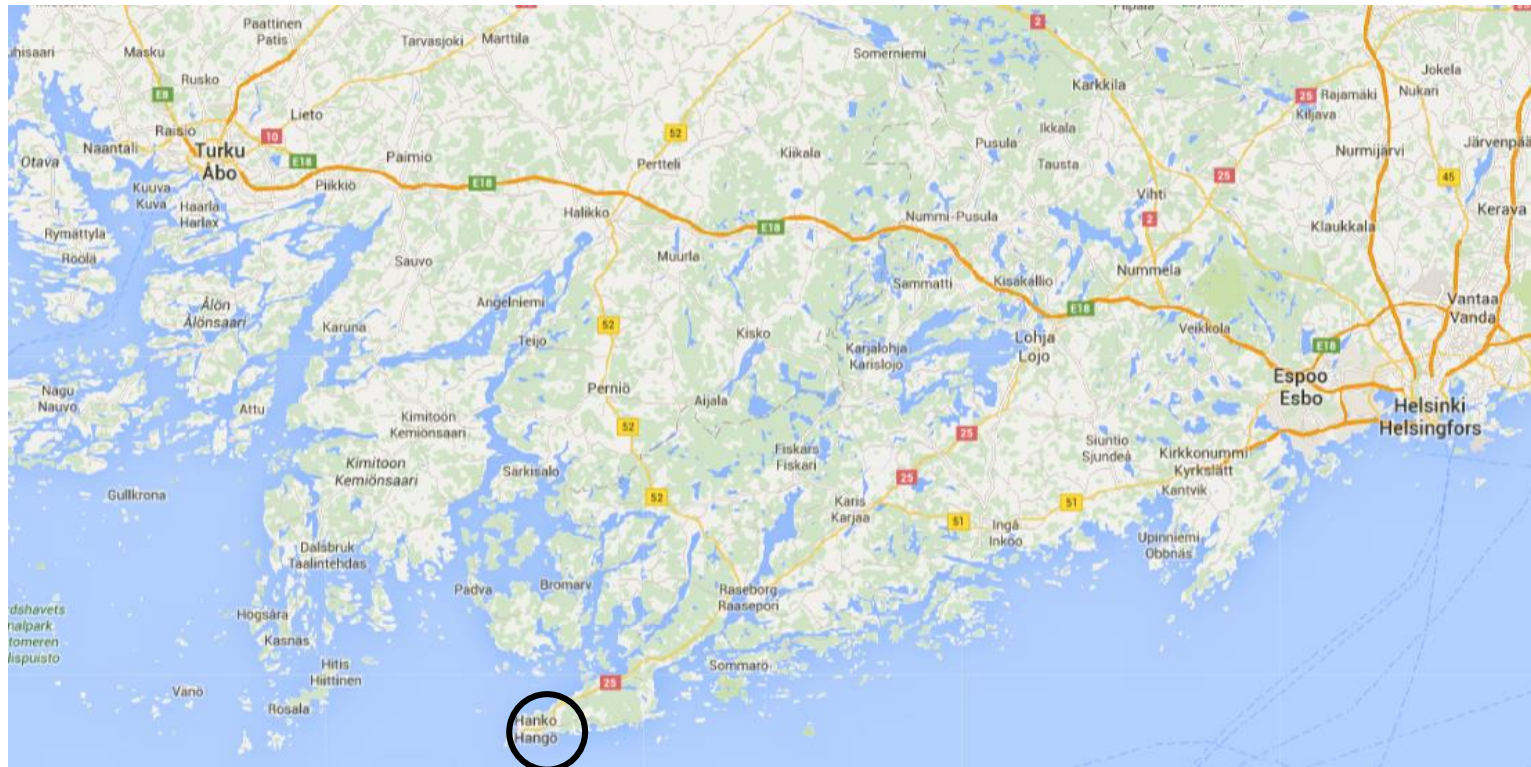


Excellent location for Data Center Campus in Hanko



CAMPUS LOCATION AND LOGISTICS

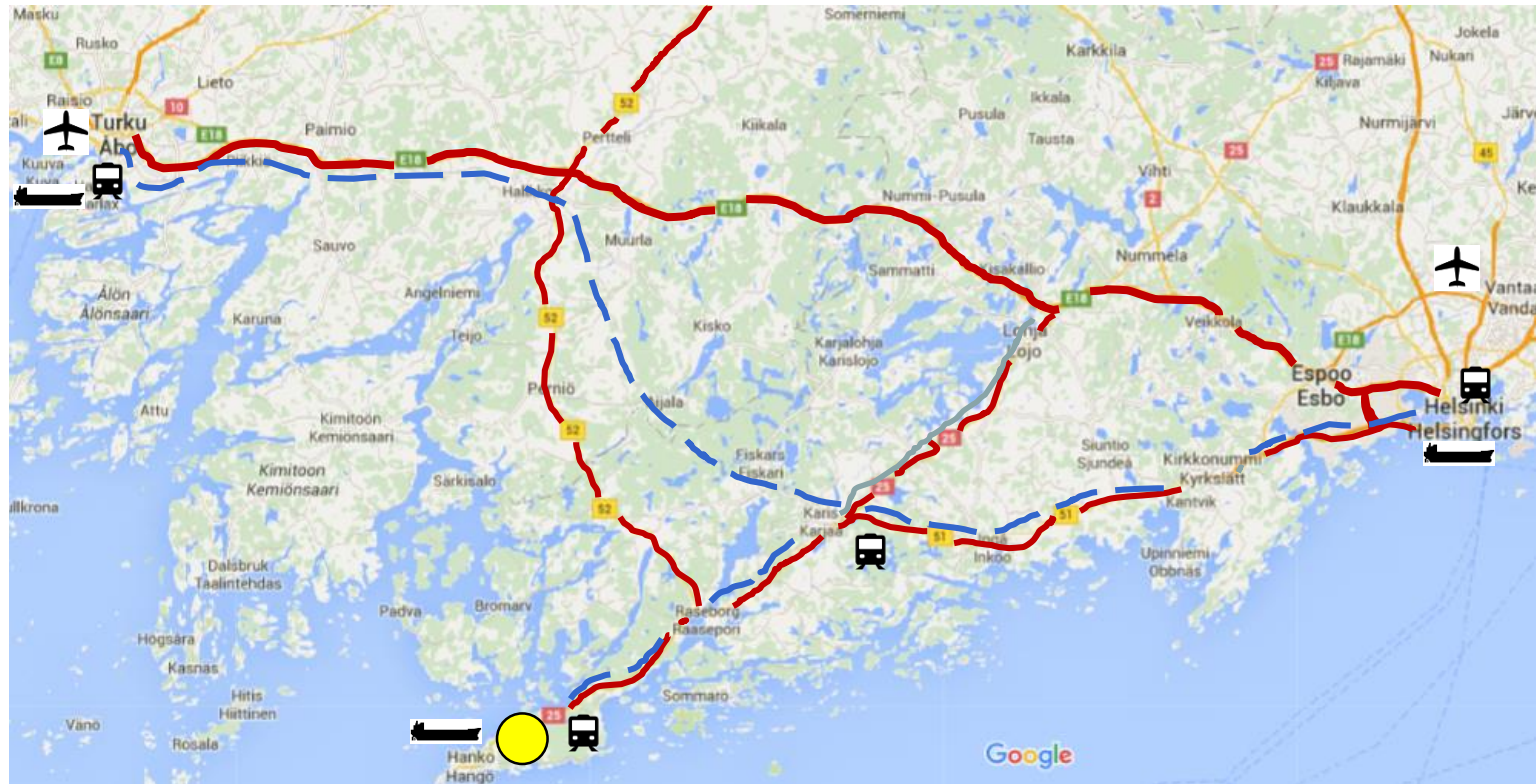
Ideal Data Center site location



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








Site is ideal for DC operations in terms of location, power, cooling, connectivity, fast track implementation and local support

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

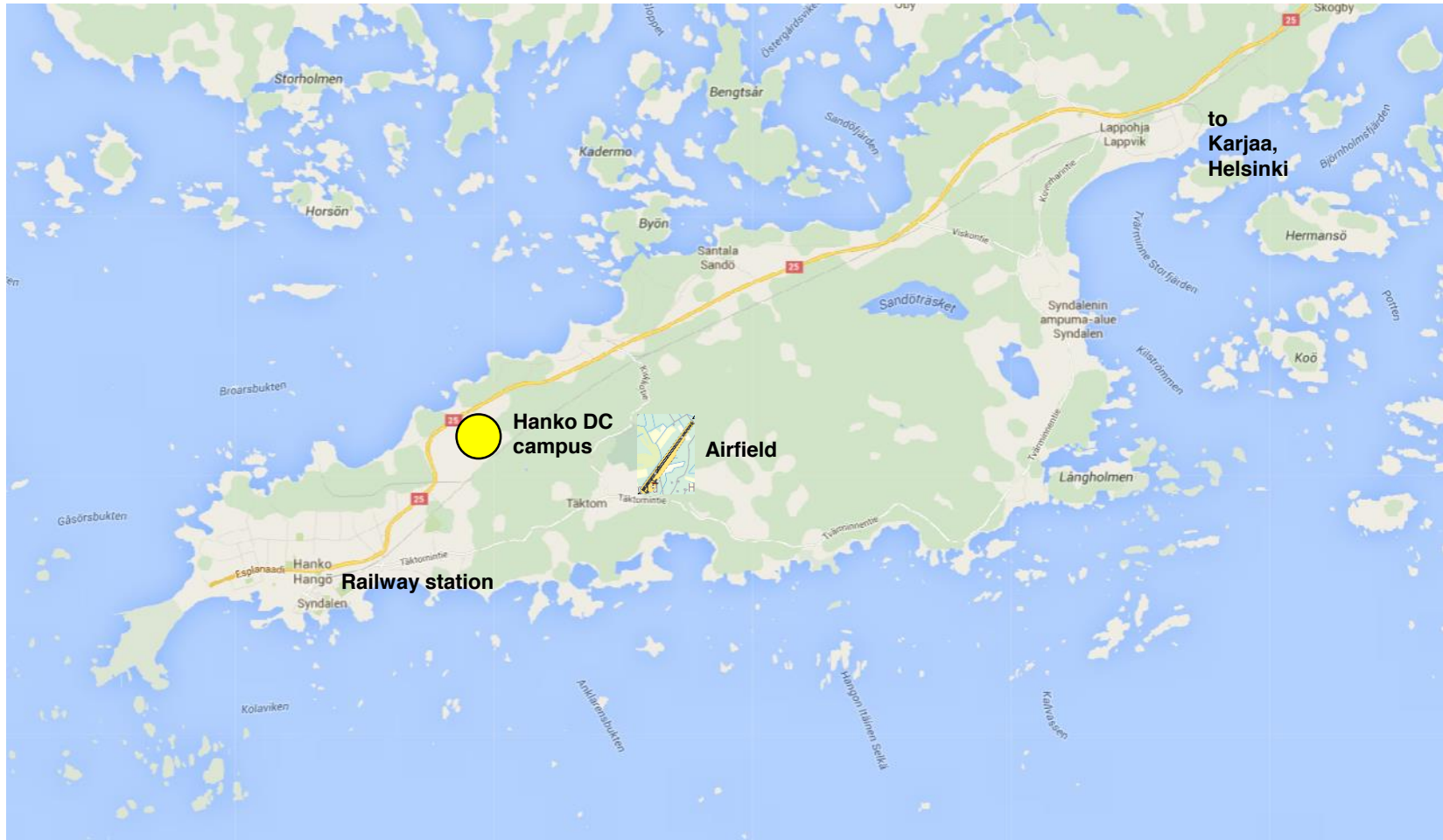


Distances from DC site:

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

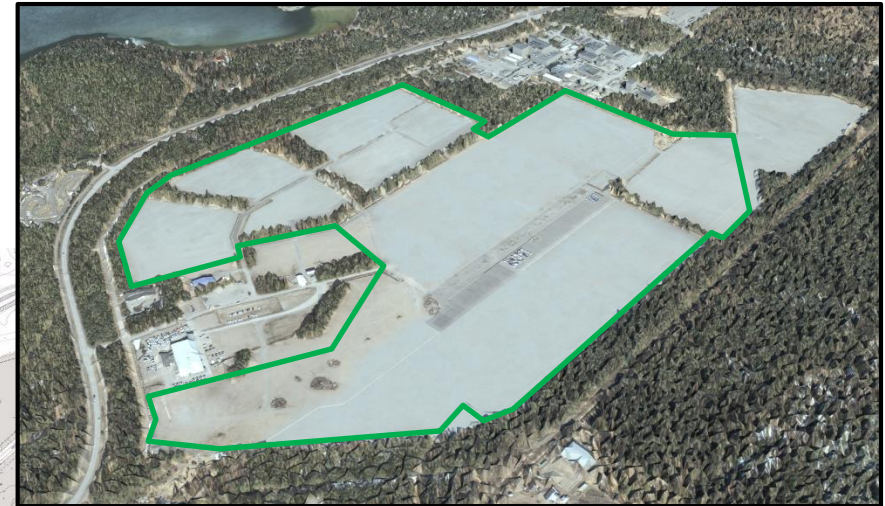
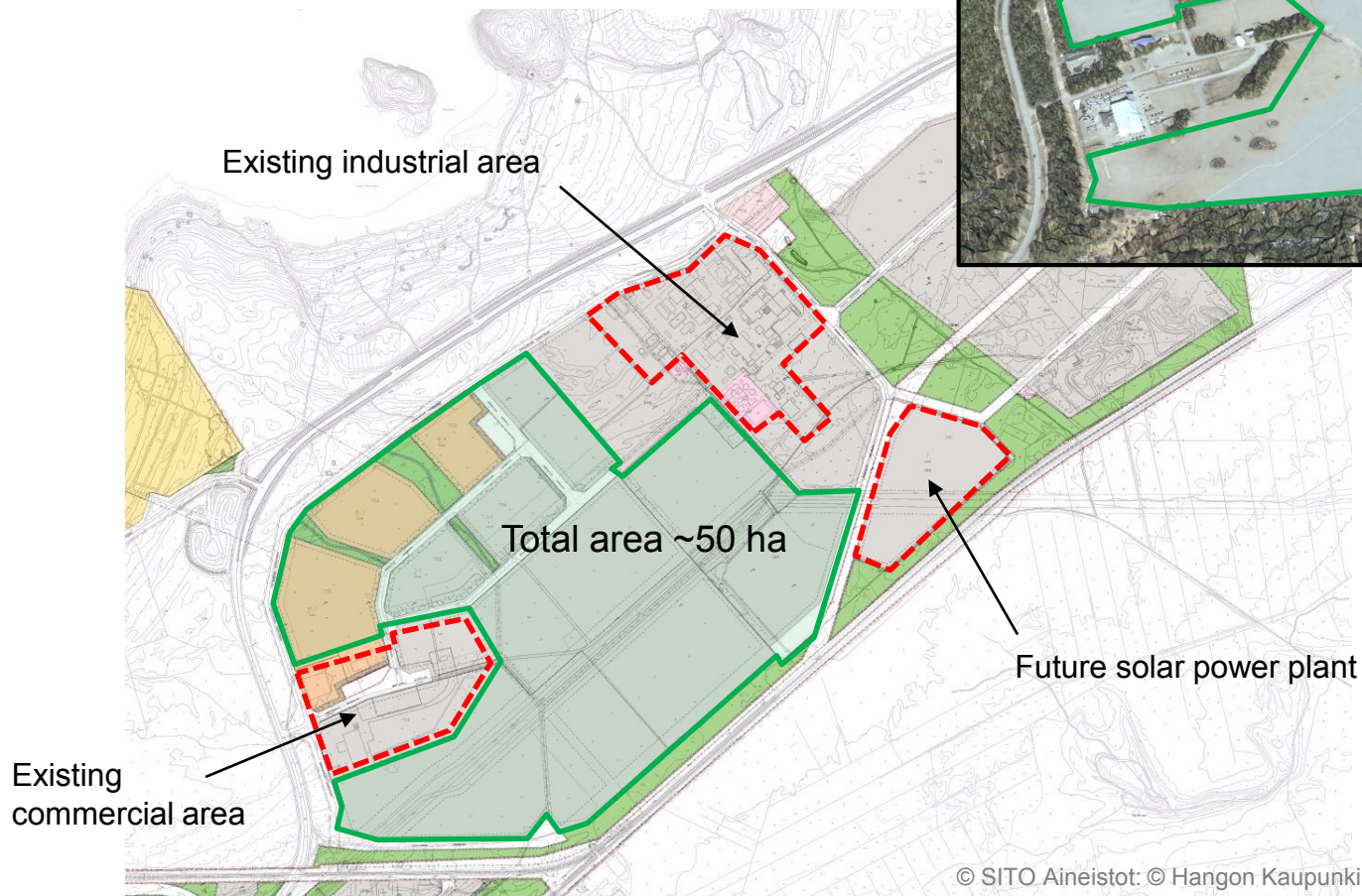
-  Port/Harbour
-  4- lane motorway
-  Main roads
-  Railroad
-  Intl. airport
-  Railway station
-  Hanko DC campus

DC Campus in Hanko



Easy-to-build area for Data Center

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

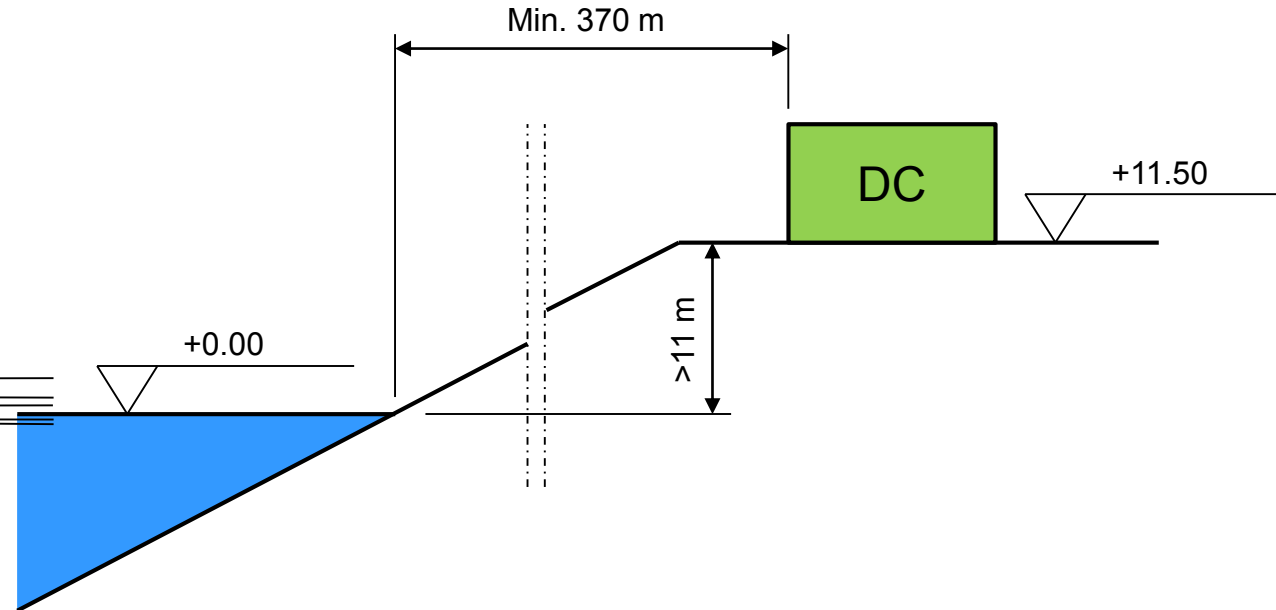


Location in relation to the sea, and minimum recommended building elevation

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

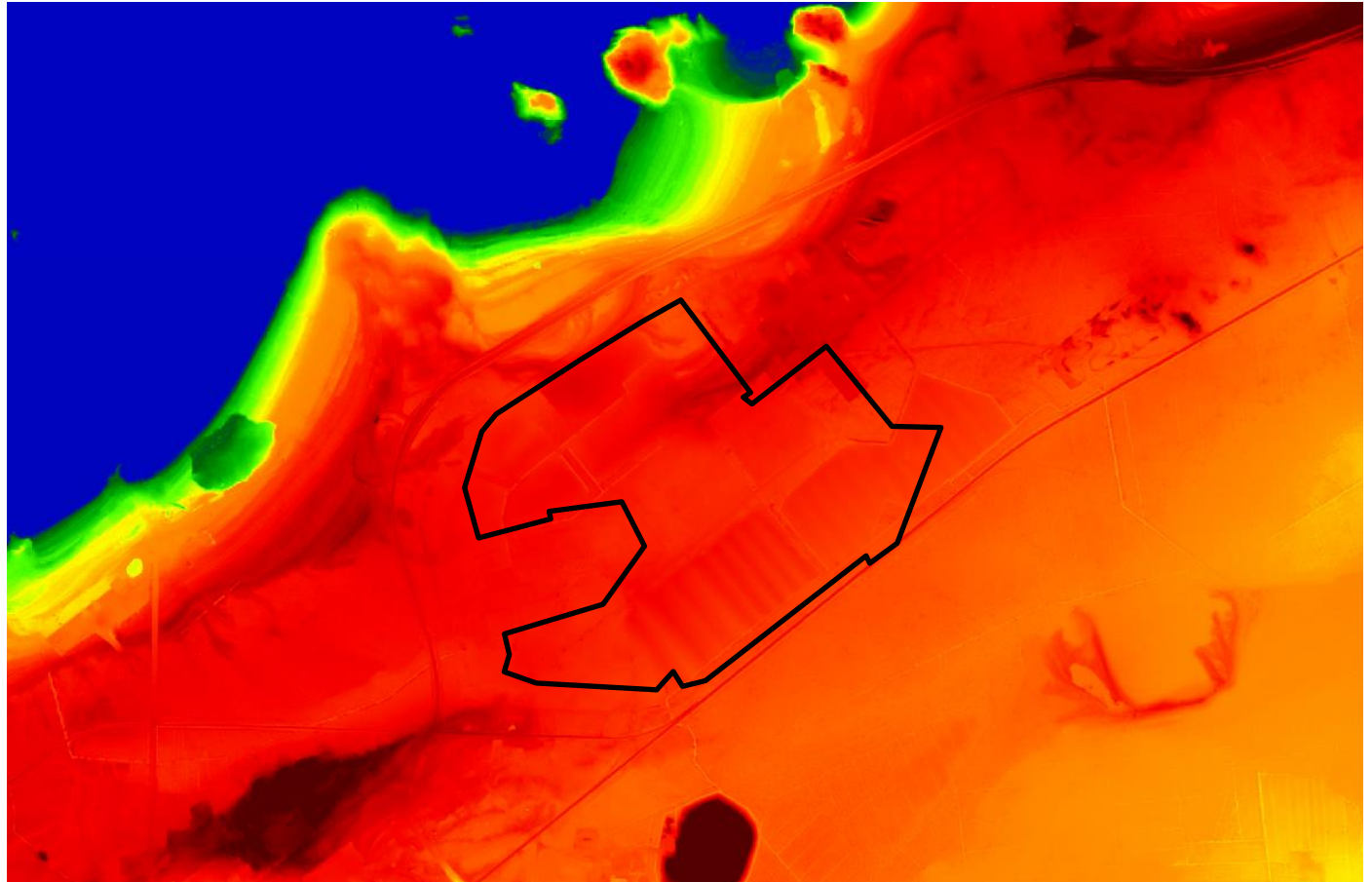
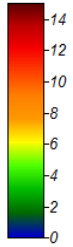


A publication by Finnish Meteorological Institute; “Long-term flooding risks and recommendations for minimum building elevations on the Finnish coast”, June 2014

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.

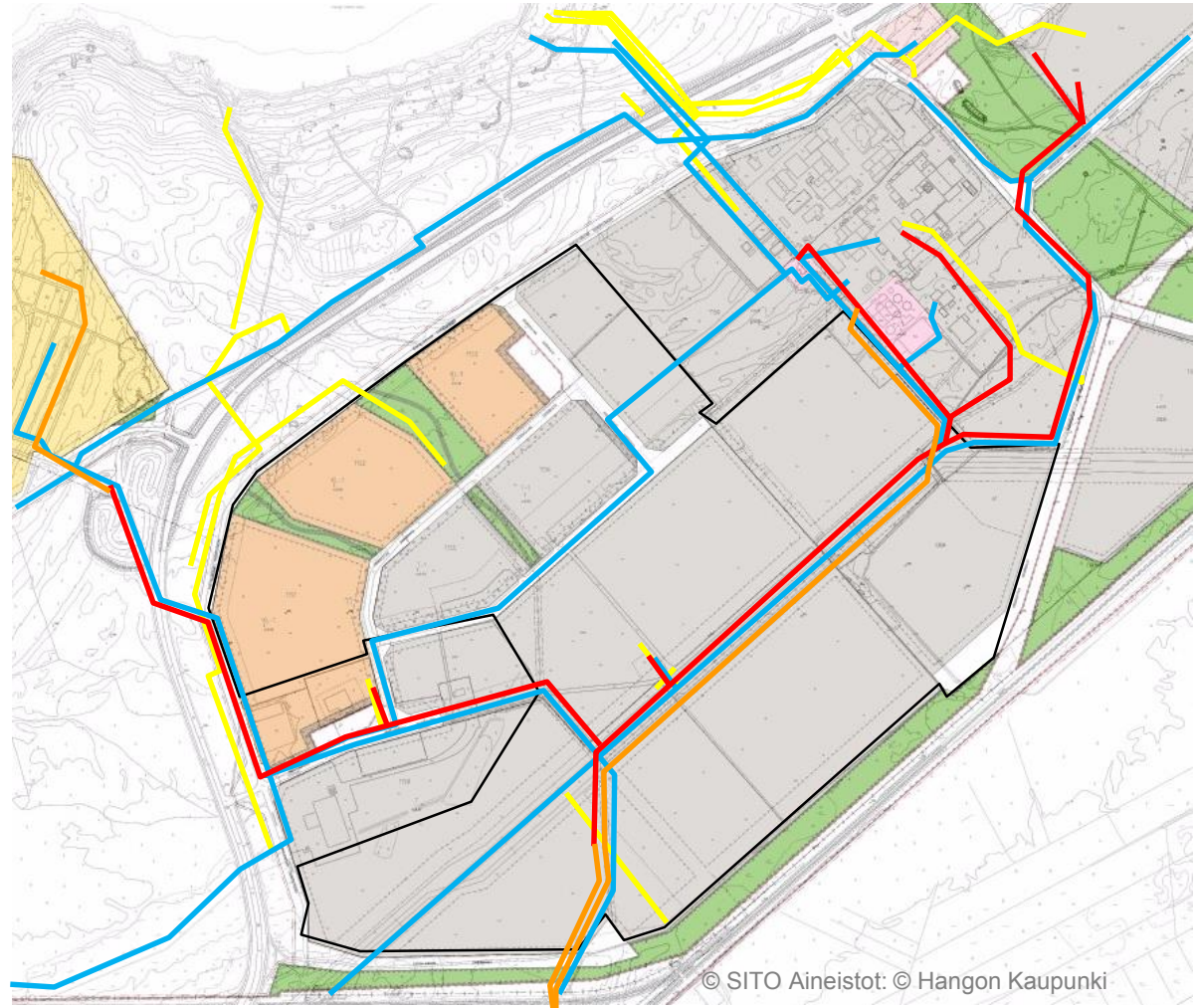
Current landscape elevations



Landscape data by
National Land
Survey of Finland
11/2015

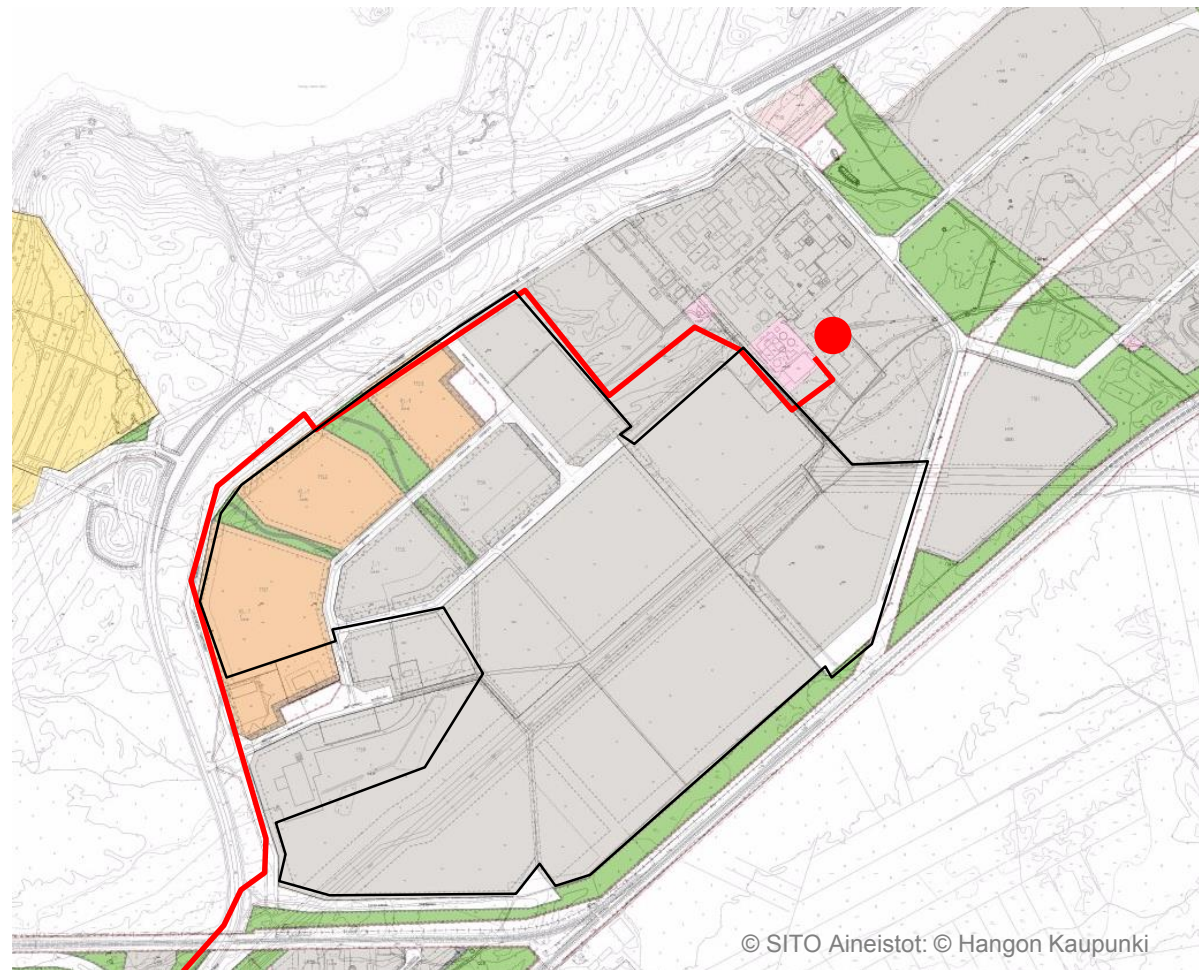
Existing utility services

- Potable water
- Sewer
- Pressure sewer
- Rain water

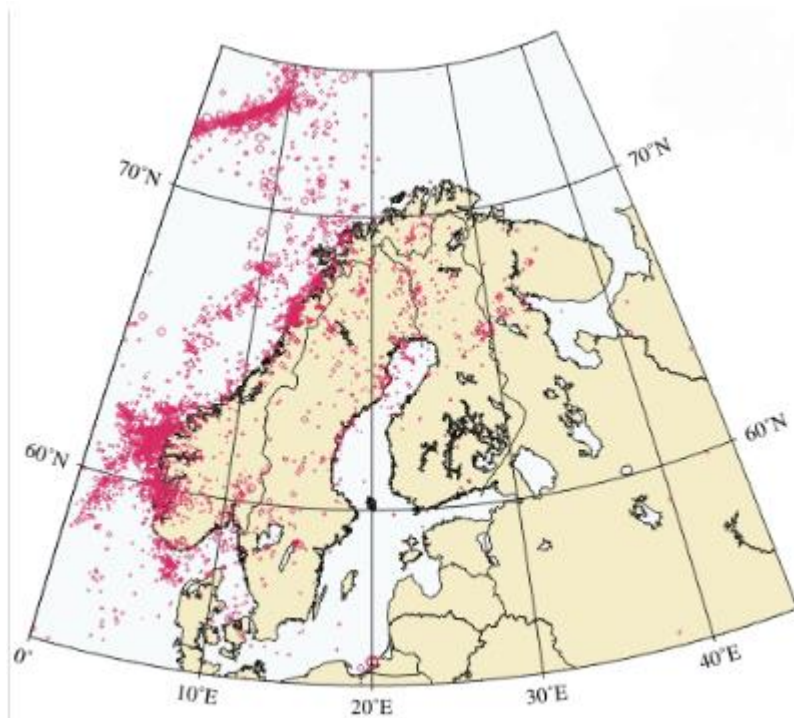


Existing district heating network

- 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.

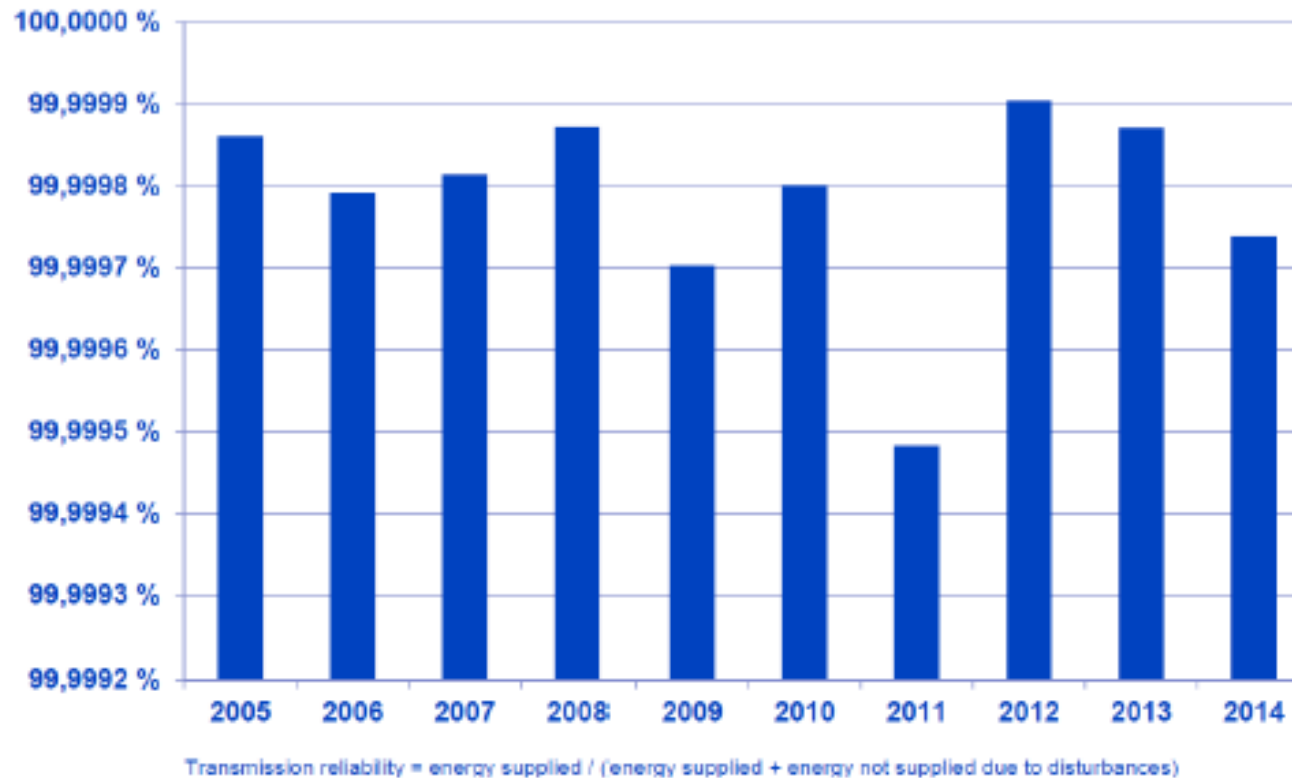
Local earthquakes are part of interplate earthquake series on Eurasian tectonic plate.

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.

POWER SUPPLY

Reliable electrical grid

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



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

FINGRID
POWER TRANSMISSION
NETWORK
1.1.2015

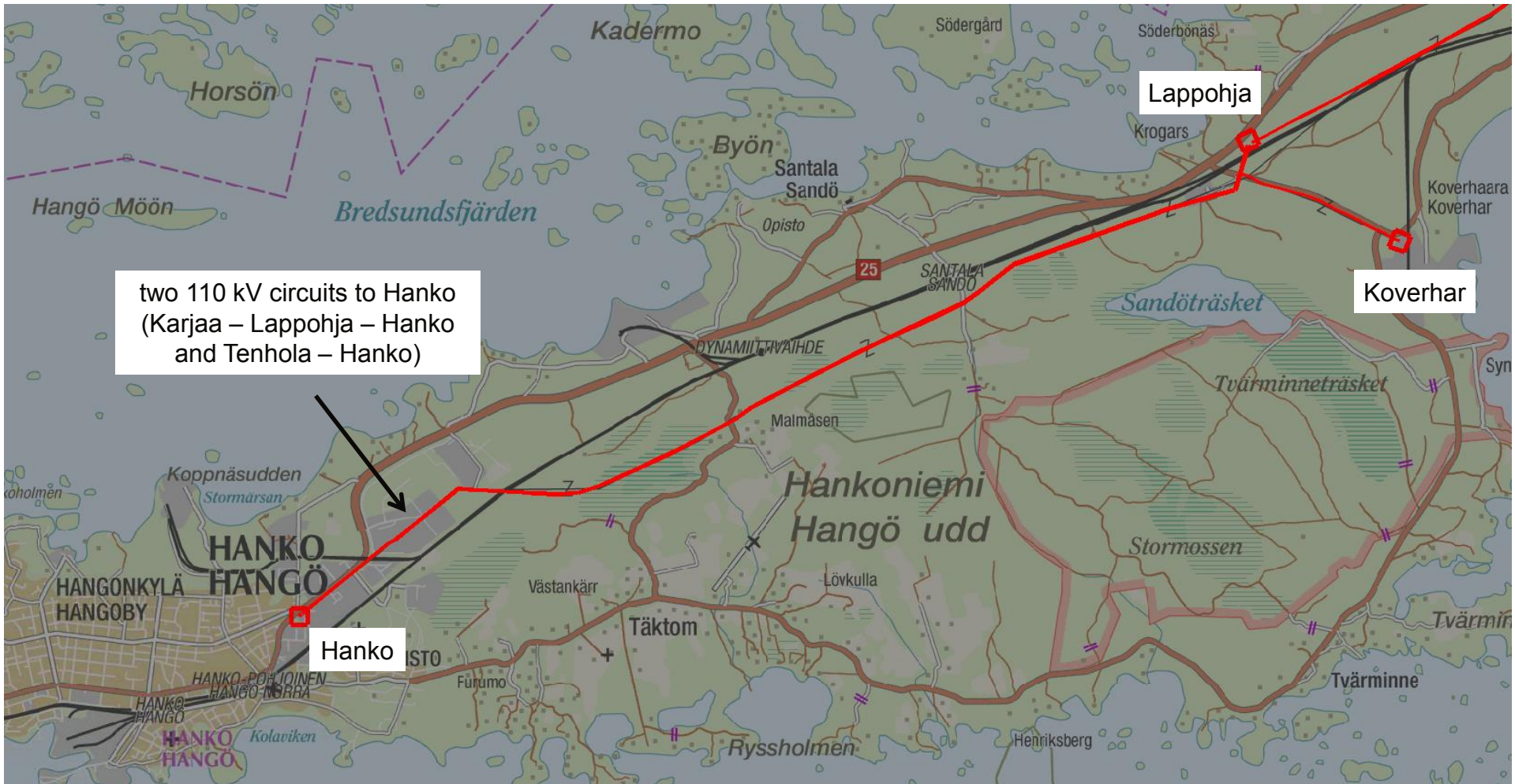
- 400 kV grid
- 220 kV grid
- 110 kV grid
- HVDC
- network owned by others



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

- **Latency to major cities:**

- Helsinki – Stockholm 8 ms
- Helsinki – Tallinn 3 ms
- Helsinki – St Petersburg 5 ms
- Helsinki – Moscow 12 ms
- Helsinki – Frankfurt 29 ms
- Helsinki – Amsterdam 26 ms
- Helsinki – Lontoo 31ms
- Helsinki – Pariisi 29 ms
- Helsinki – Madrid 60 ms
- Helsinki – Milan 43 ms
- Helsinki – Hong Kong 300 ms
- Helsinki – India 170 ms
- Helsinki – New York 110 ms

- **Baltic route:**

- Helsinki – Frankfurt 20-22 ms

- **New sea route:**

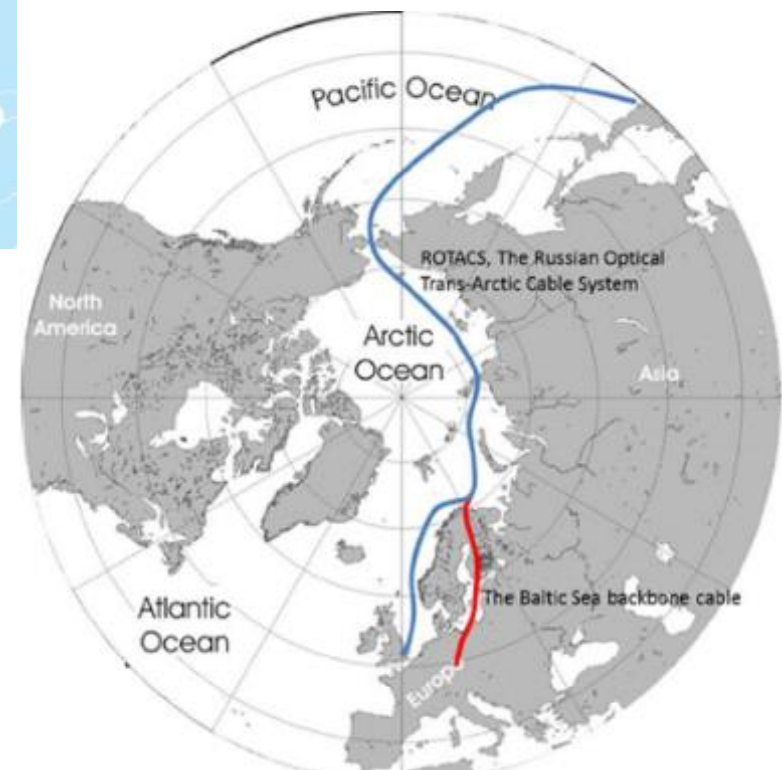
- Helsinki – Frankfurt 19,5 ms (estimate)



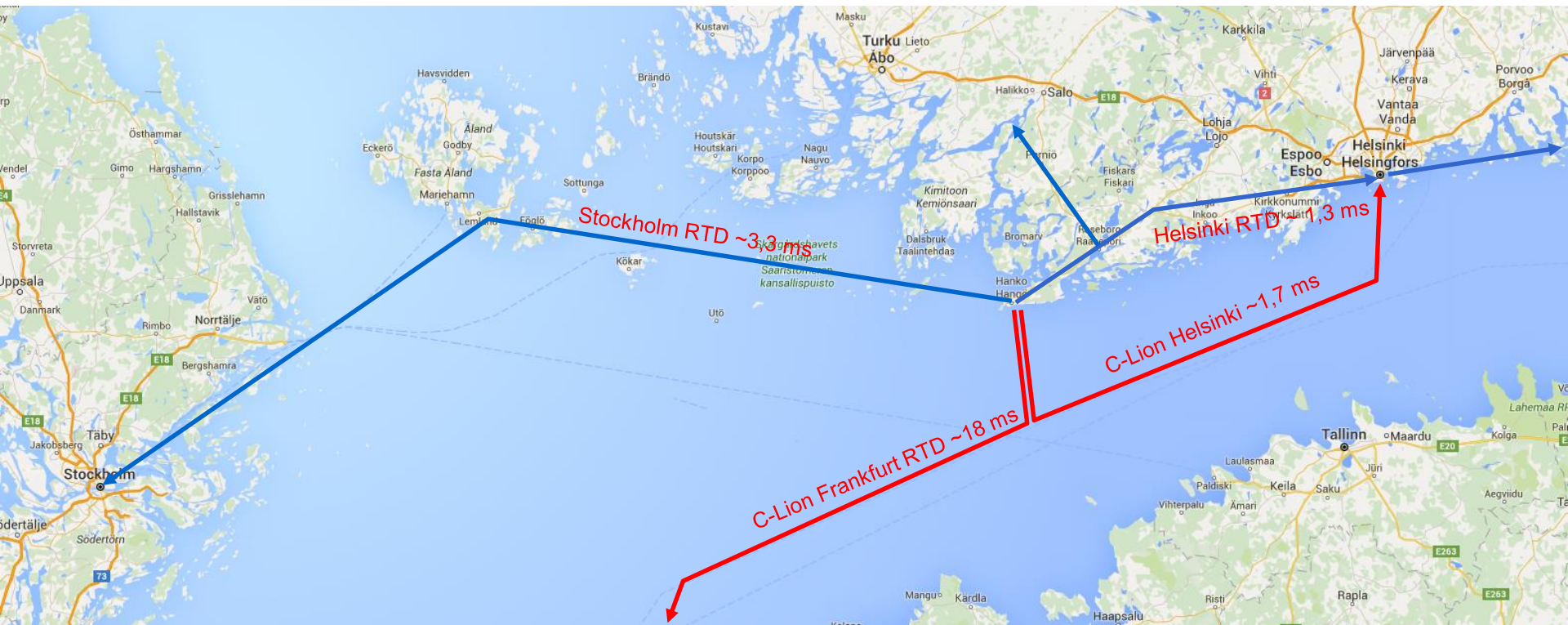
Source: Invest in Finland

- 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



General views on the available fiber infrastructure

- The local provider in Hanko is Karjaan puhelin and TeliaSonera. Cinia ja Elisa has also backbone connectivity to the Hanko.
- Karjaan puhelin has local coverage of Fiber network and duct routes in Hanko. Cinia, Elisa and TeliaSonera are ready to make local tail to the DC.
- Connectivity perspective Hanko DC is easy to be connected SeaLion1, Routes to Sweden and Routes to Russia via many diverse fiber route
- Available connectivity services today:
 - TeliaSonera, Elisa and Karjaan Puhelin has available Wavelength service, L3-VPN and Ethernet services
 - Dark fiber connectivity service from Karjaan Puhelin, TeliaSonera and Elisa

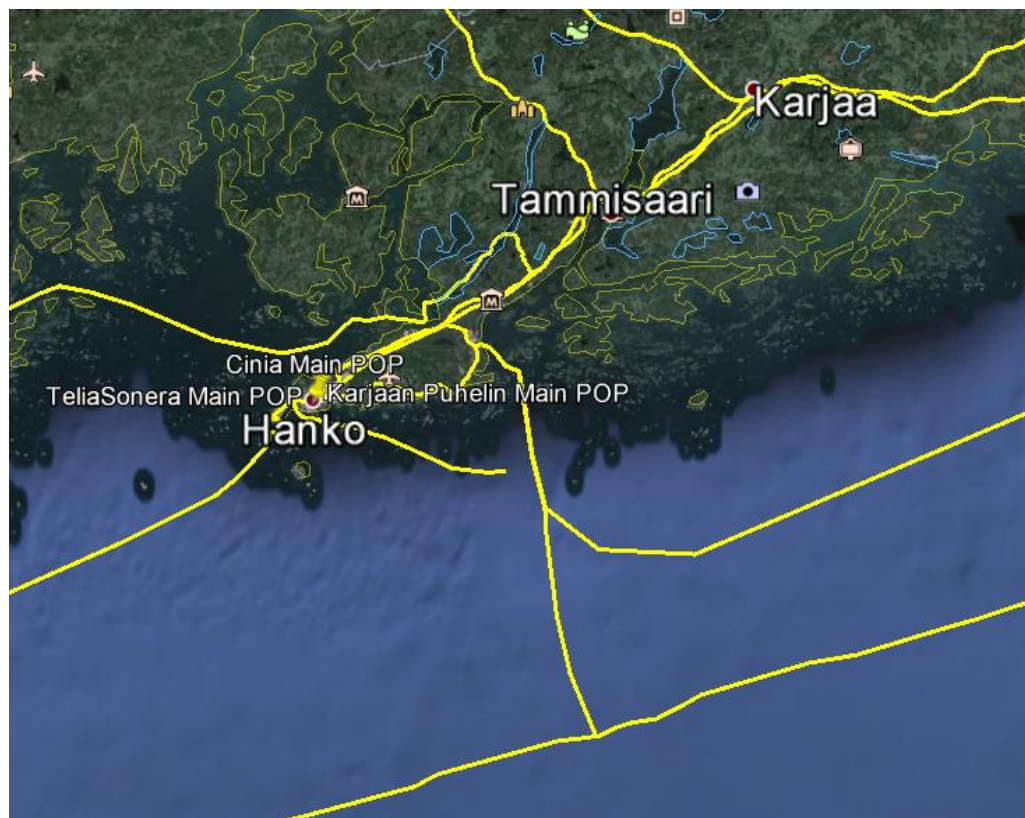
Local tail suggestion:

Depending on DC location on Hanko area but suggestion is to invest own fiber to CLS to DC. Other routes to DC will be on service providers and telecom operators responsibly. All local tail routes need to be visible for DC owner to be sure of route diversity

Route description



Hanko DC connectivity_V2.kmz



Example of Round Trip Delay

A-end	B-end	Distance	Estimated latency RTD
Hanko DC	Helsinki PoP	~125 km	~1,25 ms
Hanko DC	Finnish Russian border	~360 km	~3,6ms
Hanko DC	*Hamburg PoP	~1460 km	~14,6 ms
Hanko DC	*Frankfurt PoP	~1970 km	~19,7ms
Hanko DC	ST Petersburg	~635 km	~6,4ms
Hanko DC	Moscow	~1140 km	~11,4ms

* RTD calculated using Cinia SeaLion1 via Hanko branding

New Digital Highway at your Service

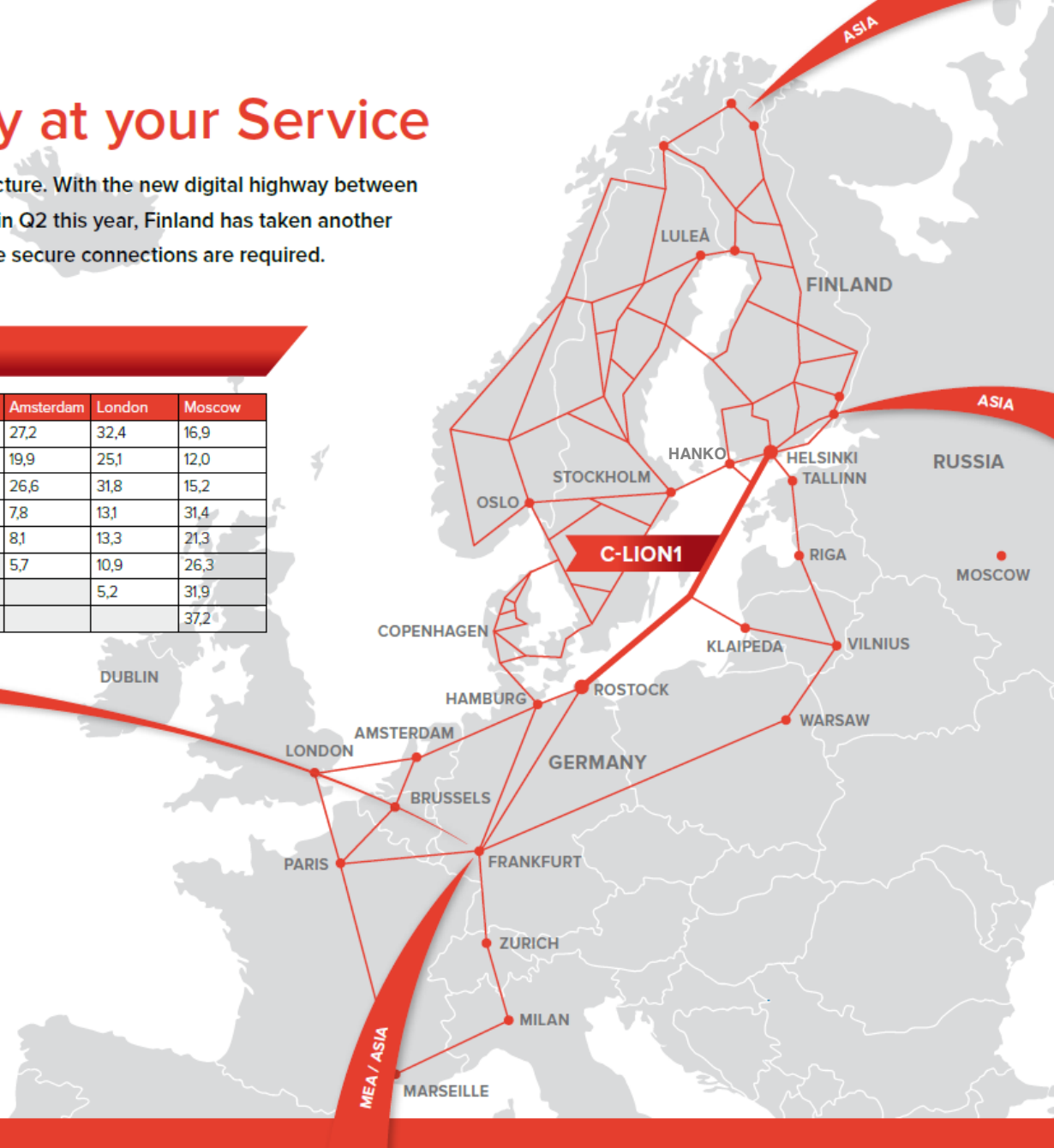
Cinia is building sustainable European digital Infrastructure. With the new digital highway between Helsinki and Frankfurt expected to be up and running in Q2 this year, Finland has taken another step forward in digitalization. Diversity, faster and more secure connections are required.

C-LION1 – ROUND TRIP DELAY (MS)

City	Helsinki	Kajaani	Frankfurt	Rostock	Hamburg	Amsterdam	London	Moscow
Oulu	7,3	1,9	26,7	19,1	21,5	27,2	32,4	16,9
Helsinki		6,7	19,4	11,8	14,2	19,9	25,1	12,0
Kajaani			26,1	18,5	20,9	26,6	31,8	15,2
Frankfurt				7,6	5,7	7,8	13,1	31,4
Rostock					2,4	8,1	13,3	21,3
Hamburg						5,7	10,9	26,3
Amsterdam							5,2	31,9
London								37,2

Expected figures

The high capacity connection is equipped with the latest cyber secure solutions to ensure safe traffic for sensitive services of public and private clouds. Expand your connectivity with Cinia for tomorrow's needs.



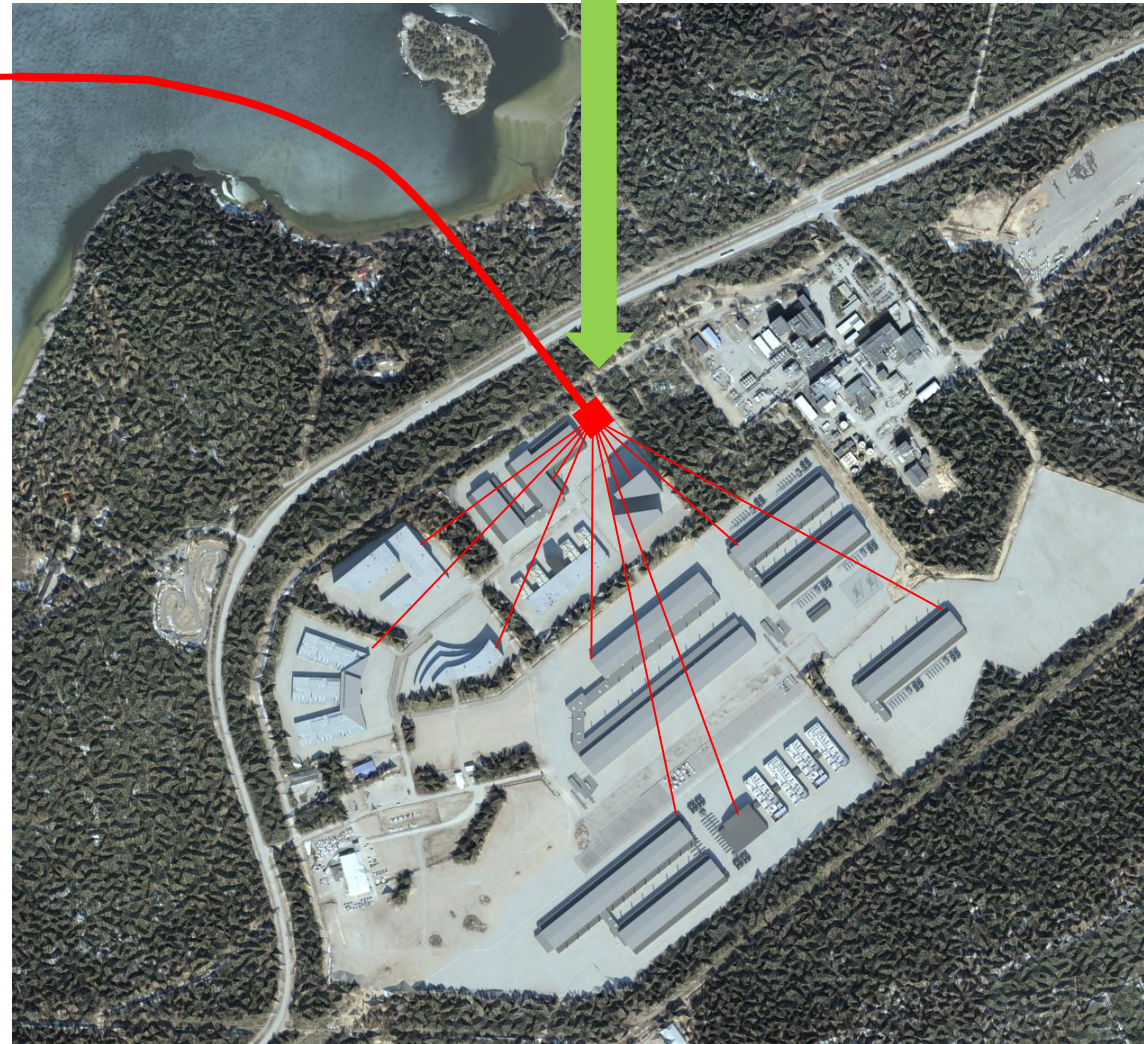
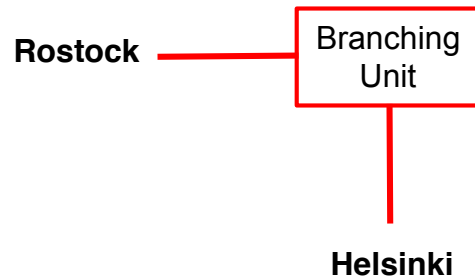
"Sea Lion" submarine fiber cable connection

Direct route to central Europe!

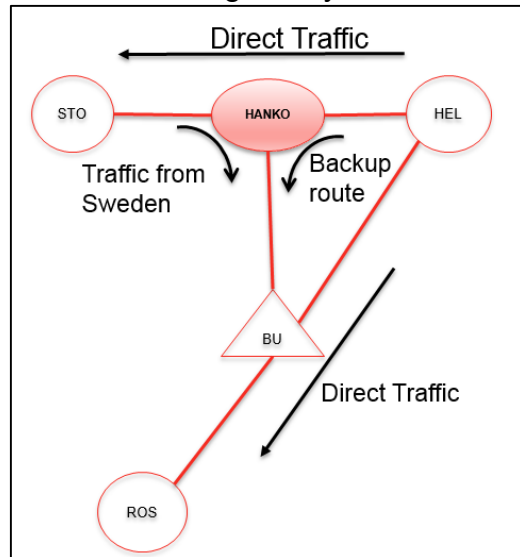
Direct "Sea Lion" submarine cable connection from Rostock Germany to Helsinki Finland. (120 Terabits/second)

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 (ICTs) for increased competitiveness and well-being.

Networked Readiness Index

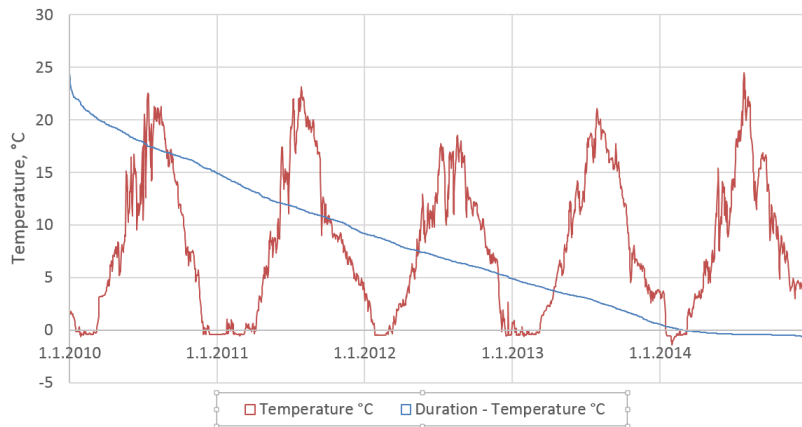
Rank	Economy	Info	Value	Trend	Distance from best
1	Singapore	(i)	6.0	—	██████████
2	Finland	(i)	6.0	—	██████████
3	Sweden	(i)	5.8	—	██████████
4	Netherlands	(i)	5.8	—	██████████
5	Norway	(i)	5.8	—	██████████
6	Switzerland	(i)	5.7	~	██████████
7	United States	(i)	5.6	—	██████████
8	United Kingdom	(i)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

COOLING AND SECONDARY HEAT REUSE

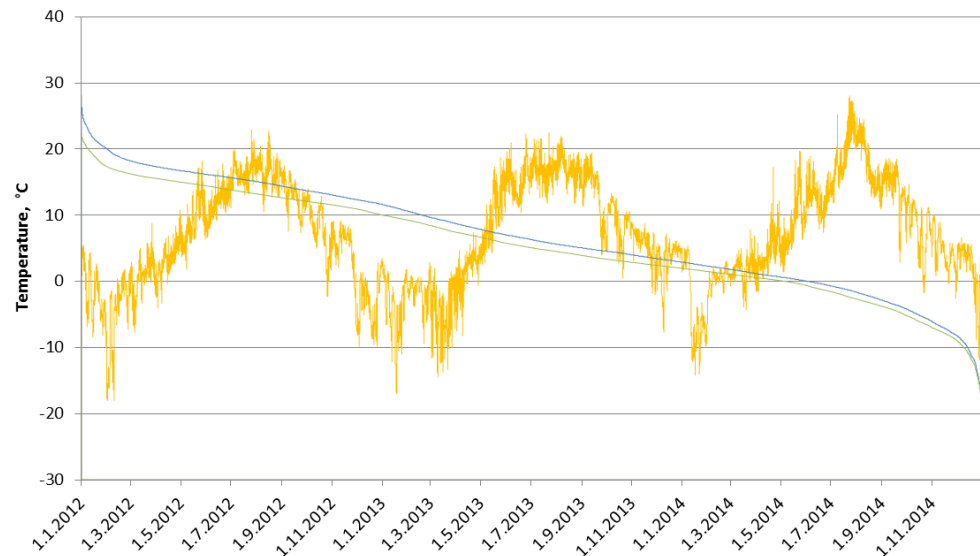
Conditions support effective cooling

- Ambient conditions suitable for free cooling
- Ambient air $>25\text{ }^{\circ}\text{C}$ $<19\text{ h/year}$ (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



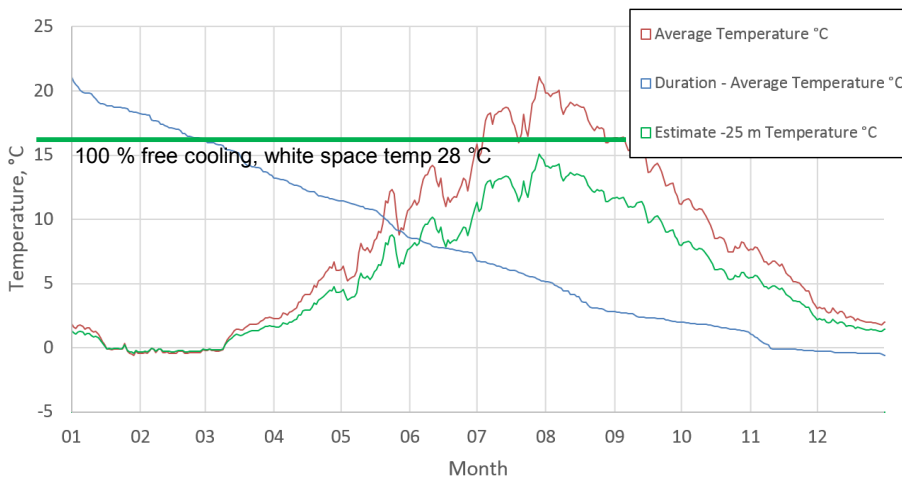
Ambient air: dry temperature and
duration of dry and wet bulb temperatures
Air data: hourly averages, Hanko/Tulliniemi 2012-2014 by FMI



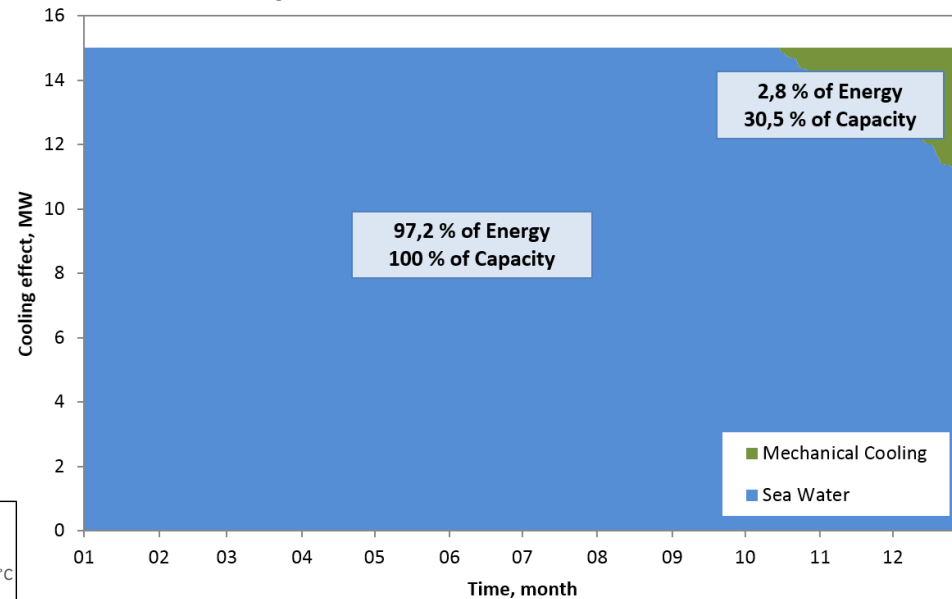
Cooling by Sea Water

- High free cooling share for white space temperature 21°C 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.

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

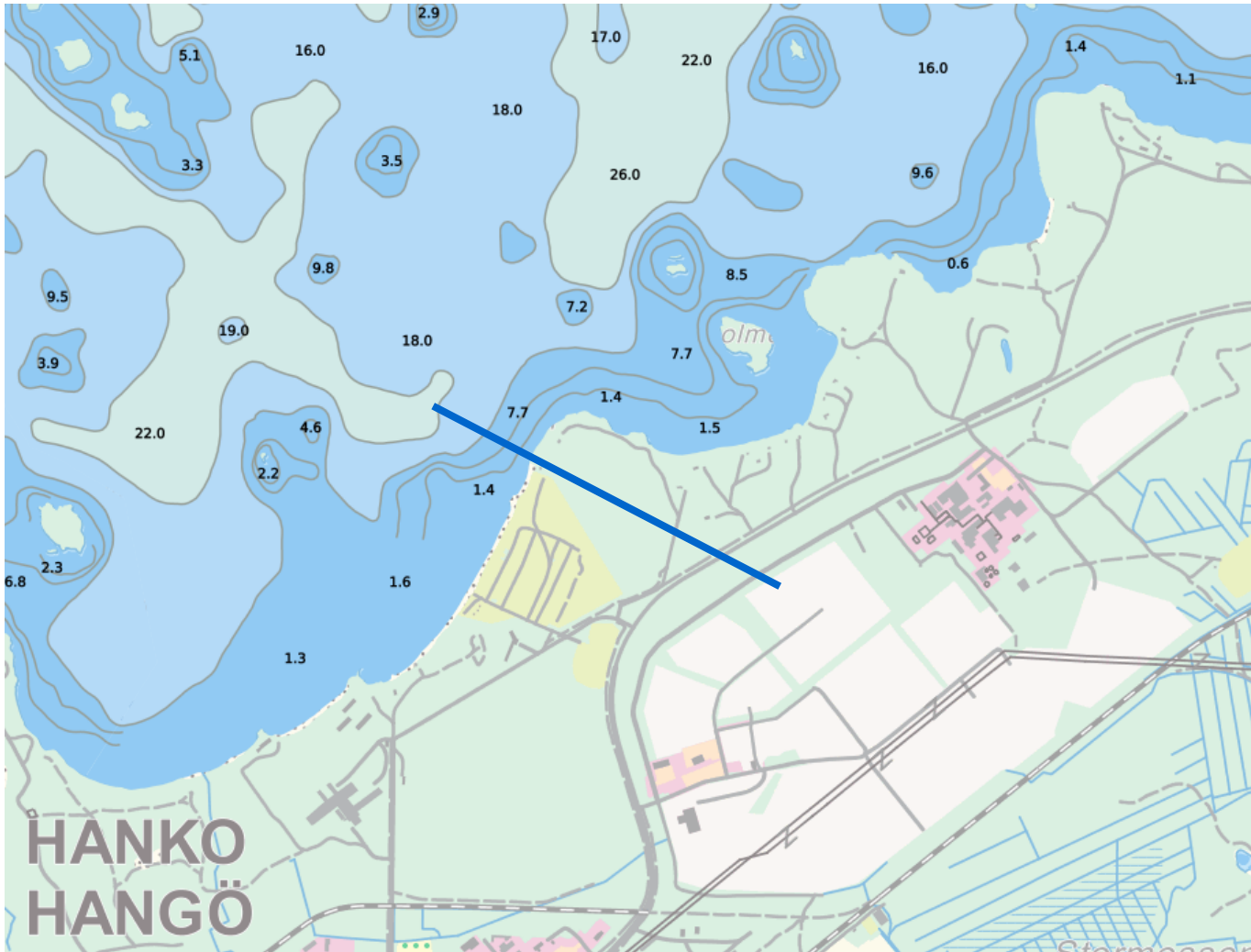


Cooling production by sea water and mechanical cooling
White space temperature 28 °C,
Data: Average surface temp. from available data, 2010-2014



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

100% free cooling possibility with sea water cooling

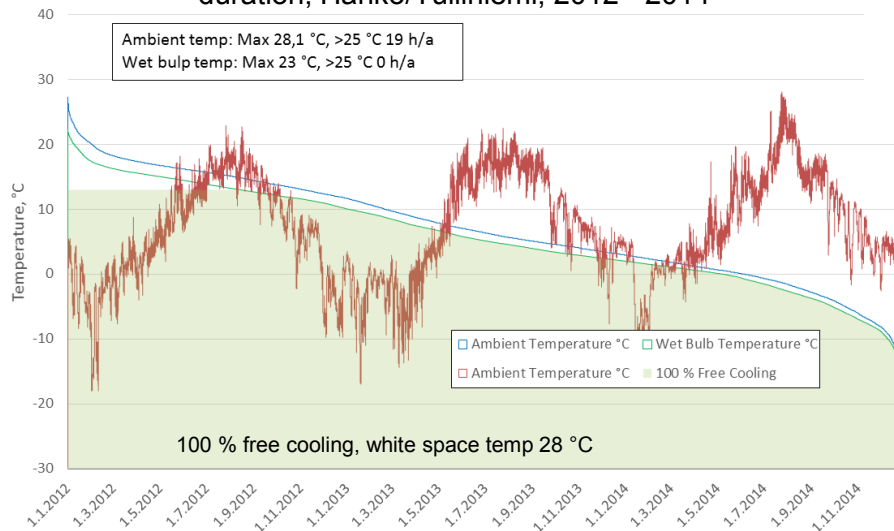


The depth chart of the nearby sea looks very promising for achieving 100% free cooling by using cold sea water for Data Center cooling.

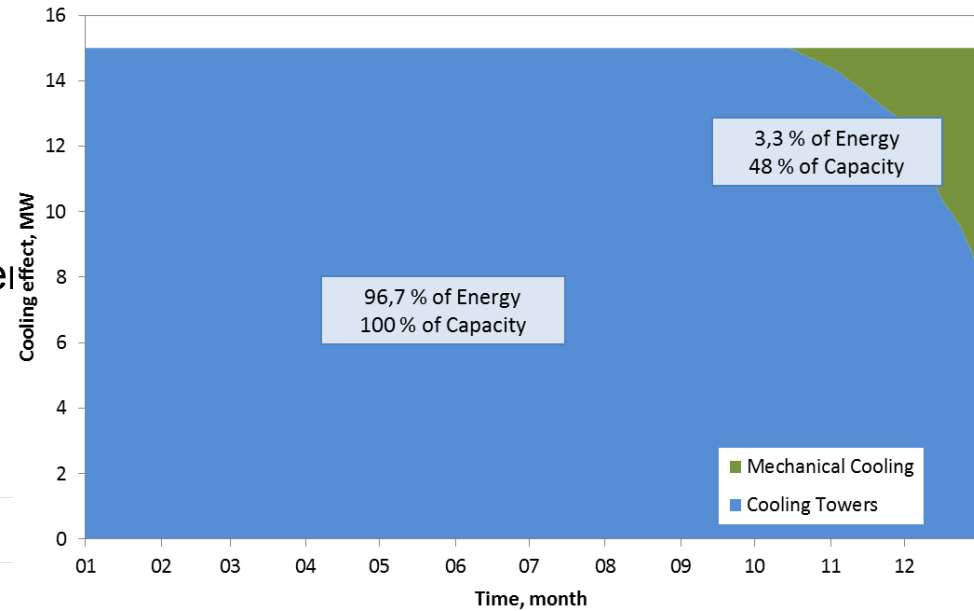
Cooling Towers and Mechanical Cooling

- Wet bulb temperature favors cooling towers
- High free cooling share for white space temp. 21°C 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



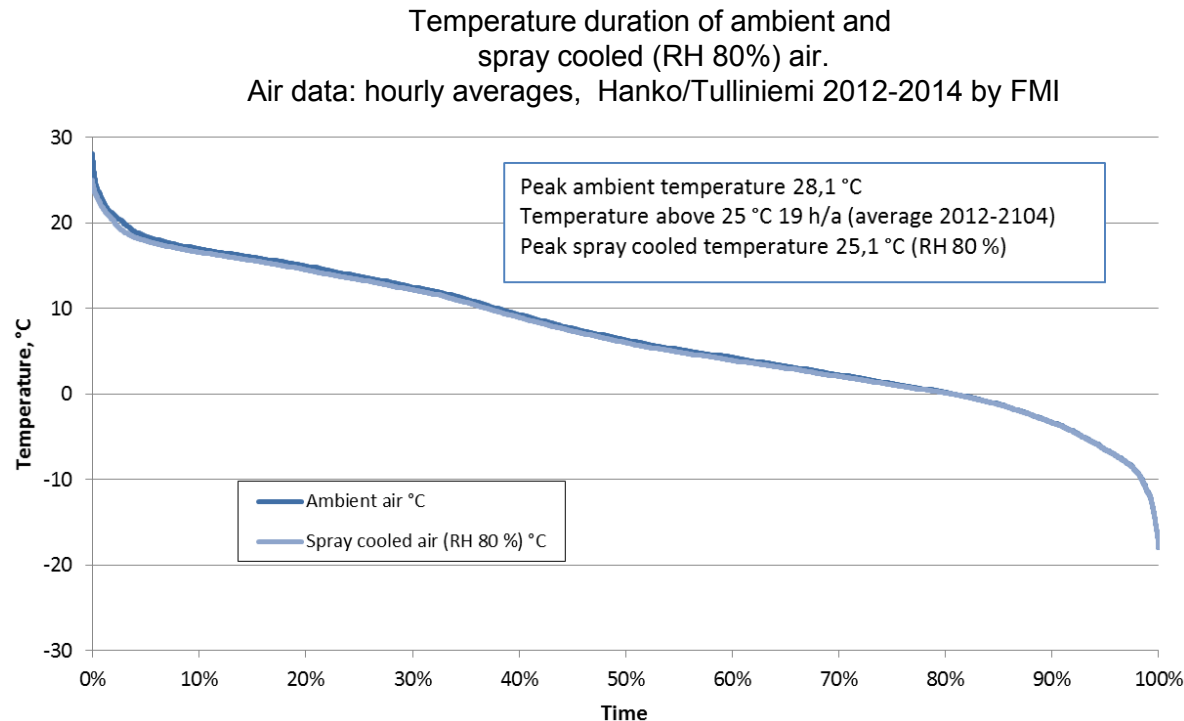
Cooling production by cooling towers and mechanical cooling
White space temperature 28 °C Temp Data 2014



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

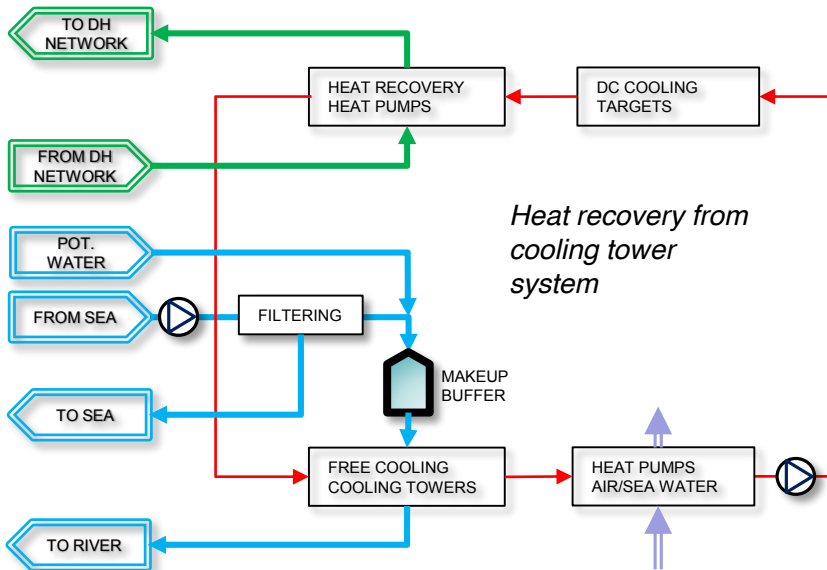
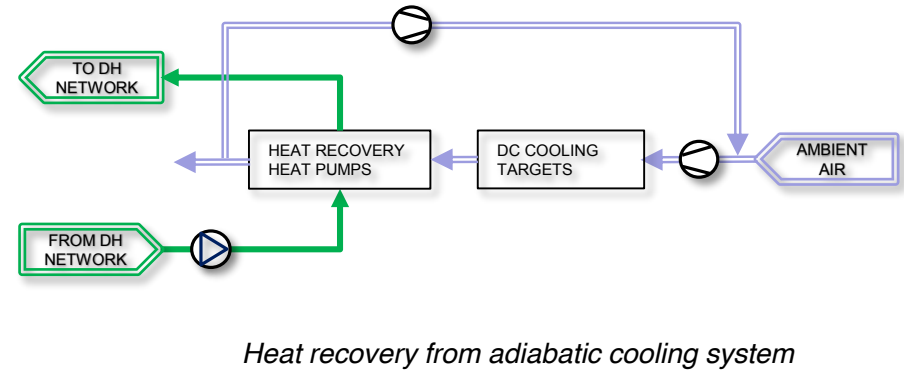
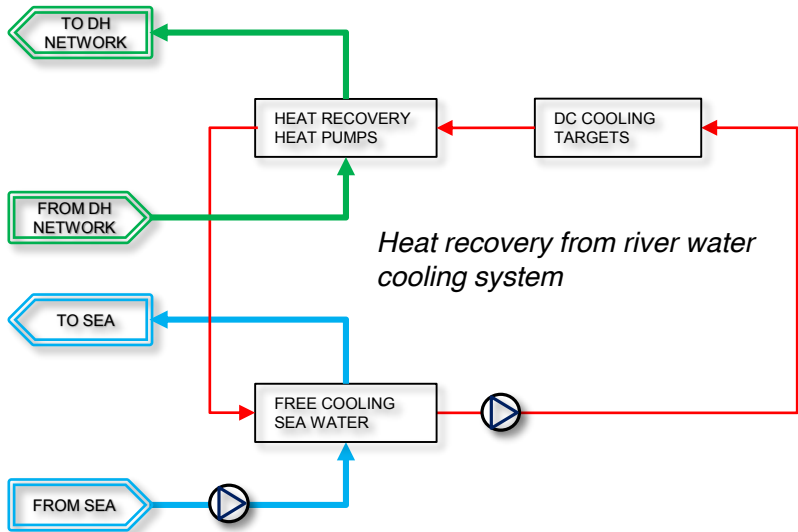
Direct Air Cooling

- 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



- 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

Examples of Secondary Heat Re-use Arrangements



SITE UTILIZATION

Example utilization, 1st build stage



Maximum 1st build stage area
utilization approx. 120 MW

Example utilization, complete build

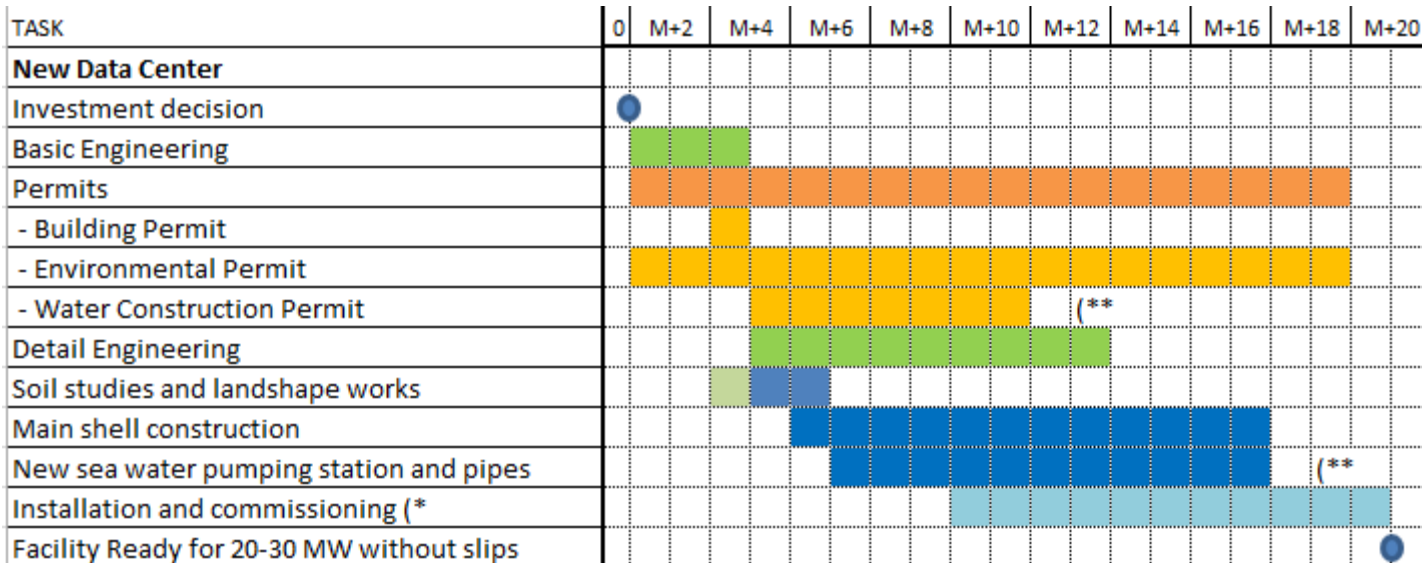
Example visualisation



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 a Green Data Center

The biggest solar power plant in Finland is being planned in the corner of Hanko's Data center Campus.

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**.



Future solar power plant

A good place to live and work

- The Hanko-Raasepori region has some 38.000 inhabitants.
- Finnish and Swedish-speaking population.
- Primary, secondary and vocational schools in the area.
- University of Applied Science offering education for DC-operations.
- Complete services for young families.
- Cultural services and sport centers
- Good housing situation.
- A wonderful nature and a good climate.



Thank You !

For further information, please contact:

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Managing Director

Novago Business Development Ltd.

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Phone: +358 40 5242590

www.novago.fi

