.4.5	Oslo-Gothenburg-Copenhagen, 8-million city	20
4.5	Improved conventional railways, alternatives to HSR	23
4.5.1	Kongsvinger-Karlstad	23
4.5.2	New railway link Mysen-Arvika	24
4.5.3	New railway link Lilleström-Arvika	25
4.5.4	Missing link Halden-Trollhättan	26
4.5.5	Climate perspectives and transport infrastructure	26
4.5.6	The Oslofjord connection	28
4.5.7	The 1-hour region, “The Scandinavian Diamond”	29
5	Scenario - Central Scandinavian Borderland with new railways	34
6	Strategy	37

## 1. BACKGROUND

The Central Scandinavian Borderland pilot case is one of a few pilot cases within the TENTacle project. It was expected to deliver following results/outputs:

### 1.1 Main expected result:

A growth and development strategy for the Central Scandinavia borderland with good connections to the TEN-T core network.

### 1.2 Expected key outputs:

- A. A borderland growth and development scenario for motivating infrastructure investments within the Central Scandinavia borderland well connected to Nordic capitals and Ten-T core network.
- B. Prosperity and Growth Strategy for the Karlstad region developed by NGO's and civic society
- C. Competence development through transnational networking with the other TENTacle partners and learning from other regions in Europe.
- D. A borderland conference with focus on the Central Scandinavia and with presentation of the growth and development outputs from TENTacle.

### 1.3 Expected outcome:

1. Increased awareness and competence among decision maker and the civic society about the Ten-T core network and European strategies
2. Increased competence about new transport technologies and concepts from international expertise in Europe and Asia
3. The missing link between Örebro and Oslo will be highlighted and revived into the Ten-T core map at the next revision
4. Learning from the other pilots and other BSR project through international networking and sharing the borderland pilot case with others.
5. A better understanding of the Central Scandinavia borderlands' challenges and growth potential among multilevel partnership and decision makers
6. A better foundation for planning and decision making about future infrastructure investments within the borderland

### 1.4 Organisational set-up:

<b>Core partner</b> (coordinating the work in the given geographical area)	Grensekomiteen Värmland-Østfold, PP10 Vangsveien 10. 1803 Askim, Norge
<b>Cooperating TENTacle partner(s)</b> (responsible for specific assignments)	Transnorden Sweden, PP14 Båtsmannsg 15 Kristinehamn, Sverige
<b>Associated partners and partners to be consulted</b>	Osloregion, Oslo City Council



	Østfold County Council and regional bodies in Østfold and Akershus/Hedmark Regional bodies in Värmland and Västra Götaland Municipalities within “Central Scandinavia Borderland” National authorities for roads and railways Industrial organisations /chambers of commerce External Experts and private actors Nordic bodies
--	--

## 2. ACTIONS AND DELIVERIES

Here is a short list of the main actions implemented within the pilot task 4.1:

### 2.1 Events organized by PP10

1. Tentacle pilot case 4.1, Kick off conference in Kristinehamn, 24-05-2016
2. Round table in Oslo, 13-03-2017
3. Seminar at Voksenåsen in Oslo, 22-05 2017
4. Workshops with Nordic Cross-border Committees and Nordic Council representatives at Arlanda 17-01-2017 and 01-06-2017
5. Workshop in Askim, with focus on HSR with international links, 08-01-2018
6. Workshop in Oslo, presentation of the case 01.10.2018

### 2.2 Reports delivered by the pilot case

7. 5 thematic maps about cross-border transport infrastructure initiatives (produced by Nordregio), 2017 (En), in cooperation with the cross-border councils' working group
8. Round table report with strategy recommendations, by Cliff Hague and Øivind Holt, 2017(En)
9. Oslo-Stockholm/Copenhagen High-Speed Railway, report from Tüv-Süd, 2018(Sw)
10. Oslofjord HSR connections, report from Tüv-Süd, 2018(Sw)
11. 3 min. video about the Oslofjord HSR connections, 2018(No/Sw)
12. Baseline report from Transnorden, The Karlstad Region Prosperity and Growth (Sw/En)
13. Strategy report from Transnorden, about Karlstad Region Prosperity and Growth (Sw/En)
14. Models for financing and organization of cross border railway structures, TEG 2018 (No)
15. Nordic region and Ten-T, input to the consultation «Streamlining the implementation of the Trans-European Transport Network (TEN-T), TEG 2017 (No)
16. Model for financing of border crossing railway Ski/Askim/Mysen and Arvika/Årjäng/Karlstad, TEG 2019 (No)
17. Nordic High-Speed Railways, thematic report, AJ 2019 (No)
18. The Growth and Development strategy report for the Central Scandinavian Borderland, final case summary report, AJ 2019 (En)

### 2.3 External meetings, group discussions and presentations

More than 50 meetings with Nordic, national, regional and local authorities, experts and stakeholders. Meetings with EU representatives (Pat Cox and others), more specified in the separate reports.

### 2.4 Communication actions

Generally spoken there has been drawn a quite big attention towards the issues addressed by the pilot case and to the initiatives taken by the case. Especially there was a big attention about the possibility and interest for private investments, even from outside Europe.

Information about the case actions and reports can be found under the webpage: [www.varmost.net](http://www.varmost.net) and at [www.tentacle.eu](http://www.tentacle.eu)

Some samples about media attention are the following:

<https://www.nwt.se/asikter/debatt/2018/07/18/annu-snabbare-tag-till-oslo-behovs/?fbclid=IwAR3CNvDvHfzWaP8GO1joyTAcPU4Ch6FE4UGXJVPWQ0gGGjIra1-h8MlfaQo>

[https://www.nrk.no/ytring/tid-for-moderne-jernbaner-i-norden\\_-1.13927135?fbclid=IwAR2LcjNmHBF54xKa9PufU90UkC\\_8DYR4IRAtvoDwSLR8s6eMz7N8HqKKGnE](https://www.nrk.no/ytring/tid-for-moderne-jernbaner-i-norden_-1.13927135?fbclid=IwAR2LcjNmHBF54xKa9PufU90UkC_8DYR4IRAtvoDwSLR8s6eMz7N8HqKKGnE)

[https://www.dagsavisen.no/innenriks/ja-til-privatbane-1.1085026?fbclid=IwAR26EoRABmEHEIoAdkvnf\\_cepGuZHn3Da7FFdRXxeANENVFEaEVO5zLUPf8](https://www.dagsavisen.no/innenriks/ja-til-privatbane-1.1085026?fbclid=IwAR26EoRABmEHEIoAdkvnf_cepGuZHn3Da7FFdRXxeANENVFEaEVO5zLUPf8)

[https://www.dagsavisen.no/innenriks/etterlyst-milliarder-til-lyntog-1.1162394?fbclid=IwAR2pm\\_XHBGS1PXQYV4GvnrVebZ7cndb-F1XN6BMQhZucM1tGe7yFJQEm90k](https://www.dagsavisen.no/innenriks/etterlyst-milliarder-til-lyntog-1.1162394?fbclid=IwAR2pm_XHBGS1PXQYV4GvnrVebZ7cndb-F1XN6BMQhZucM1tGe7yFJQEm90k)

<https://www.dagsavisen.no/innenriks/baner-vei-mot-ost-1.1095066?fbclid=IwAR3ALMuf7Qec2i-zVFjlzVQVdFH1SraEqq5JOR2uR2luRHIN33Vg9DBAz4>

[https://www.dagsavisen.no/innenriks/i-dialog-med-kina-om-lyntog-1.1082807?fbclid=IwAR12FCEjRHX4SVA7eN7Rtl-DLKcmcltmy6PzdtTGTcZRSg9t6P\\_pYvKHpi4#cxrecs\\_s](https://www.dagsavisen.no/innenriks/i-dialog-med-kina-om-lyntog-1.1082807?fbclid=IwAR12FCEjRHX4SVA7eN7Rtl-DLKcmcltmy6PzdtTGTcZRSg9t6P_pYvKHpi4#cxrecs_s)

<https://www.dagsavisen.no/innenriks/apner-for-lan-til-lyntog-1.1166212?fbclid=IwAR2oEKAhITehGN9bE8LTfsSwByebP4vUe2tPepAI5ROzLkaLtiOVXXvNbek>

### 3. The growth and development of Central Scandinavian Borderland

#### 3.1 Round table in Oslo, March 2017

Based on the Round Table organized at the 13<sup>th</sup> March in Oslo 2017, which gathered 30 experts from Norway, Sweden, Germany and UK, there was a summary report delivered by the chair team consisting of Mr. Cliff Hague (UK) and Mr. Øivind Holt (Norway), picture below.



Their conclusions and recommendation were the following:

- The main conclusion drawn from the workshop is that **there is no coherent overview that connects transport planning across Norway and Sweden and in particular across the Central Scandinavian Borderland.** The Transport Ministers no longer meet in the Nordic Council, and the national transport plans are nationally focused, and do not adequately address cross-border connections, needs and opportunities. In addition, there is no comprehensive view that addresses rail passenger and rail freight transport together. Joint work between Trafikverket and Jernbanedirektoratet is welcome, but largely an administrative exercise that so far has not been translated into political action. The Norwegian Transport Plan is a patchwork of projects to ameliorate bottlenecks, and has only a few overall strategies. The Swedish equivalent is similarly constrained. While investing in removing bottlenecks may be a useful strategy in the short run in order to optimize existing infrastructure, it needs to be set within an overall Nordic strategy.*
- A second conclusion is that **the existing transport infrastructure is already inadequate and likely to become more so in the future unless action is taken.** This imposes economic costs from congestion, delays and lack of reliability and environmental costs. In addition, with road transport being the dominant mode, there are environmental costs.*

- *Thirdly, the regional economy of Värmland in particular is disadvantaged by its poor transport connections, which hinder its potential access to the labor market of the Oslo region.*

*In short, competitiveness, efficiency, environment and equity can be tackled by stakeholders on both sides of the border working together to improve regional connectivity.*

*The workshop demonstrated how cross-border engagement of stakeholders can be put into practice. It has provided clear evidence that there is a case for further work on improving transport infrastructure between Oslo and Orebro, the missing link in the TENT-T Core Network Corridor. It has also contributed general know-how that is relevant to WP5 (the macro-dimension) of the TENTacle project.*

### 3.2 Recommendations

*Recommendations are made for actions that involve lobbying and also research.*

#### 3.2.1. Lobbying

- *Lobby the Nordic Council to reinstate its Transport Ministers meetings.*
- *Encourage active participation in TENTacle of transport providers on both sides of the border.*
- *Advocate for harmonisation of Sweden's and Norway's national transport plans.*
- *The Østfold "bench" and Värmland "bench" of political representatives should continue to work together to present the case for an integrated, cross-border approach.*
- *TENTacle might lead a debate on the scope for public-private partnership as the means to deliver the desired upgrade in rail infrastructure.*
- *Try to get the administrations of Oslo and of Stockholm involved.*
- *Try to link with agencies involved in the Scan-Med corridor, and with other projects potentially sympathetic to the case.*
- *Get the Oslo-Stockholm corridor back on the TEN-T core map by the next revision.*
- *Lobby for communes to use their municipal master plans to reserve the land for agreed new rail lines.*
- *Encourage private or state entrepreneurs to build the express network.*

#### 3.2.2 Research

- *Develop the evidence base for the financial, environmental and regional development arguments for a high-speed Oslo-Stockholm rail link and present it to both governments.*
- *Look to 2040 and show the costs of not developing the rail link – a new runway at Gardermoen, more spend on roads, more car, lorry and air trips, and a widening regional divide between the two capital cities and their hinterlands.*
- *Explore the options for commercial and/or public-private or public solutions for financing a Scandinavian Triangle express network where the desired end travel time*

*is 2 hours 30 minutes, with as many stops and stations as feasible within this time frame, so trains also can serve commuters.*

- *Allocate funds for feasibility studies for the potential express network lines.*

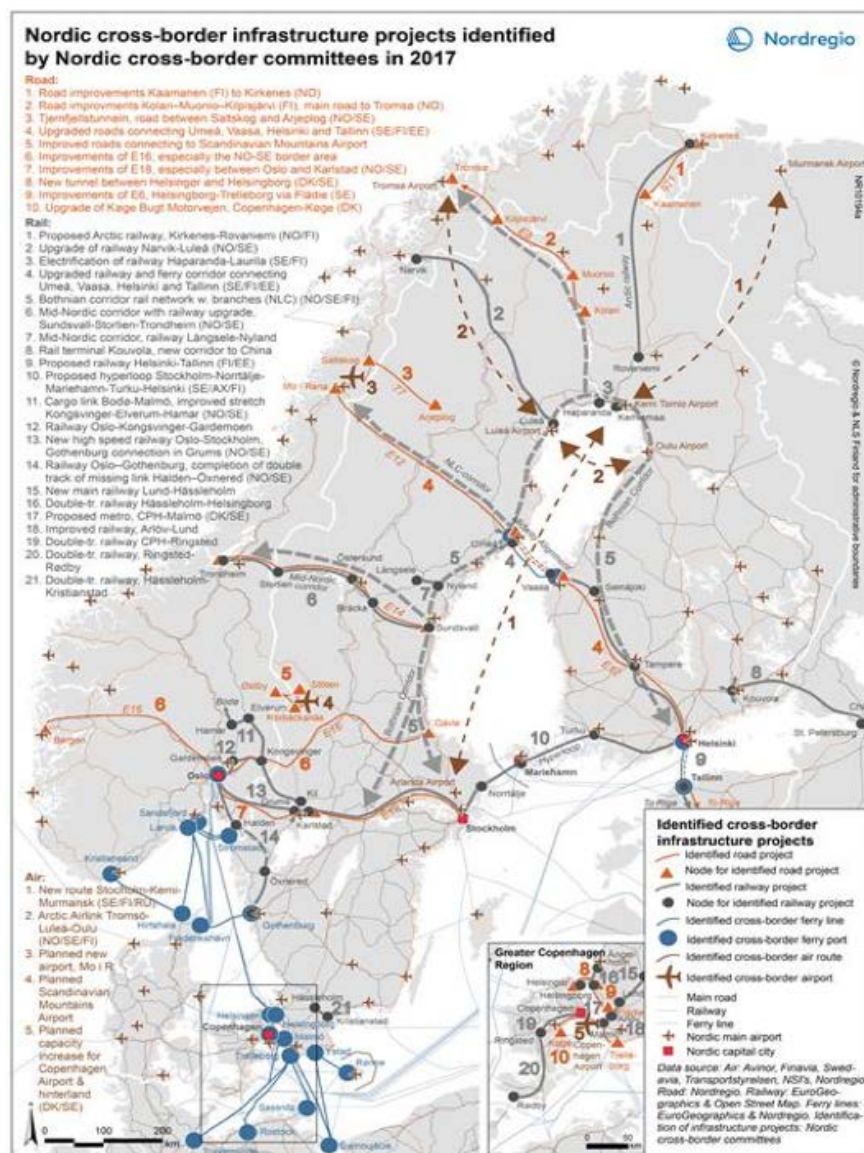
## 4. Follow up from the round table report

Several actions have been taken in line with the above recommendations, within the field of lobbying, research and development.

### 4.1 Nordic Transport cooperation

- 9th February 2016, the board of the Värmland-Østfold Border Council met with the Minister of Infrastructure, Anna Johansson, in Stockholm. Other meetings with the ministries, MPs and other decision makers have at all governmental levels, have been organized in both countries.
  - The summary of these meetings, seminars and conferences (2016-2019) is, joint Nordic transport strategy is not going to be established. Only incremental steps are to be taken on certain railway lines. There is no shared strategy about how to establish an integrated cross border railway structure in Scandinavia. And absolutely no shared HSR strategy. Neither is there any budget decisions for major investments in new railways between the Nordic capitals for the next decades.
  - However, there is now more attention about the need for better railway transport within the Nordic region. The international climate accord and the push from industries, NGOs and other has managed to influence the public discussion.
- Lack of coherent planning and united Nordic strategies has become an acknowledged fact and the 12 Nordic cross border councils (funded by NMR) have addressed this at several occasions. During 2017 there were 2 workshops in Stockholm organized by the TENTacle case 4.1 in cooperation with the Nordic Council and the cross-border councils.
  - The Nordic research Institute Nordregio was engaged, and 5 thematic maps were developed, which show the high number of missing links and ongoing regional cross-border project initiatives. The maps are covering airports and ports, marine and land corridors, roads and railways.
  - The maps are in use by leading Nordic politicians and others and had already an impact. The Nordic Council decided in April 2018, to send a shortlist of 15 measures to the Nordic governments, for the enhanced cooperation on transport infrastructure. The need for better cross-border infrastructure was highlighted, and “our map” was attached.





- Through a range of meetings, letters and other actions, the TENTacle project has addressed the need of bringing the missing link between Oslo and Stockholm back on the prioritized CNC map, by the next revision of the TEN-T. The ministries in Sweden and Norway sent letters to the EU in 2018 and highlighted the importance of the corridor. It's too early to evaluate the result of the process, if this goal will be reached. The coming CEF budgets will have no post for the Oslo-Stockholm corridor, west of Örebro, so the result can only come in the longer perspective.

## 4.2 Research and analyses

### 4.2.1 Railways, legal framework and funding

- TENTacle established a cooperation with the Nordic working group for “Sustainable cities and urban regions”. A case study on the consequences and impact from a new modern railway connection (including HSR) between Oslo and Stockholm conducted by Nordregio is ongoing.

- Investigation about opportunities for funding of new railway links by the public sector or in cooperation with private investments. Pure commercial funding has also been considered. There have been several meetings and consultations with the Nordic Investment Bank and other financial actors about these issues. The conclusion so far is:
  - Private investments require low traffic risk and a certain predictable framework. It seems to be hard to get private money into a mixed railway system, where there is a combination of old public and new private railways. Old railways are vulnerable and need extensive maintenance. New railway links within the mix of old and new, will not be very attractive for private investments. However, this is a field for more research and considerations.
  - Separate railway systems more likely achieves private investments. This can be metro, suburban lines or highspeed railways (HSR) between the capitals and major cities. The main thing is that the traffic risk caused by other systems should be limited to a minimum.
  - Projects that ask for financing by private sources need some estimated upsides, some good chances for profit. Separate HSR systems can be such interesting business cases. They shall of course meet the requirements for inter-operability and have smooth connections to the public railways. HSR become the “motorways” of the integrated railways, and there will be a win-win-situation.
  - Experiences from Spain show that the HSR are the only railways with net profit. According to indicative budgets and estimations for Scandinavia, HSR will most likely be possible to build and operate without public funding. It will save tax payers money and bring many new jobs, taxes and development to the regions. The market will pay for the service. HSR are able to compete with air traffic at the distances up to 600 km, and even beyond, depending on the designed speed.
  
- Several reports, addressing alternative financial models, are elaborated by the pilot case. Some reports (TEG AS, 2018 and 2019) have introduced the idea and analyzed the options of charging climate & environment taxes on lorries and private cars crossing the border. E6 at Svinesund and E18 at Ørje are both within Østfold county, and tolls could be active for 30 years and dedicated to the funding of new border crossing railways. This may make it easier also to add public budget money to the projects for faster implementation of these missing railway links.
  
- EU funding for new railways through the TEN-T program / CEF has been discussed with the Scan-Med coordinator Mr. Pat Cox (Malmö, May 2018) and others. Mr. Cox explained that only projects that is on the national governments’ priority list is existing within the TEN-T, and in this case the Swedish government must put it there. And he also explained the limitations of the CEF funding opportunities. He didn’t rule out any project initiatives but explained the large competition from all EU countries.
  
- The Norwegian parliament decided in the National Transport Plan 2018-2029(chapter 3.4.3) that all new railways shall be constructed to become included in a high-speed railway network. (*«alle nye jernbanestrekninger planlegges slik at de vil kunne inngå i*

et høyhastighetsnett»). This means that the specific focus on HSR is clearly stated by the lawmakers. But what does this ambition mean? It is not yet clearly communicated or expressed in national projects and budgets.

- Based on this there have been meetings between the TENTacle partners and the Norwegian Ministry of Transport and Communications and with the Parliament MPs. The current Norwegian government is not going to initiate a public financed HSR network, as there are other projects with much higher priority.
- However, The Ministry has confirmed and clarified in a letter to the Innovation Circle Network/TENTacle from 22 March 2018 (and also in the media), that there are no legal obstacles for private investments in any kind of railways. On the contrary, the Norwegian government is encouraging private initiatives within this field. The MPs from various parties in Norway have also been positive to the search for alternative and additional funding for railway investments.
- The railway law (Jernbaneloven) does not separate between public or private railways. No party in Norway has been arguing against the idea of private investments in new railways. However, some has argued that the state should spend more money and take a greater responsibility for railways in general, including HSR. And some are negative to privatization of existing public railways and have criticized the Government and the EU railway directives, which leads to more competition and new organizational structures. The EU driven process opens up for private actors on the public railways, such as Go-Ahead taking over the traffic on Sørlandsbanen in Norway. This is obviously another question than private investments into new railways.
- The TENTacle project has also conducted meetings with the national railway authorities in Norway (Jernbanedirektoratet and Jernbanetilsynet) and introduced the ideas and possibilities for the construction of an HSR network in Norway and Sweden with connections to Europe and Asia. Relevant EU standards, national laws and procedures have been discussed as well as capacities and interoperability issues. Based on these meetings, the conclusion is again that there are no other formalities for private actors than for state actors. There is a will to cooperate and treat private initiatives at the same level as public initiatives.
- The position of the Swedish government and from the members of parliament should be further explored. More clarification would be valuable. However, the railway law in Sweden is not dividing between public and private railways, and do not provide any regulations which should not open up for private investments, or PPP.

#### 4.2.2 The Karlstad region study

Transnorden Sweden organized a separate base study about the Karlstad region. This study can be read by entering the project website

<http://www.varmost.net/prosperity-and-growth-karlstad-region.6185586-484058.html>

The report analyzed how Karlstad has developed during the last 50 years compared to similar sized cities like Umeå and Växjö, and how Värmland region has developed. The findings are that the relative position within Sweden has weakened, and Karlstad as the largest city in Värmland, was not able to give and facilitate the same powerful development for the city itself and for the region, as done by Umeå and Växjö, for their regions Västerbotten and Kronoberg.

The demographic development lead to a higher percent elderly in Värmland than in the 2 other regions, and the Värmland region's and Karlstad city's share of the Swedish population has not developed as prosperous as for the others.

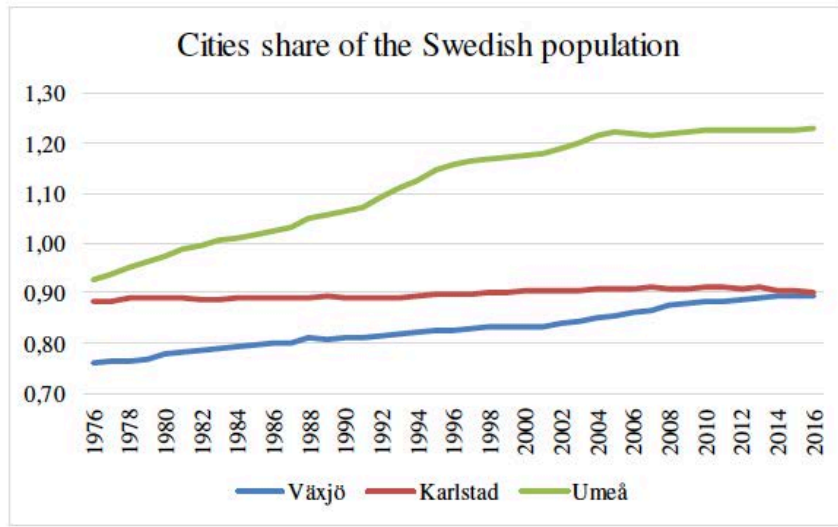


Figure 5.6. Cities share of the Swedish population (SCB, 2017)

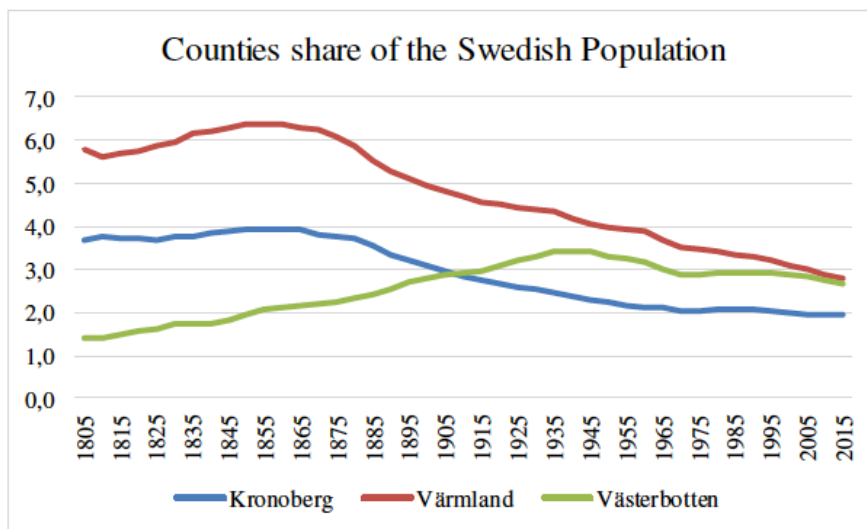


Figure 5.17. Counties share of the Swedish population



The Nordregio map below shows how the demographic development has been for the last 10 years. Centralization and urbanization are the global megatrends, which also continues in the Nordic countries. Large is getting larger and decline continues at most of the rural regions and smaller communities. The decrease is not very significant in Norway and more severe in Finland and Denmark, than in Sweden. One reason behind this is the level of immigration. But there are also other reasons. The economic development in Norway has reached all regions and even in rural regions there are growth, or at least a pretty stable situation.

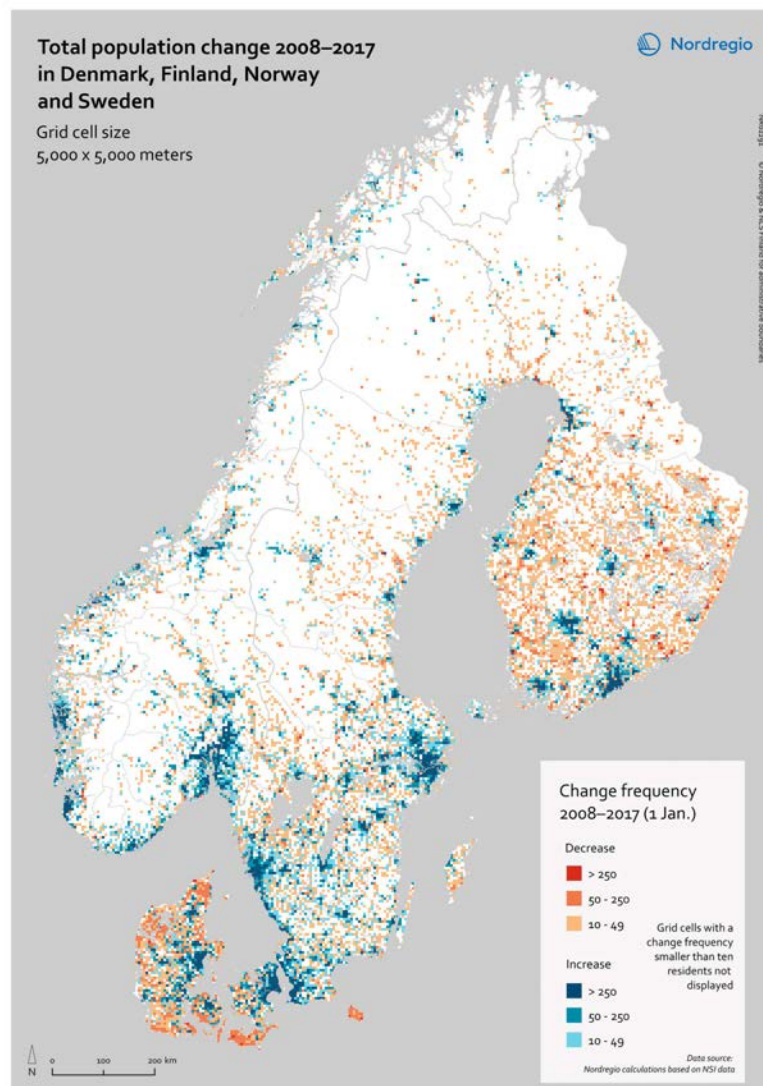


Figure 3. Absolute population change at the grid level (5,000 × 5,000 m) in Denmark, Finland, Norway and Sweden between 2008 and 2017. Map by Oskar Penje

Looking at the Central Scandinavia, it is quite obvious that Värmland and some other regions between the capitals, did not manage to reap benefits from the strong growth within the metropolitan areas. Lack of efficient railways may be one of several explanations.

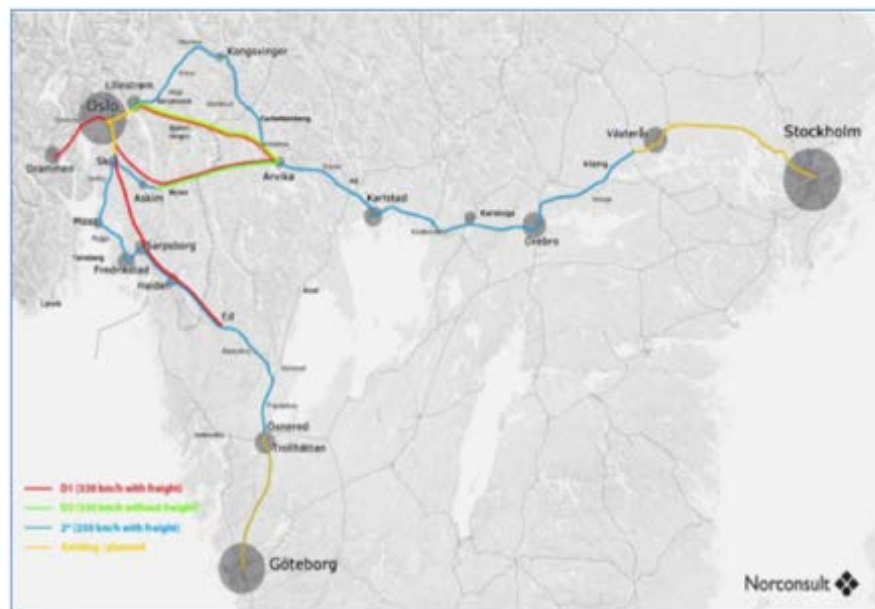
The capitals and other major cities are interacting with each-other by a rapid growth in air traffic. High-speed railways would probably change the situation as there would also be connections for the towns and cities in between the capitals. However, HSR connections to



more remote urban nodes like Bergen, Stavanger, Trondheim, Oulu and Tampere is also important for the whole Nordic territorial and economic development.

#### 4.3 Development and planning of better railways

- The TENTacle project case 4.1 has been involved in the public Åtgärdsvalstudie Oslo-Stockholm organized by Trafikverket in Sweden, and the ongoing KVVU process for the Kongsvinger-line organized by Jernbanedirektoratet in Norway.
- The conclusion on the KVVU process is not reached yet, but the target will most likely be to upgrade the old railway gradually by small steps for several years, to become a better service for local and regional passenger traffic and cargo. The Oslo-Stockholm perspective will not be in focus in the short-term period.
- In a medium-term perspective there is a wish for a better connection between Kongsvinger and Gardermoen airport and Hovedbanen, by construction of new double track link either from Skarnes or from Årnes.
- In the long-term perspective there is an understanding of the need to build a faster connection between Oslo and Stockholm, with less than 3 hours travel time. It can be done with faster and modernized railways Oslo-Karlstad-Ørebro-Västerås, which is the shortest cut, or by HSR Oslo-Gothenburg-Jönköping-Stockholm. (The 8 million city project (COINCO North) suggested the latter alternative).
- The Norwegian high-speed railway feasibility study from 2011, considered several alternative cross border options (illustration below). They did not conclude on any.



Figur 34 – Korridorskisse Øst

#### 4.4 HSR alternatives in the Nordic Triangle perspective

- The TENTacle project case 4.1 has looked into this state report (Stillesby-report) and later reports from others.

- The Nordic Triangle is the geography between Oslo-Stockholm/Helsinki and Copenhagen. They are all included in the Scan-Med corridor, but the northern axis between Oslo and Stockholm is not fully included, in the prioritized TEN-T corridors. However, for many good reasons the Nordic Triangle is still a label which is used for the geographic area between the Nordic capitals.
- TENTacle has considered several HSR alternatives for Oslo-Stockholm in order to achieve a compatible and commercially viable railway. The target has been maximum 2:00 non-stop travel time, or as fast as possible and reasonable.

#### 4.4.1 HSR alternative 1, Oslo-Stockholm/Copenhagen

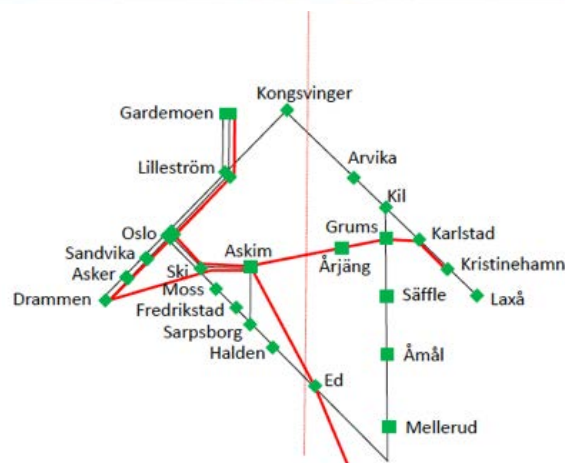
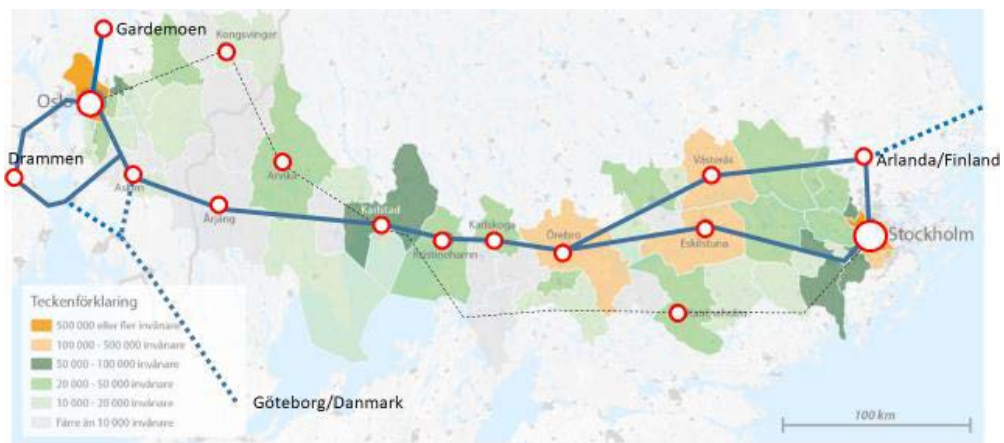
- The pilot case 4.1 is primarily suggesting a new separate HSR (high-speed railway) **Oslo-Mysen-Årjäng-Grums-Karlstad-Karlskoga-Örebro-Västerås-Stockholm** (north of Mälaren), and with fast connections to Gardermoen and Arlanda airports. The travel time between the two capitals central stations can be 1:45 hours nonstop and 2:20 with 8 stops per departure. The distance is close to 500 km. This requires an average speed at 250-300 km/h. Top speed may be 450 km/h at some parts of the line. This is an option confirmed by the Tüv-Süd study 2018. Geometric solution will be a horizontal curve radius 5-7000 m. This will most easily be resolved by the use of railway bridges.



- The construction of HSR on railway bridges goes faster and is not more expensive than constructions on the ground, if there is an industrial process with a big amount of prefabricated railway bridges.



The figures below illustrate the HSR line Oslo-Stockholm with correspondence to other lines, such as Gothenburg and Drammen (Tüv-Süd, 2018).



4.4.2 HSR alternative 2, Oslo-Stockholm

- The second HSR alternative is based on more or less the same geography **Oslo-Ski-Askim-Mysen-Årjäng-Grums-Karlstad-Karlskoga-Örebro-Västerås-Stockholm**. Norsk Bane AS is a Norwegian consulting company which recruited Deutsche Bahn



International GmbH to deliver the first report. DB analyzed possible HSR corridors Oslo-Karlstad and looked in particular into the corridor Oslo-Ski-Swedish Border. Without any definite conclusions, they regarded the southern corridor Ski-Mysen-Årjäng-Grums-Karlstad as a good alternative from many reasons. At later stages Norsk Bane developed the HSR analysis further, in a close cooperation with the local government.

- Norsk Bane has planned an HSR line with a travel time non-stop 2 hours, and 2:35 with 8 stops. This requires an average speed at 225-250 km/h. Top speed at the railway may be maximum 320 km/h.
- Norsk Bane is suggesting less use of railway bridges, more ground-based construction and tunnels, and a horizontal curve radius at minimum 4500 m. They have investigated different corridors between Oslo and Karlstad. The studies were financed by the Norwegian and Swedish regions and municipalities, including funds from the Oslo Region and the Värmland-Østfold Border Council.
- More information about the very detailed study can be explored at the following webpage: <http://www.norskbane.no/default.aspx?menu=4&id=281>



- The Station structure based on the NB alternative, may include the following stations (Illustration below, AJ 2019).



#### 4.4.3 Slab track all the way

Both HSR alternatives are based on slab track (image below). It is needed in order to drive faster than 250 km/h. It's cheaper to maintain than ballast tracks, and it will avoid sun buckles which are making big disorders in the train transport during summertime. Slab tracks are not used many places in Scandinavia. In Norway, slab track is used only in the new Follo-tunnel, as far as we know. Trafikverket didn't recommend slab track for Stockholm-Malmö. It is probably a big mistake and will establish speed limitations from day 1. In the long run it will also increase maintenance costs, which is lower with slab track.



#### 4.4.4 Flexible stop and high frequency of trains

- Both HSR alternatives are based on flexible stop, meaning that a number of stations (15-20) will have HSR service every hour, but many trains will pass the stations or drive through them and pick up customers at another station. Some non-stop services will go between Oslo and Stockholm every day. In total about 70 trains in each direction per day will give 5-6 trains in rush hours and 2-4 at other hours. Compared to the about 40 flights in each direction per day, there is a market already for many departures per hour, including the big number of commuters and travelers on the shorter distances, in between the capitals.
- The stations will be constructed as real HSR stations, letting trains which are not stopping, drive straight through the middle section of the station in rather high speed, while other trains can serve customers at the platforms. This is not possible with most of the current stations at the conventional railways in Scandinavia. Consequently, trains are lining up and waiting for green signals. Valuable time is wasted.
- Some stations are small compared to the larger hubs. The argument for having them is, that even small stations will add customers, and the effect on the railway economy and climate will be positive. This doesn't mean that many trains per hour or day will stop there, but even 1 or more train stops per hour or day will give a good train service compared to nothing. And it will facilitate regional growth and development.

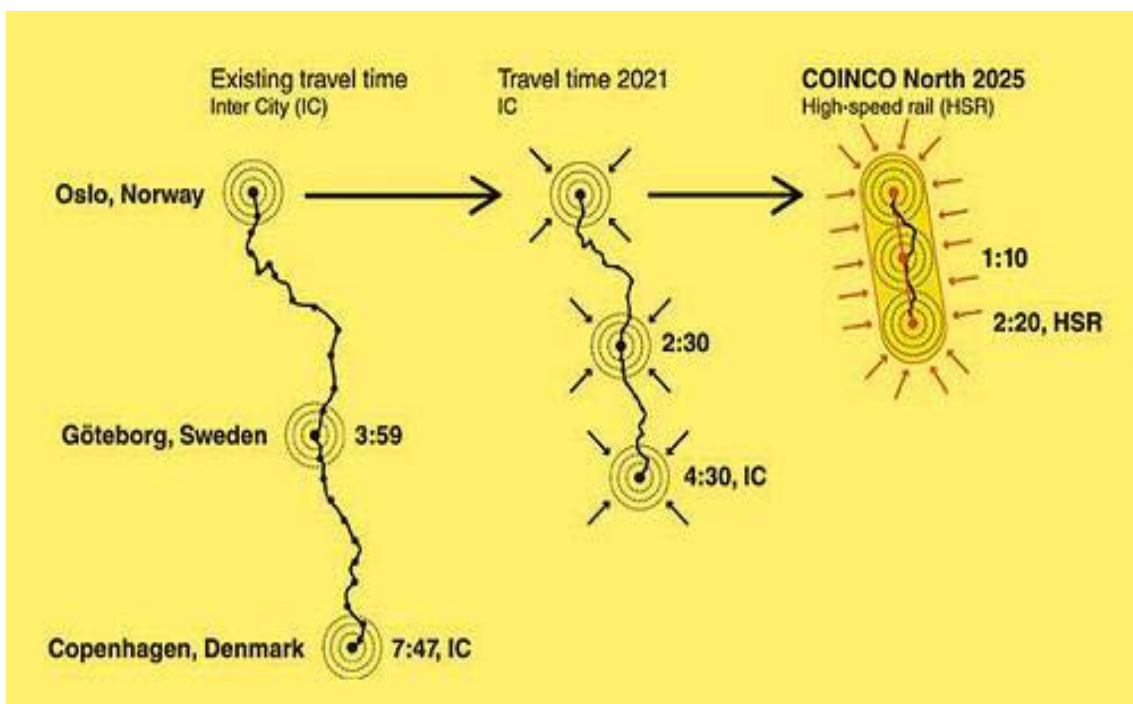


- The number of train stops depend on the market and the frequency of trains. The HSR concept is opposite of the conventional public railway. It's not about putting on several limitations and bypassing towns and customers. It's about picking up as many customers as possible, and to adjust the operation of trains to the market. Small stations if they are designed for HSR, are not a barrier for non-stop trains, which can pass the stations without significant delays.

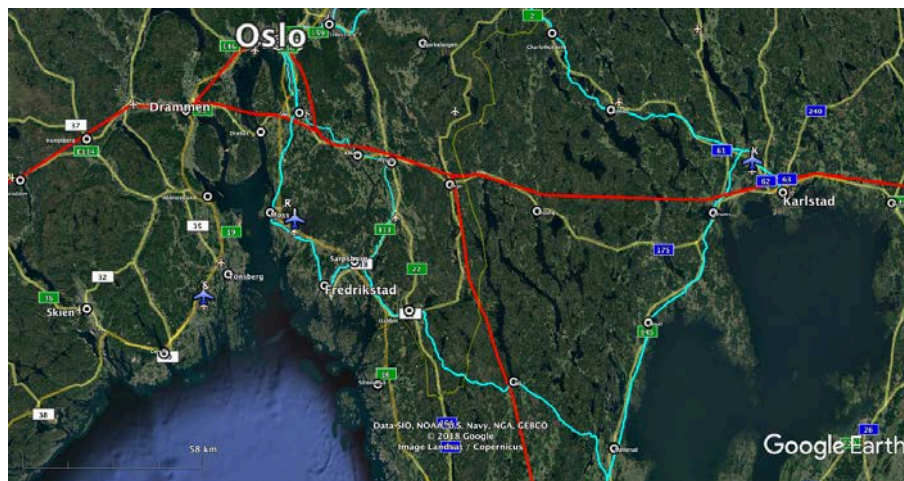
#### 4.4.5 Oslo-Gothenburg-Copenhagen, 8-million city

- The HSR Oslo-Stockholm shall be properly connected to Gothenburg/Landvetter and further on to Copenhagen/Kastrup. Travel time Oslo-Gothenburg shall be about 1 hour nonstop, and Oslo-Copenhagen maximum 2h:20 min. nonstop. This will be in line with the **"8 million city"** vision created by the COINCO North project. No compromises can be made on the travel time, in order to make the trains compatible with planes. Compromises on travel time will ruin the climate effect as well as the railway economy. That's why the Intercity-network is not a platform for fast compatible connections between the capitals. It's not even a good beginning. It is only a supplement, which can be more optimal when connected to the HSR network. It is important to realize the differences between train transport that will shift a significant amount of air traffic to rails, and the train services that are not doing that.

There are 8 million flight passengers per year, only within the triangle of Copenhagen-Oslo-Stockholm. 80% can be moved to the railway, if there are no compromises on the train travel time. For the whole Nordic region, 30 million flight passengers can be moved to the HSR network. That would give a significant contribution to reach the climate goals, by reducing CO2 emissions from the air traffic. This is not some wild fantasy, it is a political choice.



- The exact connection between the 2 HSR lines from Sweden to Oslo, is to be explored and discussed further. There is more than one good option, between Ski and Årjäng.
- A 200 km HSR line will connect Gothenburg with the Oslo-Stockholm railway and the whole distance between Oslo and Gothenburg will be between 280 and 300 km, depending on where the connection point (the split) will be established. There are 4 alternatives:
  - First alternative is to go straight Ski-Sarpsborg-Halden(as suggested by Norconsult/Stillesby , 2011). However, it will give little synergy with the Oslo-Stockholm line. All trains would need to stop at Ski station, Sarpsborg station and Halden station, which unfortunately will be bottlenecks, as they are not constructed as HSR stations. This will prolong the travel time significantly.
  - A second and better alternative, is from Askim/Mysen, to Halden-Ed-Uddevalla, or to Rakkestad-Ed-Uddevalla. Compared to the Stillesby alternative it would be more or less the same distance, but travel time will be shorter, as there will be no bottlenecks avoiding high speed all the way. All trains can drive through new stations designed for HSR, or pass outside the towns.
  - Looking further east, there is a third alternative at the Swedish side of the border. There can be a connection point from Töcksfors to Ed-Uddevalla or from Årjäng to Bengtsfors-Ed-Uddevalla. This alternative will give up to 20-30 km longer distance compared to the other alternatives, and the travel would take 10 minutes more. But, it would reduce investment costs and give the best synergy effect.
  - However, the fourth and most reasonable connection point from many considerations, seems to be at the border town Örje in Norway, as illustrated below.



- This can give a quite optimal HSR route Oslo-Gothenburg, without many technical, political or environmental obstacles. The travel time can be 1 h nonstop service, without bottlenecks. In combination with the Intercity network Oslo-Ski-Fredrikstad-Halden-Kornsjø, it will be a good solution for whole Østfold county and for Värmland/Dalsland. The Intercity and the HSR

- can be connected close to Ed. Trains from Fredrikstad, Sarpsborg, Halden can use the HSR-line from Ed.
- For the 3 latter alternatives, they require a new double track between Oslo and Askim, east of the Follo-tunnel. This is useful from many perspectives. It will give less traffic risk for HSR, good capacity, create redundancy, and can also give a travel time Askim-Oslo at 15 minutes, compared to 55 minutes today. For the night hours the new line can also take some cargo trains in/out of Oslo.
  - The exact decision about where to connect the 2 railways need to be explored more in detail with experts, and in dialogue with the local and regional government. It will be based on technical optimal solutions and market potential (cost/benefit), but also influenced by politics and environmental considerations. TENTacle has analyzed the situation pretty well and there are arguments for the different solutions.
  - The only element which is 100% crucial is the travel time between Oslo and Gothenburg. Longer distances must be compensated by higher speed. 1-hour travel time is the prime target(!) It will boost the regional development and immediately shift a big number of private car travels to railway. When extended to Copenhagen, it will also shift a high number of flight travels to railway. This will bring the two big cities Oslo and Gothenburg so close together that commuting is much easier.
  - The HSR Oslo-Gothenburg will connect with the existing railway structure at Kungälv and also at Mölndal/Landvetter. Some trains will pass Gothenburg Central Station, and go directly to the next station on their way to Copenhagen. Top speed will be 450 km/h and average speed on a non-stop service will be about 300 km/h. The HSR to Gothenburg/Copenhagen will only use slab tracks (rails fixed in concrete) and railway bridges will be used as much as possible. This is in line with the suggestions in the report from Tüv-Süd 2018. This will reduce the land use conflicts, be more cost efficient, faster to build, make possible for up to 7000 m. horizontal curve radius. Rail bridges will also increase the traffic safety by the reduction of accidents. It will avoid colliding with wild animals, landslides or flooding, which can cause problems to the train service, and other problems connected to the ground.

*The current railway between Oslo and Gothenburg (this is at Halden) was opened in 1896 and the same geometry still remains.*

*Train travel time is almost 4 hours. Private car travel at E6 takes normally 3 hours and bus services 3:30.*

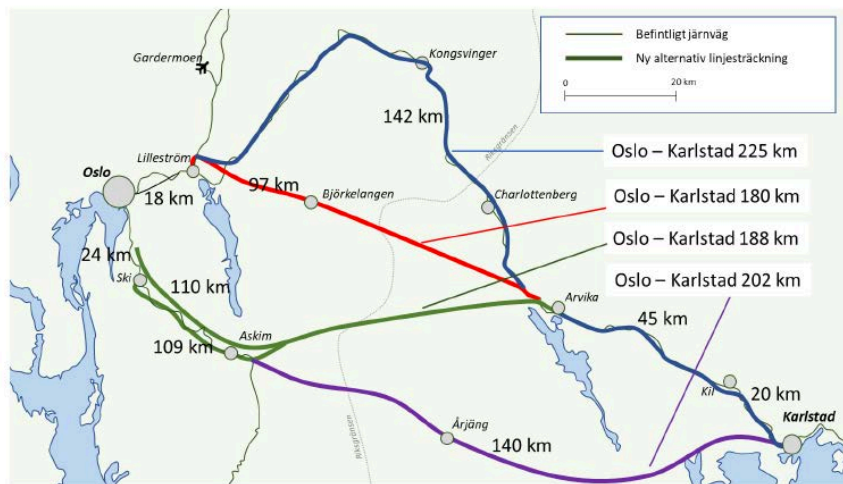




#### 4.5 Improved conventional railways, alternatives to HSR

There are also conventional cross border railway projects, which are alternatives and supplements to HSR, even if they cannot compare with the HSR speed. There are several conventional alternatives, as Trafikverkets' illustration is showing.

##### Tidigare studerade korridorer för "Gränsbanan"



46

TRAFIKVERKET

##### 4.5.1 Kongsvinger-Karlstad

This is the first conventional project with the highest national priority. This is the main cargo-line between Sweden and Norway in addition to the Ofotbanen (iron-line) between Kiruna and Narvik. The train passengers between Oslo and Stockholm are also going through Kongsvinger.

There is a need for an upgrade with crossing points, platforms and a double track between Kongsvinger and Gardermoen/Hovedbanen. This double track may be extended across the border to Charlottenberg and to Arvika. The current process with the KVVU will come up with proposals, for measures to be implemented.

##### 4.5.2 New railway link Mysen-Arvika

- A second conventional alternative is to establish a regional railway from **Ski-Mysen to Arvika-Karlstad** (primarily via Örje and Töcksfors) as an extension of the Intercity network in Østfold.
- The background for this alternative is that the Norwegian national authorities has written in the Railway Strategy (Appendix to the National Transport Plan 2018-2029), that it sooner or later is necessary to construct a double track from Ski to Mysen. The figure below has a quotation from page 17, where step 4 and 5 indicates that a double track to Mysen has to be established, where the goal is to upgrade the Oslo-Mysen-Sarpsborg (Østre Linje) to become the main cargo line and at the same time increase the number of passenger trains from 1 to 4 per hour.

### 2.1.5 UTVIKLINGSSTRATEGI REGIONTOG ØSTLANDET SØRØST

Trinn 1. Follobanen, InterCity-utbyggingen til Sarpsborg og planskilt avgrensning til Østre linje korter ned reisetiden for alle tog mot Østfold og gir økt frekvens, inkludert 10-minuttersintervall Oslo-Ski over Follobanen. Rutemodell 2027 innebærer forbedring til fire tog i timen til Moss, hvorav to er raske InterCity-tog som fortsetter til Sarpsborg. I tillegg kjøres flere tog i rush til Moss og Fredrikstad. Innføring av to tog i timen til Mysen hele dagen er også en mulighet. Dersom Østfoldbanens Østre linje i fremtiden skal brukes som hovedkorridor for godstrafikk mellom Göteborg og Alnabru, må strekningen imidlertid få dobbeltspor hvis det også skal kjøres to persontog i timen hele dagen.

Trinn 2 og 3. Med økt kapasitet i Oslo-navet vil flere av togene fra Østfoldbanen kunne kjøre gjennom Oslotunnelen mot Lysaker, slik at flere reisende kan nå større deler av Oslo sentrum uten å måtte bytte tog. Kvartersintervall til Ås/Vestby vil gi betydelig økning i frekvens til voksende nærings- og universitetsmiljøer. Dobbeltspor mellom Sarpsborg og Halden gir mulighet for to tog i timen mellom Oslo og Halden, og ytterligere redusert reisetid på strekningen.

Trinn 4. Etablering av ny hovedkorridor for godstrafikk mellom Ski og Sarpsborg via en oppgradert Østre linje gir mulighet for å forbedre persontogtilbudet til Moss og Fredrikstad, med åtte tog i timen til Moss, hvorav fire er InterCity-tog (til Fredrikstad og Halden) og fire er regiontog som stopper på stasjonene mellom Ski og Moss. Dobbeltspor på Østre linje gir mulighet for både to persontog i timen og godstrafikk.

Trinn 5. Det langsiktige målbildet for togtilbudet i sørkorridoren innebærer fire tog i timen også til Mysen.

Nasjonal transportplan 2018 - 2029

VEDLEGG 5

## Langsiktig jernbanestrategi

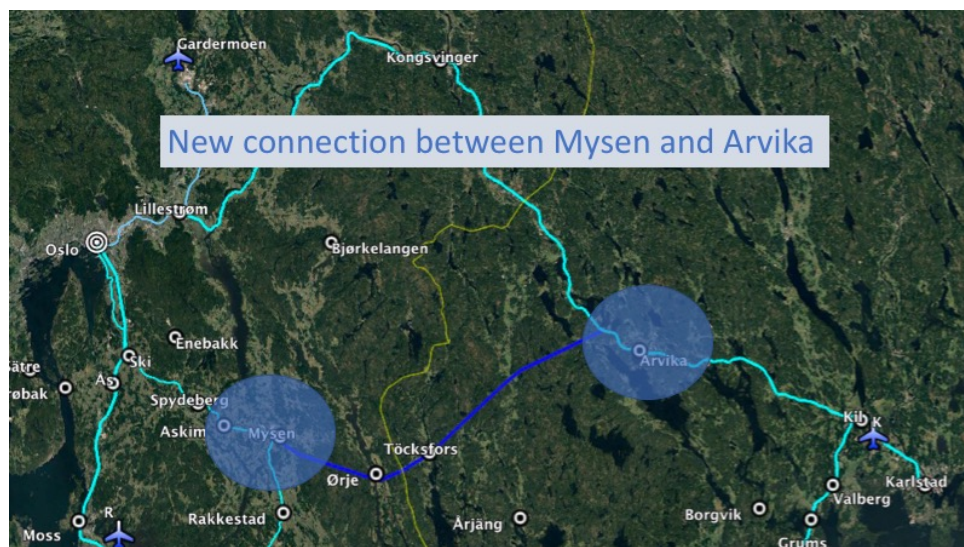
Februar 2018



Foto: Anders Østby/NTNU



- Later it is indicated by the national authorities that this investment may come before the Intercity line to Fredrikstad is open, because of the whole capacity picture in Østfold county.
- Given that a modern double track to Mysen is established, and financed by the state, then the remaining distance from Mysen to the Swedish border is only 25 km. That is an investment cost at approximately 500 million Euro. This sum can in principle be paid by a dedicated toll road at the E18 border crossing between Örje and Töcksfors. From the national border to the railway west of Arvika (Hungalsvik), there are less than 50 km, which will cost about 1 billion Euro, and in such case this latter sum has to be covered by Sweden/EU.



- This will connect the railways in Värmland and Østfold and establish more capacity for freight and passengers. It will be an additional railway route between Oslo and Karlstad. Good for redundancy and it will give a reasonable travel time in the local/regional perspective.
- It can also be easily connected to a future Oslofjord railway link.



#### 4.5.3 New railway link Lilleström-Arvika

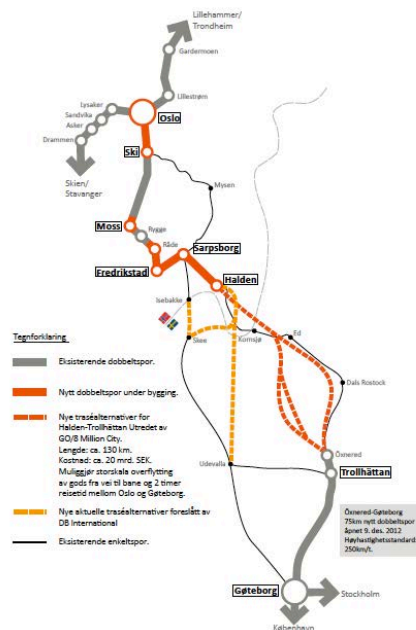
- A third conventional alternative is to construct a new railway link, **Oslo-Lilleström-Arvika-Karlstad**, 80-100 km, depending on the exact solution (pink or orange line in the illustration below).



- This alternative is promoted by Infrastruktur-kommisjonen and Oslo-Stockholm 2.55
- The strength of this alternative is that it will give more capacity (and redundancy) and will definitely shorten travel time Karlstad-Arvika-Oslo, which is now 2:30-3:20, depending on the service. With a new line as suggested, the travel time Karlstad-Oslo may be about 1:30. The travel time today between Karlstad and Arvika is 0:48 at the fastest service. However, it depends how much of the current structure which will remain to be used, and how much which will be brand new. That is still an open question and needs more in-depth investigation.
- The main obstacle is that the capacity is very limited at Lilleström and Romeriksporten (tunnel Oslo-Lilleström) according to Jernbanedirektoratet. This will give small options for many more trains per hour from Sweden to Oslo as the estimated traffic growth from Oslo to Gardermoen and Lillehammer/Trondheim is rather big and need to use the same tunnel. If this alternative shall work then it must be established a new line from Lilleström to Oslo city center, which will be quite expensive.
- This alternative cannot use the new Follo-tunnel and will not be connected to a future Oslofjord railway link. That means that all cargo trains/passenger trains between Drammen and Sweden will still need to drive through Oslo Central station, where the capacity is very limited already and vulnerable for all future, even with a new Oslo tunnel.
- The capacity and speed with this alternative will not be compatible with air traffic Oslo-Stockholm. That makes it hard to attract private investment. The toll road funding options are less as there is no cross-border road that makes it relevant.

#### 4.5.4 Missing link Halden-Trollhättan

- The fourth conventional alternative is the construction of a new railway connection between Halden in Norway and Trollhättan (Öxnared) in Sweden. This alternative has been discussed for decades. So far very little has happened.



- It will add on the planned Intercity line Oslo-Halden and can in the best case reduce the travel time Oslo-Gothenburg to 2:30.
- This alternative will definitely cut the travel distance and time and will contribute to modernization of the cross-border railway. However, it will not meet the ambitions about “8 mill. city” and will primarily be the conventional supplement to HSR.
- In combination with HSR Gothenburg-Ed, it will for sure give a much better solution for the connections Fredrikstad - Gothenburg, as trains from the Intercity line can use the HSR line between Ed and Gothenburg. Then the travel time Oslo-Fredrikstad-Halden-Ed-Uddevalla-Gothenburg can be as fast as 1:45.

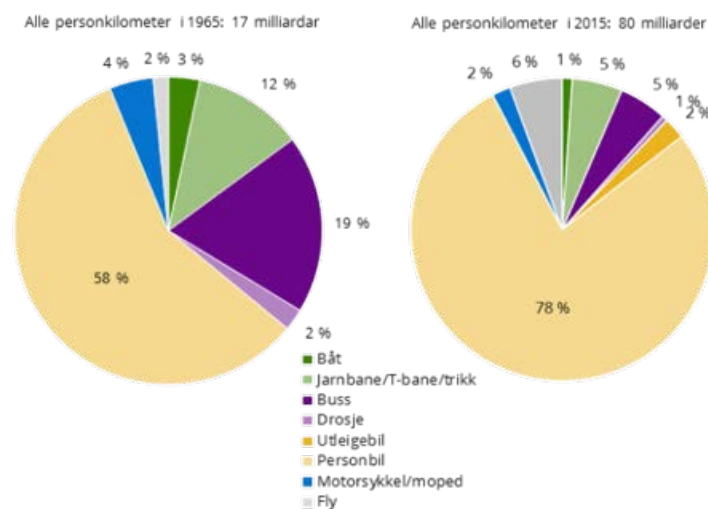
#### 4.5.5 Climate perspectives and transport infrastructure

- None of the 4 conventional alternatives will be enough to meet the Norwegian law makers’ ambitions about a future HSR network and will not give a strong enough answer to the climate challenges. They will not significantly reduce the air traffic and CO2 emissions from planes between the Nordic capitals and major cities.
- Climate and environment are very important issues and has been considered in the discussion about what kind of railways are needed.
  - Railways are climate friendly in general. The research based on international reports such as the UIC’s report about Infrastructure and carbon footprint 2016, shows that high speed railways are more climate friendly compared to suburban railways, and of course compared to roads and air traffic. The

carbon footprint from HSR will be paid back for 7-9 years and will be close to zero polluters for another 60 years.

- The HSR line Oslo-Stockholm will save emissions with about 0,5 mill. ton CO<sub>2</sub>e per year by the passenger number of 6 -7 million, compared to road and air transport, according to estimations. Suburban or conventional train services will not give the same results.
- The reduction of emissions from the transport sector is an obligation signed by the national governments (Paris accord). The EU White Paper on transport is outlining the key targets for EU. The need for the green shift from air and road traffic towards rails and waterways, is by now widely acknowledged. This means that the number of passengers reached by the train services is important. The level of impact on the number of air and car travels is crucial. It is important to understand that the money used for railway investment, is not equally good, if some projects don't have any real impact on the other transport modes. The projects with high impact on the CO<sub>2</sub> emissions should be prioritized higher. Because it is certainly urgent to give a serious answer to the climate change. The good thing is that a high number of train travelers is good for the railway economy and for the environment at the same time(!)
- In Norway the railway declined its' market share from 12 % in 1965 to 5% in 2015. From 1990 the awareness about emissions and climate change has become stronger. However, very little has changed as few and weak actions have been taken. Intercity is prioritized by the governments, but very little has been achieved when it comes to long distance and cross border travels.

Delen til transportformer av alle personkilometer. Noreg. 1965 og 2015. Prosent



In Sweden the situation is slightly better. Norwegians are flying more than Swedes, actually 10 times more than an average European. Norway has flights enough to be a population of 50 million. And many domestic routes are among the busiest in Europe. More than 2 million flight passengers are flying Oslo-Trondheim and the same Oslo-Bergen. Oslo-Stockholm 1,5 million and about the same for Oslo-Copenhagen. Oslo-Tromsø has 1 million flight passengers. In order to resolve the challenge, there is a need for more railways, also to parts of the Nordic region without railways and

modern fast railways. A whole new HSR network should be constructed, interoperable with conventional railways of different standard.

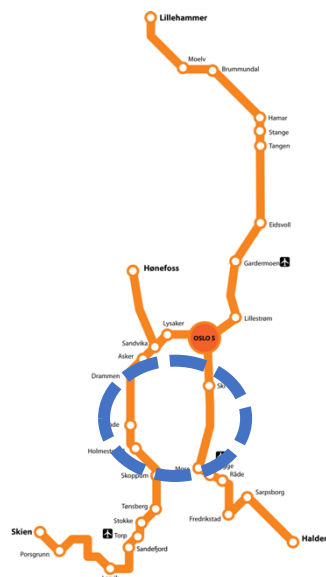
#### 4.5.6 The Oslofjord connection

The big bottleneck in the Norwegian railway system is Oslo. No trains can avoid the Oslo-tunnel in order to go from east to west, in the southern Norway. The capacity today is very limited and the whole network is vulnerable when some incidents happen in the Oslo-tunnel. Serious actions are discussed in order to build a new tunnel through the capital, and other capacity related actions.

Even the Romerik-tunnel and Lilleström station and the new Follo-tunnel and Ski station, will sooner or later have capacity problems due to the expanding market demand, which create more traffic. These 3 tunnel systems are forming the heart of the Norwegian railway network. Today there are too many breakdowns and unforeseen train stop almost every week from a number of reasons, due to lack of capacity, maintenance, technicalities and construction work. It is paramount to make bypasses and establish redundancy at strategic places to avoid more breakdowns and even a critical “heart attack”. A new Oslofjord railway link can become the most important bypass investment with a huge impact on environment, regional economy and labor market.

The figure below shows the Intercity railway project, which currently is under construction in 4 directions from Oslo Central station to the cities Lillehammer, Halden, Skien and Hønefoss. It will provide a travel time between Oslo and Halden at 70 minutes.

The missing link is the Oslofjord railway connection, to be established somewhere within the blue area (illustration below). It may actually be 1 or 2 railway links, depending on the location for the first one.



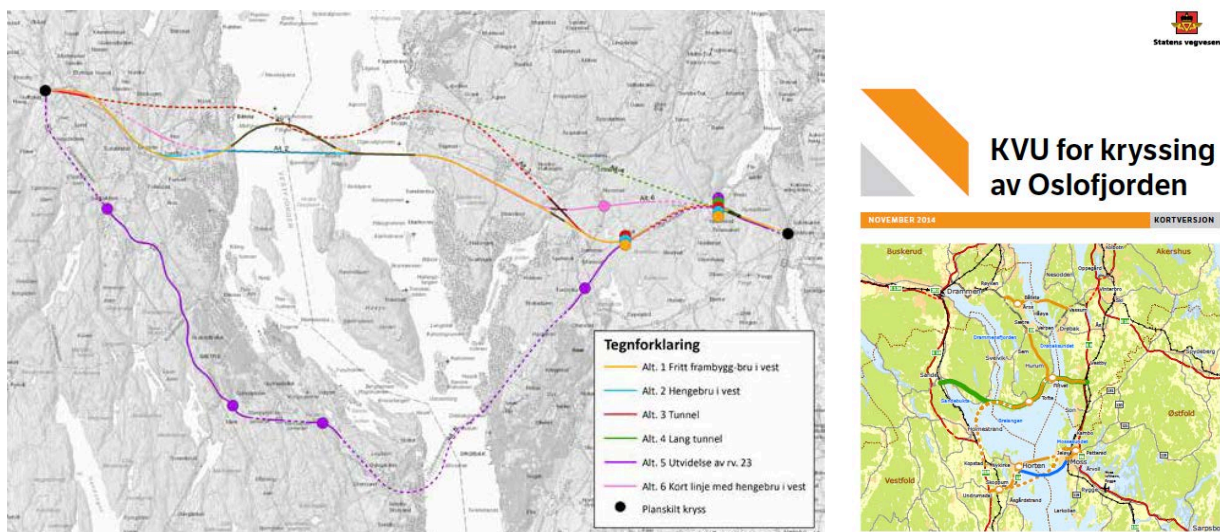
The Oslofjord is the “Öresund” or “Fehmarn Belt” of Norway. However, narrower at some parts and wider at other parts. It certainly divides Southern Norway and especially when it comes to railways. All trains and high number of cars are driving through Oslo, not because



they have any business to do in Oslo, but simply because it is the only alternative. Even though many are choosing the Oslofjord-tunnel for cars and lorries, many are choosing not to drive there from various reasons. There have also been several serious accidents in the tunnel, and it has been closed from time to time.

About 25000 passengers are crossing the Oslofjord every day (not counting the ferry traffic to Oslo). The Oslofjord-tunnel is counting 10000 cars per day, the ferry between Moss and Horten about 2000 cars and 10000 passengers and Sandefjord-Strømstad is transporting more than 3000 passengers per day. The interaction and current mobility would be boosted by a railway bridge and connections to Intercity-network as well as to the HSR network. It would ease the transport challenges through Oslo and through the Oslofjord-tunnel. It would obviously help to reduce the CO2 emissions, but also strengthen the regional economy and facilitate a more sustainable development for the whole Oslo region. The great potential for a high number of passengers and freight trains would make it possible to pay back the whole investment for 20 years. The railway link can be using a multimodal bridge where also cars and bikes are included.

The national road authorities (Statens Vegvesen) has investigated the situation and considered a variety of options, railway and road in combination, bridge or tunnel etc. (illustration below) and suggested a new road bridge north of Drøbak/Sætre, to the cost of about 1,7 billion Euro.



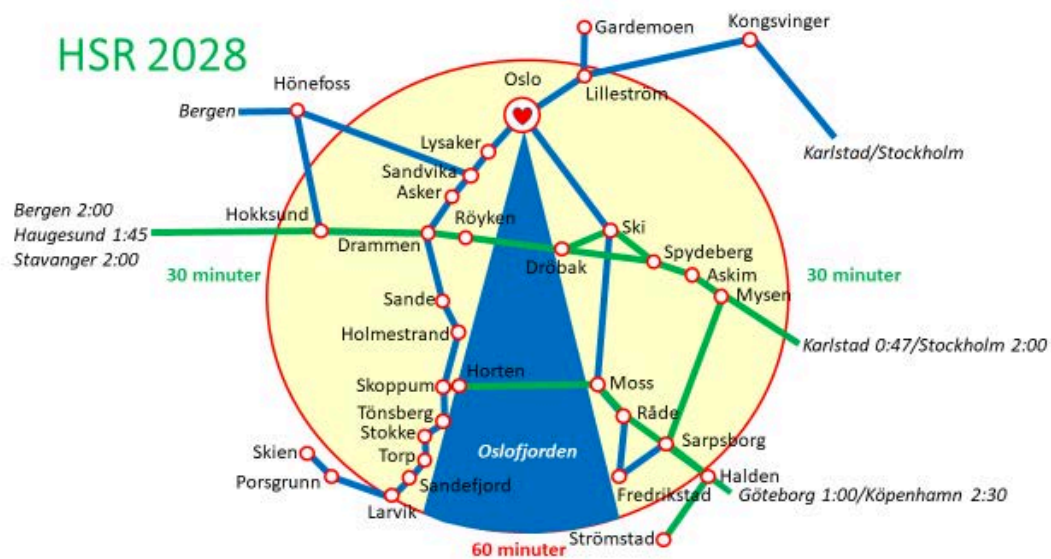
They have also considered a multimodal bridge in the combination between road and railway, but due to the additional costs the government has ruled it out.

#### 4.5.7 The 1-hour region, “The Scandinavian Diamond”

Tüv-Süd delivered a report to TENTacle in 2018 about a possible future railway connection. They came up with the idea of an Oslofjord ring with 2 connections (Tüv-Süds’ illustration below. Per Corshammar, 2018.) It suggests a combined railway/road/bike bridge at Drøbak and a railway/road tunnel between Moss and Horten. In this way it will be possible to establish a more coherent Oslofjord region connected by a modern railway system, including



HSR. It will be good for the climate and environment and will facilitate the fast growing Oslofjord region in a more sustainable way.



For the new Viken region, which will be operating from 2020, the Oslofjord railway connection would be very valuable. The Viken region includes Østfold county and most of Akershus county (East-Viken) where several towns and municipalities are near the Swedish border. Buskerud county together with Bærum and Asker in Akershus county are forming the West-Viken.

The new railway with bridge across the Oslofjord at Drøbak, will connect these two parts of Viken region. It will also link Viken more efficiently to the Scan-Med corridor and connect big cities in Southern Norway, like Bergen, Stavanger and Kristiansand, with big cities in Sweden/Denmark, like Copenhagen, Gothenburg, Malmö and Stockholm. That is the greater picture.

In the more narrow perspective, an Oslofjord bridge with railway connection, in combination with both Intercity and HSR, will bring the West-Viken with the Drammen region and cities beyond Viken (Skien, Larvik, Sandefjord, Tønsberg etc.) closer to the cities and towns in East-Viken (Ås, Ski, Drøbak, Moss, Fredrikstad, Sarpsborg, Askim, Mysen, Halden), and also closer to the nearby towns and cities in Sweden (like Årjäng, Arvika, Säffle, Karlstad, Kristinehamn, Trollhättan, Uddevalla etc.)

With the second connection Moss-Horten it will definitely take away the ferry transport and make a wider impact also between Vestfold/Telemark/Agder and the East-Viken (Østfold ect.)

Viken and Oslo have approximately 1,9 million inhabitants today. With Vestfold/Telemark included, the number is already 2,3 million. The Oslofjord region with Intercity/HSR and with the "Viken Bridge" will, within 1-hour travel time from Oslo, consist of 3-4 million people. It will be one of the strongest and most attractive regions, in Europe. It will become the "Scandinavian Diamond" (Illustration on the map below).

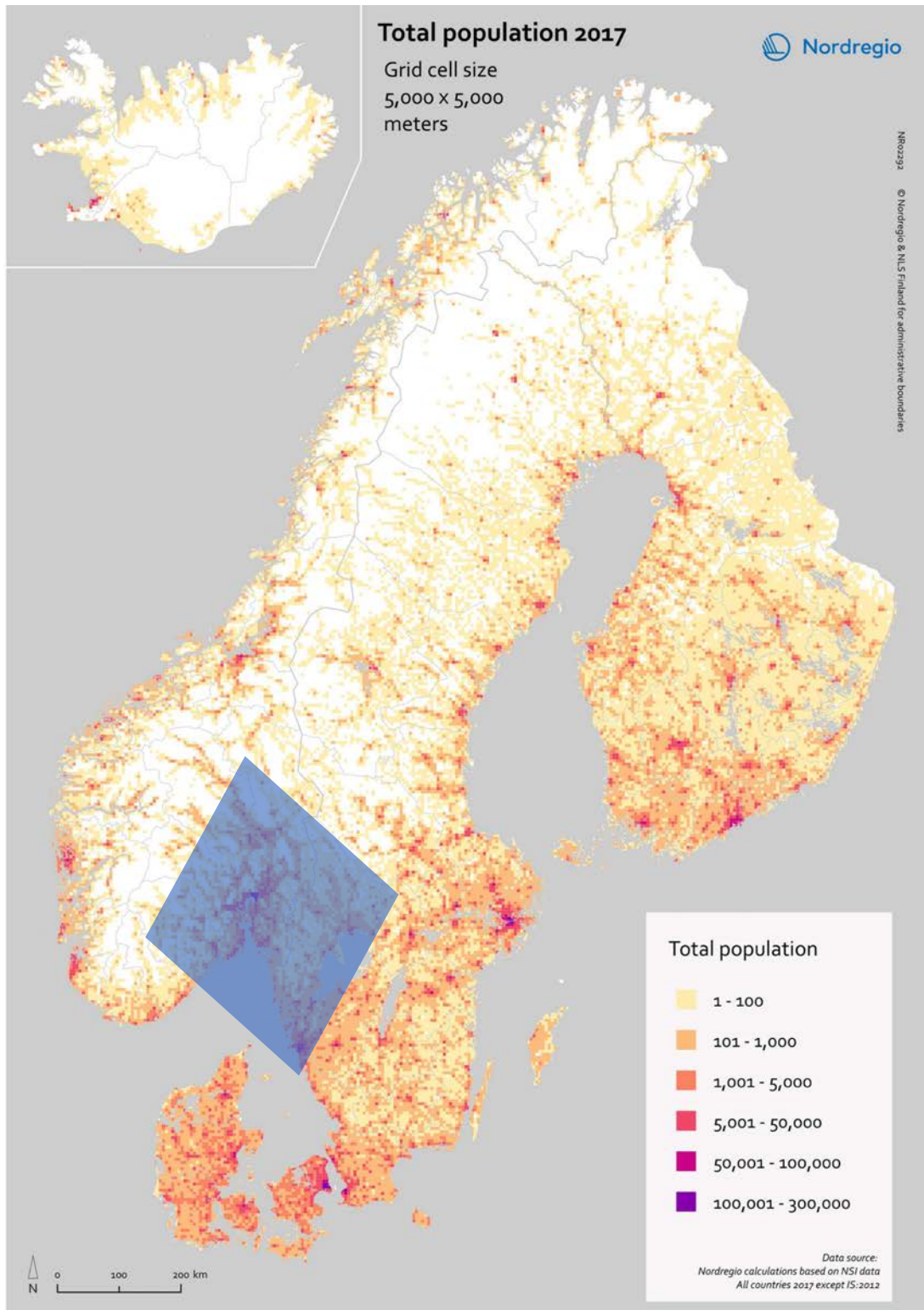


Figure 2. Total population at the grid level (5,000 x 5,000 m) in Denmark, Iceland, Finland, Norway and Sweden. Map by Oskar Penje. (The blue diamond is added by the author of this report, and is not the responsibility of Nordregio)

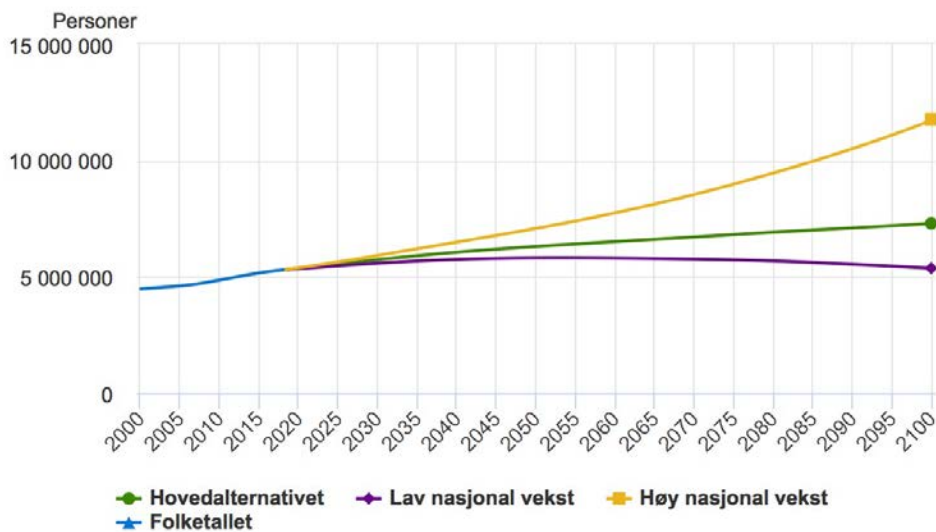
## 5 Scenario 2050 - Central Scandinavian Borderland and the “Scandinavian Diamond”

### 5.1 Population growth

The population had a steady growth in all Nordic countries. Norway, Denmark and Finland have 7 million each, Sweden 12 million, Iceland, Åland, Greenland and Faro Islands have about 0,5 mill. people, all in all 33,5 million.

#### Norway:

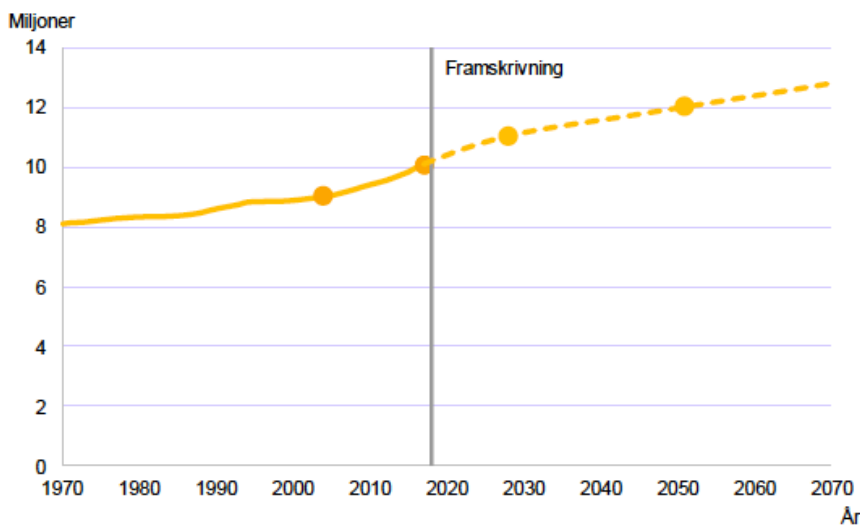
Fremskrevet folketall mot år 2100



Kilde: Befolkningsframskrivninger, Statistisk sentralbyrå

#### Sweden:

Diagram 1  
Folkmängd 1970–2017 samt framskrivning 2018–2070  
Population 1970–2017 and projection 2018–2070. Millions



The Oslo population has increased, and within the Oslo metropolitan area live now about 1,5 million inhabitants, a 50% growth since 2020. However, the smaller cities and towns within



the commuting zone take a lot of the growth and are “releasing” the capital, so less pressure is put on the land use within the capital city. Stockholm, Gothenburg and other major Nordic cities are growing with more than 2 % per year and the total Nordic population is now counting around 33 million people. Karlstad has reached 140 000 inhabitants, Askim/Spydeberg/Knapstad towns are now one urban area with 50 000 inhabitants. Mysen, Ørje and Årjäng had 3-4 % annual growth. 225 000 inhabitants are now living between Karlstad and Oslo, a 50 % growth since 2020.

The Oslofjord region (within 1 h train travel from Oslo) has passed 4 million. Gothenburg, Karlstad and other nearby Swedish cities are integrated in the Oslo commuting zone by HSR.

The Nordic HSR network has now reached all regions in Norway, Sweden, Finland and Denmark (See illustration below, which is a rough illustration, and not an exact drawing of the comprehensive HSR network). It is more or less completed by 2050. All cities with more than 50 000 inhabitants are directly connected.



## 5.2 Economy and labour market

The Nordic HSR project became a game changer with more than 100 billion euro invested in new railway infrastructure and related structures, for 25 years. 15 000 new jobs were created directly within the construction sector connected to the HSR investment, and the multiple effect of the investment resulted in thousands of new jobs.

The big railway investments moved from the Central Scandinavia to other regions after 2030. However, business created business, and many SME's were founded, during the last decades. The unemployment is still low. The Nordic economy is generally good and among the strongest in Europe. The Norwegian oil area is almost over. However, many new industries have been developed and due to the good railway connections to all Nordic regions, and to Europe and Asia, there is a good development within the marine and coastal industries, including export of sea food, minerals and wood-based products.



Värmland and Dalsland/Bohuslän are prospering. Karlstad region has managed to turn the trends and is now climbing the indexes of competitive and attractive regions.

The advantage of living in Sweden/EU and work in the Oslo region with short train travels, did attract many families and others to settle down in the border region, close to the Norwegian border.

The tourism is growing in the whole Central Scandinavia border region. The Dalsland channel and the Halden channel have a growing number of visitors, from Europe, Asia and North America. The bike tourism related to the “Unionsleden” bike trail between Moss and Karlstad became a success, in combination with nature adventure activities. The railway provides convenient bike and ride systems.

**UNIONSLEDEN**

Vi utvikler Unionsleden mellom Moss og Karlstad

**TA FRAM SYKKELEN OG BLI MED PÅ FLOTTE AKTIVITETER OG OPPLEVELSER!**

Unionsleden er en merket led (åpner 2019) og strekker seg fra Moss ved Oslofjorden til Karlstad ved Vänerens breidd, og er utmerket for sykling i et lett og fint terrenng.

Opplev norsk og svensk natur i den delen av landene som har åpne landskap, beltefjord, dype skoger og tuensvis av små og store vann.

*Opplev Skandinavia på sitt beste!*

Culture and social life are thriving and growing. Towns became more vibrant with many new cafes, restaurants and hotels. A variety of housing managed to attract young people and students with short distances to good schools, jobs, and universities.

### 5.3 Commuting and travels

The car traffic on the E18 and E6 border crossing increased until 2028, but as the railway connection became significantly better, it stopped growing. Every second car is now electrified or run by biogas, including heavy vehicles. The Intercity network was extended with new conventional rail links and well connected the HSR network.

The older railways were upgraded. Vänerlänken, Värmlandsbanen, Østfoldbanen and Kongsvingerbanen, gained more traffic, and got more space for freight trains, after the HSR line was established. Everyone is happy about the new situation with a more reliable and efficient railway network.

Hyperloop has been introduced in Europe and is only working for freight between some cities, not for passengers, due to security reasons.

The travel time by train to Oslo is now 45 minutes from Karlstad and 60 min from Gothenburg, 1:45 from Stockholm and 2:20 from Copenhagen. Karlstad managed to take advantage out of a new situation and became a very popular meeting point for conferences and other business. Ørje became the railway crossing point and Töcksfors and Ørje became very attractive places to live at, as the fast railways and good roads, turned them into prime locations for families and others who wanted to live outside the big cities.

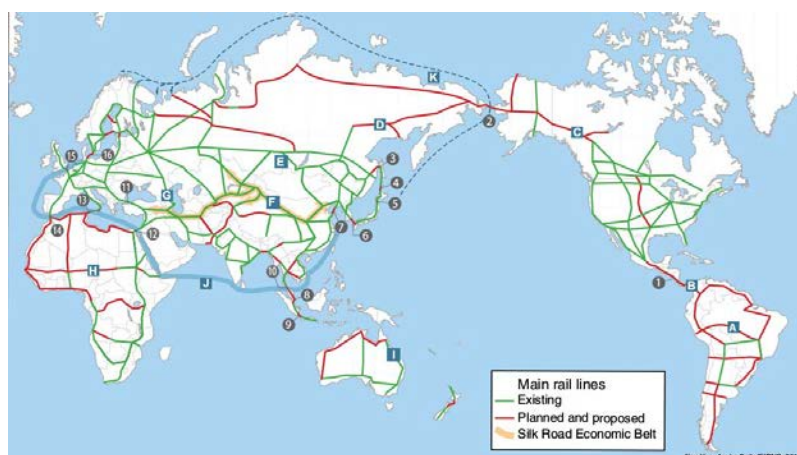
The commuting between Gothenburg and Oslo has grown to 15 000 HSR travels per day. Totally the HSR line Oslo-Gothenburg has as much as 30 000 passengers per day, around 11 million per year. This number has increased gradually from 5 million in 2028, the first year it operated.

Between Stockholm and Oslo, the railway opened in 2032 and had 6 million passengers. 85% of the flights between Oslo and Stockholm disappeared as the customers shifted to HSR. In 2050 there are already 12 million train passengers per year.

#### 5.4 Environment

There have been some discussions related to the HSR's impact on the environment. One issue was the long railway bridges cutting through the landscape. Another issue was the establishment of more windmills in order to give energy supply for the trains. Most of these questions are now resolved due to good dialogue between the railway company, the civic society and the local and regional government.

The global focus on climate change has increased due to rapid global heating and the international deals are urging for new and bold actions to reduce the CO2 emissions. The emissions from the Nordic transport sector has been stabilized as the new fast trains took over much of the domestic air transport. In total 25 million air travels were eliminated.



The Belt and Road Initiative and EU's TEN-T, managed to establish good intercontinental train routes between Asia and Europe (Illustration above). This resulted in more train traffic between China/Asia and Europe/Scandinavia, even to the Arctic towns like Kirkenes, Ivalo, Luleå, Kemij, Kiruna, Alta and Tromsø.



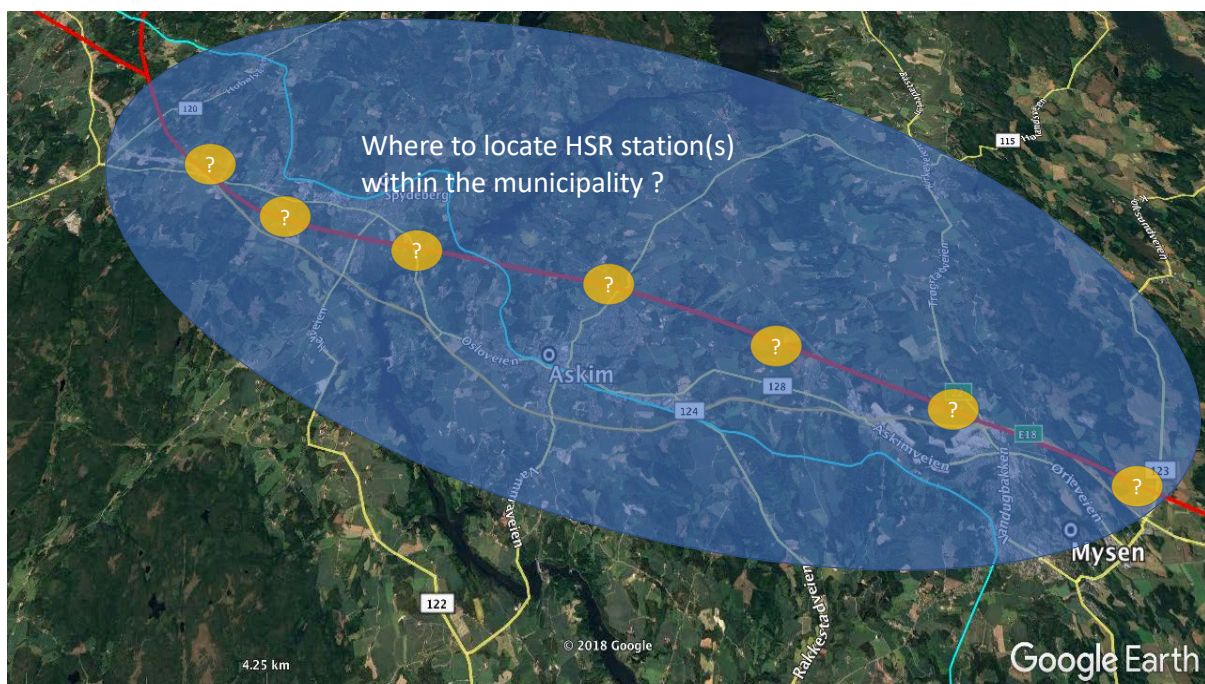
## 5.5 Urban development

The smaller towns with its living qualities became more attractive for settlements as the fast railway were opened. Askim, Mysen, Ørje, Ed, Färgelanda, Säffle, Grums etc. achieved fast annual population growth and decided to adopt more urban planning actions.

The railway required new masterplans for the towns, not only around the stations, but also for housing and industries. One question with long term impact on the urban development, was the location of the new HSR station.

There was a discussion and if it should be more than one HSR station within the municipality of Indre Østfold with about 50 000 inhabitants. During the planning of the new HSR line some argued that there should be more than one station, because of the polysentric structure. The solution was that one new station was placed close to Mysen town and one station at the border between Spydeberg and Askim.

The HSR railway company agreed to offer funds for environment friendly infrastructure investments, such as bike tracks and good parking facilities. There were many urgent issues that demanded the use of good and dynamic dialogue with industries and private land owners. Multilevel governance was implemented for quick decision making.



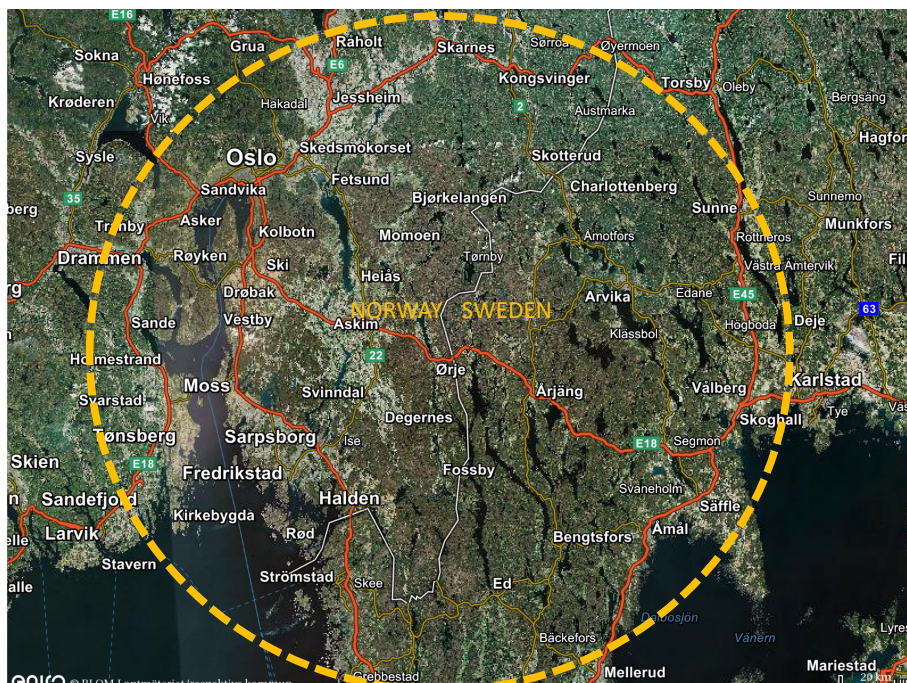
The integrated regional planning is now including the “1-hour region” across the border and is revolving around how the business, transport, housing and service development can prosper and grow in a sustainable way, with protection of agricultural land and with less CO2 emissions.

## Strategy

### 6.1 Introduction

The TENTacle case 4.1. will suggest a development strategy for a better and seamless connected Central Scandinavian Borderland. Connections to Oslo as the closest capital city is very important. However, good connections to the other major cities and Scandinavian capitals is also of great importance.

This strategy is based on research and investigations by experts, state of the art technology, national policy documents, regional and local visions, consultations with national authorities and the study of Nordic and European targets for climate and environment. The illustration below shows the target area.



This strategy will focus on the need for better cross-border transport infrastructure, improvement of roads and railways. A wider perspective includes ports, airports and logistical hubs which is an important background for the strategy, but not focused so much in this document.

The proposal is based on the realistic view that public resources are limited. The cross-border transportation structures are not at the top of the national priority lists. Neither is high speed railways, even if it would be one of the most climate friendly measures.

However, global warming is not waiting. The mandate from the global community and from future generations, is to do what is possible today, in order to combat the climate change, reduce CO2 emissions and to build a more environment friendly transportation system. It is due time to take more bold and integrated Nordic actions.

As the public budget resources are limited, it will be important to search for alternative ways of funding infrastructure, especially railways. The good thing is that the economic viable



railways need many passengers, shifted from cars and planes. And that is exactly what the environment also needs. Non-competitive railway services are not good for any reasons. 99% of the cargo through Østfold county is coming on lorries. 11% of the passengers are using train between Oslo-Stockholm, 16% Oslo-Gothenburg, 15% Oslo-Trondheim and 15% Oslo-Bergen. (Jernbanemagasinet 3/2018). This is not good enough. The Nordic region shall have higher ambitions for railways.

Therefore, the strategy includes both new high-speed railways and upgrading of the existing ones. Smaller incremental steps are also needed; to establish missing links and other improvements of the old railways.

### 6.2 Overall goal

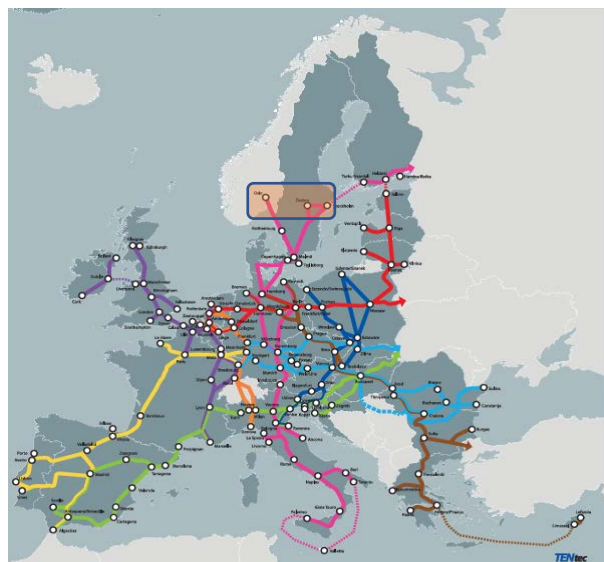
Efficient, modern infrastructure and climate friendly public transport service, which connect the Central Scandinavian Borderland with the Scandinavian capitals and to the Scan-Med corridor, in order to facilitate sustainable economic growth and a more coherent region.

### 6.3 Strategy part 1-TEN-T

The whole Oslo-Stockholm corridor shall be included in the CNC/Scan-Med by the next revision of the TEN-T program.

- Lobby towards EU in cooperation with the Ministries, Nordic Council and the regional authorities.
- Highlight the opportunities for Europe and the Nordic countries, and which wins for climate and regional economy that can be achieved by the strengthening of the Oslo-Stockholm corridor.

*The missing link between Oslo and Örebro shall be revived on the map of prioritized TEN-T corridors*



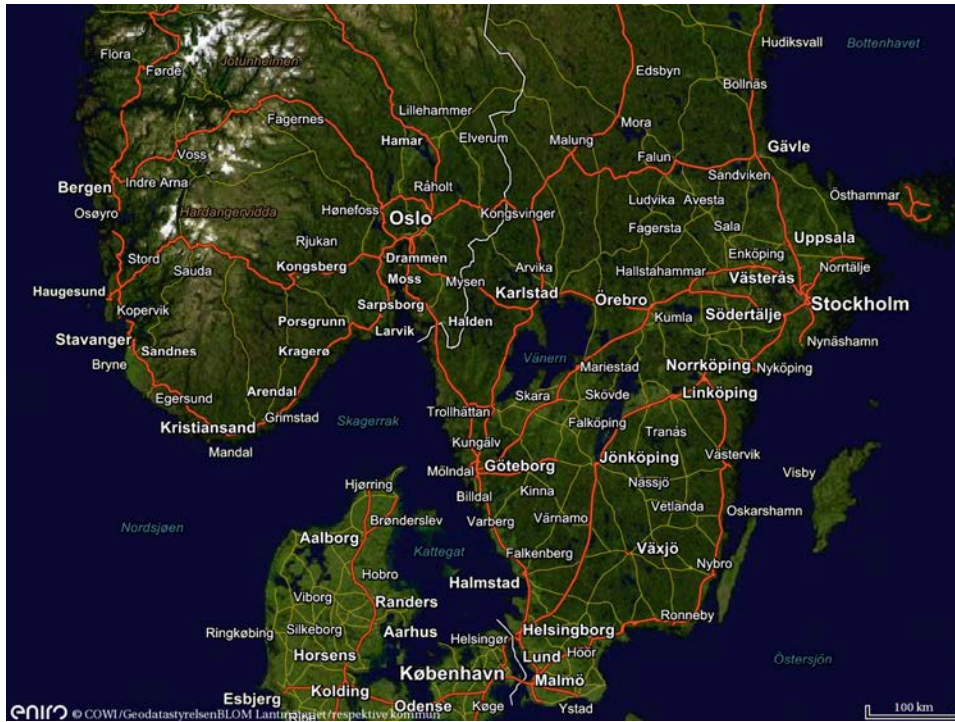
### 6.4 Strategy part 2 - Roads

To continue lobbying for the development of the E18 between Oslo and Stockholm so it can serve the needs for cargo traffic, public transport and private cars.

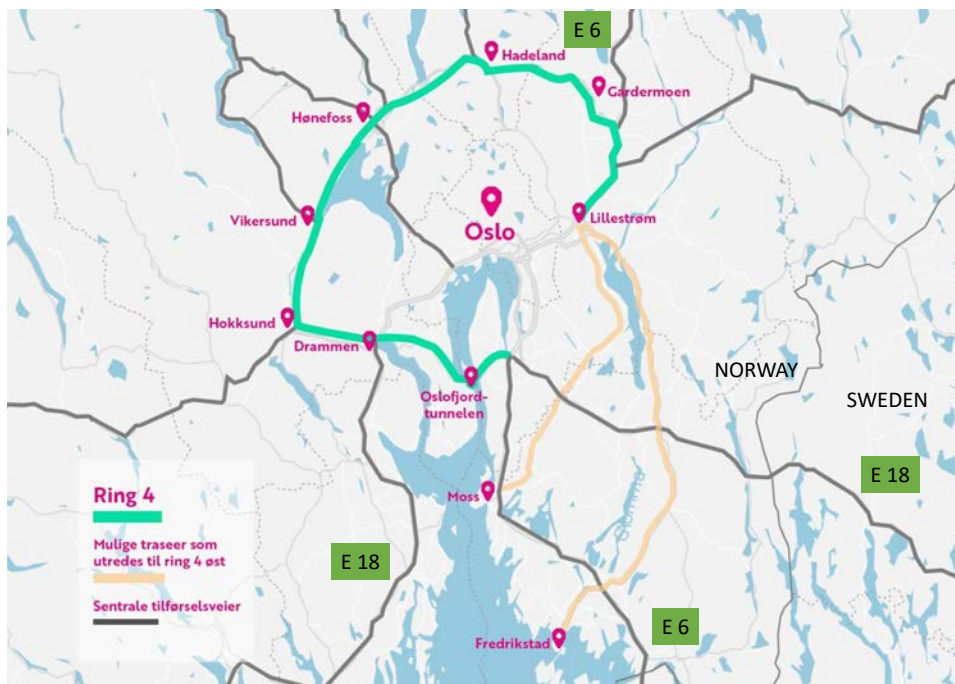
- Fulfill the 4-lane road project at the E18 between Oslo and Østfold.
- Improve capacity at E18 through Värmland from 2 to 4 lanes all the way.
- Establish more fast charge facilities for electric cars and bikes.

- Work for the improvements and better connections between roads, especially between the E18 and E6, including “Ring 4” across the Oslofjord, and between Østfold and Lilleström.

MAIN ROADS IN THE CENTRAL SCANDINAVIA



RING 4 (The Oslofjord ring)





### 6.5 Strategy part 3 -Improvement of the current conventional railways

Work for new investments in the current railways for better connections between Norway and Sweden.

- Improvement of the railway between Halden and Trollhättan, new tunnel and double track. Explore options for partly financing by dedicated climate related tolls at the E6.
- Improvement of the connections between Kongsvingerbanen and Värmlandsbanan
- Connect Kongsvingerbanen to Hovedbanen and to the Gardermoen airport (from Skarnes or Årnes), with double track.
- New cross border railway link between Mysen and Arvika, primarily via Ørje and Töcksfors. Explore the option for climate related toll taxes on the E18 border, dedicated to fund the new railway link.

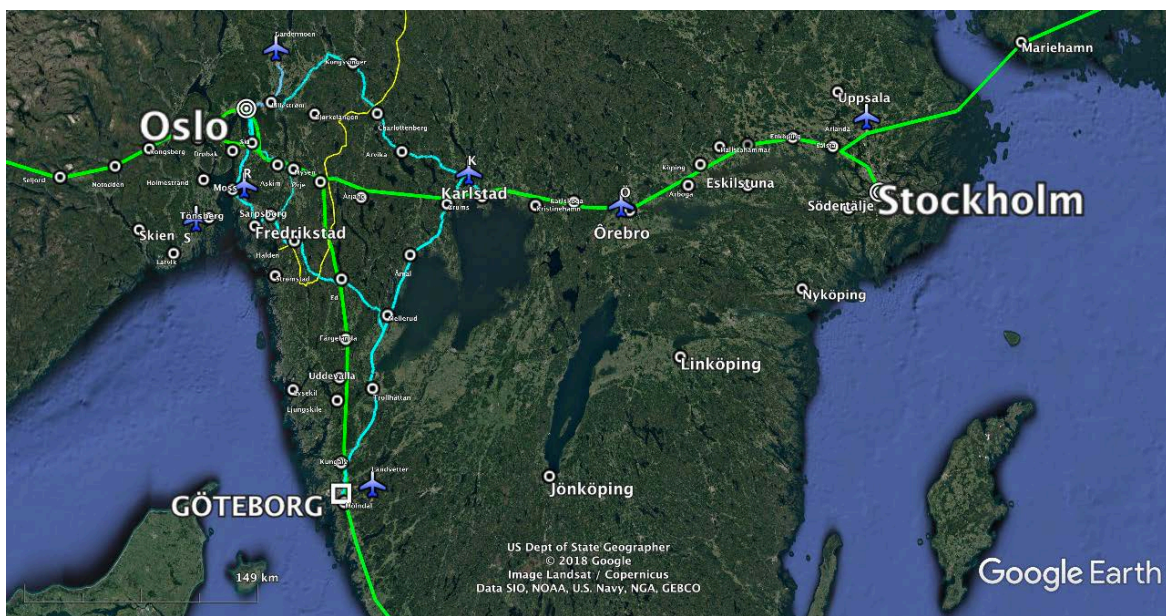
### 6.6 Strategy part 4 - Highspeed railway Oslo-Gothenburg/Stockholm/Copenhagen

Work for the establishment of an HSR network in Central Scandinavia.

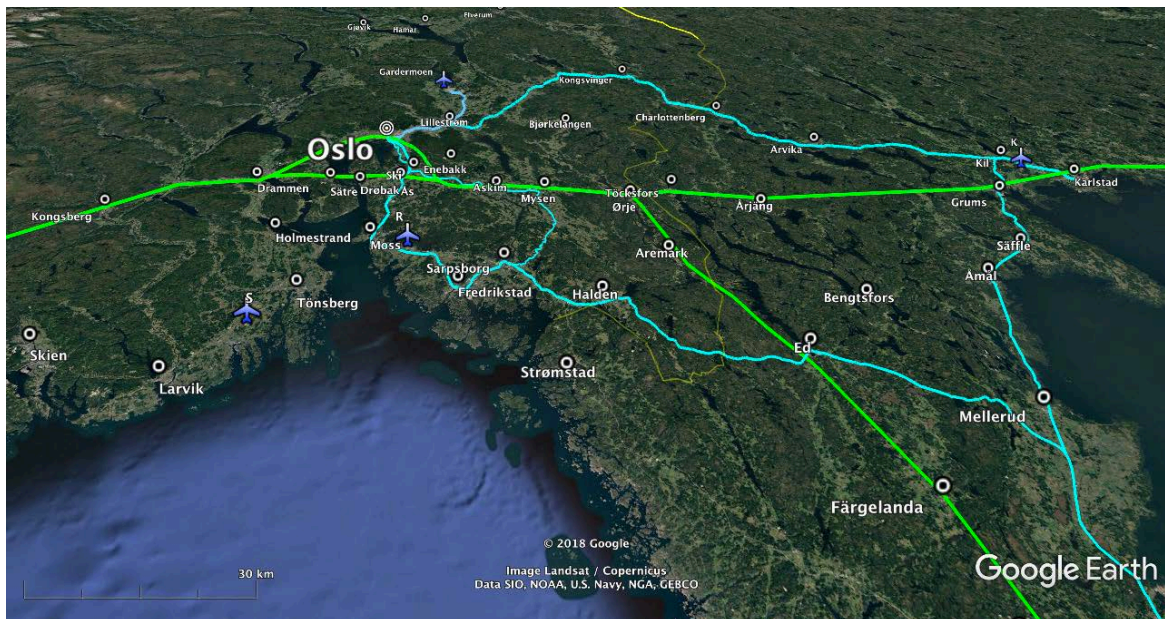
- Support and initiate further studies for implementation of an HSR network between Oslo-Gothenburg-Copenhagen-Stockholm and other major cities.
- Explore alternative funding opportunities.
- Cooperate with private and public partners for the realization of HSR.
- Lobbying towards potential investors and national authorities.
- Work for the Oslofjord railway bridge and HSR railway connections on both sides of the fjord, in order to strengthen the regional coherence and economic development.

Map-illustrations below:

The green line is the possible route for the high-speed railway lines. The other lines are current railways within the same area.







The illustration below shows how major Nordic cities and regions can be connected when the HSR network is further elaborated.



### 6.7 Environment, regional and urban development

Work for the realization of the coherent 1-hour region, the “Scandinavian Diamond”, with sustainable, fast and efficient transport across the Oslofjord and across the national border.

New railways and roads have impact on the land use, environment and urban development. New town-plans for logistic areas, roads, car parking, bicycle lanes, pedestrian areas, services, housing and industries need to be developed.

This part needs involvement of multilevel governance and the private sector. It can include new cross-border projects (e.g. Interreg Norway-Sweden), in order to apply a wider territorial perspective and for the exchange of ideas and planning methods.



### 6.8 Responsibility for the strategy

- The responsibility for implementation of the development strategy is first of all for the Värmland-Østfold Border Council (PP10), in cooperation with local municipalities, regional and national authorities in Norway and Sweden. NGOs and other public and private actors will be included when relevant.
- Transnorden Sweden (PP14) and the Innovation Circle Network (PP6) will help to work with the strategy part 4 (HSR), as this requires an “out of the box” approach and innovation. If the HSR network is going to be established without any public funding, then it needs to involve various stakeholders, operators, logistic companies, constructing companies, banks and other financial actors.

### 6.9 Decisions on the strategy

This strategy document is delivered from the task 4.1 case leader and will be tabled to the boards of TENTacle partners, PP10, PP14 and PP6 for further considerations, and finally adopted by the annual meeting of the Värmland-Østfold Border Council, in May 2019.

This document will also be published and disseminated to all stakeholders and others.



*The task 4.1 team, from the left:  
Urban Hermansson, Leif Lendrup and Alf S. Johansen*