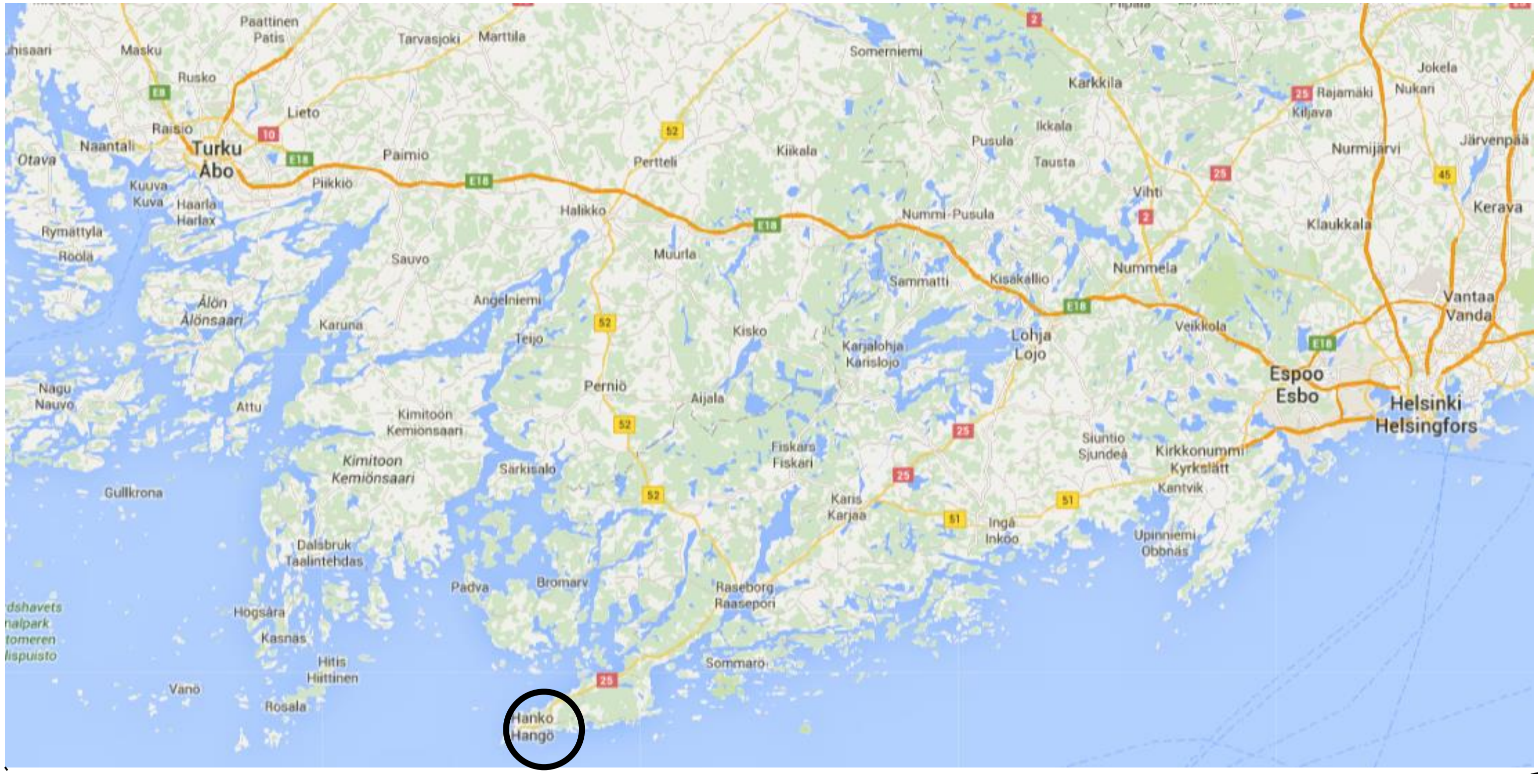
Excellent location for Data Center Campus in Hanko

CAMPUS LOCATION AND LOGISTICS

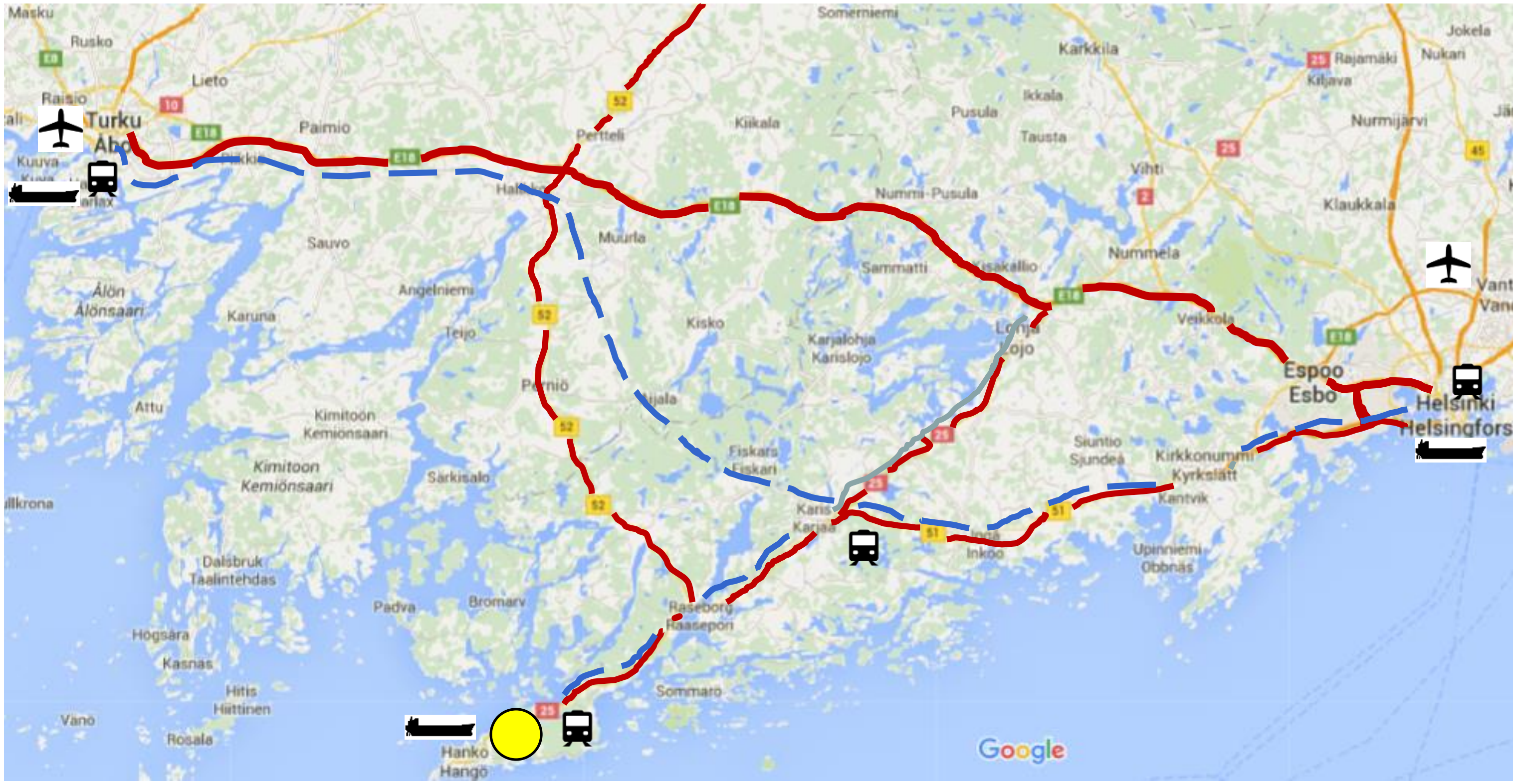
Ideal Data Center site location



Hanko Data Center campus is located in the City of Hanko, Southern Finland

The site is ideal for data center operations in terms of location, power, cooling, connectivity, fast track implementation and local support

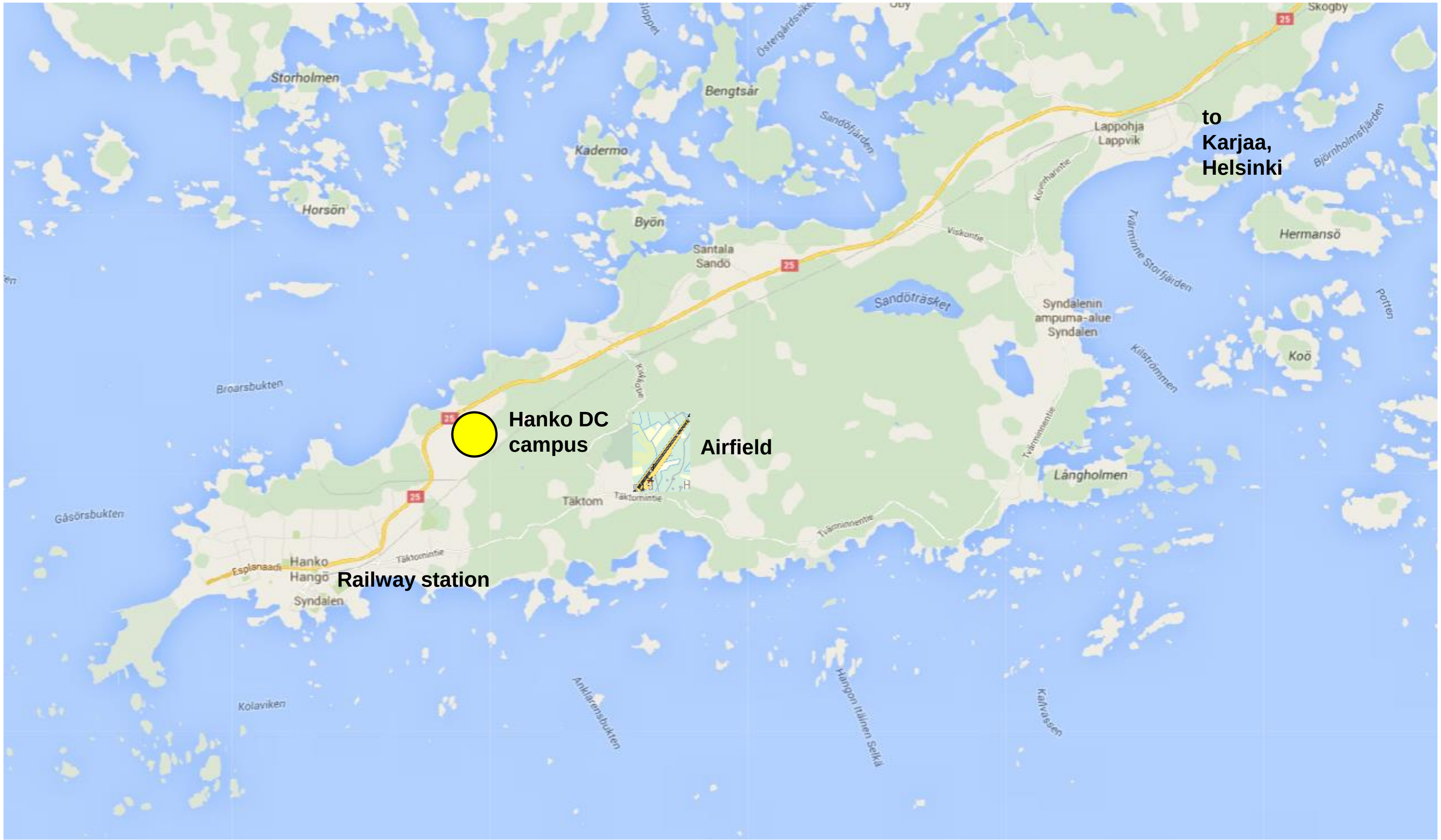
Only 1h 30 min from Helsinki-Vantaa airport to Hanko



Distances from DC site:
Railroad: 2 km
To highway: 0,5 km
Port of Helsinki: 130 km
Hki-Vantaa Intl. airport: 125 km
Turku : 140 km

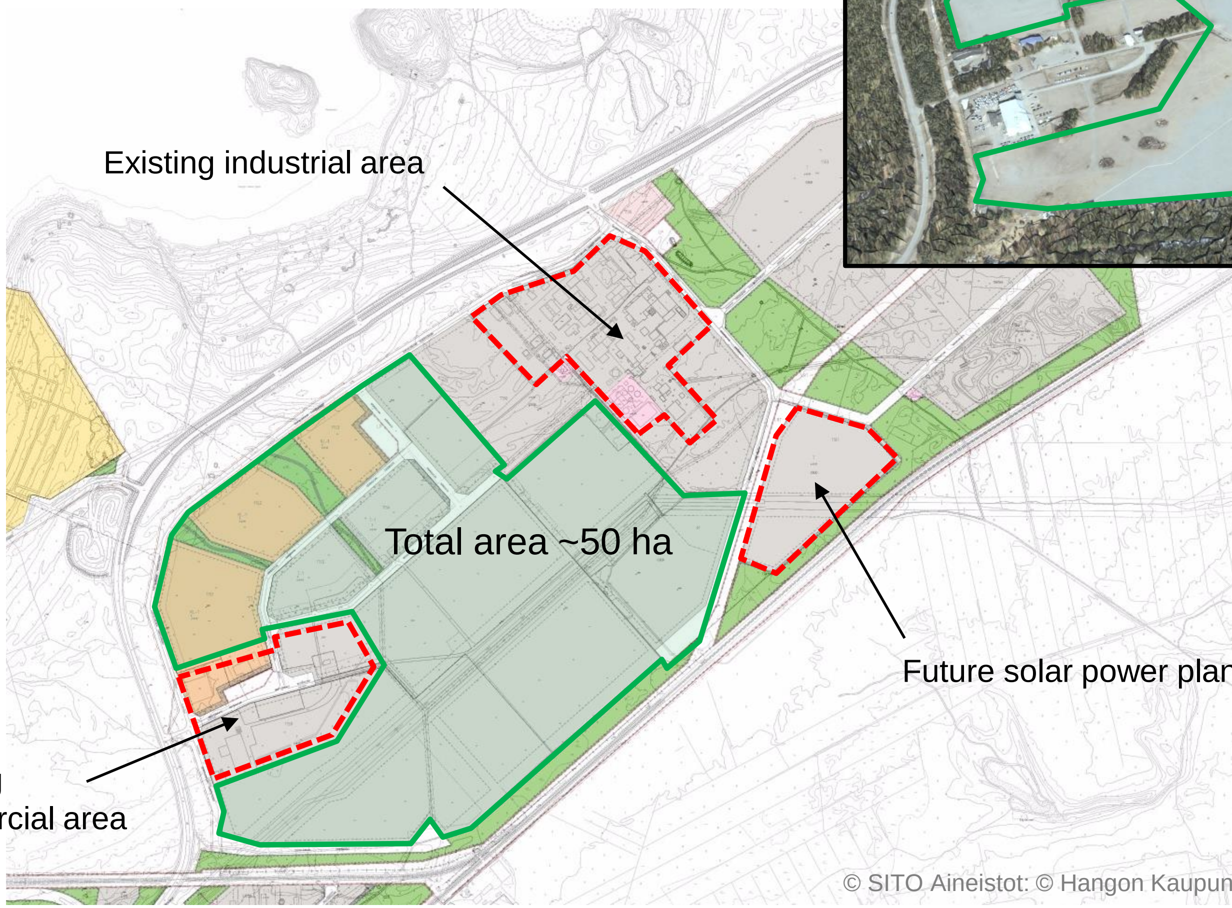
Port/Harbour
4- lane motorway
Main roads
Railroad
Intl. airport
Railway station
Hanko DC campus

Data Center Campus in Hanko



Easy-to-build area for Data Center

- Flat landscape
- Partially used as storage area for imported cars
- Easy to build



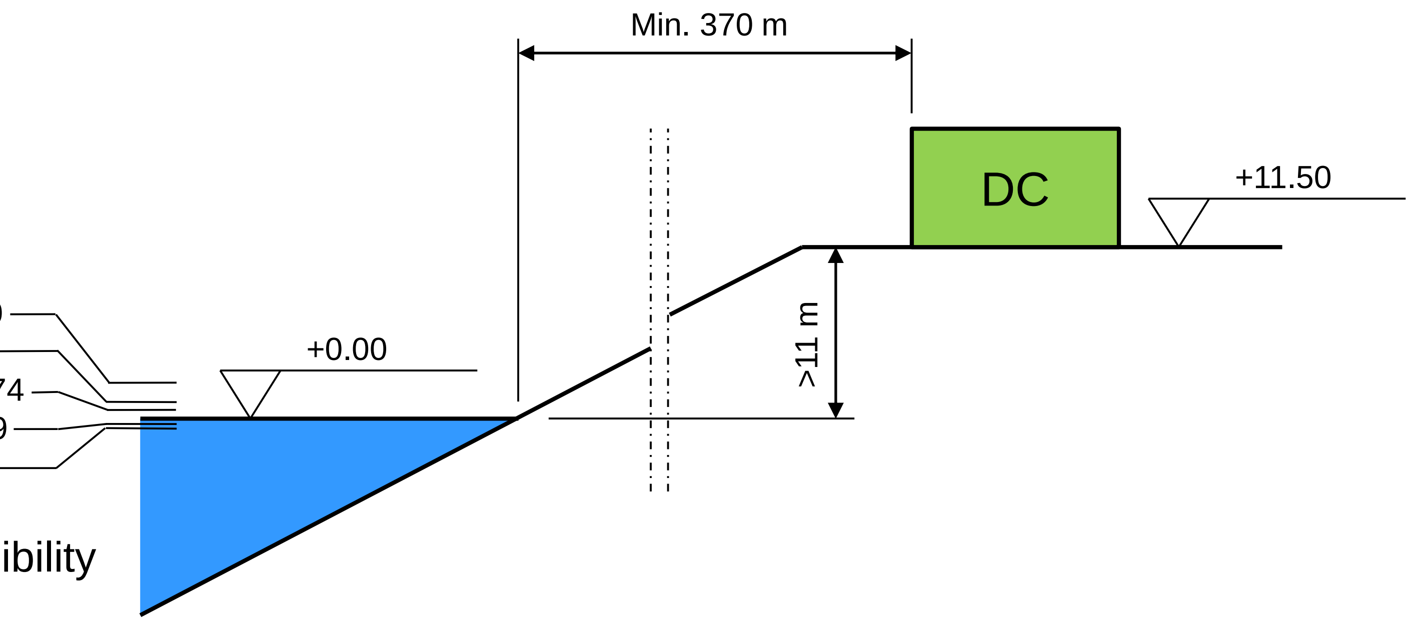
Location in relation to the sea,

and minimum recommended building elevation

Statistics since establishing of Hanko mareograph in 1887:

- Min. building elevation +2.50
- Maximum +1.32
- Average of annual max. +0.74
- Average of annual min. -0.49
- Minimum -0.79

→ No flooding possibility

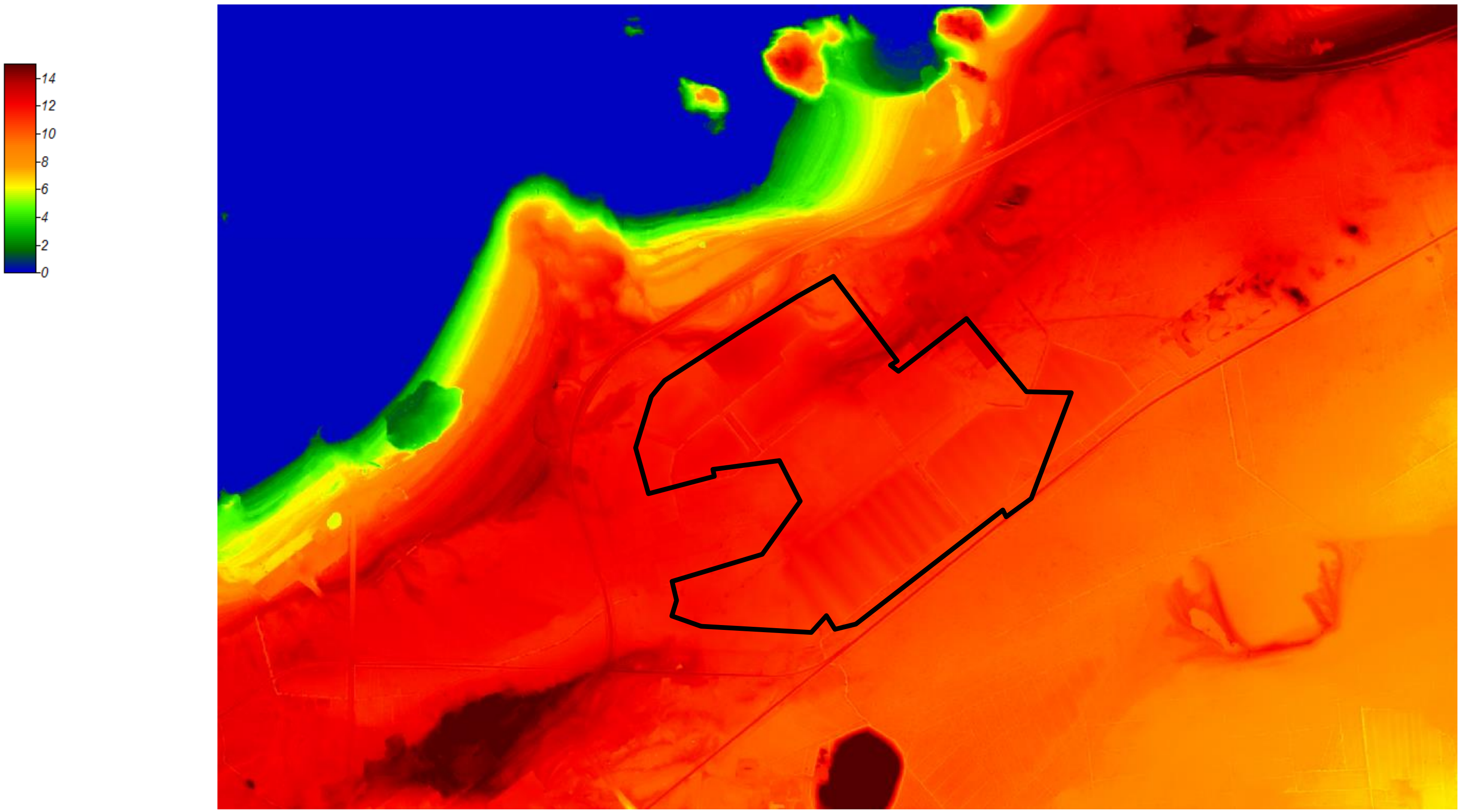


A publication by Finnish Meteorological Institute; "Long-term flooding risks and recommendations for minimum building elevations on the Finnish coast", June 2014

The minimum recommended building elevations are based on the sea level in 2100 with an exceedance frequency of one event per 250 years.

Minimum recommended building elevation without wave compensation in Hanko is +2.50 m above sea level.

Current landscape elevations



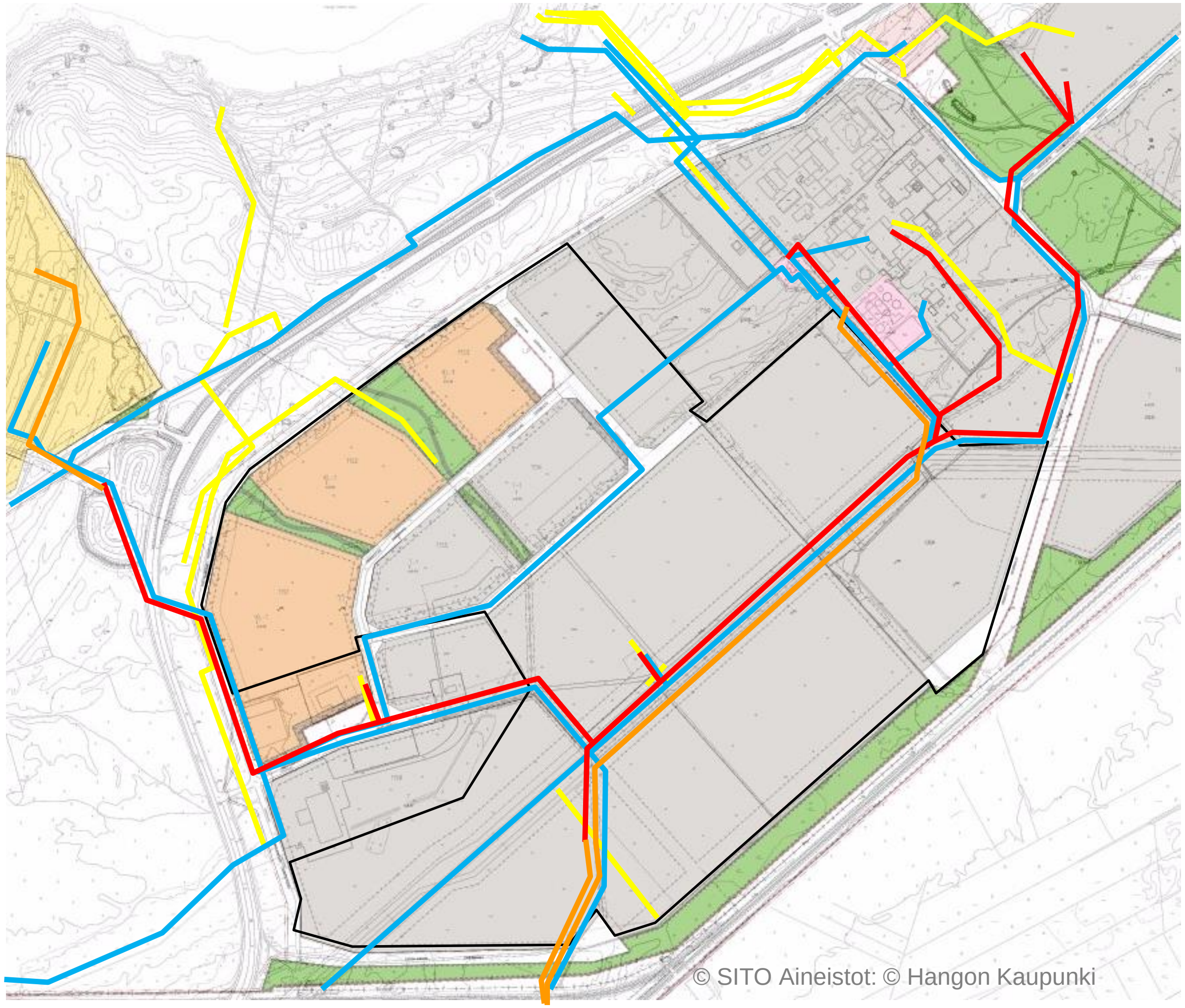
Existing utility services

Potable water

Sewer

Pressure sewer

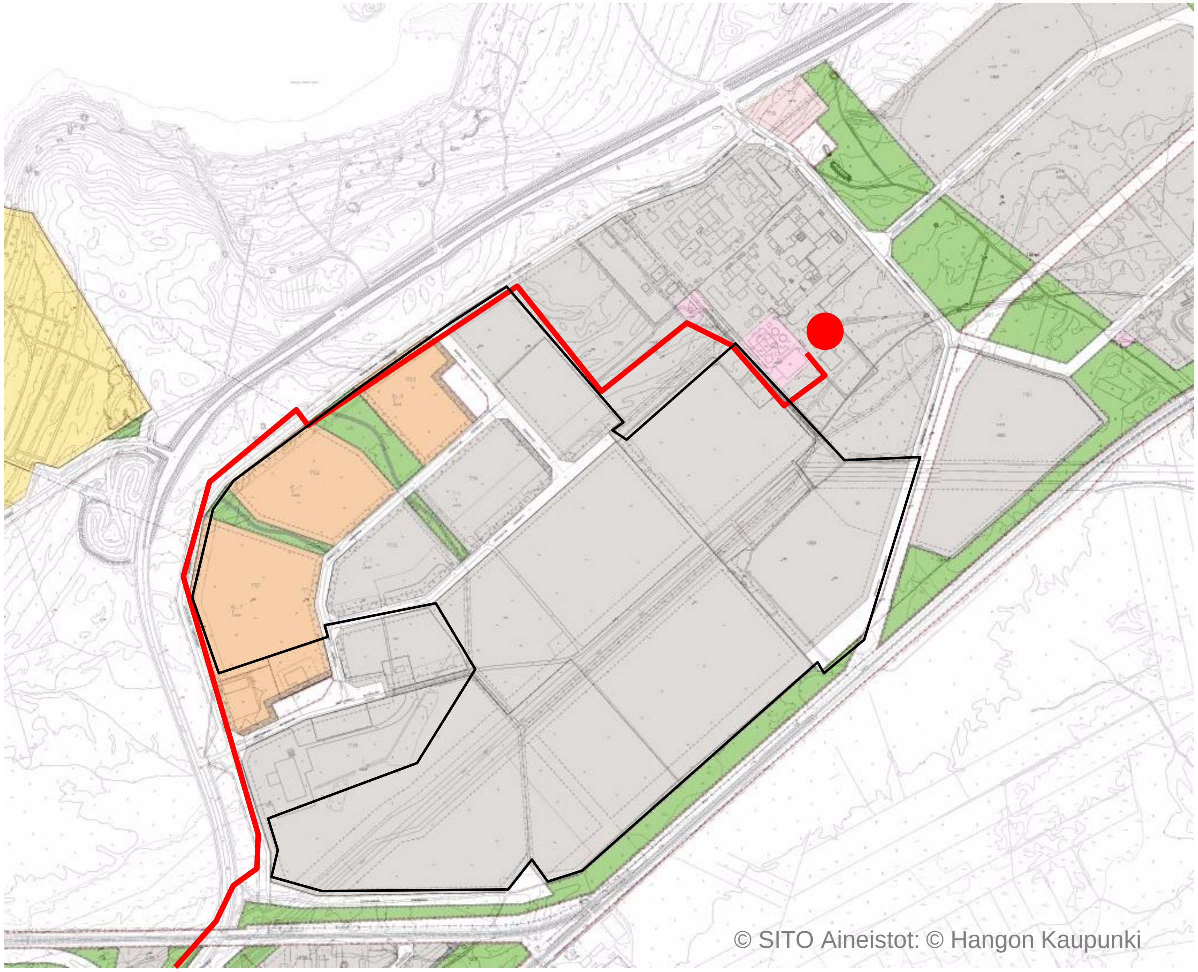
Rain water



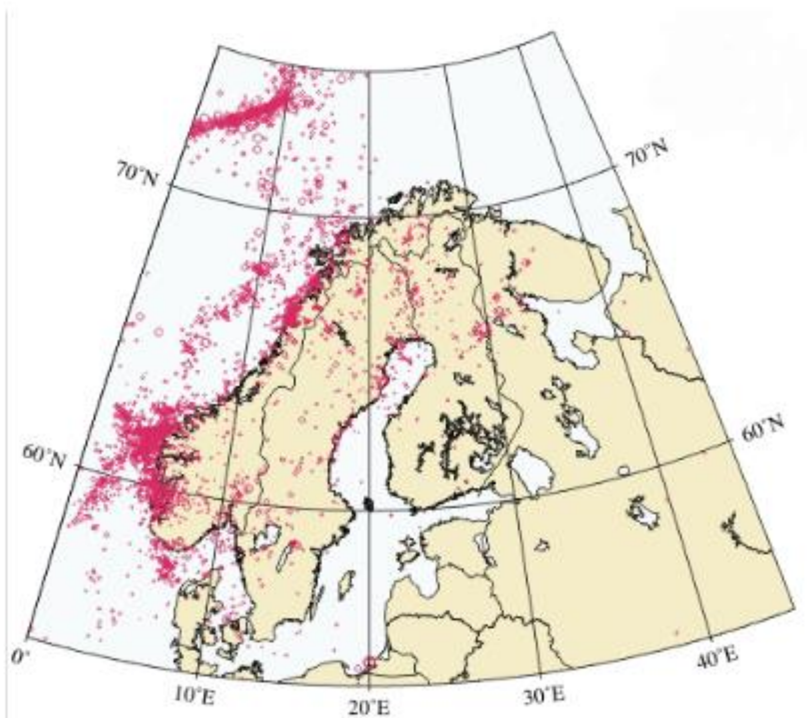
Existing district heating network

18 MW Power plant

District heating pipe



Peaceful seismological environment in Finland



Picture: Earthquakes in Fennoscandia during 1965-2005.

The largest earthquake in the region was in Tammisaari in 2006: magnitude 2.0.

Southern Finland is located in very peaceful area concerning earthquakes.

There have been some minor earthquakes also in Hanko area, but the magnitude of those events has been small even compared to the rest of Finland.

Local earthquakes are part of interplate earthquake series on Eurasian tectonic plate.

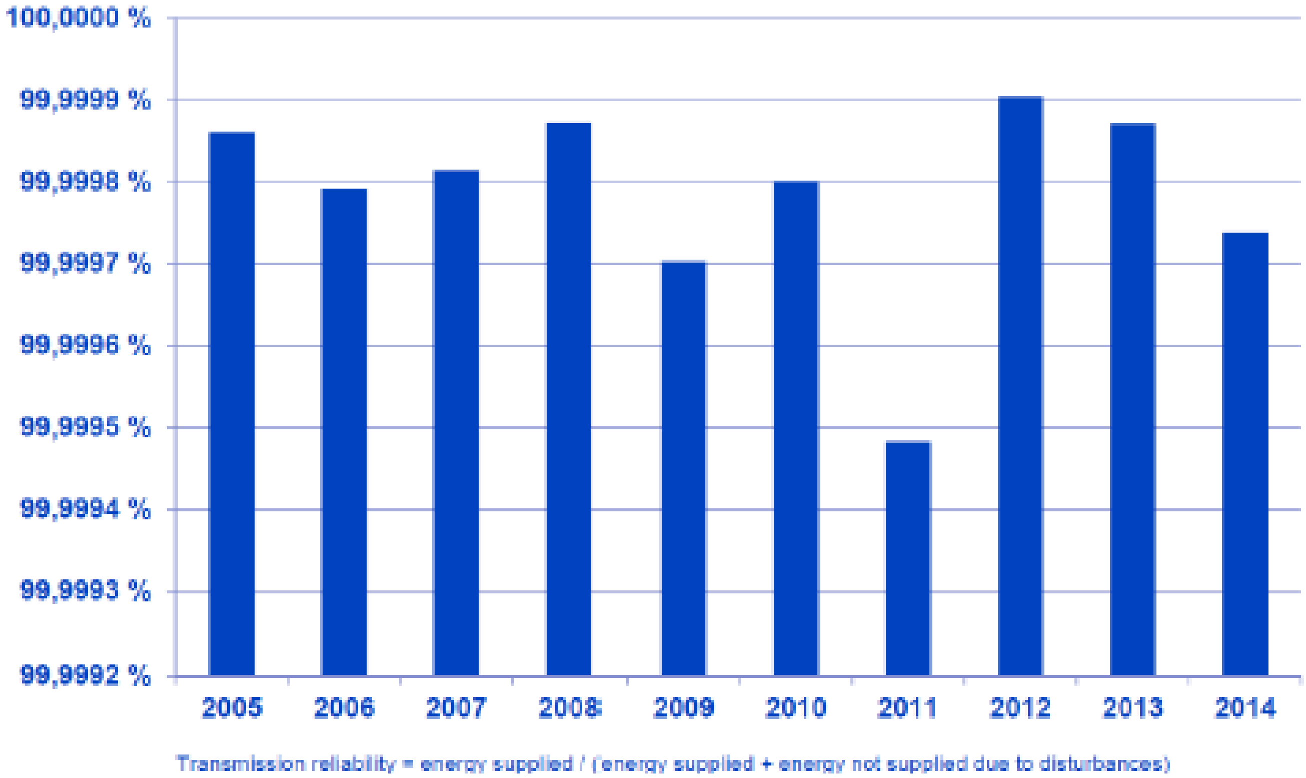
Due to the fact that there have been only minor earthquakes, they are not required to be taken in to account in any local building regulations or codes.

Source: University of Helsinki, Institute of Seismology

POWER SUPPLY

Reliable electrical grid

- Transmission in Electrical Grid is one of the most reliable in the World. Fingrid operates the National Electrical Grid.



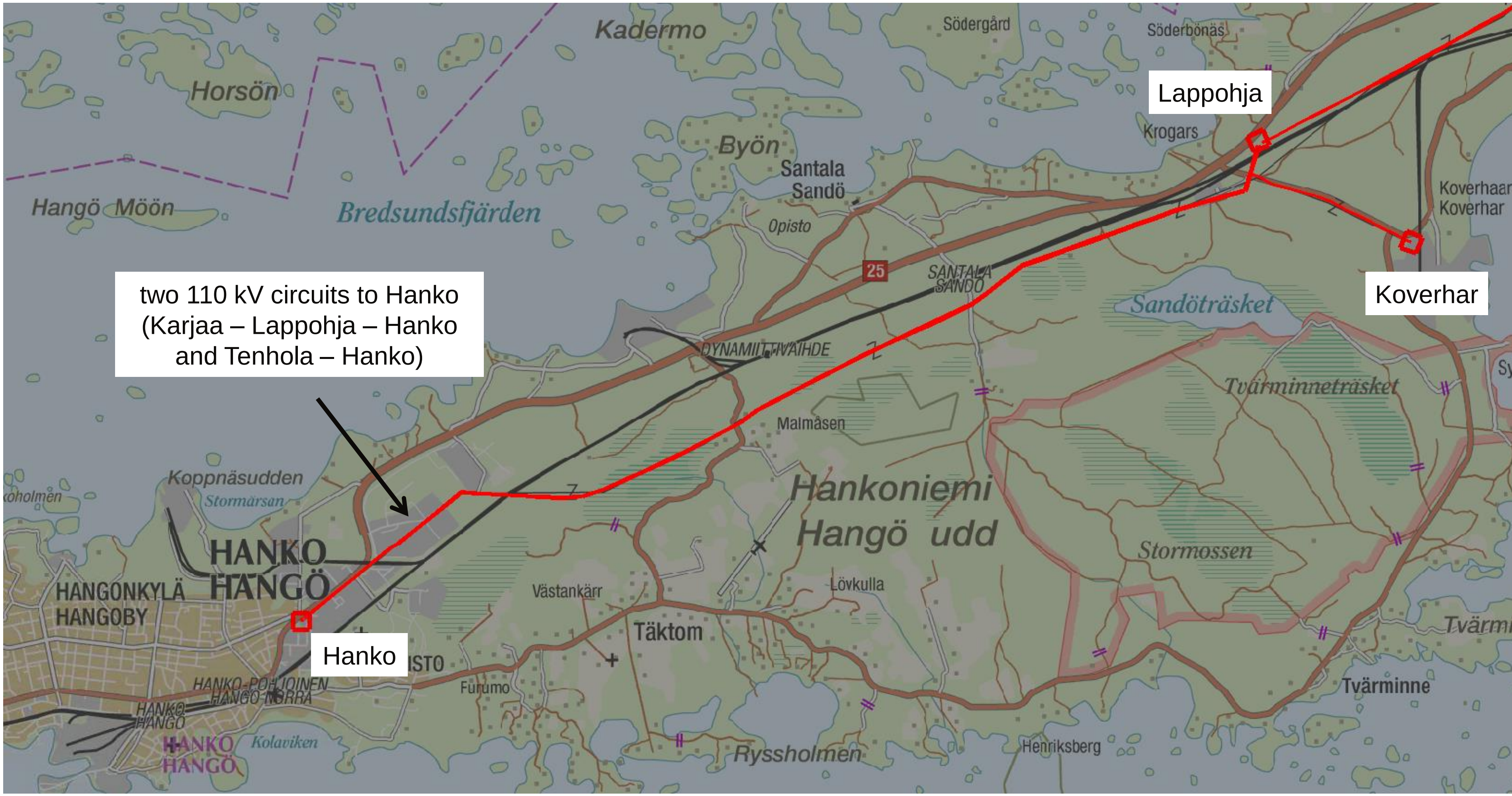
Source Fingrid

Fingrid Oyj's national grid (110 and 400 kV)

Source Fingrid

Caruna Oy's 110 kV regional network in Hanko-Raasepori area (planned upgrade in yellow colour)

Hanko electrical grid



Power ramp up to Hanko DC site, phase 1

Phase 1

- 15 MW double supply 20 kV

Time needed 6 months

Power ramp up to Hanko DC site, phase 2

Phase 2

- 30 MW supply from Hanko 110 kV + phase 1
- New 110/20 kV transformer and 110 kV overhead line

Time needed 12 months

Power ramp up to Hanko DC site, phase 3

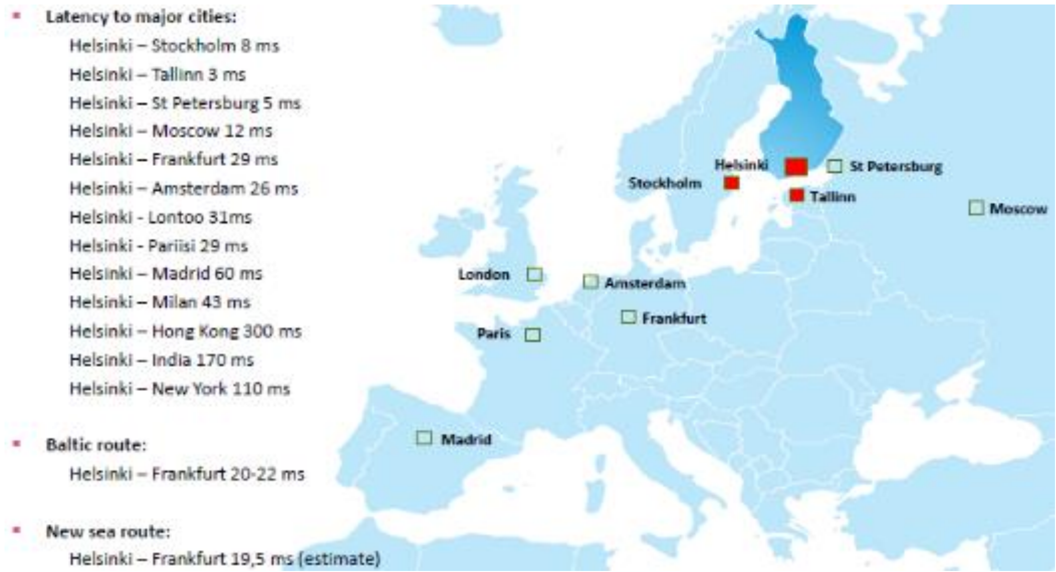
Phase 3

- External 110 kV network upgrade app. 25 km between Karjaa and Tenhola
- 100 MW double supply 110 kV

Time needed 2,5-3 years

CONNECTIVITY

Connectivity to major cities

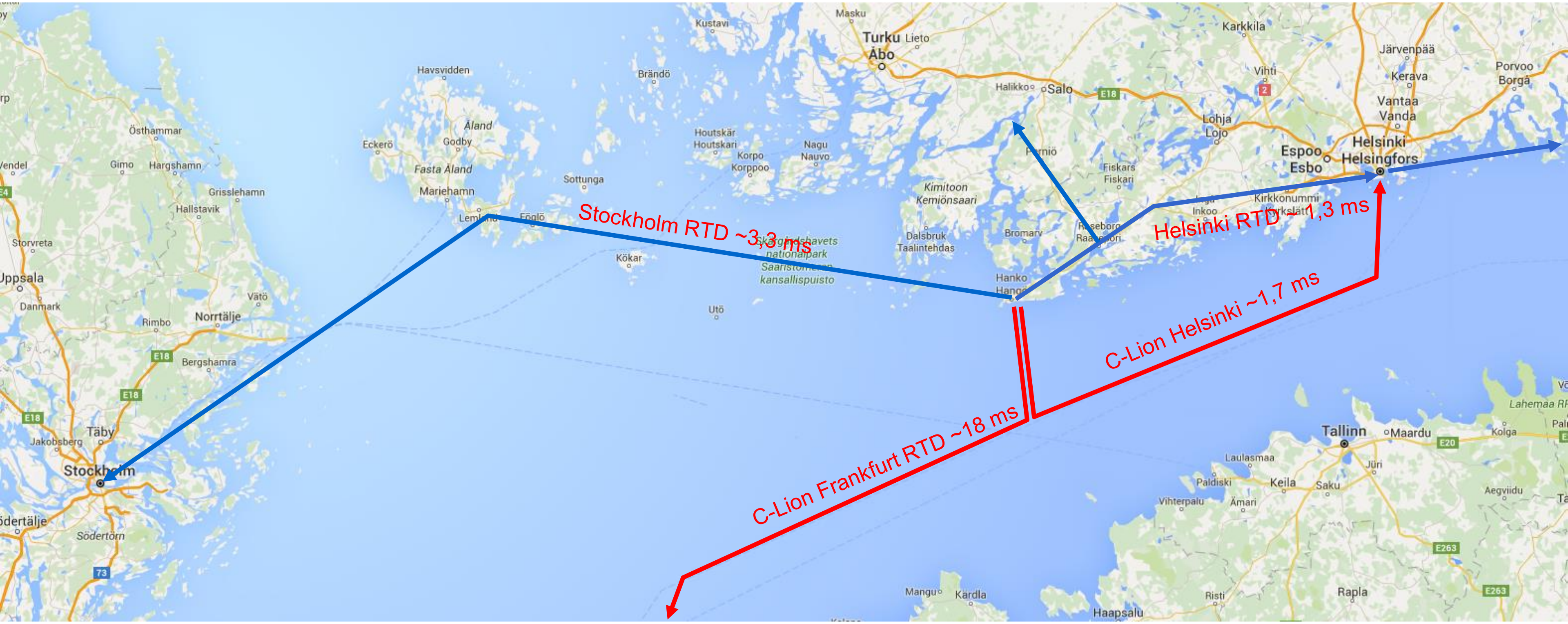


Source: Invest in Finland

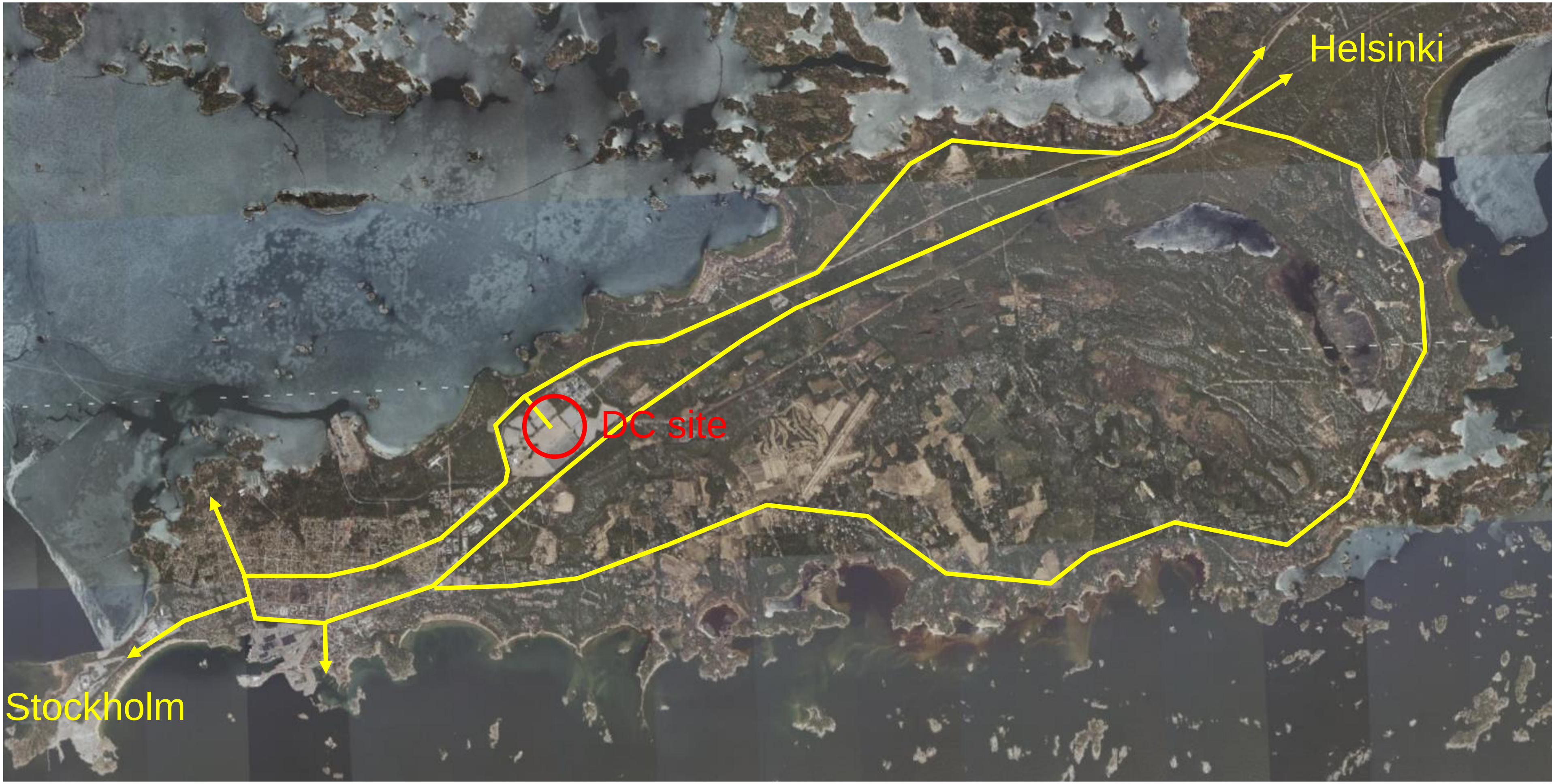
- The new submarine fiber optic route from Europe to Asia (=ROTACS project) will lower latency between Europe and Asia about 90ms.
- The project is waiting for implementation decision.

- The new submarine fiber optic route under Baltic Sea lowers latency to Finland.
- Estimated to be in service in early 2016

Hanko Data Center global connectivity



Hanko Data Center local connectivity

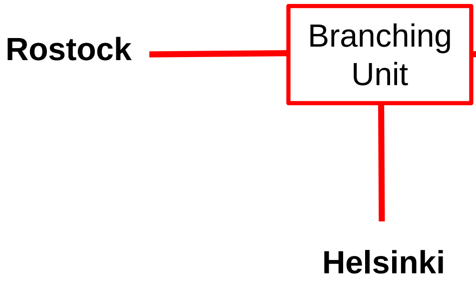


”Sea Lion” submarine fiber cable connection Direct route to central Europe!

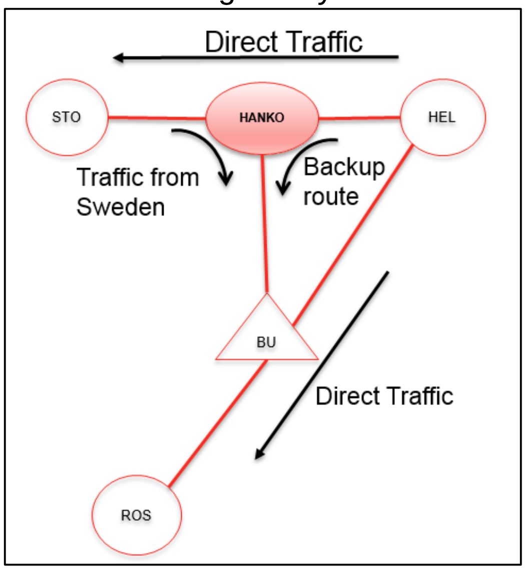
Direct ”**Sea Lion**” submarine cable connection from Rostock Germany to Helsinki Finland. (120 Terabits/second)

Data centers connected directly to the heart of Central Europe via the on-site landing station.

Landing station to be located at DC campus area



Connection diagram by Cinia:



Network readiness in Finland

- Finland is one of the best countries in the world concerning Network Readiness. The study has been done by World Economic Forum and published in the Global Information Technology Report 2015. The report features the Network Readiness Index which assesses the factors, policies and institutions that enable a country to fully leverage information and communication technologies (ICTSs) for increased competitiveness and well-being.

Networked Readiness Index

Rank	Economy	Info	Value	Trend	Distance from best
1	Singapore		6.0		
2	Finland		6.0		
3	Sweden		5.8		
4	Netherlands		5.8		
5	Norway		5.8		
6	Switzerland		5.7		
7	United States		5.6		
8	United Kingdom		5.6		
9	Luxembourg		5.6		
10	Japan		5.6		

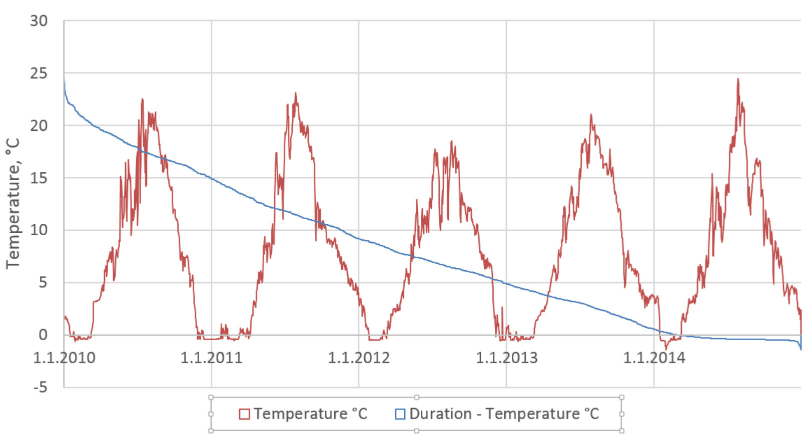
Source: The Global Information Technology Report 2015

COOLING AND
SECONDARY HEAT REUSE

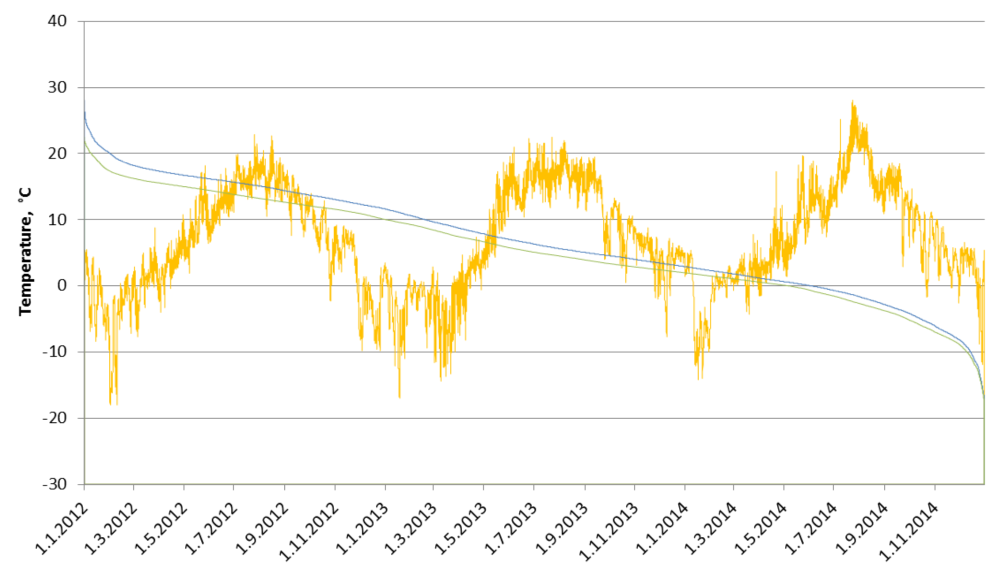
Conditions support effective cooling

- Ambient conditions suitable for free cooling
- Ambient air >25 °C <19 h/year (average 2012 – 2014)
- Potential cooling methods: direct air cooling with or without adiabatic cooling, cooling towers, sea water
- Energy re-use possible

Sea water temperature and temperature stability,
Data: daily averages, Hanko/Pikku Kolalahti 2010-2014,
Missing data replaced by annual average of exisating data



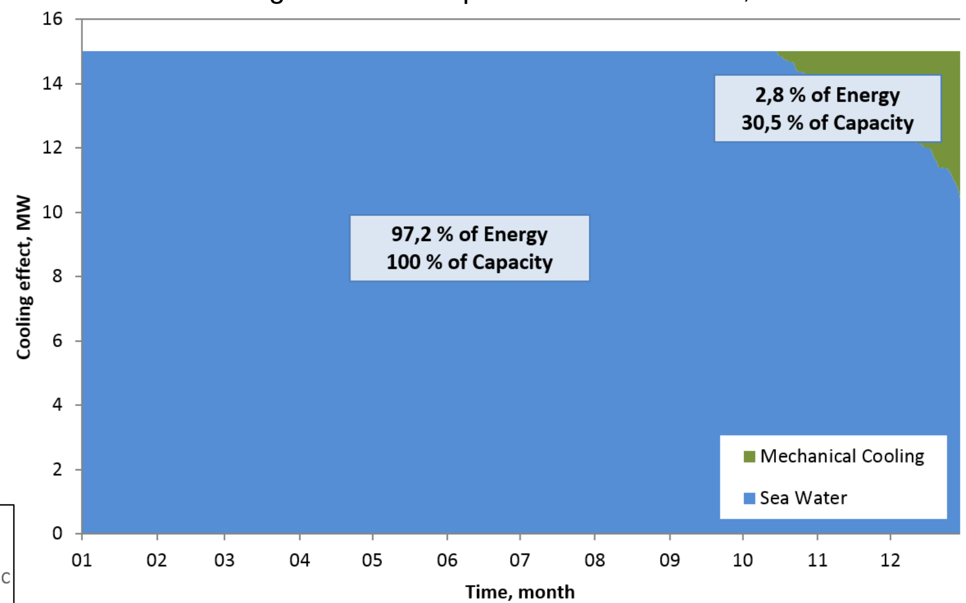
Ambient air: dry temperature and
duration of dry and wet bulb temperatures
Air data: hourly averages, Hanko/Tulliniemi 2012-2014 by FMI



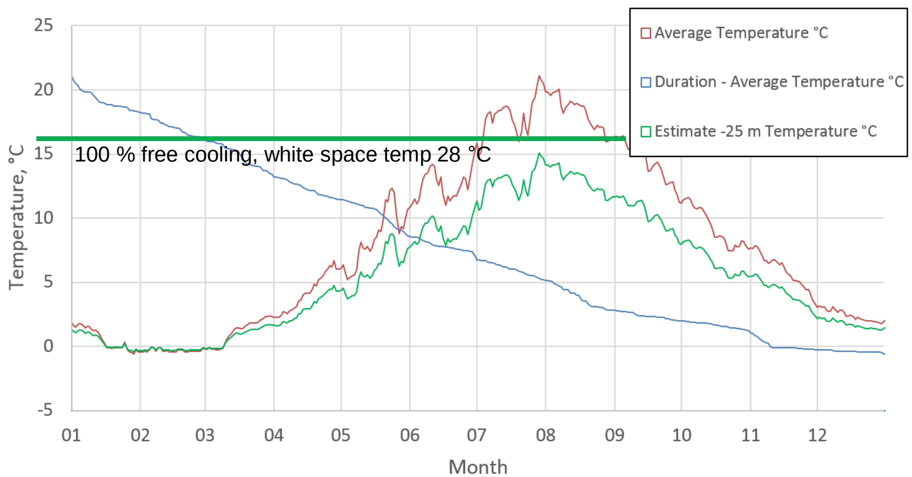
Cooling by Sea Water

- High free cooling share for white space temperature 21ºC and above
- Cool sea water available from basin near the sea shore
- Sea water stays reasonably cool also in summer. Thus high free cooling energy share.

Cooling production by sea water and mechanical cooling
White space temperature 28 °C,
Data: Average surface temp. from available data, 2010-2014



Sea water average temperature and temperature duration and estimated temperature in 25 m depth.
Annual averages Hanko/Pikku Kolalahti 2010 – 2014

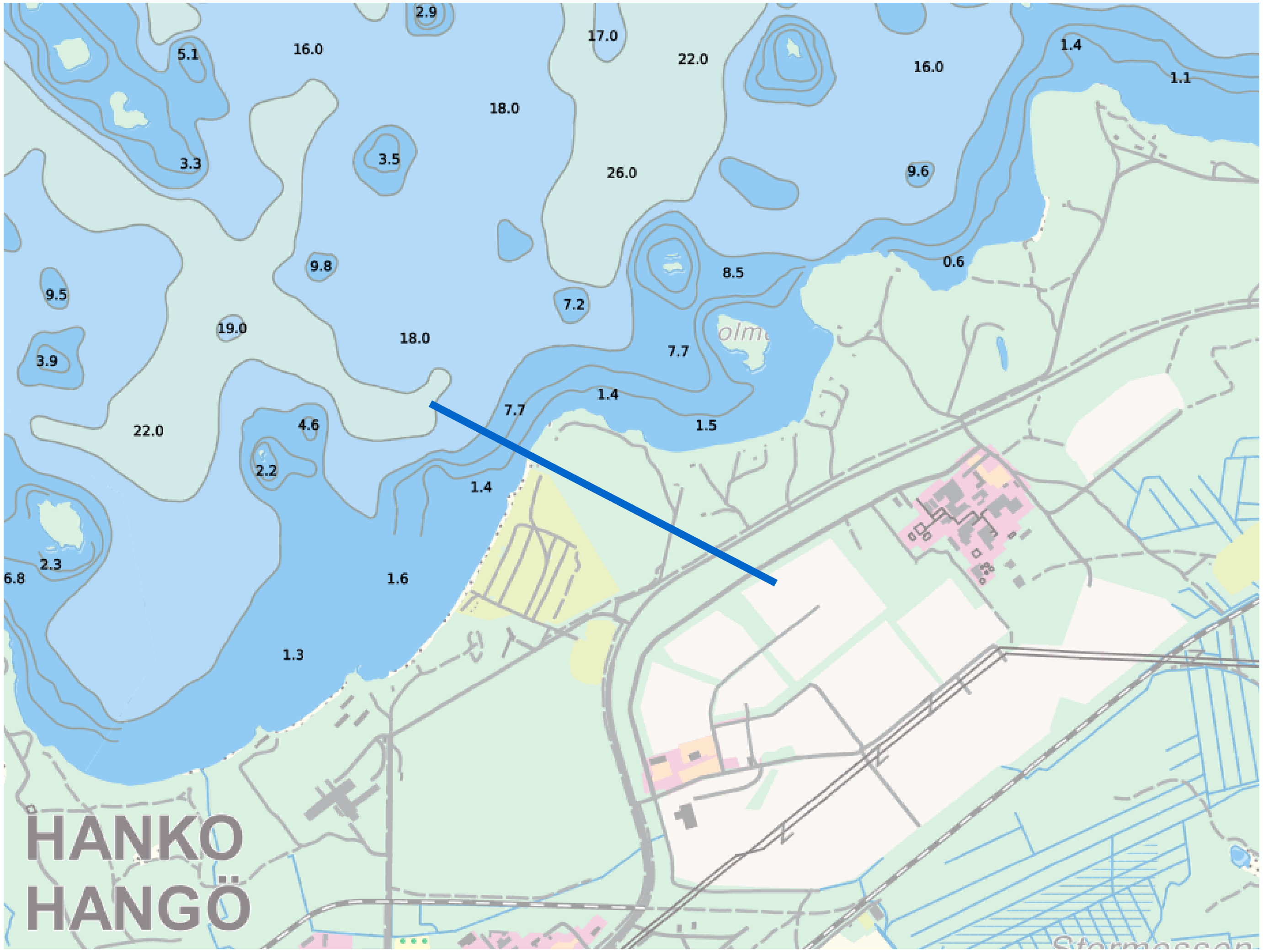


Target white space temp	**28 ºC**	**25 ºC**	**21 ºC**
Primary water circ temp.	**18 ºC**	**15 ºC**	**11 ºC**
Free cooling, energy	**97%**	**94%**	**86%**
Mech. cooling capacity	**31%**	**45%**	**66%**

Environmental data source: © Finnish Meteorological Institute

CTS ENGTEC

100% free cooling possibility with sea water cooling



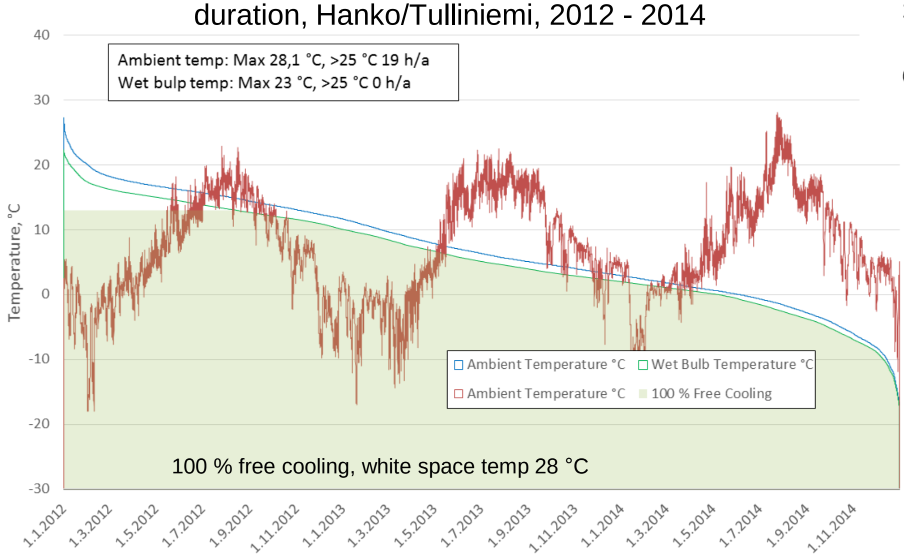
Includes nautical chart database material of Finnish Transport Agency 11/2015

The depth chart of the nearby sea looks very promising for achieving 100% free cooling by using cold sea water for data fenter cooling.

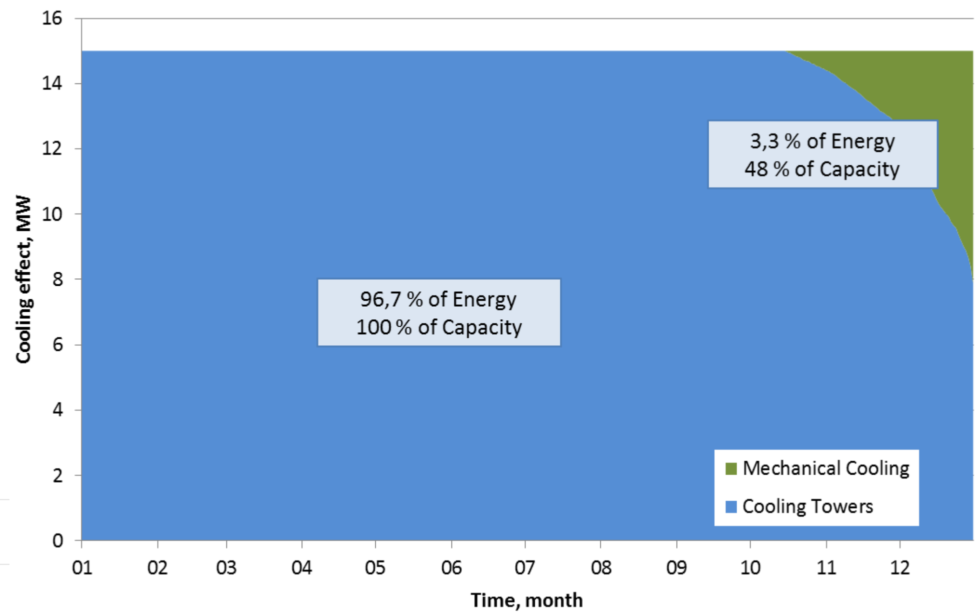
Cooling Towers and Mechanical Cooling

- Wet bulb temperature favors cooling towers
- High free cooling share for white space temp. 21ºC and above
- Make-up water is available from sea
- Tower excess water led to storm water system without treatment or via oil-separation

Ambient air temperature and dry and wet bulb temperature duration, Hanko/Tulliniemi, 2012 - 2014



Cooling production by cooling towers and mechanical cooling
White space temperature 28 °C Temp Data 2014



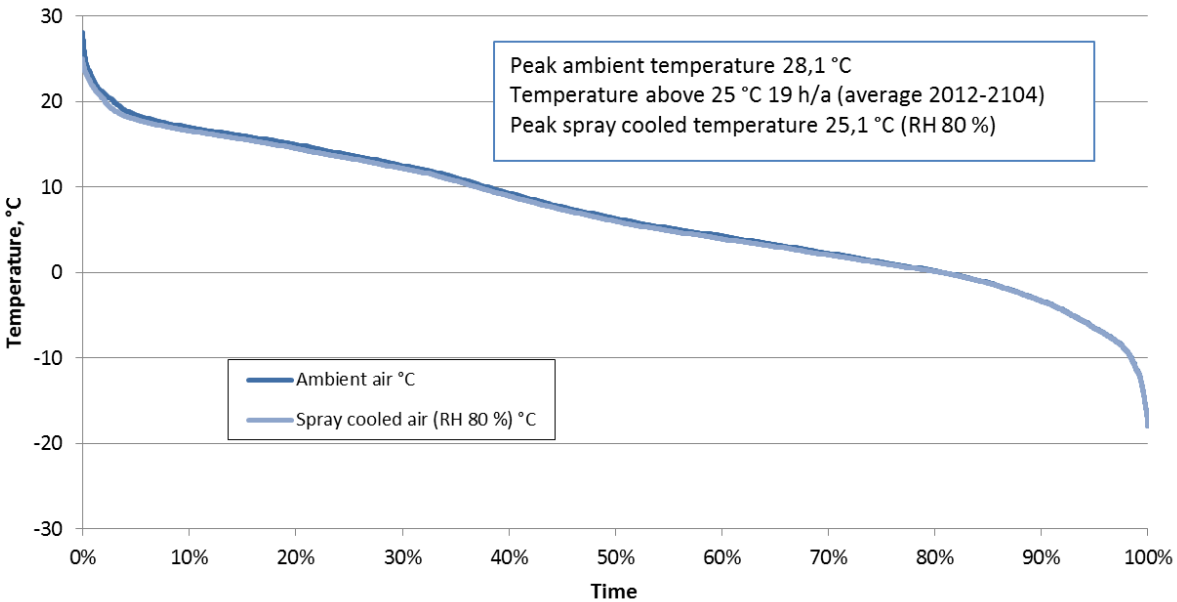
Target white space temp	28 ºC	25 ºC	21 ºC
Primary water circ temp.	18 ºC	15 ºC	11 ºC
Free cooling, energy	97%	93%	85%
Mech. cooling capacity	48%	63%	82%

CTS ENGTEC

Direct Air Cooling

- Ambient conditions suitable for free cooling
- Maximum ambient air temperature 28,1 °C
- Ambient temperature >25 °C <19 h/a (average 2012 - 2014)
  - Longest continuous period 13 h, average peak duration 5,2 h
- With adiabatic cooling (RH 80 %) max temp 25,1 °C

Temperature duration of ambient and
spray cooled (RH 80%) air.
Air data: hourly averages, Hanko/Tulliniemi 2012-2014 by FMI



Ambient air data source © Finnish Meteorological Institute

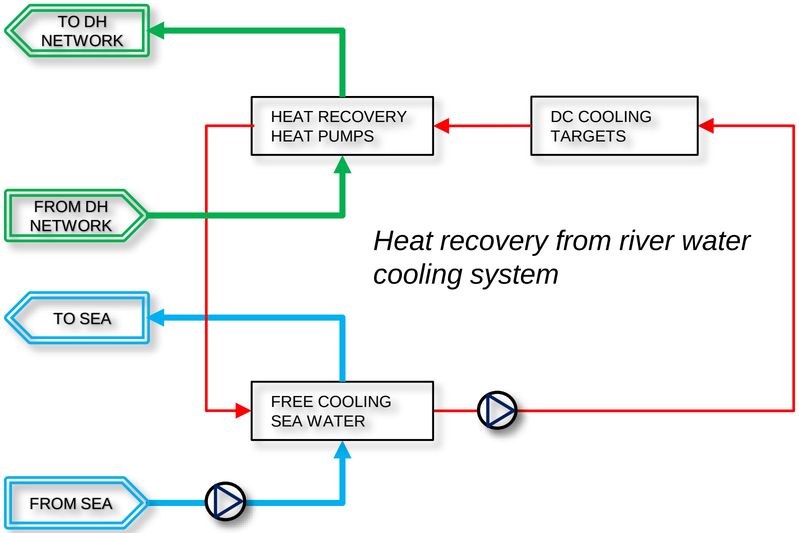
CTS ENGTEC

Mechanical Cooling

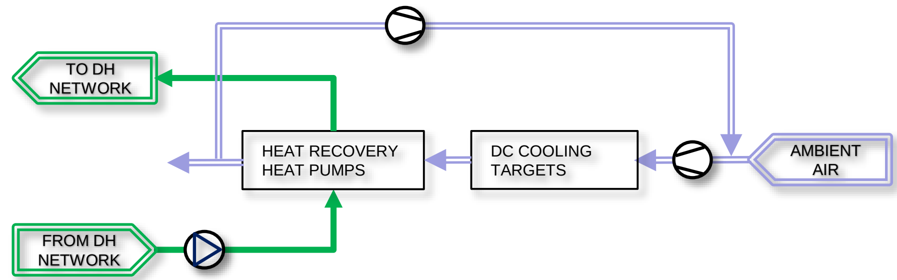
- Mechanical cooling (heat pumps/compressors) is necessary
  - Covering summer temperature peaks
  - Backup
  - Raising heat temperature for energy re-use
- Potential heat sinks for heat pumps/compressors
  - Local district heating network (energy re-use)
  - Building heating (energy re-use)
  - Ambient air
  - Sea water
  - Cooling tower circulation
- Dimensioning for summer peak demands or as full backup
- Mechanical cooling energy production share is low even though capacity need can be quite high
- Mechanical cooling EER from 3 up to >7 depending on heat sink
- Potential for energy re-use up to 1,3 x DC power consumption

CTS ENGTEC

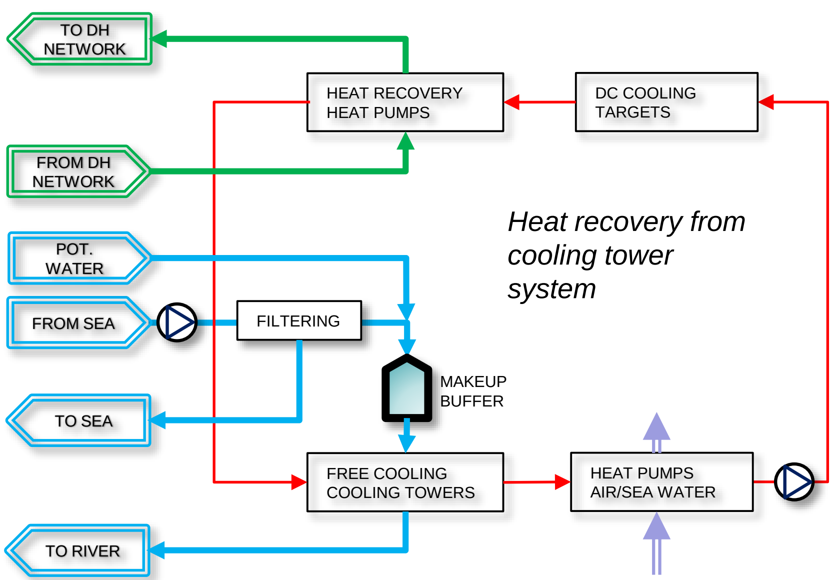
Examples of Secondary Heat Re-use Arrangements



Heat recovery from river water cooling system



Heat recovery from adiabatic cooling system



Heat recovery from cooling tower system

SITE UTILIZATION

1st phase, utilization example

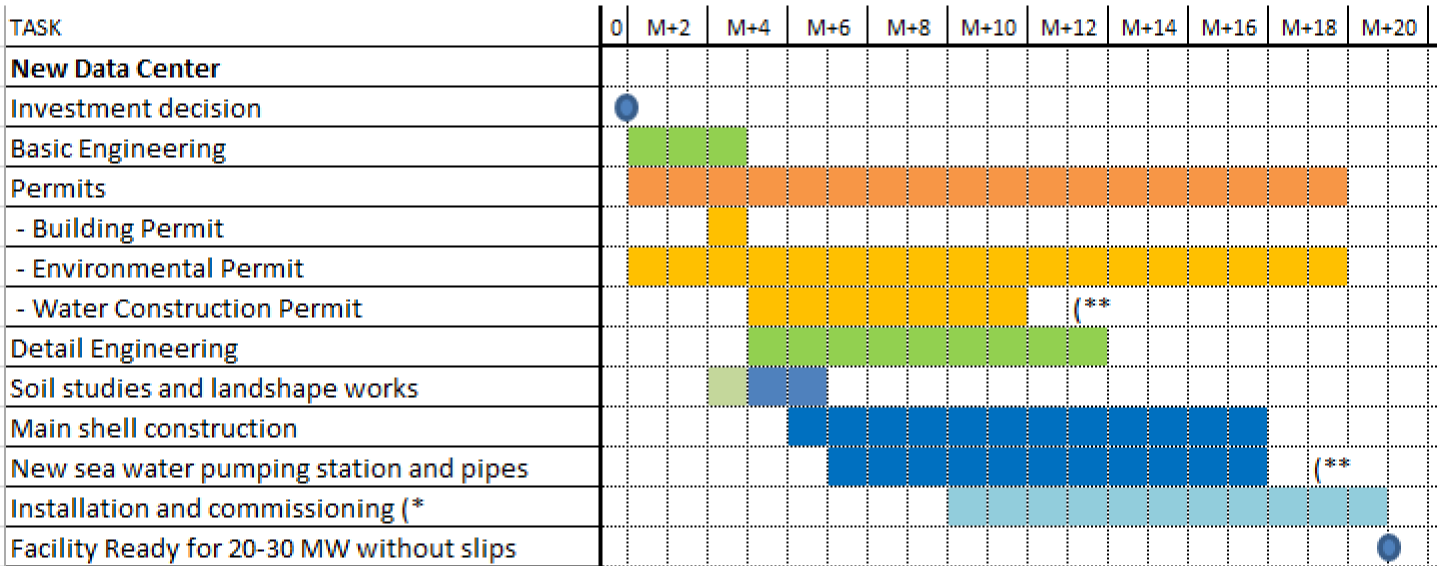
Maximum building area for 1st phase approx. 120 MW

Construction phase completed, visualisation example

IMPLEMENTATION PLAN

Implementation schedule

- Example schedule for data center investment in Finland



(* Includes 1,5-2 month period for inquiries, tender comparisons, POs

(** If it is decided to have sea water cooling system

Remarks for the Implementation Schedule

- Feasibility Study is completed before the investment decision and Basic Engineering should continue in streamline
  - Layout, cooling process, electrification and automation system are usually fixed in Basic Engineering phase
- Permitting process should also start immediately after the Investment Decision
  - Especially Environmental Permit requires full attention in order to get accepted before operation starts
  - Other Permits should be accepted before construction starts
- Building shell and roof construction and water construction works are easier and cheaper done in summer time
- All equipment or materials that requires longer delivery time should be ordered first in order to avoid slips in start-up
- All construction, installation and commissioning contractors should have proven record of successful contracts preferably also to foreign customers and English speaking main personnel to taking care of the project

A unique location for Green Data Center

A local electrical company in region can build own **solar power** system for Data Center. It is possible to feed AC and DC power and if needed also store energy for Data Center use.

Locally produced **wind- and bioenergy** are also available to allow carbon free Data Center operation.

In Finland it is possible to purchase part or all energy as **Certified Green Energy** from energy distribution and selling companies.

HELEN (a former named Helsingin Energia) is planning to build the biggest solar power plant in Finland just the corner of Hanko's Data Center campus area. The plant will consist of 2000 solar panels.