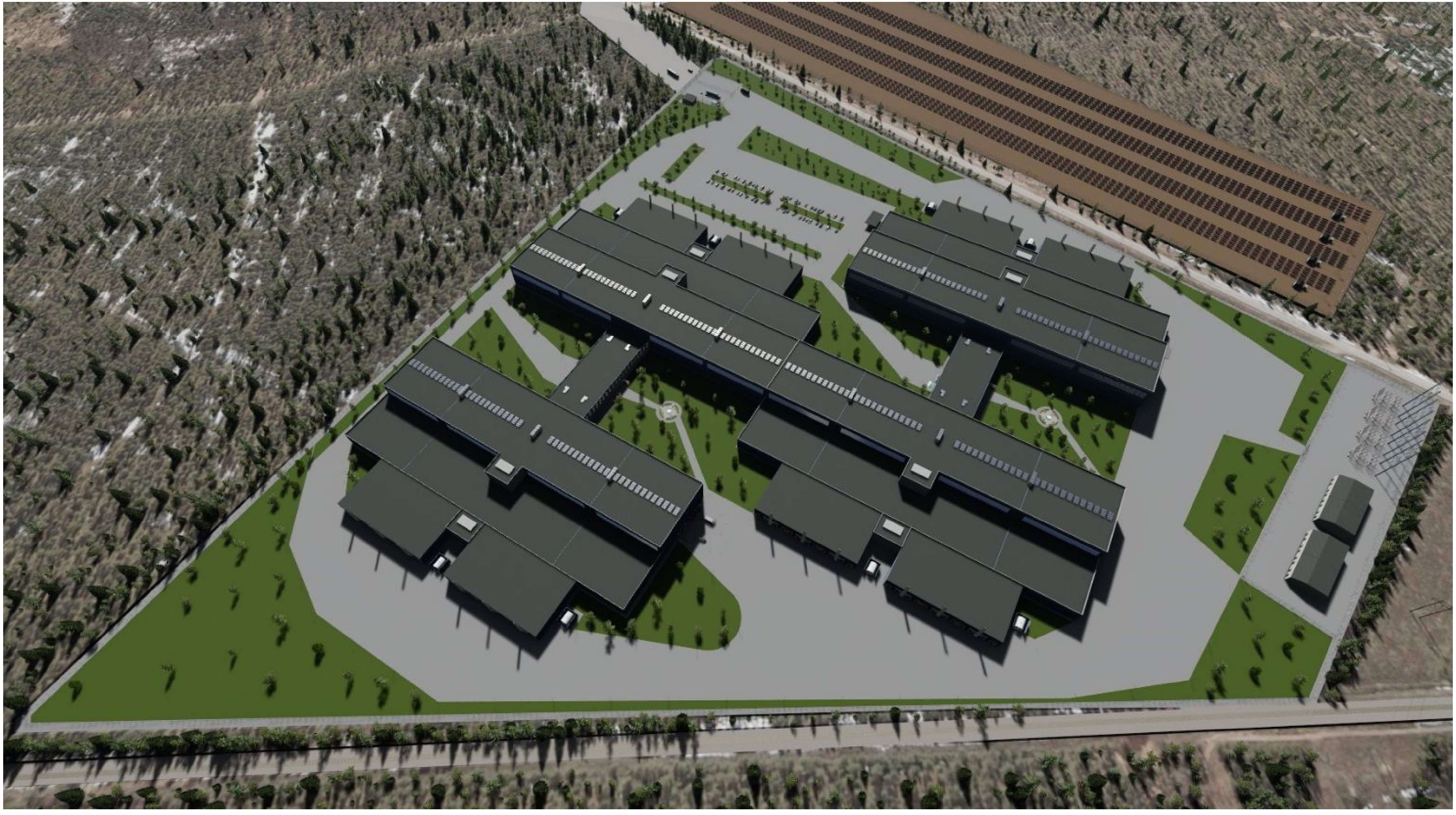
Hanko Koverhar Megasize Data Center Site

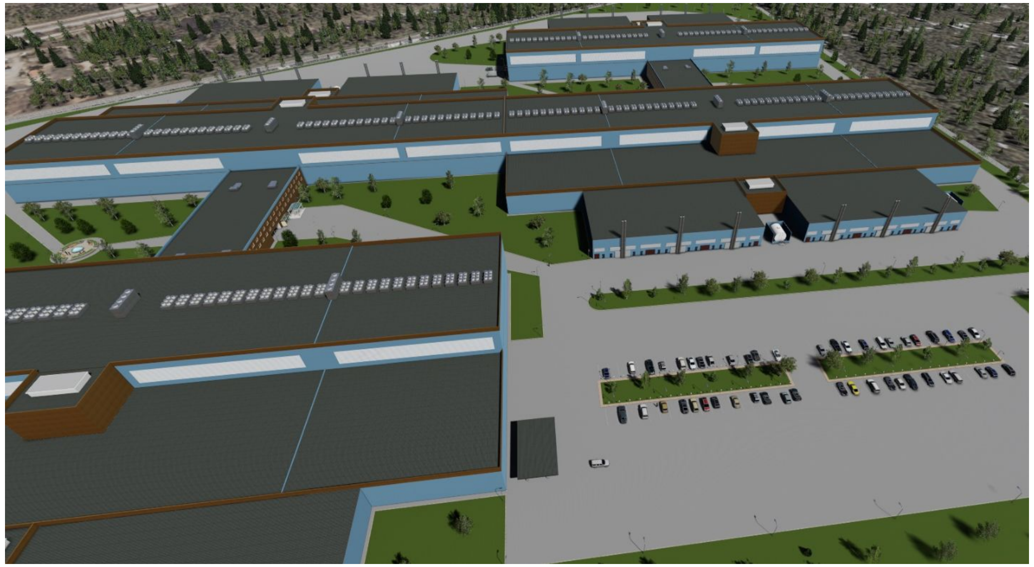


WHY INVEST YOUR DATA CENTER IN FINLAND?

Finland offers major benefits for Data Center investors and operators

Reliable and green energy

Build your next DC in Finland



Cost efficient to invest and operate

World class connectivity

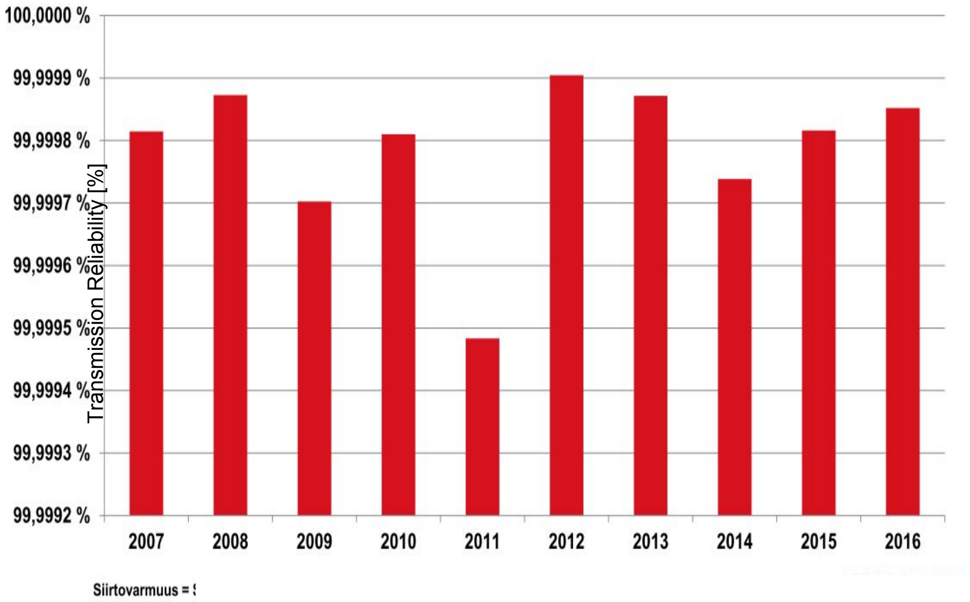
Safe society and cyber security

Reliable energy production and distribution

Finland has One of the Most Reliable Electric Grids in the World!

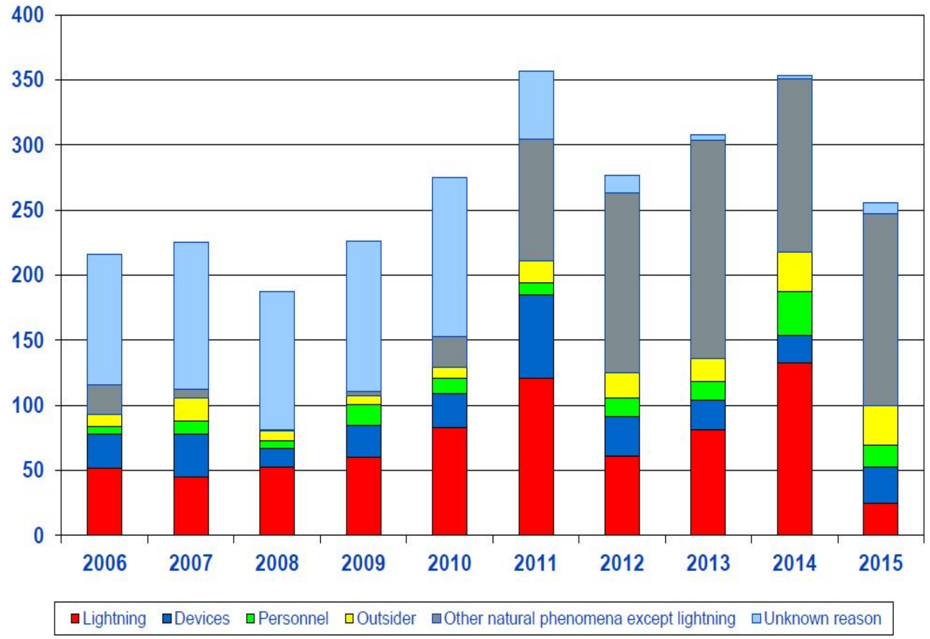
Transmission reliability: **99,99982%**
Average duration of forced interruptions: **2.1 min**

Fingrid Transmission Reliability History



Transmission reliability [%] = Energy supplied / (Energy not supplied + Energy supplied)

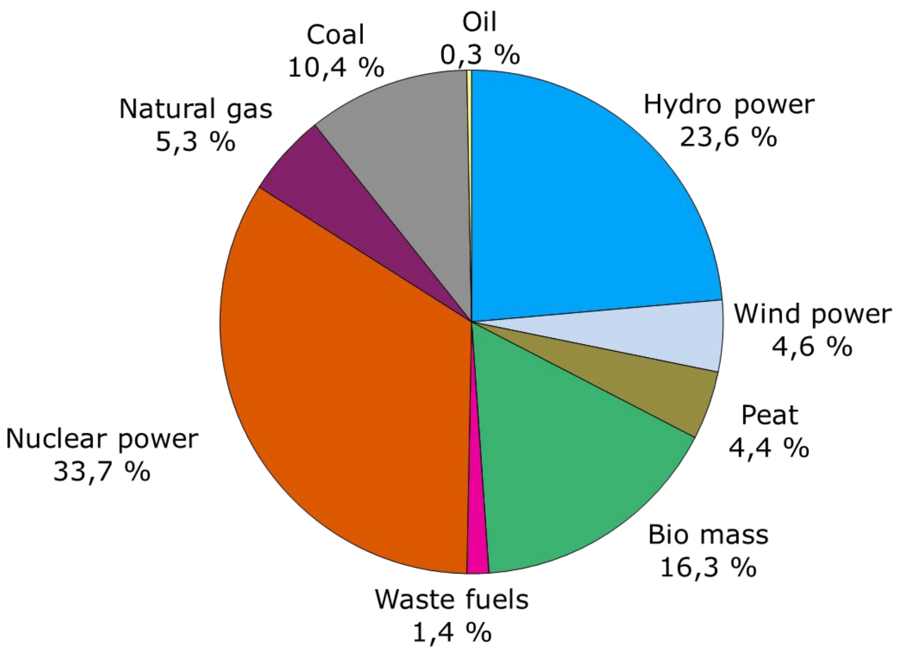
Number and Reasons of Disturbances



Source: Fingrid, 2016

Renewable electricity production

Electricity Production by Energy Sources 2016 (66,1 TWh)



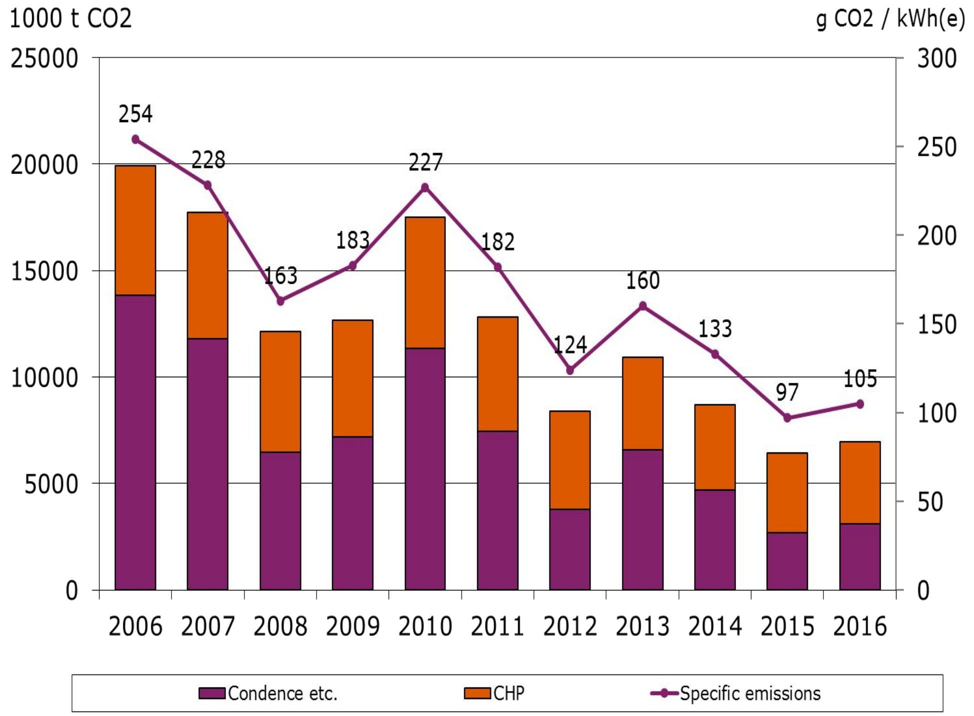
Renewable 45 %

(Year 2015: 45 %)

Carbon dioxide free 78 %

(Year 2015: 79 %)

CO_2-emissions of Power Production



CO_2-emissions are reduced to 1/3 from 2006 to 2016

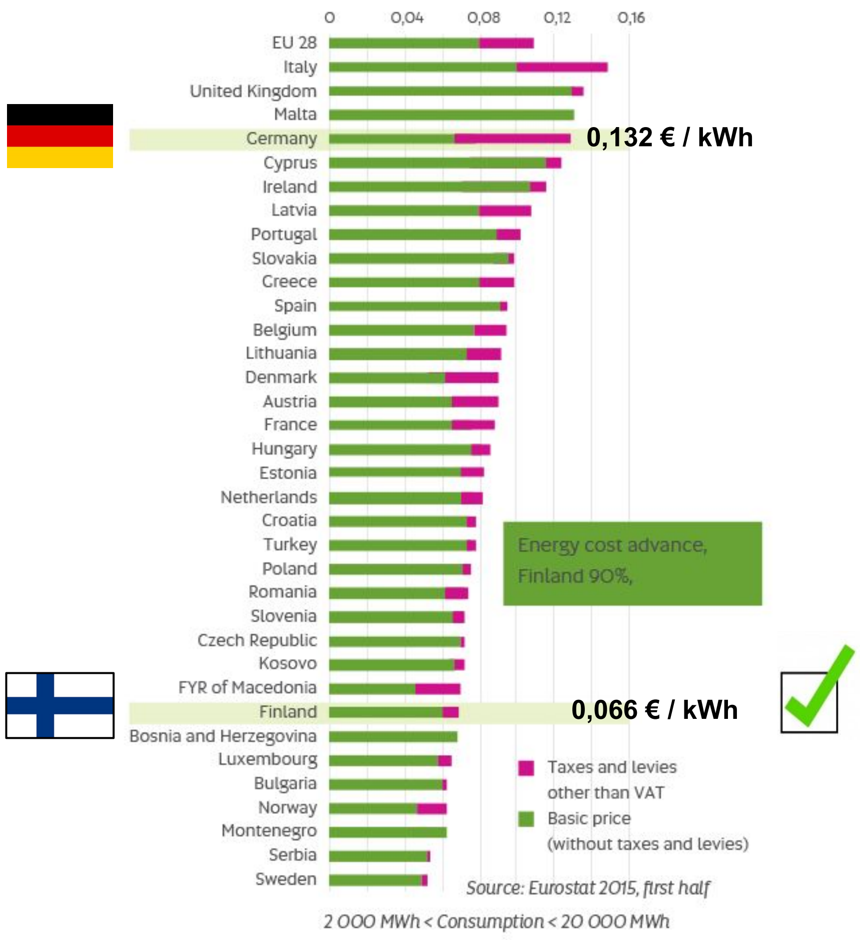
Source: Energiateollisuus (Energy Industry) 2017

Low energy price invites to Finland

Energy cost in Finland is about 50% LESS than in Germany?

ELECTRICITY PRICES FOR INDUSTRIAL CONSUMERS

Save up to 50 % on energy cost as compared to Central Europe



Breakdown of Energy Cost

Cost item	€ / MWh
– Nord Pool Spot (3.10.2016)	26,95
– National grid fee	7,40
– Local margin	1 – 3
– Electricity tax	7,16
– Total	**43 – 46 € / MWh**

- The Nord Pool is the common Nordic and Baltic wholesale market
- The price of electricity is determined hourly, based on the balance of demand and supply
- Price differences and electricity price level are expected to be very stable and low due to decentralized energy production in Finland. The power production capacity will increase significantly within the next 2-3 years when Olkiluoto 3 (a new 1600MW power plant) will start operations.

Source: Gartner September 2014

Potential improvements to TCO in Finland

CTS ENGTEC

Top education but competitive employment costs

- Finnish people enjoy top level education for it´s students. PISA (Programme for International Student Assessment) has qualified Finland many times as the best in the world regarding the level of education
- Althought top education, the employment costs for Finnish engineers are lower than in other European countries in average.

Free cooling saves energy and costs

- Cool climate and pure air including numerous clean lakes and rivers plus 1100 km coast line gives many cost effective locations for cooling Data Center servers.
- Due to cool climate the need to invest to mechanical cooling systems is lower and warm periods are short in Finland => lower TCO

Lower company tax structure

- Company taxation in Finland is 20 % which is much lower than average in OECD or EU countries.

Lower taxation for project key personnel

- It´s possible to get lower taxation for the project key management personnel for two years.

Unique possibility to sell Data Centers’ waste heat

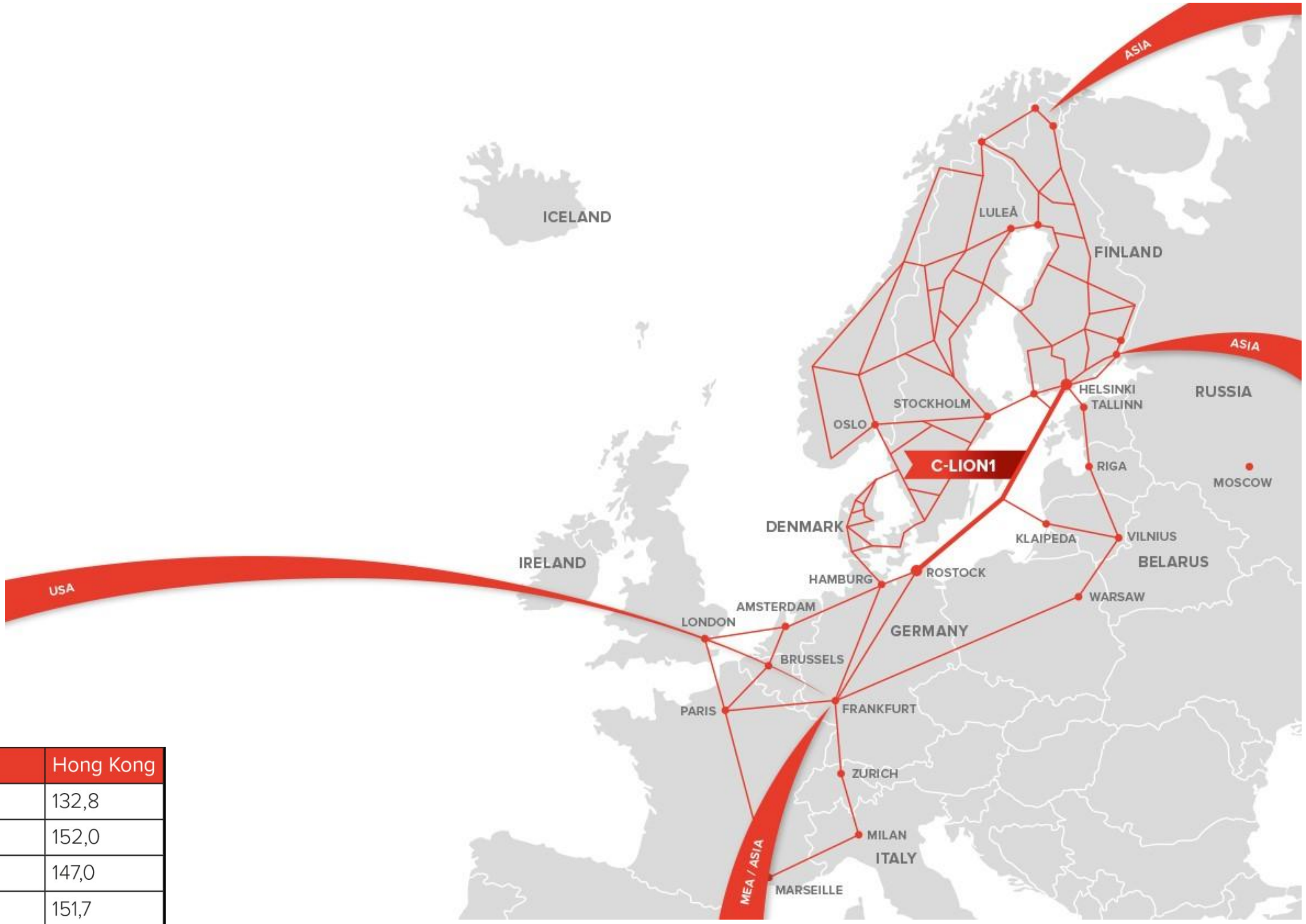
Waste Heat = Product for Sale

- Finland has a district heating system in almost every town. This creates an excellent possibility to re-use waste heat from Data Centers
- Yandex – Russian search engine, has built Data Center in Mäntsälä, Southern Finland. Yandex sells its waste heat to local utility Nivos. Nivos primes waste heat with help of heat pumps suitable for the district heating network for Mäntsälä’s consumers.
- This is an excellent showcase of the ”win win” trade for the waste heat use.
- In addition, with the use of DCs waste heat as an energy source, Nivos can lower their carbon footprint significantly.

Nivos could reduce their CO_2-emissions by 40% by re-using waste heat from Yandex Data Center.

Finland is a gateway between East and West

- State of the art domestic fiber network is well connected to global networks
- Hub of global data flows linking Europe, Russia and Asia
- C-Lion1, The new high capacity, super fast submarine cable route from Finland to Central Europe, is now operational.
- C-Lion1 has a record breaking capacity of 18 Tbit/s per fiber pair, total capacity of 144 Tbit/s.
- Measured RTD between Helsinki-Frankfurt is 19,7 ms



City	Frankfurt	Hamburg	Amsterdam	London	Moscow	Tokyo	Hong Kong
Helsinki	19,7	14,2	19,0	23,9	11,7	130,8	132,8
Frankfurt		5,8	11,1	11,6	31,4	150,0	152,0
Hamburg			5,3	10,3	25,9	145,0	147,0
Amsterdam				5,2	30,7	149,7	151,7
London					35,7	154,7	156,7

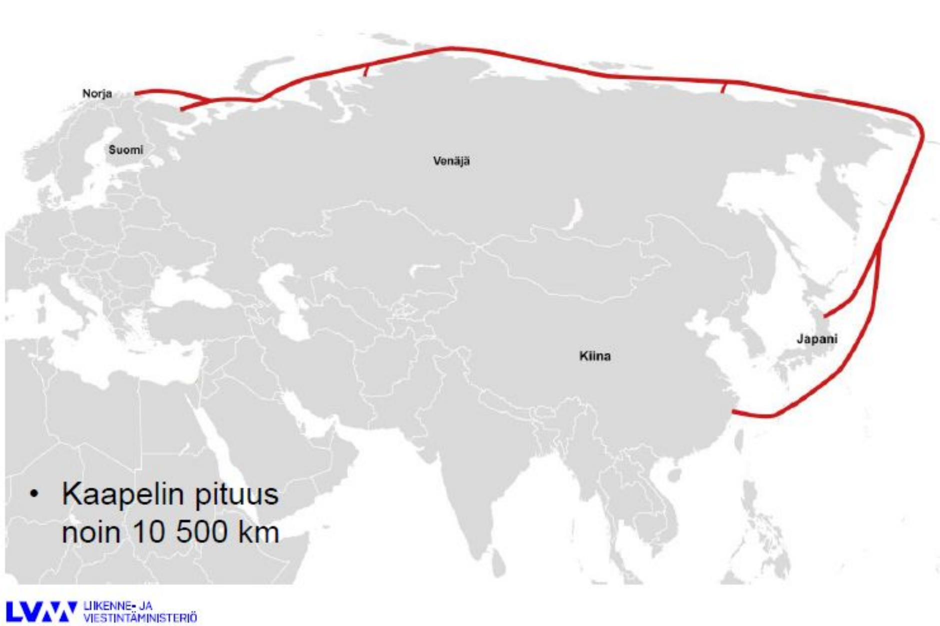
Source: Cinia Group Oy

Future connectivity plans

- The new submarine fiber optic routes from Europe to Asia (ARCTIC CONNECT and ARCTIC FIBRE) will lower latency between Europe and Asia about 90 -100ms compared to traditional route *(Atlantic-Mediterranean-Suez-Red Sea-Indian Ocean-South China Sea)*
- These projects are waiting for the implementation decision.

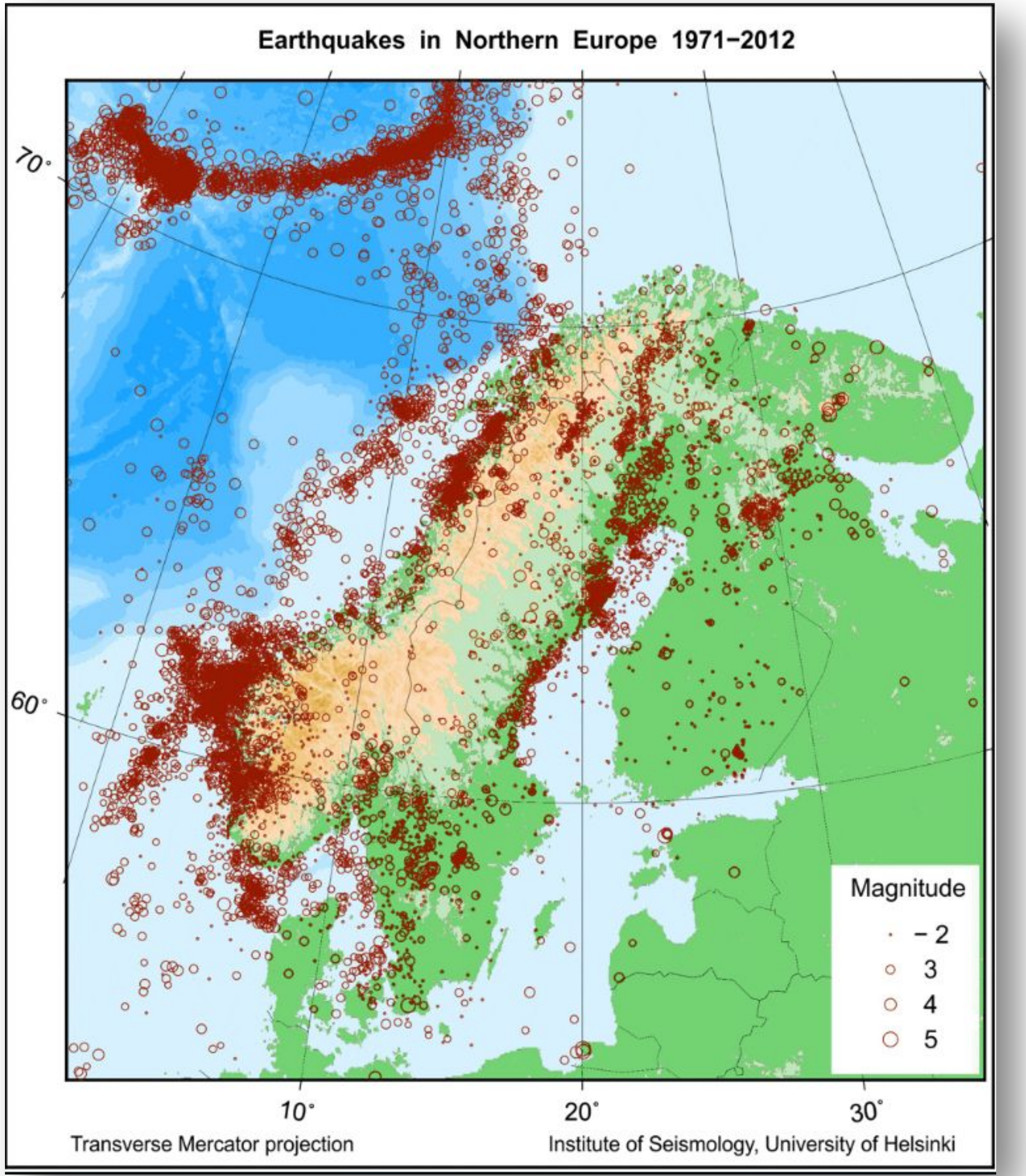
Source: Datacenter Dynamics

Source: LaserFocusWorld



Safe geological location and nature

- Finland is geologically very safe because it lies on a very old and stable bedrock
- Finnish climate is generally mild with no hurricane class storms
- Baltic Sea floods very seldom and its all time record of sea level rise have been only 1.9 m in 2005. Areas that face risk of flooding are predictable.
- Building Regulations demands to build a min. of 3 m above the sea level



Source: Institute of Seismology, University of Helsinki

Stable society honours privacy

CTS ENGTEC

- In addition to Finland being an ideal location for Data Centers, it is also a safe place to save and keep information
- The Finnish information privacy legislation is quite different from other European countries
    - Unlike most other European countries and including other Nordic countries, Finland adheres strongly to its policies on the right of privacy of individuals and corporations and enforces it´s own regulation without exception.

- In Finland privacy of information is a basic right that is inviolable and sacred
    - The same laws on data sovereignty applies to all forms of (stored) information and communication (digital or not)
    - In Finland there is a strong legal protection over any surveillance of information and a dedicated authority that has the power to ensure compliance
    - Officials may not survey information unless their work requires it.

- The favorable legislation to store and handle information has led many datacenter operators to establish business in Finland.

Source: Institute of Seismology, University of Helsinki

Finland qualified no.1 in Fragile State Index

"The Fragile States Index is an annual ranking of 178 nations based on their levels of stability and the pressures they face. The Index is based on The Fund for Peace's proprietary Conflict Assessment Software Tool (CAST) analytical platform. Based on comprehensive social science methodology, data from three primary sources is triangulated and subjected to critical review to obtain final scores for the Fragile States Index".

Global Innovation index states that with innovation Finland is in 5th place 2016. Global Innovation

Very Sustainable

17.8	Finland (178)

Sustainable

20.2	Sweden (177)
20.8	Norway (176)
21.5	Denmark (175)
22.2	Luxembourg (174)
22.3	Switzerland (173)
22.6	New Zealand (172)
23.4	Iceland (171)
24.3	Australia (170)
24.7	Ireland (169)
25.7	Canada (168)
26.0	Austria (167)
26.8	Netherlands (166)
28.1	Germany (165)
29.7	Portugal (164)

Highly Stable

30.4	Belgium (163)
31.6	Slovenia (162)
33.4	United Kingdom (161)
33.7	France (160)
34.4	Singapore (159)
35.3	United States (158)
36.0	Japan (157)
36.3	South Korea (156)
36.5	Uruguay (155)
37.4	Czech Republic (154)
39.8	Poland (153)

Very Stable

40.9	Malta (=151)
40.9	Spain (=151)
41.5	Chile (150)
42.6	Slovak Republic (149)
43.0	Lithuania (148)
43.2	Italy (147)
43.8	Estonia (146)
45.2	Mauritius (145)
46.2	United Arab Emirates (144)
46.3	Qatar (143)
46.7	Costa Rica (142)
47.6	Argentina (141)
48.6	Latvia (140)
49.1	Hungary (139)
49.3	Barbados (138)

Stable

51.0	Croatia (137)
51.6	Bahamas (136)
52.0	Oman (135)
52.6	Greece (134)
54.2	Romania (=132)
54.2	Montenegro (=132)
54.6	Panama (131)
55.4	Bulgaria (130)
57.0	Mongolia (129)
57.5	Kuwait (128)
57.8	Antigua & Barbuda (127)
58.7	Trinidad & Tobago (126)

Low Warning

61.9	Albania (125)
62.1	Seychelles (124)
62.6	Brazil (123)
62.8	Botswana (122)
63.0	Brunei Darussalam (121)
63.4	Grenada (120)
64.3	Bahrain (119)
64.5	Macedonia (118)
64.6	Jamaica (117)
65.3	Belize (116)
65.9	Malaysia (115)
66.2	Cyprus (114)
67.0	South Africa (113)
67.4	Cuba (112)
68.2	Samoa (111)
68.3	Kazakhstan (110)
68.4	Suriname (109)
69.7	Armenia (108)

Warning

70.5	Guyana (107)
70.8	Namibia (106)
71.2	Dominican Republic (105)
71.3	Gabon (=103)
71.3	Paraguay (=103)
71.4	El Salvador (102)
71.6	Saudi Arabia (101)
71.8	Mexico (100)
71.9	Ghana (=98)
71.9	Peru (=98)
72.4	Vietnam (97)
73.0	Moldova (96)
73.5	Cape Verde (95)
73.6	Micronesia (94)
73.7	Sao Tome & Principe (93)
73.8	Serbia (92)
74.2	Maldives (91)
74.5	Turkey (90)
74.6	Morocco (89)

Finland is no. 1 also in 2016.

'eace, The Fragile State Index 2015

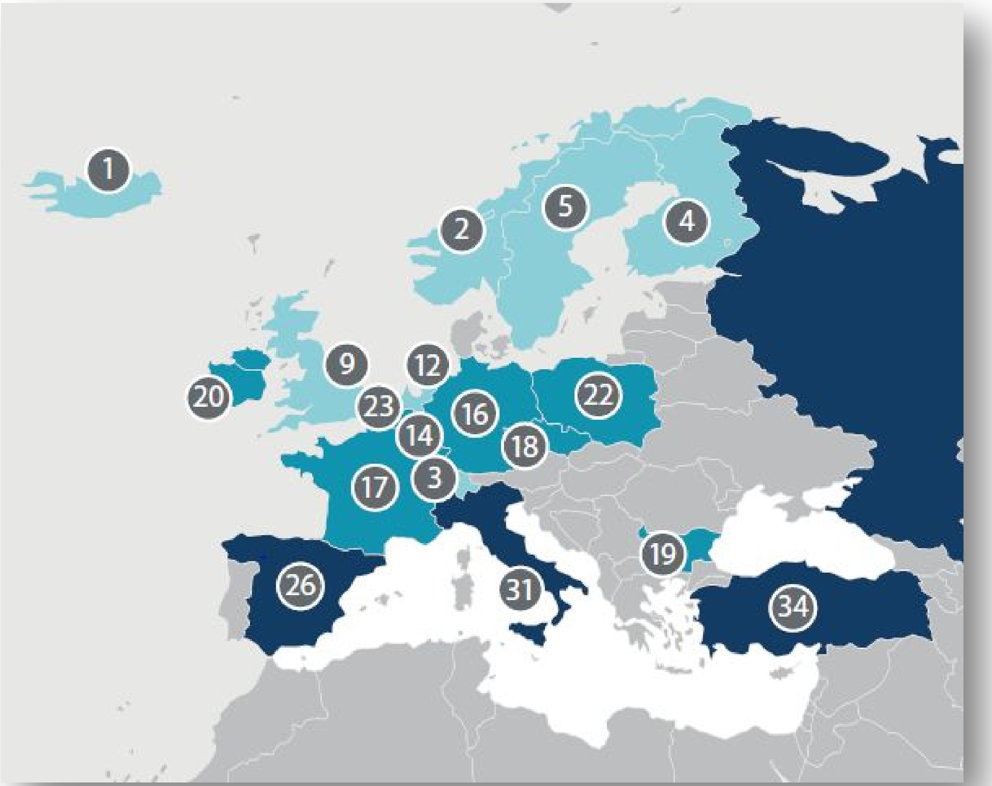
Data Center Risk Index 2016 qualified Finland no. 4

CTS ENGTEC

THE INDEX RANKING BY COUNTRY

2016 RANK	REGION	INDEX SCORE (100= BEST)	COUNTRY	ENERGY - ELECTRICITY (COST PER KWH)	INTERNATIONAL BANDWIDTH (MEGABYTE PER S)	EASE OF DOING BUSINESS	CORPORATION TAX
1	EMEA	100.00	ICELAND	6	10	14	9
2	EMEA	96.21	NORWAY	11	7	7	23
3	EMEA	90.26	SWITZERLAND	8	5	16	6
4	EMEA	90.19	FINLAND	13	8	8	9
5	EMEA	89.92	SWEDEN	22	4	6	14
6	AMERICAS	85.07	CANADA	4	16	10	22
7	APAC	84.50	SINGAPORE	23	11	1	4
8	APAC	83.23	KOREA, REP.	2	1	2	16
9	EMEA	79.81	UNITED KINGDOM	30	14	4	13
10	AMERICAS	78.73	UNITED STATES	3	15	5	36
11	APAC	78.73	HONG KONG	21	2	3	3
12	EMEA	78.06	NETHERLANDS	29	6	18	17
13	APAC	76.48	JAPAN	20	3	21	35
14	EMEA	74.98	LUXEMBOURG	27	22	30	25
15	EMEA	74.73	QATAR	1	29	31	7
16	EMEA	73.75	GERMANY	34	18	11	26
17	EMEA	73.61	FRANCE	24	24	17	31
18	EMEA	73.31	CZECH REPUBLIC	28	9	22	7
19	EMEA	71.53	BULGARIA	14	13	23	1
20	EMEA	71.53	IRELAND	32	17	12	2

Risk Index listed 20 best qualified countries with least risk.



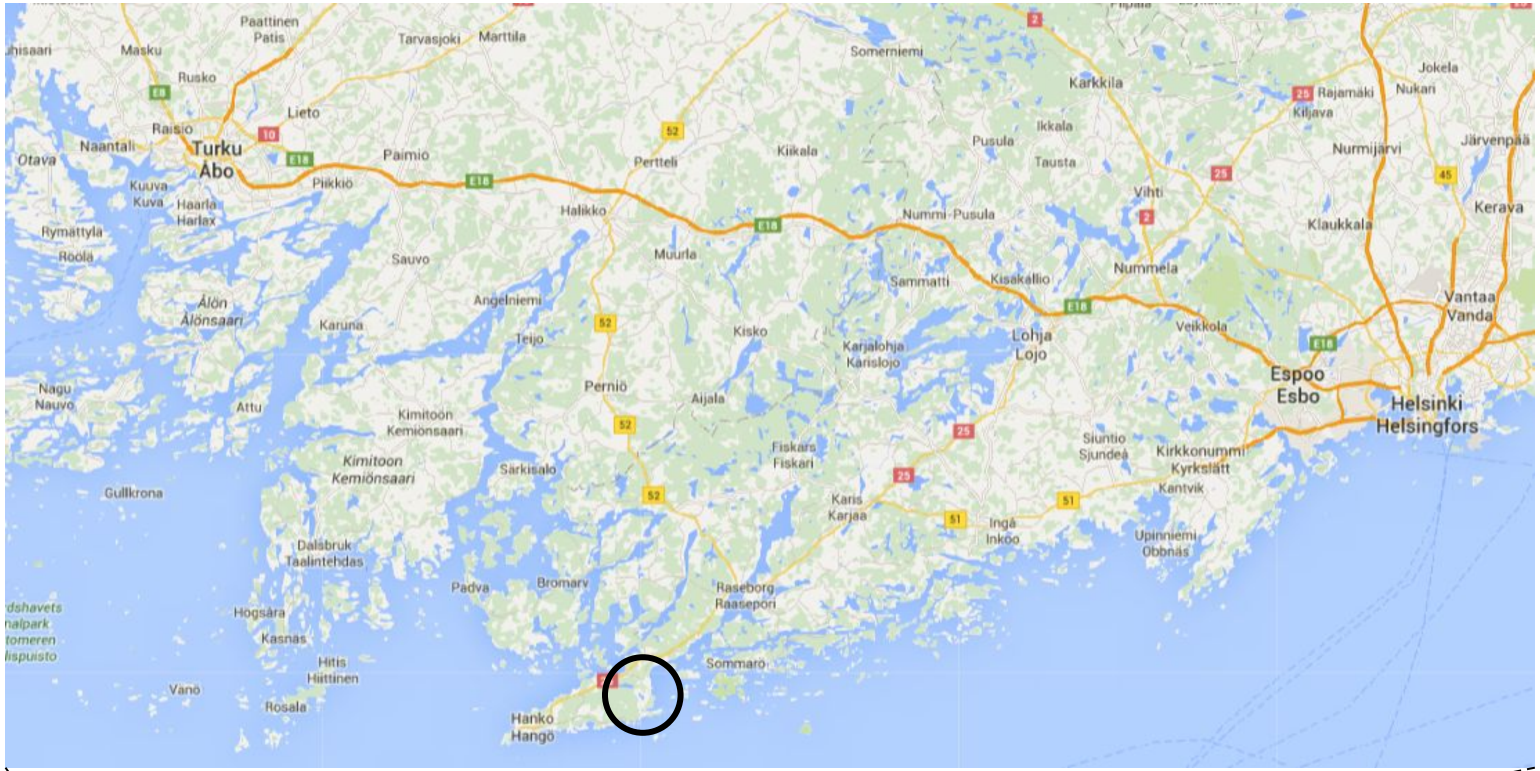
European countries' qualification in the Risk Index.

Cushman & Wakefield Data Center Risk Index 2016 Report highlights the most appropriate risks affecting data centre operations in today's current climate. It has been designed primarily to support data centre due diligence and senior decision making when considering global investment and deployment activities.

Source: Cushman & Wakefield: Data Center Risk Index Report 2016

LOCATION AND LOGISTICS

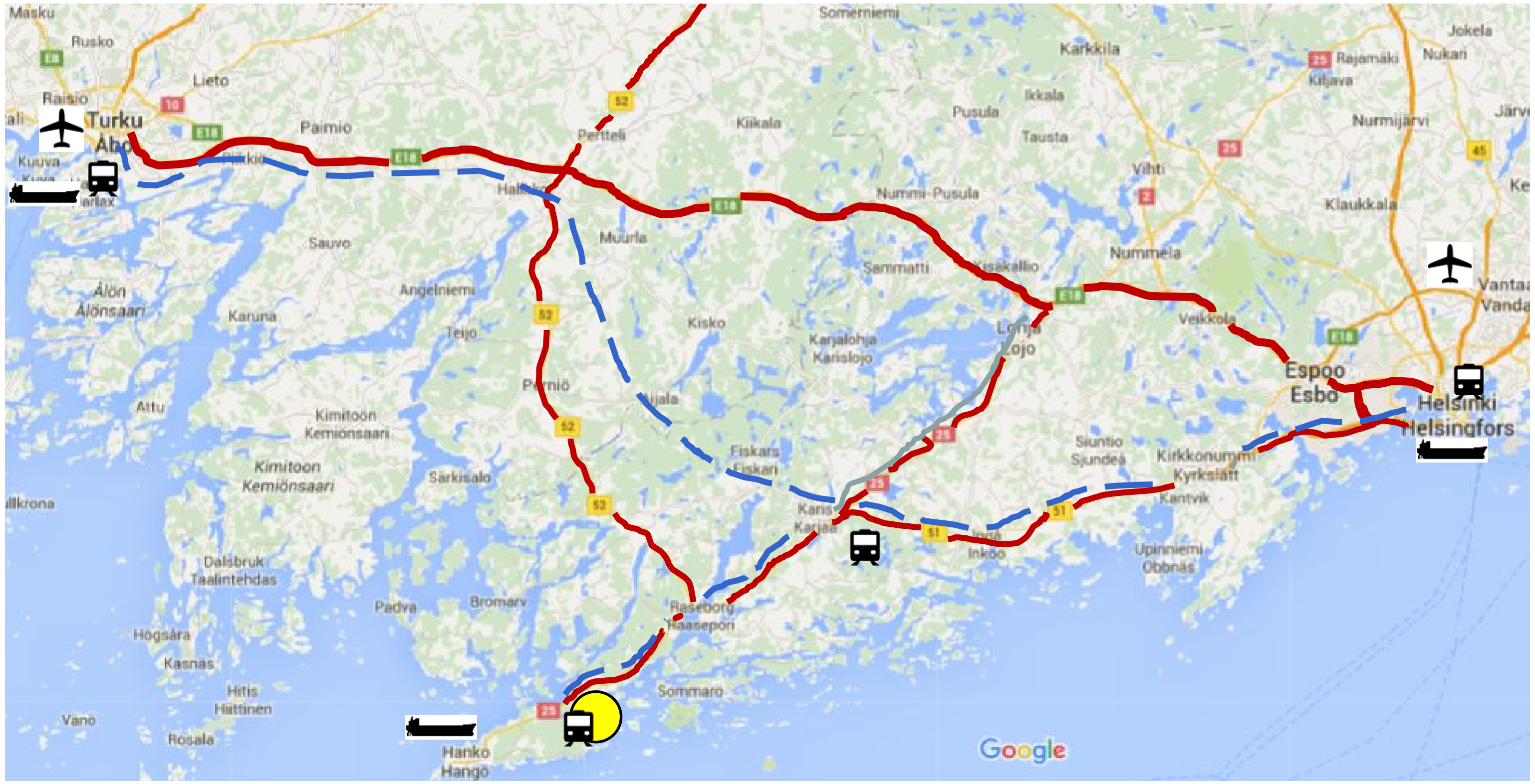
Ideal Data Center site location



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

Site is ideal for DC 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

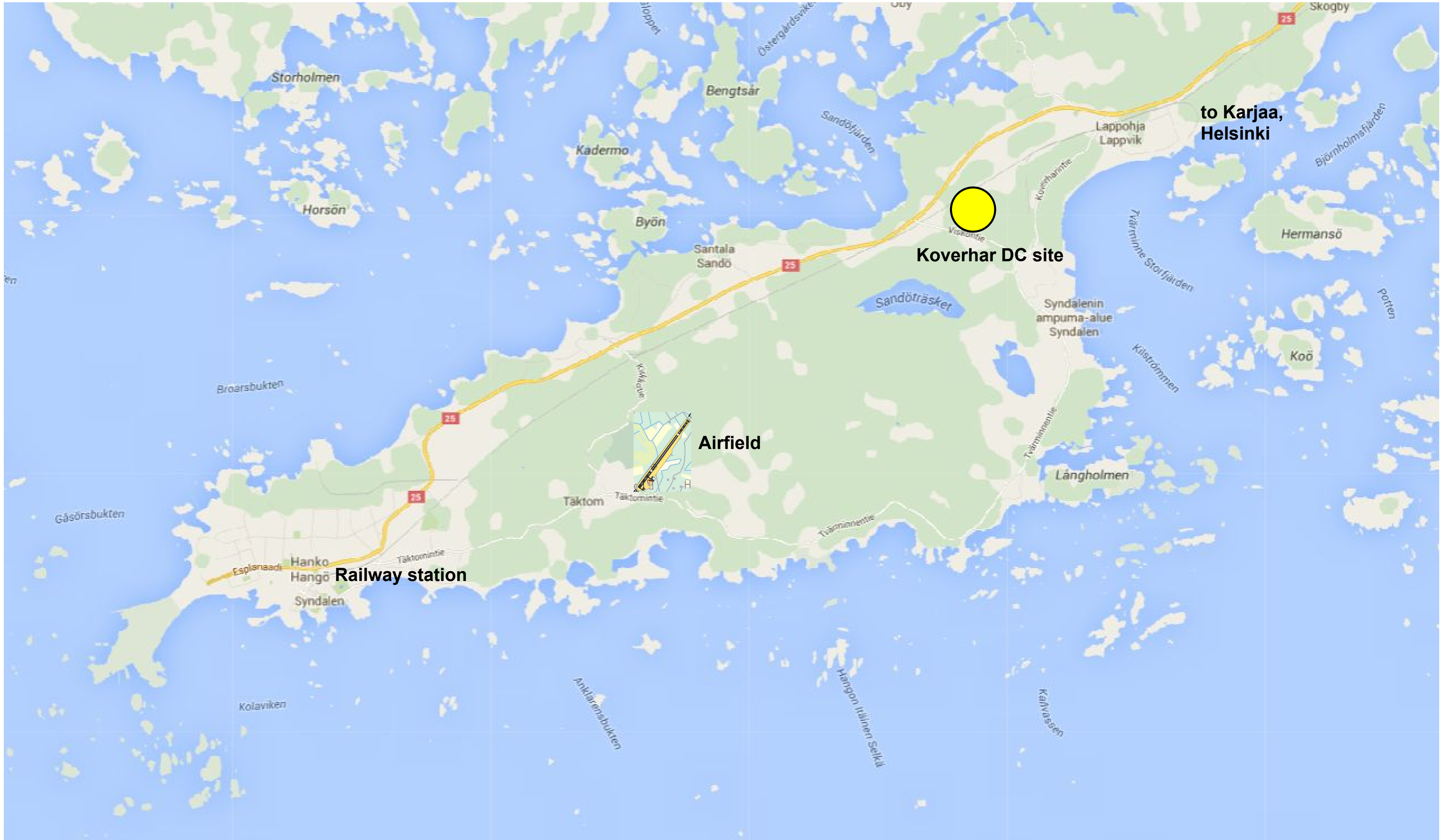
Railroad

Intl. airport

Railway station

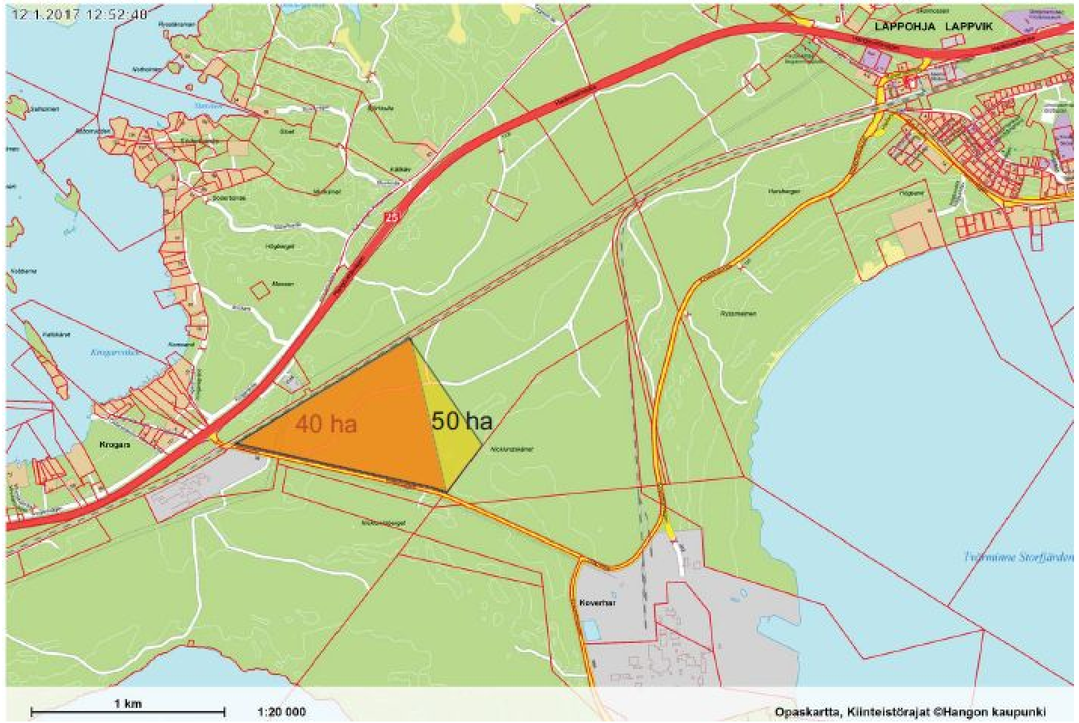
Hanko Koverhar Data Center site

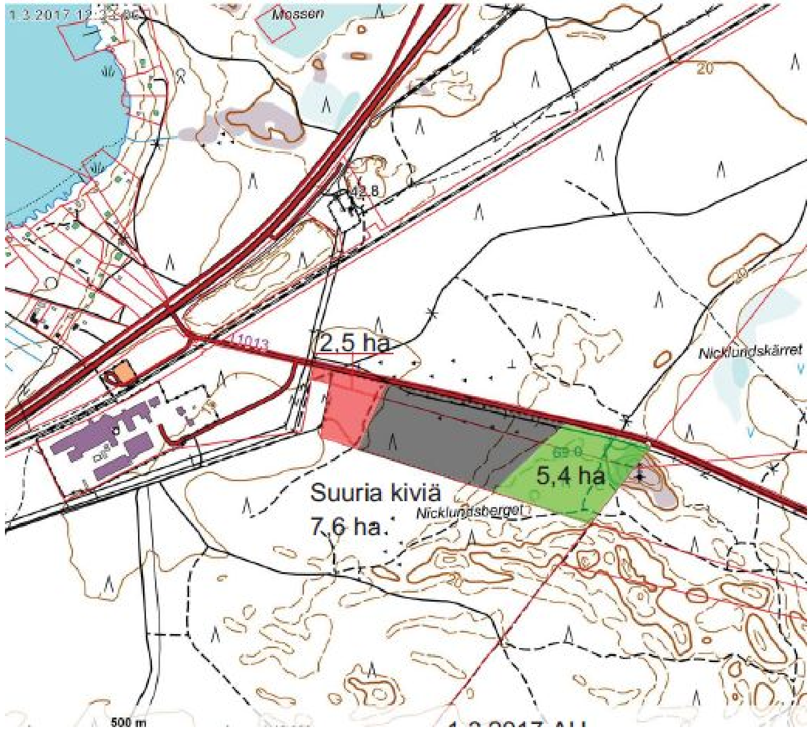
Hanko Koverhar DC site



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 DC area up to 100 ha if necessary

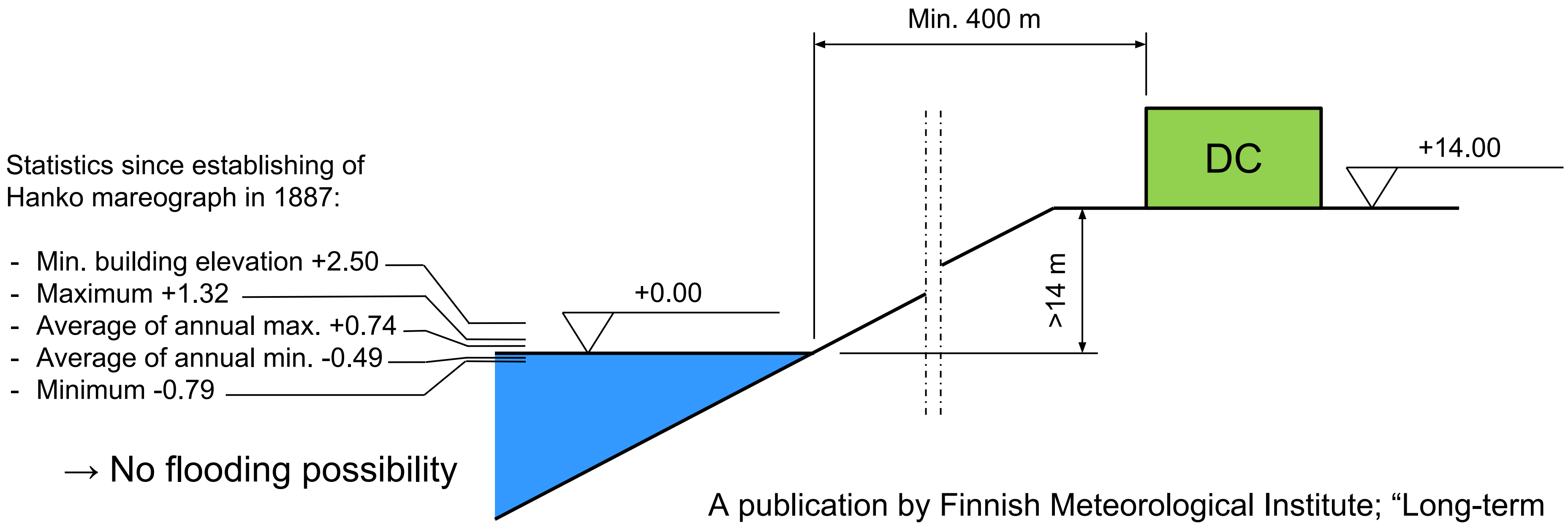




Sustainable and Green solar energy to DC use from nearby.

Colored area next to the DC site is reserved for planned future solar power use.

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

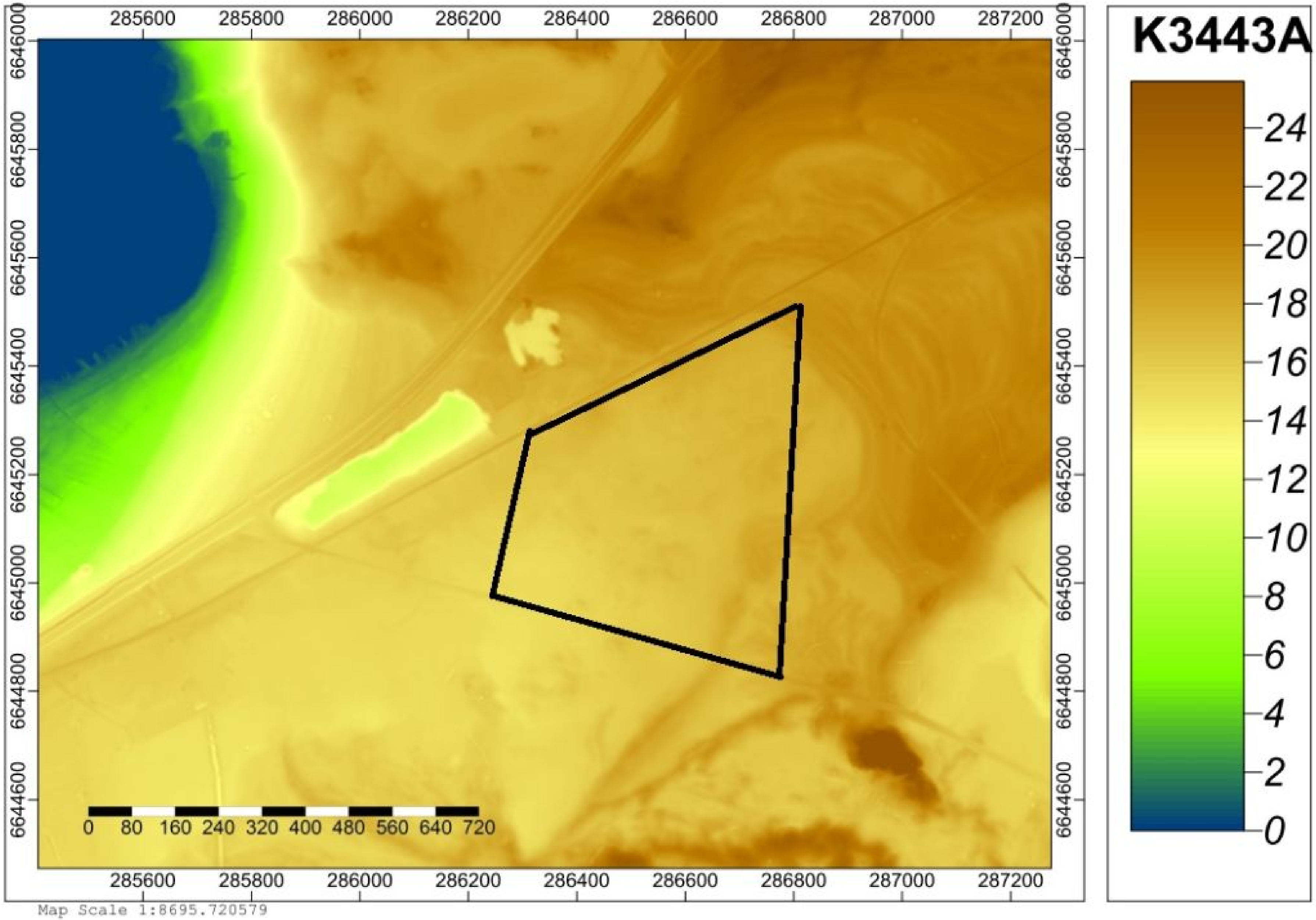


A publication by Finnish Meteorological Institute; “Long-term flooding risks and recommendations for minimum building elevations on the Finnish coast”, June 2014

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.

Current landscape elevations

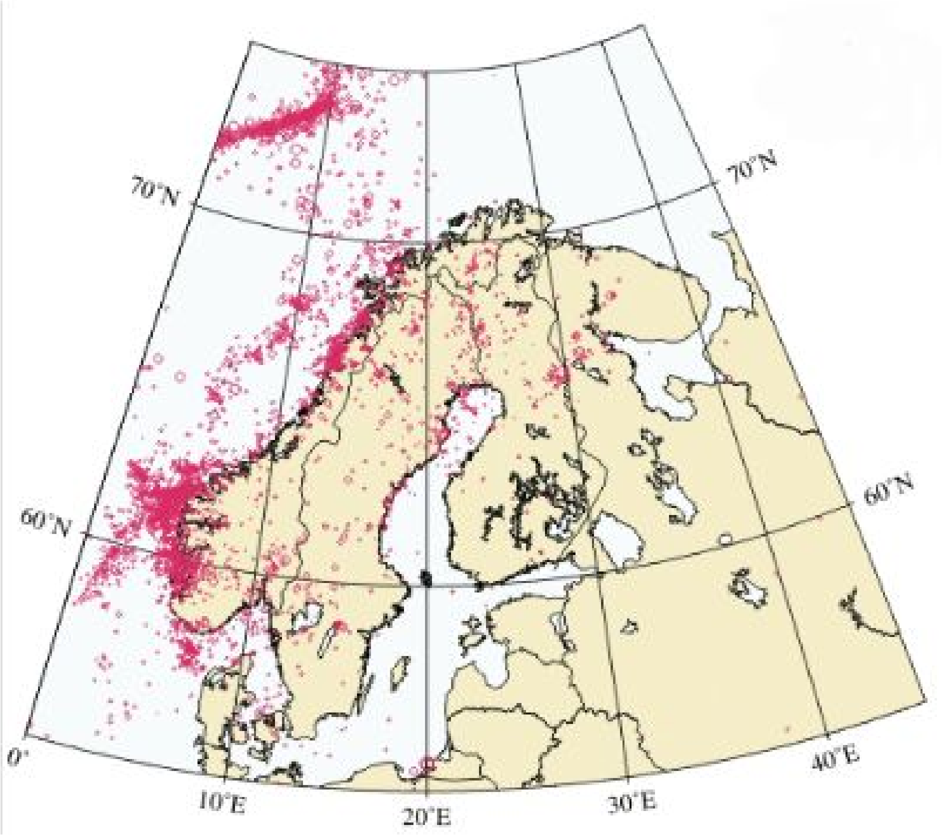


Utility connections available at the DC site

Potable water and sewage water connections are close to DC area.

Potable water and sewer connections

Peaceful seismological environment in Finland



Picture: Earthquakes in Fennoscandia during 1965-2005.

The largest earthquake in the region was in 2006: magnitude 2.1.

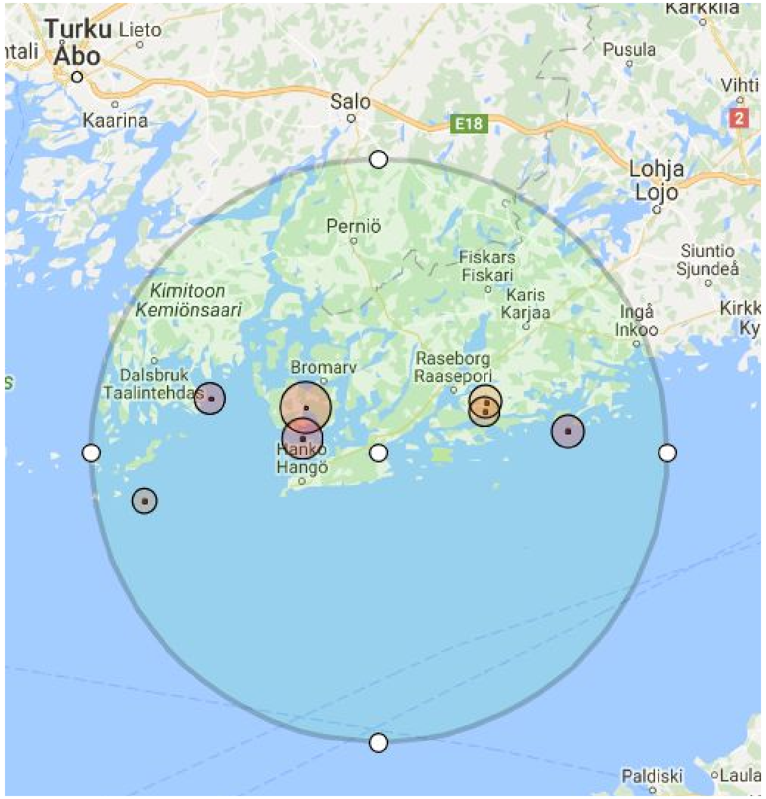
- Finland is located in a very peaceful area concerning earthquakes.
- There have been some minor earthquakes also in Hanko area, but the magnitude of those events has been small.
- Minor earthquakes in Finland are part of interplate earthquake series on Eurasian tectonic plate.
- Due to the fact that 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

Peaceful seismological environment in Finland

List of all recorded earthquakes in the 50 km radius from the Hanko Koverhar DC site since 2000.

#	Year	Mnt	Day	Time (UTC)	Lat. (°)	Lon. (°)	Dist. (km)	Max. mag.	Depth (km)
1	2016	5	20	01:25:58.0	59.803	22.477	41,5	0.6 *(LH)*	5.0F
2	2014	4	22	19:22:55.3	59.940	23.531	19,4	0.9 *(LH)*	2.0F
3	2014	3	31	23:06:00.4	59.956	23.536	20,4	1.1 *(LH)*	5.0F
4	2007	1	10	19:45:05.5	59.961	22.683	*30,5	1.0 *(L)*	4.0F
5	2006	10	3	21:02:22.3	59.901	22.969	*13,4	1.5 *(L)*	3.0F
6	2006	8	16	18:23:46.1	59.948	22.980	14,8	2.1 *(LN)*	5.0F
7	2004	2	23	21:46:57.8	59.912	23.791	32,9	1.1 *(L)*	3.0

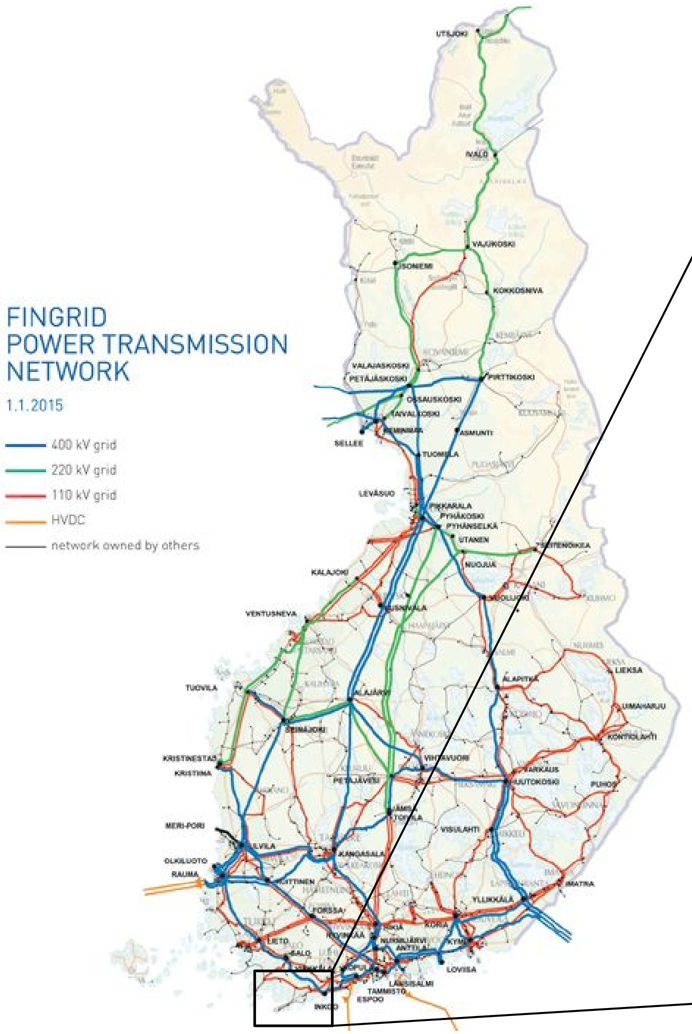


Magnitudes are local magnitudes in ML scale (the Richter scale) based on readings from Finnish BBZ/SPZ stations

Source: University of Helsinki, Institute of Seismology

POWER SUPPLY

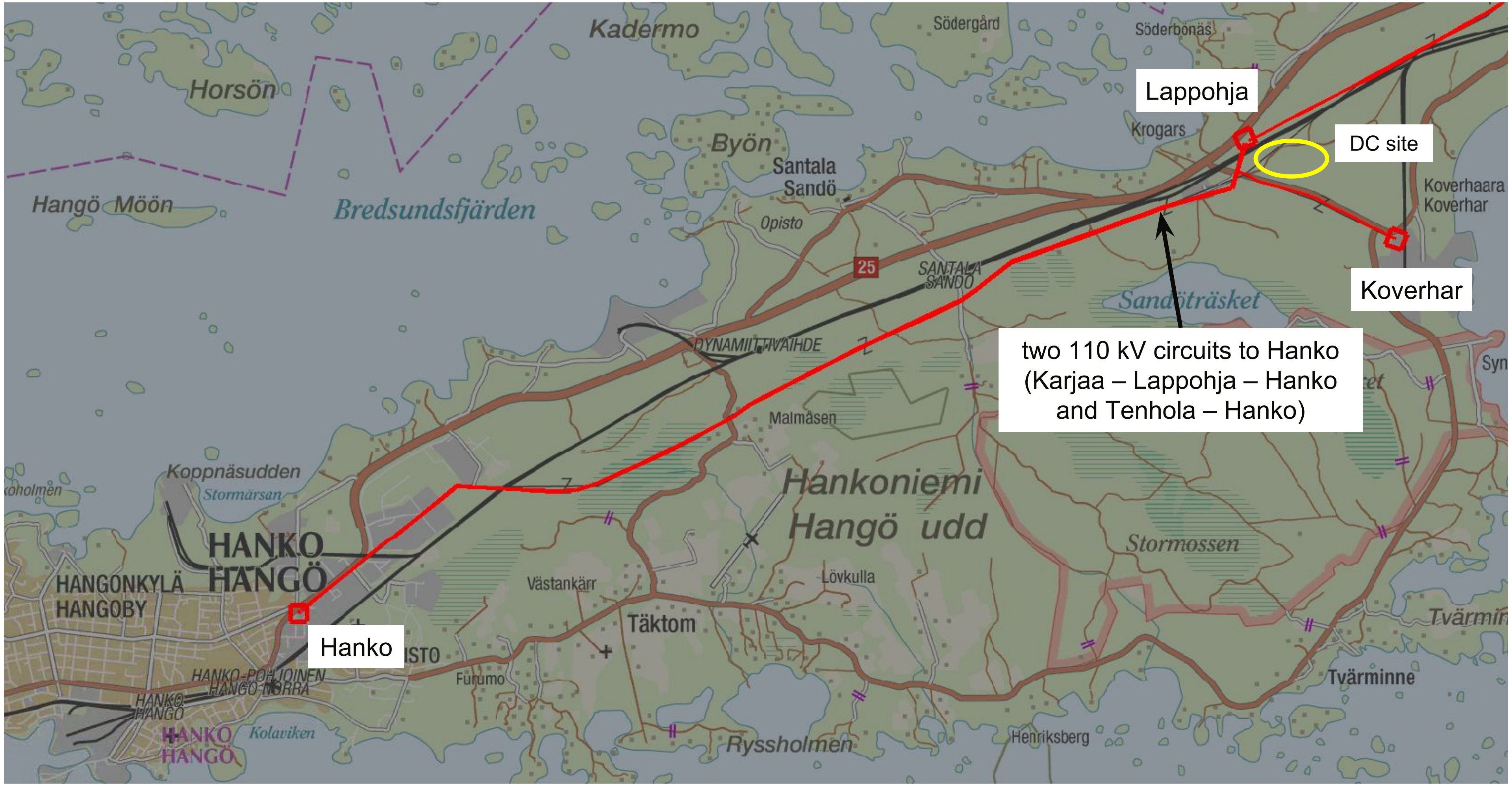
Fingrid Oyj's national grid (110 and 400 kV)



Source Fingrid

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

Hanko electrical grid



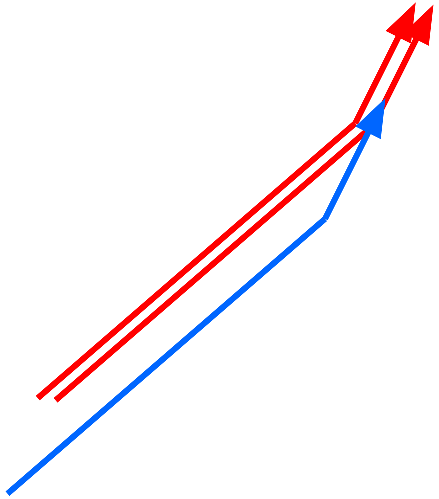
Power ramp up to Hanko DC site; phase 1

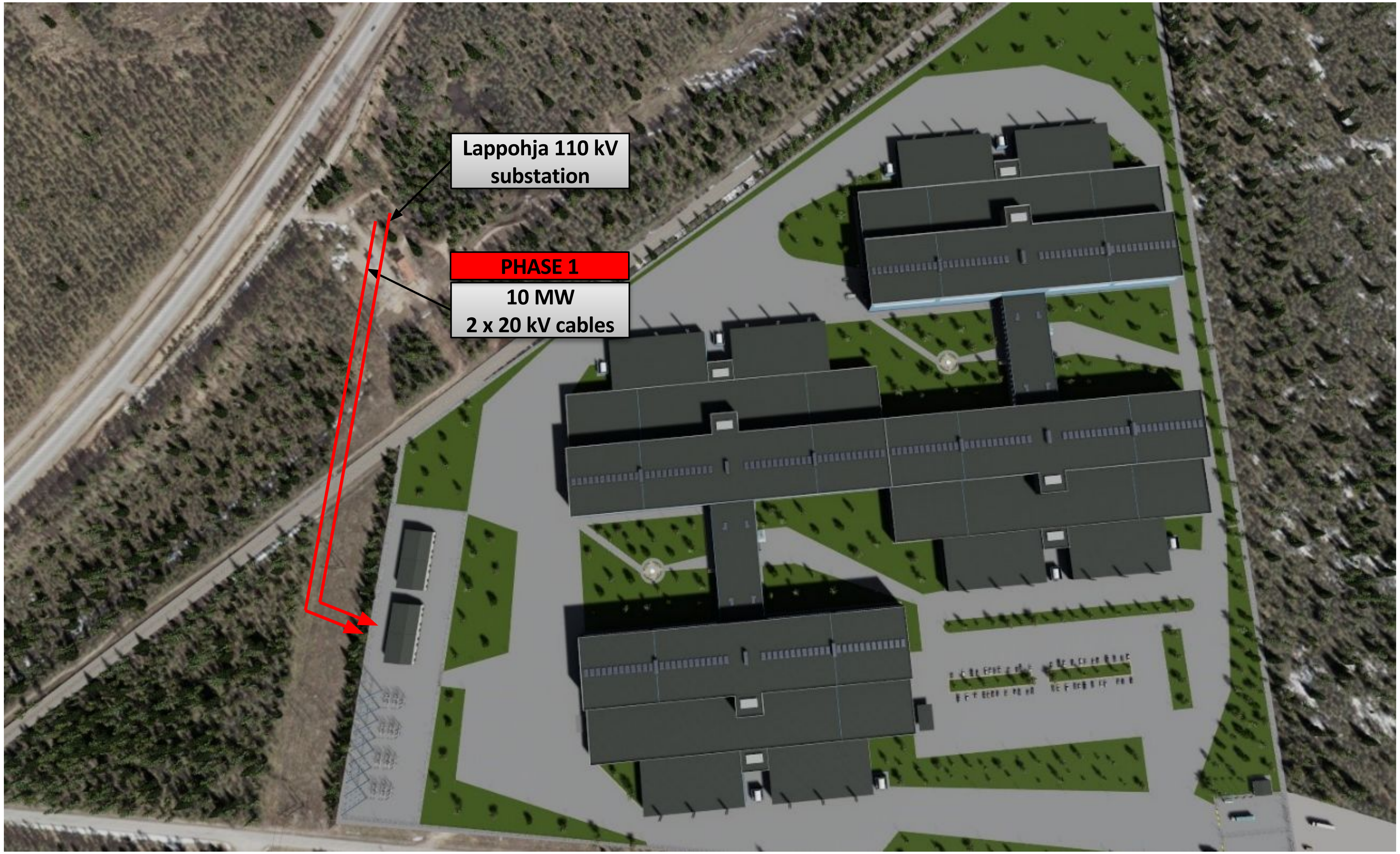
Phase 1   10 MW

Required investment

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

Time needed 6 months





Power ramp up to Hanko DC 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

Power ramp up to Hanko DC site; phase 3

Phase 3   100 MW, redundant feed 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

Power ramp up to Hanko DC site; phase 4

Phase 4 100 - 200 MW,

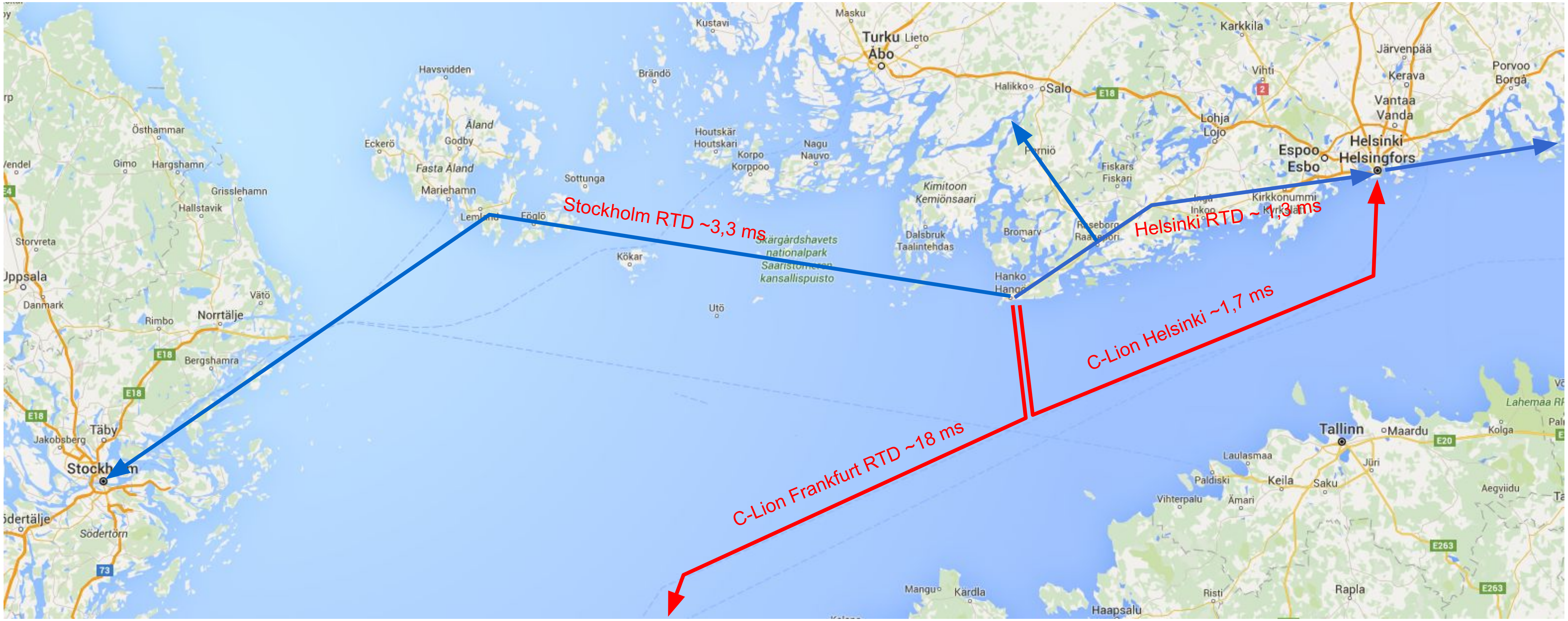
Required investment

- 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

CONNECTIVITY

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

Source: Cinia Oy

Route description

Hanko DC connectivity_V2.kmz

Source: Cinia Oy

Example of Round Trip Delay

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

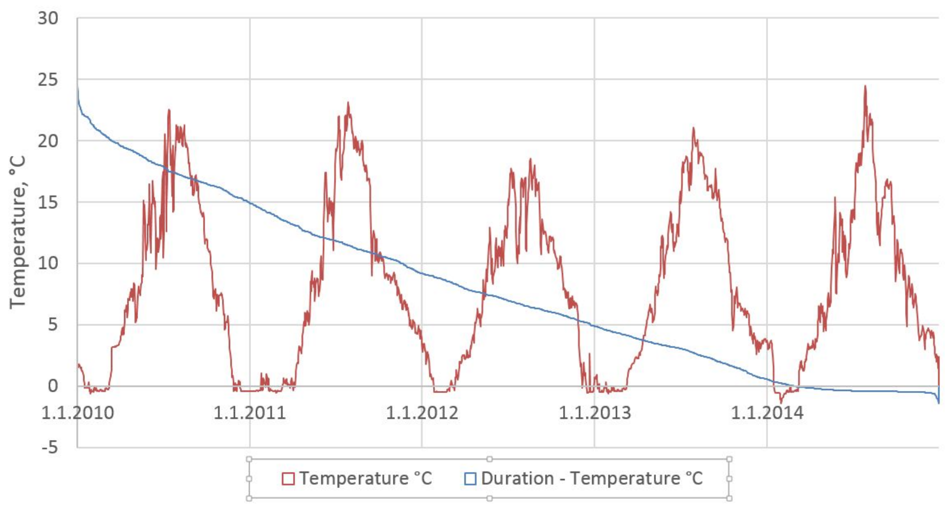
Source: Cinia Oy

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 exisating data

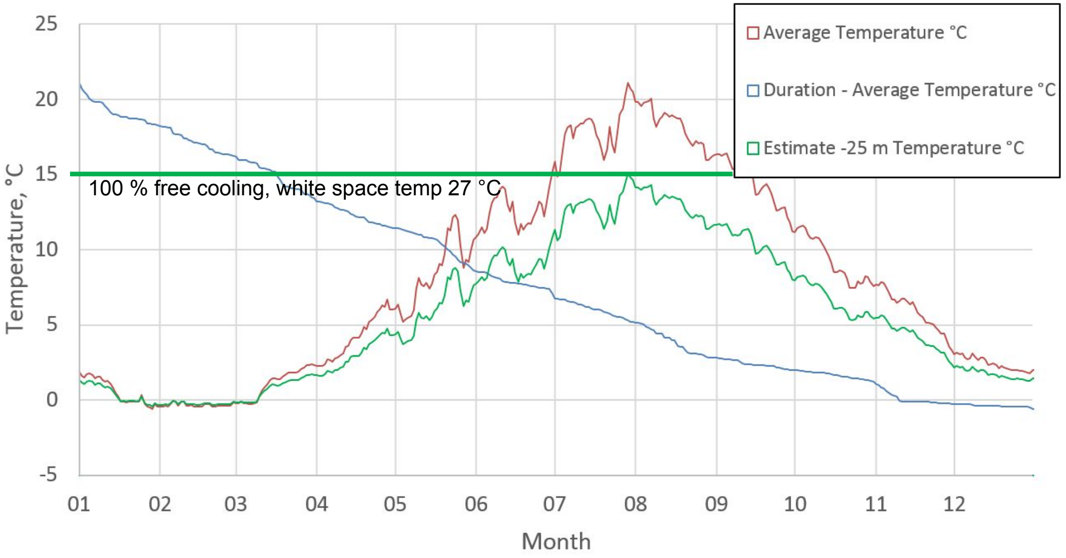


Ambient air: dry temperature and
duration of dry and wet bulb temperatures
Air data: hourly averages, Hanko/Tulliniemi 2012-2014 by FMI

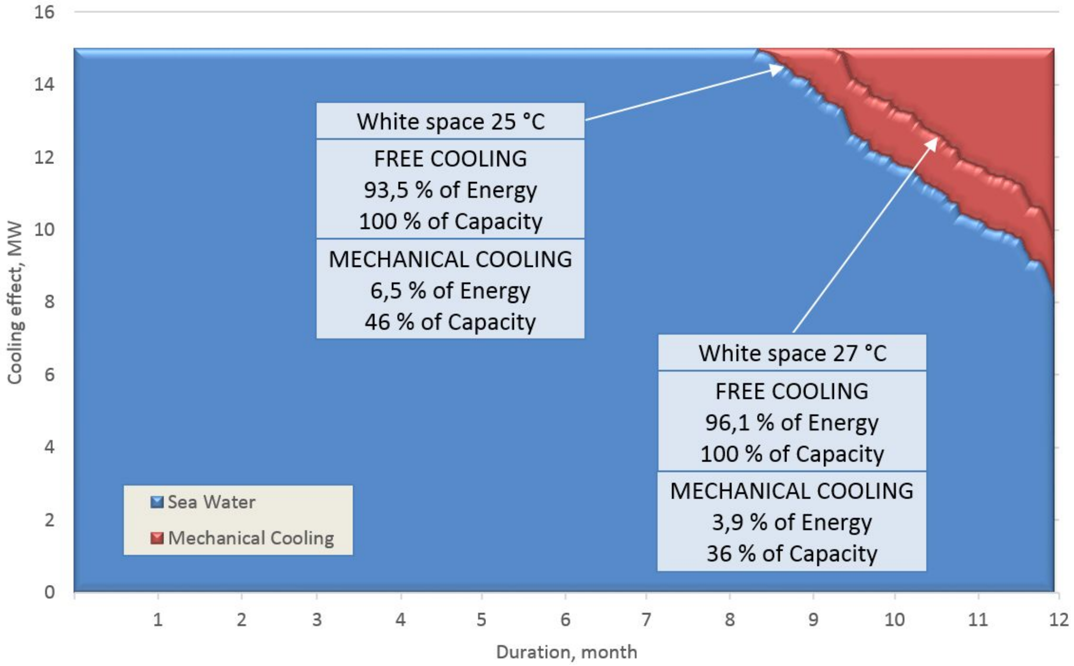
Cooling by Sea Water

- 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

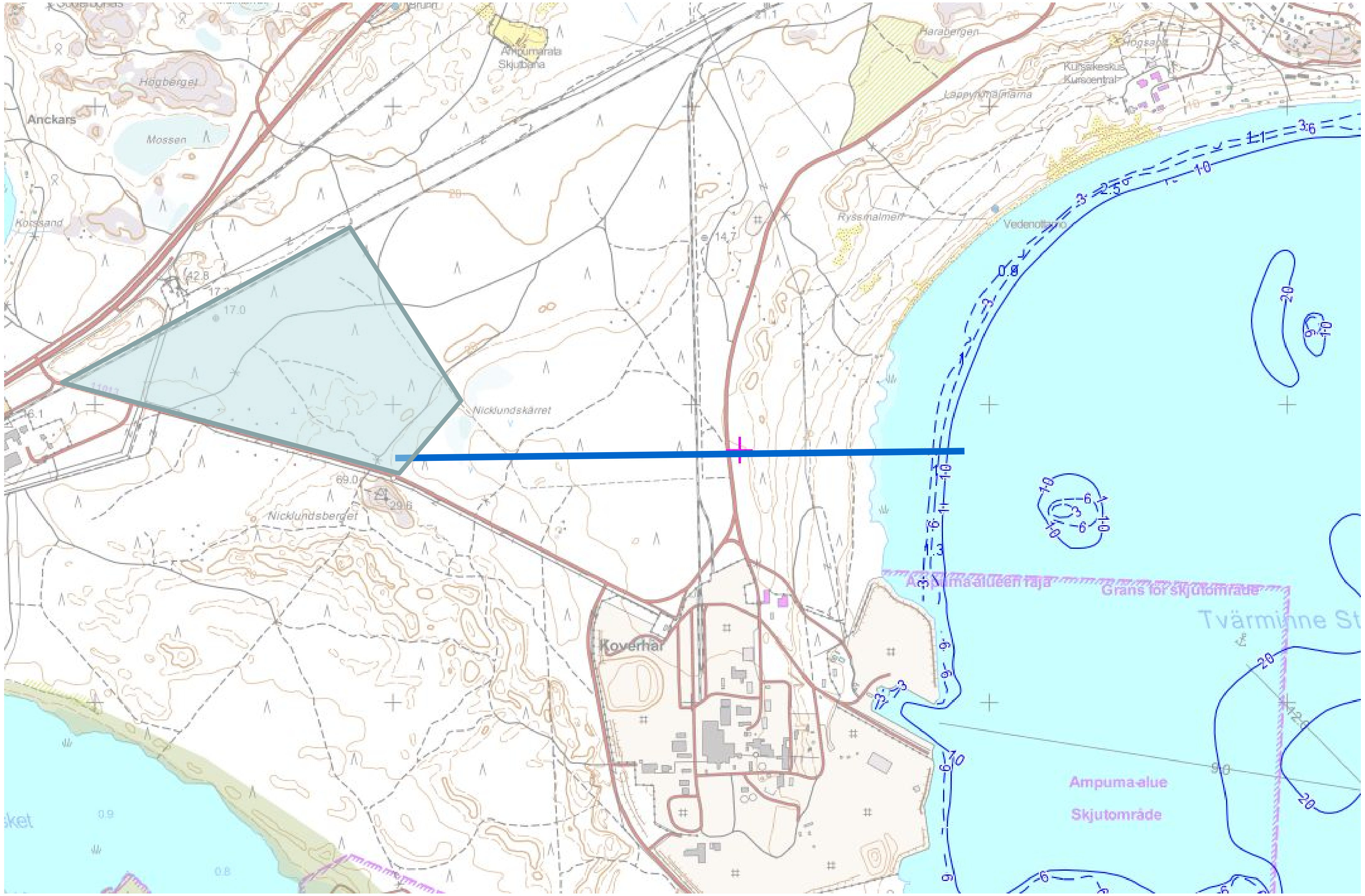


Cooling production by sea water and mechanical cooling
White space temperatures 27 and 25 °C,
Data: Average surface temp. from available data, 2010-2014



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

100% free cooling possibility with sea water cooling

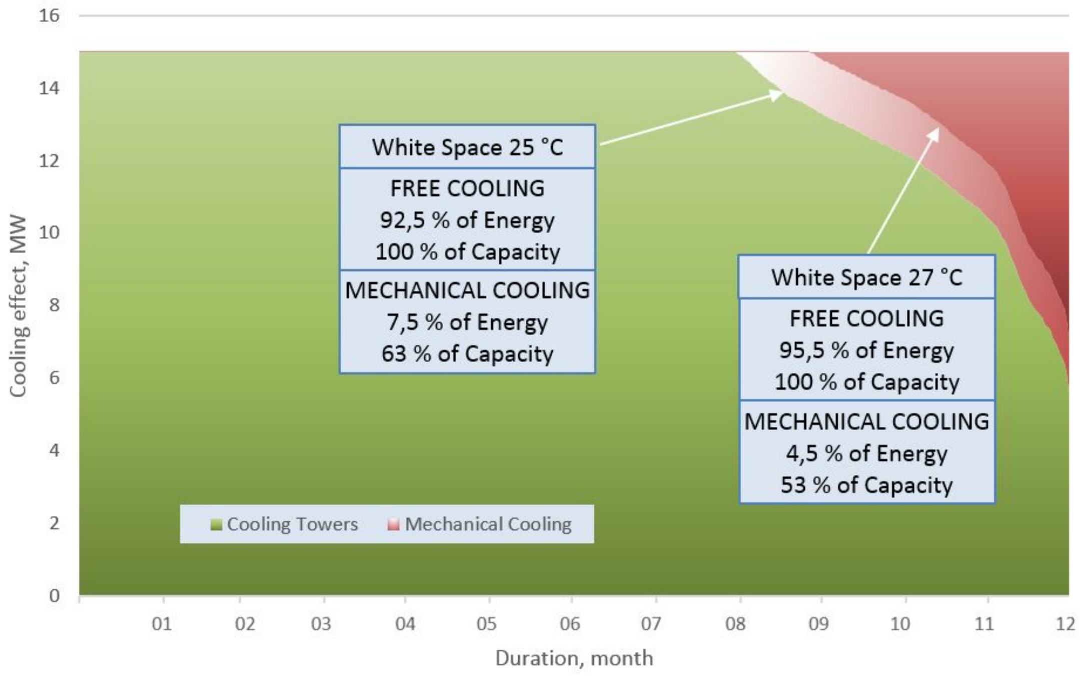


The depth chart of the nearby sea looks promising for achieving 100% free cooling by using cold sea water for Data Center cooling.

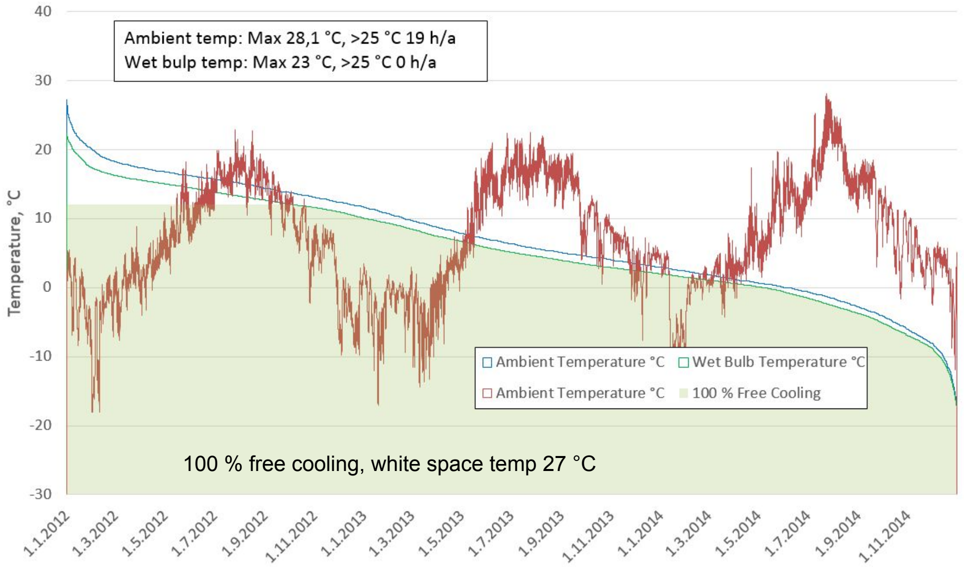
Cooling Towers and Mechanical Cooling

- Wet bulb temperature 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

Cooling production by cooling towers and mechanical cooling
White space temperatures 27 and 25 °C Temp Data 2014



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

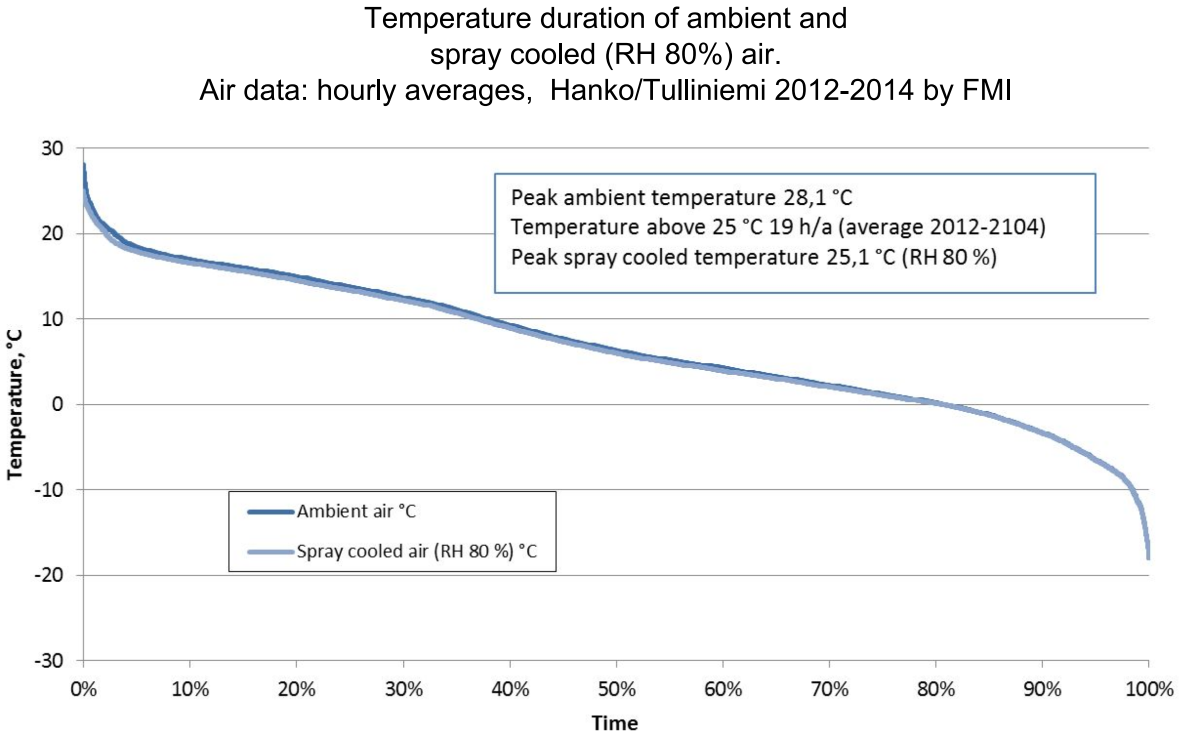


Target white space temp	27 °C	25 °C	21 °C
Primary water circ temp.	17 °C	15 °C	11 °C
Free cooling, energy	96%	93%	85%
Mech. cooling capacity	53%	63%	83%

Ambient air data source © Finnish Meteorological Institute

Direct Air Cooling

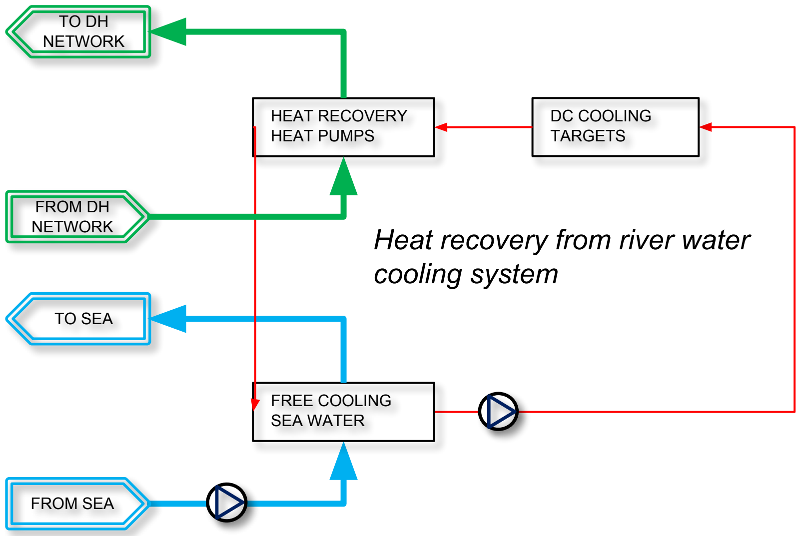
- Ambient conditions suitable for free cooling
- Maximum ambient air temperature 28,1 °C
- Ambient temperature >25 °C <19 h/a (average 2012 - 2014)
  - Longest continuous period 13 h, average peak duration 5,2 h
- With adiabatic cooling (RH 80 %) max temp 25,1 °C



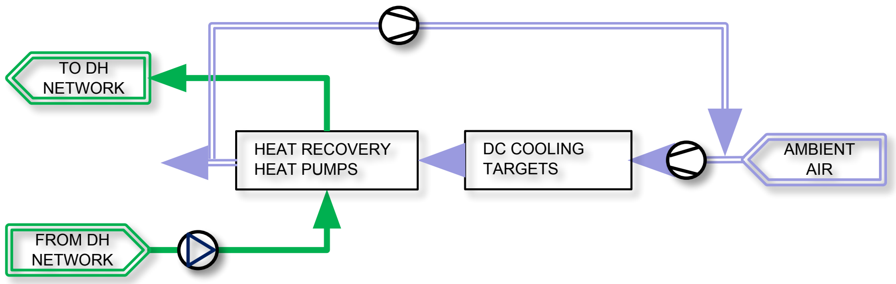
Mechanical Cooling

- 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

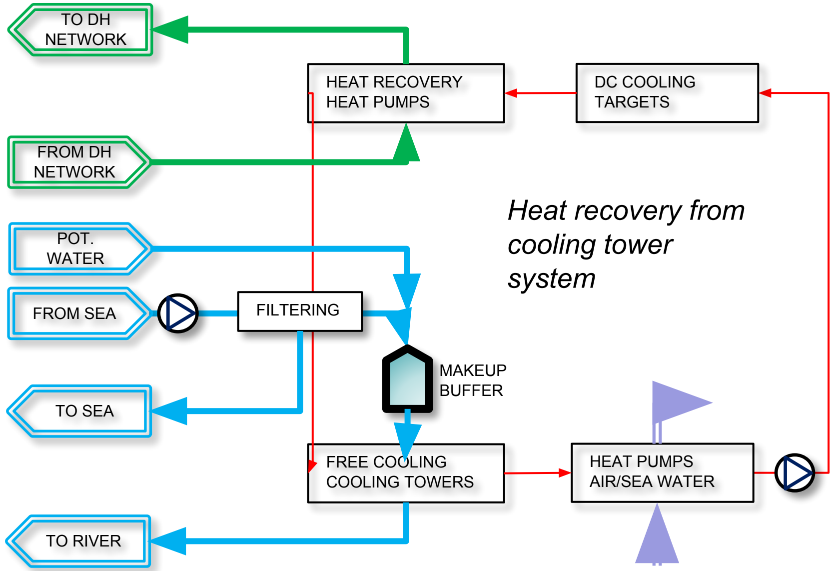
Examples of Secondary Heat Re-use Arrangements



Heat recovery from river water cooling system



Heat recovery from adiabatic cooling system



Heat recovery from cooling tower system

SITE UTILIZATION

Air cooling example utilization

Air cooling example utilization

Air cooling example utilization

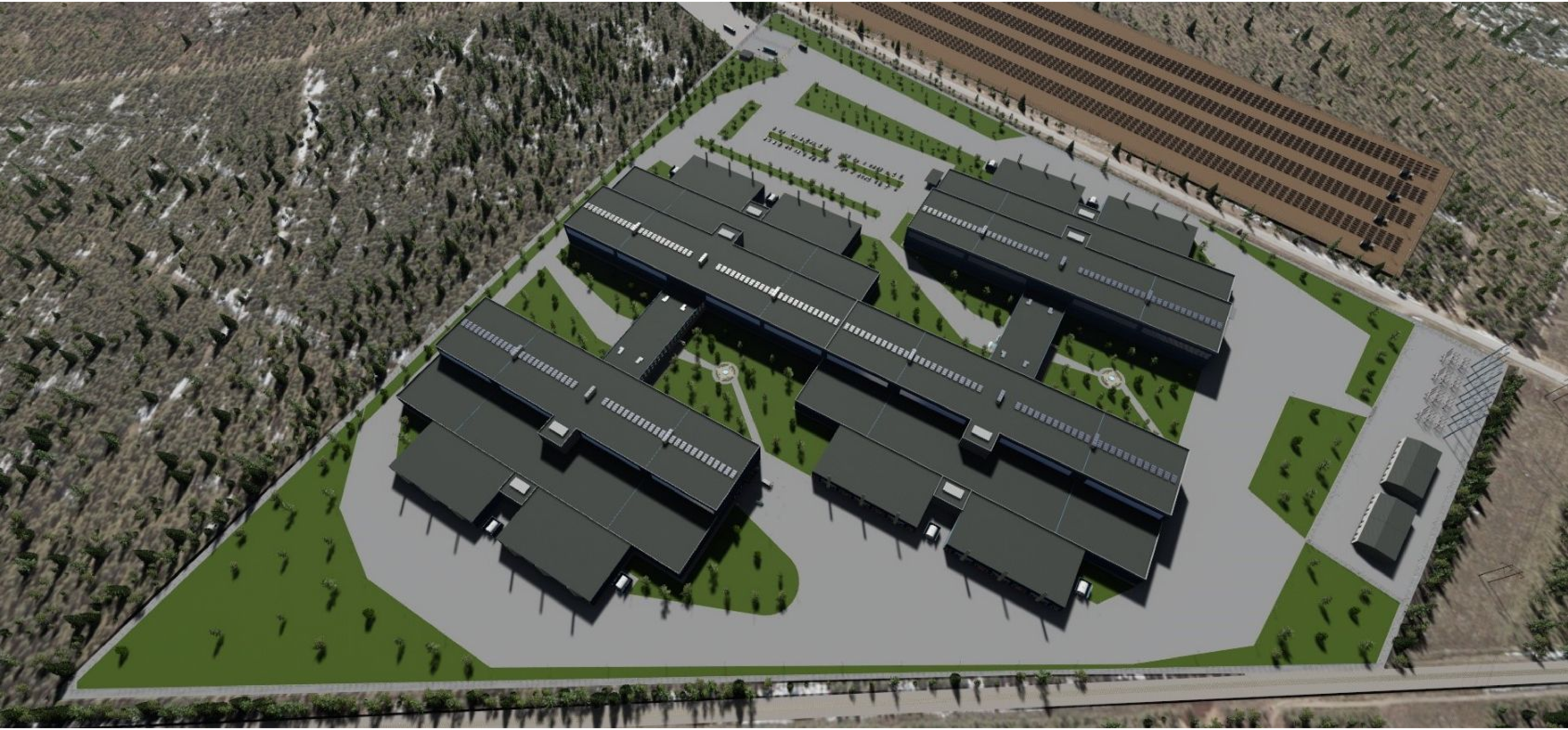
Air cooling example utilization

Air cooling example utilization

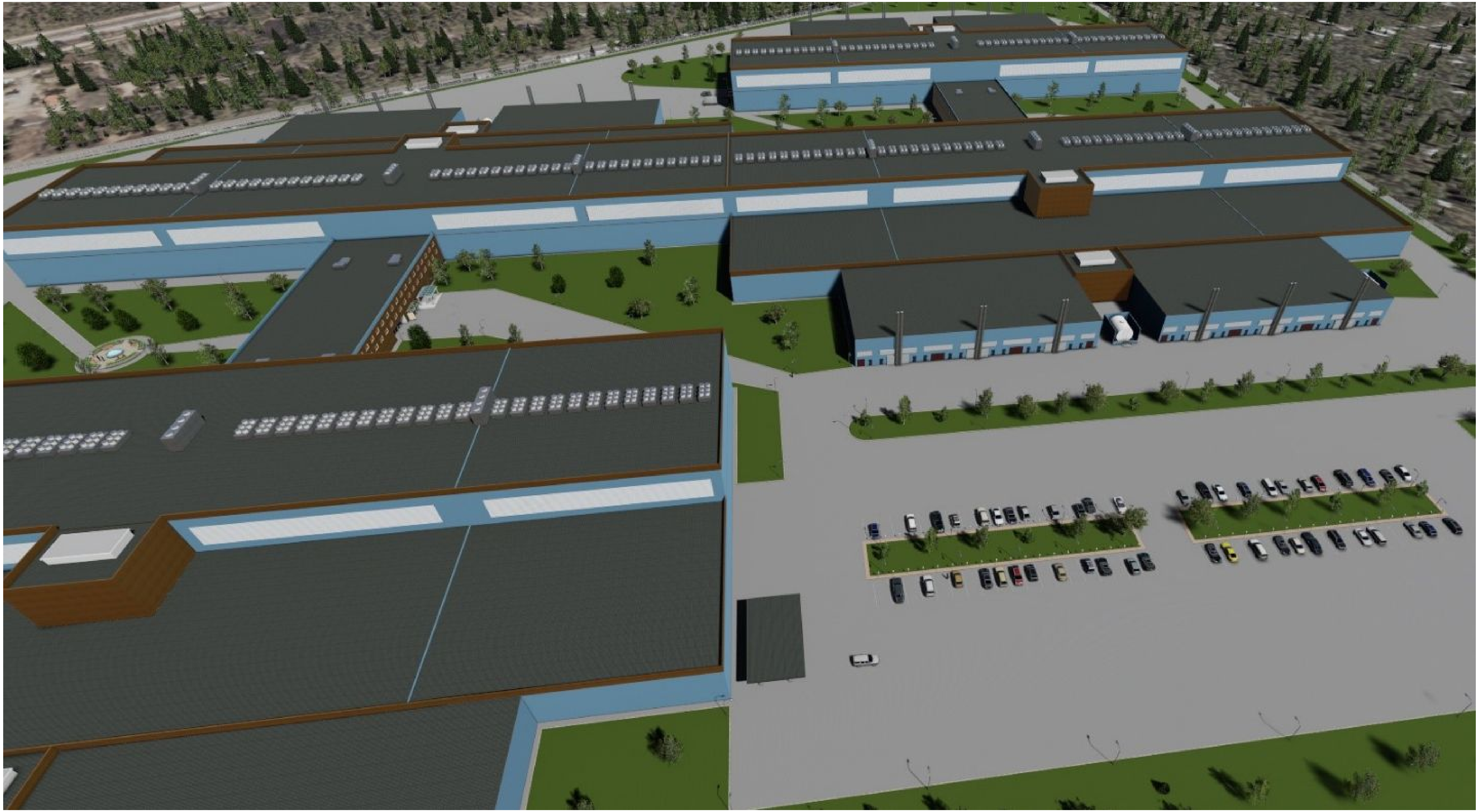
Air cooling example utilization

Air cooling example utilization

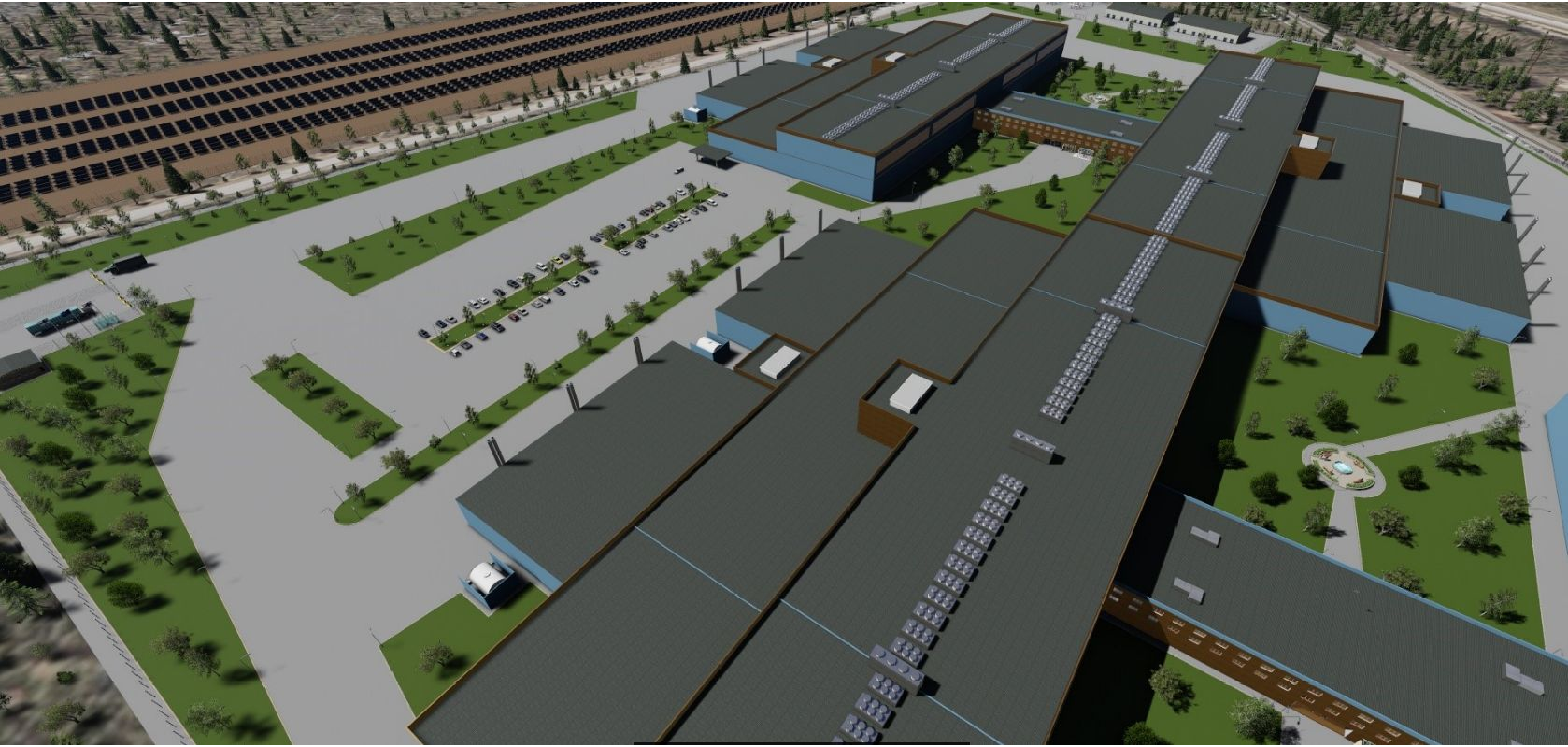
Air cooling example utilization



Air cooling example utilization



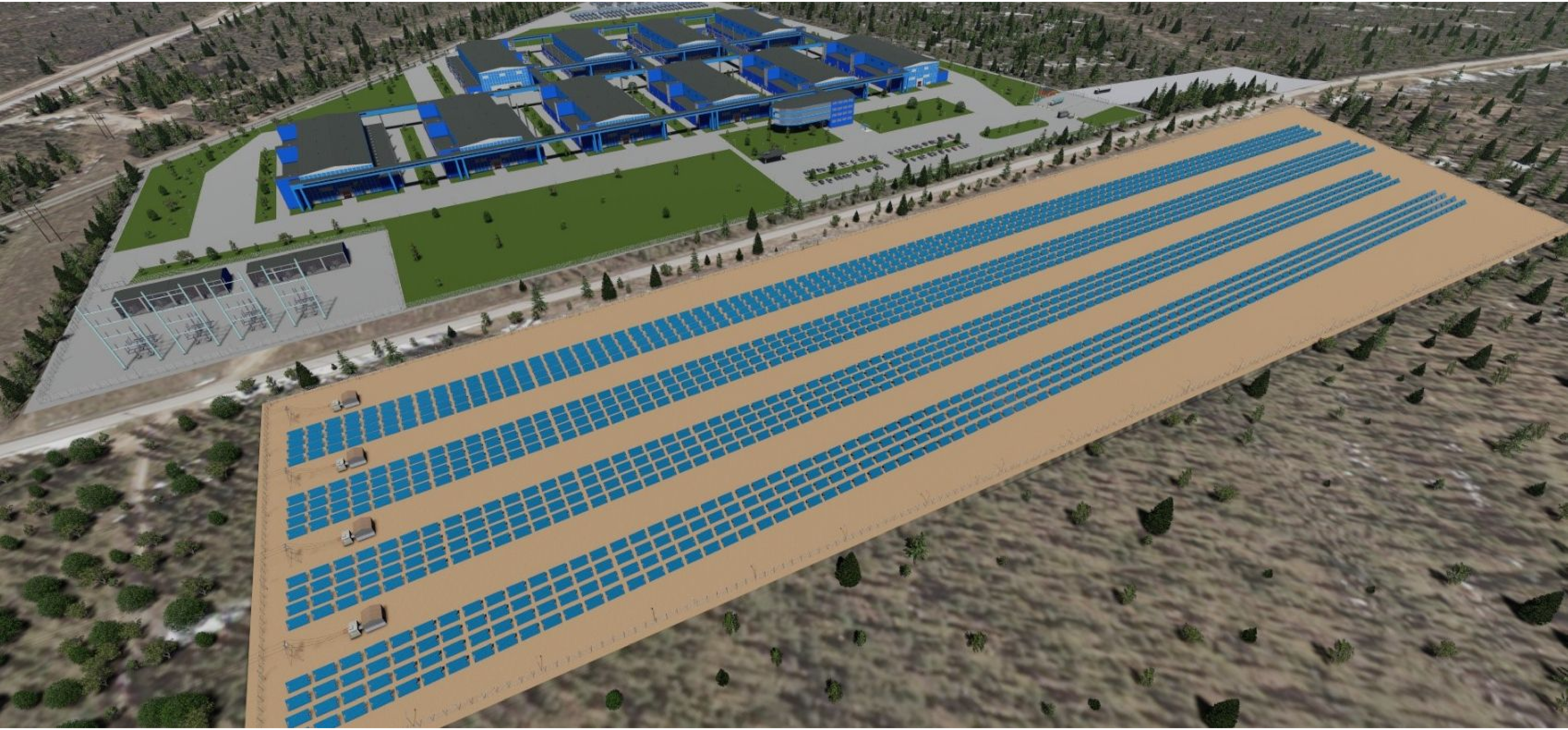
Air cooling example utilization



Water cooling example utilization

Water cooling example utilization

Water cooling example utilization

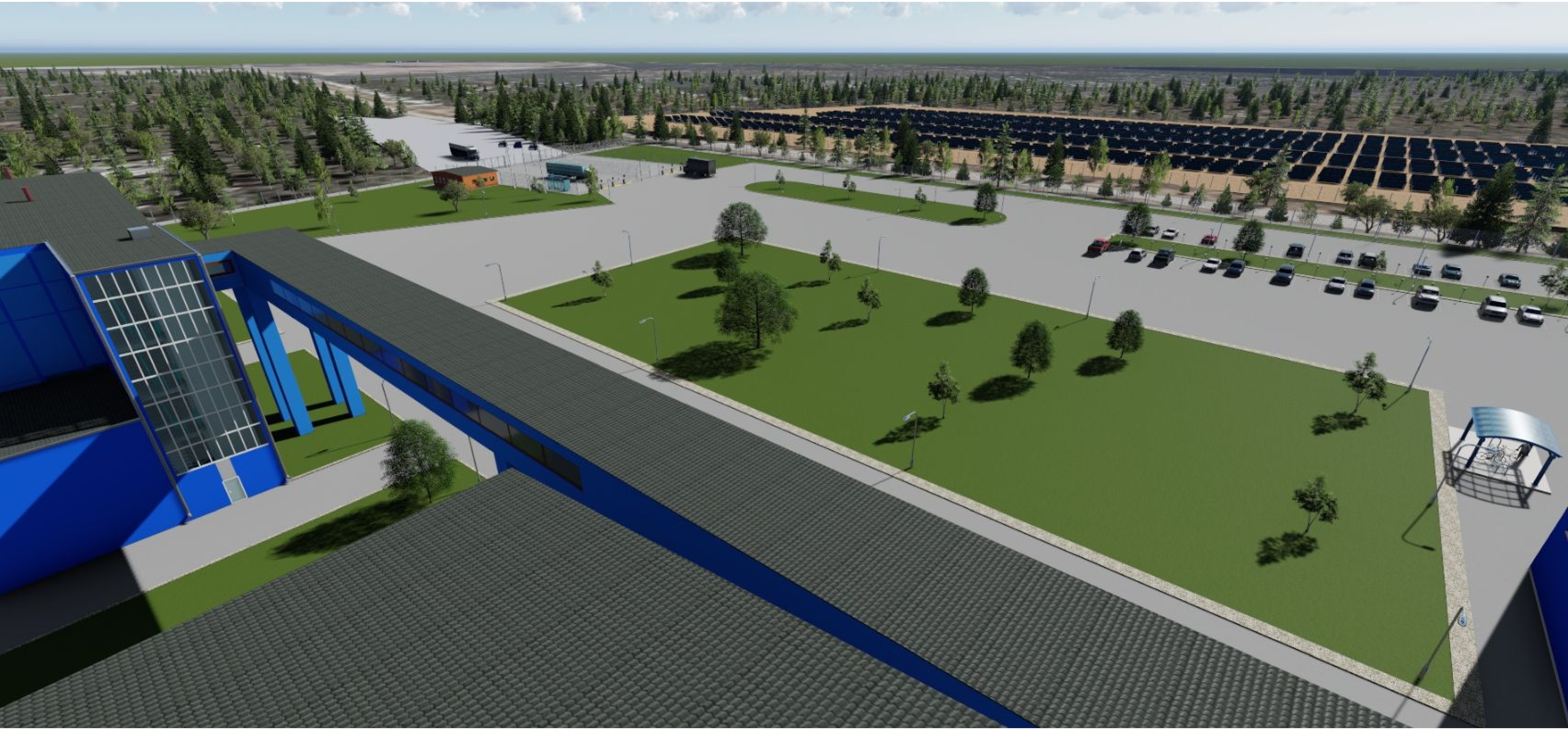


Water cooling example utilization

Water cooling example utilization

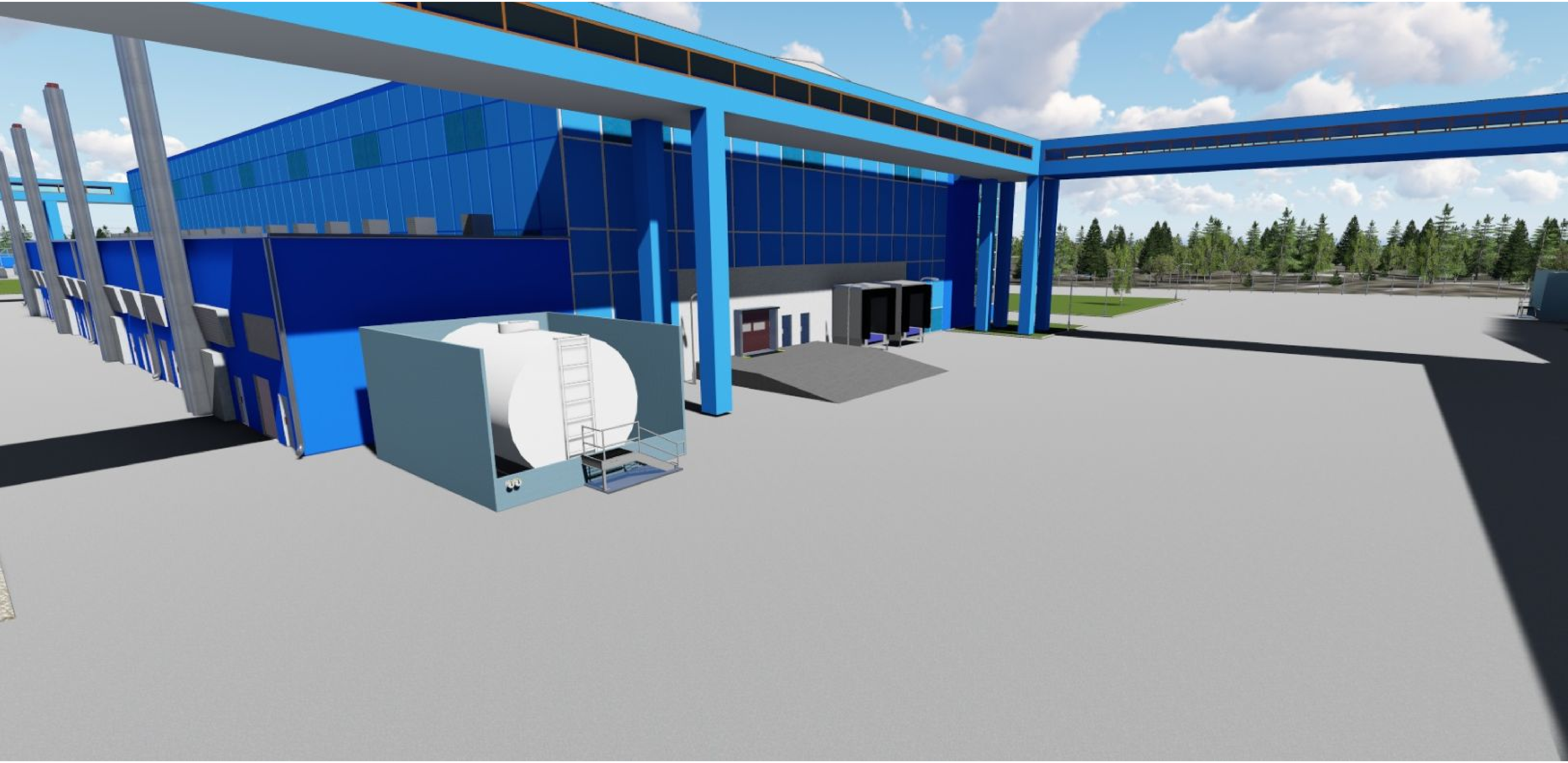
CTS ENGTEC

Water cooling example utilization



Water cooling example utilization

Water cooling example utilization



Water cooling example utilization

Water cooling example utilization

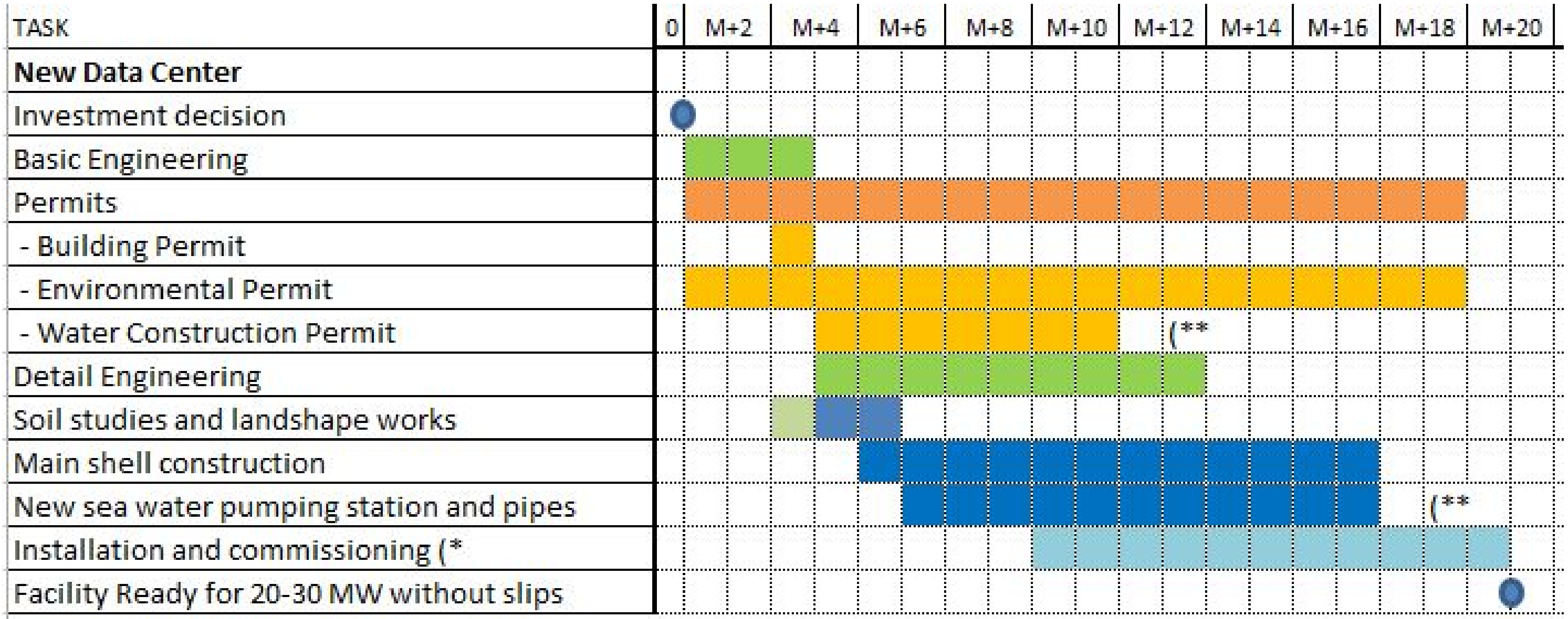
Water cooling example utilization

IMPLEMENTATION PLAN

Implementation schedule

CTS ENGTEC

- 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

CTS ENGTEC

- 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 successfull contracts preferably also to foreign customers and English speaking main personnel to taking care of the project