ÖRESUND METRO CONNECTS GREATER COPENHAGEN
RESULTS OF PHASE 3 – PRELIMINARY STUDY

ÖRESUND METRO »
COPENHAGEN
MALMÖ
2017
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ÖRESUND METRO CONNECTS GREATER COPENHAGEN
- RESULTS OF PHASE 3 – PRELIMINARY STUDY

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ABOUT THE ÖRESUND METRO PROJECT

An Öresund metro between Copenhagen and Malmö is the vision for a metro line below Öresund with departures every 1½ minutes and a travel duration of approximately 20 minutes. It is a long-term and sustainable life-line that can bring the region’s two largest cities and Greater Copenhagen closer to each other and create greater accessibility and stronger cohesion.

With support from the EU Interreg Fund (European Regional Development Fund), between 2012 and 2017 the Municipality of Copenhagen and the City of Malmö have compiled preliminary studies in three phases for an Öresund metro.
PHASES 1 AND 2 (2012–2015)

Phases 1 and 2 of the preliminary study investigated construction technology, alignment, station design, environmental effects, social economic benefits and dynamic effects.

All in all the analyses show that an Öresund metro can be realised in terms of construction and building technology. In Copenhagen it will be a part of the metro system which is presumed to be extended with, for example, M6 and M7 as a circular line on the stretch: Copenhagen Central station – Prags Boulevard – Østerport – Copenhagen Central station. An Öresund metro can play a decisive role in strengthening integration in the region by increasing accessibility through fast and flexible transport across Öresund and a greater number of travellers.

An Öresund metro is planned as a driverless, high-frequency and fast (120 km/h) metro line between Copenhagen and Malmö. The experience of driverless metro lines in Copenhagen is that they are punctual and very reliable. An Öresund metro can create better conditions for commuters and visitors and support the development of a better integrated labour market. Meanwhile the load on the regional trains of the Öresund Bridge is eased so that capacity is released for more freight trains and high-speed trains.

The Öresund metro can increase the number of journeys on public transport across Öresund by up to 35 per cent from the current 54,000 to 65–73,000 passengers daily.

The construction price is valued at approximately EUR 4 billion (including 50 per cent surcharge for risk), of which approximately EUR 2.7 billion comprises the coast to coast area. The financing can take place through ticket revenue, which is estimated at approximately EUR 2.6 billion, contributions from the EU as well as government grants and bridge fees from the Öresund Bridge. The establishment of an Öresund metro can be done by the Danish and Swedish States deciding that the revenue from the Öresund Bridge when the bridge has been repaid by 2035 can be reinvested in infrastructure in Greater Copenhagen as state grants. Consequently, the Öresund metro is largely user-financed and will become a “third phase” of the Öresund Bridge.
INTRODUCTION PHASE 3

The competition when it comes to attracting investments on a global level has never been greater. Strong infrastructure, qualified labour and special driving forces for growth and positions of strength comprise substantial criteria for the establishment of global operations. Greater Copenhagen is dependent on cooperation to be able to distinguish itself as an attractive international metropolis and to secure the region’s international competitiveness and long-term, sustainable development.

The vision for Greater Copenhagen is to be an international hub for investments and knowledge. A more connected region with shorter travel times increases the critical mass for different operations and equips the region with international competitiveness.

The Öresund metro is a part of Greater Copenhagen’s traffic charter (2016) – a joint agreement on a well-functioning and sustainable traffic infrastructure as a prerequisite for the creation of a competitive metropolitan region.

Phase 3 investigated the link to high-speed trains, weighting of functionality, overhead expenses and environmental impact, connection of districts in Copenhagen and Malmö, effects of shorter travel time as well as communications for an Öresund metro.

Main results

- The shorter travel time of approximately 20 minutes creates a larger common labour market and expands the local market. This means that more people can reach each other within 60 minutes.

- A driverless metro line ensures high punctuality and great reliability. It is beneficial for commuters as well as trade and industry and creates opportunities for a good balance between work and leisure.

- The shorter travel times break down the mental barriers and increase integration throughout Greater Copenhagen.

- If the Öresund metro is combined with high-speed trains, this will create competitiveness in relation to flights between Copenhagen and Stockholm. The travel duration will be reduced by approximately 30 minutes and at the same time it will be possible to work or rest undisturbed during the train journey.

- The construction price of an Öresund metro has been recalculated for the coast to coast area and costs approximately EUR 2.7 billion including 50 per cent surcharge for risk. It can be constructed in 6.5 to 7 years and it has only marginal environmental consequences.

- There is interest in an Öresund metro both, regionally and locally, but there are differing views on its impact. Knowledge of the local and regional effects and connections with the Fehmarn link and high-speed trains are limited.

- The Öresund metro is located in the EU’s TEN-T ScanMed corridor which will secure balanced economic growth throughout the corridor from Scandinavia in the north to Italy in the south. The Öresund Bridge and Fehmarn Fixed Link are parts of this ScanMed corridor. The European Commission’s Directorate-General MOVE sees great potential in having an Öresund metro in order to secure a more efficient utilisation of the Öresund Bridge and the Fehmarn Fixed Link.
Greater Copenhagen needs to strengthen international competitiveness in relation to other comparable metropolitan regions in terms of being able to attract international investments and skills.

More foreign companies and skills can contribute to increased productivity. By using foreign investments, it is possible to utilise existing resources in a better manner and increase the critical mass in Greater Copenhagen, which promotes growth and development.

At the same time the population in the region is increasing. It is estimated that the population in the region will increase from 3.8 million to 4.1 million residents between 2015 and 2025. Higher population means a larger local domestic market and a critical mass which can attract investments and skills.

However, a growing population also necessitates well-functioning transport infrastructure that can secure high and efficient mobility.

In terms of traffic, in the future Greater Copenhagen will face several different challenges:

- The Fehmarn Fixed Link is expected to open in 2028 and double the number of freight trains across the Öresund Bridge. In some cases, freight trains are assigned a higher priority than passenger trains. A mix of train types (freight, regional and high-speed trains) will thus put pressure on passenger transport on the track of the bridge.

- As of 2035 Sweden has plans for high-speed trains to be able to drive up to 320 km/h. They will connect Stockholm, Gothenburg and Malmö, and through a continued link Copenhagen airport and possibly also Hamburg. It expands the catchment area of the airport and accordingly also supports its growth vision ‘Expanding CPH’ on increasing the number of passengers by 40 million.

According to Öresundsinstituttet 85 per cent of all passenger transport across Öresund takes place via the Öresund Bridge. If we are unable to handle the increasing rail traffic, the Öresund Bridge and Fehmarn link risk becoming future bottle necks for growth and development.
THE ÖRESUND METRO EXPANDS THE FUNCTIONAL LABOUR MARKET AND CREATES SPACE FOR GROWTH

Phase 3 focused on the potential significance of an Öresund metro line for Copenhagen, Malmö and the Greater Copenhagen Region. Travel time estimates show that an Öresund metro will not only make the cities of Copenhagen and Malmö each other’s districts, but it will also enable the entire Greater Copenhagen Region to be better connected.

According to Öresundsinstitutet in 2015 on average 95,900 persons travelled across Öresund (single journeys) daily. 75,000 persons travelled via the Öresund Bridge and 20,900 persons via Helsingör-Helsingborg. Of the 75,000 passenger journeys via the Öresund Bridge, 32,100 were made by train, of which 17,000 comprised pure commuter journeys.

According to several forecasts, the number of public transport journeys is expected to increase to 54,000 journeys per day by 2030. However, with an Öresund metro the number of public transport journeys can potentially increase to 65,000–73,000 passenger journeys per day in the southern part of Öresund.

Together with the Öresund Bridge and Fehmarn Fixed Link, the Öresund metro is located in the TEN-T ScanMed corridor, the Trans-European Transport Network in the EU. Commuters, business travellers and tourists can use the metro across Öresund and thus create space for more and different types of trains on the Öresund Bridge.

The significance of an Öresund metro is that the functional region and local market within a travel duration of 60 minutes will be expanded. This means that more people will have a shorter travel time to reach their workplace, education institutions, business meetings or cultural experiences across the region.

With an Öresund metro you can break down the mental barriers across Öresund and connect Greater Copenhagen Region in a better manner.
THE ÖRESUND METRO CONNECTS CITIES

Phase 3 analysed the reduction in travel time, including average waiting times. The current travel duration between Copenhagen Central station and Malmö Central station is 35 minutes with the Öresund train. The travel time will decrease to approximately 20 minutes with an Öresund metro. This radically changes the mobility across Öresund in Greater Copenhagen Region.

Copenhagen and Malmö will become each other’s districts
The cities will become each other’s districts. The short travel time namely means that private travellers, business travellers and tourists can reach many travel destinations in both cities within 45 minutes.

This facilitates a good balance between work and leisure so that you, for example, have the time to drop off your children at pre-school or go shopping even though you work on the other side of Öresund.

With an Öresund metro, business people, researchers and employees from Malmö can, for example, travel to Copenhagen Science City in Copenhagen in only 22 minutes (including the average waiting time at the start of the journey). This is a reduction in the travel time by 37 minutes compared to the Öresund train.

Figure 3 The map shows travel time (incl. average waiting duration at the start of the journey) from Copenhagen Central station and Malmö Central station across Öresund with the Öresund train (with departures every 10 minutes) to the other side. Dark green: travel time less than 30 minutes, light green: 30–45 minutes, yellow: 45–60 minutes, red: travel duration above 60 minutes.

Figure 4 The map shows travel time (incl. average waiting time at the start of the journey) from Copenhagen Central station and Malmö Central station across Öresund with an Öresund metro and the Öresund train (with departures every 10 minutes) to the other side. Dark green: travel time less than 30 minutes, light green: 30–45 minutes, yellow: 45–60 minutes, red: travel time above 60 minutes.
Similarly, Copenhageners can travel to the other side to visit a specialist doctor, have food in Gamla Staden in Malmö or see a concert at Malmö Opera in 22–30 minutes. The reduction in travel time for journeys to Malmö is normally 10–20 minutes compared with the Öresund train currently.

The shorter travel time creates the conditions for greater exchange of labour. In particular, the frequent departures of the Öresund metro and good punctuality provide commuters with optimal opportunities to travel across Öresund and be sure that they will reach on time.

This is important for both commuters and for the opportunities of businesses to attract qualified labour without impacting the work-life balance of labour. Consequently, the Öresund metro supports a metropolitan region with a high quality of life.

With significantly greater accessibility, better labour market opportunities are created as companies find it easier to locate qualified labour. The appeal of the region will improve and can attract both qualified labour and businesses in need of a central location.

In the same way the local market will expand, something which can contribute to breaking down the mental barriers so that business people or tourists, for example, choose to have lunch on the other side of Öresund as the journey is so short. This can benefit tourism and retail trade in the two cities.

### Regional opportunities

However, the vision of an Öresund metro covers much more than simply connecting Copenhagen and Malmö in terms of traffic. Commuters are normally willing to travel for up to 60 minutes between their home and workplace. With a travel time of only approximately 20 minutes between the cities, there is thus a margin for changing to other means of public transport, for example, long-distance train, regional train, local train, light rail and bus, and thus the functional regional labour market is also significantly expanded within a travel time of 60 minutes.

The shorter travel time with an Öresund metro connects research and education institutions and creates opportunities for greater use and thereby productivity of businesses. An Öresund metro supports the Triple Helix Cooperation between academia, trade and industry as well as public agencies. A well-functioning and connected public transport system creates a foundation for growth within both trade and industry, education and tourism, which can strengthen the position of the cities and region internationally.

The decreased travel duration can also increase accessibility to cultural institutions throughout the region.

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**Table 1** Example of reduction in travel time (including the average waiting time at the start of the journey) from Malmö Central station with Öresund metro combined with other public transport in Copenhagen.

<table>
<thead>
<tr>
<th>Stations</th>
<th>Travel time with Öresund train</th>
<th>Travel time with Öresund metro</th>
<th>Reduction in travel time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prags Blvd. st.</td>
<td>48</td>
<td>18</td>
<td>30</td>
</tr>
<tr>
<td>Islands Brygge st.</td>
<td>43</td>
<td>20</td>
<td>23</td>
</tr>
<tr>
<td>København H</td>
<td>40</td>
<td>22</td>
<td>18</td>
</tr>
<tr>
<td>Rigshospitalet st.</td>
<td>59</td>
<td>22</td>
<td>37</td>
</tr>
<tr>
<td>Rådhuspladsen st.</td>
<td>45</td>
<td>27</td>
<td>18</td>
</tr>
<tr>
<td>Nordhavn st.</td>
<td>53</td>
<td>27</td>
<td>26</td>
</tr>
<tr>
<td>Krydstogtkaj st.</td>
<td>57</td>
<td>31</td>
<td>26</td>
</tr>
<tr>
<td>Ny Ellebjerg st.</td>
<td>48</td>
<td>35</td>
<td>13</td>
</tr>
</tbody>
</table>

**Table 2** Example of reduction in travel time (including the average waiting time at the start of the journey) from Copenhagen Central station with Öresund metro combined with other public transport in Malmö.

<table>
<thead>
<tr>
<th>Stations</th>
<th>Travel time with Öresund train</th>
<th>Travel time with Öresund metro</th>
<th>Reduction in travel time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malmö C</td>
<td>40</td>
<td>22</td>
<td>18</td>
</tr>
<tr>
<td>Gustav Adolfstorg</td>
<td>43</td>
<td>32</td>
<td>11</td>
</tr>
<tr>
<td>Stadshuset</td>
<td>49</td>
<td>32</td>
<td>17</td>
</tr>
<tr>
<td>Triangeln stn</td>
<td>37</td>
<td>33</td>
<td>4</td>
</tr>
<tr>
<td>Folkets park</td>
<td>51</td>
<td>34</td>
<td>17</td>
</tr>
<tr>
<td>Rosengårds centrum</td>
<td>58</td>
<td>41</td>
<td>17</td>
</tr>
<tr>
<td>Höja</td>
<td>60</td>
<td>43</td>
<td>17</td>
</tr>
</tbody>
</table>
In phase 3 estimates showed that an Öresund metro with links to Swedish high-speed trains can become a competitive alternative to the flight between Copenhagen and Stockholm.

The National Negotiation on Housing and Infrastructure is an investment which has been commissioned to build at least 100,000 more homes and expand the infrastructure with high-speed trains in Sweden by 2035. The high-speed trains will link Stockholm with Malmö and Copenhagen in the European TEN-T ScanMed corridor and reduce the travel time by train.

The stretch currently has 4 million passenger journeys per year and the train’s market share comprises 25 per cent. According to estimates of the National Negotiation on Housing and Infrastructure, it is expected that there will be 5.2 million passenger journeys by 2039, of which 57 per cent or 3 million passenger journeys will be made by train. The train will become competitive compared to the flight and will change market shares.

The journey from Copenhagen Central station with the Öresund metro and high-speed train to Stockholm can be made in approximately 2 hours and 50 minutes. If you take the Öresund train instead and change to a high-speed train in Malmö to continue your journey to Stockholm, you will reach Nyköping approximately 110 km south of Stockholm in the same travel time.

The flight from Copenhagen Central station via Kastrup to Stockholm Arlanda and further to Stockholm C takes approximately 3 hours and 15 minutes, which includes transport to and from the airport, security check and waiting time. The total travel time is approximately 30 minutes longer than with the Öresund metro and high-speed train.

On the train journey you have access to several stations on the stretch, and you can work or rest undisturbed throughout the journey from centre to centre. In addition to a shorter travel duration, the train journey also contributes to more eco-friendly and sustainable passenger transport.

**Figure 5 Copenhagen-Malmö-Stockholm with Öresund train (blue) and with Öresund metro (red).**
In phase 3 detailed analyses were conducted of construction technology, safety concept and legislation and a new estimate of the construction price for the coast to coast area was also made.

**Drilled tunnel**

Several tunnel options, with and without low bridge, have previously been investigated. A 22 km long drilled tunnel below Saltholm is assessed to be particularly beneficial for the environment in a construction phase. A tunnel with two tracks in separate channels in one level as well as channels for installation, ventilation and maintenance is assessed to be the most beneficial solution in a construction technology, construction finance and operational respect.

**Safety**

A 22 km long tunnel below Öresund must fulfil the highest safety standards. A safety concept has been analysed in more detail and shows that it is possible to construct a safe tunnel below Öresund. It is possible to plan for 7 trains with 120 passengers in each pipe at the same time, and a potential frequency of up to 36 trains hours per hour, which corresponds to 100 seconds between each departure.

**Legislation**

The cross-border regional infrastructure necessitates that legislation in Denmark and Sweden can handle a new fixed link. Railway legislation in Denmark and Sweden only differs marginally, and therefore it is possible to construct a drilled tunnel for a metro line below Öresund.

**Construction price**

The construction price for the selected solution model with a drilled tunnel below Öresund has been re-calculated. The calculations are robust and show that it will cost approximately EUR 2.7 billion, including 50 per cent surcharge for risk, to construct the coast to coast stretch from Prøvestenen outside Amager on the Copenhagen side to Scaniaparken on the Malmö side. The sea bed comprises limestone and this is a material which we have experience of using in the City Tunnel in Malmö and the metro in Copenhagen. The total duration of planning and construction work is 6.5–7 years and will only have marginal environmental consequences in the construction phase.

![Figure 6 Cross section of tunnel pipe.](image-url)
KNOWLEDGE OF THE ÖRESUND METRO AND ITS SIGNIFICANCE AND EFFECTS

A stakeholder analysis and communication plan were conducted in phase 3.

There is interest in an Öresund metro – but knowledge needs to increase
27 qualitative interviews were conducted with key players on a national, regional and local level, including representatives of trade and industry as well as unions in Denmark and Sweden.

The interviews show a great interest in and positive view of the vision of an Öresund metro. However, there are different views on what it will entail locally, regionally and nationally as well as on the EU level. There is no doubt that the cities of Copenhagen and Malmö will be each other’s districts and that the metro will play a major role in a better integrated labour market, trade and tourism.

However, the players have differing views on the regional and national effect. For example, there is limited knowledge on the significance for Greater Copenhagen Region in terms of the relationship between the capacity of the Öresund bridge and the consequence of double the quantity of goods on the track when the Fehmarn link opens. In addition, there will be the link to a high-speed train from Stockholm to Malmö and Copenhagen airport.

The analyses show that an Öresund metro is exactly what is required for handling these future traffic challenges in Greater Copenhagen Region.

No doubt in the European Commission on the significance of the Öresund metro for a more efficient Öresund bridge and Fehmarn link.

The European Commission’s Directorate-General MOVE is confident. An Öresund metro is a part of the European TEN-T ScanMed corridor which connects Scandinavia in the north and Italy in the south. TEN-T aims to ensure balanced economic growth in Europe.

Together with the Hamburg Rapid Transit Railway S4-project on the stretch between Lübeck (Bad Oldesloe) and Hamburg, an Öresund metro can create the capacity across Öresund which is required to handle double the quantity of goods on the railway when the Fehmarn link opens. In this manner the two projects ensure more efficient utilisation of the major state investments in the Öresund Bridge and the Fehmarn Fixed Link.

Figure 7 The Öresund metro (light blue) is a part of the European Commission TEN-T ScanMed corridor (red), just like the Öresund Bridge (blue) and Fehmarn Fixed Link (green).
The cities of Copenhagen and Malmö seek to continue to create the conditions for an Öresund metro and to increase the information level and dialogue on the metro’s design and properties. Therefore, Copenhagen and Malmö have applied for and been granted funds from the Interreg programme for a fourth phase of the preliminary study.

Phase 4 will include communication based on the stakeholder analysis in phase 3. Here the focus will be on the importance of a higher railway capacity in the European TEN-T ScanMed corridor and thus better utilisation of both the Öresund Bridge and the Fehmarn Fixed Link. The work will include a comparative analysis of the S4-Bahn project between Hamburg and Lübeck and an Öresund metro. The regional and local effects are examined in more detail in order to see which synergies an Öresund metro can provide for a more functional and connected labour market. For example, it may entail hospitals, research institutes and tourism in the Greater Copenhagen Region. The national socio economics and dynamic effects in connection with, among other things, the Fehmarn Fixed Link will need to be examined in more detail.

**Facts about an Öresund metro**

- **Price**: approx. EUR 4 billion, including a 50 per cent surcharge for risk.
  - The price covers the stretch from coast to coast, a local land stretch from the coast until Malmö Central station with the stations Västra Hamnen and Malmö Central station, short local land stretches from Amager’s coast up until the link with the M6/M7 stretch between Prags Boulevard and Kløvermarken, as well as the extra metro material which is required to serve Malmö.
- **Departures every 1.5 minutes.**
- **Tunnel length from coast to coast**: 22.1 km
- **Max capacity**: 36 trains per hour/direction
- **Max speed**: 120 km/h
- **Ticket revenue**: approx. EUR 2,6 billion, cf. Incentive Partners 2013
- **Deepest point of the tunnel**: 55 m below the surface of the water
- **Travel duration**: Copenhagen Central station to Malmö Central station: approx. 20 minutes
- **Construction time**: 6.5–7 years.
FUTURE RAILWAY NETWORK IN THE GREATER COPENHAGEN REGION

In 20-30 years from now a common railway network could look like this – long-distance train, regional train, local train, Öresund metro, metro and light rail in one integrated system.

READ MORE ABOUT THE ÖRESUND METRO
See all presentations and interim reports on the Internet: www.malmo.se/oresundsmetro
www.kk.dk/oresundsmetro

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