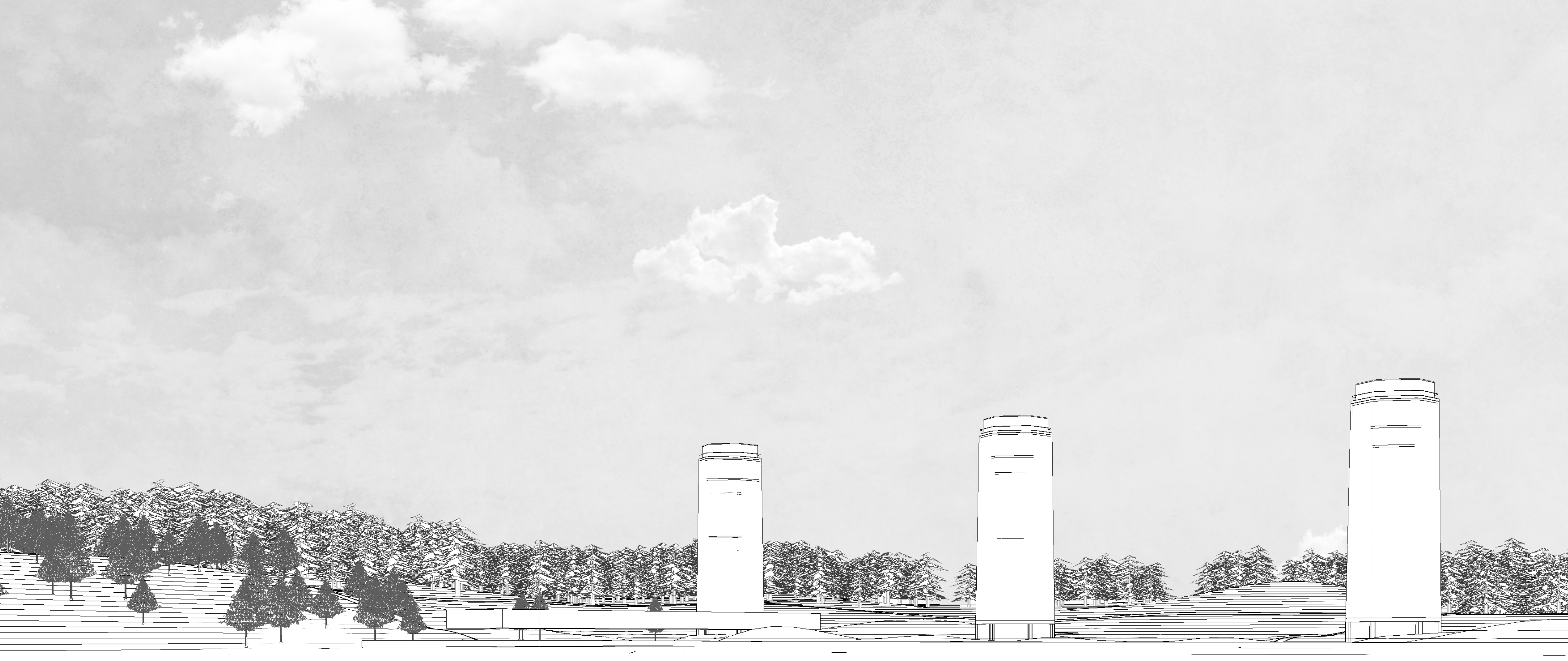
HOTSPRING FOR PARKSTAD

Synergy between a datacenter and hotspring in the Sibelco quarry



LOCATION IBA PARKSTAD

RESEARCH

DESIGN

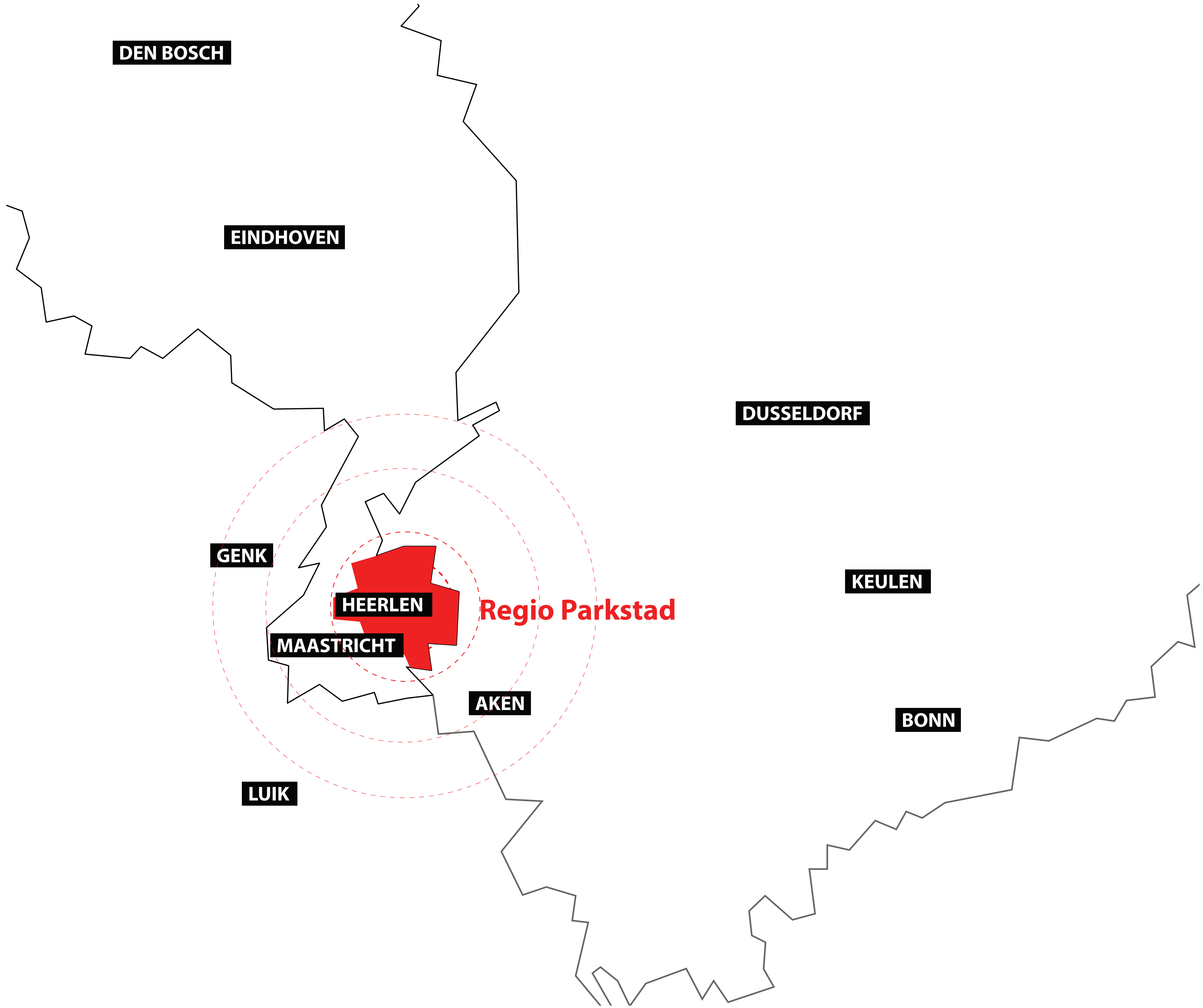
LANDSCAPE

BUILD

CONCLUSION

LOCATION IBA PARKSTAD


iba


DEN BOSCH
EINDHOVEN
DUSSELDORF
GENK
KEULEN
HEERLEN
Regio Parkstad
MAASTRICHT
AKEN
BONN
LUIK

NATURE

TOURISM

INDUSTRIAL HISTORY

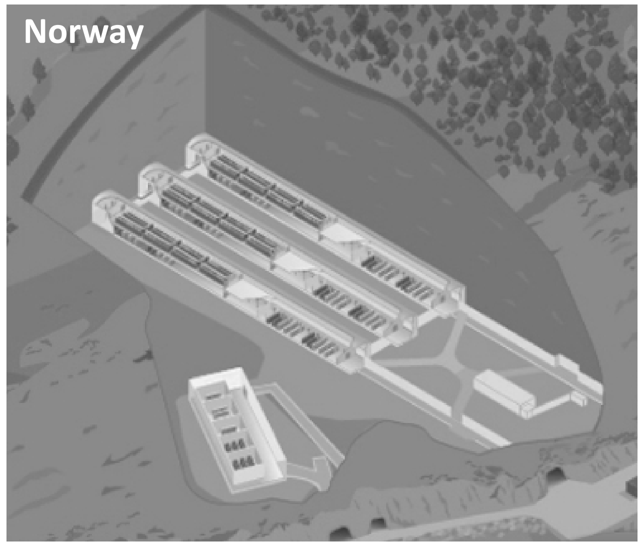
“Onder de noemer Open Oproep zocht IBA Parkstad de afgelopen maanden naar buitengewone ideeën om de Limburgse regio nog meer op de kaart te zetten”

RESEARCH





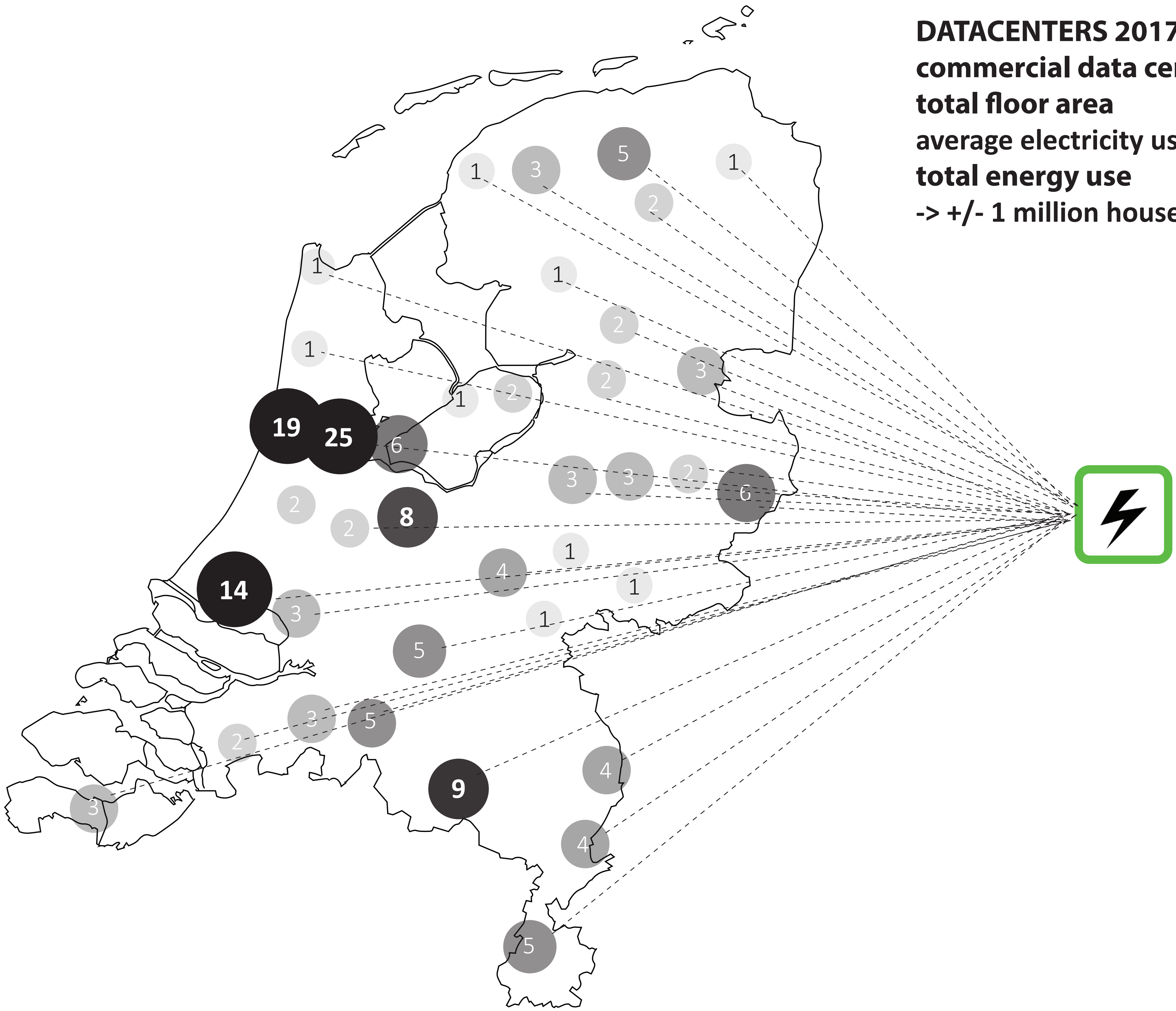
1. RESEARCH TYPOLOGY



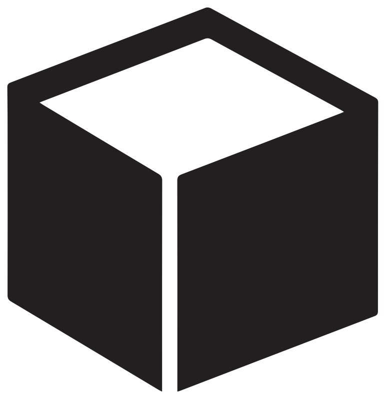
2. RESEARCH RESIDUAL HEAT

3. MAPPING DATA CENTERS

DATACENTERS 2017	
commercial data centers	**+/- 260**
total floor area	**+/- 770.000 m2**
average electricity use	+/- 3,46 MWh/m2/y
total energy use	**+/- 2,7 TWh/y**
-> +/- 1 million households	



= 1 million houses



1. ANONYMOUS BOX

2. SOURCE OF RESIDUAL HEAT

RESEARCH QUESTION

What are the challenges and opportunities for achieving energetic synergy by implementing a data center in **IBA-Parkstad** and **what requirements does this set for the architectural design**?

2. RESIDUAL HEAT USERS

Datacenter	Heat supply	Cold demand
Demand [kWh/year/m2]		21900
$T_{evaporator}$ [°C]	35 °C	
$T_{condensor}$ [°C]	45 °C	

Office buildings	Heat demand	Cold demand
Demand [kWh/year/m2]	44 - 127	6,1
Demand hours per year [h]	2618	441
Equivalent peak hours [h]	321	126
Peak demand [W/m2]	137	49
$T_{condensor}$ [°C]	45°C	
Required temperature	18 °C - 23 °C	

Congress buildings	Heat demand	Cold demand
Demand [kWh/year/m2]	141	4,6
Demand hours per year [h]	4210	445
Equivalent peak hours [h]	833	86
Peak demand [W/m2]	169	53
$T_{condensor}$ [°C]	45°C	
Required temperature	x	

Housing	Heat demand	Cold demand
Demand [kWh/year/m2]	48,5	
Demand hours per year [h]	x	
Equivalent peak hours [h]	1200	
Peak demand [W/m2]	40,4	
$T_{condensor}$ [°C]	45°C	
Required temperature	18 °C - 23 °C	

Healthcare buildings	Heat demand	Cold demand
Demand [kWh/year/m2]	84	4,9
Demand hours per year [h]	3792	334
Equivalent peak hours [h]	778	128
Peak demand [W/m2]	108	38
$T_{condensor}$ [°C]	45°C	
Required temperature	x	

Swimming pools	Heat demand	Cold demand
Demand [kWh/year/m2]	459 - 1500	
Demand hours per year [h]	8760	
Equivalent peak hours [h]	3648	
Peak demand [W/m2]	126	
$T_{condensor}$ [°C]	x	
Required temperature	28°C - 32°C	

Sports buildings	Heat demand	Cold demand
Demand [kWh/year/m2]	55	22,6
Demand hours per year [h]	3783	613
Equivalent peak hours [h]	709	205
Peak demand [W/m2]	78	111
$T_{condensor}$ [°C]	45°C	
Required temperature	15°C - 25°C	

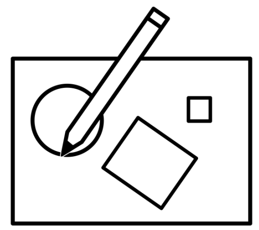
Schools	Heat demand	Cold demand
Demand [kWh/year/m2]	102	3,45
Demand hours per year [h]	1143	232
Equivalent peak hours [h]	432	276
Peak demand [W/m2]	237	45
$T_{condensor}$ [°C]	45°C	
Required temperature	x	

Fish farms	Heat demand	Cold demand
Demand [kWh/year/m2]	3305	
Demand hours per year [h]	8760	
Equivalent peak hours	x	
Peak demand [W/m2]	x	
$T_{condensor}$ [°C]	x	
Required temperature	30°C	

Greenhouses	Heat demand	Cold demand
Demand [kWh/year/m2]	518	495
Demand hours per year [h]	x	x
Equivalent peak hours [h]	2590	848
Peak demand [W/m2]	200	584
$T_{condensor}$ [°C]	45 °C	
Required temperature	x	

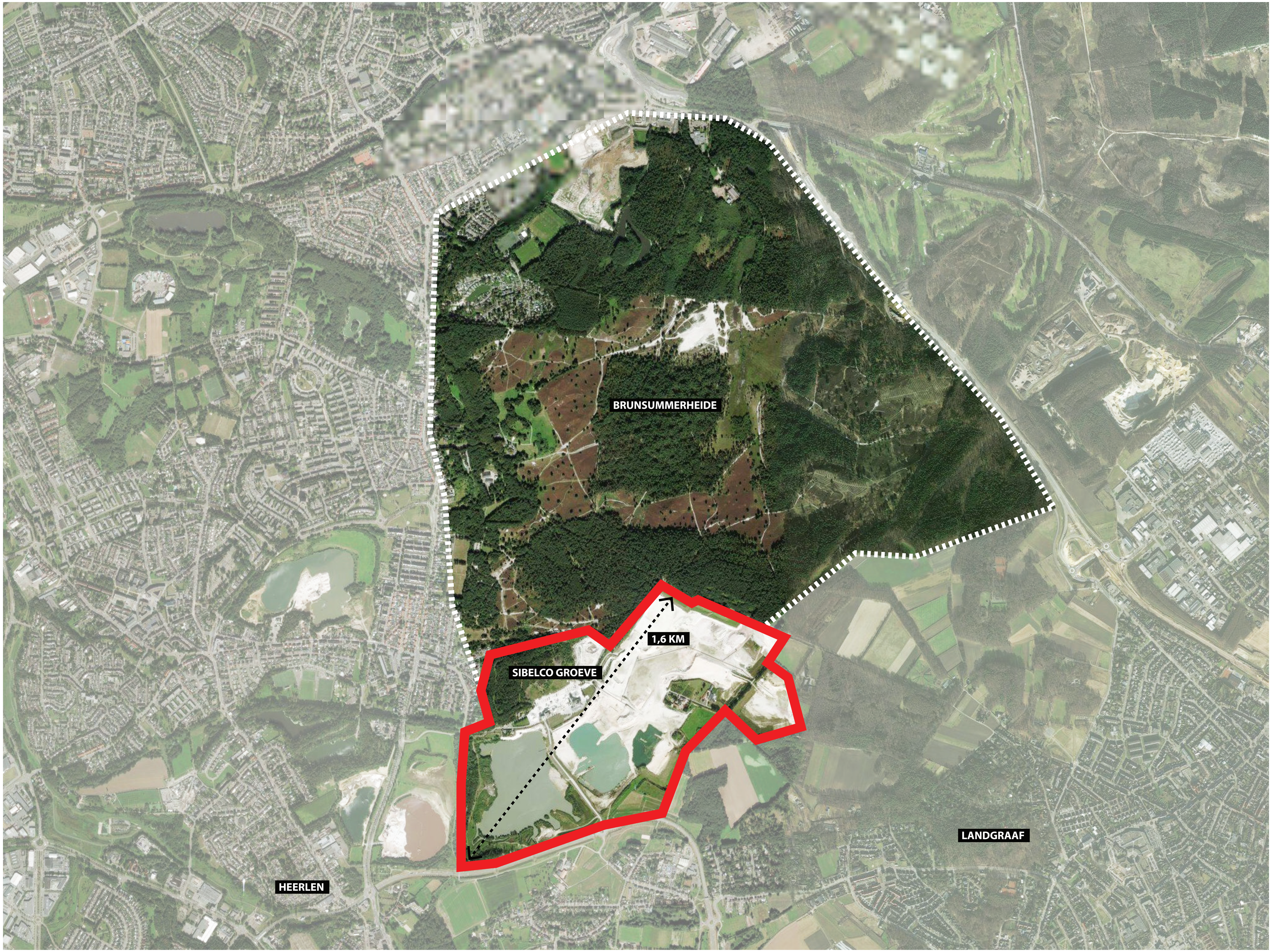
Algae farms	Heat demand	Cold demand
Demand [kWh/year/m2]	x	
Demand hours per year [h]	8760	
Equivalent peak hours [h]	x	
Peak demand [W/m2]	x	
$T_{condensor}$ [°C]	x	
Required temperature	25°C - 28 °C	

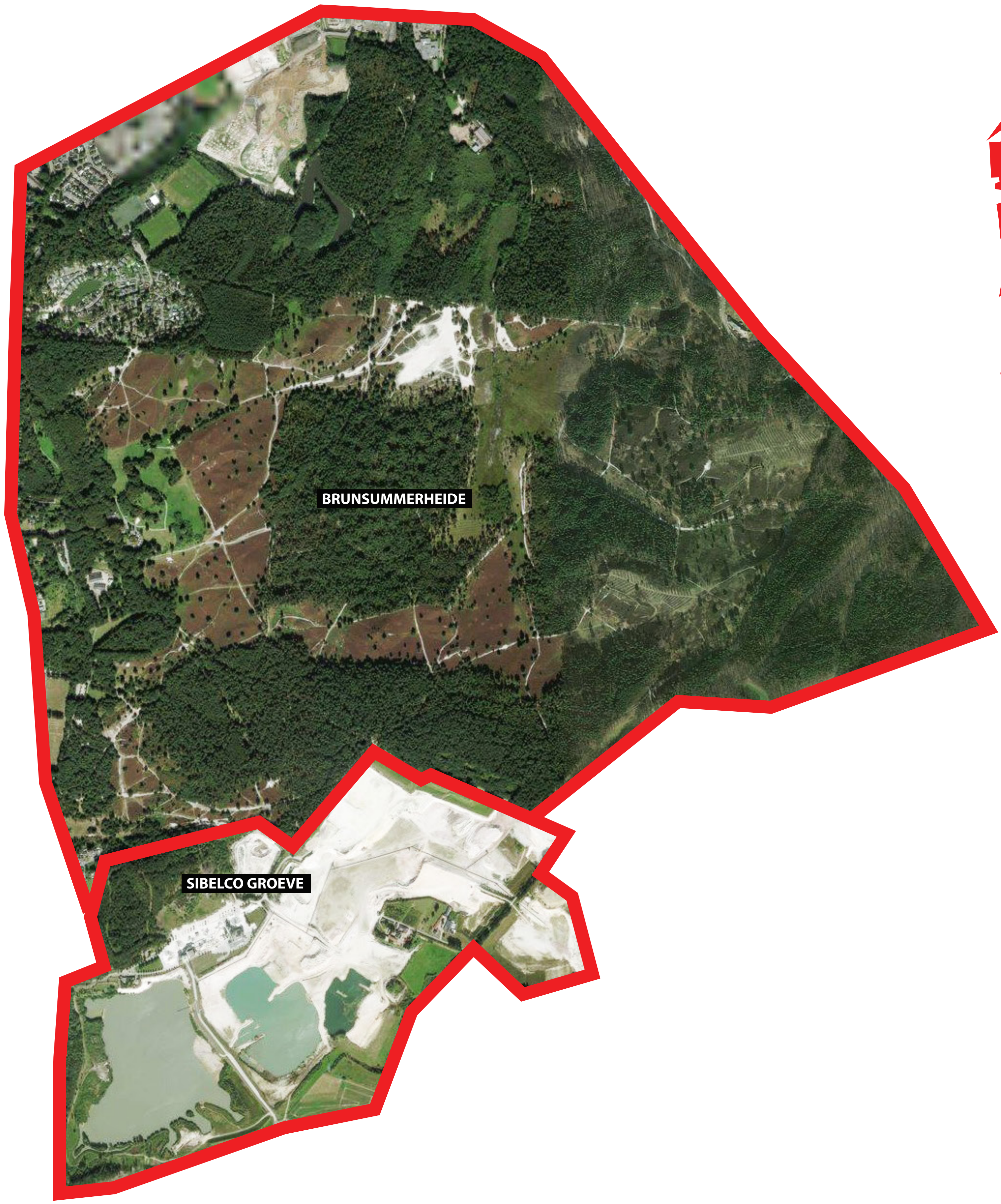
OVERALL DESIGN QUESTION

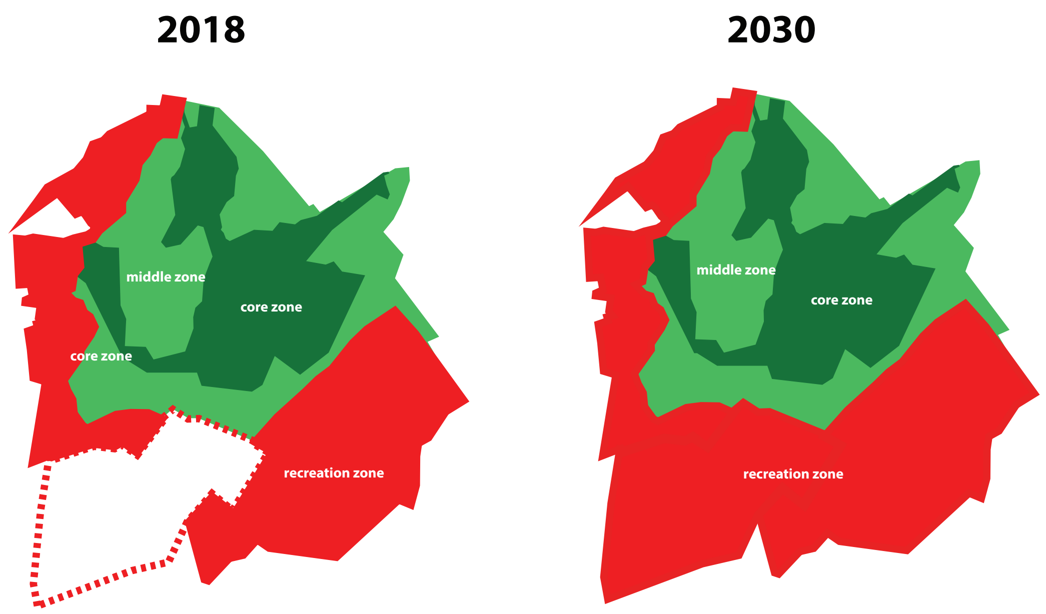


How can a datacenter manifest its societal importance in the public realm and **what** opportunities does this offer for architectural, urban and energetic synergies in IBA-Parkstad?


ONDERBANKEN
BRUNSSUM
NUTH
LANDGRAAF
HEERLEN
KERKRADE
VOERENDAAL
SIMPELVELD

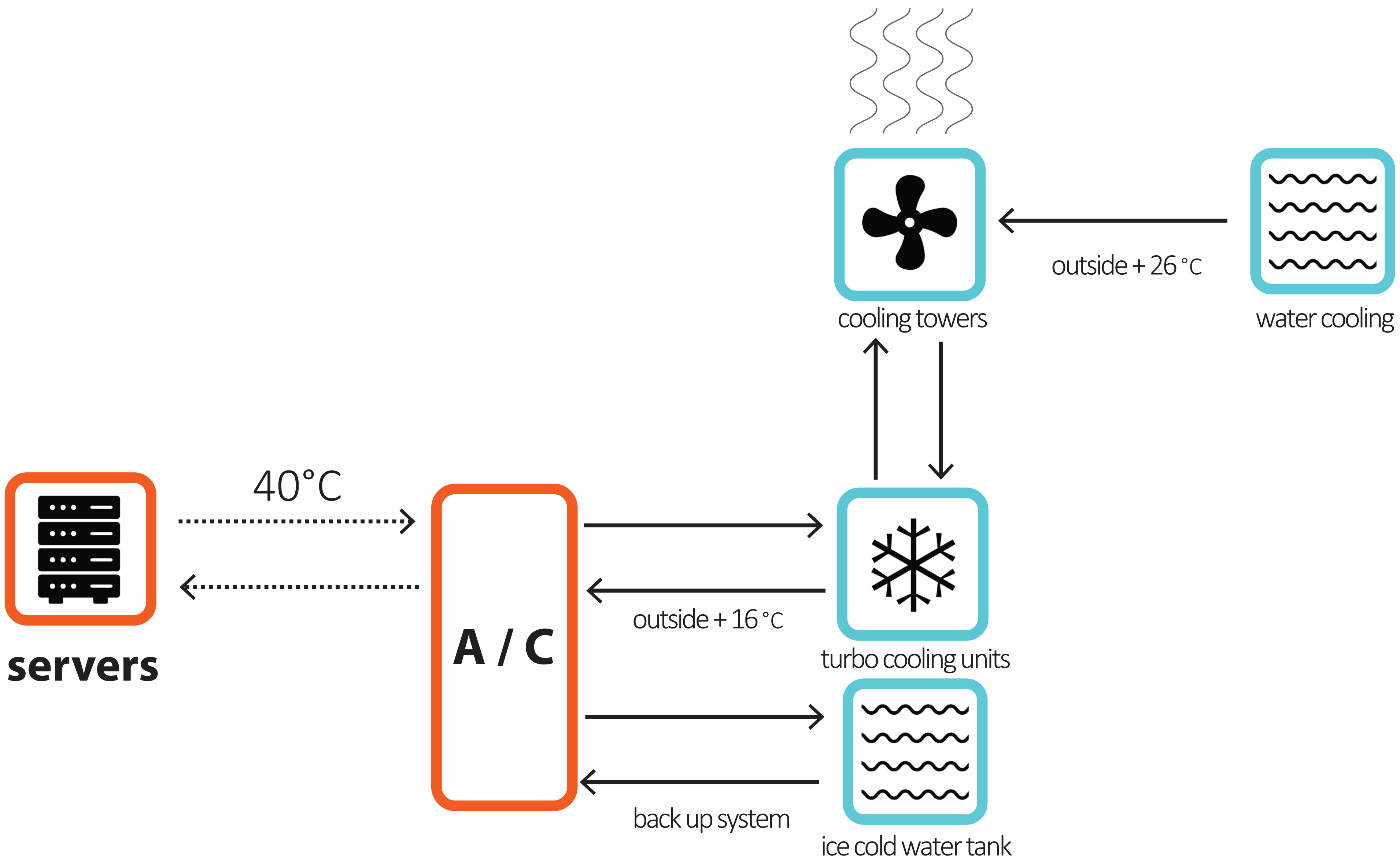

BRUNSUMMERHEIDE
1,6 KM
SIBELCO GROEVE
LANDGRAAF
HEERLEN


BRUNSUMMERHEIDE
SIBELCO GROEVE

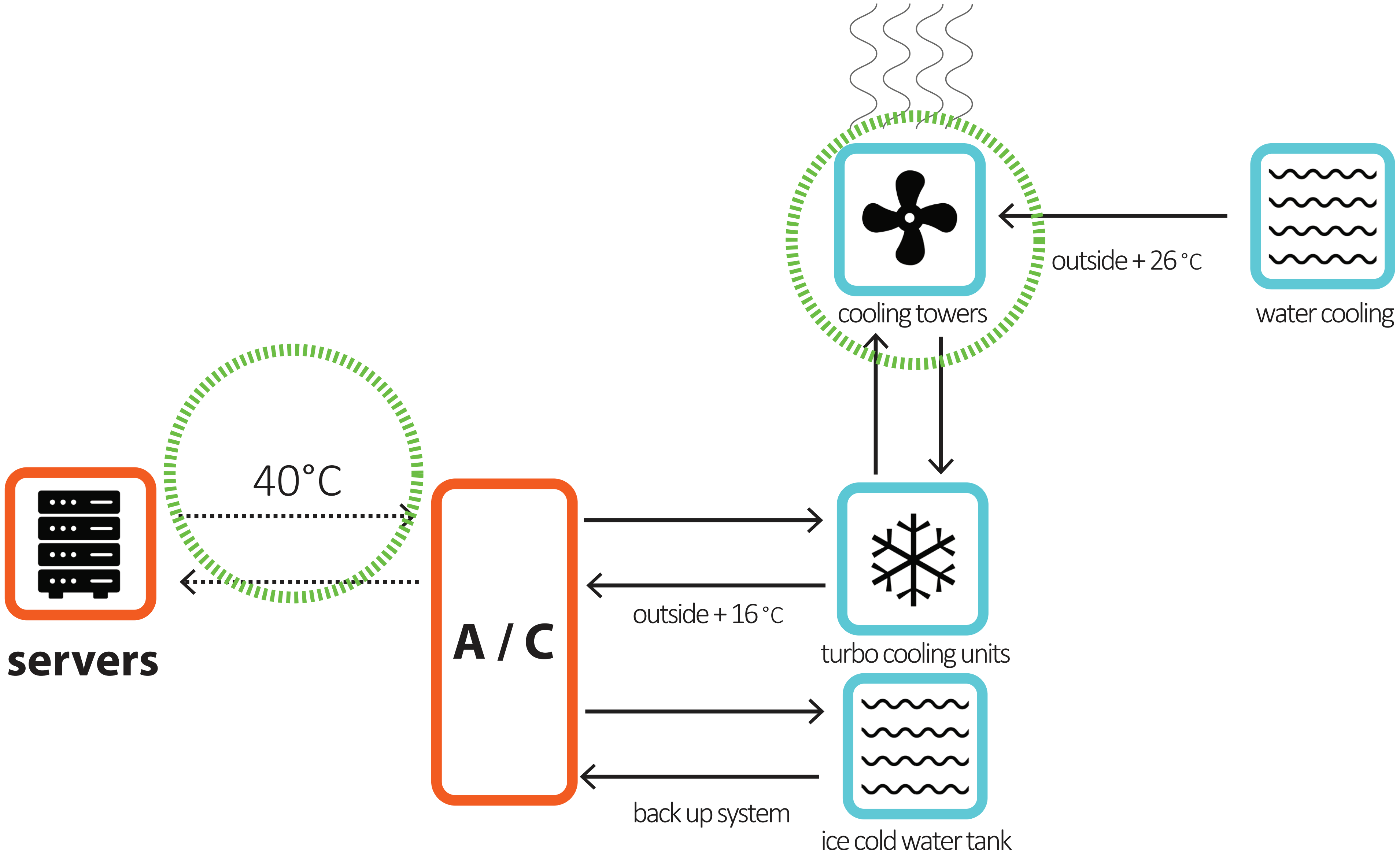

2018
middle zone
core zone
core zone
recreation zone
2030
middle zone
core zone
recreation zone


2017

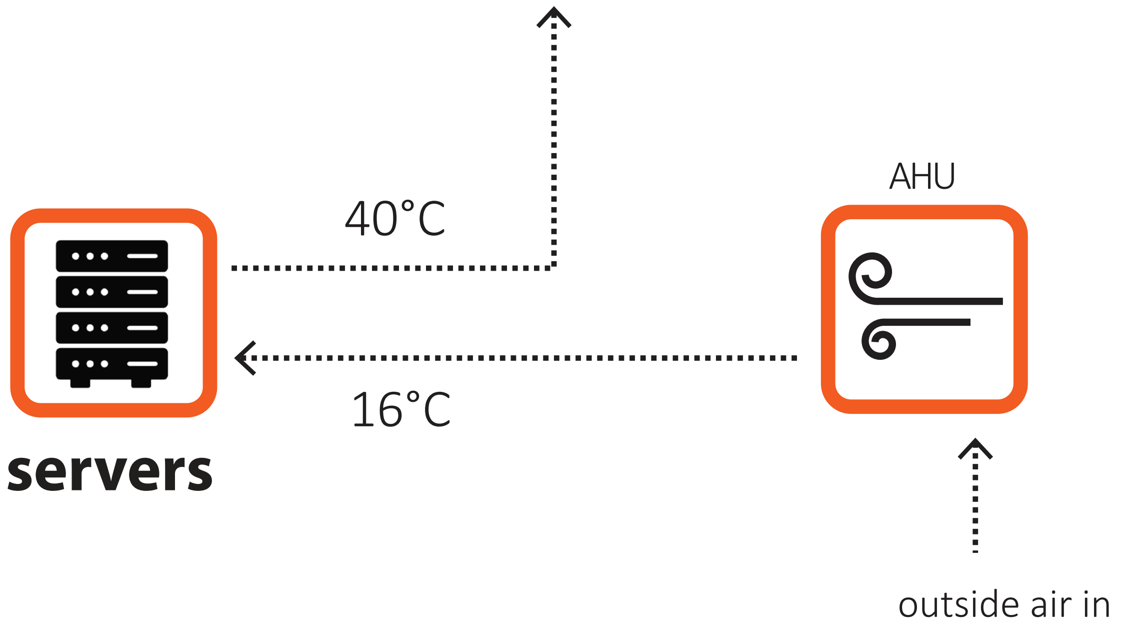

2030



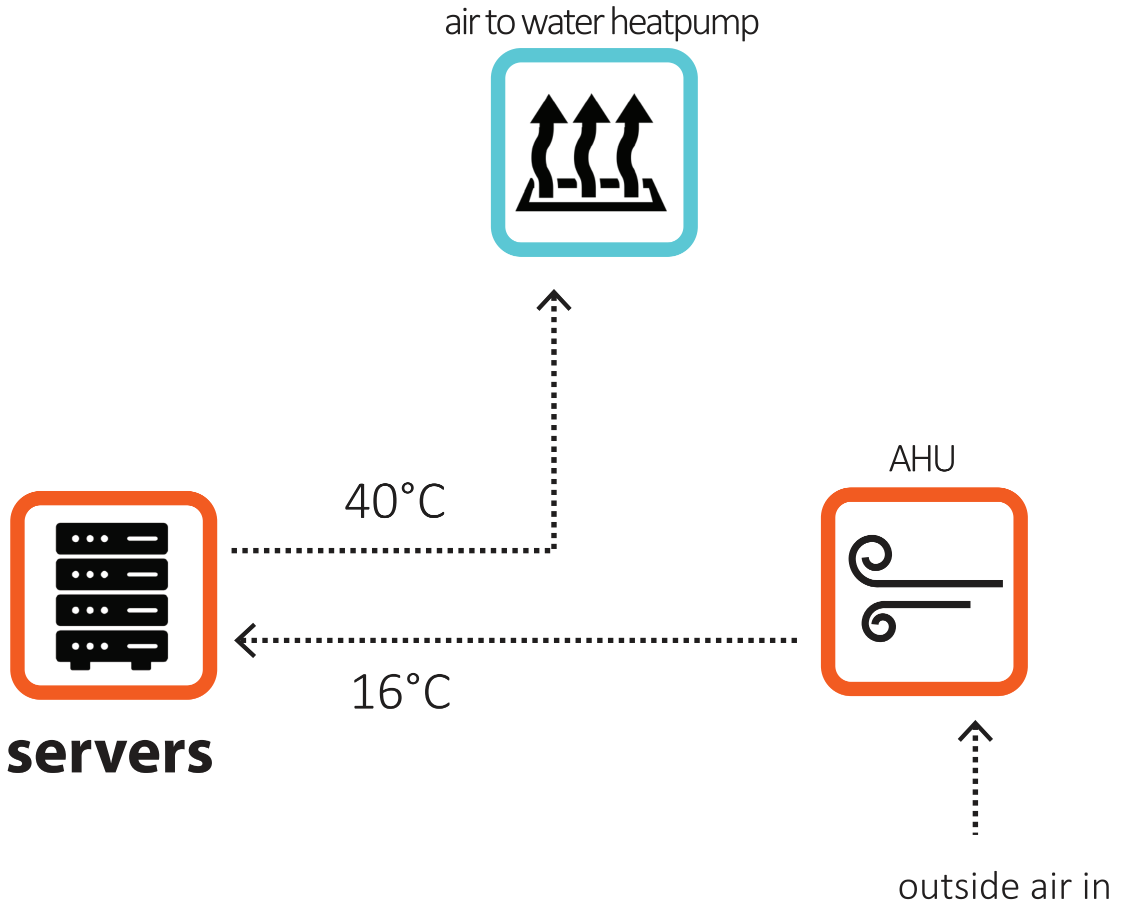
DATA CENTER EXISTING SITUATION



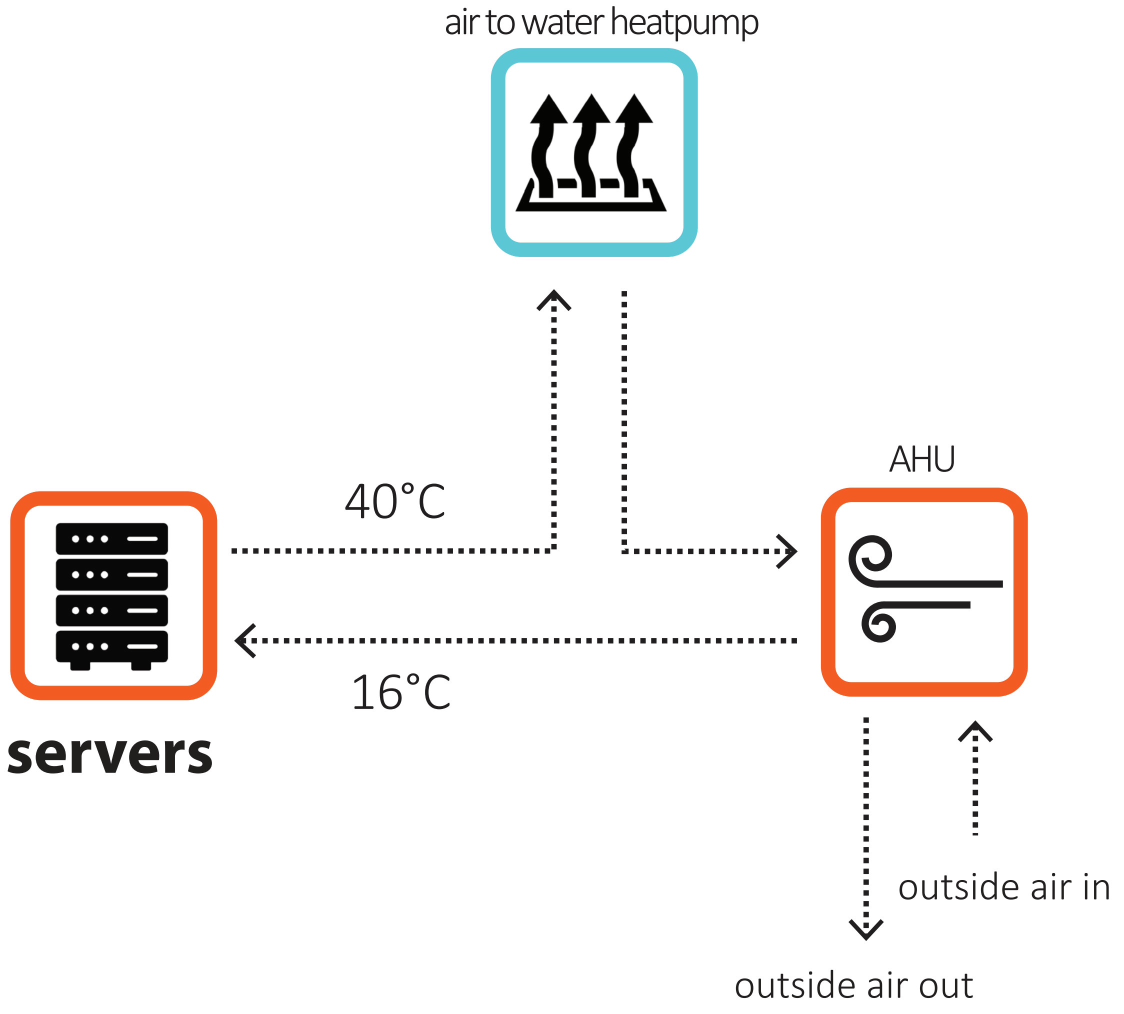
DATA CENTER EXISTING SITUATION



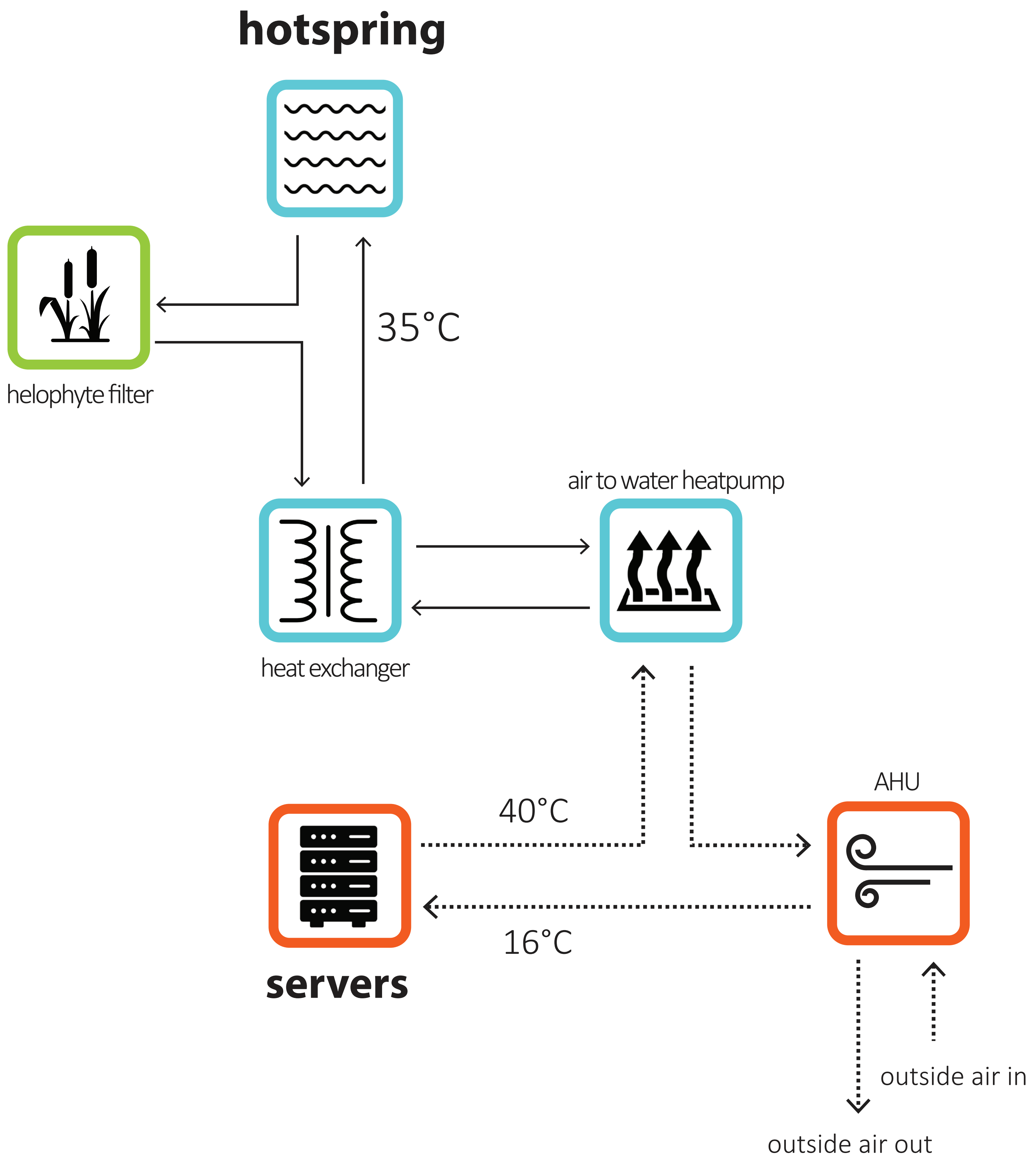
DATA CENTER WITH HOTSPRING



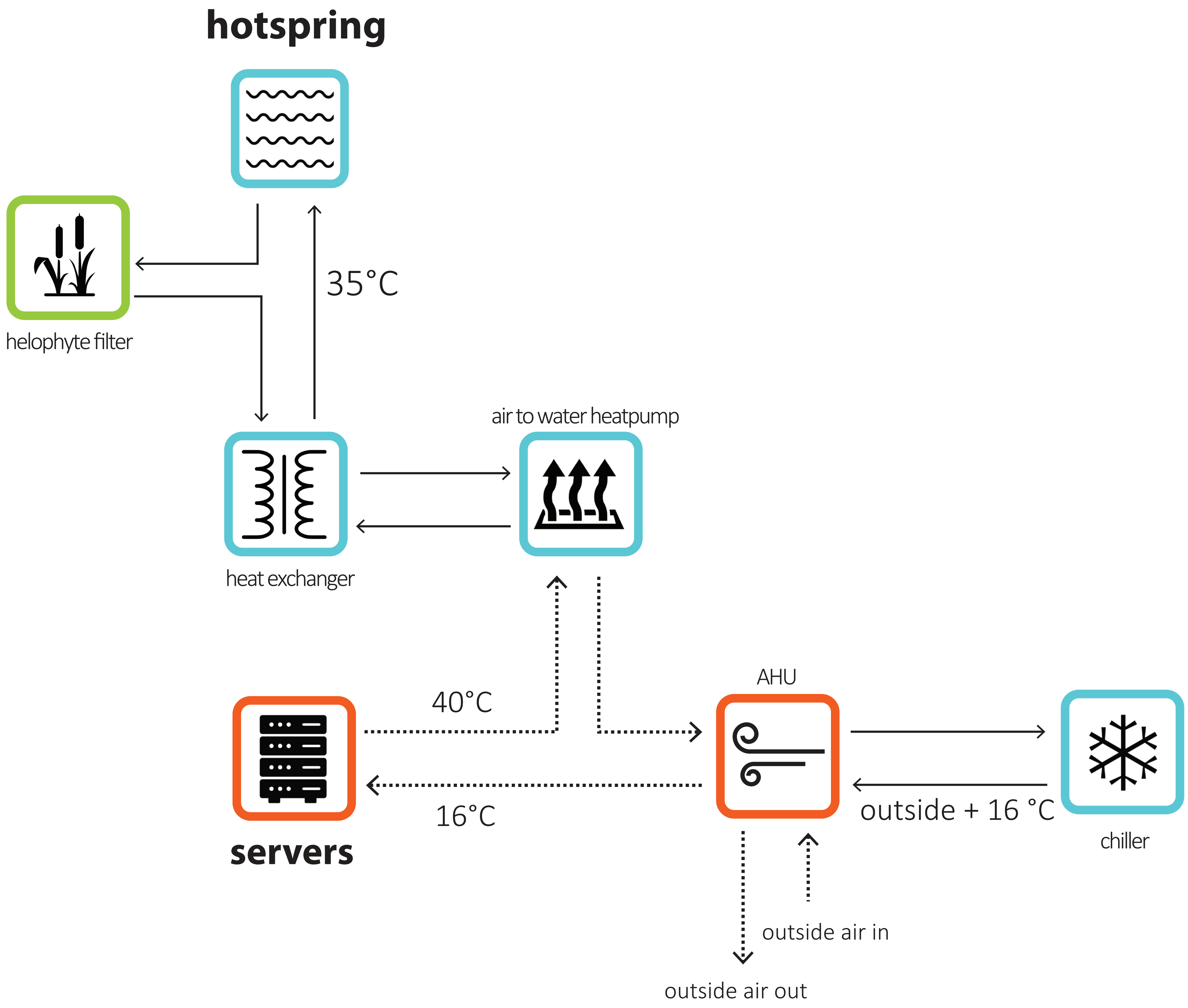
DATA CENTER WITH HOTSPRING



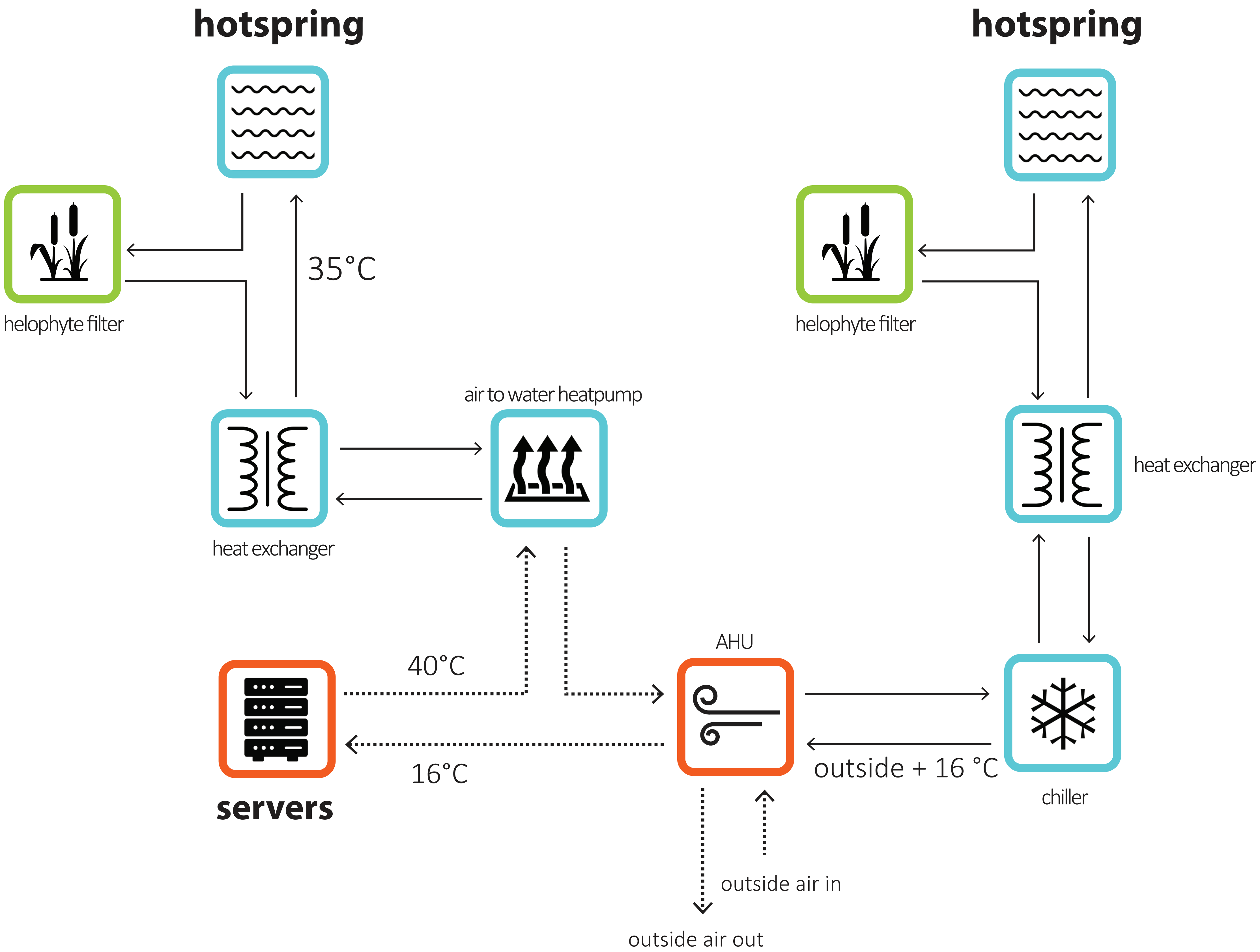
DATA CENTER WITH HOTSPRING



DATA CENTER WITH HOTSPRING

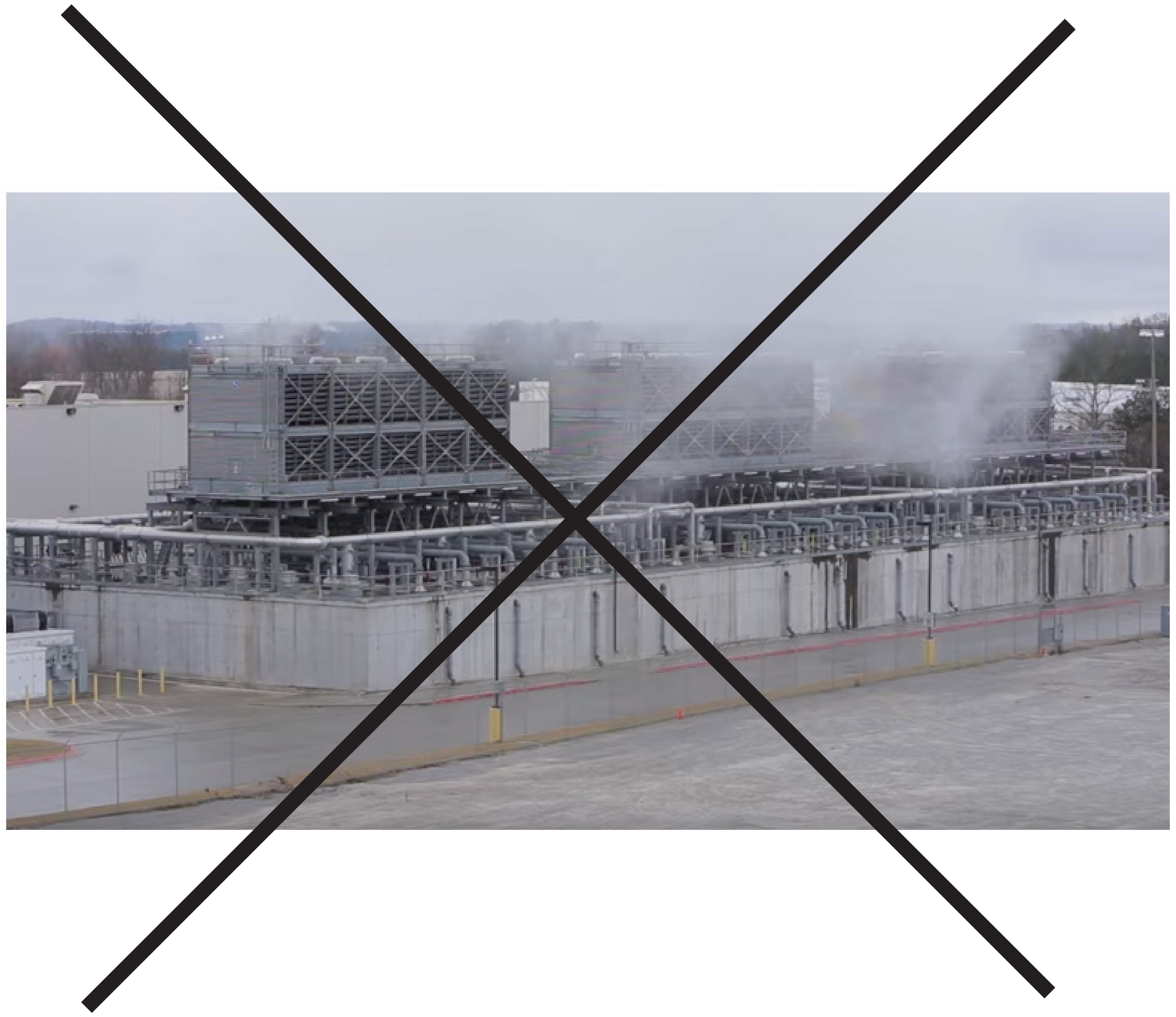


DATA CENTER WITH HOTSPRING



DATA CENTER WITH HOTSPRING

COOLING TOWERS



COOLING TOWERS

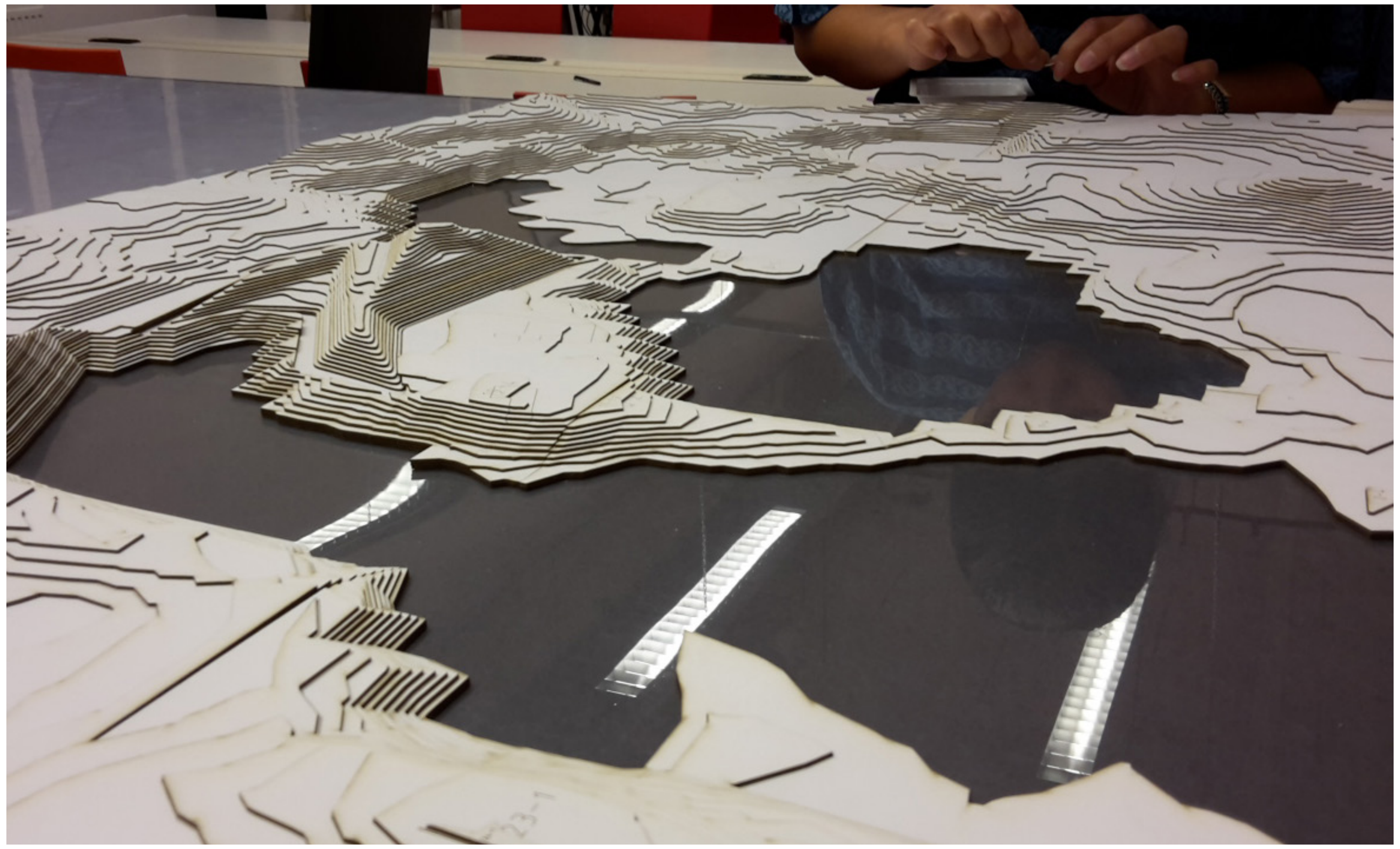
HOT SPRING

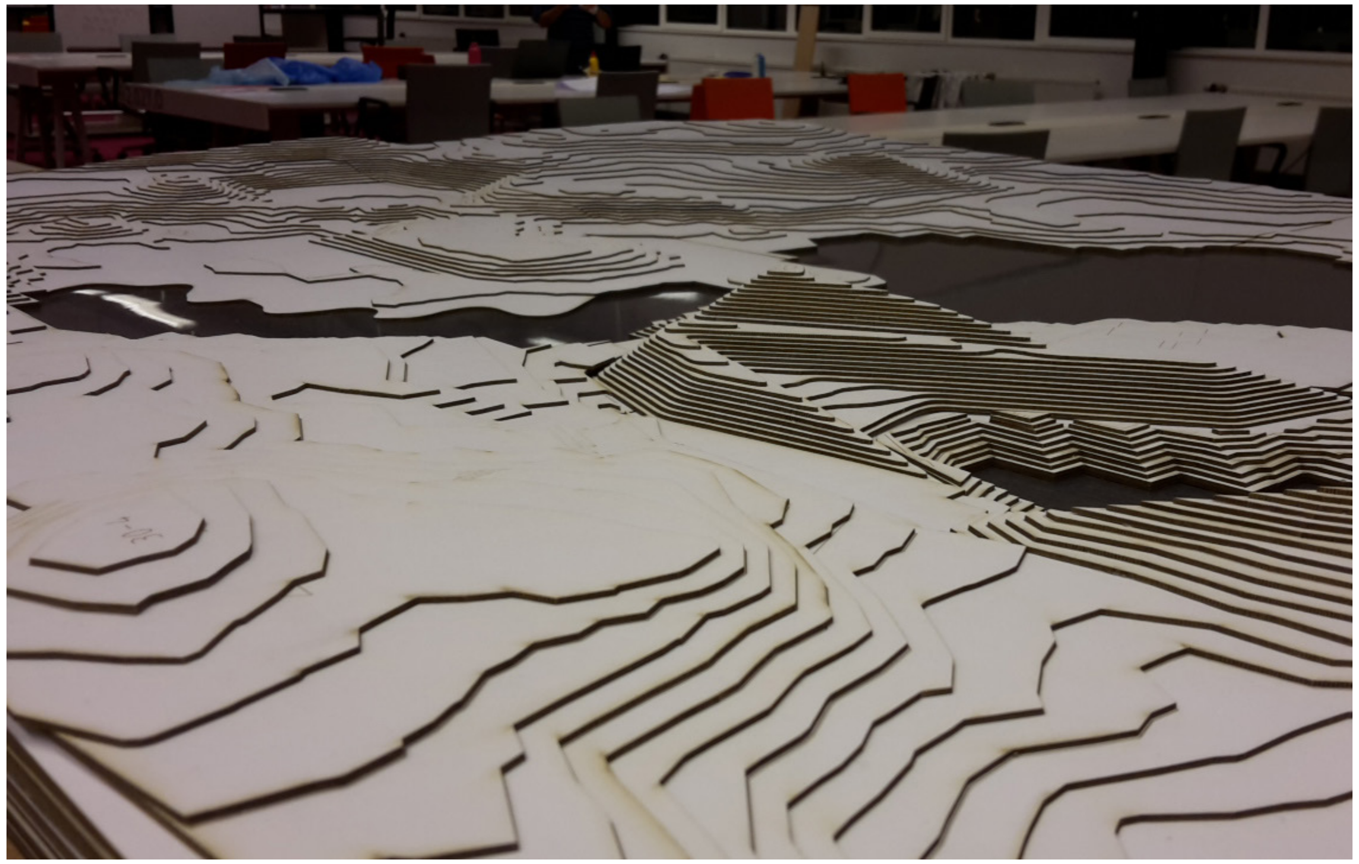
DESIGN

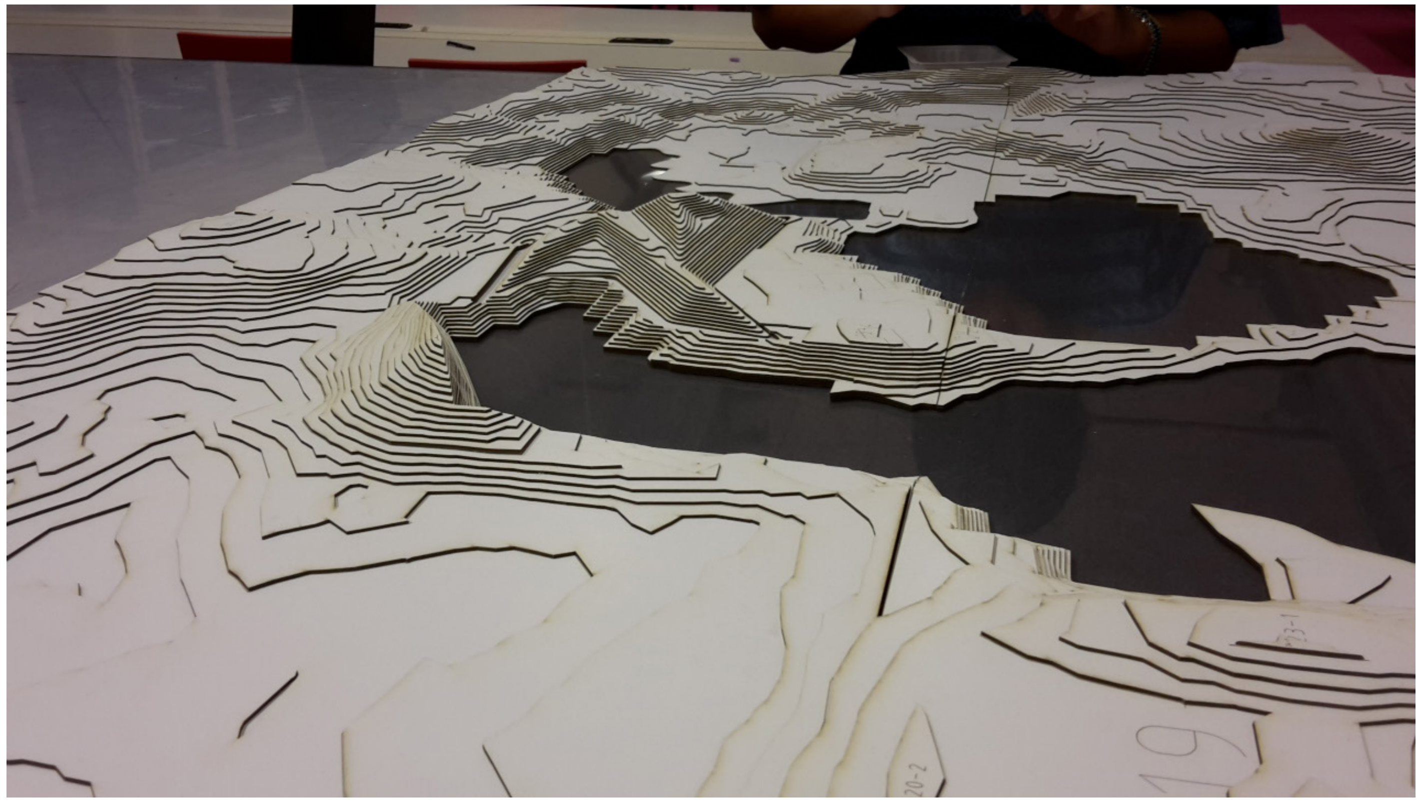

Mattheeuws
ALDERS
3
4

DESIGN LOCATION

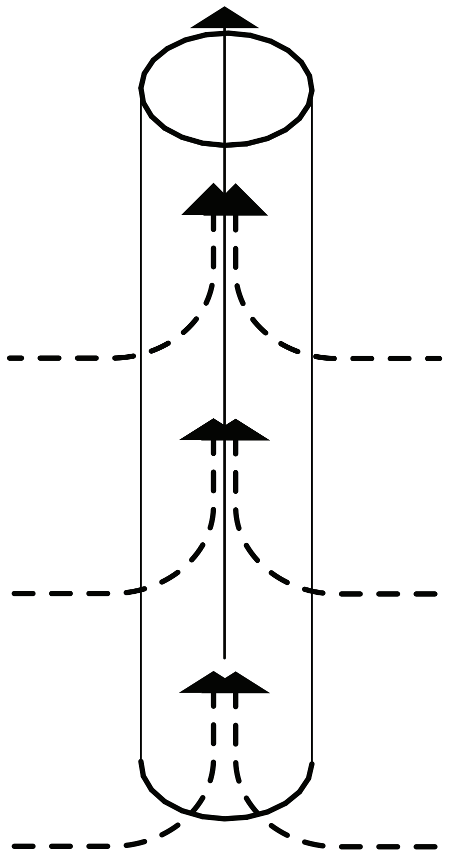
MODELLING STUDY OF LANDSCAPE





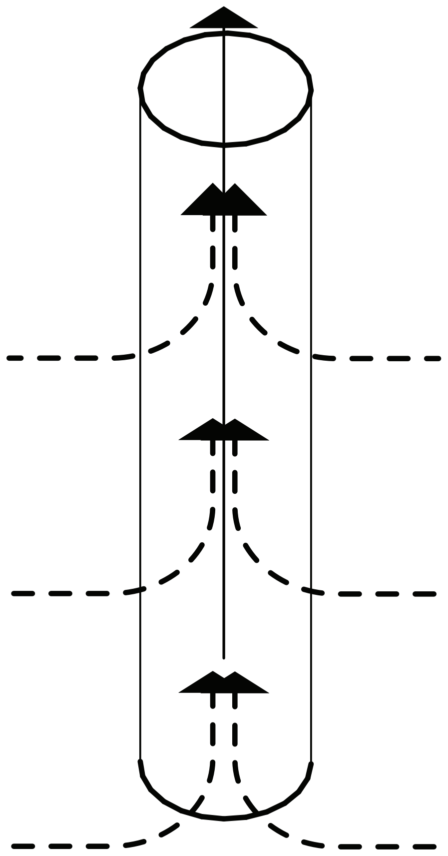


1. FORMING THE TOWER

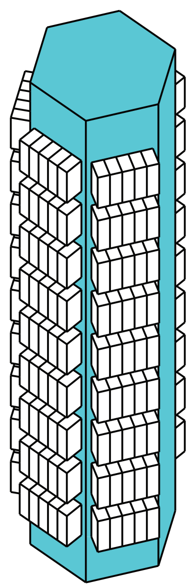


thermal core for updraft heat

1. FORMING THE TOWER

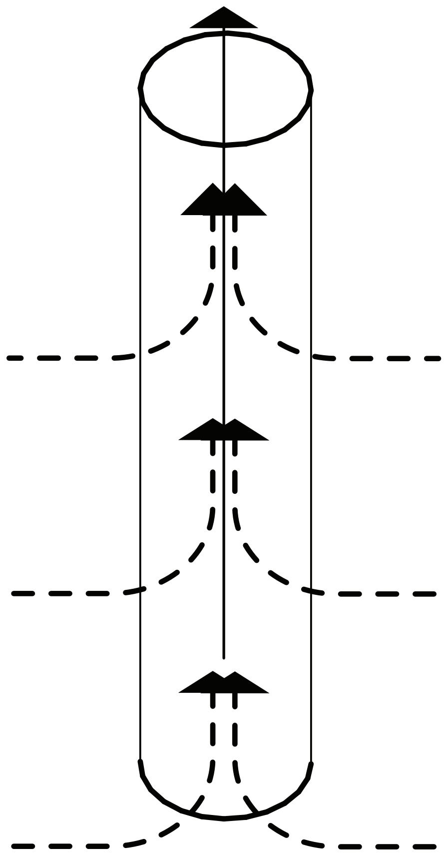


thermal core for updraft heat

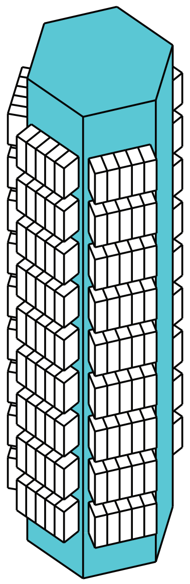


shaping the core to a hexagon for maximum surface thermal core...

1. FORMING THE TOWER



thermal core for updraft heat



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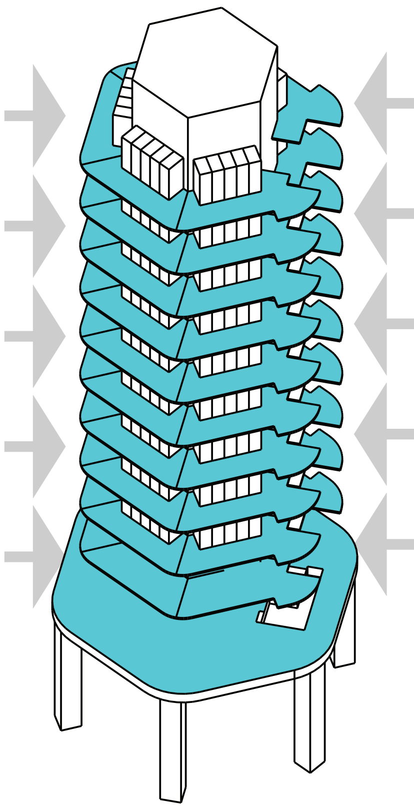
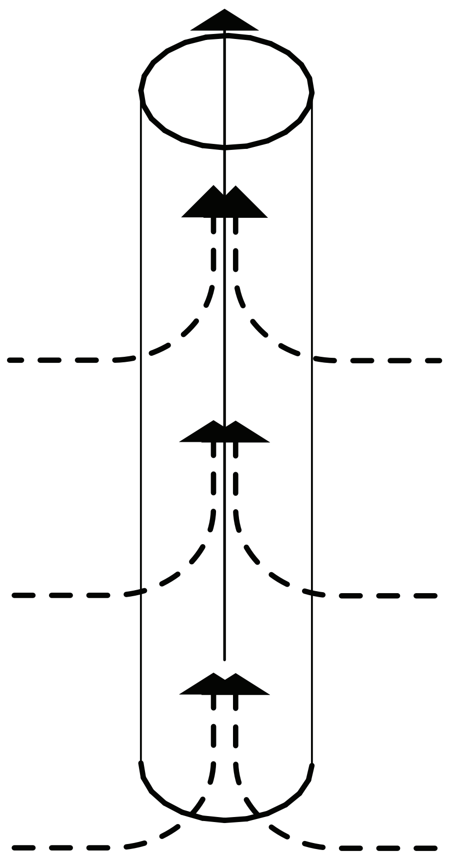
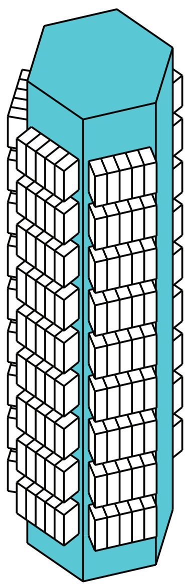


create a cold ring around the thermal core to cool the servers...

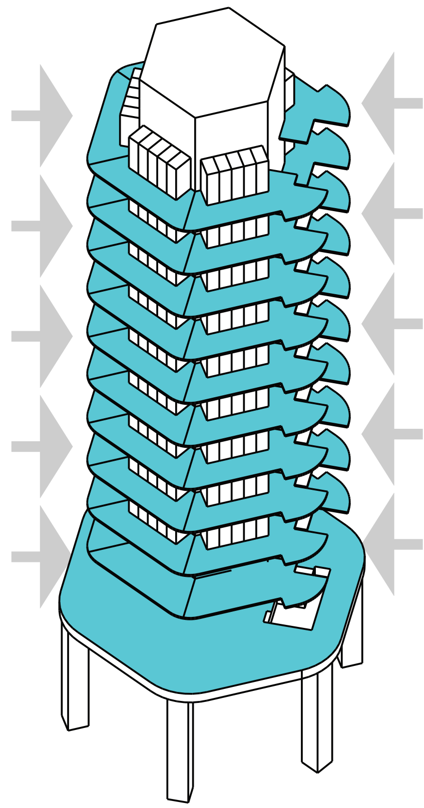
1. FORMING THE TOWER



thermal core for updraft heat



shaping the core to a hexagon for maximum surface thermal core...



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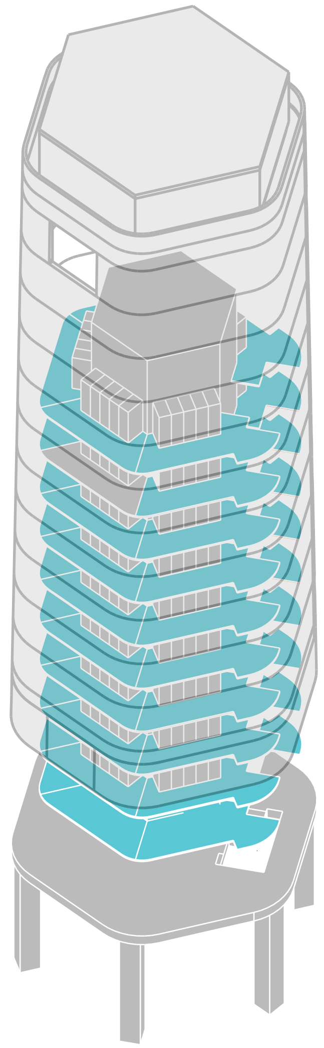
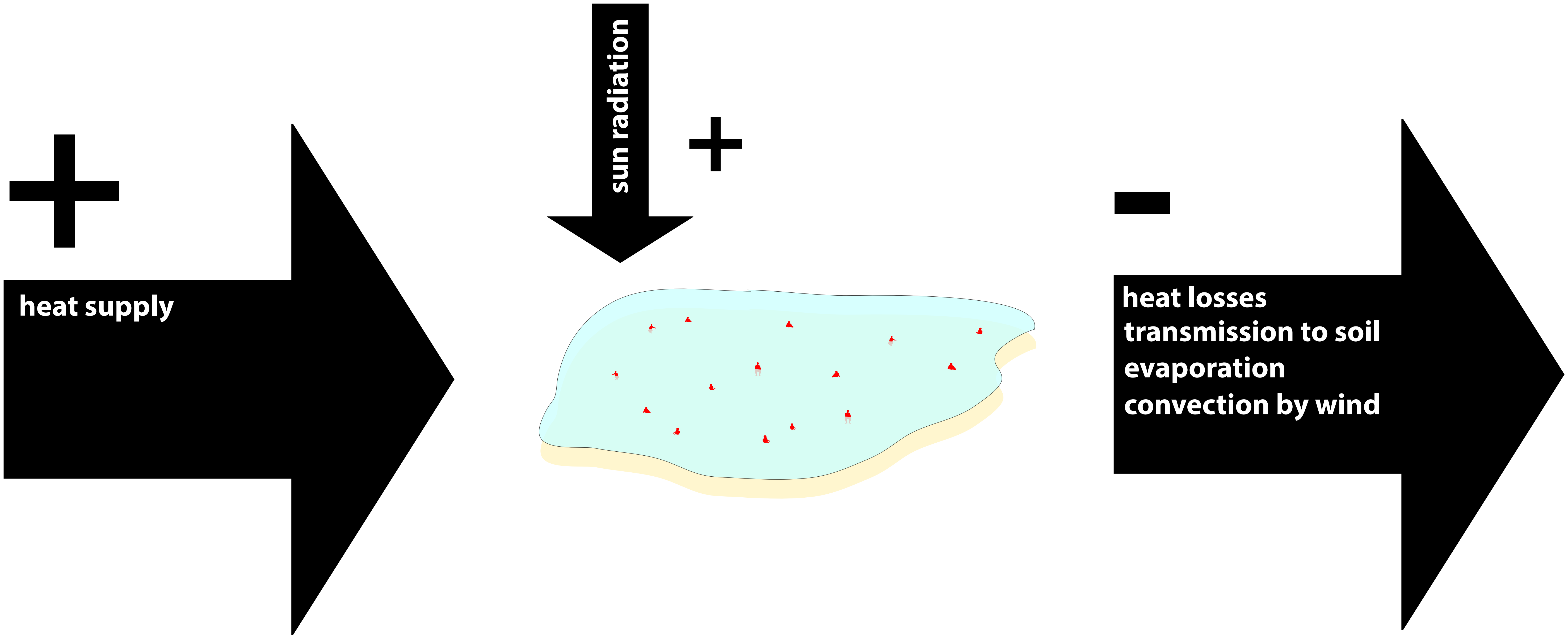
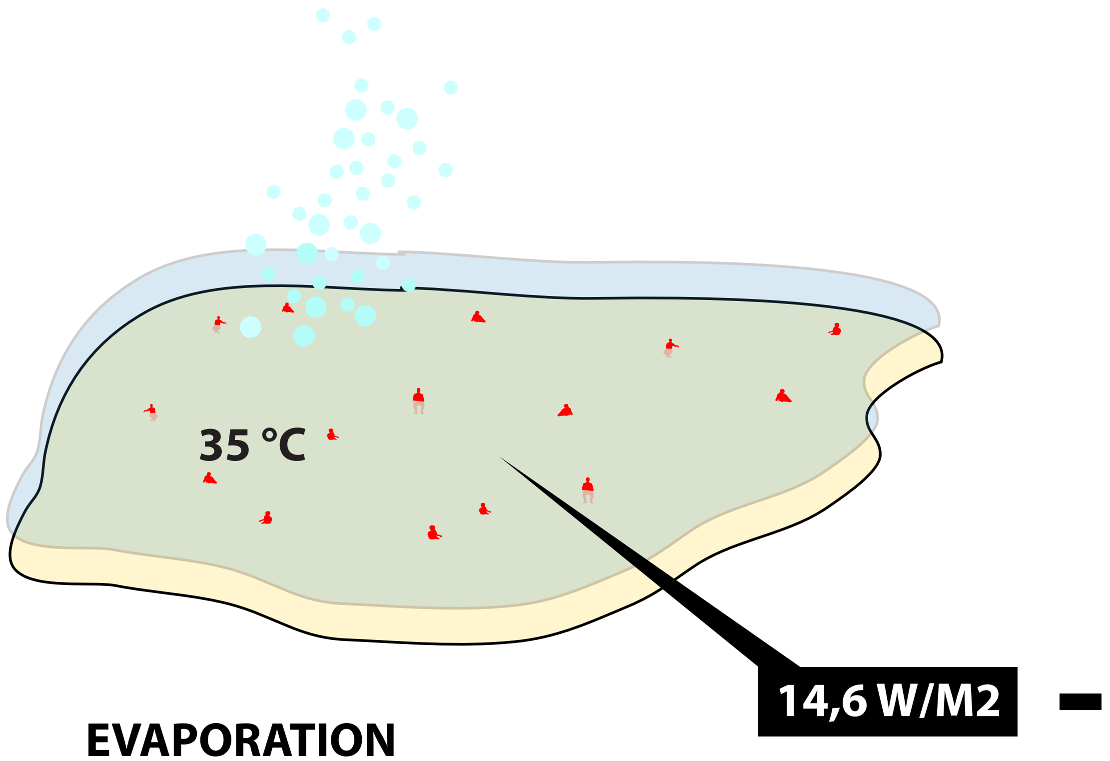


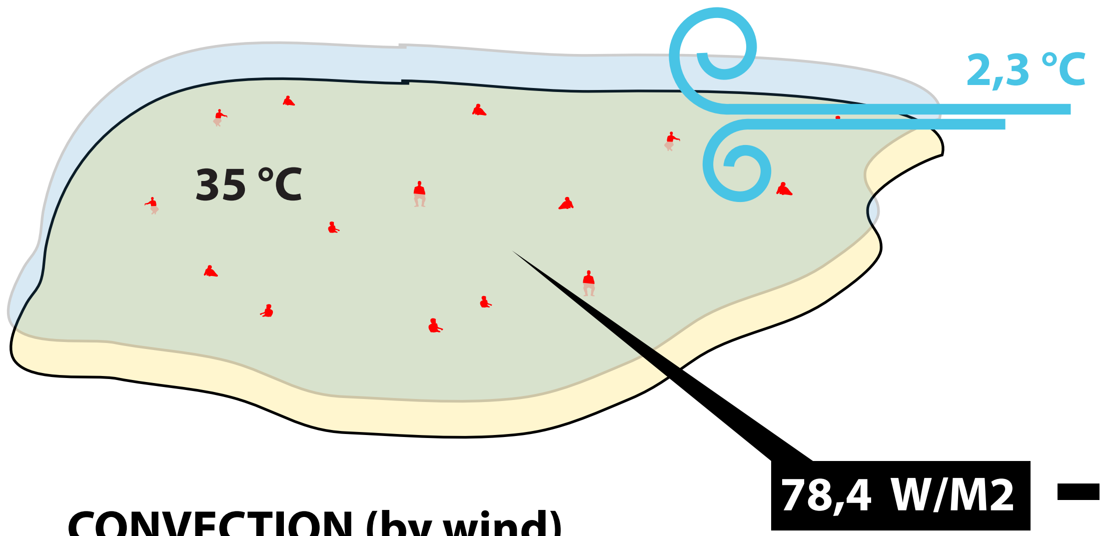
use loadbearing shell to create open floorplan and regulate climate inside...

2. RATIO DATA CENTER - HOTSPRING

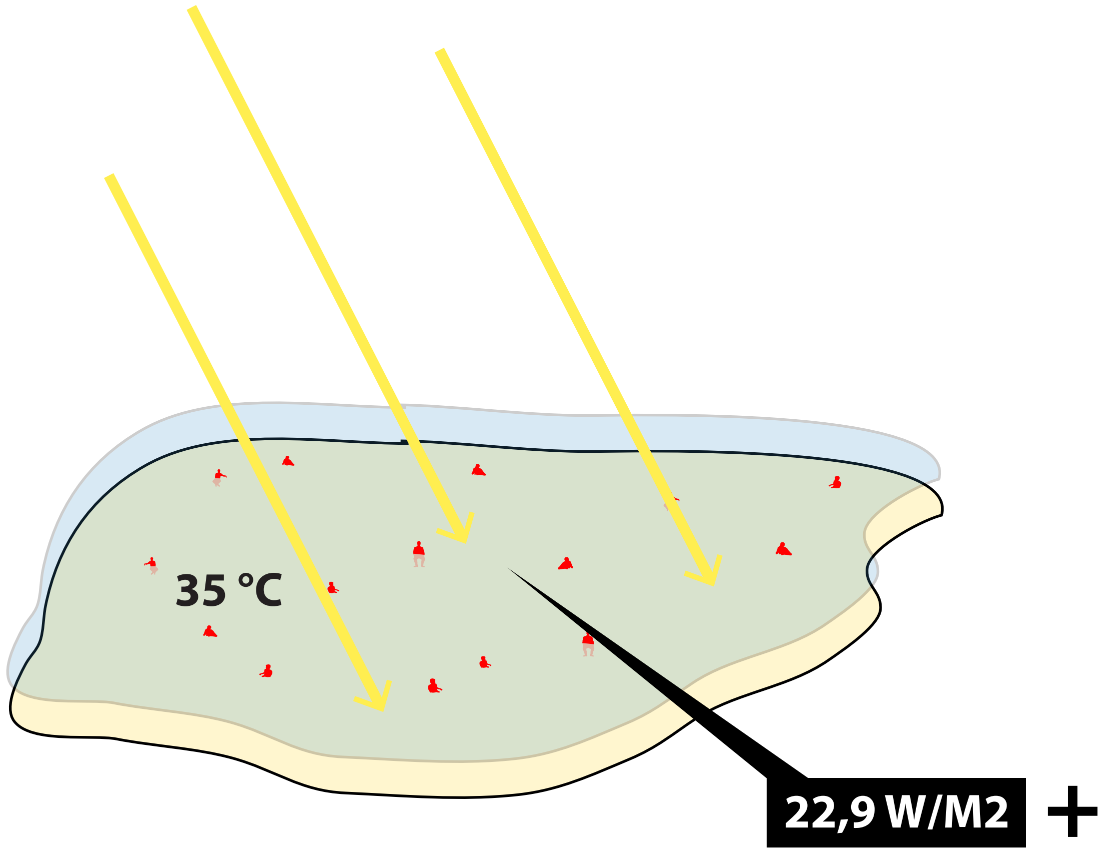




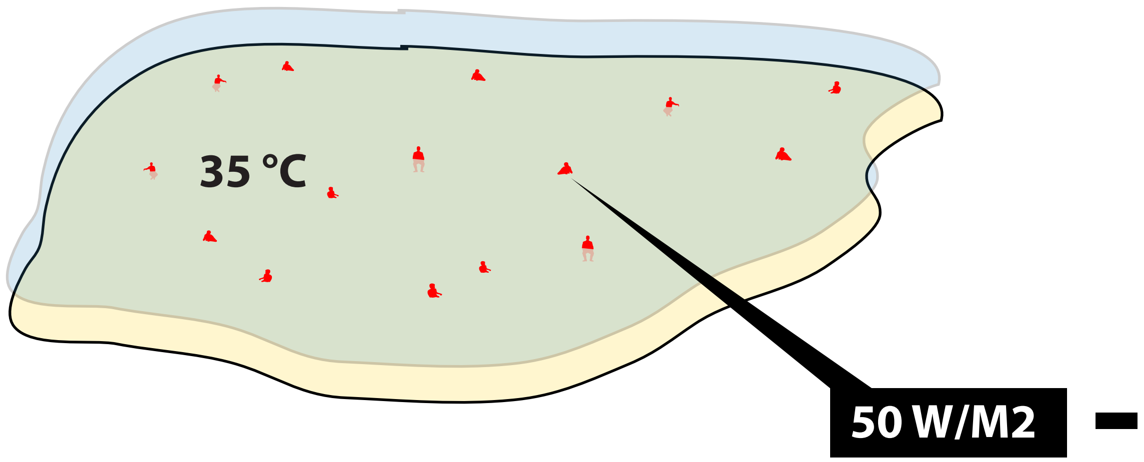
EVAPORATION



CONVECTION (by wind)



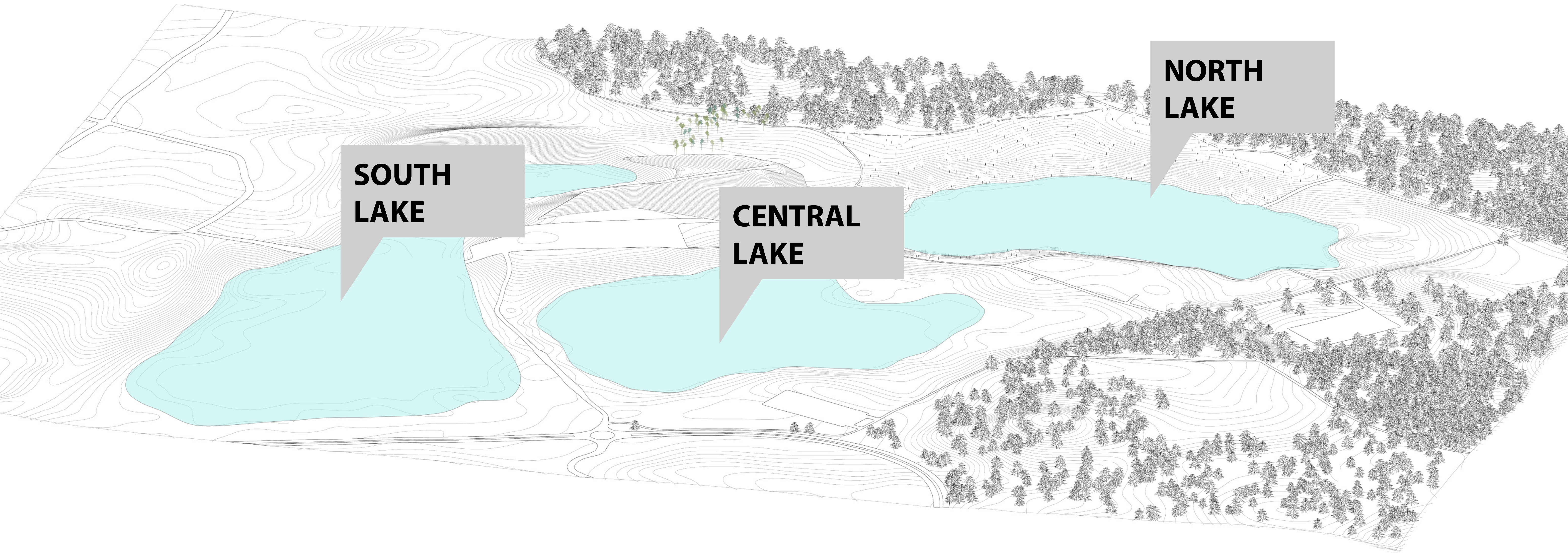
SUN RADIATION



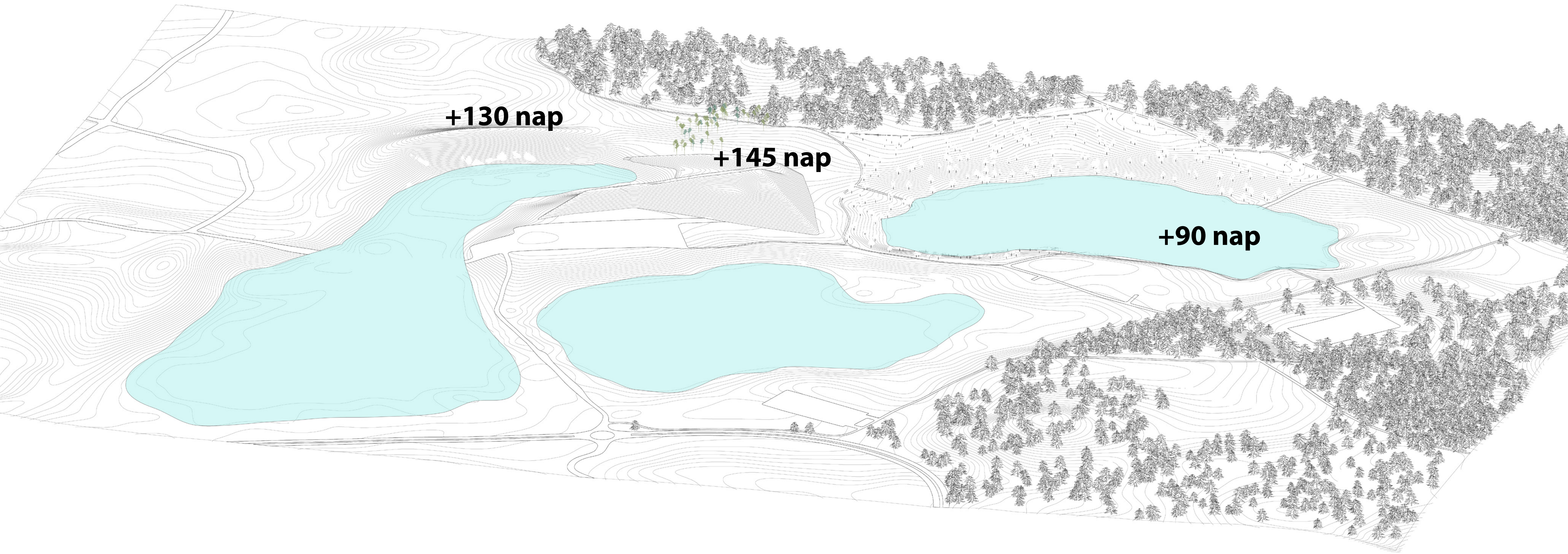
TRANSMISSION (to soil)

LANDSCAPE

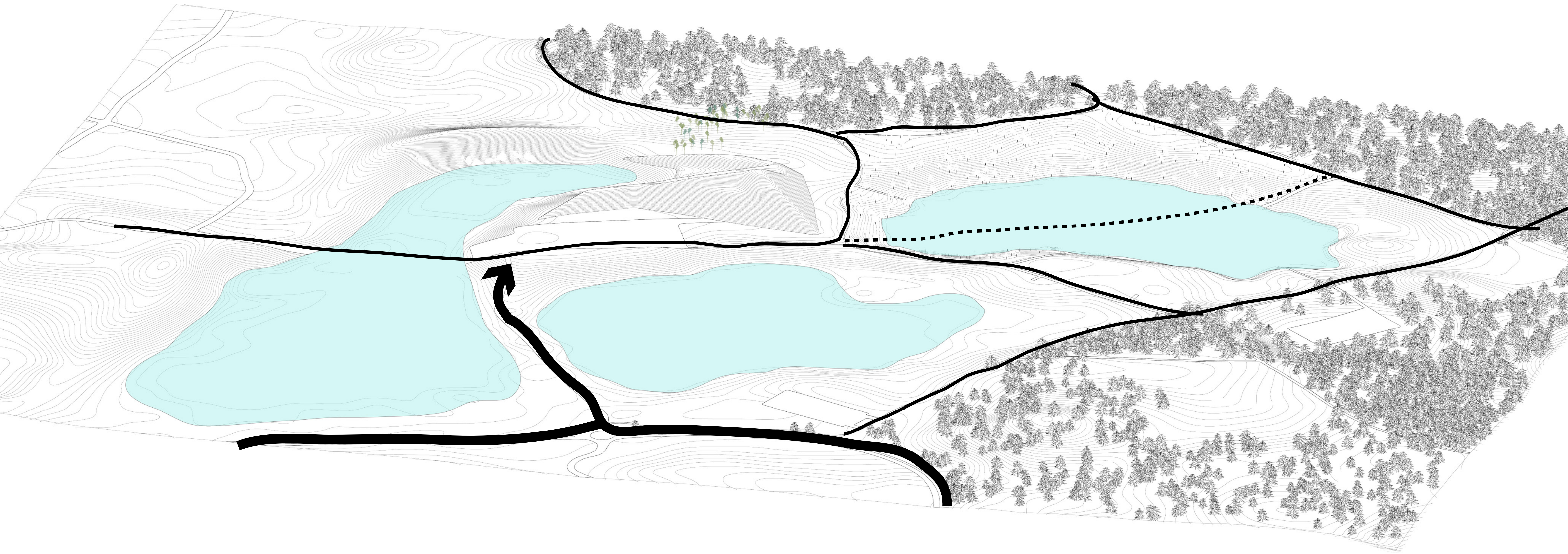
SITUATION 2017



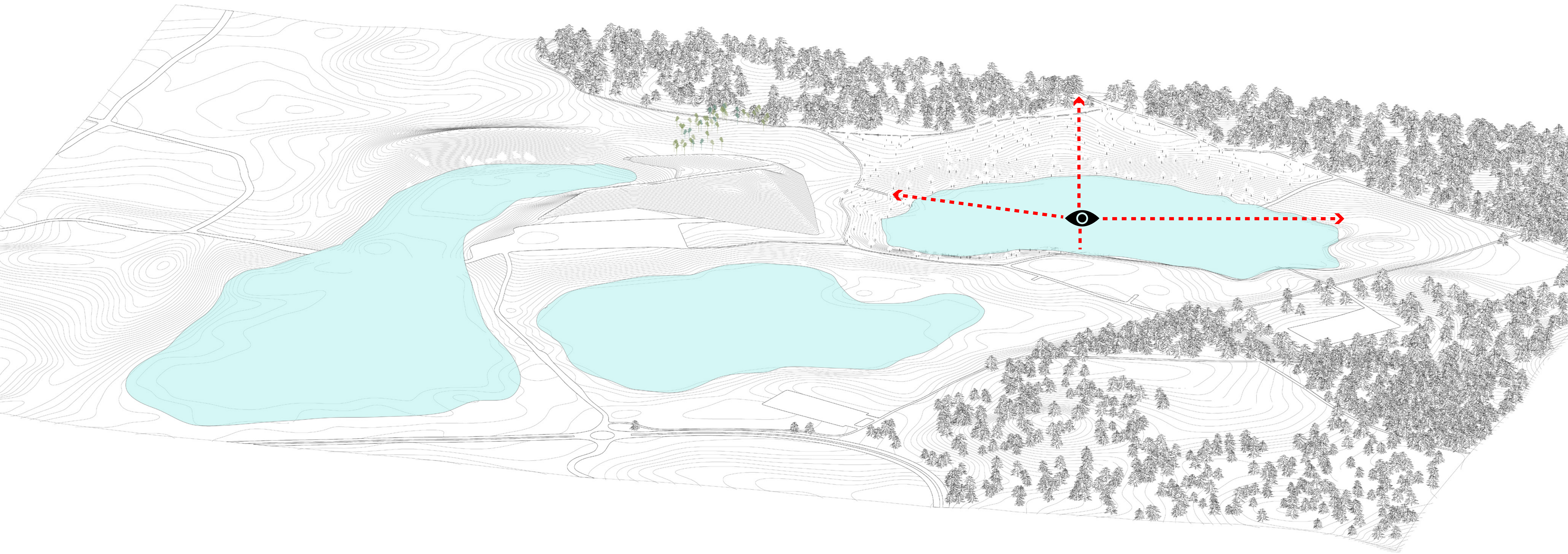
SIBELCO QUARRY 2030



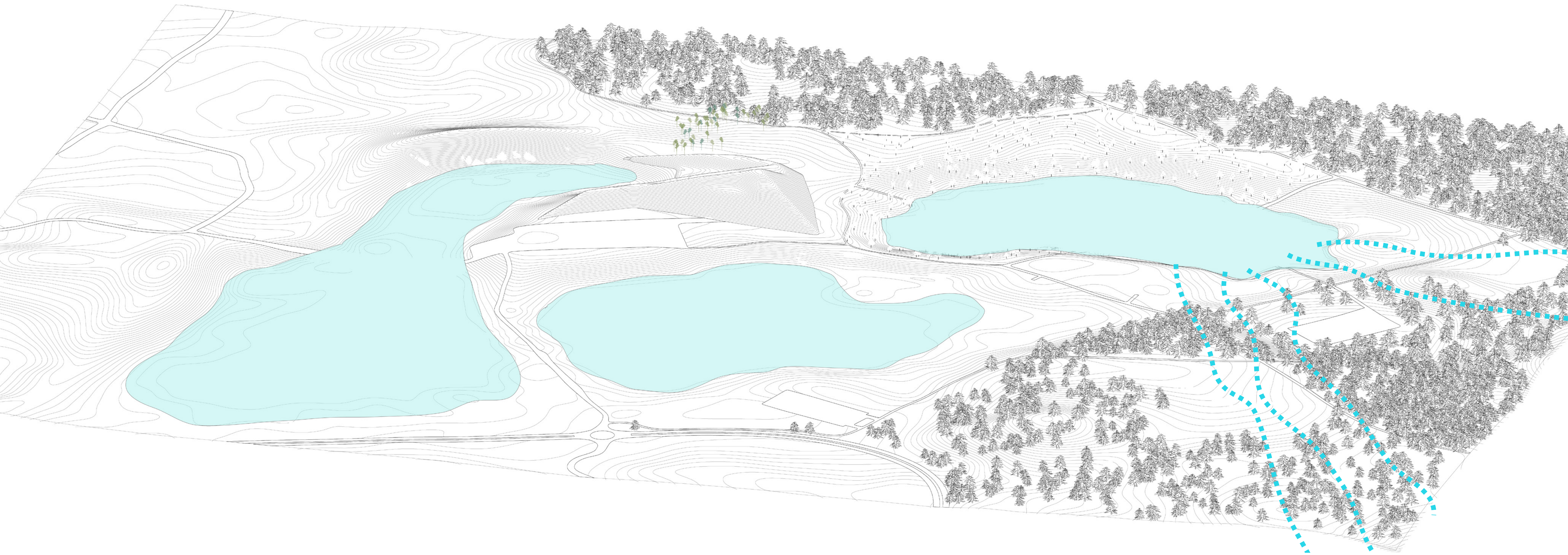
SIBELCO QUARRY 2030



SIBELCO QUARRY 2030

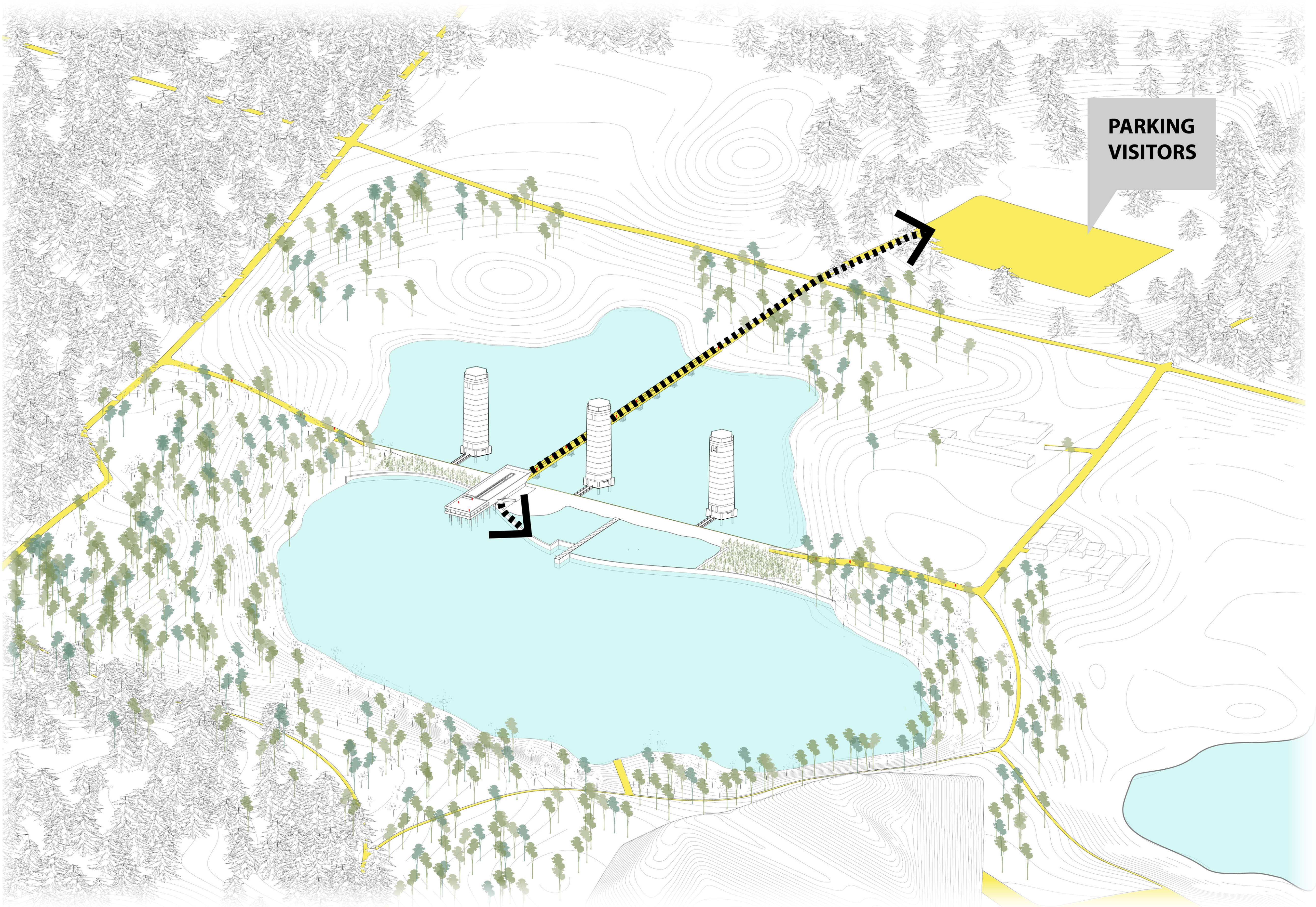


SIBELCO QUARRY 2030

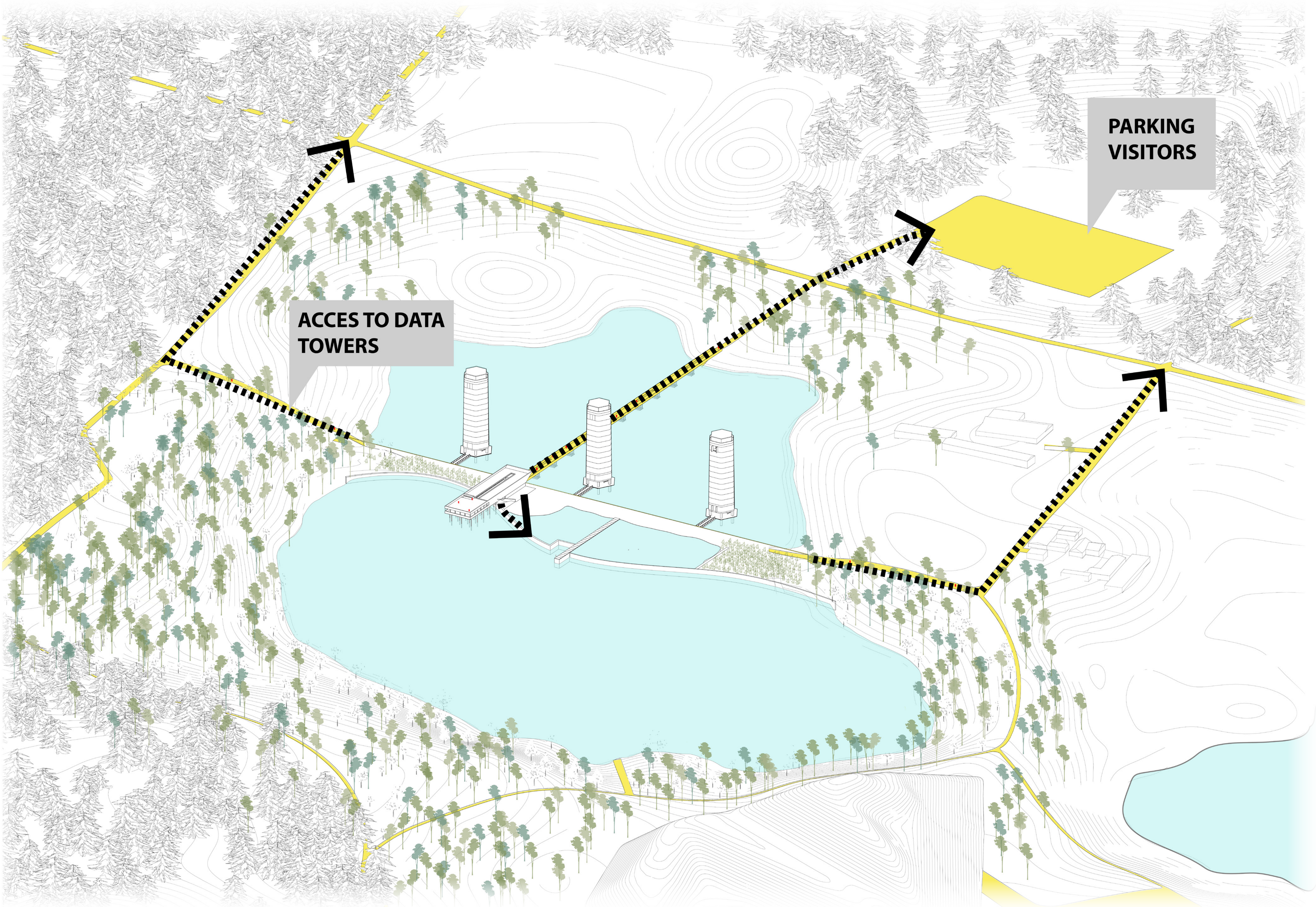


SIBELCO QUARRY 2030

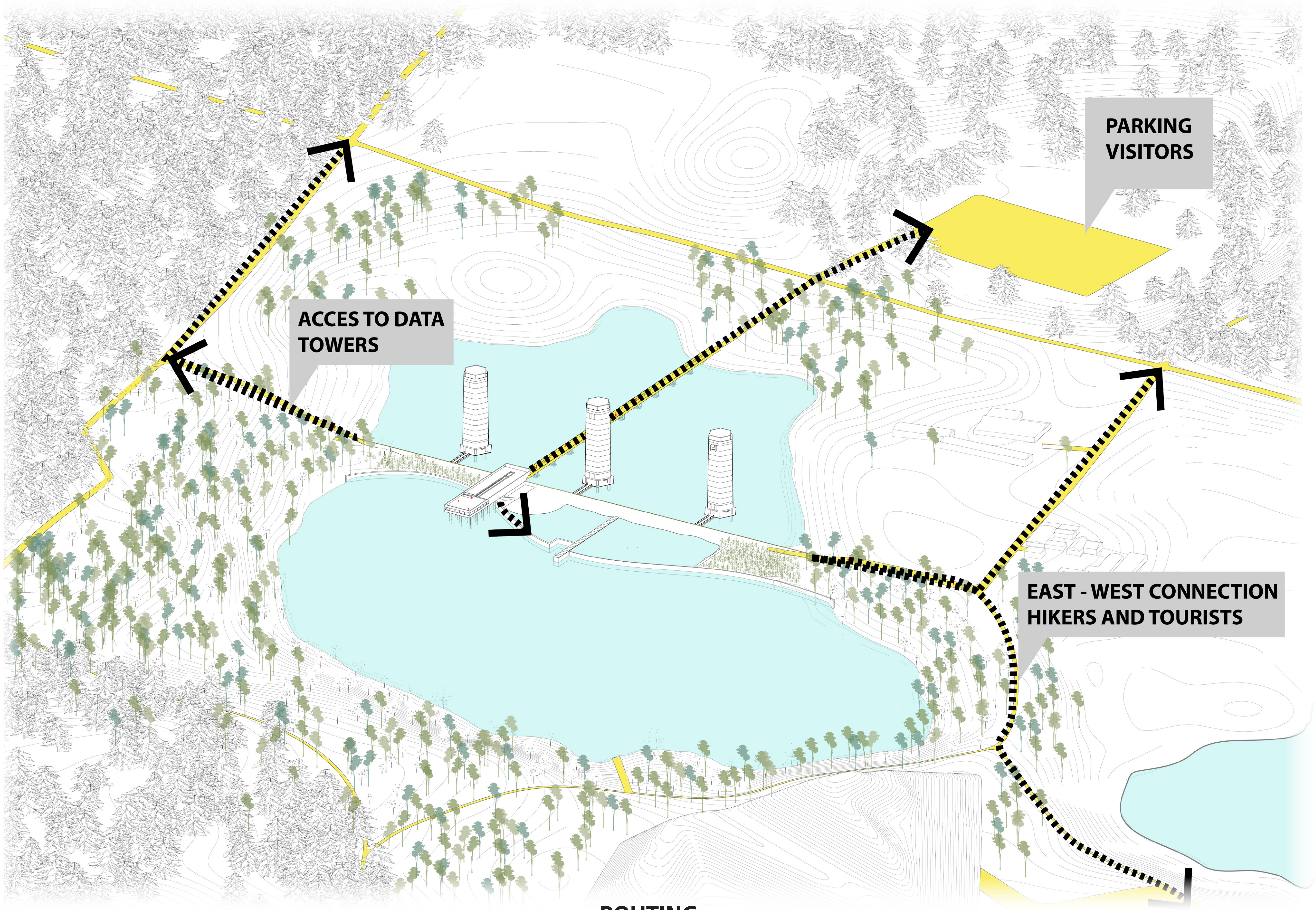
COMPOSITION IN LANDSCAPE



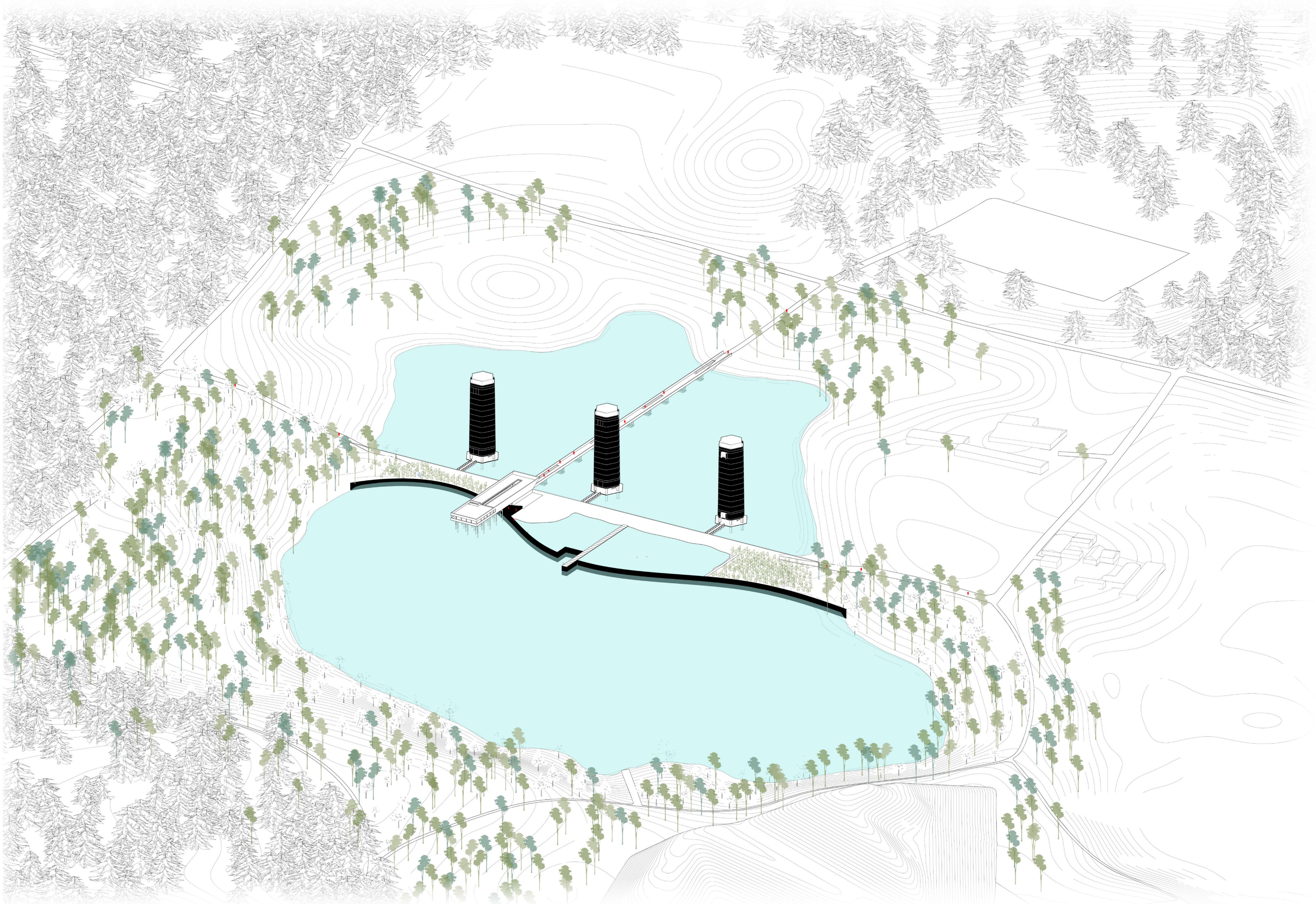
ROUTING



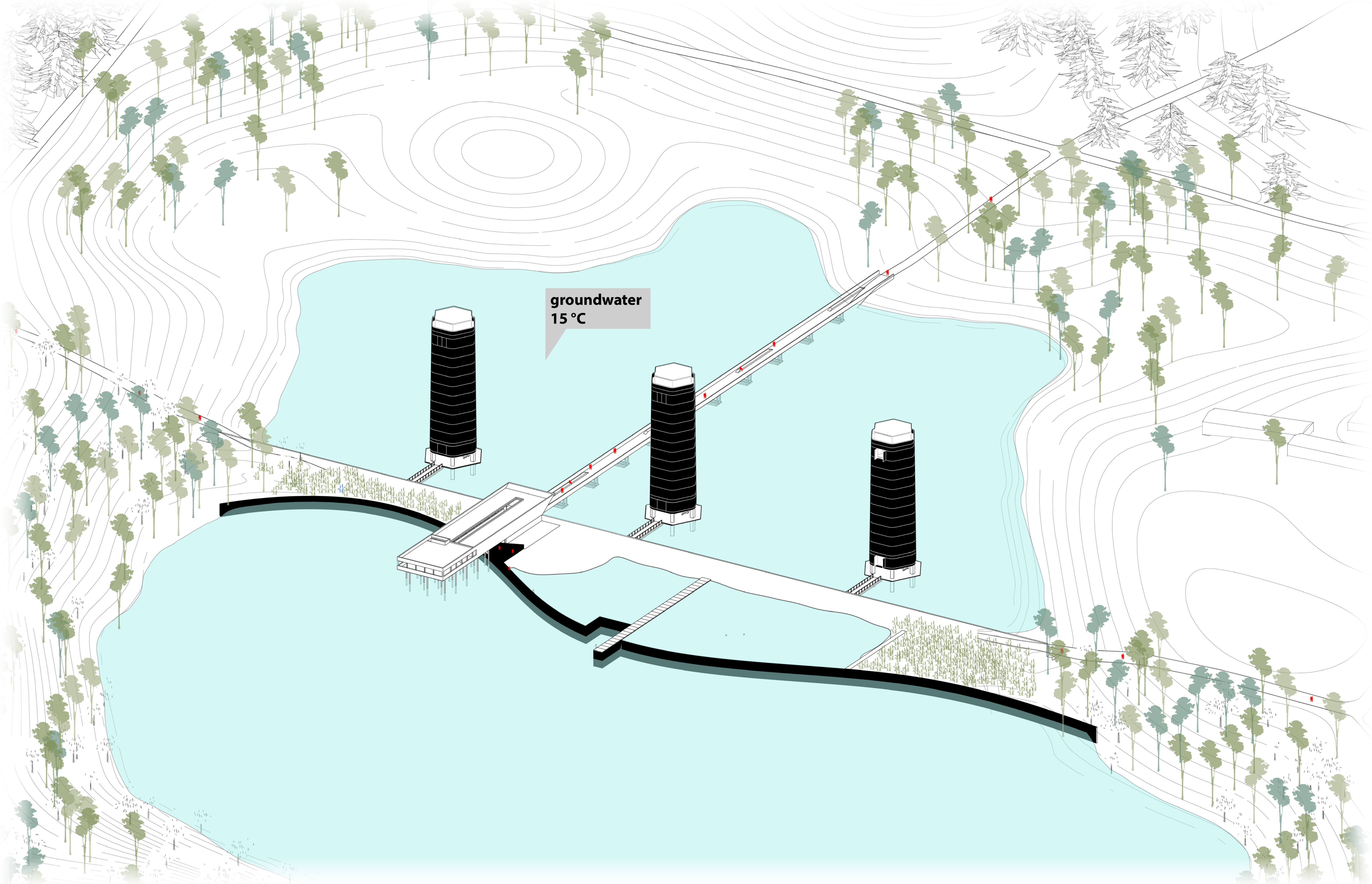
ROUTING


PARKING
VISITORS
ACCES TO DATA
TOWERS
EAST - WEST CONNECTION
HIKERS AND TOURISTS

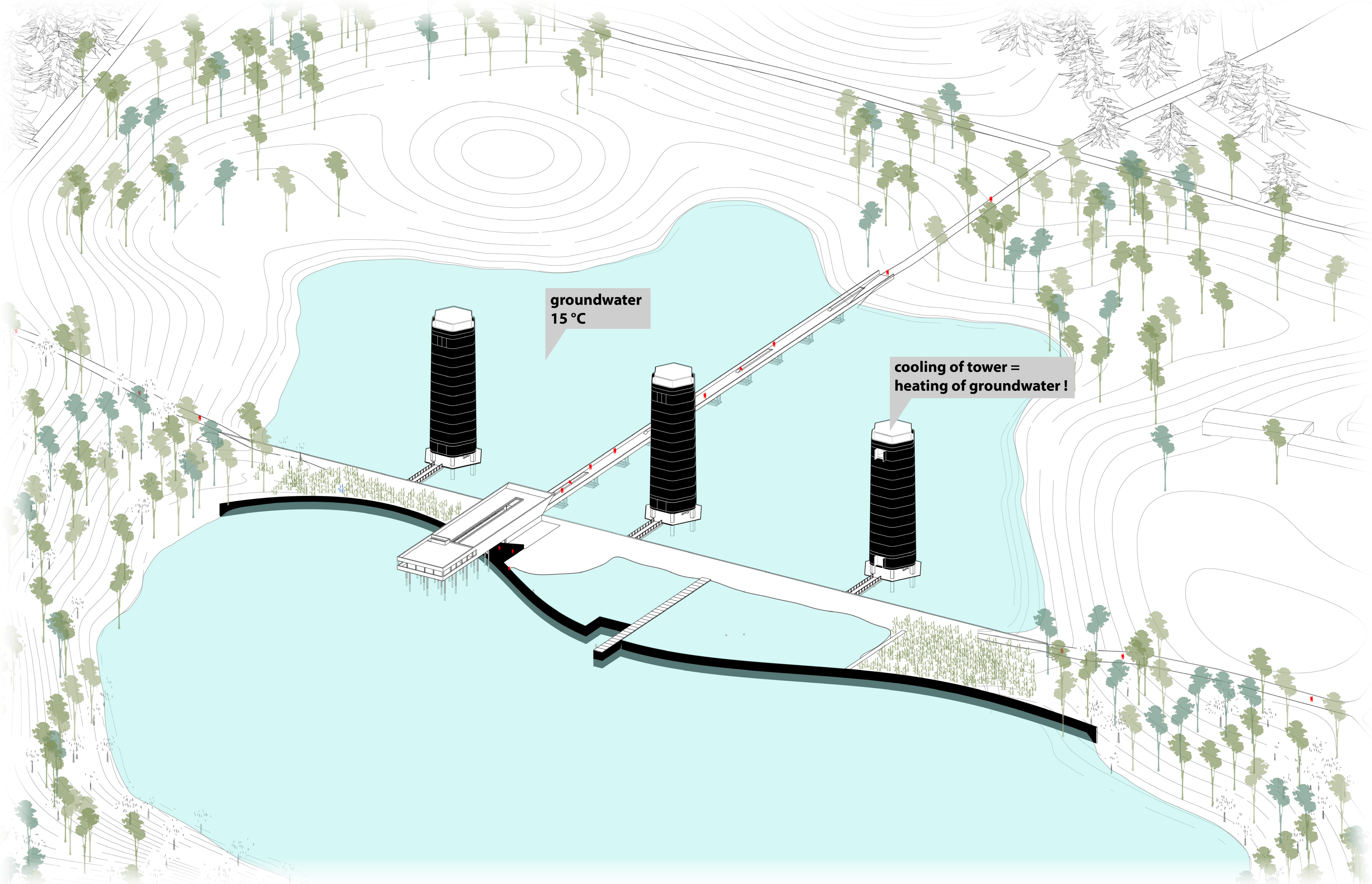
ROUTING



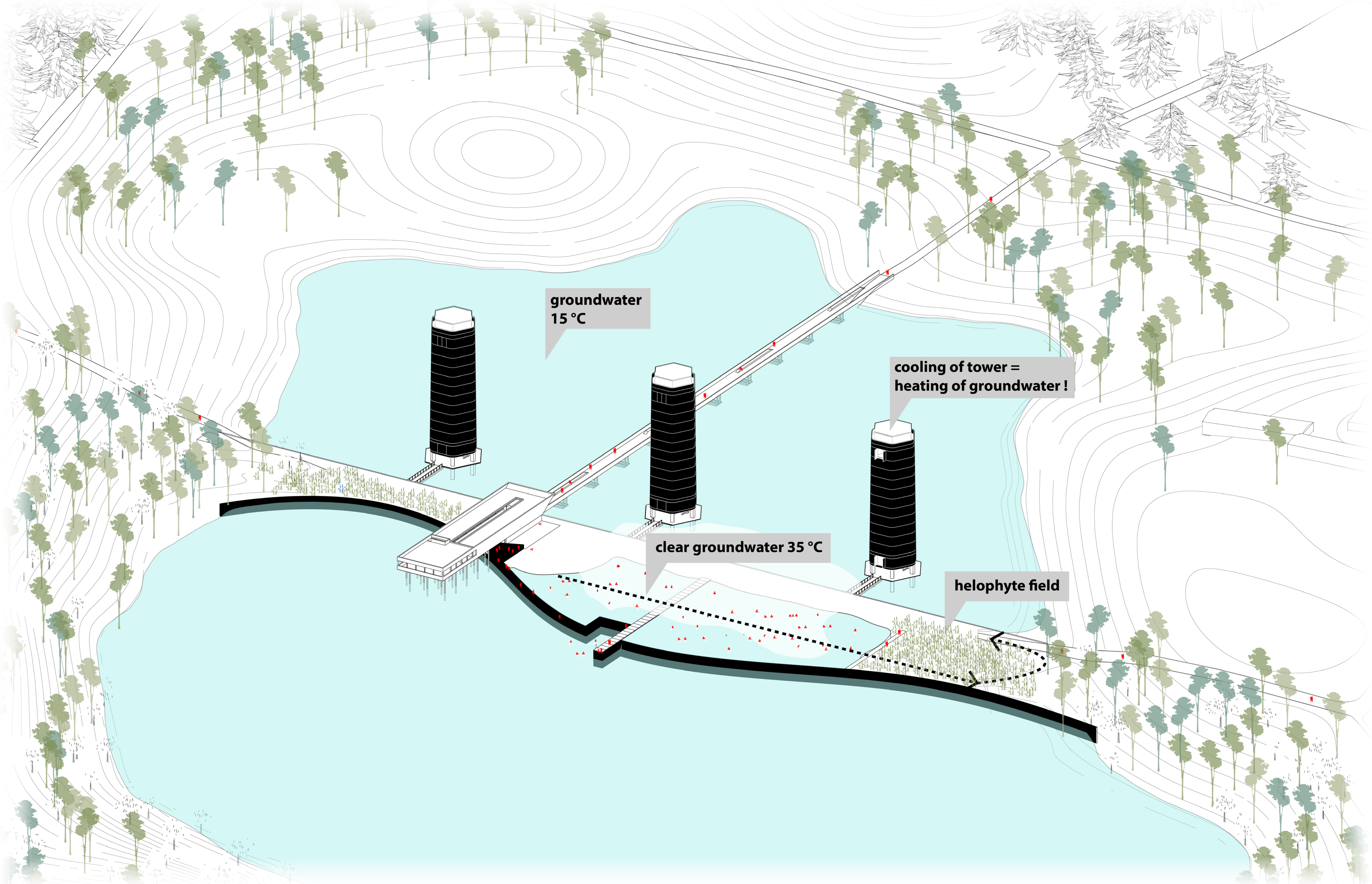
WATER



WATER



WATER

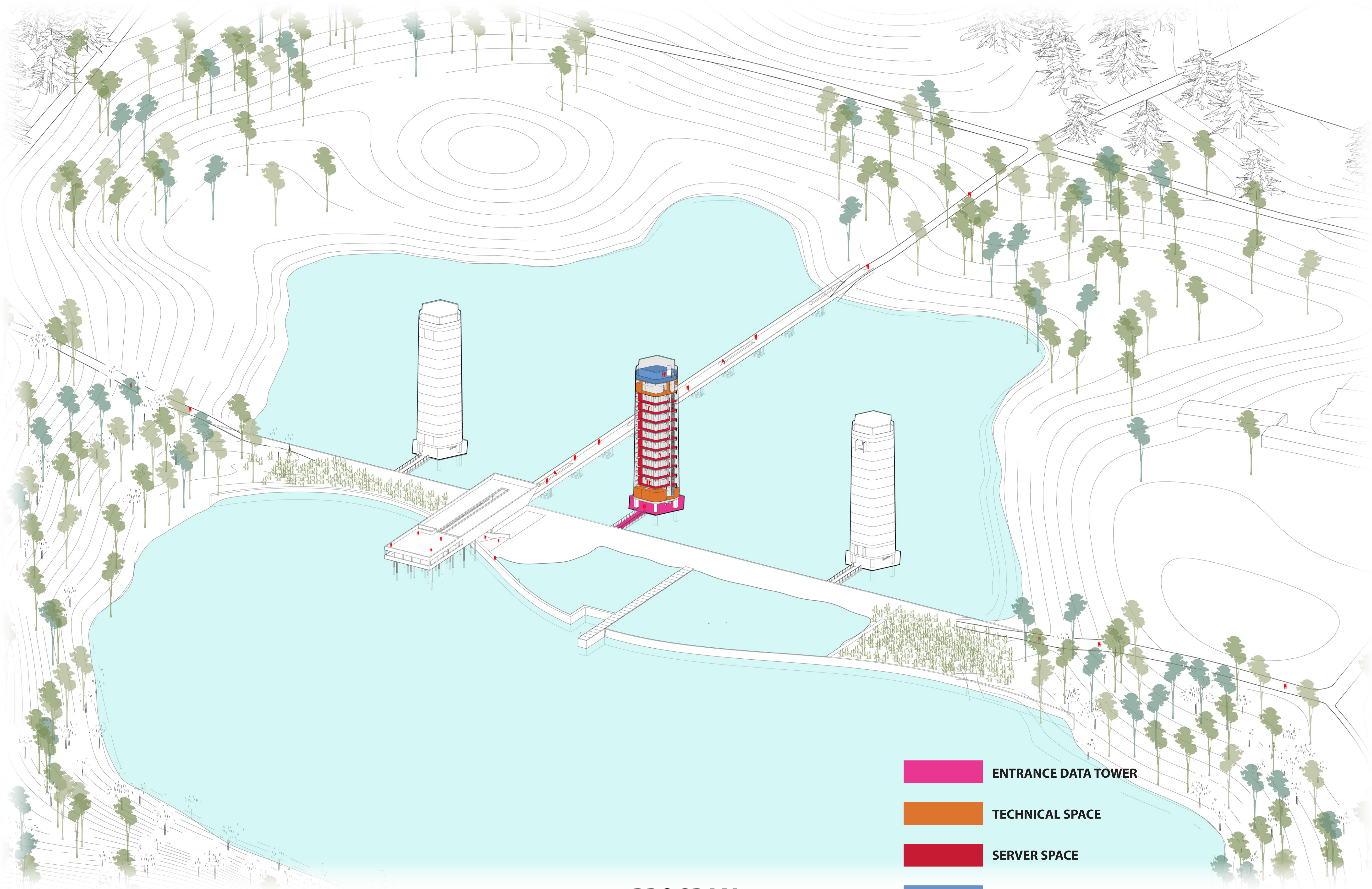

groundwater
15 °C
cooling of tower =
heating of groundwater !
clear groundwater 35 °C
helophyte field

WATER

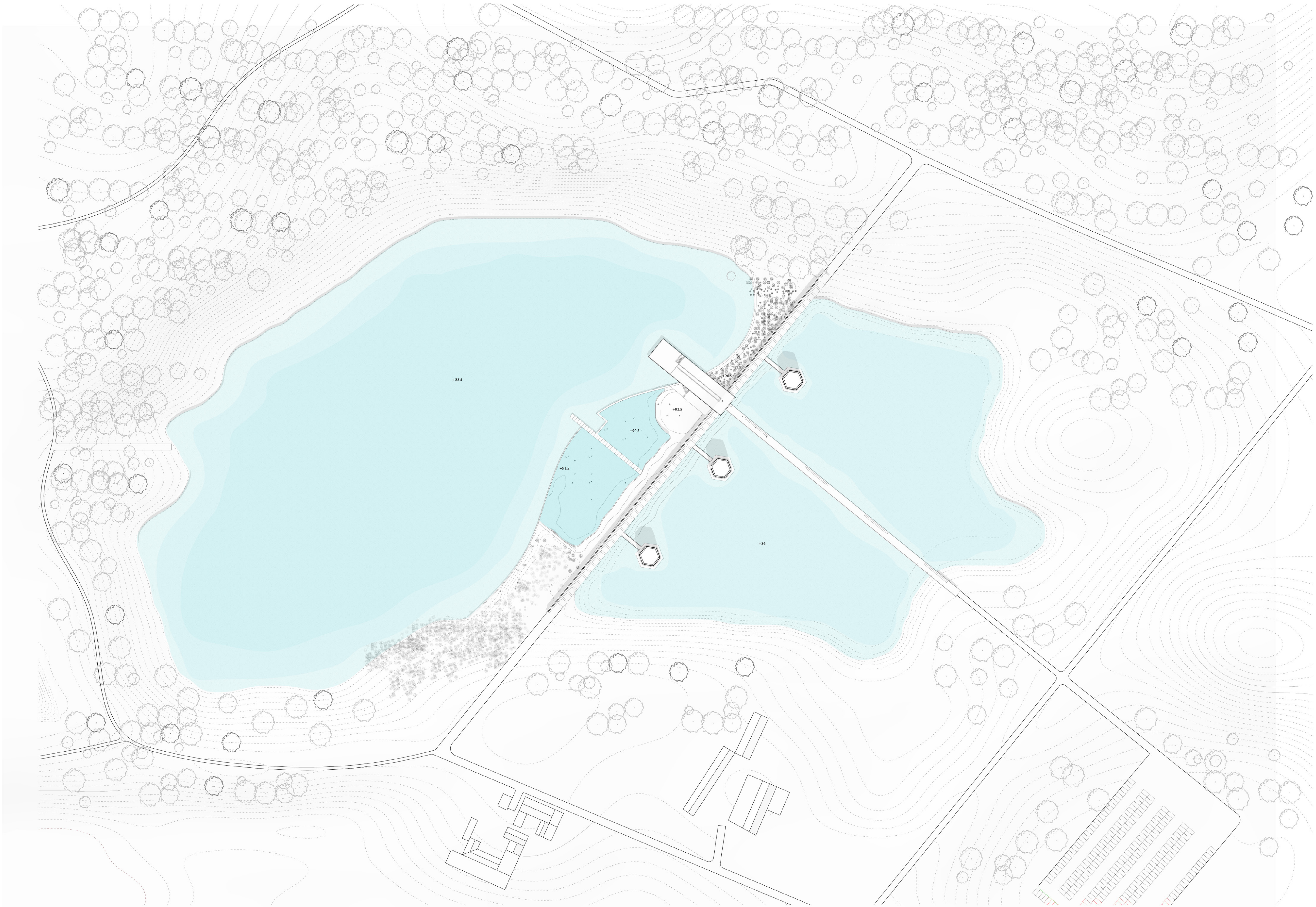
PROGRAM

PROGRAM

PROGRAM

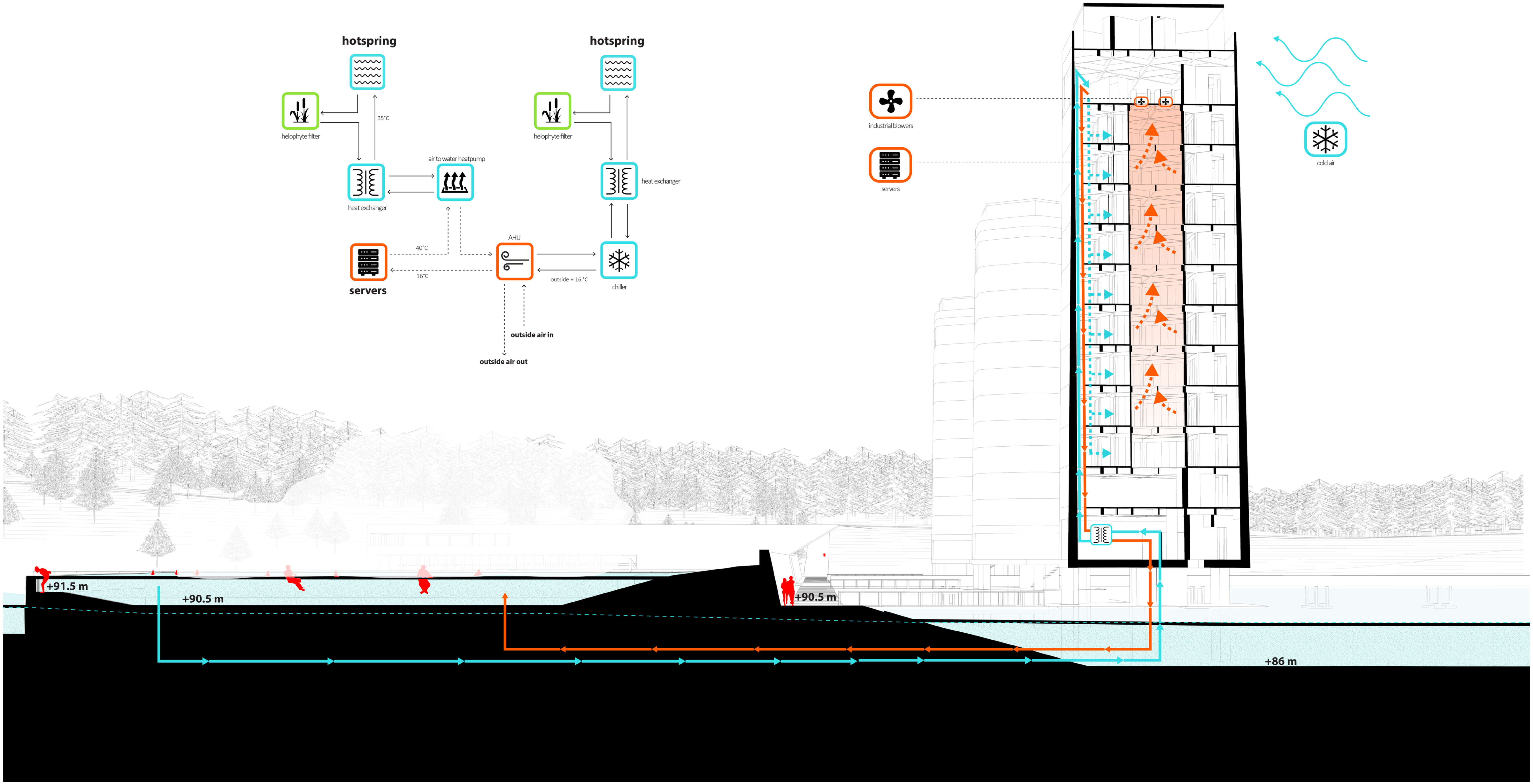

ENTRANCE DATA TOWER
TECHNICAL SPACE
SERVER SPACE
OFFICE AND VIEWPOINT

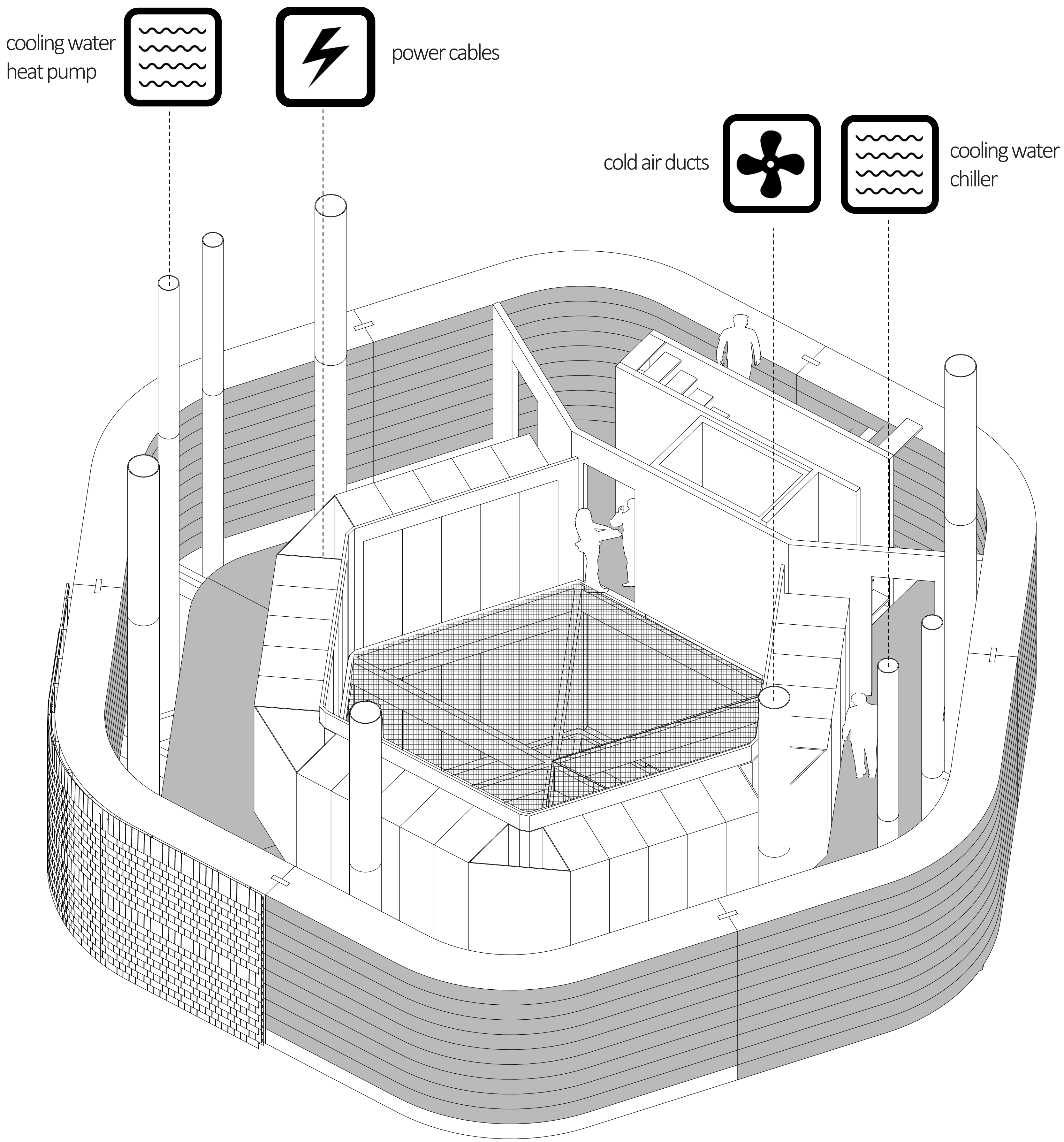
PROGRAM

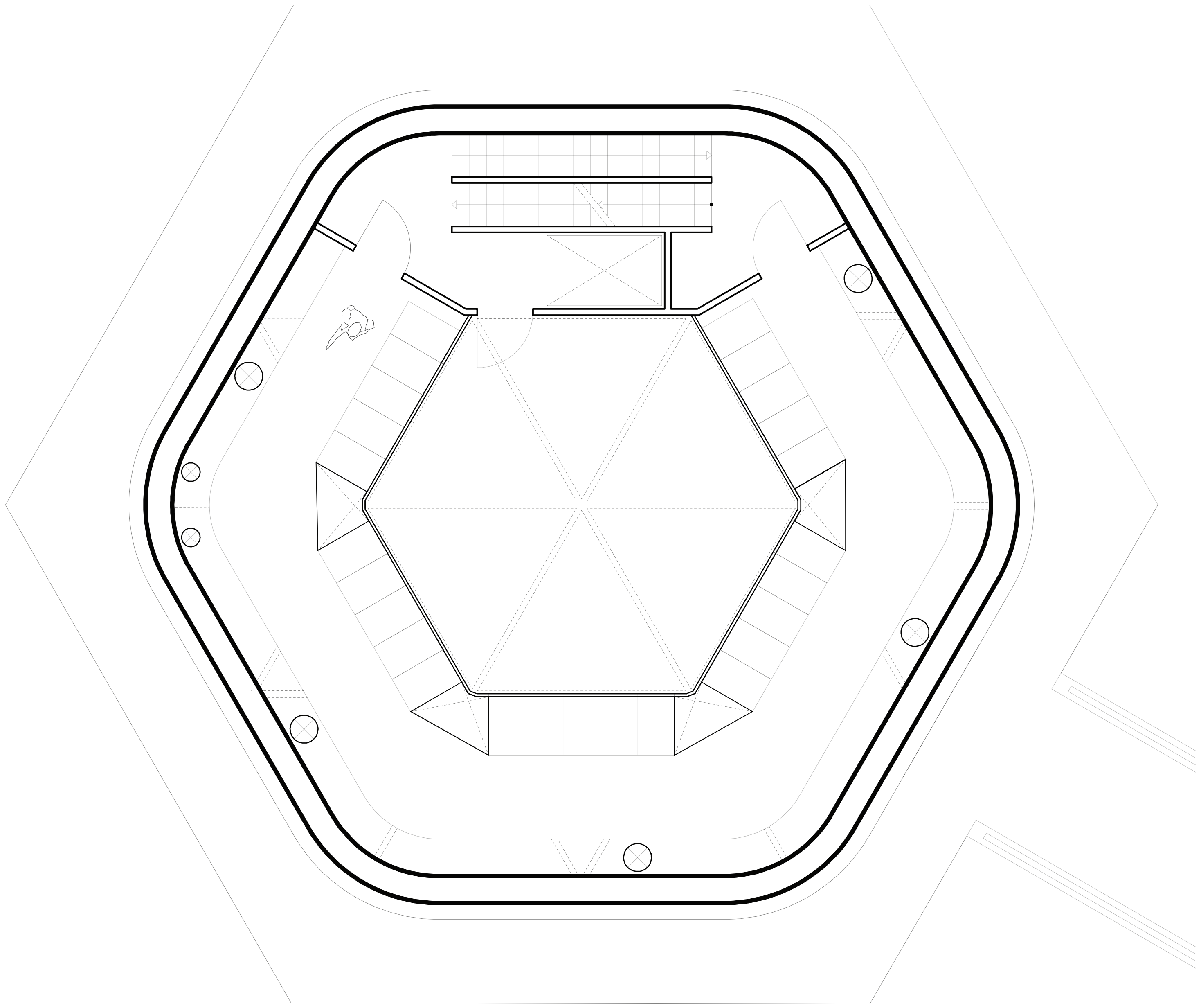


MASTERPLAN 1:1000

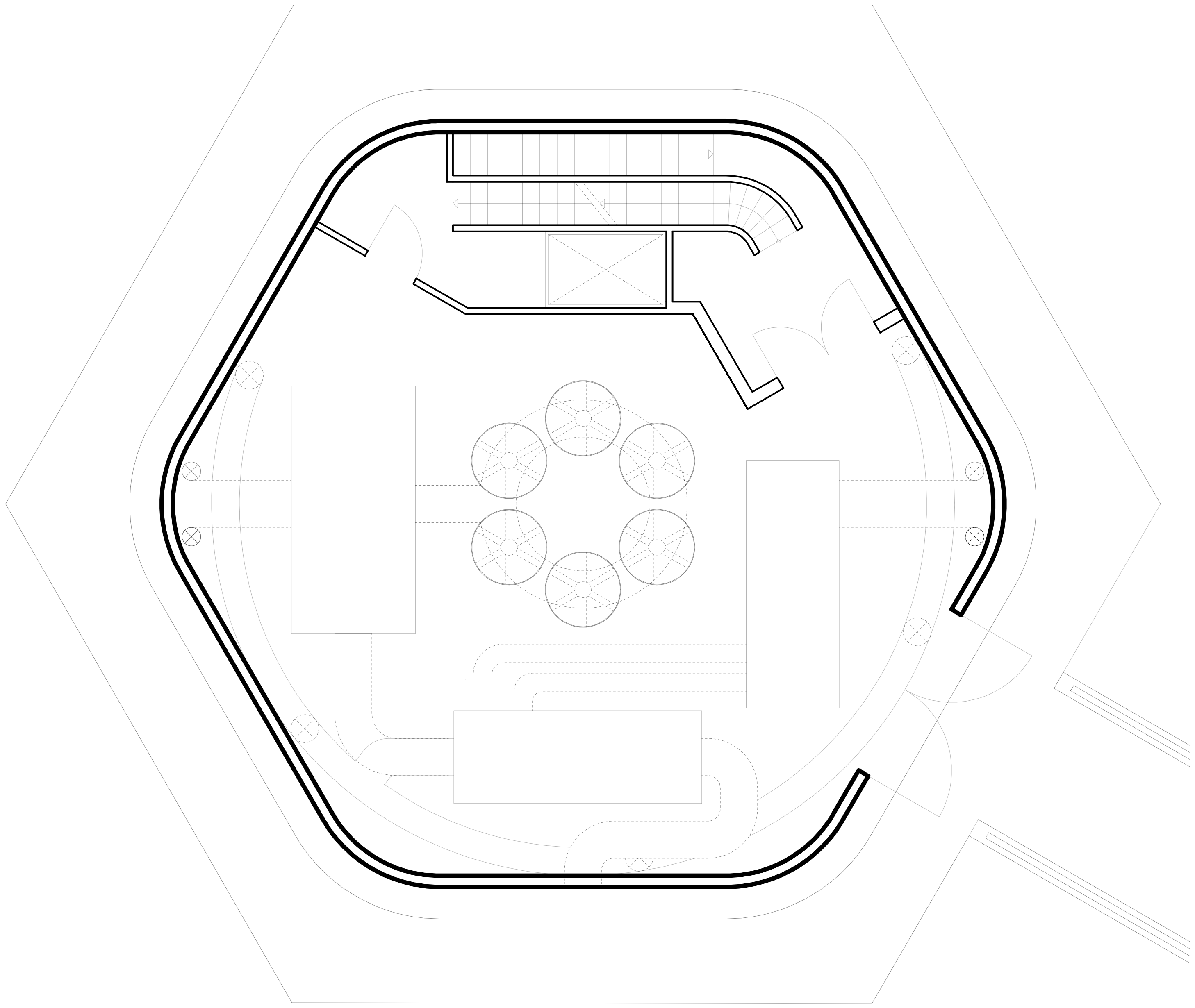
FLOORPLAN 1:500


hotspring
hotspring
helophyte filter
helophyte filter
35°C
air to water heatpump
heat exchanger
heat exchanger
AHU
40°C
16°C
outside + 16 °C
servers
chiller
outside air in
outside air out
industrial blowers
servers
cold air
+91.5 m
+90.5 m
+90.5 m
+86 m


cooling water
heat pump
power cables
cold air ducts
cooling water
chiller

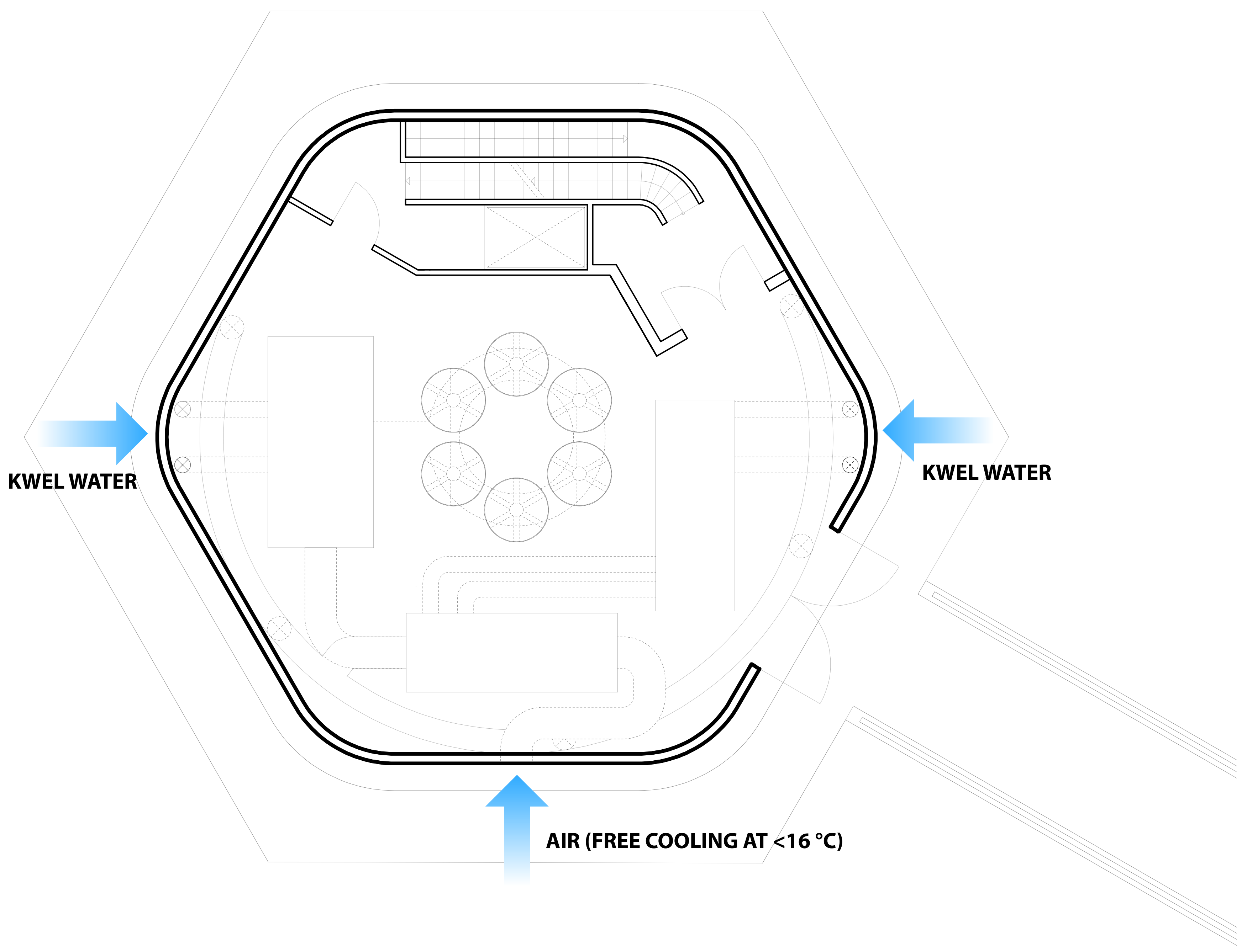


level 5 - server space / 1:100

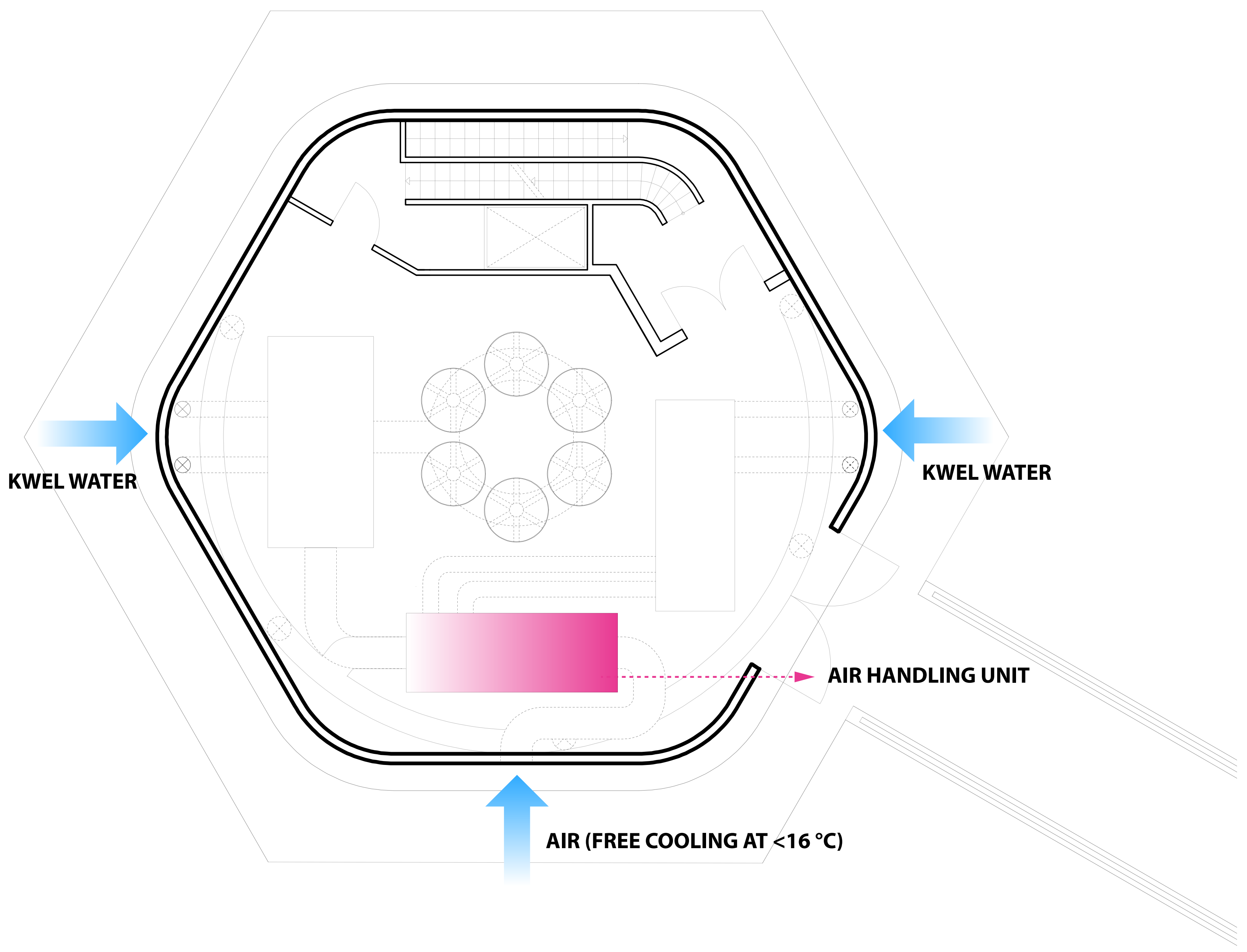


level 12 - technical space / 1:100

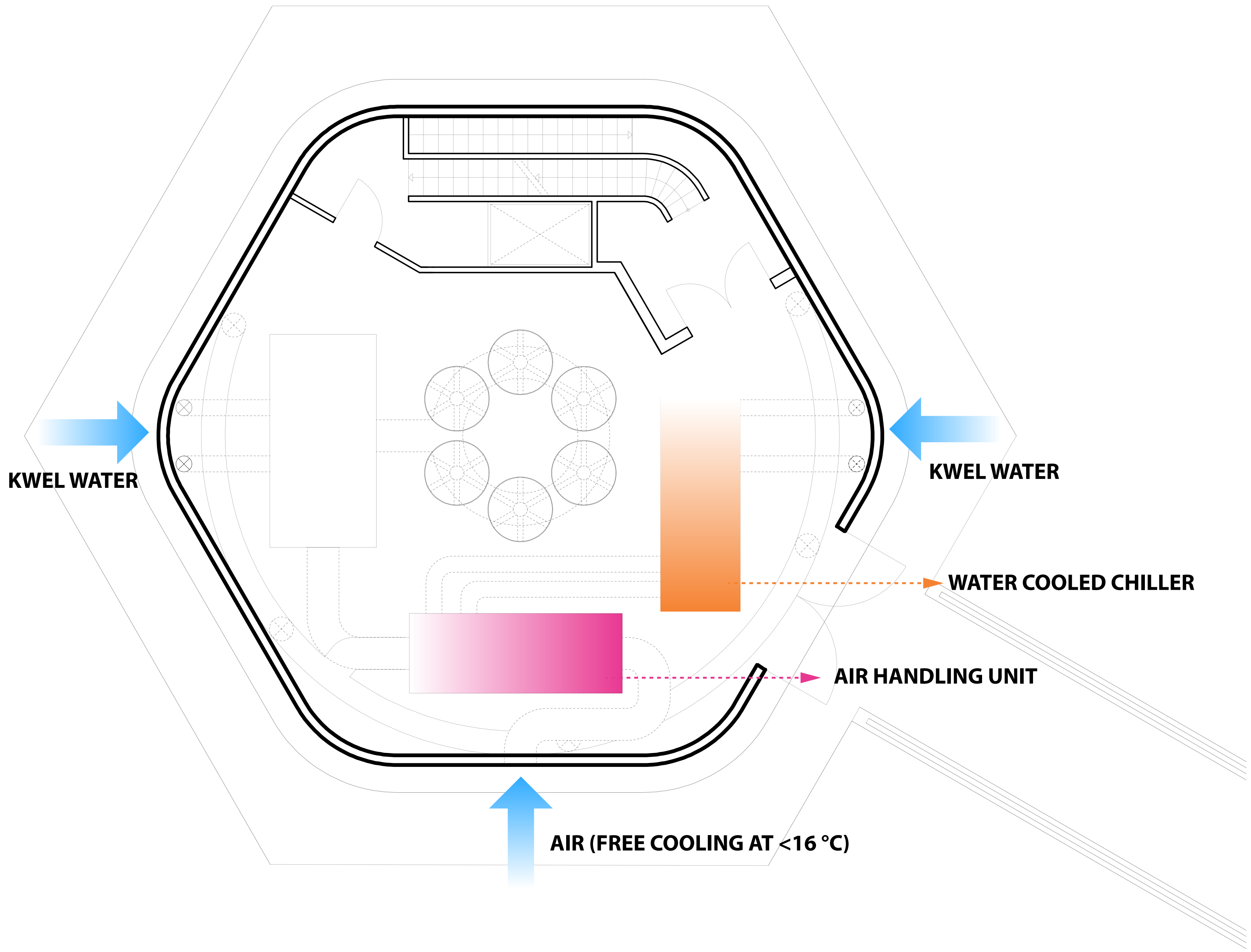
FLOORPLANS 1:100



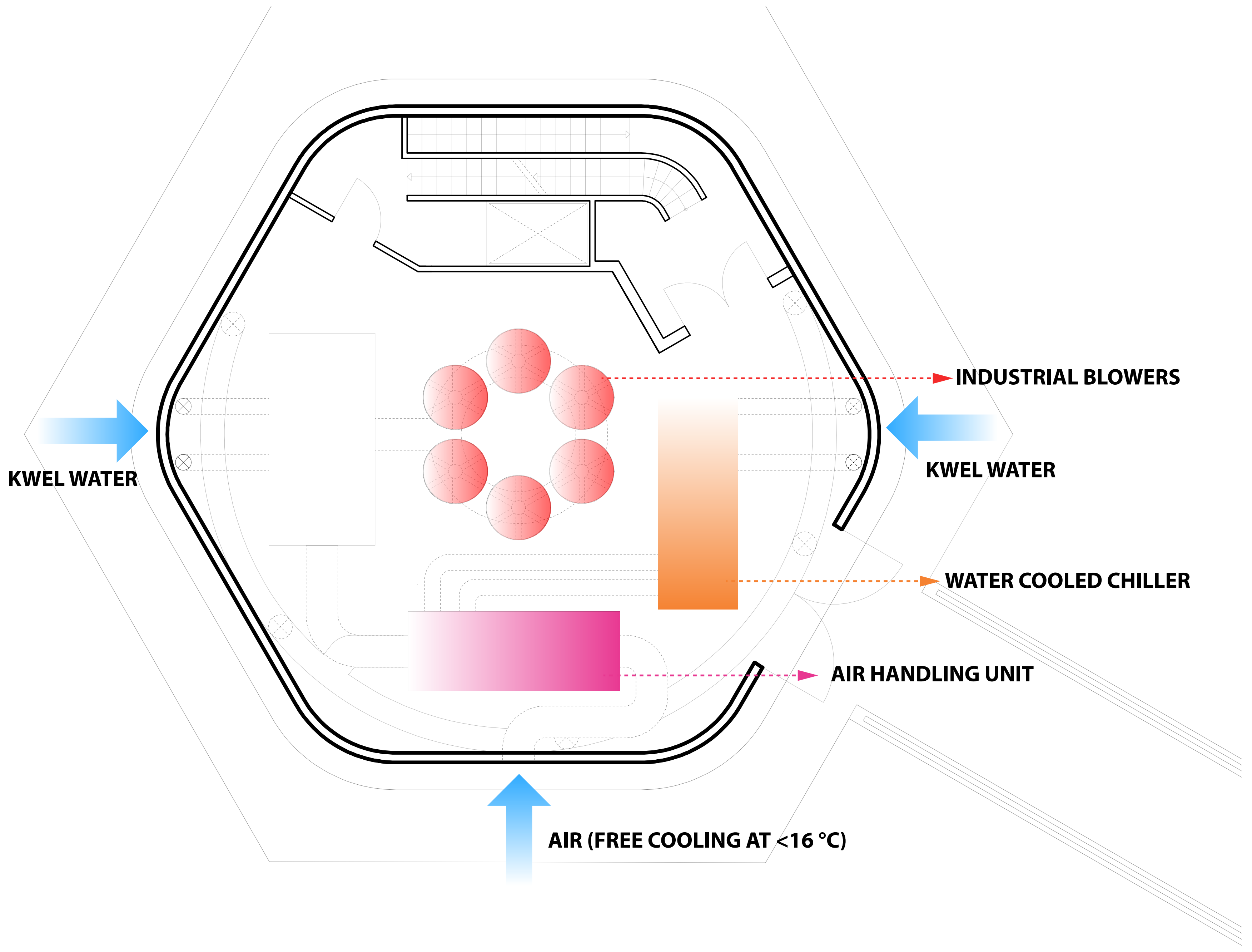
12th FLOOR


KWEL WATER
KWEL WATER
AIR HANDLING UNIT
AIR (FREE COOLING AT <16 °C)

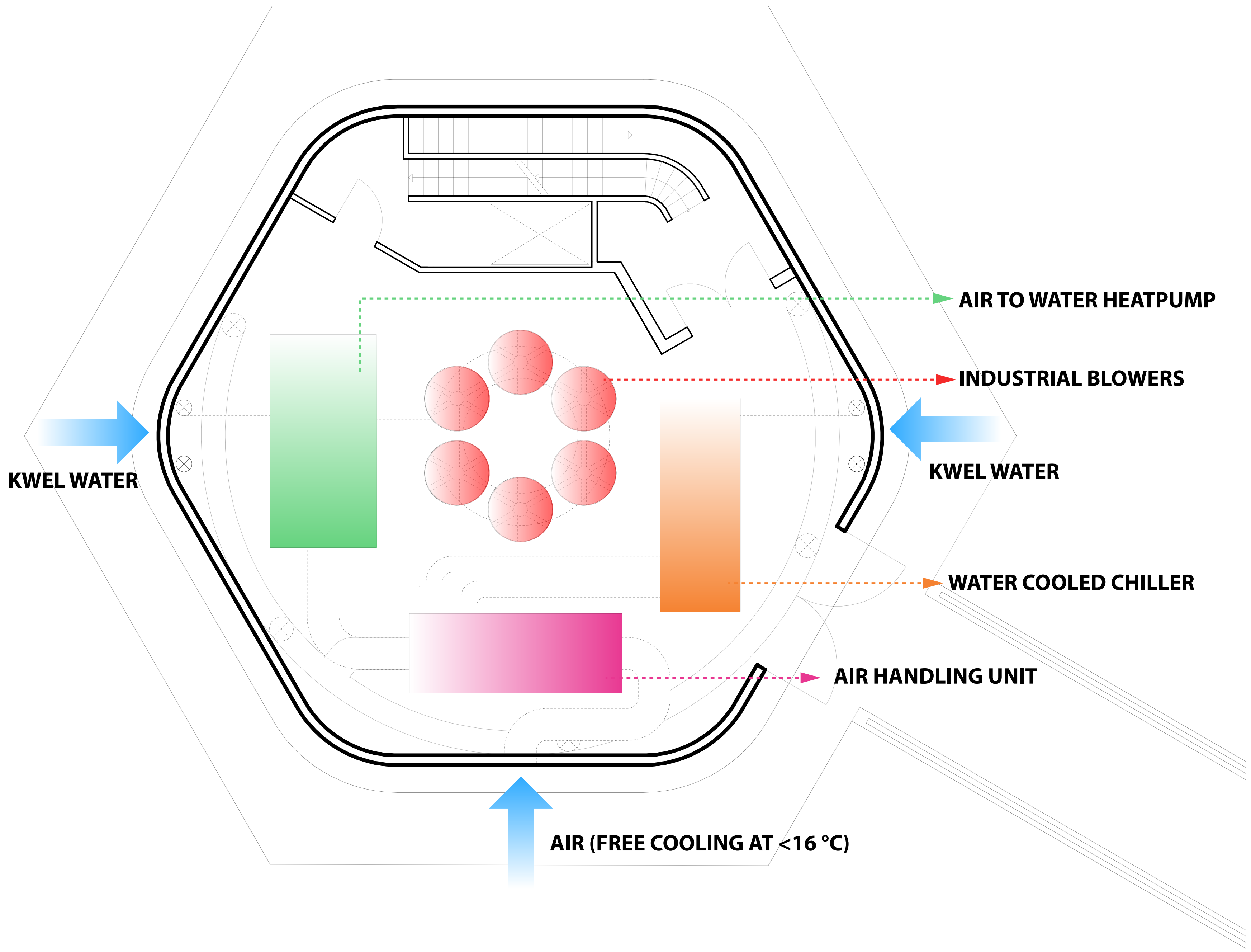
12th FLOOR


KWEL WATER
KWEL WATER
WATER COOLED CHILLER
AIR HANDLING UNIT
AIR (FREE COOLING AT <16 °C)

12th FLOOR


INDUSTRIAL BLOWERS
KWEL WATER
KWEL WATER
WATER COOLED CHILLER
AIR HANDLING UNIT
AIR (FREE COOLING AT <16 °C)

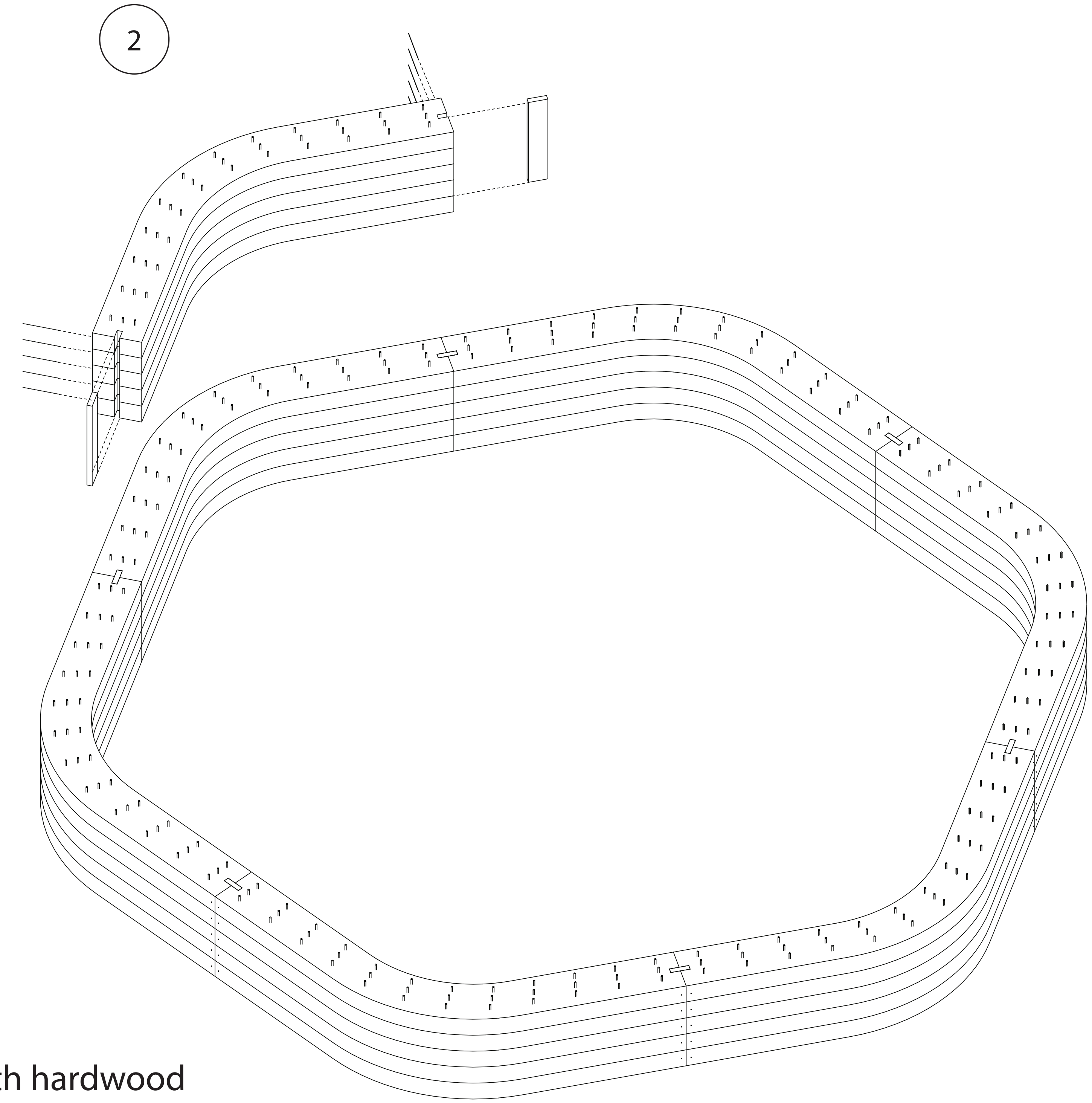
12th FLOOR


AIR TO WATER HEATPUMP
INDUSTRIAL BLOWERS
KWEL WATER
KWEL WATER
WATER COOLED CHILLER
AIR HANDLING UNIT
AIR (FREE COOLING AT <16 °C)

12th FLOOR

BUILD

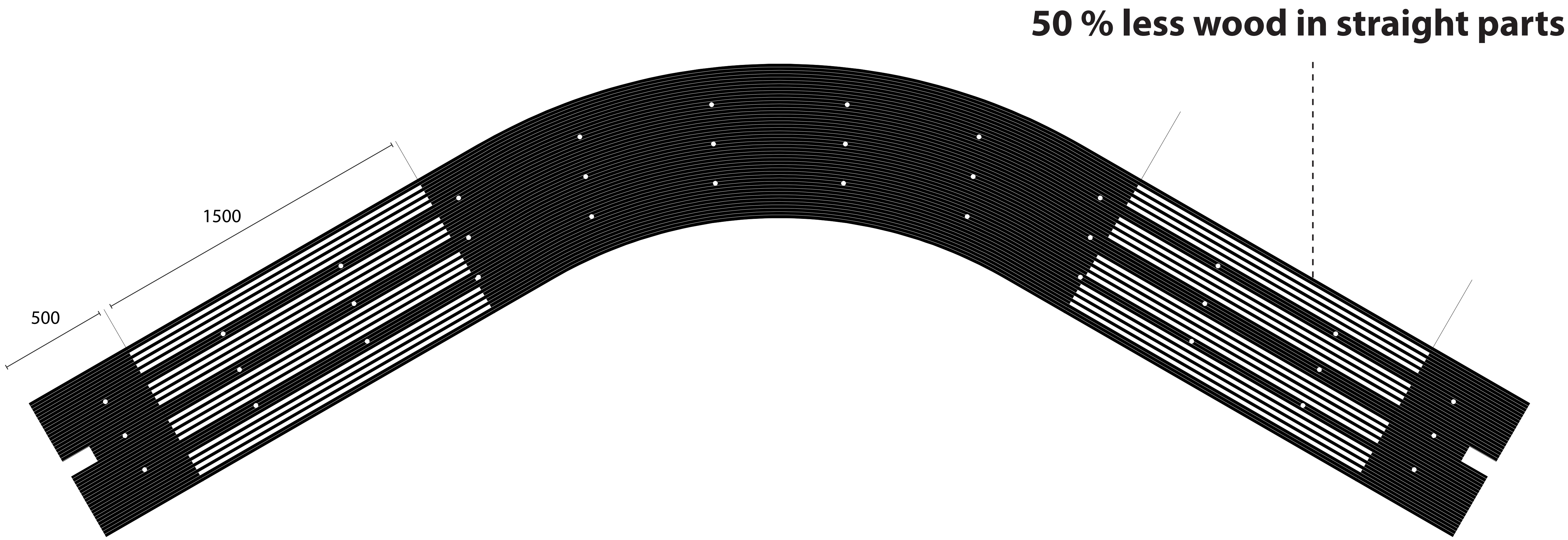
LOCAL PINE WOOD BRUNSUMMERHEIDE

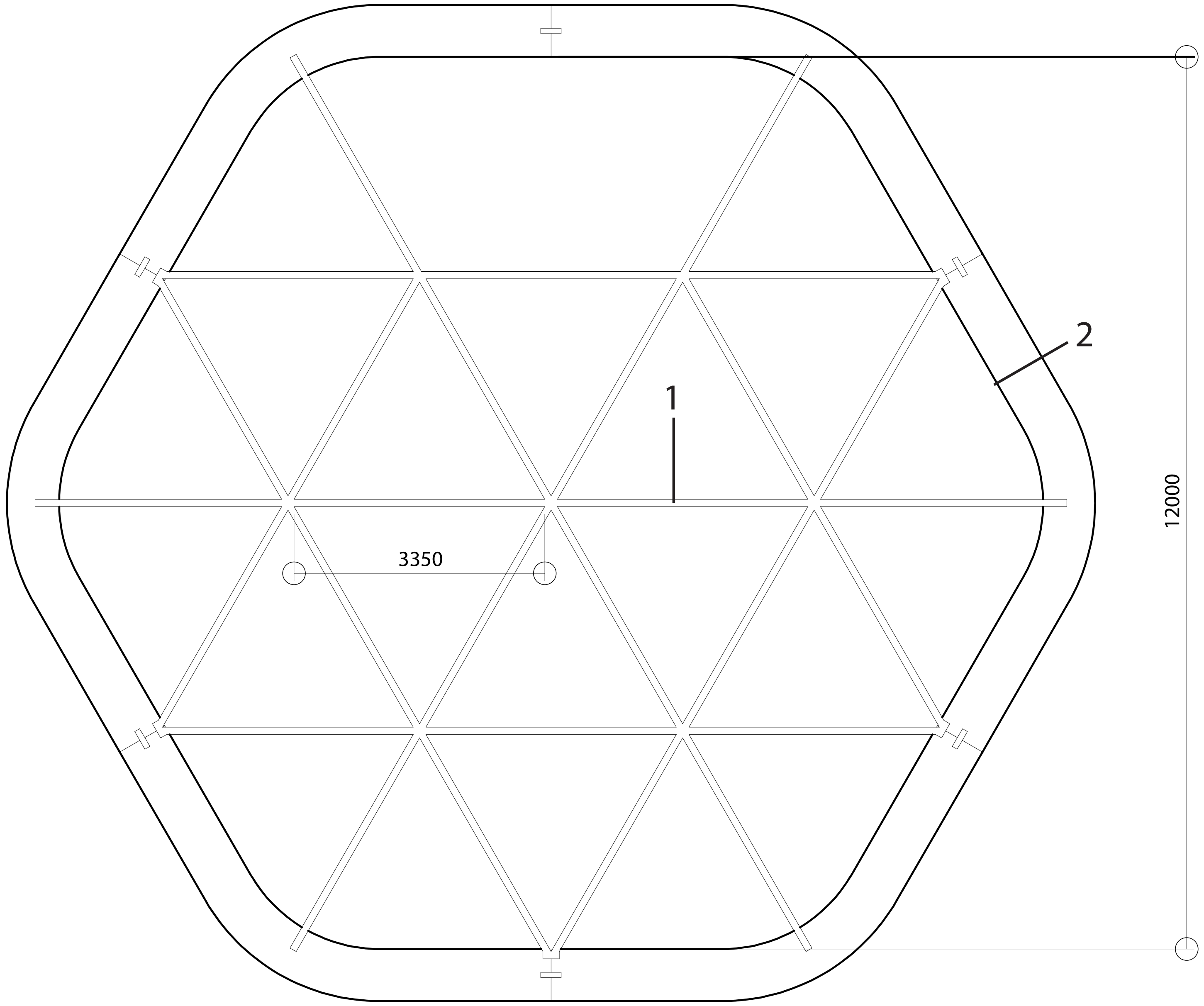


BUILDING ORDER

1 prefabricating parts with hardwood beech dowels
2 modular parts to building site
3 assemble first floor
4 place the floors in the wood shell

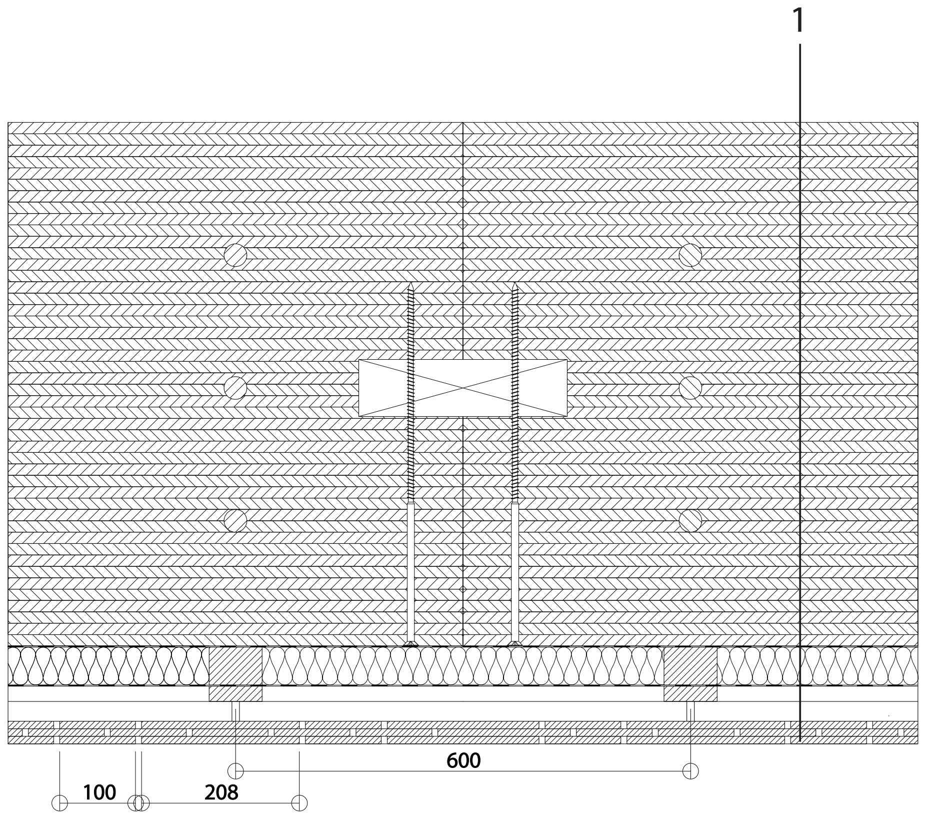
BRETTSTAPEL METHODE


50 % less wood in straight parts
1500
500

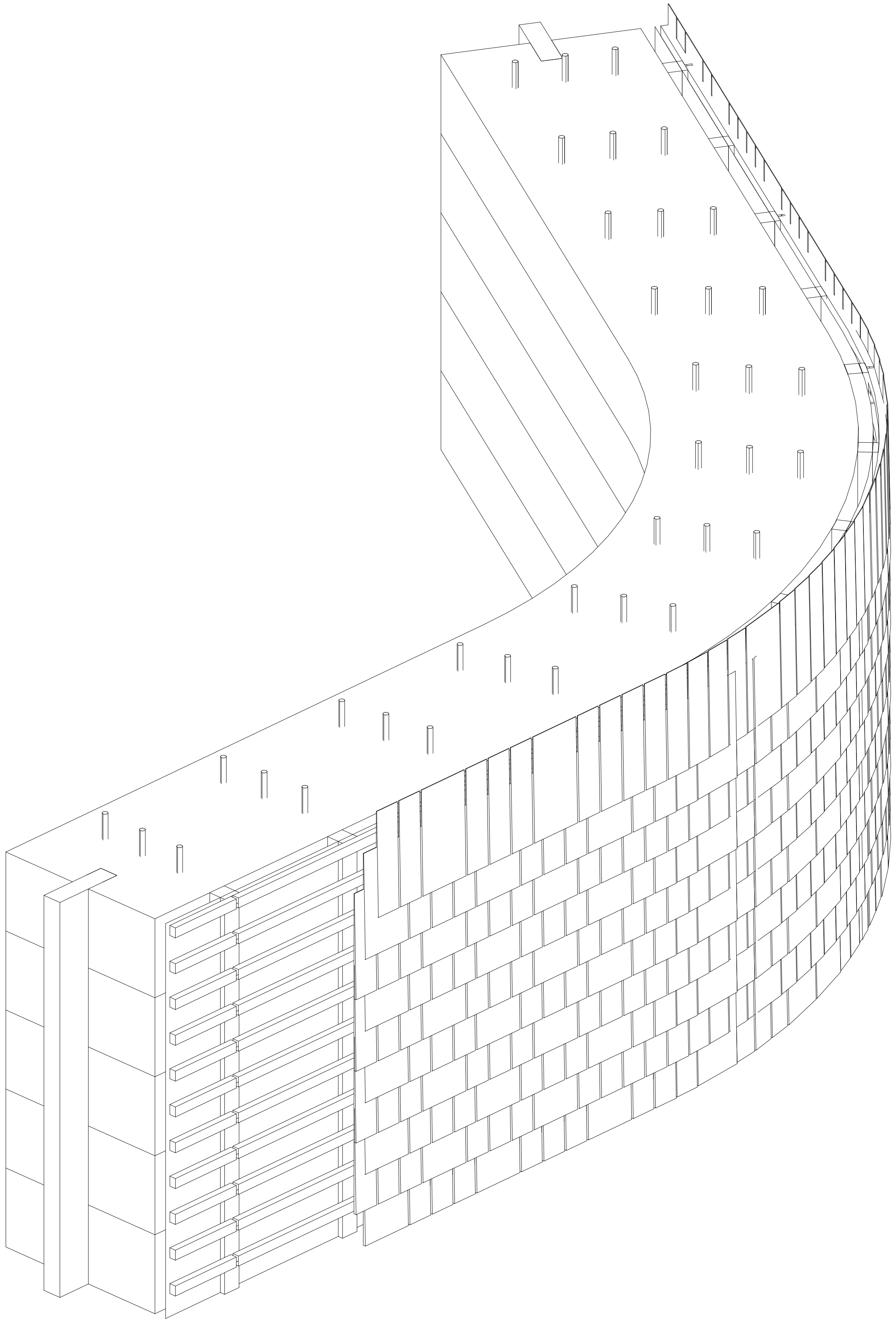


LOADBEARING CONSTRUCTION BEAM GRID

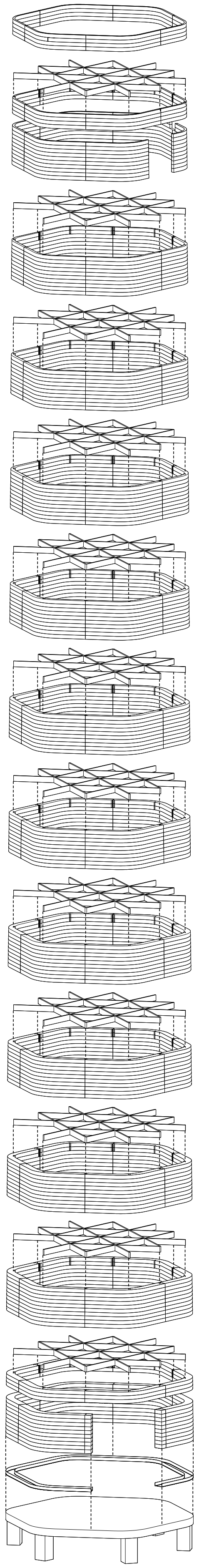
1 540/115 mm glulam beam
2 laminated pine wood



H1 - HORIZONTAL SECTION SCALE 1:5

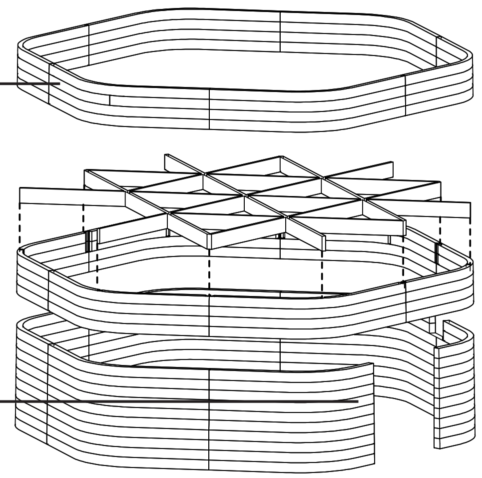


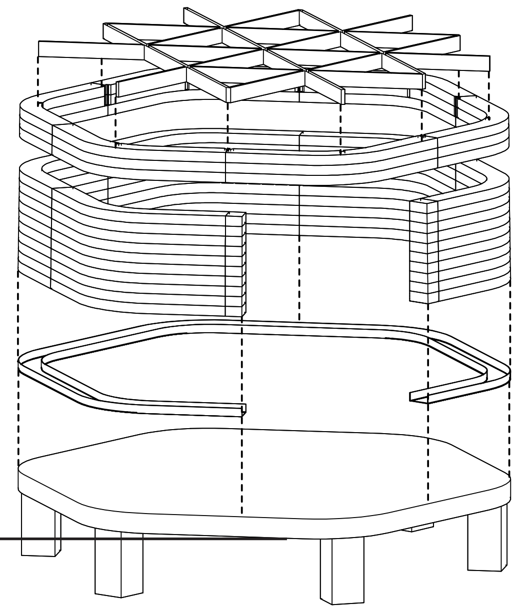
ISOMETRIC WALL CONSRUCTION



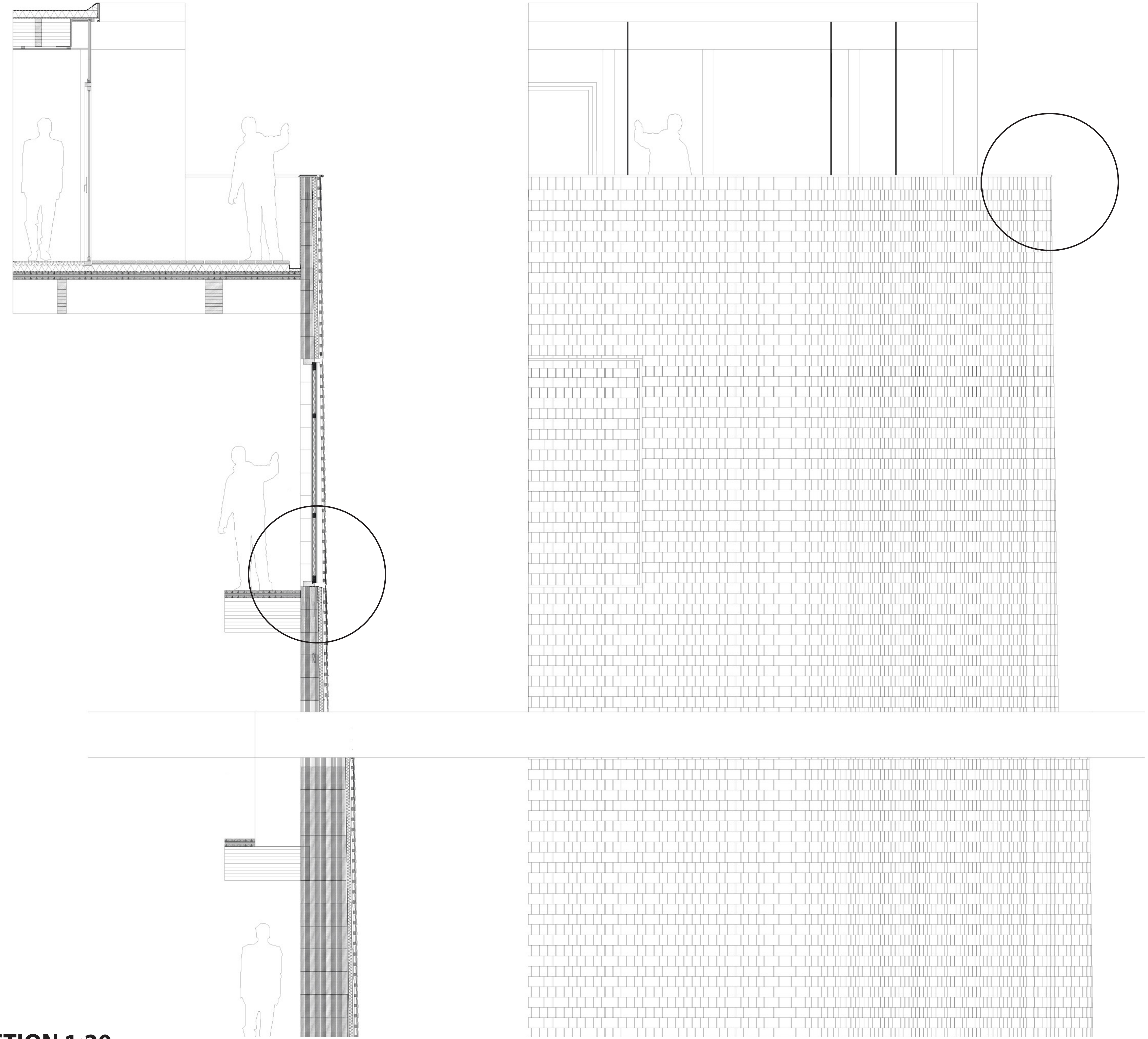
WOODEN SHELL FORMS BALCONY

CUTOUT IN WOODEN SHELL GIVES
TRANSPORTATION EXIT FOR EQUIPMENT

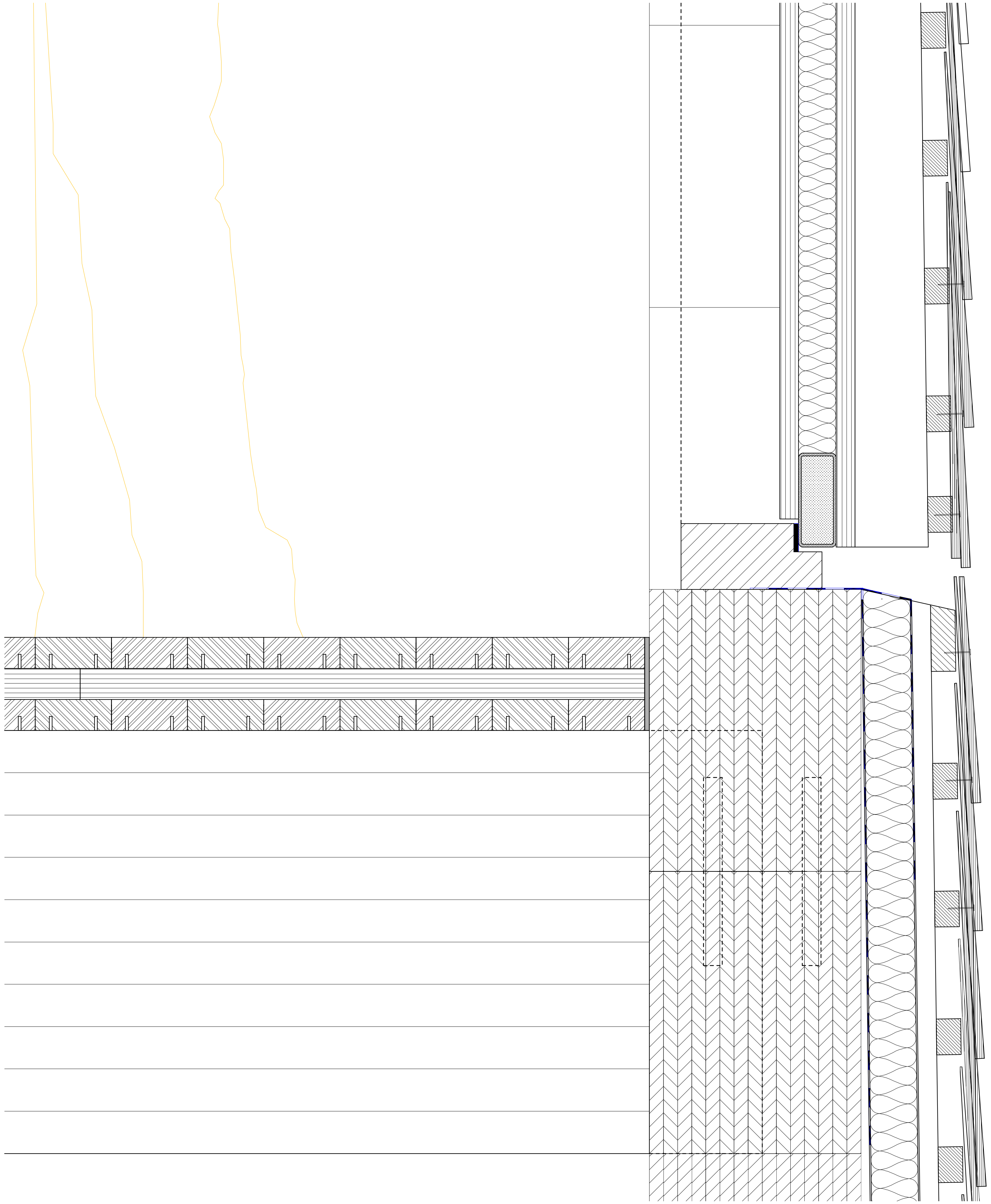




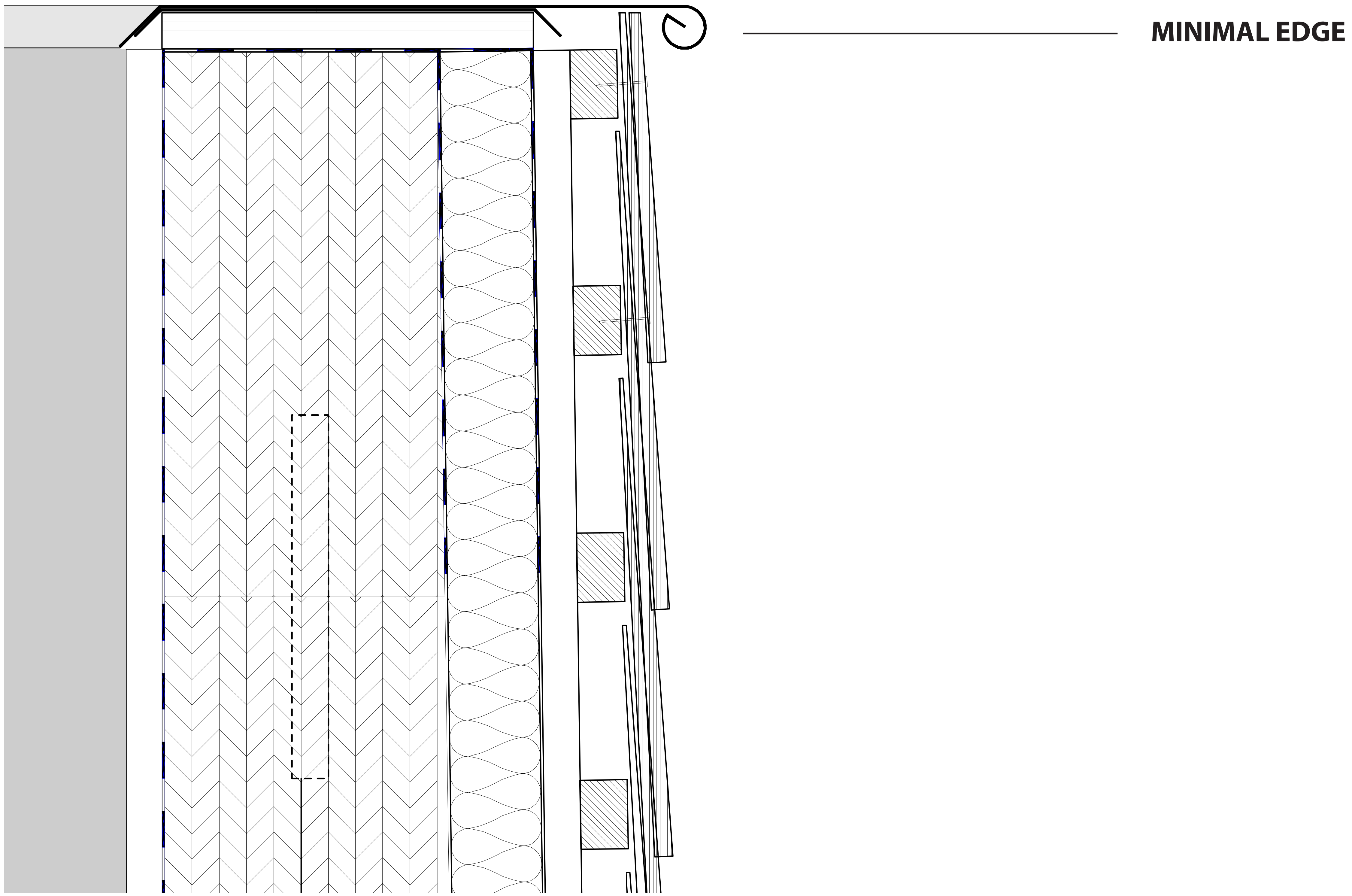
WOODEN SHELL STANDS ON CONCRETE
BASE ON THE WATER



SECTION 1:20



DETAIL TRANSPORTATION DOOR 1:5



DETAIL BALCONY 1:5

CONCLUSION