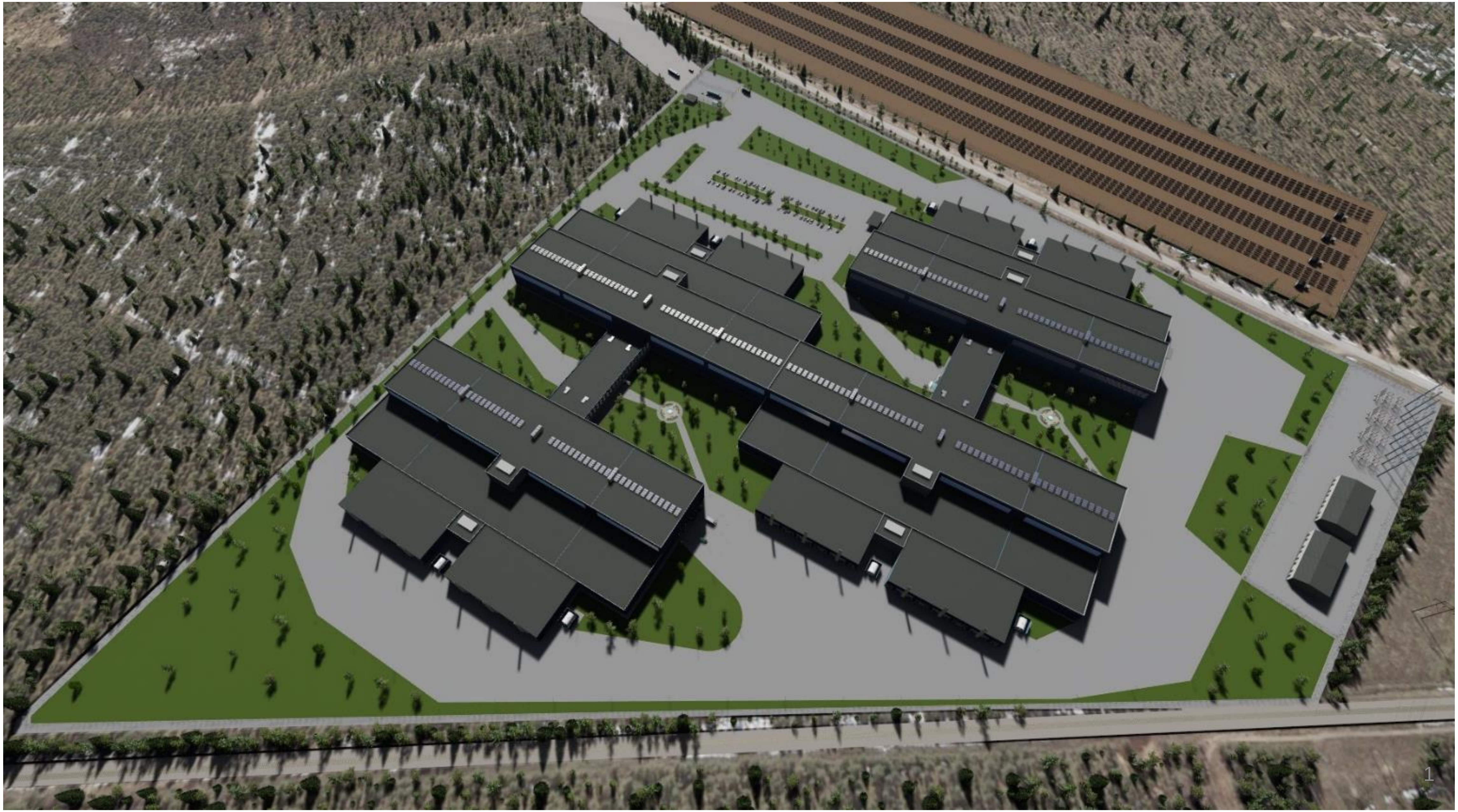
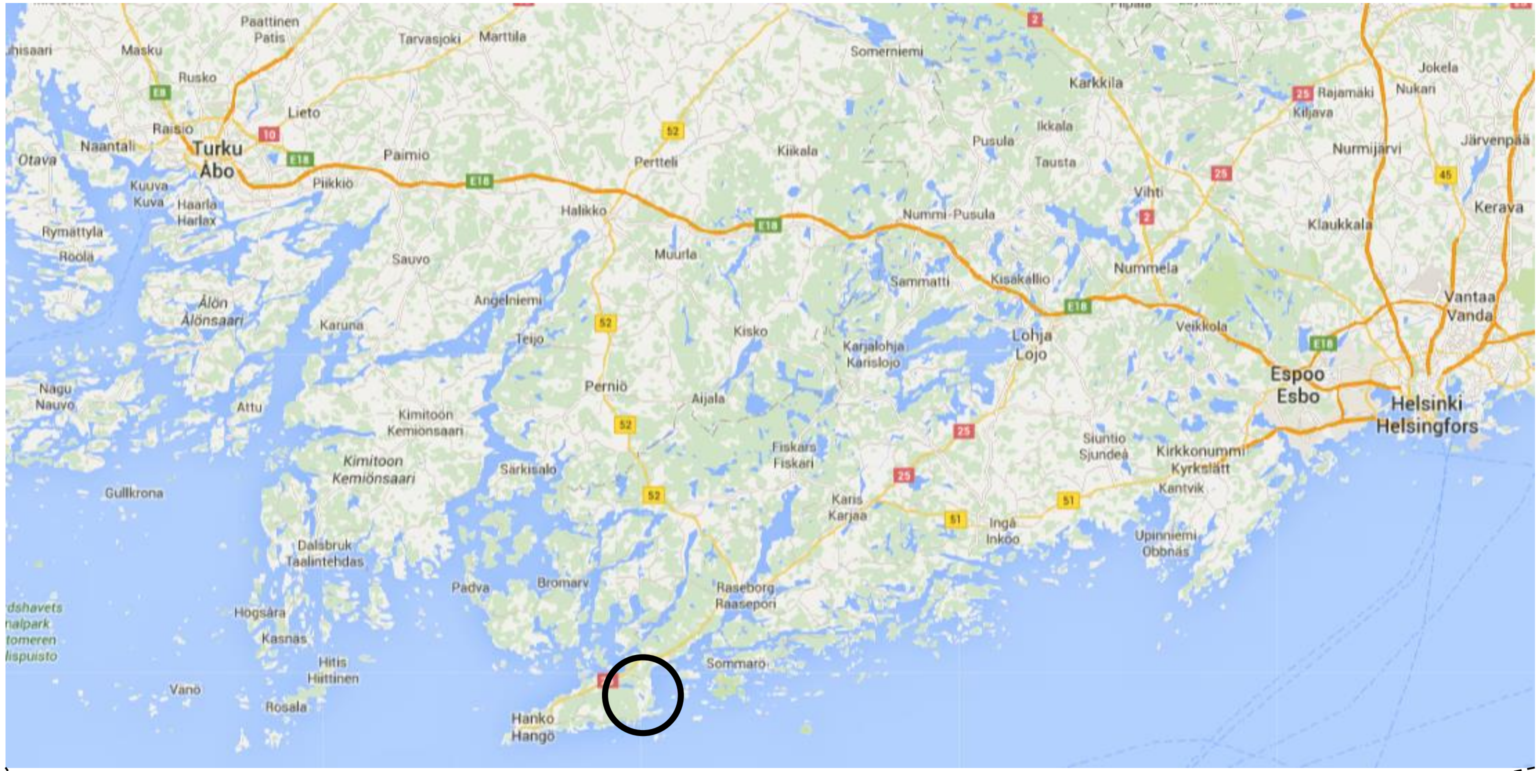
Hanko Koverhar Megasize Data Center Site



LOCATION AND LOGISTICS

Ideal Data Center site location

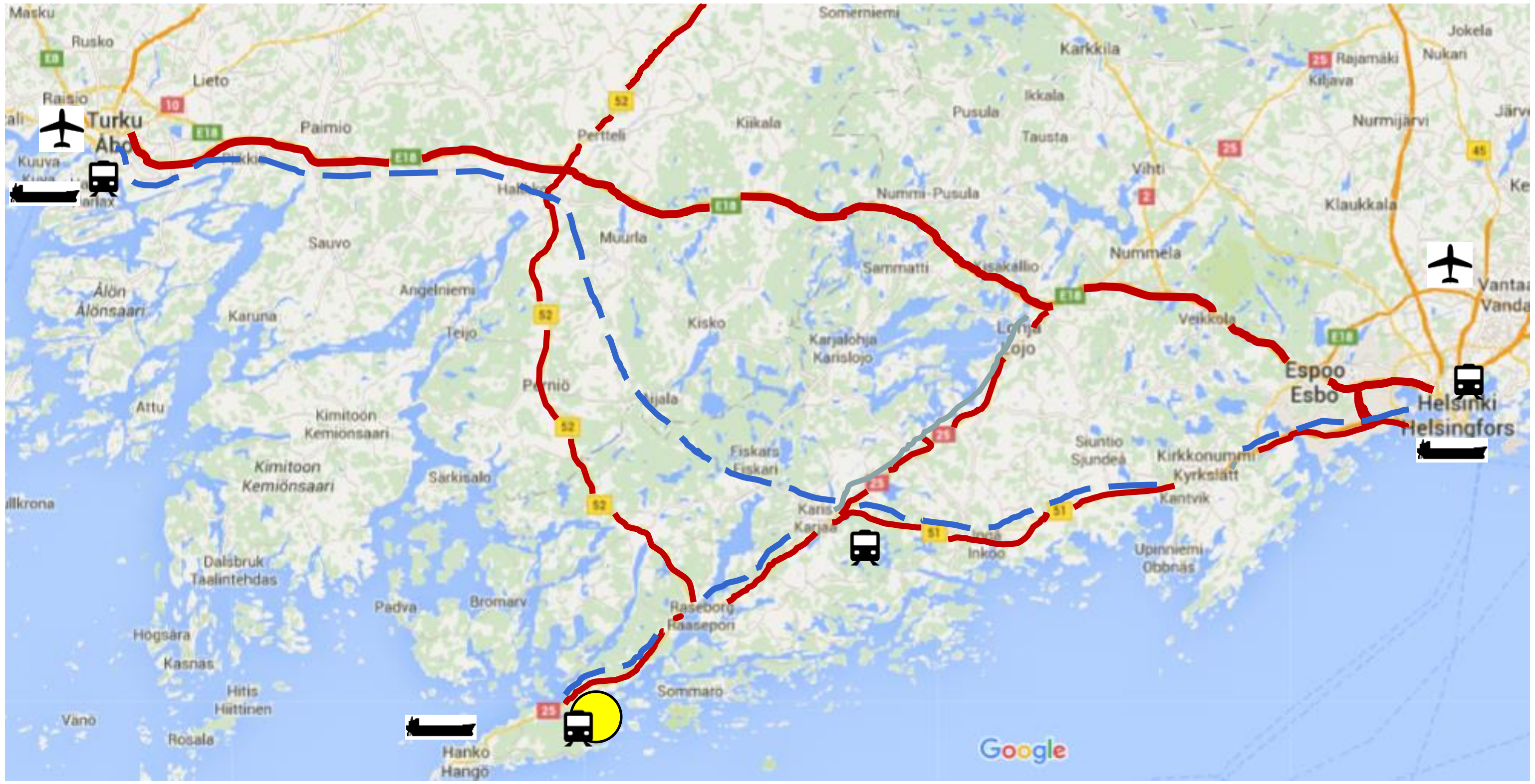
CTS ENGTEC



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

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

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

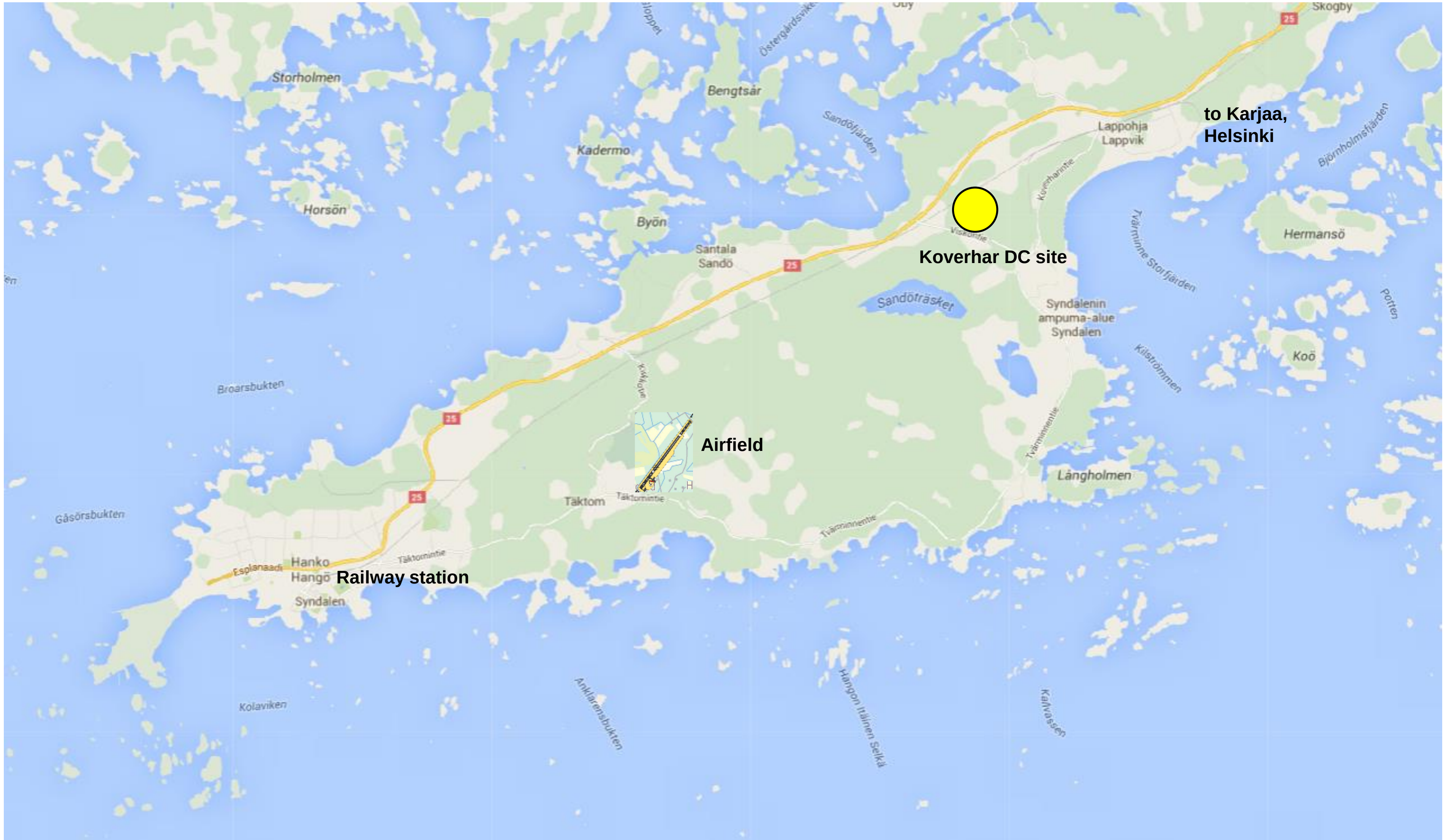


Distances from DC site:

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

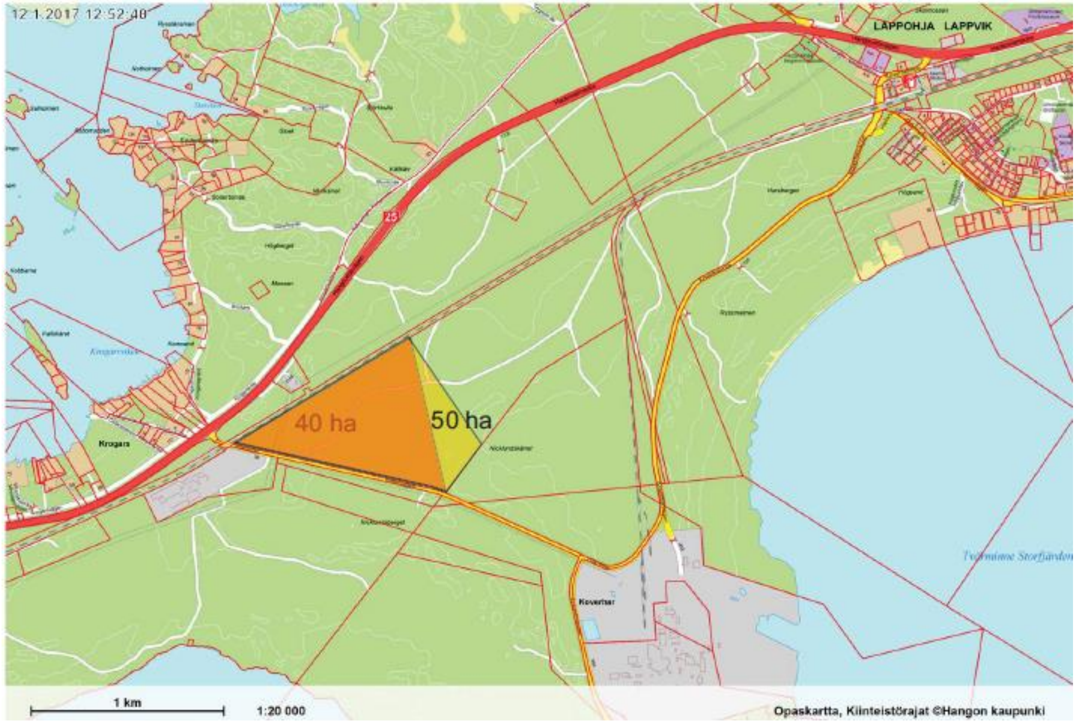
Port/Harbour
4- lane motorway
Main roads
Railroad
Intl. airport
Railway station
Hanko Koverhar Data Center site

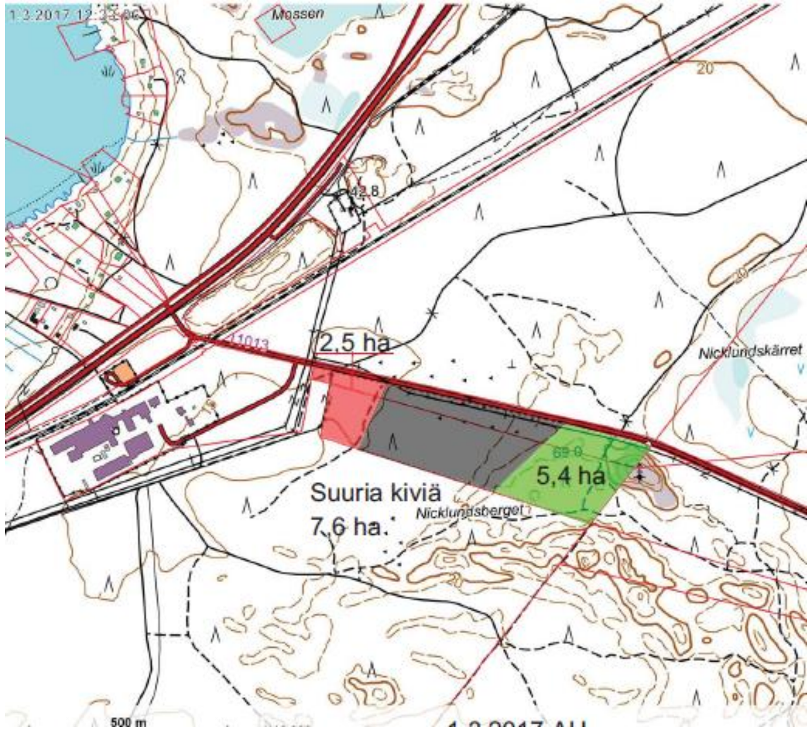
Hanko Koverhar DC site



Large area for Data Center use

- Almost flat landscape
- Zoned for industrial use like data centers
- Easy to build
- Feeding substation right next to the site
- Possible to enlarge data center area up to 100 ha if necessary





Sustainable and Green solar energy to DC use from nearby.

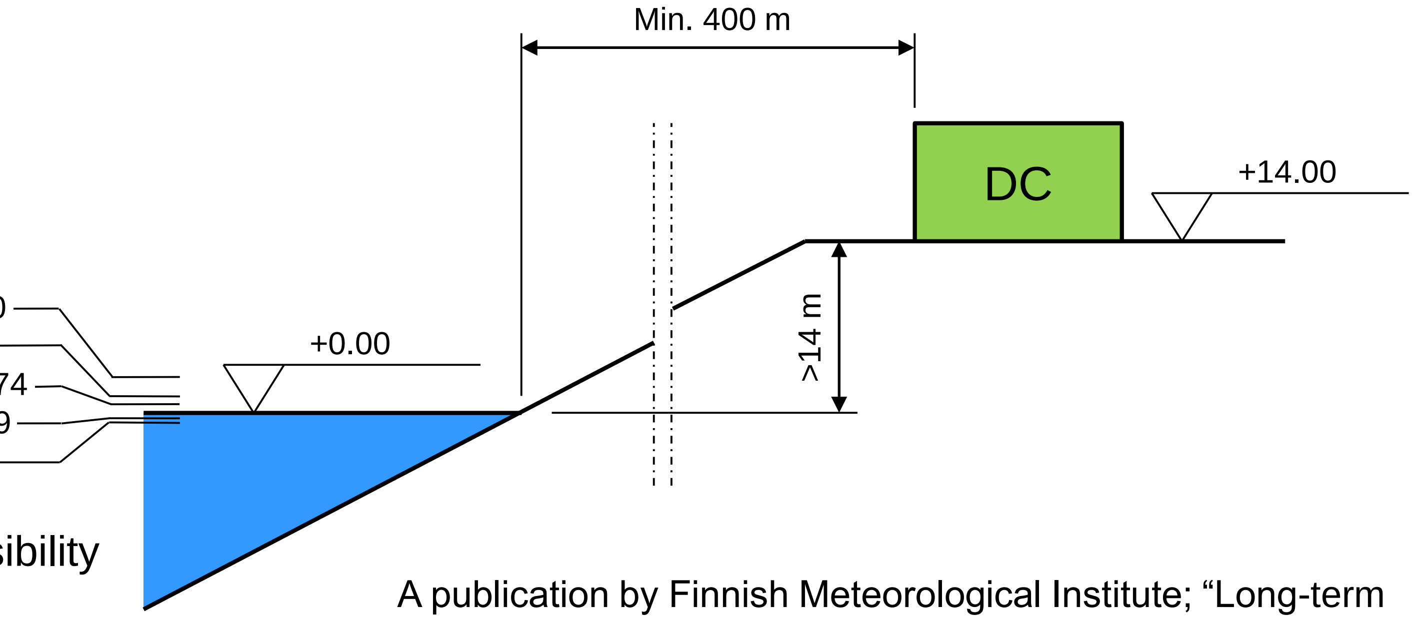
Coloured area next to the data center site is reserved for planned future solar power use.

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

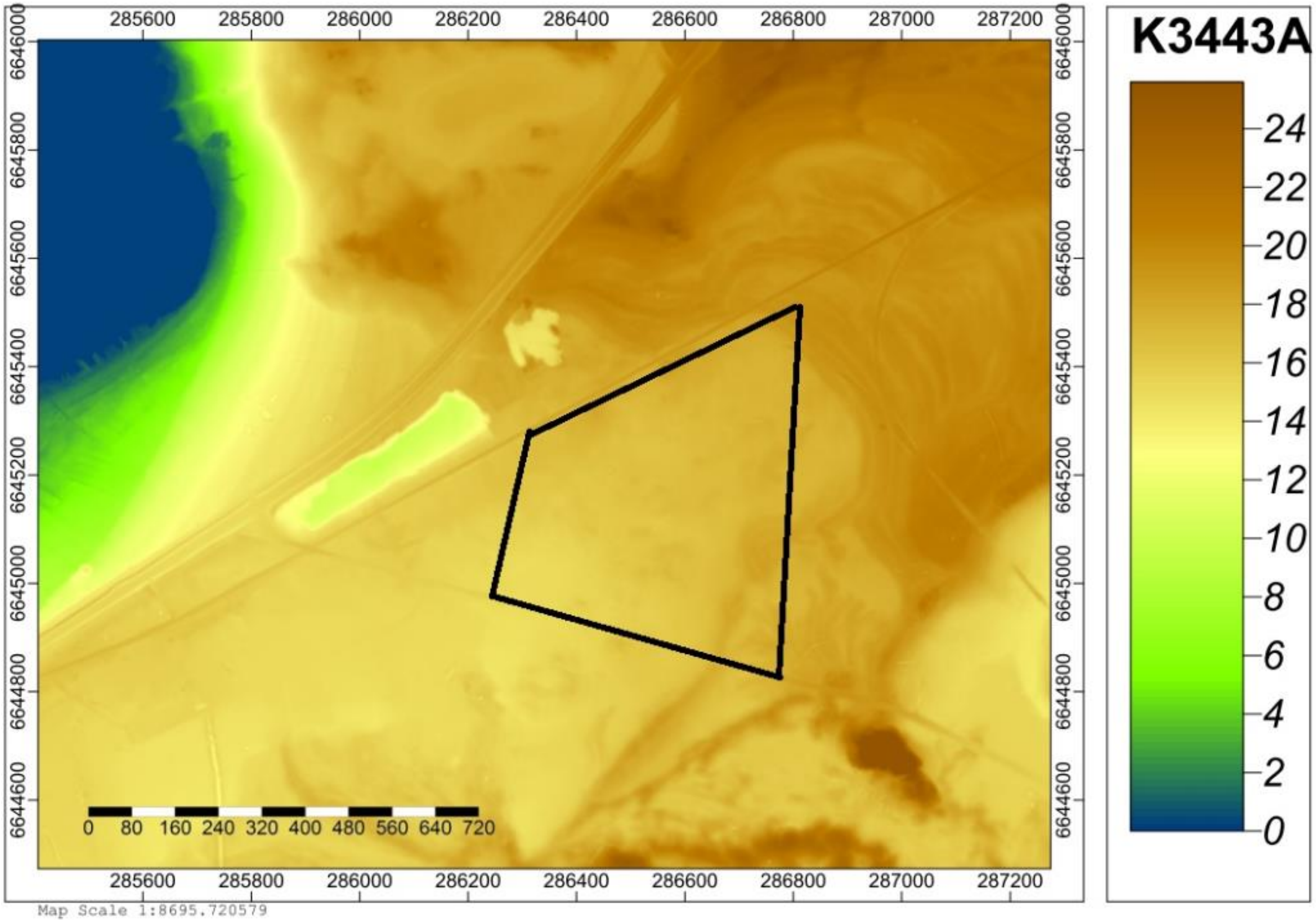


A publication by Finnish Meteorological Institute; “Long-term flooding risks and recommendations for minimum building elevations on the Finnish coast”, June 2014

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

Utility connections available at the Data Center site

Potable water and sewage water connections are close to data center area.

Potable water and sewer connections

POWER SUPPLY

National power grid connection (110 and 400 kV)

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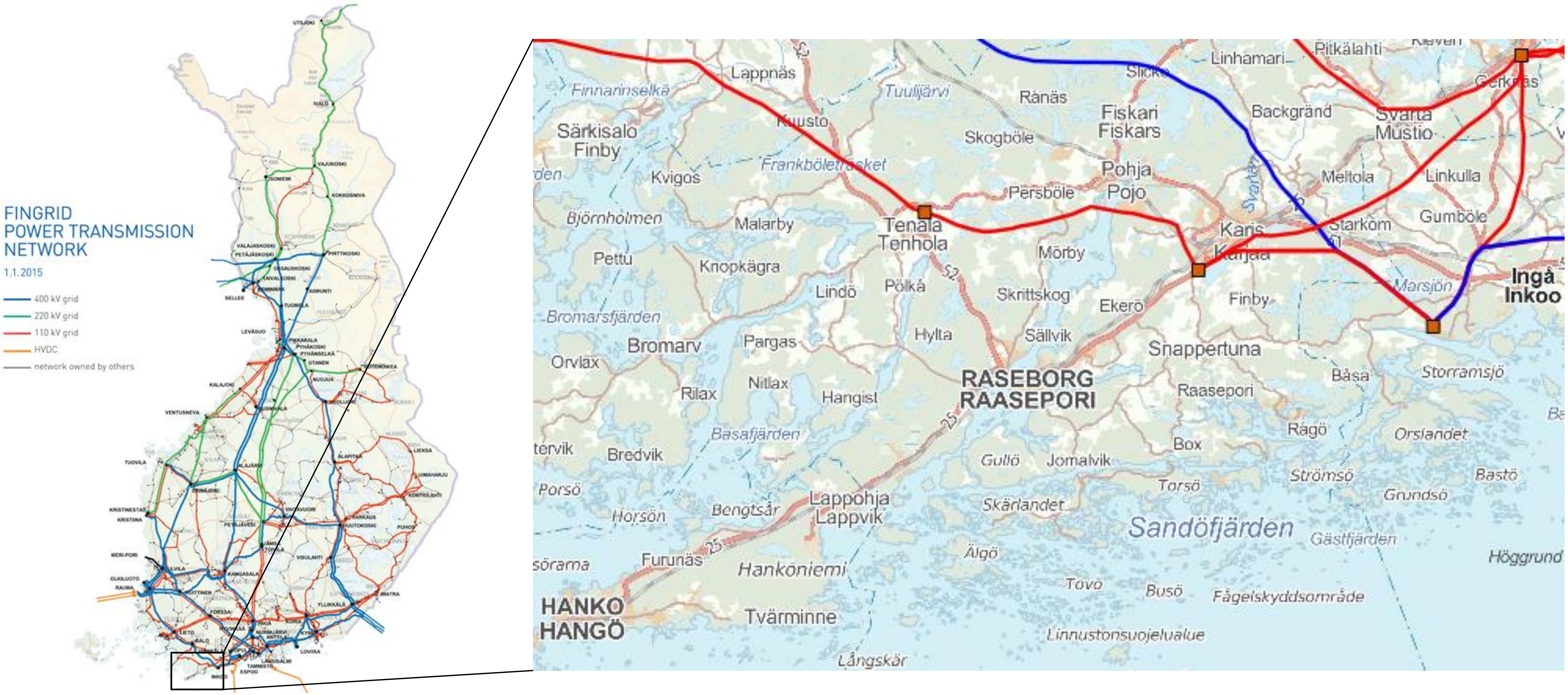
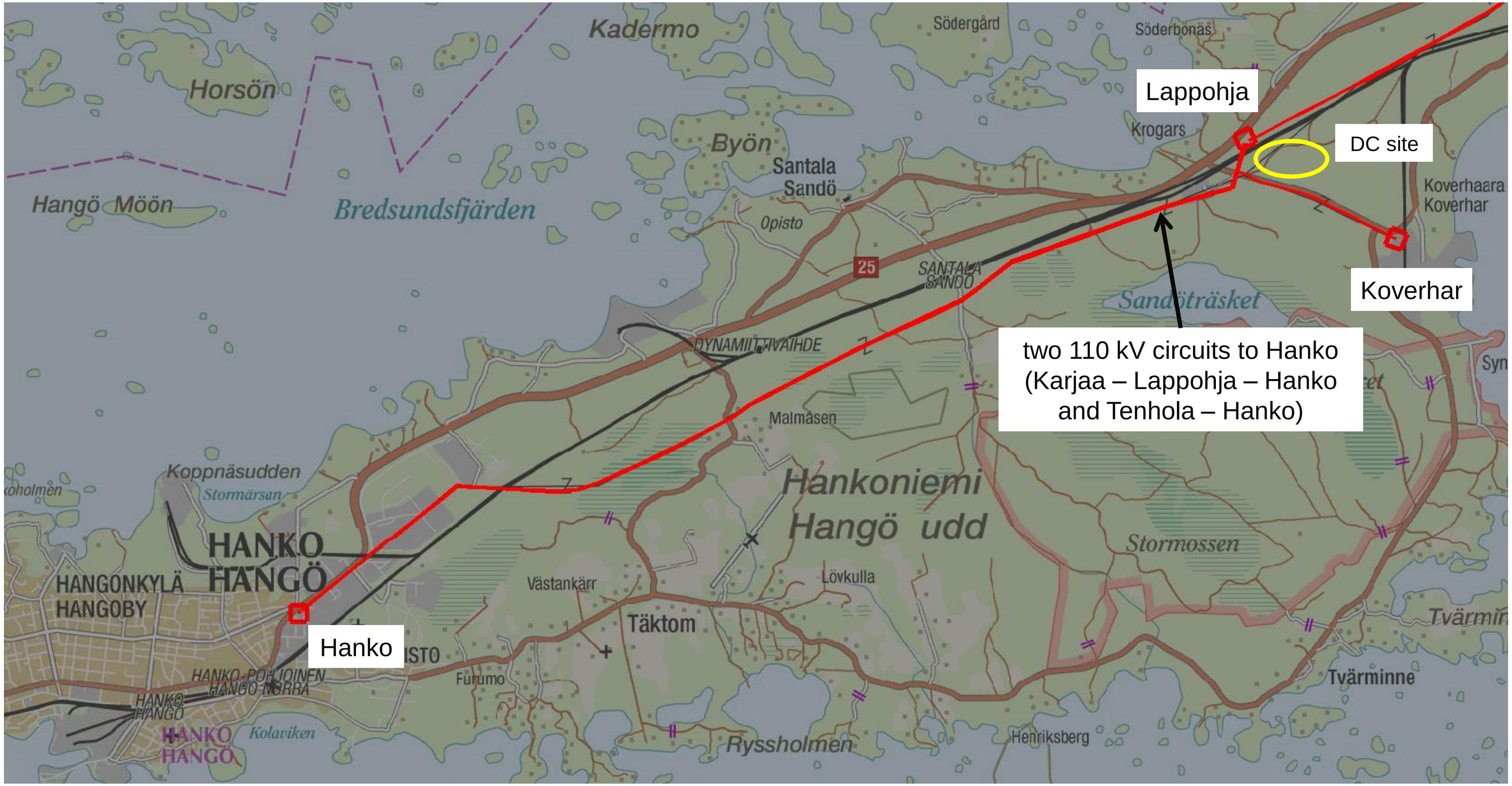


Source Fingrid

110 kV regional network in Hanko - Raasepori area (ongoing upgrade in yellow colour)

Hanko electrical grid



Power ramp up to Hanko Data Center site; phase 1

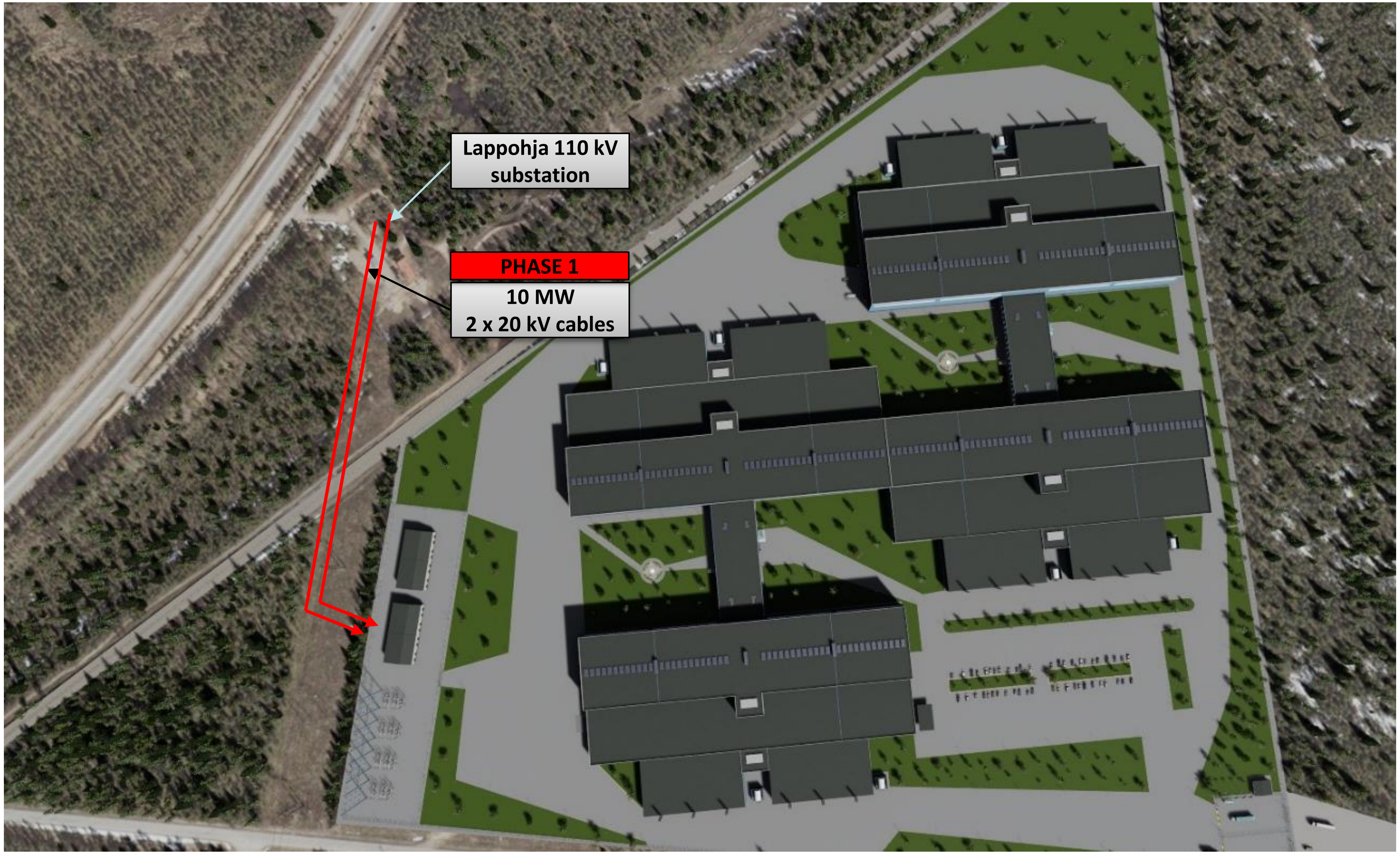
Phase 1   10 MW

Required investment

- 10 MW double supply 20 kV cables
- 20 kV switchgear on site

Time needed 6 months

Cost estimation 0,5 M€



Power ramp up to Hanko Data Center site; phase 2

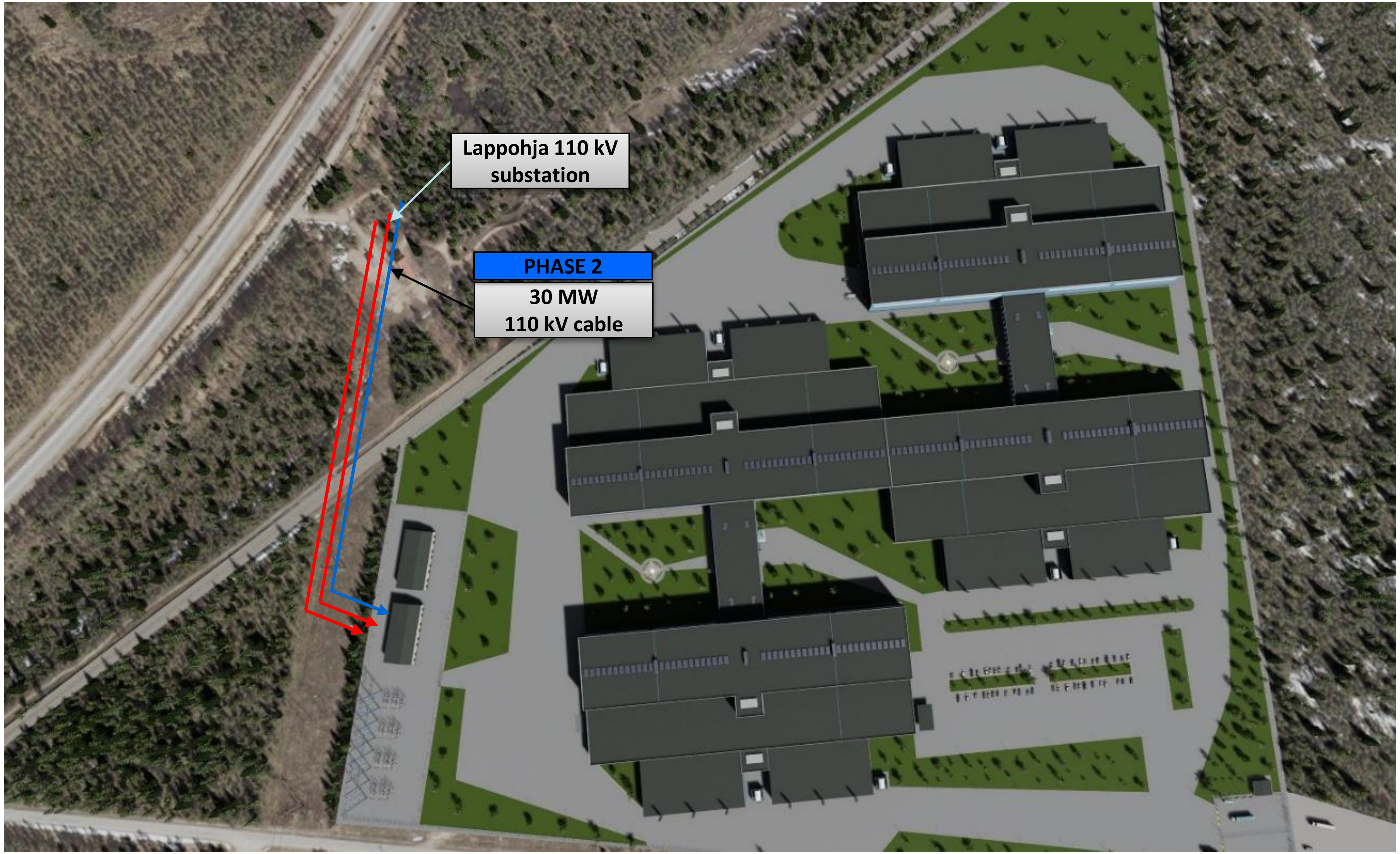
Phase 2 30 MW

Required investment

- 110 kV cable
- 110 kV switchgear on site
- 20 kV extension
- 110/20 kV transformer
- 20 kV cables are redundant feed

Time needed 18 -24 months

Cost estimation 1,5 M€



Power ramp up to Hanko Data Center site; phase 3

Phase 3 100 - 200 MW,

Required investment

- New 110 kV cable
- 110 kV switchgear extension on site
- 20 kV extension
- 110/20 kV transformer

Time needed 36 - 60 months

Cost estimation 2,2 M€

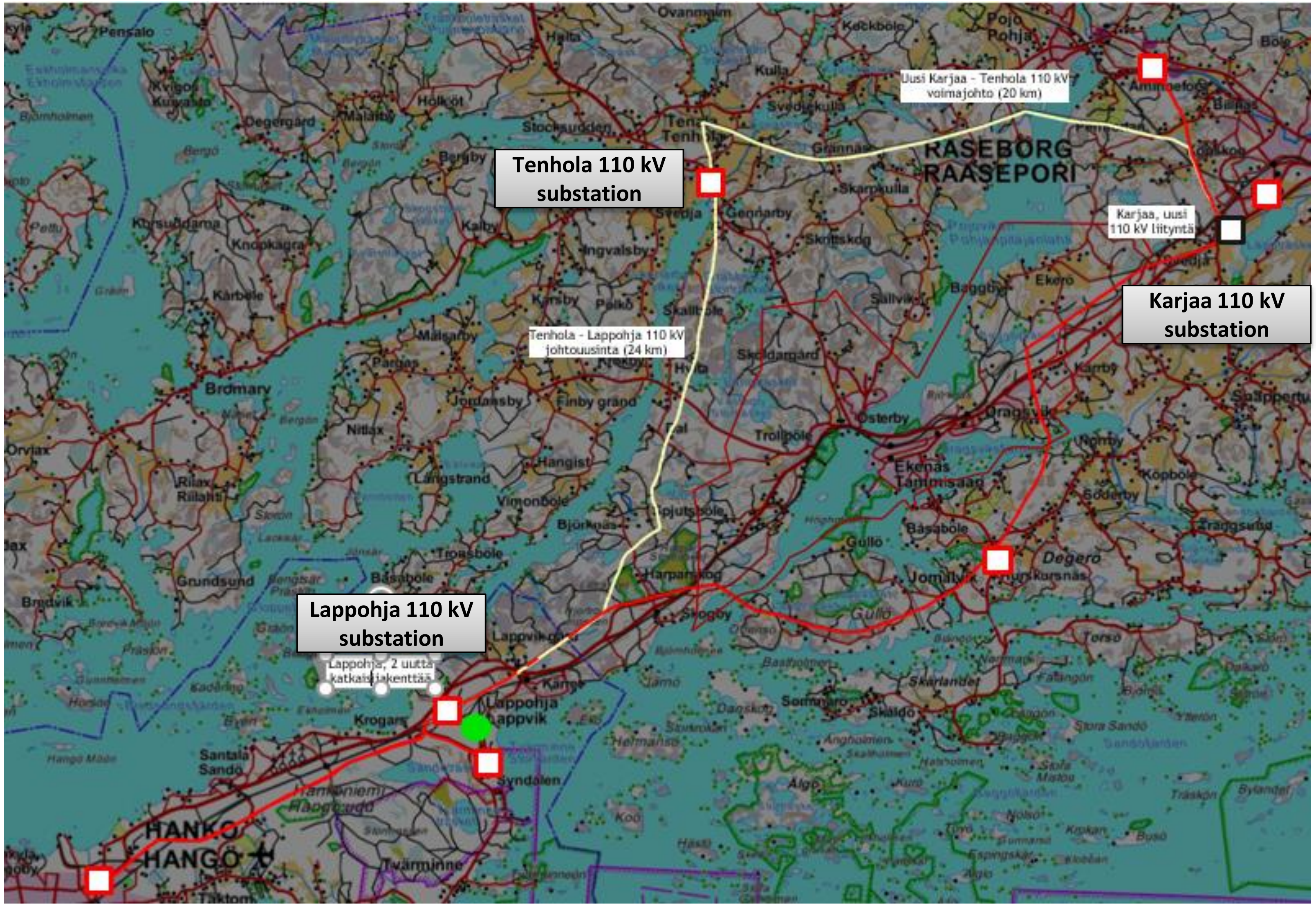
Power ramp up to Hanko Data Center site; phase 3 Local 110 kV network upgrades

Phase 3 100 - 200 MW,

Required investment to the local 110 kV network

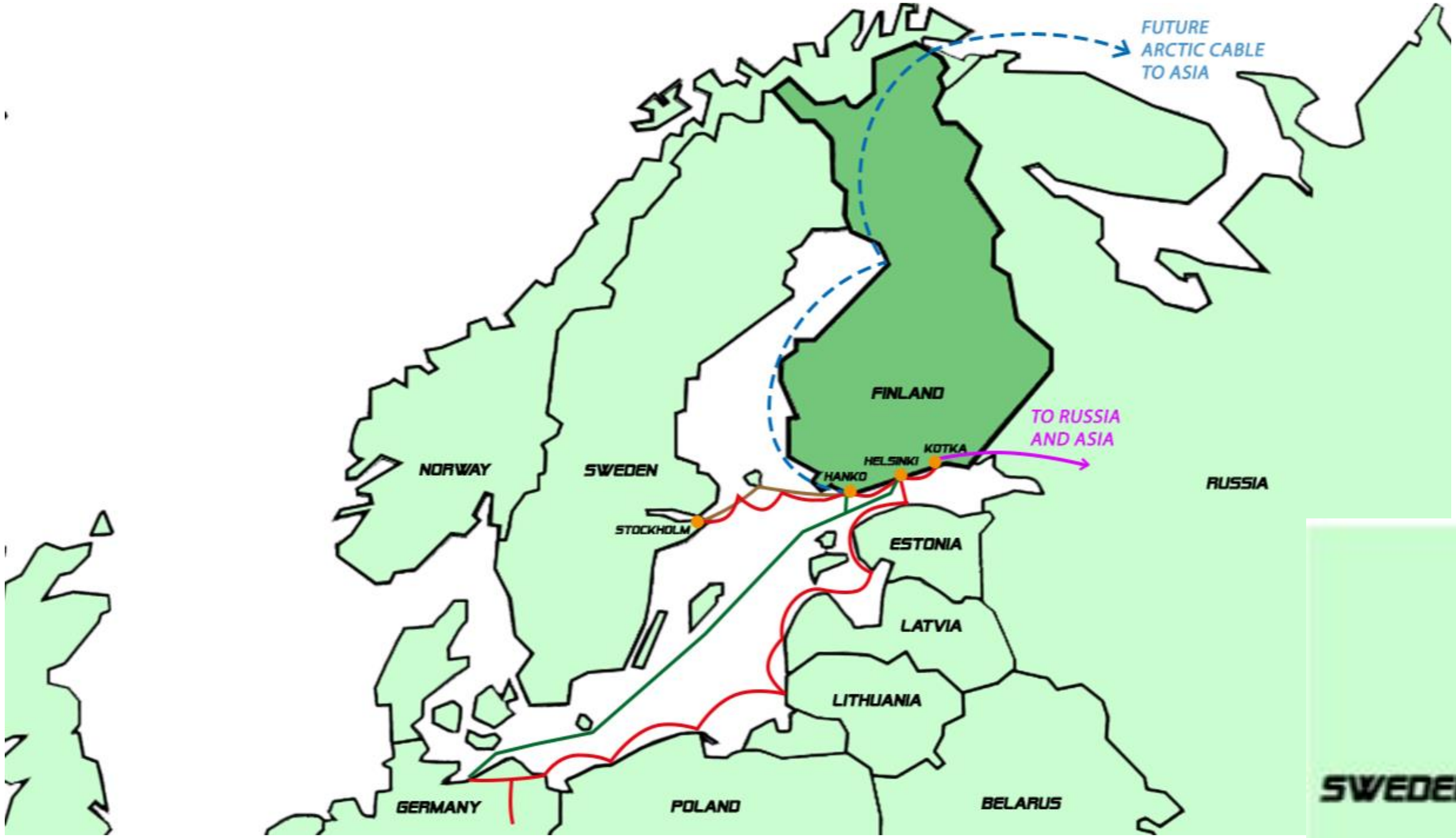
- Karjaa new 110 kV connection
- New 110 kV line Karjaa - Tenhola
- Upgrade 110 kV line Tenhola – Lappohja
- Lappohja 110 kV substation extension

Time needed 36 - 60 months

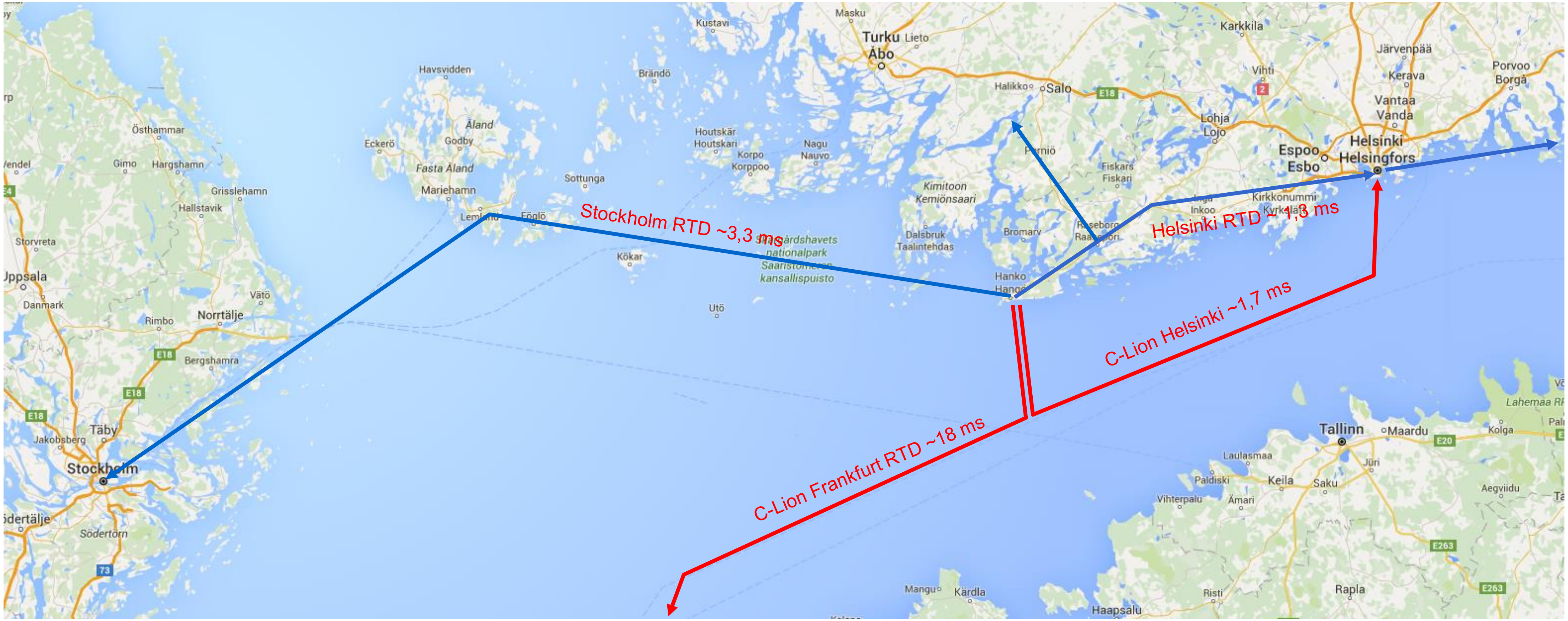


CONNECTIVITY

Hanko Data Center global connectivity



Hanko Data Center global connectivity



Hanko Data Center local connectivity

Example of Round Trip Delay

CTS ENGTEC

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

* RTD calculated using Cinia SeaLion1 via Hanko branching

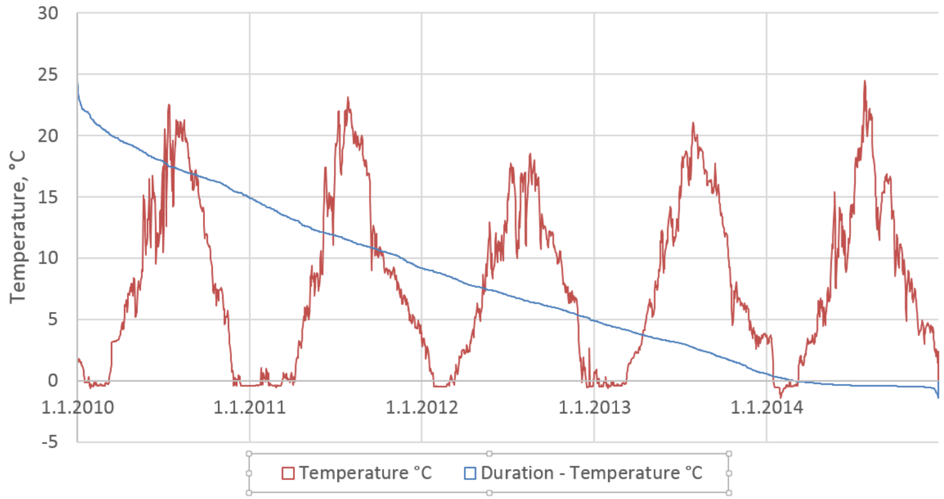
Source: Cinia Oy

COOLING AND
SECONDARY HEAT REUSE

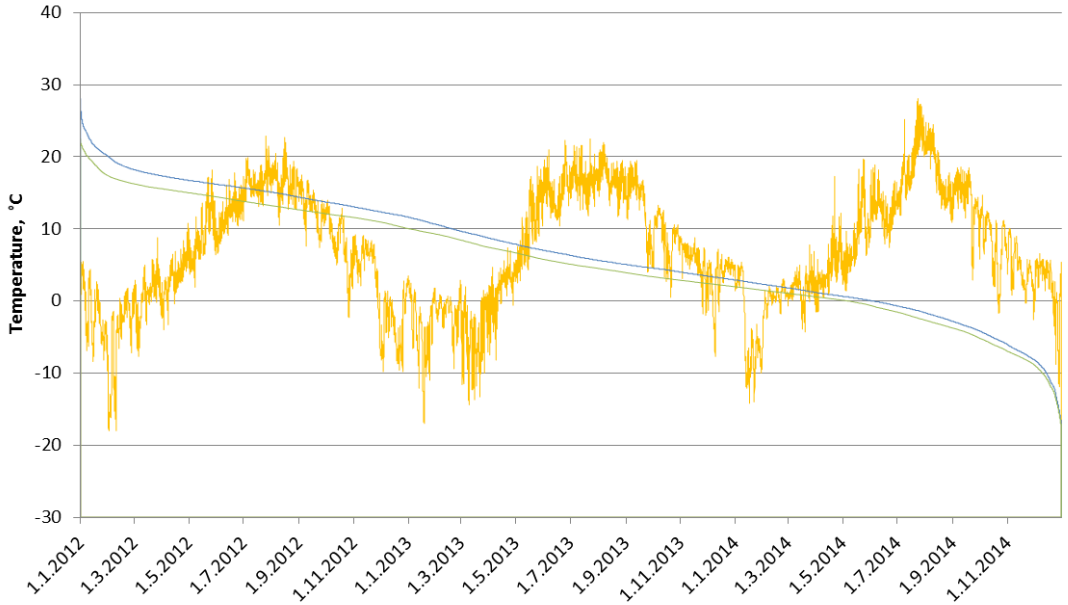
Conditions support effective cooling

- 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



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

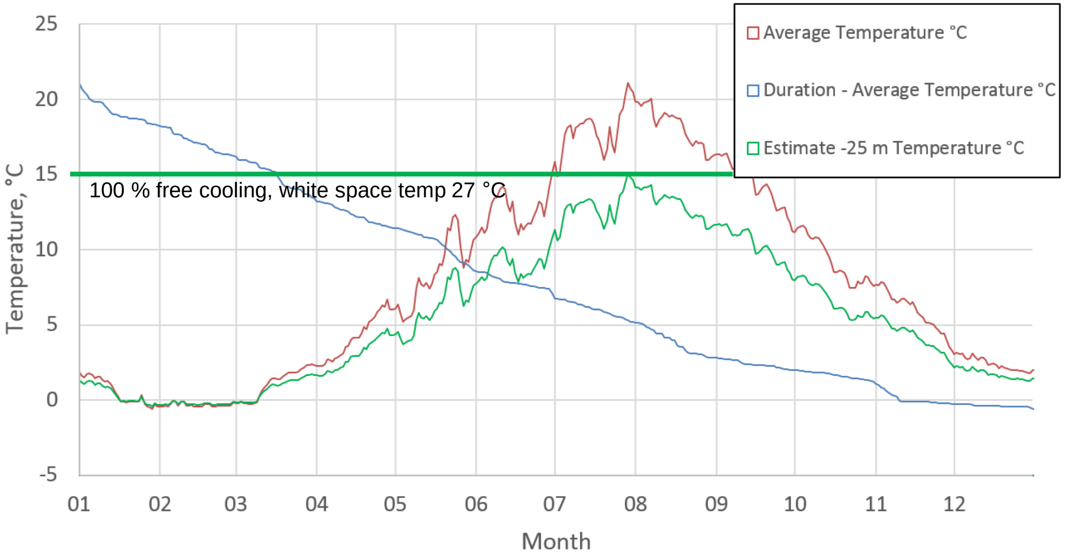


Environmental data source: © Finnish Meteorological Institute

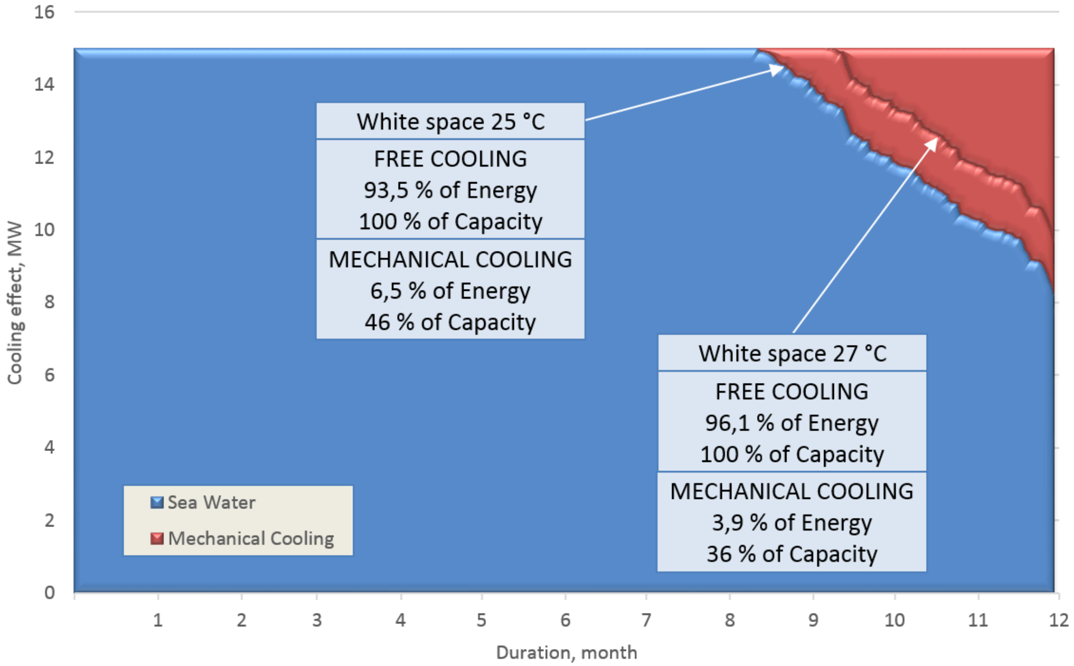
Cooling by Sea Water

- High free cooling share for white space temperature 21 ºC 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

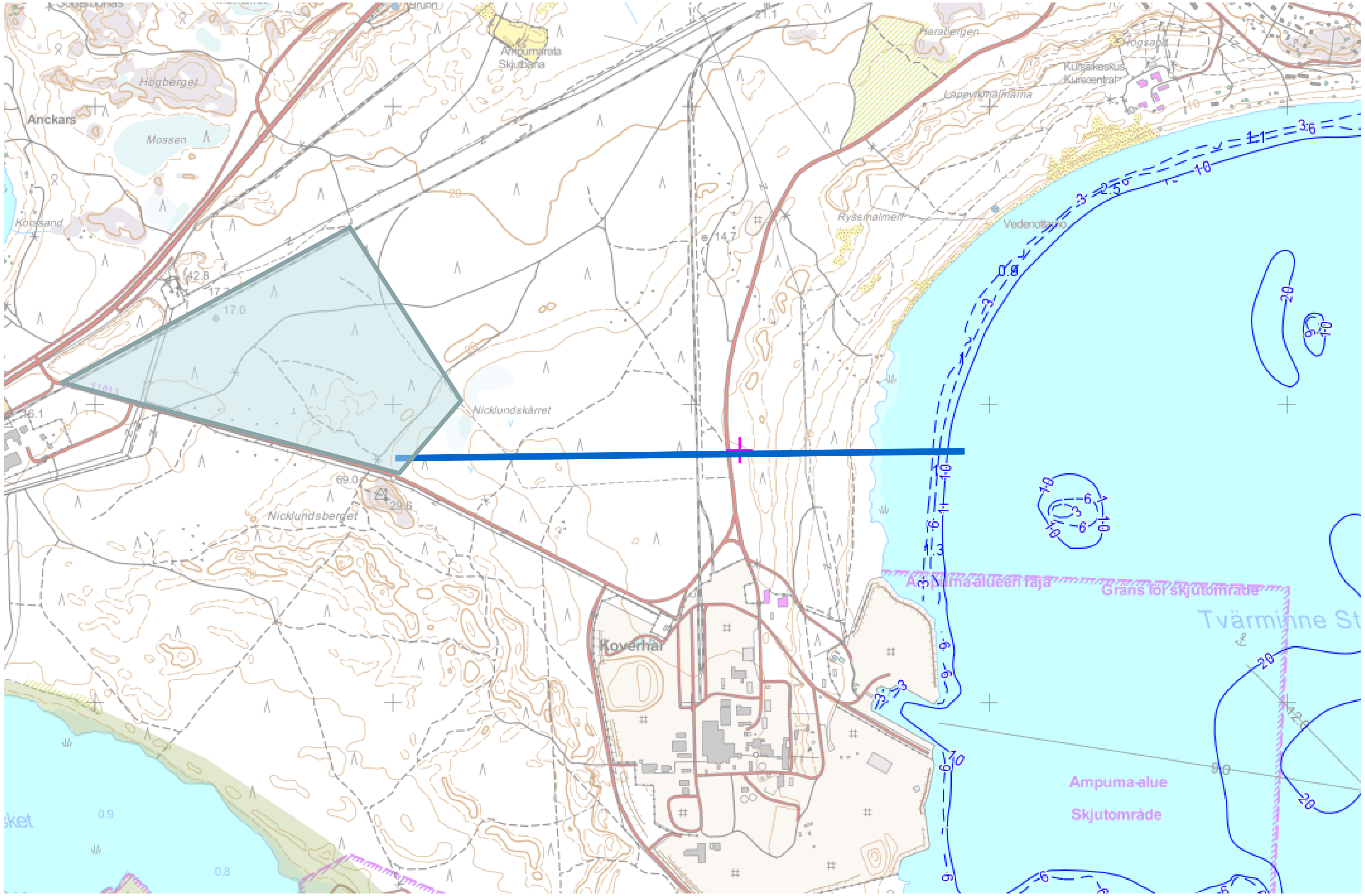


Cooling production by sea water and mechanical cooling
White space temperatures 27 and 25 °C,
Data: Average surface temp. from available data, 2010-2014



Target white space temp	**27 ºC**	**25 ºC**	**21 ºC**
Primary water circ temp.	**17 ºC**	**15 ºC**	**11 ºC**
Free cooling, energy	**96%**	**93%**	**86%**
Mech. cooling capacity	**36%**	**46%**	**66%**

100% free cooling possibility with sea water cooling

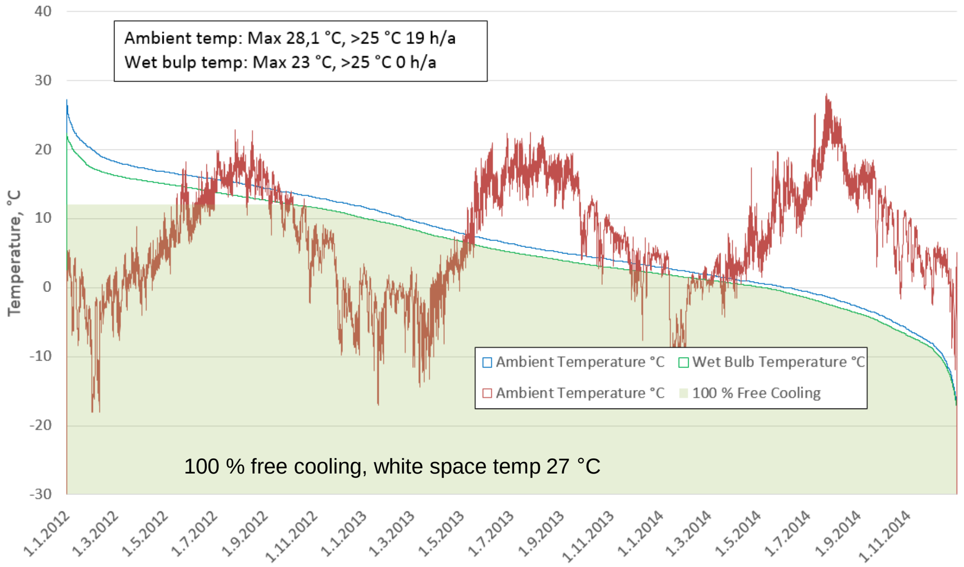


The depth chart of the nearby sea looks promising for achieving 100% free cooling by using cold sea water for data center cooling.

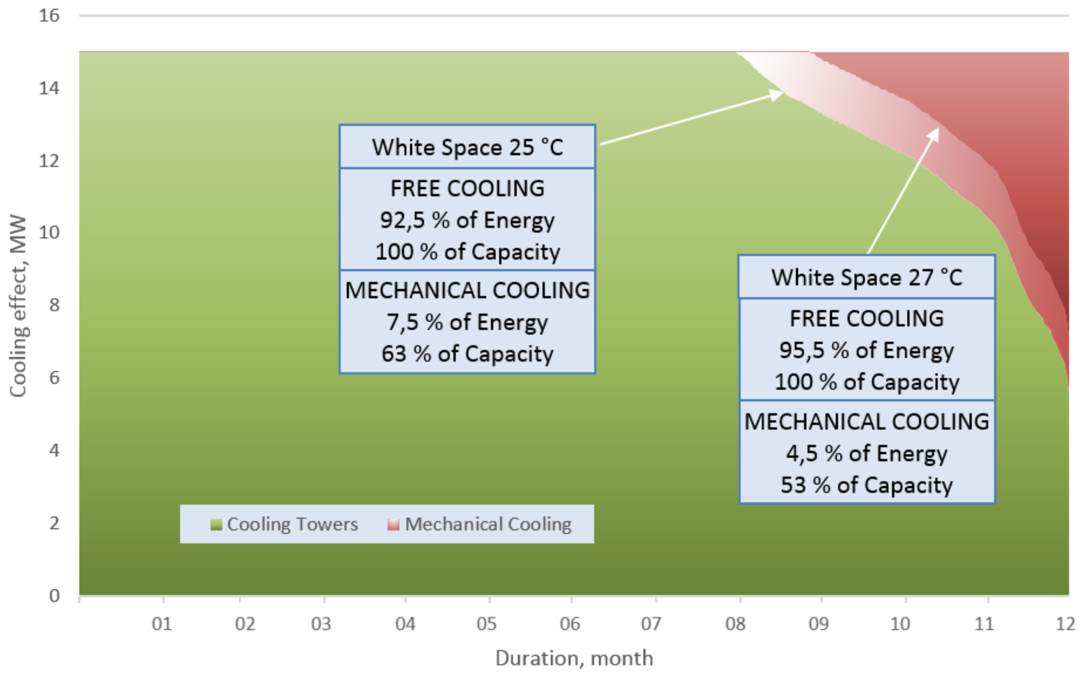
Cooling Towers and Mechanical Cooling

- Wet bulb temperature favours 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 temperatures 27 and 25 °C Temp Data 2014

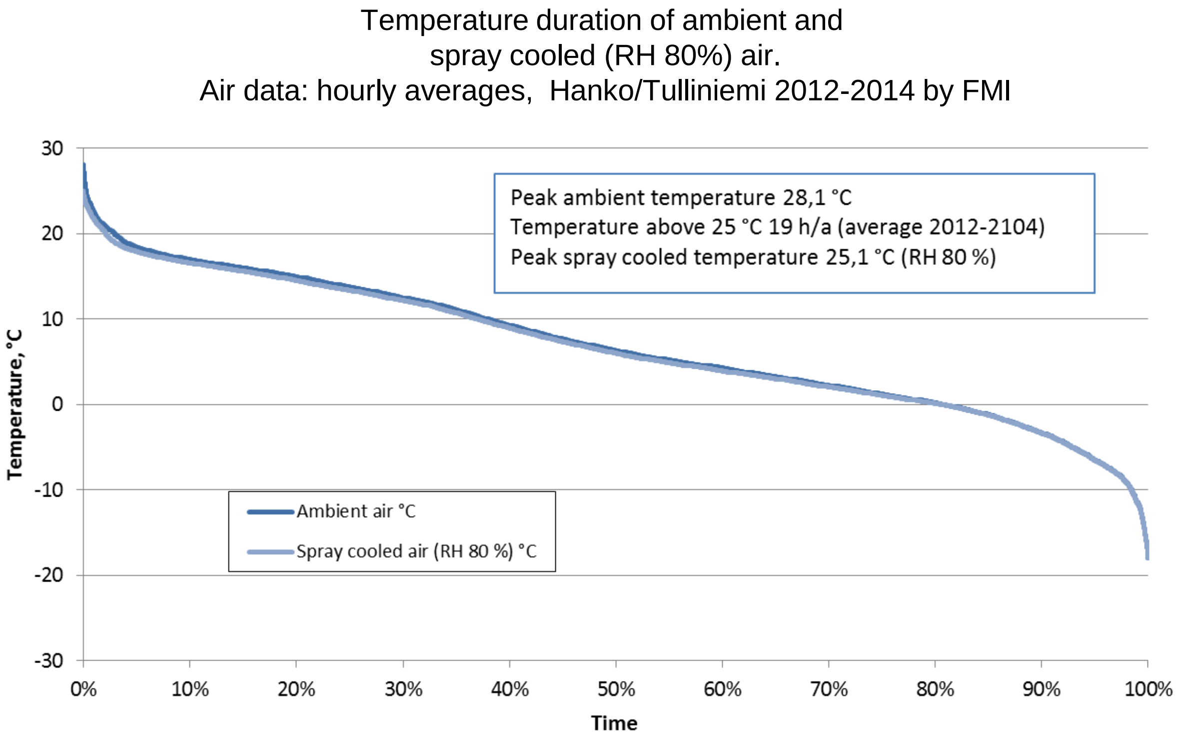


Target white space temp	27 ºC	25 ºC	21 ºC
Primary water circ temp.	17 ºC	15 ºC	11 ºC
Free cooling, energy	96%	93%	85%
Mech. cooling capacity	53%	63%	83%

Ambient air data source © Finnish Meteorological Institute

Direct Air Cooling

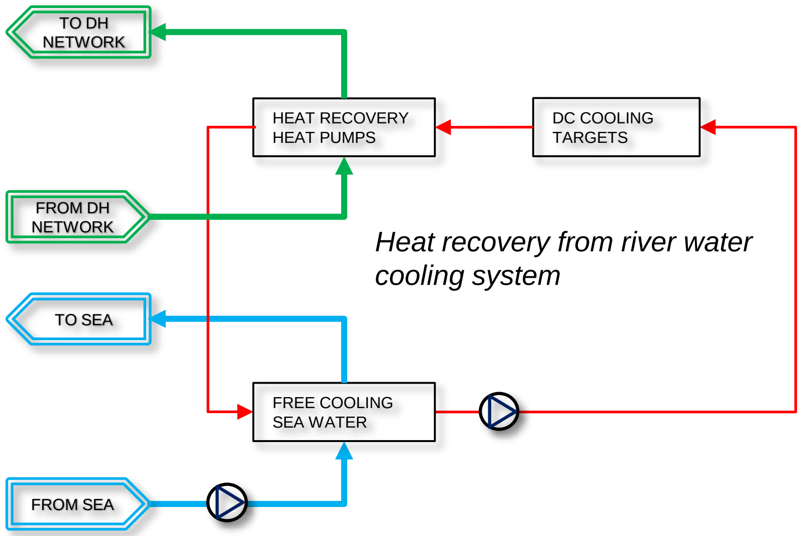
- Ambient conditions suitable for free cooling
- Maximum ambient air temperature 28,1 °C
- Ambient temperature >25 °C <19 h/a (average 2012 - 2014)
  - Longest continuous period 13 h, average peak duration 5,2 h
- With adiabatic cooling (RH 80 %) max temp 25,1 °C



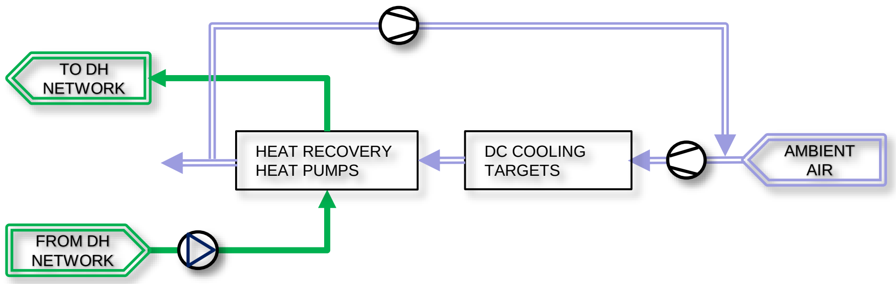
Mechanical Cooling

- 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

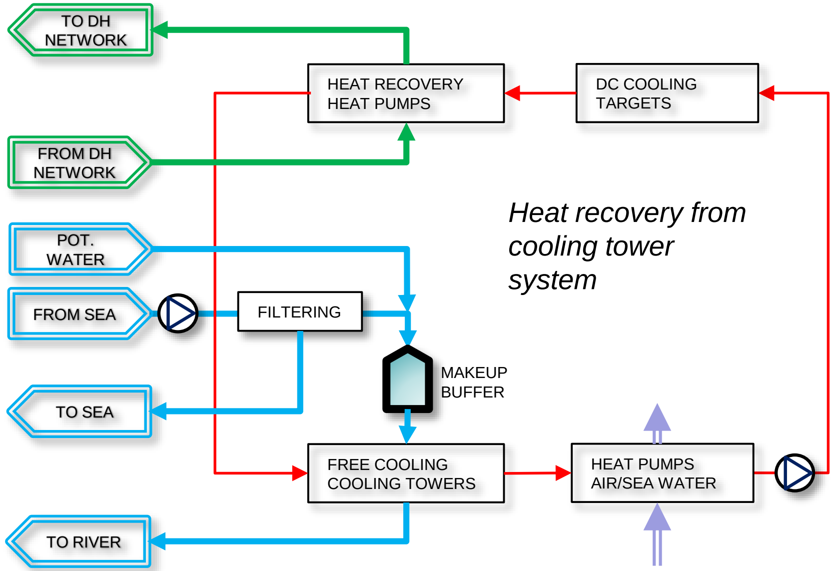
Examples of Secondary Heat Re-use Arrangements



Heat recovery from river water cooling system



Heat recovery from adiabatic cooling system



Heat recovery from cooling tower system

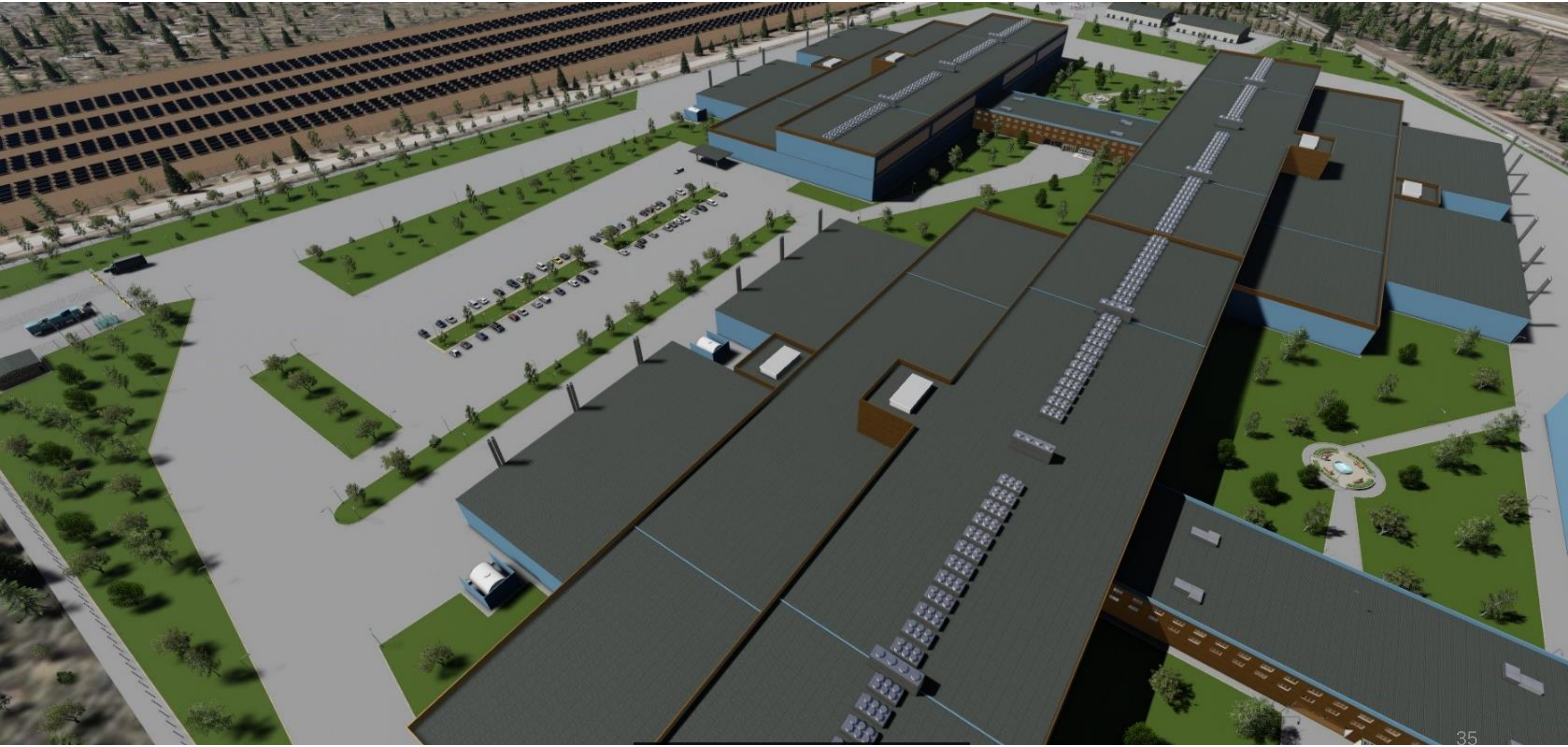
SITE UTILIZATION

Air cooling utilization example

Air cooling utilization example

Air cooling utilization example

Air cooling utilization example



Water cooling utilization example

Water cooling utilization example

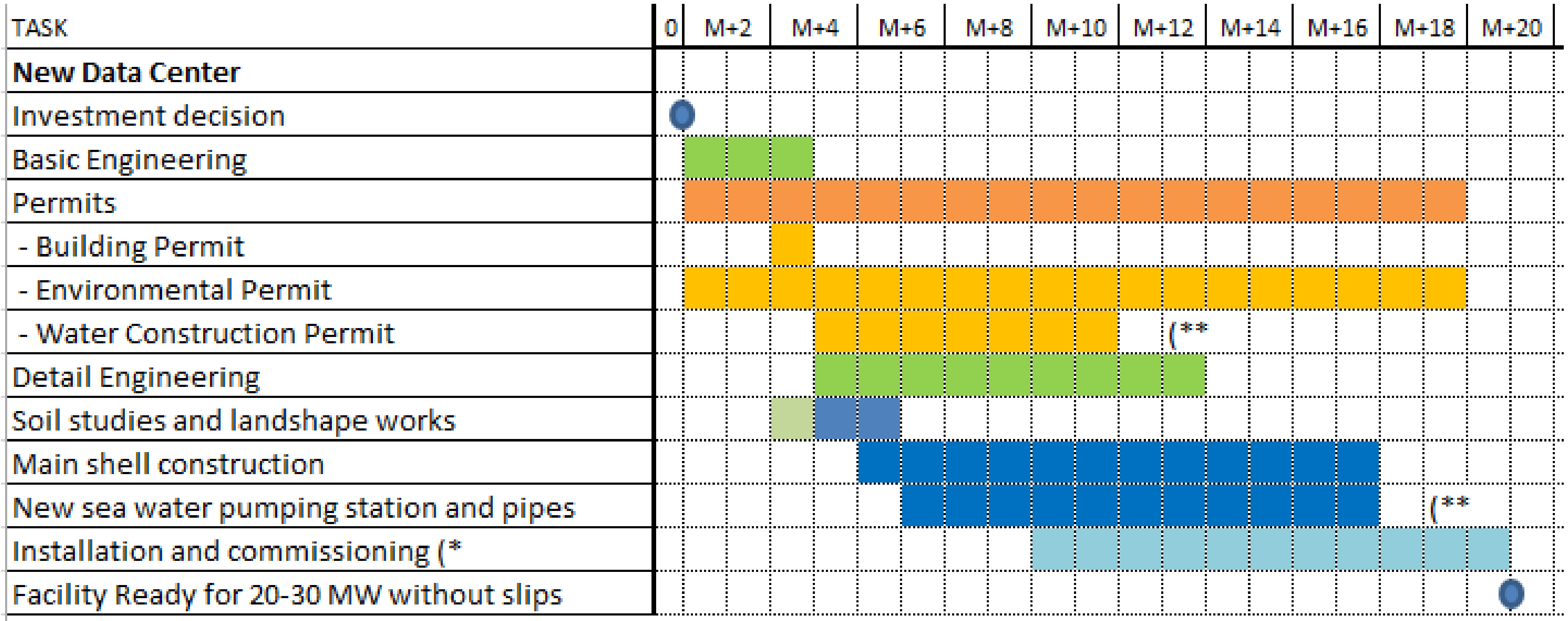
Water cooling utilization example

Water cooling utilization 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