Femern Baelt Fixed Link

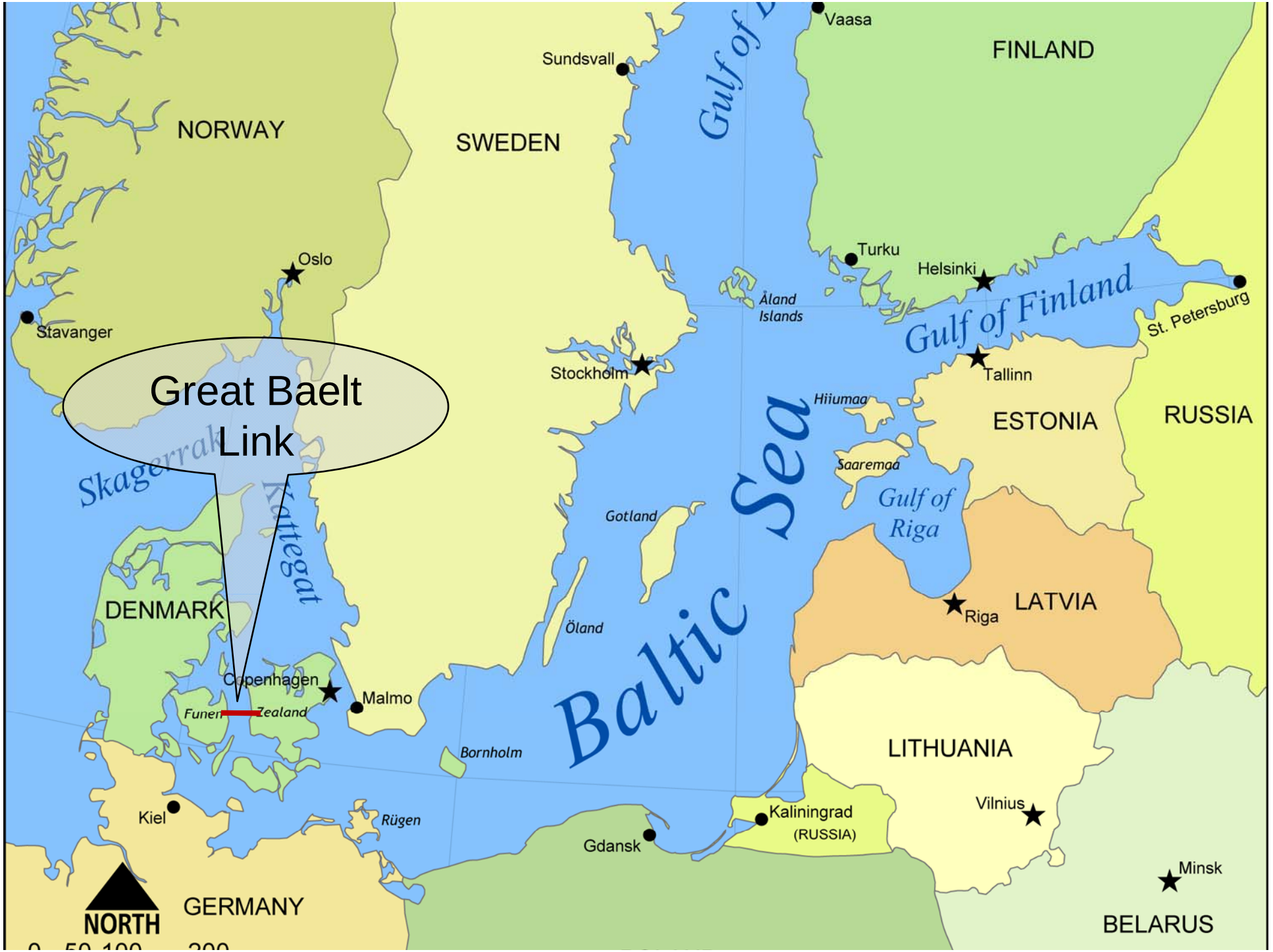
Concrete Strategy
Macro Perspective

Steen Lykke, M.Sc., Project Director, Tunnel

- 2008 – date, Project Director, Tunnel Femern Bælt A/S
- 2001 – 2008 Project Manager, Bosphorus, Istanbul, The Marmaray Project
- 1993 – 2001,Contracts Director, Oeresundskonsortiet, DK
- 1979 – 1993, Steensen & Varming Director, Civil & Structural Works Denmark

Femern Sund Bælt

The Danish Tradition


Great Baelt Link
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SWEDEN
FINLAND
Vaasa
Sundsvall
Gulf of Bothnia
Oslo
Stavanger
Turku
Helsinki
Åland Islands
Gulf of Finland
St. Petersburg
Stockholm
Tallinn
Hiiumaa
ESTONIA
RUSSIA
Saaremaa
Gulf of Riga
Gotland
Baltic Sea
Skagerrak
Kattegat
DENMARK
Öland
Riga
LATVIA
Copenhagen
Malmo
Funen
Zealand
Bornholm
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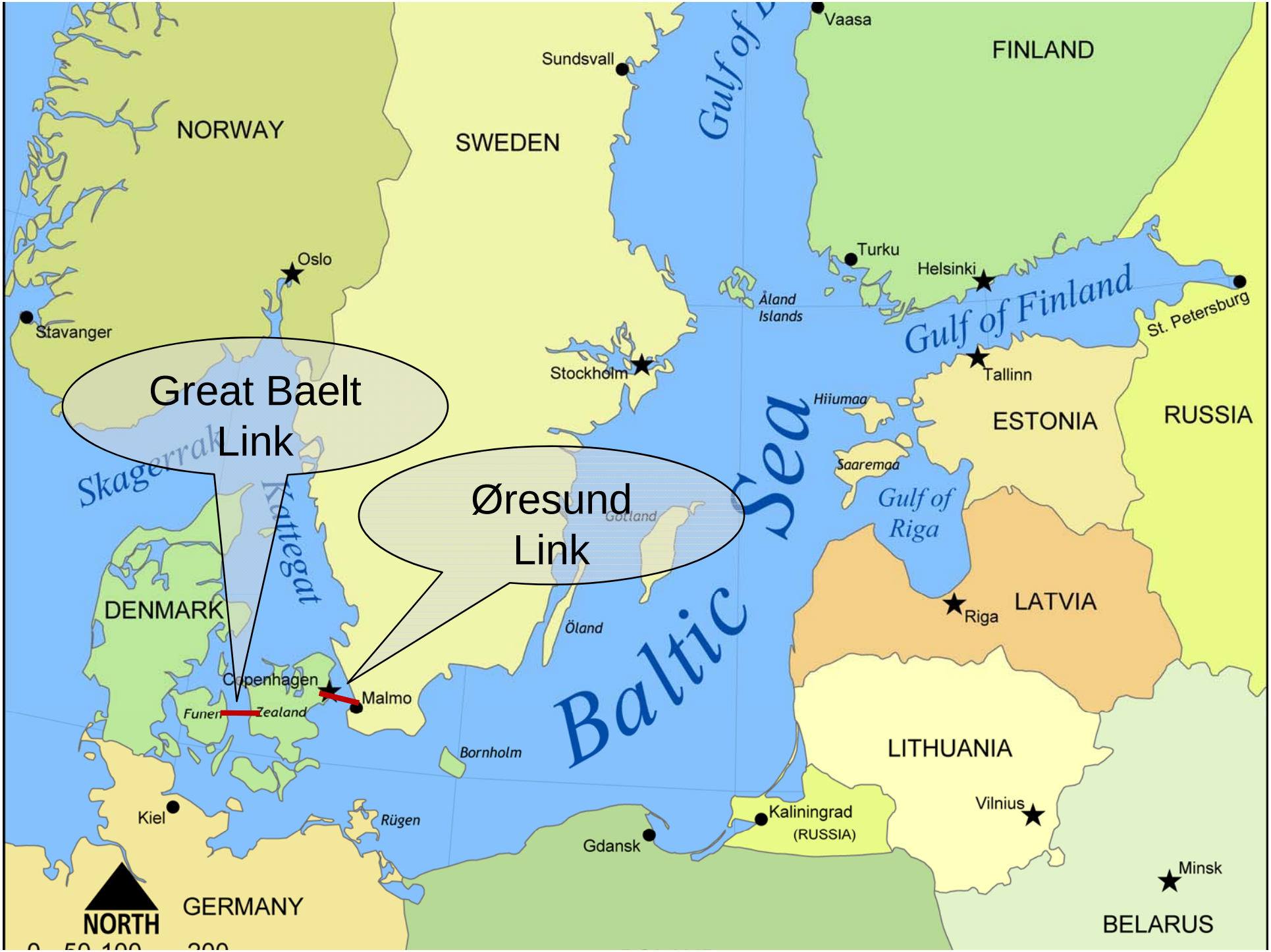
Kaliningrad (RUSSIA)
Vilnius
Gdansk
Minsk
BELARUS
NORTH
GERMANY


Great Baelt Link
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Minsk
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NORTH
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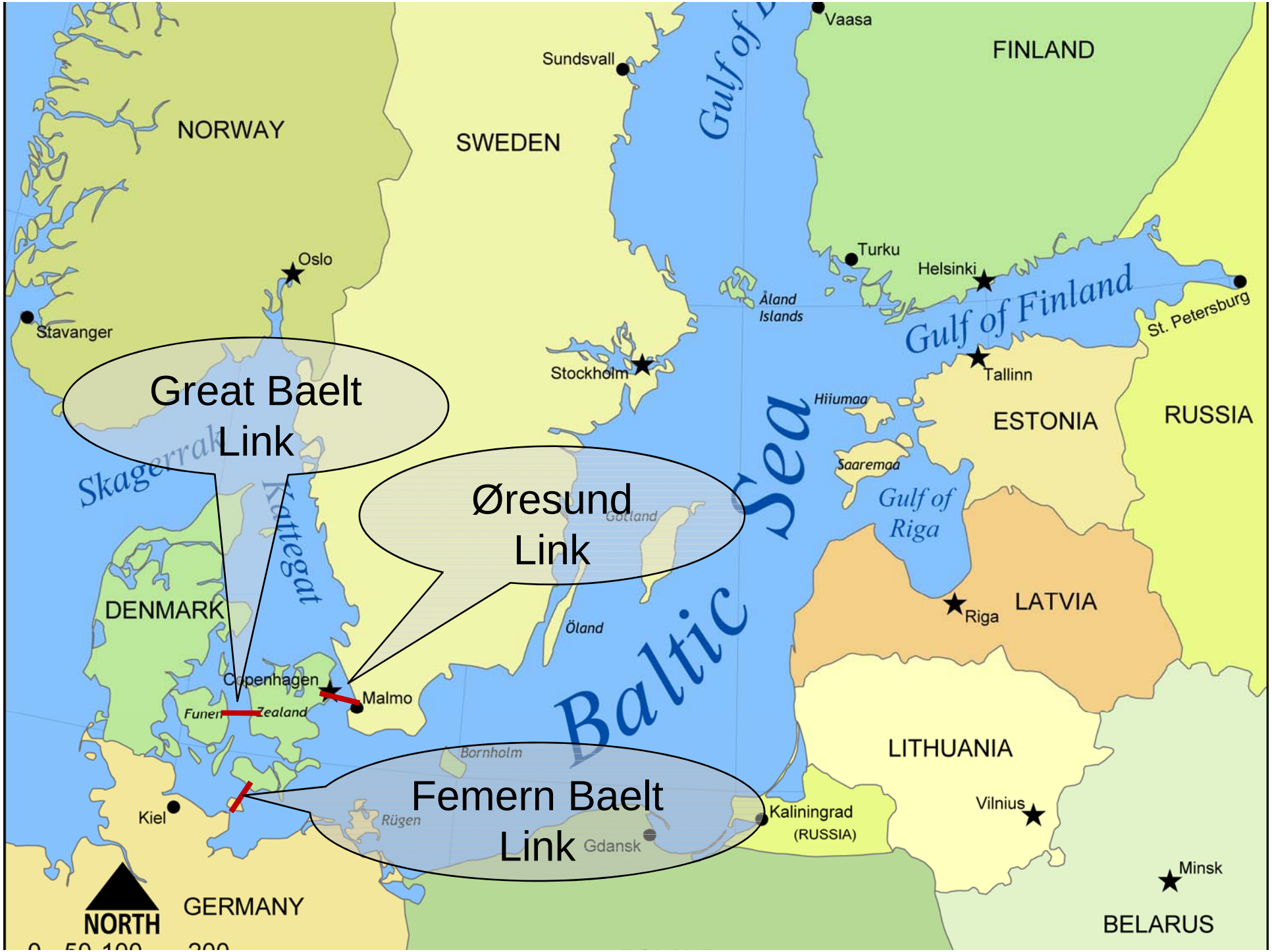
Great Baelt Link
Øresund Link
Femern Baelt Link
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Rügen
Funen
Zealand
NORTH


OSLO
STOCKHOLM
GÖTEBORG
KOPENHAGEN
MALMÖ
Fehmarnbelt
LÜBECK
HAMBURG
BERLIN
KOPENHAGEN
MALMÖ
Großer Belt
Öresund
Fehmarnbelt
LÜBECK

A new growth region ?

Facts and Figures

- Strait Width: 19 – 20 kilometers
- Max Water Depth: approximately 30 meters
- Total Budget including Hinterland: 6.5 – 7 billion €
- No tax-money involved, Users will pay (Coast to Coast)
- Prognoses: Pay-back period 27 years
- Ship traffic east – west: App. 46,000 / year
- Ship traffic north - south: App. 20,000 / year
- Is a combination Bridge / Tunnel an option: NO
- A cable stayed bridge is the preferred solution
- An immersed tunnel is the preferred alternative

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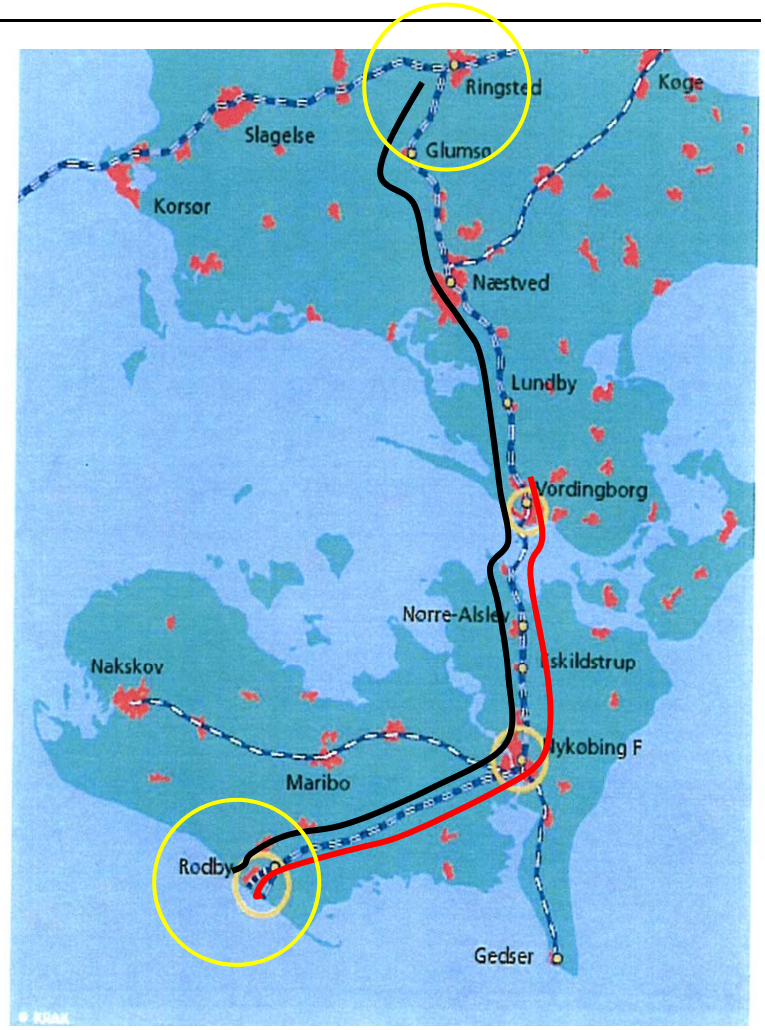
Danish Hinterland

- Railway Ringsted-Rødby, Upgrading, electrification
- Railway Vordingborg-Rødby from one to two tracks except Storstrøms-bridge
- Minor upgrading of Sakskøbing-Rødby motorway



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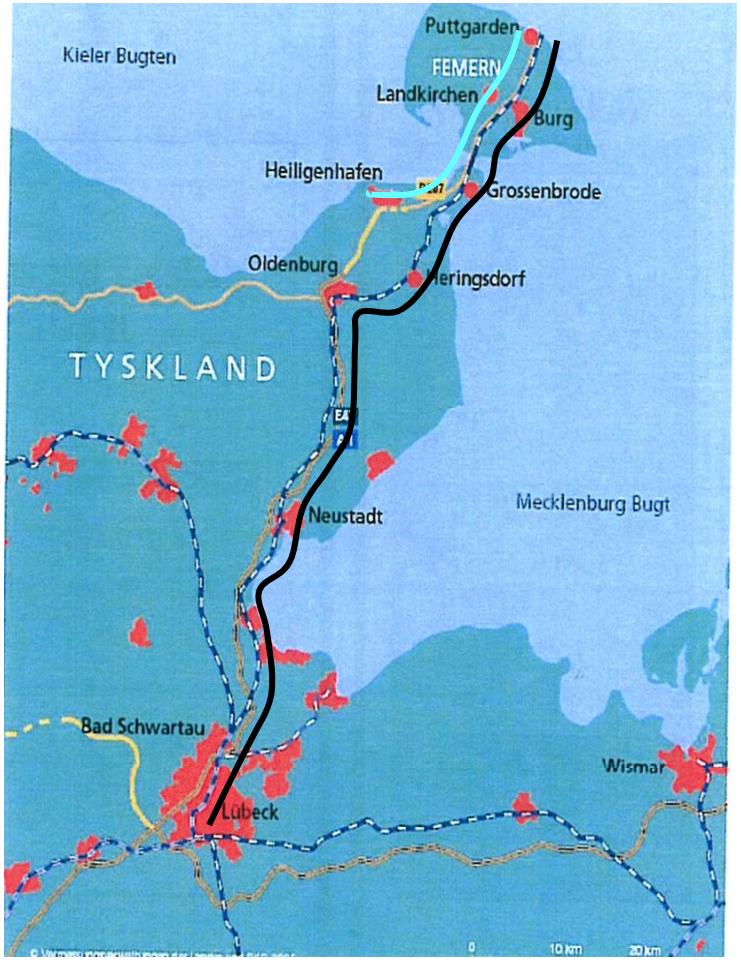
German Hinterland

- Ensure sufficient capacity of Railway Bad Schwartau - Puttgarden
- Railway Lübeck-Puttgarden electrified
- Railway upgraded to two tracks 7 years after opening
- Road Heiligenhafen-Puttgarden upgraded to 4 lanes



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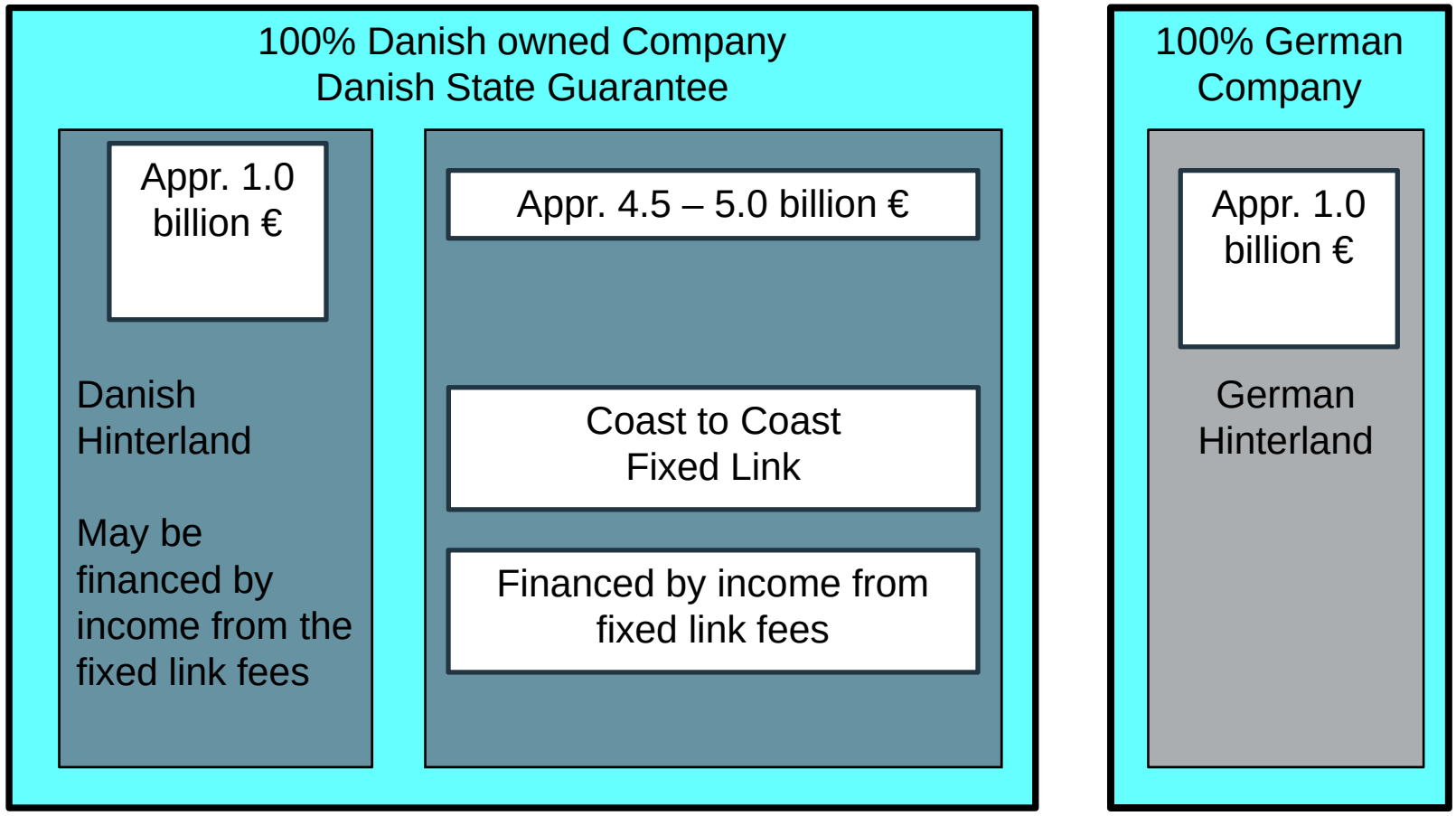
Finance Model



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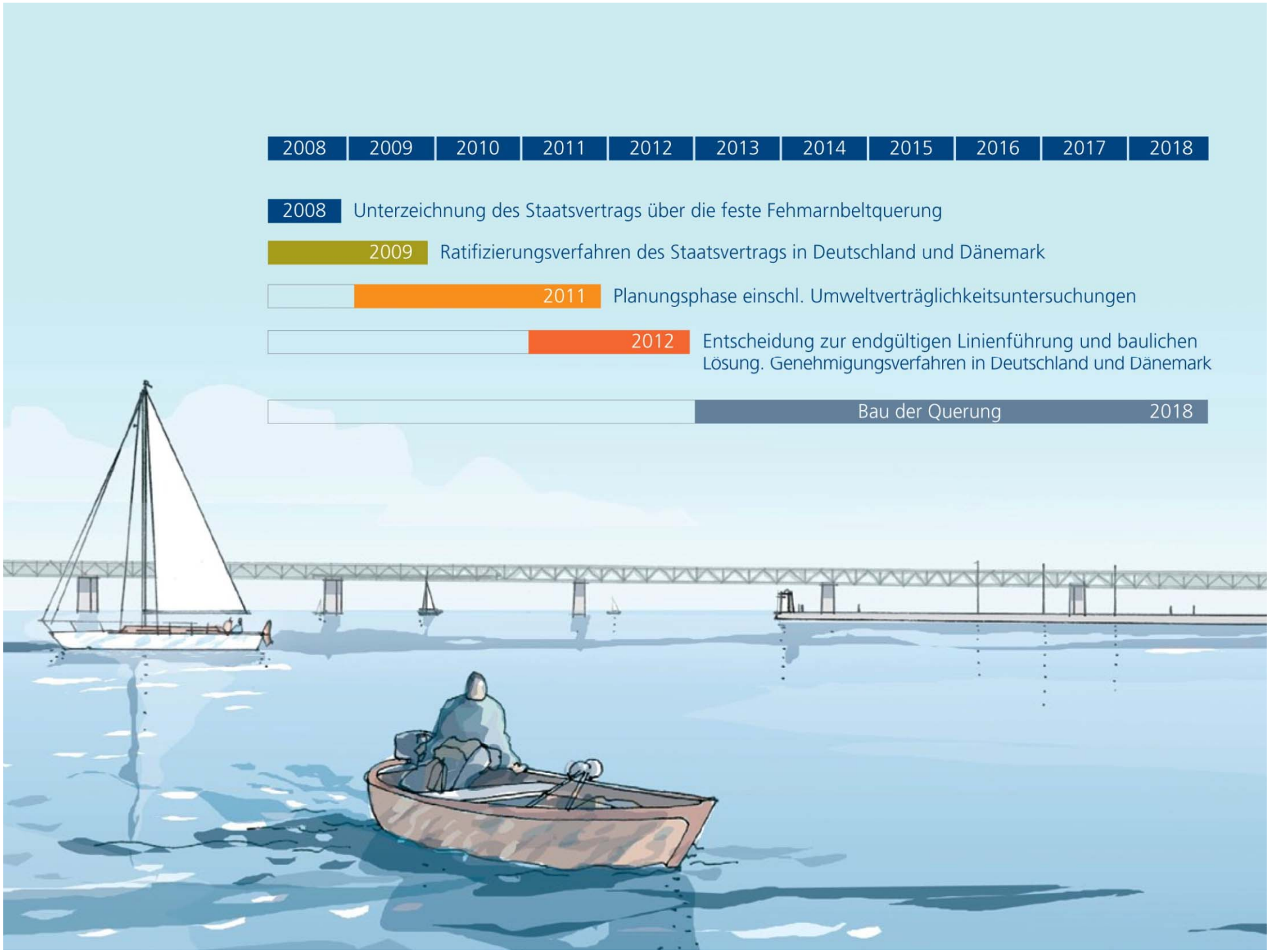
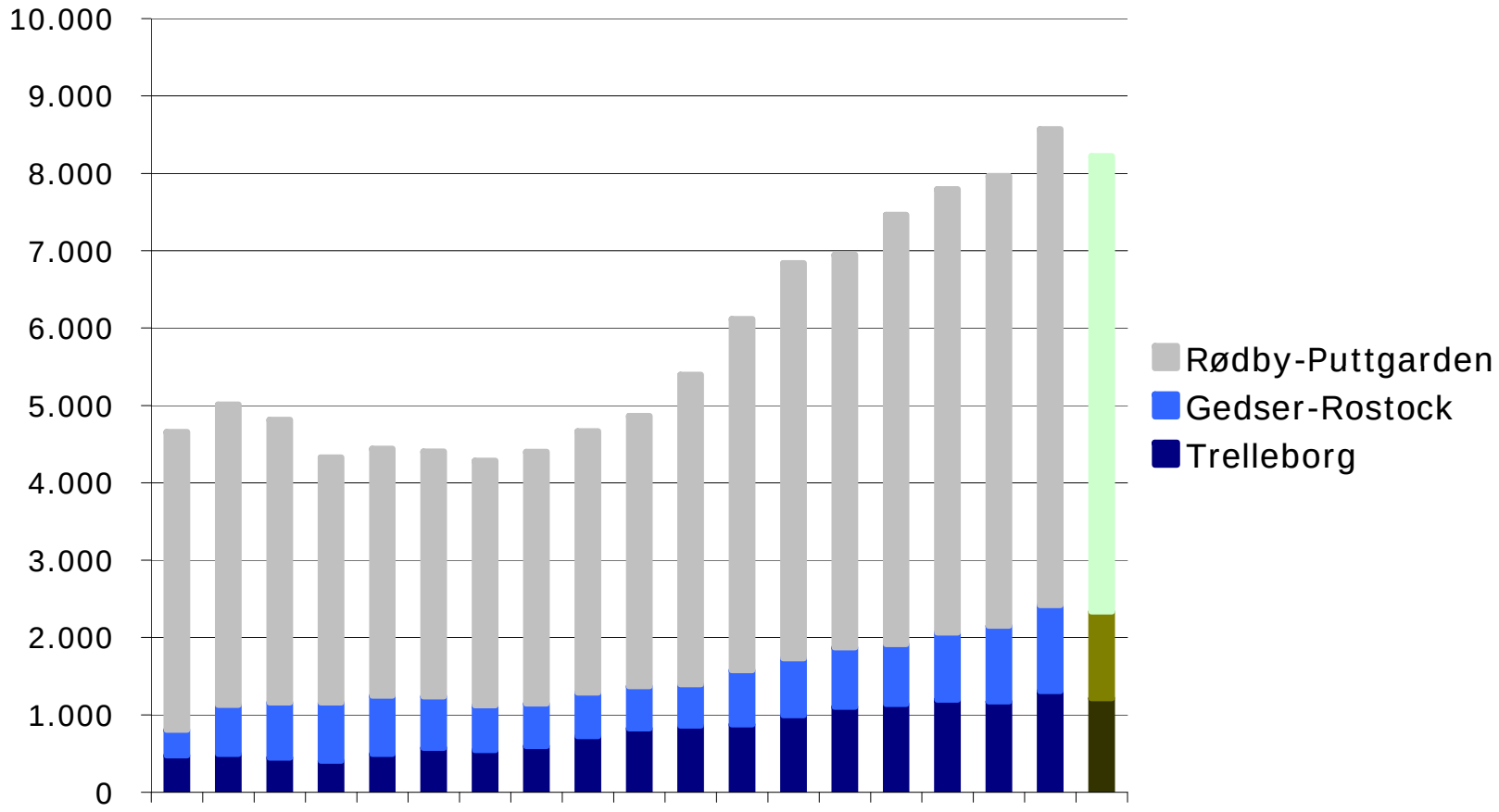

2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
2008 Unterzeichnung des Staatsvertrags über die feste Fehmarnbeltquerung
2009 Ratifizierungsverfahren des Staatsvertrags in Deutschland und Dänemark
2011 Planungsphase einschl. Umweltverträglichkeitsuntersuchungen
2012 Entscheidung zur endgültigen Linienführung und baulichen Lösung. Genehmigungsverfahren in Deutschland und Dänemark
Bau der Querung 2018

Average daily traffic
Scandinavia - Continent



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Bridge or tunnel?

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Technical Solutions not yet fixed

From here,
POTENTIAL SOLUTIONS

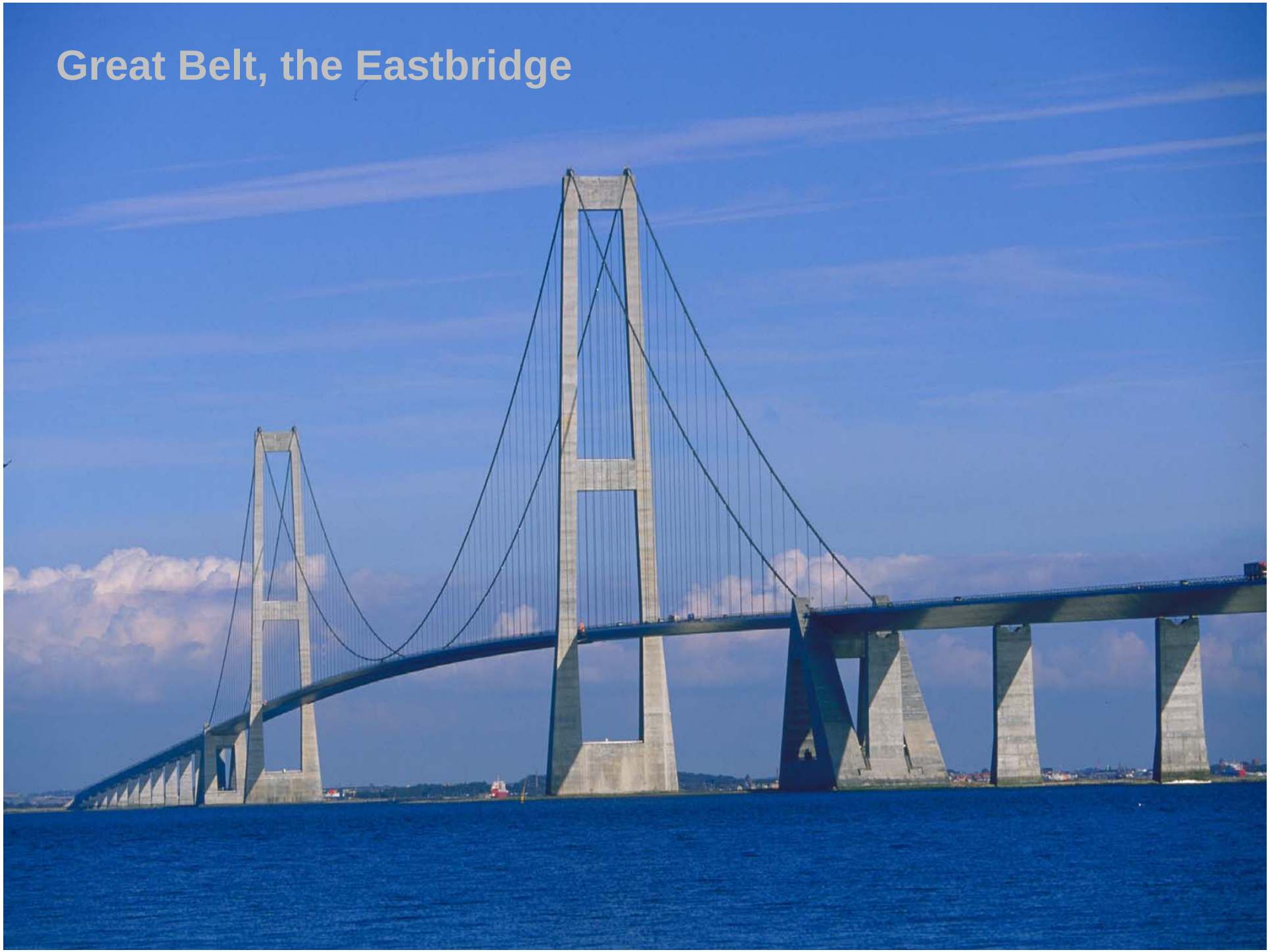
The Preferred Solution

A cable stayed Bridge

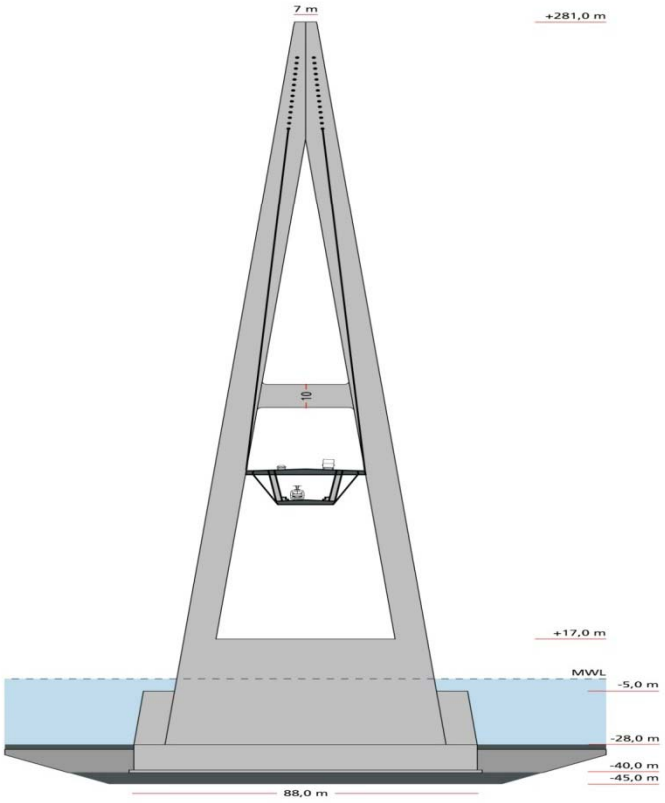

Cable Stayed bridge
– The preferred Option

Oresund Bridge

Great Belt, the Eastbridge



Bridge, facts and figures so far



- Top of pylon:
  - Femern 281 m
  - Great Belt 254 m
  - Øresund 204 m
- Clearance:
  - Femern 65 m
  - Great Belt 65 m
  - Øresund 55 m

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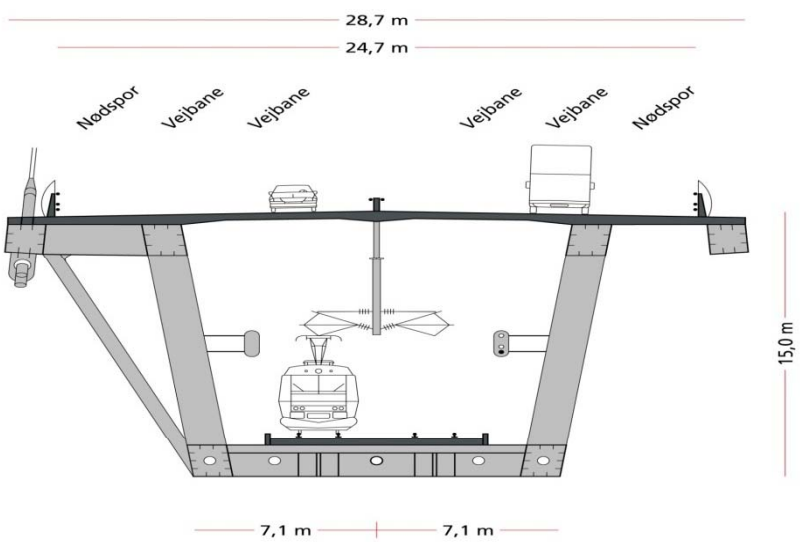
Section of typical Girder



Dimensions	Width	Height	Weight per Span
Femern	***Ca. 28,7 m***	***Ca. 15,0 m***	***Ca. 14.000 T***
Øresund	**23,5 m**	**10,9 m**	**Ca. 7.000 T**
Great Belt	**31,0 m**	**10,4 m**	**-**

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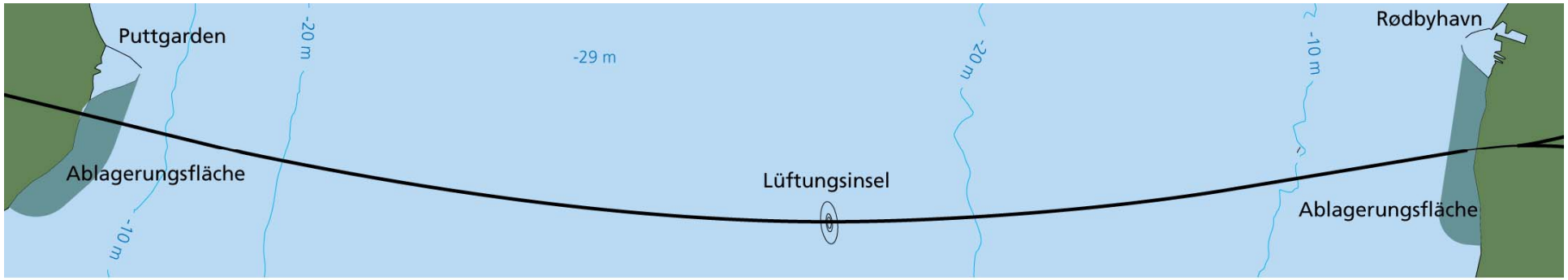
A cable stayed Bridge

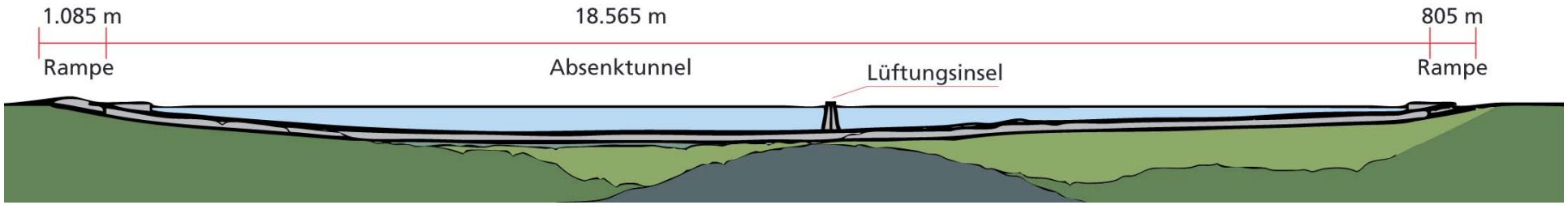
Respect the Challenge !
We can do it !

Femern Bælt A/S

The Preferred Alternative

An Immersed Tunnel

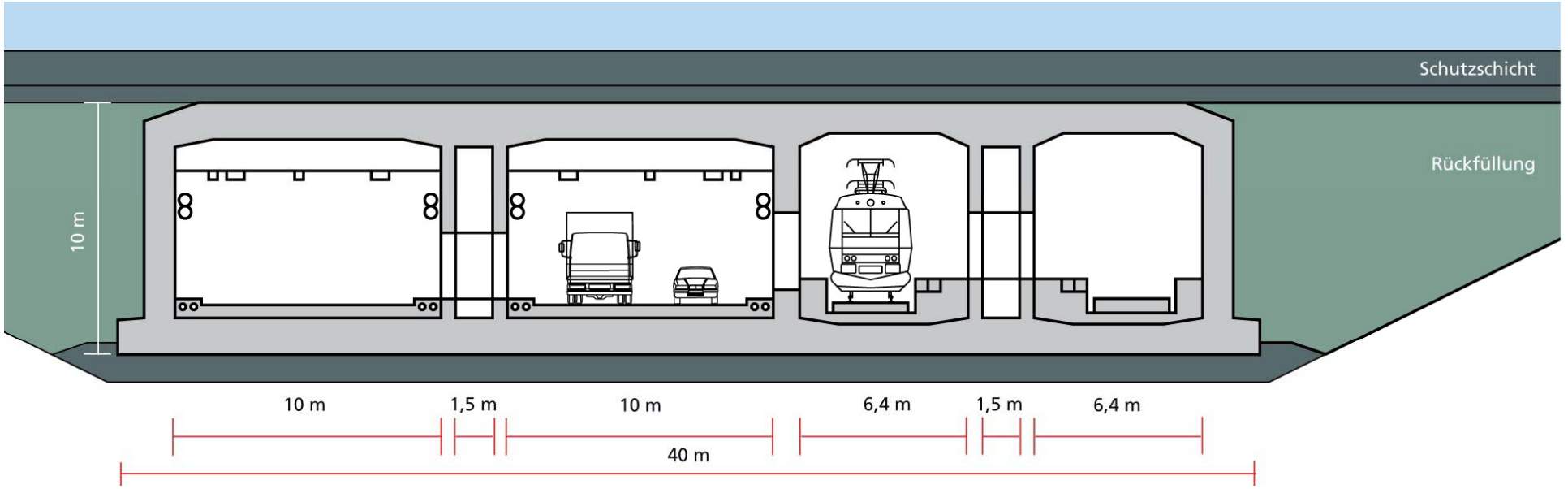




Alignment & Cross Section

Ventilation & Safety

West ← → East



The Øresund Immersed Tunnel

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The Øresund Immersed Tunnel

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The Bosphorus Immersed Tunnel

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Elements, Bosphorus

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Primary Areas of Focus Points

- Optimising Immersed Tunnel Cross Section and Alignment
- Optimising Ventilation and Safety Installations
- Optimising the ”experience” of passing through the Tunnel and the Aestetics
- Optimising construction methods
- Minimising Risks during Construction and under Operation
- Minimising adverse effects on the environment

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Oresund Tunnel, Construction Yard

Physical Conditions, Bosphorus

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Aesthetics, Landscape and Architecture

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Some facts, Øresund versus Femern IMT

Øresund

- (3.5) 4.0 km long
- No of elements 20
- Deepest Point ~ 23 m
- Weight per element ~ 55.000 tons
- Amount of concrete ~ 700.000 m3
- Dredged material, trench ~ 2.200.000 m3

Femern

- (19.0) 19.5 km long
- No of elements ~ 105 *
- Deepest point ~ 43 m
- Weight per element ~ 63.000 tons *
- Amount of concrete ~ 4.000.000 m3
- Dredged material, trench ~ 20.000.000 m3

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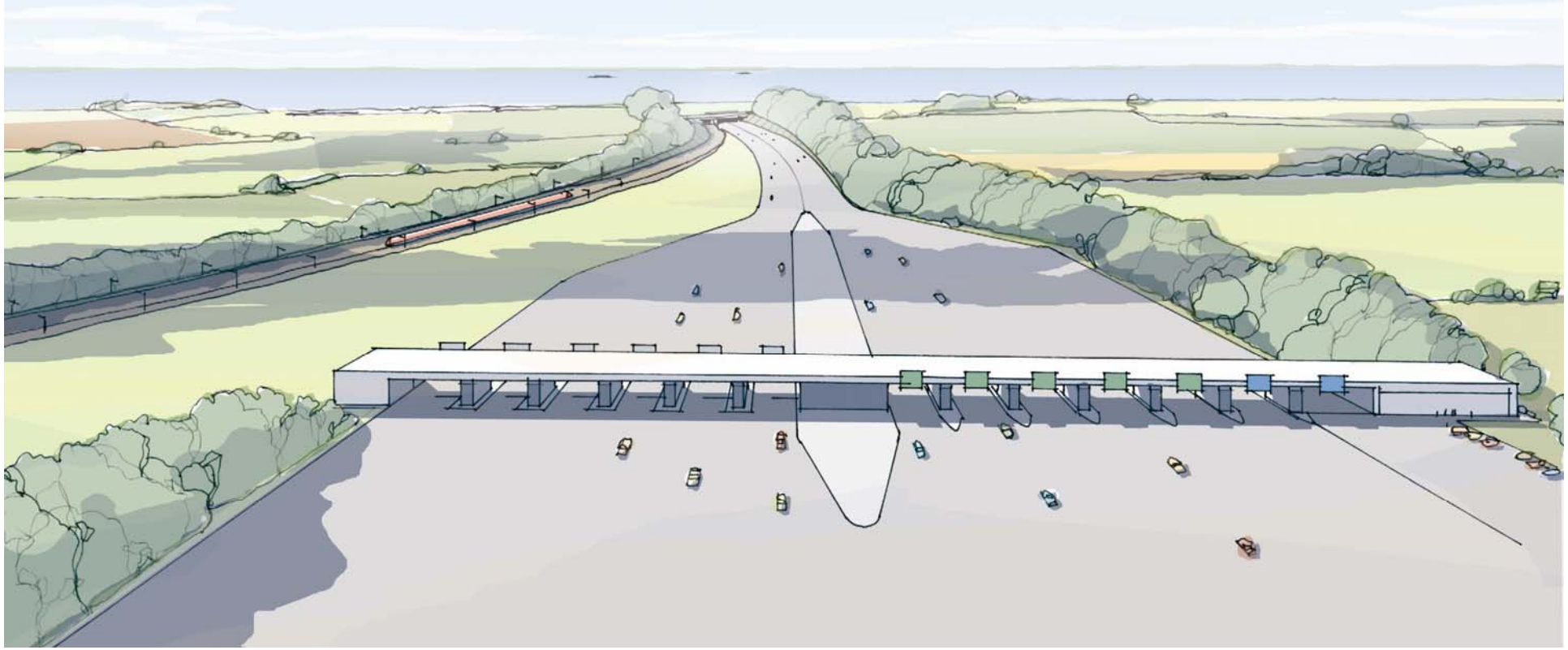
The Preferred Alternative

Respect the Challenge !
We can also do it !

It is nice to go underground !



EIA Study – Services

1. Hydrographic services
2. Marine biology services
3. Bird study services
4. Fish & fishery services
5. Marine mammals services
6. Danish ramp area EIA
7. German ramp area EIA

Scoping report & EIA Study report

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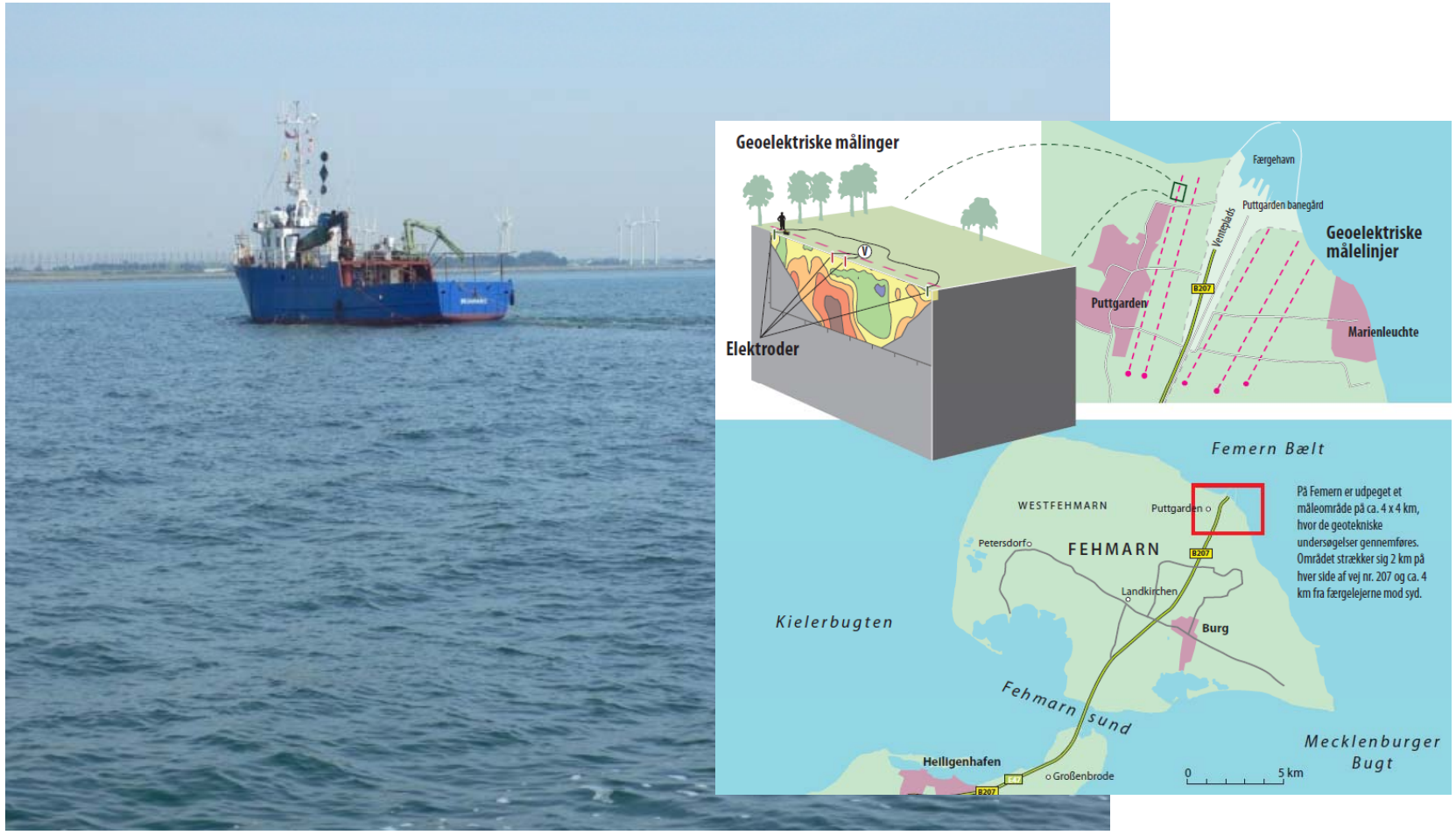
Geotechnical Investigations



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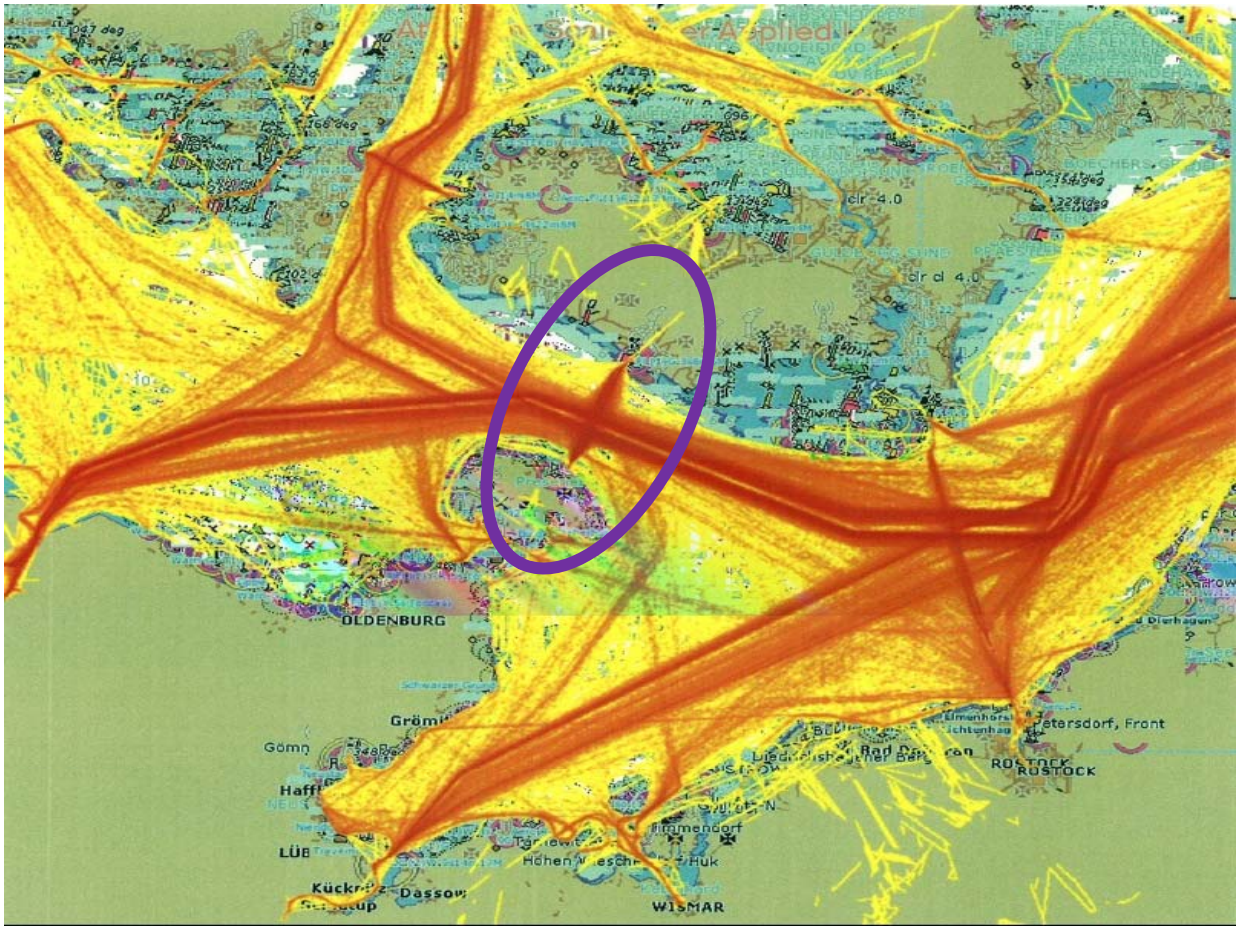
Navigational Studies, Marine Safety



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Special Focus:

Concrete

Documented Success no 1 for the Concept

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Documented Success no 2 for the Concept

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Femern Concrete Group

- Contract Strategy Design & Build
  - Functional Requirements (physical properties, sustainability and durability)
  - Minimum Requirements (stay within known technology)
  - Exclusions (clarity)
- Common requirements for Bridge and Tunnel
- Headed by Femern
  - Ulf Joensson and Christian Munch-Petersen
  - Experts from the Design Groups
  - External experts
- Works started in April 2009
- Draft requirements ready May 2010

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Concrete Strategy

- Service life of 120 years using well-known technology
  - Well-tried with positive results in similar conditions
  - No initiation of corrosion or major repair works
- No competition on quality!
- As much flexibility to Contractors as possible
- Use experience from Øresund Link and Bosphorus Tunnels

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Basis for the Requirements

- EN 206-1 and EN 13 670-1 + Femern “NAD”
- Stand alone document
- Comprehensive pre-testing and FS trial castings
- QC program supported by Conformity Procedures
- Systems for certification/accreditation where possible

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State-of-the-Art Reports

- Technical notes from Øresund Link + New areas (e.g. SCC, FRC)
- 11 background reports
- Scientific basis and documentation for the requirements
- Serves as support for management of the construction phase

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Femern Exposure Site – Special Activity

- Installation is planned in Rødbyhavn
- Start installation end of 2009
- Collect early data for check of the requirements
- Long term data collection for knowledge build-up
- Follow up of Contractors mix designs during construction
- Platform for research activities

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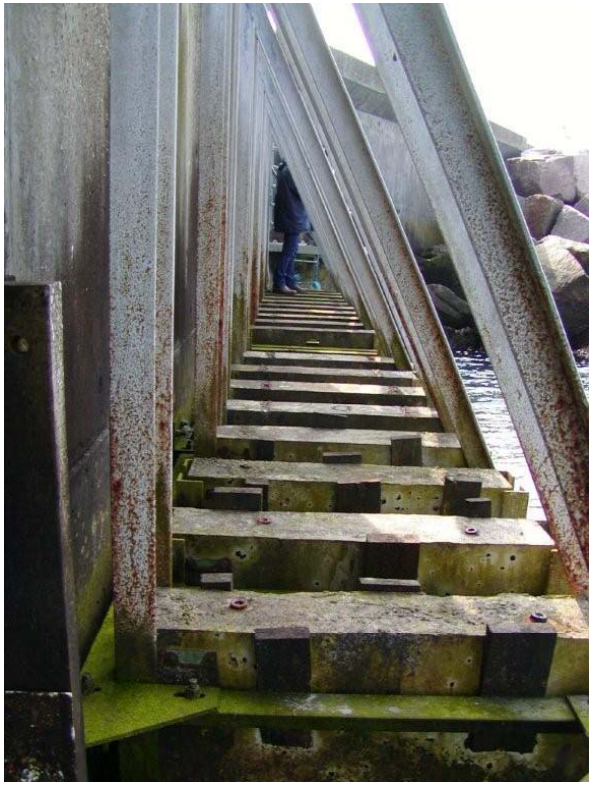
Exposure Sites, Examples



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Collaboration Research Activities

- Femern A/S takes an active part in research activities
- Present engagements:
  - Senso-Byg, D2 – Store konstruktioner
  - Nanotech DTU: Resistance to reinforcement Corrosion in Concrete Structures
- More may come

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Thank you for listening –
Questions & Answers

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