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

Railway station

Hanko DC campus

Airfield

to Karjaa, Helsinki
Easy-to-build area for Data Center

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

Existing industrial area

Total area ~50 ha

Future solar power plant

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

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.

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
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
POWER SUPPLY
National power grid connection (110 and 400 kV)

Source: Fingrid
110 kV regional network in Hanko-Raasepori area (ongoing upgrade in yellow colour)
Hanko electrical grid

Two 110 kV circuits to Hanko (Karjaa – Lappohja – Hanko and Tenhola – Hanko)
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
A unique location for Green Data Center

A solar power plant for Data Center is planned close to the site. It is possible to feed AC and DC power and if needed also store energy for Data Center use.

Locally produced wind- and bioenergy is 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 (former named Helsingin Energia) is planning to build the biggest solar power plant in Finland just at the corner of Hanko’s Data Center campus area. The plant will consist of 2000 solar panels.
CONNECTIVITY
Hanko Data Center global connectivity
Hanko Data Center global connectivity

- Stockholm RTD ~ 3.3 ms
- Helsinki RTD ~ 1.3 ms
- C-Lion Helsinki ~ 1.7 ms
- C-Lion Frankfurt RTD ~ 18 ms
Hanko Data Center local connectivity
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 existing data

Environmental data source: © Finnish Meteorological Institute
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

<table>
<thead>
<tr>
<th>Target white space temp</th>
<th>28 °C</th>
<th>25 °C</th>
<th>21 °C</th>
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<td>Primary water circ temp.</td>
<td>18 °C</td>
<td>15 °C</td>
<td>11 °C</td>
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<td>Free cooling, energy</td>
<td>97%</td>
<td>94%</td>
<td>86%</td>
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<td>Mech. cooling capacity</td>
<td>31%</td>
<td>45%</td>
<td>66%</td>
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</table>

Environmental data source: © Finnish Meteorological Institute
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

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<th>Time, month</th>
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<td>48%</td>
<td>63%</td>
<td>82%</td>
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Ambient air data source © Finnish Meteorological Institute
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
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
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

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<tr>
<th>TASK</th>
<th>M-2</th>
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(* Includes 1,5-2 month period for inquiries, tender comparisons, POs
(** If it is decided to have sea water cooling system