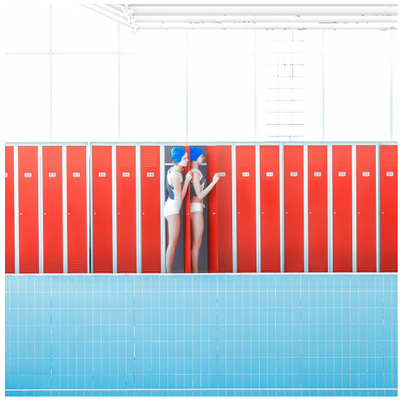
P2 Architectural Engineering

DE CENTRALE

Public indoor pool and datacentre located in the West Port of Amsterdam.

Femke Groot 4550862
Tutors: Annebregje Snijders, Jos de Krieger & Ger Warries
26/01/22'

Photograph by Maria Svarbova



INTRO | DE WOLKENFABRIEK

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Havenstad
40.000-70.000 new homes

The city and its industry have grown apart from each other, due to a **spatial demand** *and* **conflicting interests**. *This results in a* **segregated industrial area** *with a* **hard boundary** *along the edge of the city, which is problematic for adjecent development projects.*

However, **the growing city also depends on the industry** *as a machine room. The spatial seperation between consumer (city) and producer (industry) causes for difficult cooperation and a* **lack of awareness**.

INTRO | PROJECT GOALS

1.

Synergy between city programs and industry
+
awareness.

2.

Upgrade and **redevelop** industrial areas
(not move them away).

3.

Decrease **overall energy consumption**.
Increase sustainable footprint.

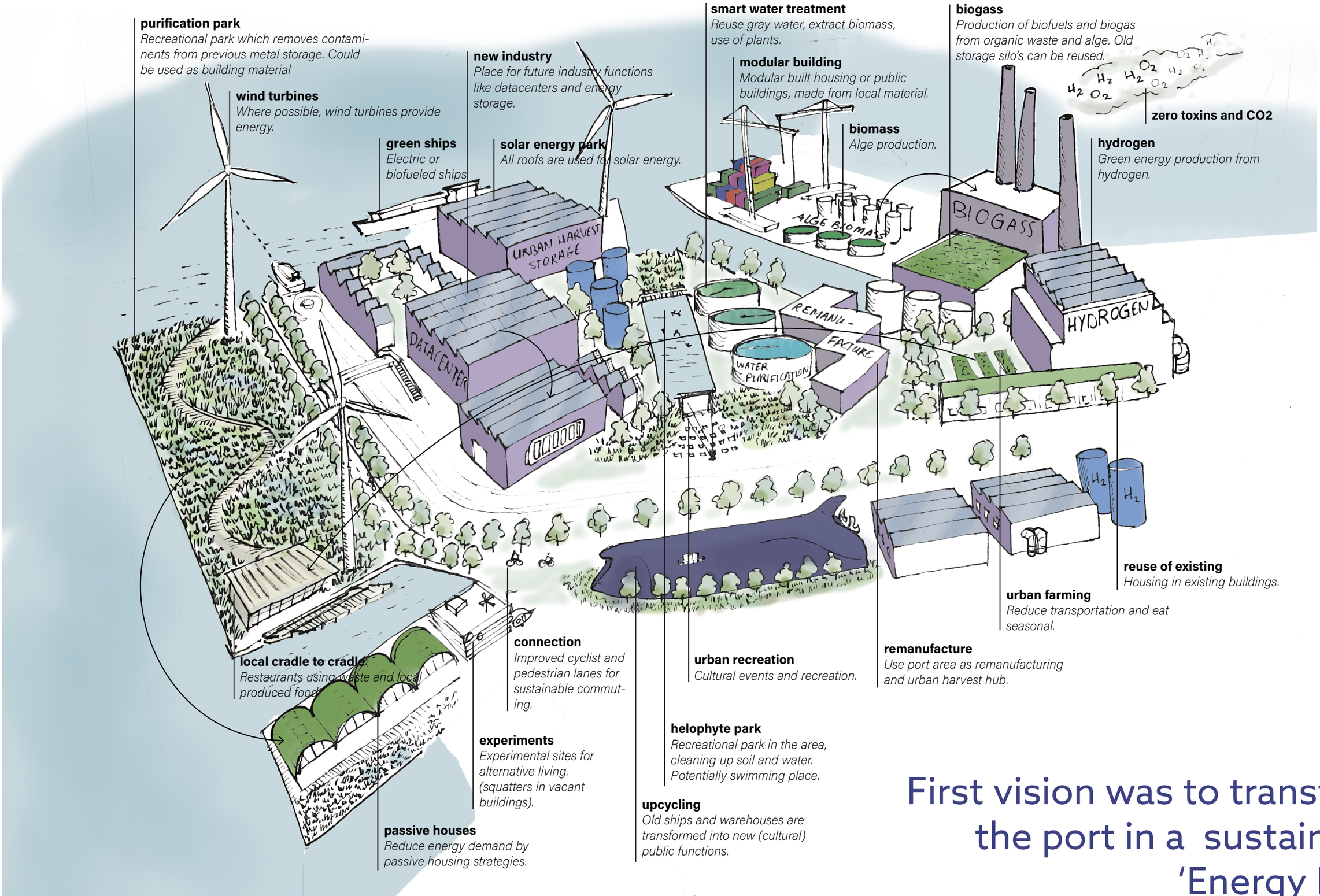
4.

Raise appreciation for **industrial heritage** of the (recent) past.

5.

Use the ‘new industry’ to its **full potential**.

INTRO | FIRST IDEAS



First vision was to transform the port in a sustainable 'Energy Hub'.

H_2

PTA

But what does Energy Hub and Circulair Hub mean spatially?

Gemeente Amsterdam. (2021). Omgevingsvisie Amsterdam 2050, een menselijke metropool. Retrieved Oct 2021, from https://amsterdam2050.nl/

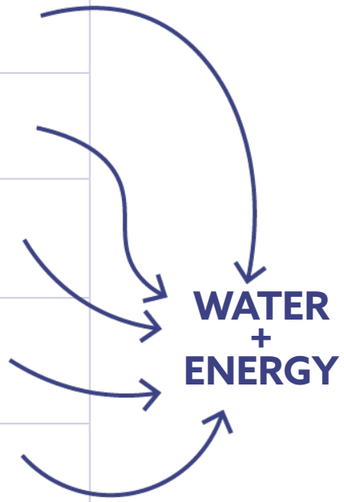
RESEARCH

PRELIMINARY RESEARCH
DATACETRES
RESEARCH QUESTION
MODELS
MFA
SCALE
CHANGE OF STRATEGY

*"**How can connection between flows of** [emerging port industries] **and** [public city functions] **increase sustainability and restore the relationship between port and city?**"*

RESEARCH | PRELIMINARY RESEARCH

FUTURE INDUSTRIAL PROGRAMS	*SUSTAINABLE IMPACT*	*HAZARD (URBAN) ENVIRONMENT*	*OPEN TO THE PUBLIC*	*ENERGY GENERATING POSSIBILITY*
GREEN BATTERY	10	6	4	7
BLUE BATTERY	10	10	10	6
HYDROGEN ELEKTROLYSIS	10	5	2	6
WASTE/DRINKING WATER HEAT RECOVERY	10	10	10	5
DATACENTRES LIQUID COOLING	10	10	9	10
DATACENTRES AIR COOLING	10	10	9	7
BIO ENERGY FROM BIO MASS	5	6	2	9
AEB WASTE TO ENERGY PLANT	8	6	2	8
DEEP GEOTHERMAL ENERGY	10	8	8	10



Which industrial and urban program could be connected and would fit in the context of the West-Port?

Metabolic Flux Analysis;

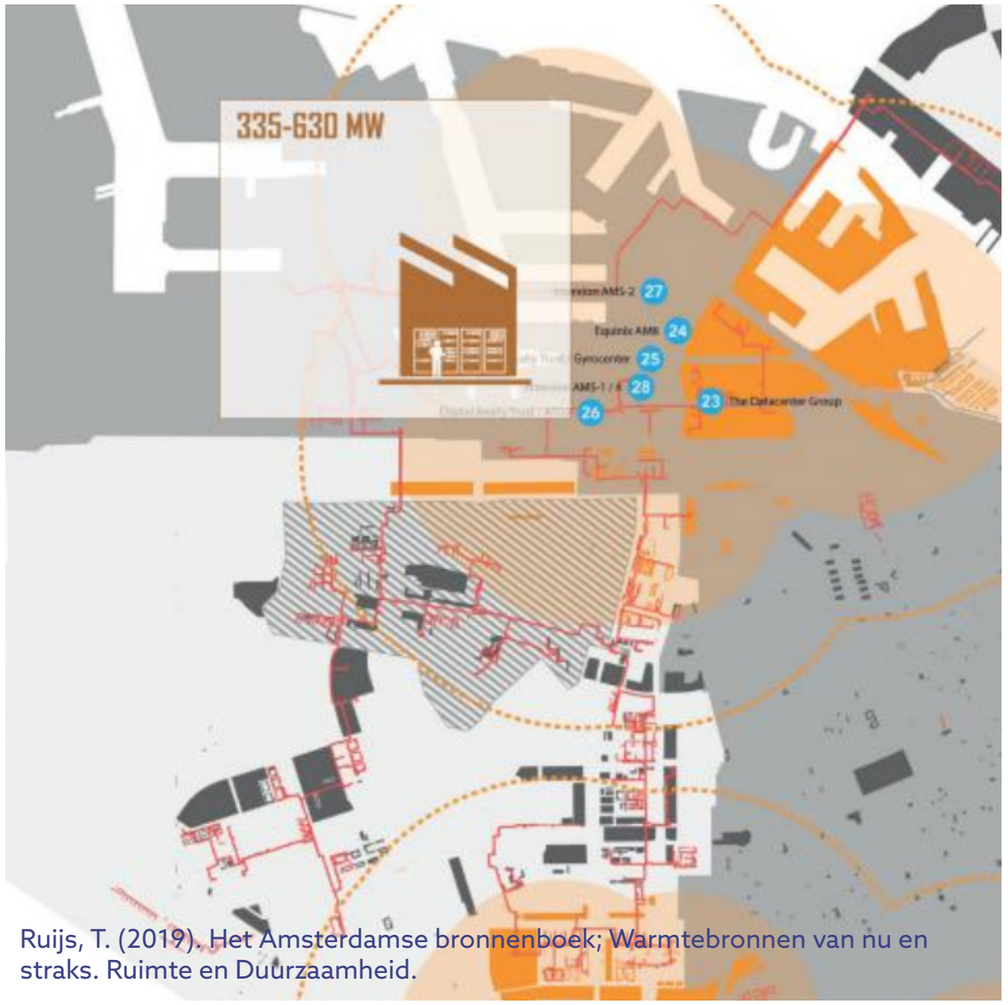
*A method based on **Urban Metabolism** in which the fluxes (or flows) of energy or materials within a system boundary over a specific time are represented in a diagram.*

With the special theory of relativity ($E=mc^2$), the sum of energy can be calculated for every flux. These values give insight in the impact of the complete system.

RESEARCH | DATACENTRES

https://www.telegraaf.nl/nieuws/1838648650/pas-op-plaats-met-besluit-grootste-datacenter-zeewolde

ZEEWOLDE DATACENTRE META



Ruijs, T. (2019). Het Amsterdamse bronnenboek; Warmtebronnen van nu en straks. Ruimte en Duurzaamheid.

AMBITION AMSTERDAM

Datacentres, a problem or an opportunity?

''The datacentre sector accounts for **3% of the global electricity use** *and is responsible for* **4% of total greenhouse gas emissions**.''

Andersen, J., Clarke, H., Luo, Y., Maroto-Valer, M., & Rajendra, M. (2019). *A dicision support system for waste heat recovery and energy efficiency improvement in datacenters*. Applied Energy, 250, pp. 1217-1224. Retrieved Dec 2021, from https://www-sciencedirect-com.tudelft.idm.oclc.org/science/article/pii/S0306261919308827

*''How can connection between flows of a **datacentre** and a **public swimming pool** increase **sustainability** and **restore the relationship** between port and city?''*

1 + 1 = 3

RESEARCH | MODELS

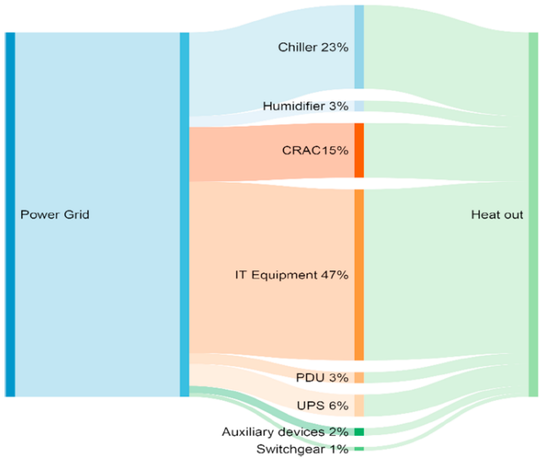


Fig. 1. A Sankey diagram demonstrating the energy attributes within a typical data centre from [22].

ANDERSEN ET AL.
Unknown location
950 kW

Andersen, J., Clarke, H., Luo, Y., Maroto-Valer, M., & Rajendra, M. (2019). https://www-sciencedirect-com.tudelft.idm.oclc.org/science/article/pii/S0306261919308827

EQUINX AM3-AM4
Amsterdam
51 MW

https://www.benthemcrouwel.com/projects/data-centers-equinix

ZEEWOLDE (META)
Zeewolde
158 MW

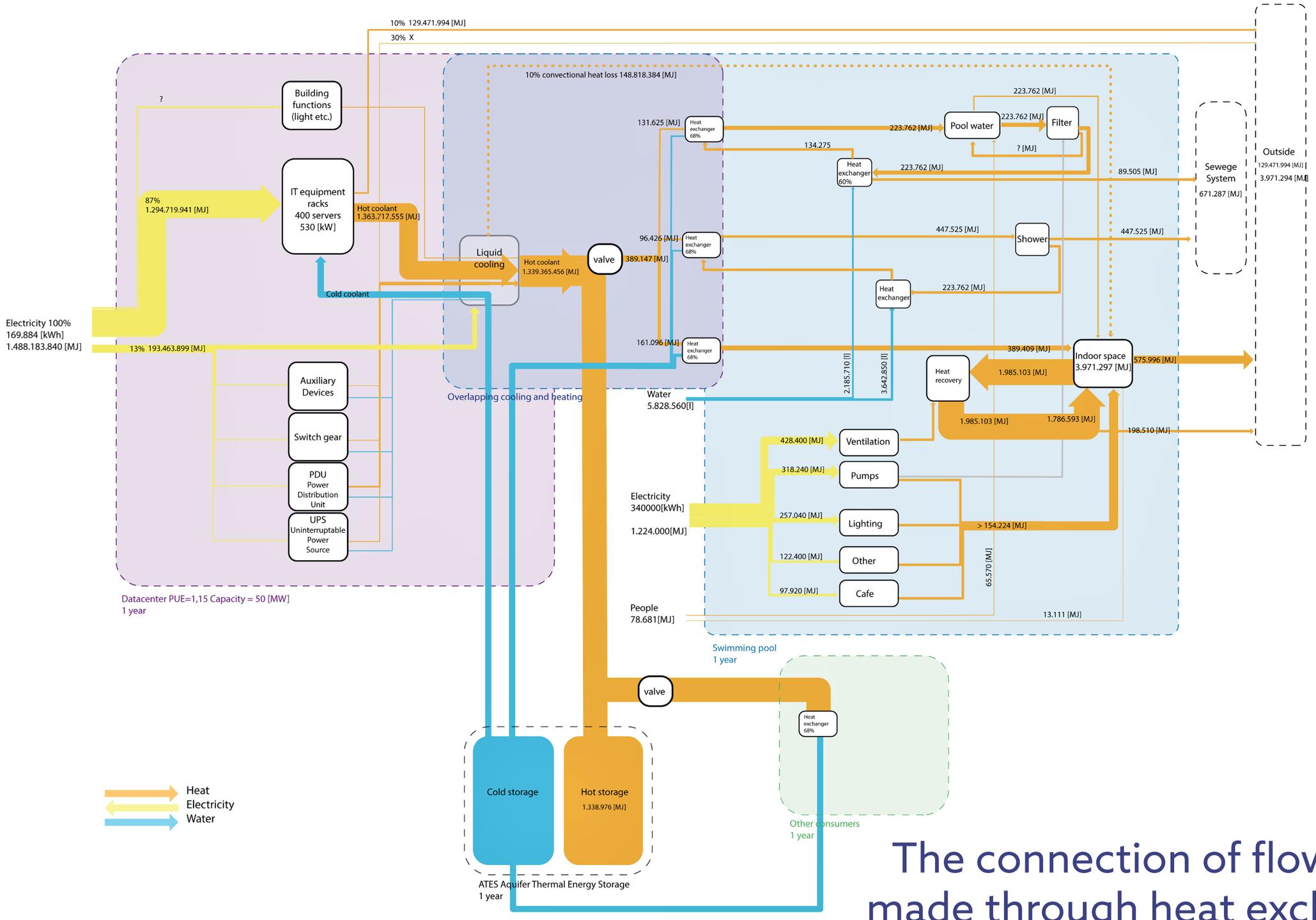
https://www.telegraaf.nl/nieuws/1838648650/pas-op-plaats-met-besluit-grootste-datacenter-zeewolde

PUE = Indication for efficiency
White space = Floor area used for servers

All energy that goes into the servers is eventually tranformed into heat. Datacentres have large cooling systems to cool the servers with air (CRAC) or coolant (Liquid cooled).

Servers and cooling are the main energy consumers of a datacentre.

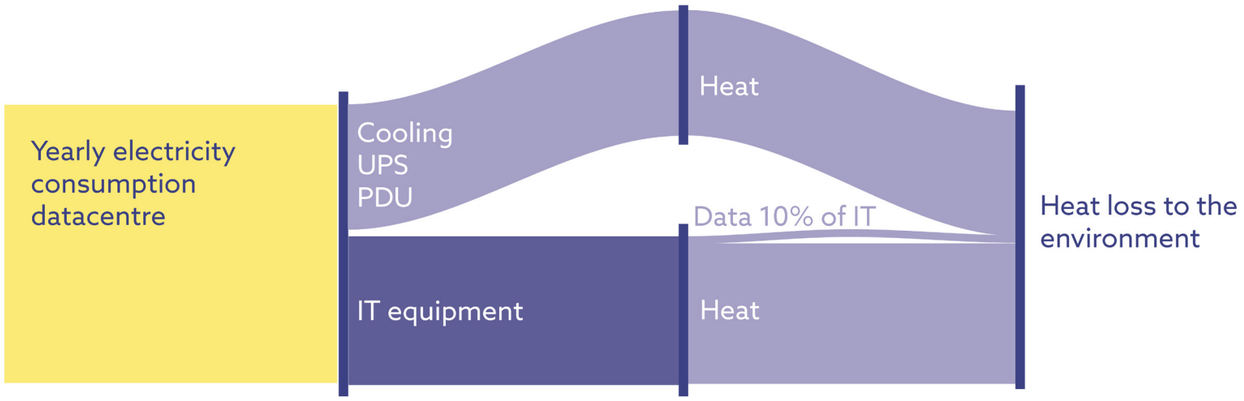
RESEARCH | MFA



The connection of flows was made through heat exchange.

$$PUE = \frac{E_{TOTAL}}{E_{IT}} = 1,x$$

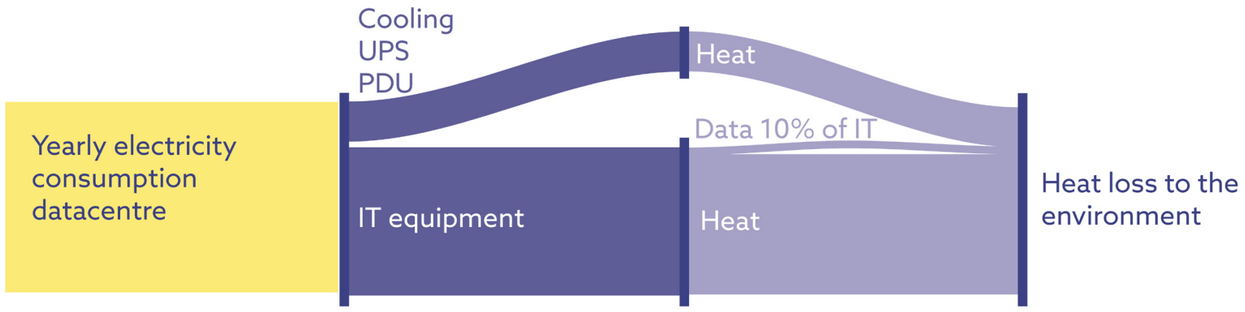
$$1 = E_{IT},\ x = E_{\text{Cooling, CPU and UPS}}$$



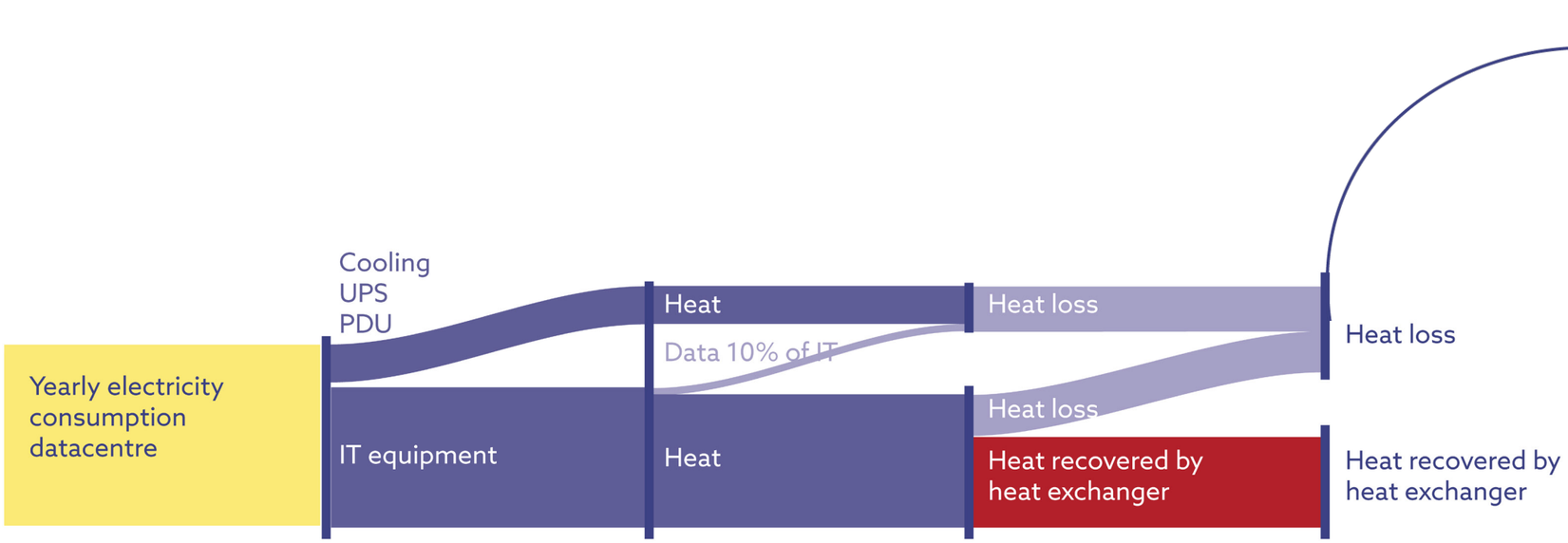
Common datacentre model with a PUE of 1,8. Cooling leads to Urban Heat Island Effect.

$$PUE = \frac{E_{TOTAL}}{E_{IT}} = 1,x$$

$$1 = E_{IT},\ x = E_{\text{Cooling, CPU and UPS}}$$

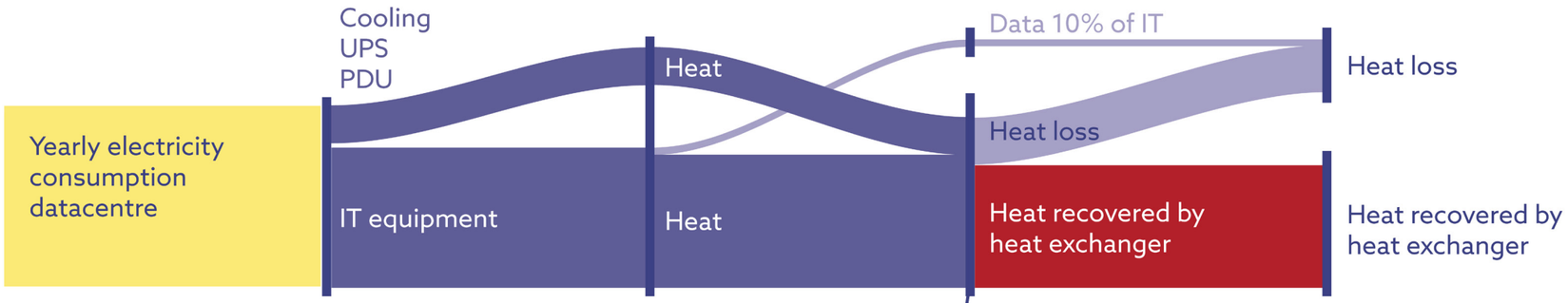


Liquid cooled datacentre model with a PUE of 1,2.



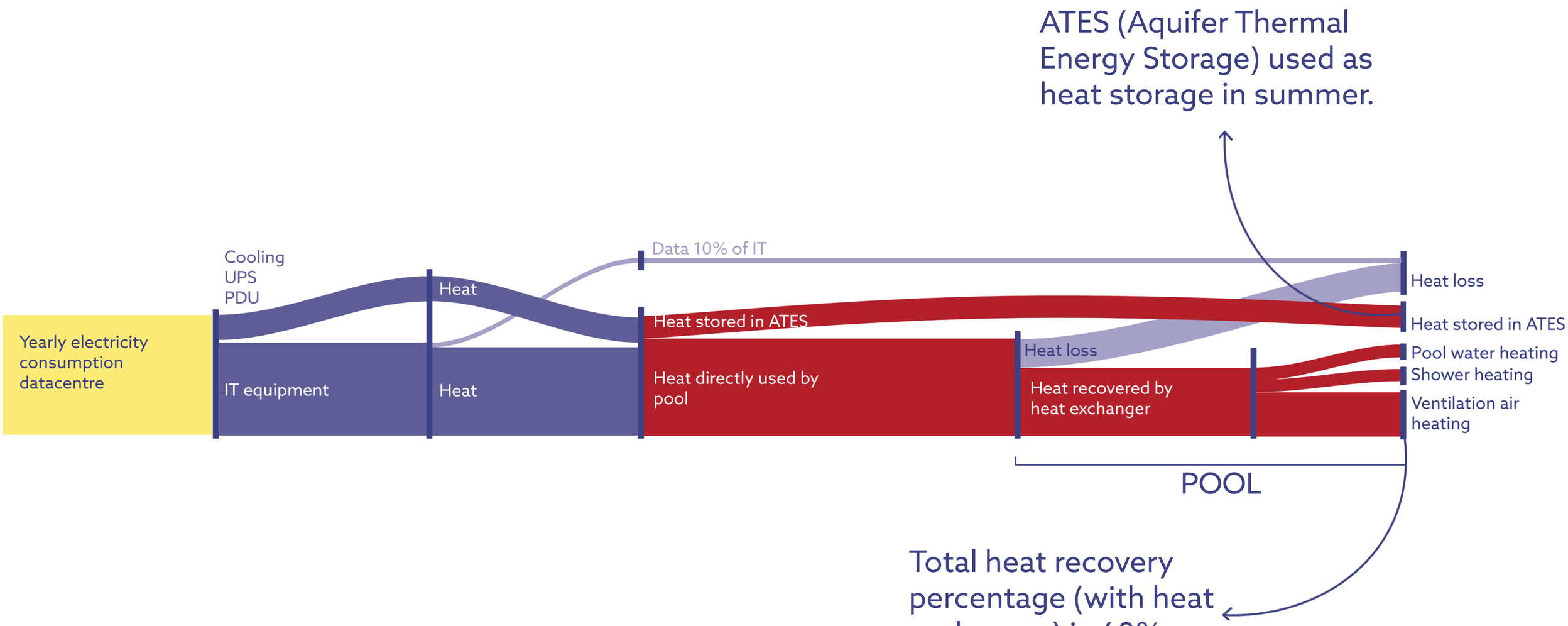
Liquid cooled datacentre model with a PUE of 1,2 and heat recovery.

RESEARCH | MFA



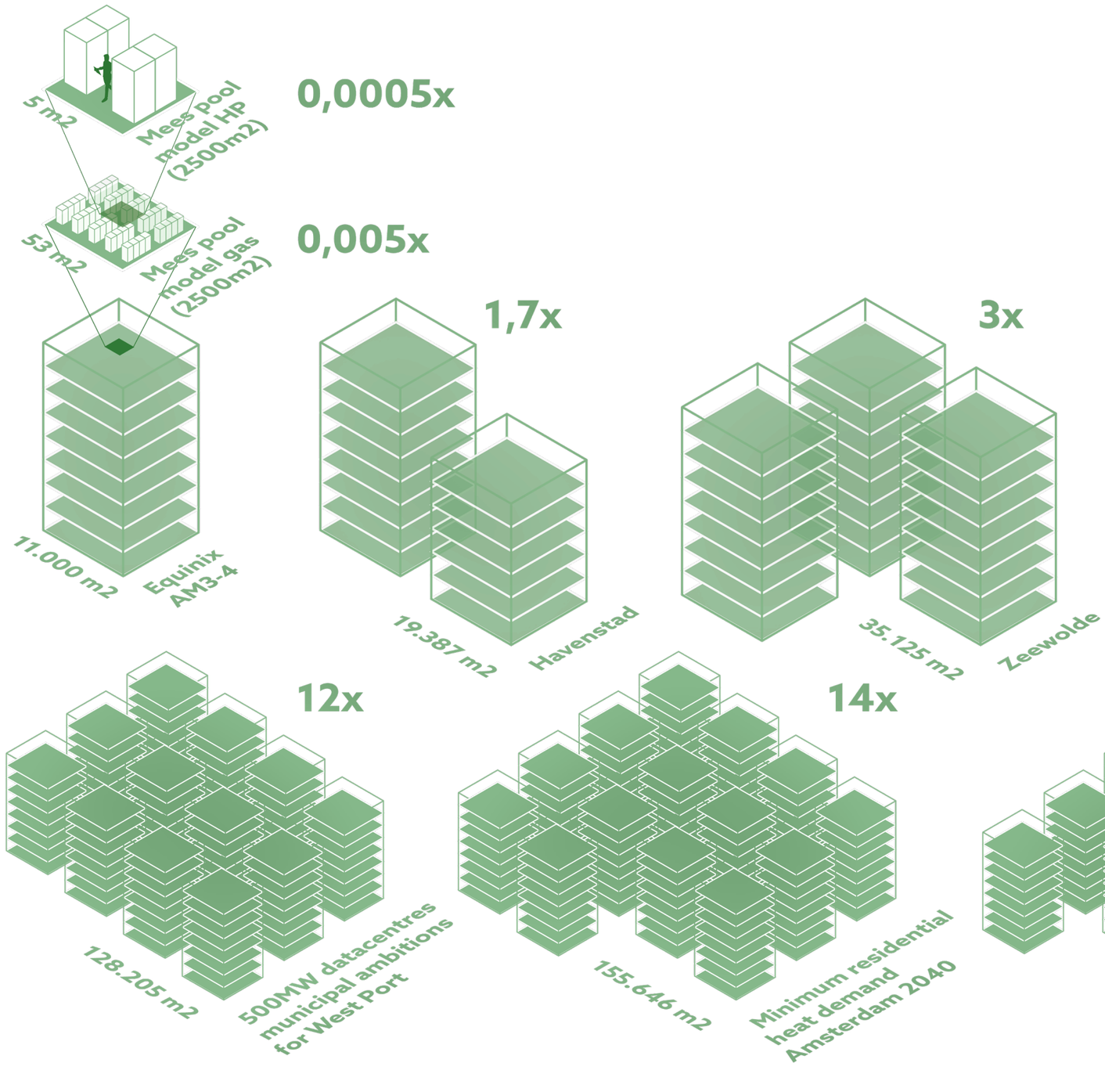
Up to 90% heat recovery would be possible if liquid cooling was optimal and HE was more efficient.

Heat exchanger efficiency is the limiting factor for heat recovery.

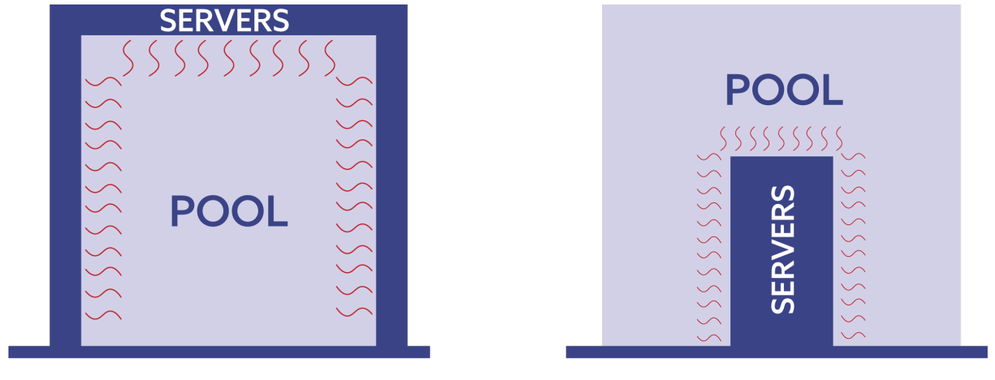


Datacenre heat recovery connected to pool, with storage.

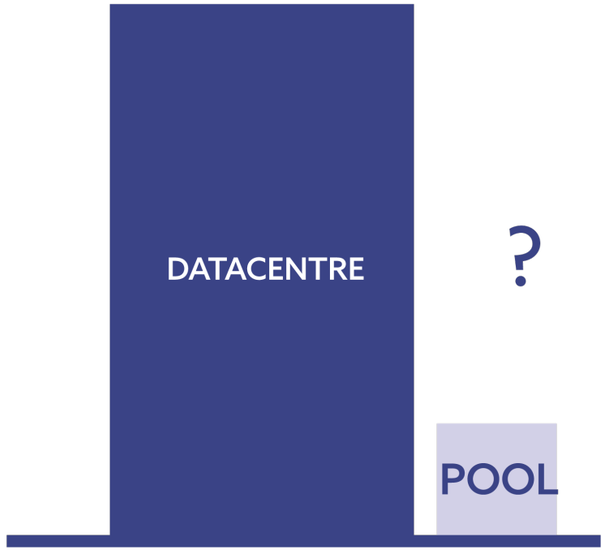
RESEARCH | SCALE



Size of model datacentres compared to Equinix Am3-4.

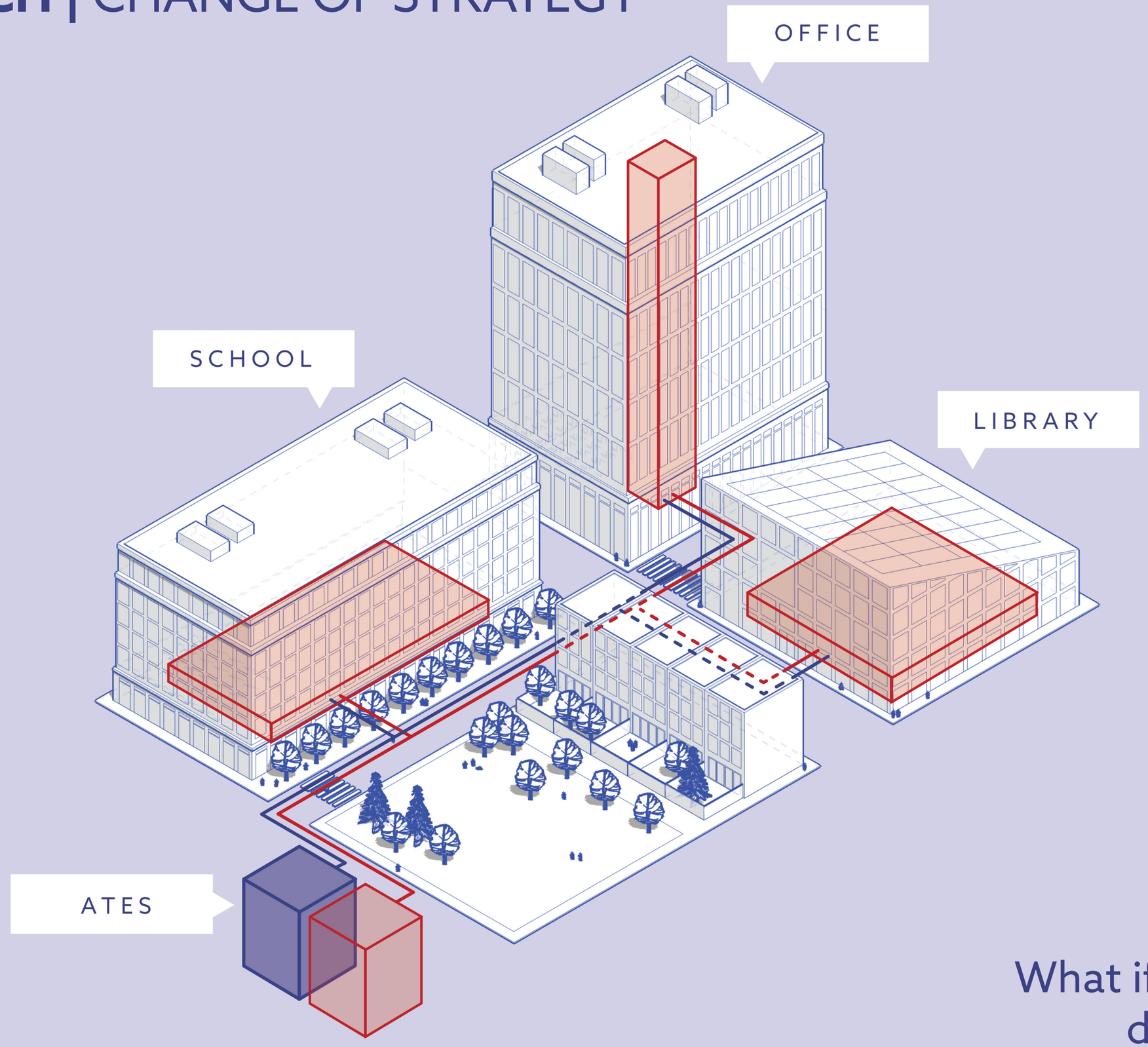


HOT BUFFER ZONES



HAVENSTAD HEAT DEMAND LARGER THAN POOL

RESEARCH | CHANGE OF STRATEGY



What if we split up datacentres?

Existing heating network Vattenfall.

Public building with datacentre heat exchange

Every neighbourhood its own public building with datacentre heat exchange and storage.

DESIGN

DESIGN QUESTION
CONTEXT
MASTERPLAN
NEW INDUSTRIAL HERITAGE
FIRST STUDIES
SILHOUET
PROGRAM
HEAT EXCHANGE
FRONT FACADE

DESIGN | DESIGN QUESTION

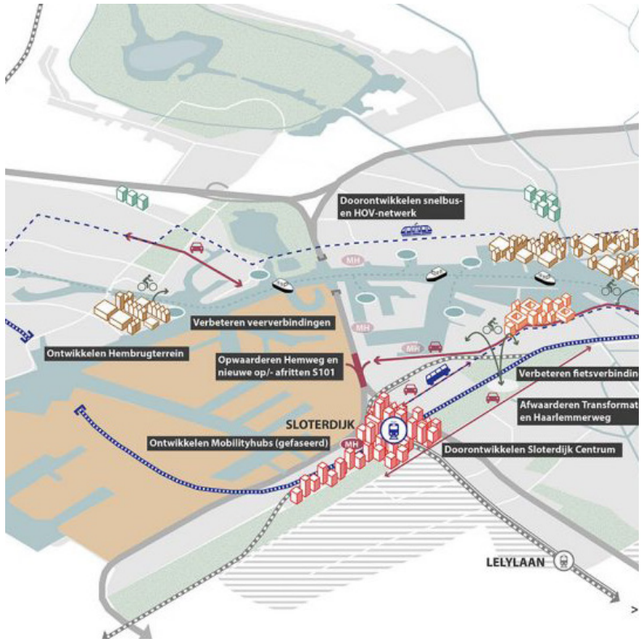
Generic:
''How can industrial areas and cities work together in symbiosis though architectural design?''
(legitimize industry)

Specific:
''Which program can be added to the Hemhaven to close the loop of urban developments which benefits the city?''
(mutual benefit)

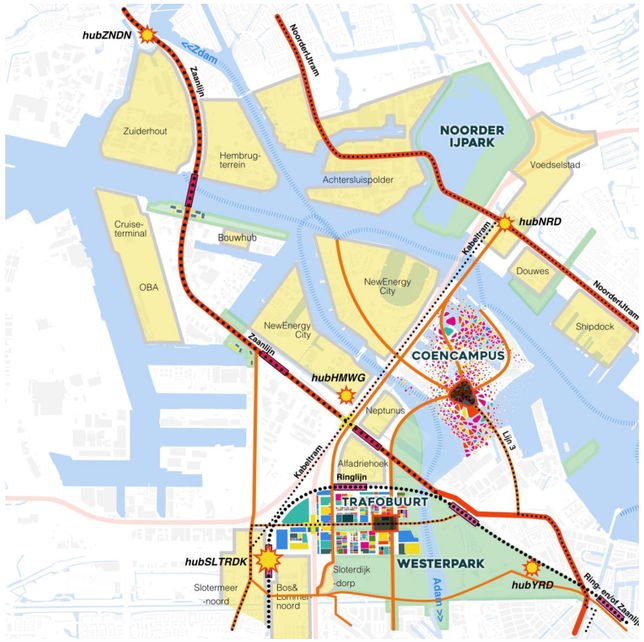
Applied:
''How can the design of a public pool and datacentre be integrated at the old coal plant terrain to accomplish the above mentioned goals?''

DESIGN | CONTEXT

GEM. AMSTERDAM | HAVENSTAD



URHAHN | HAVENSTAD



BLAU | HAVENSTAD

BOOM! | NOORDERIJPLAS

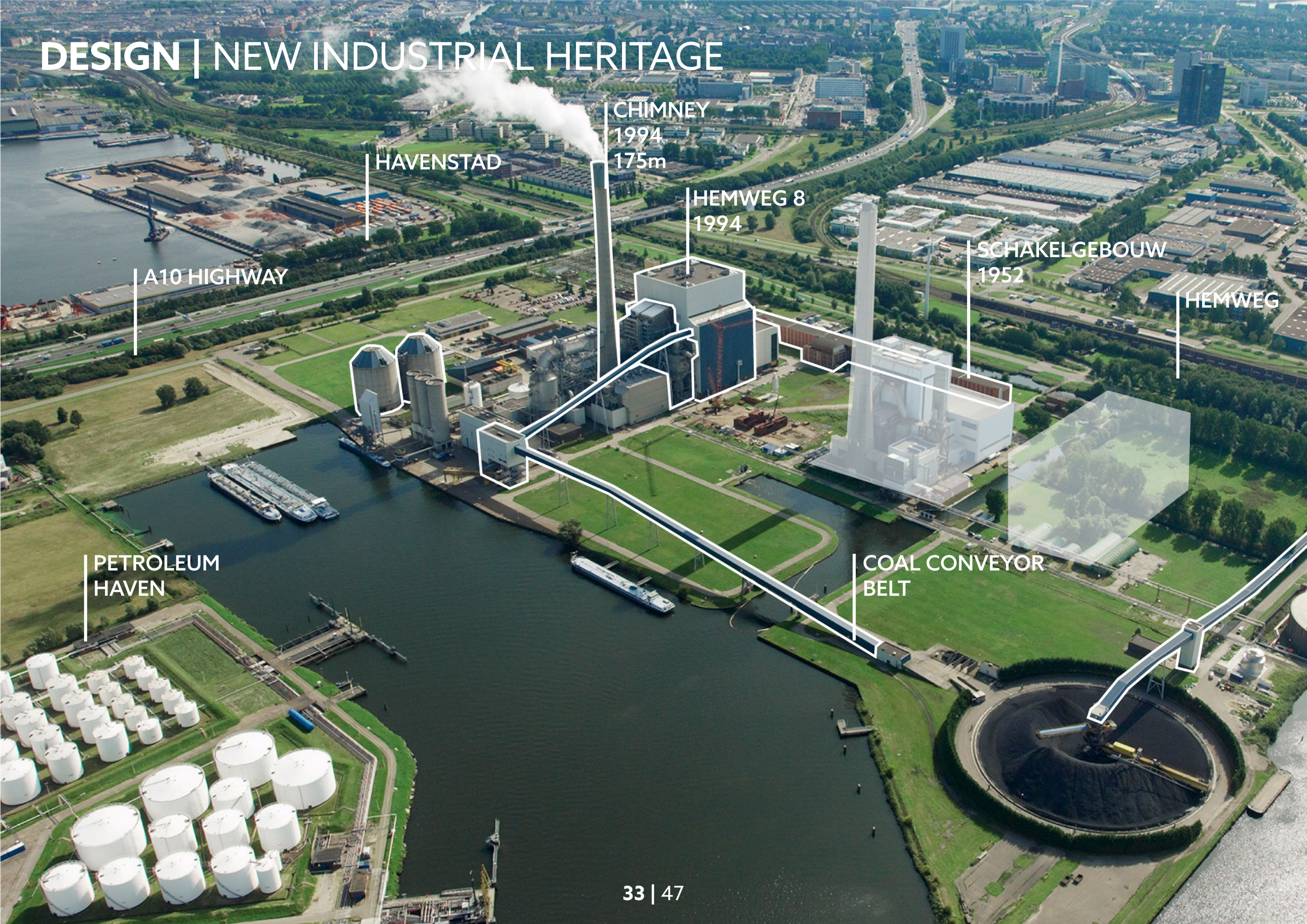
BURA | HEMBRUGTERREIN

A lot of development but Hemhavens are excluded.

DESIGN | MASTERPLAN

1:10000
0 200m 400m

DESIGN | NEW INDUSTRIAL HERITAGE



LUCHTSINGEL | ZUS

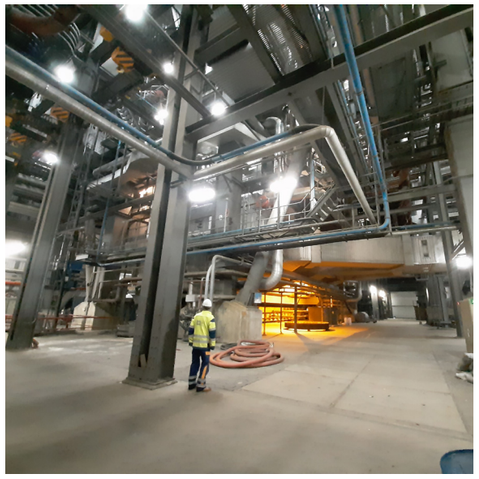
COAL CONVEYOR BELT

A new route for pedestrians.

DESIGN | NEW INDUSTRIAL HERITAGE

HEMWEG 8
1994

SCHAKELGEBOUW
1952

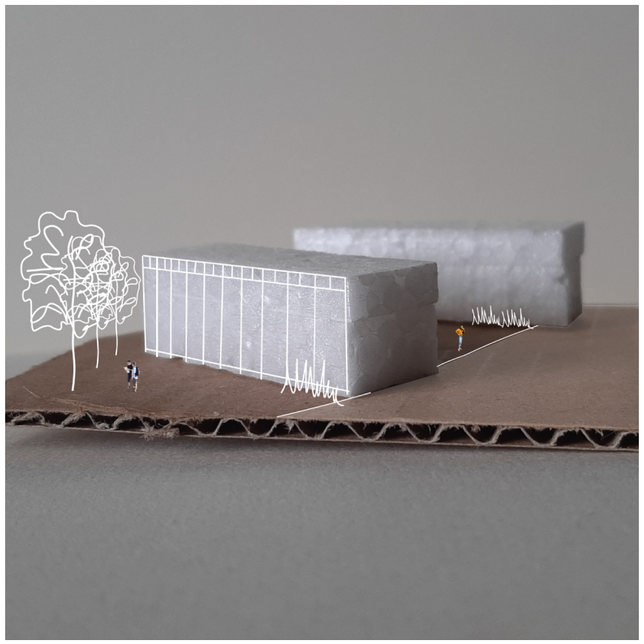


KETTLE

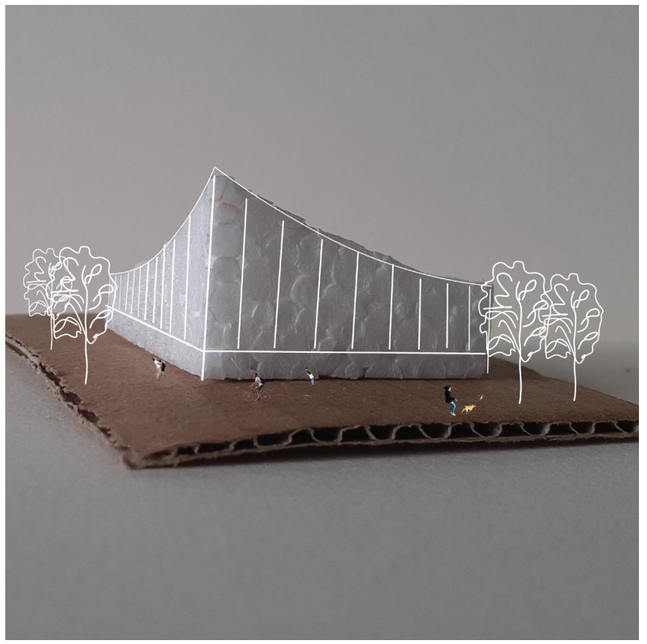
HEAT EXCHANGE AND
TRANSPORT OF ASHES

DESIGN | FIRST STUDIES

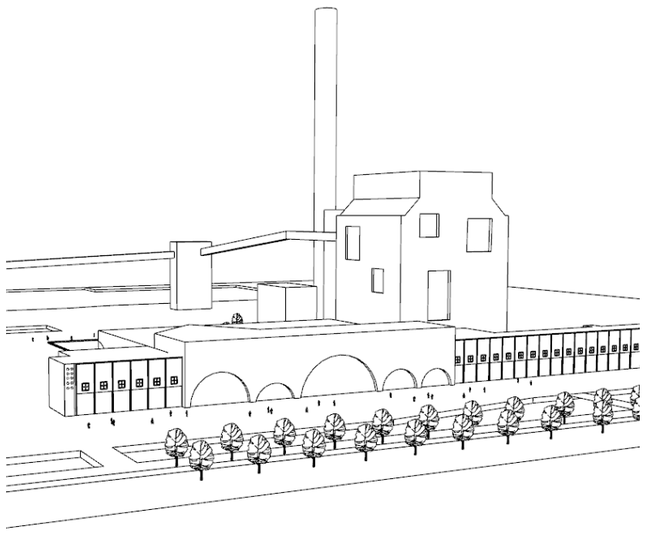
ROMAN BATHHOUSE



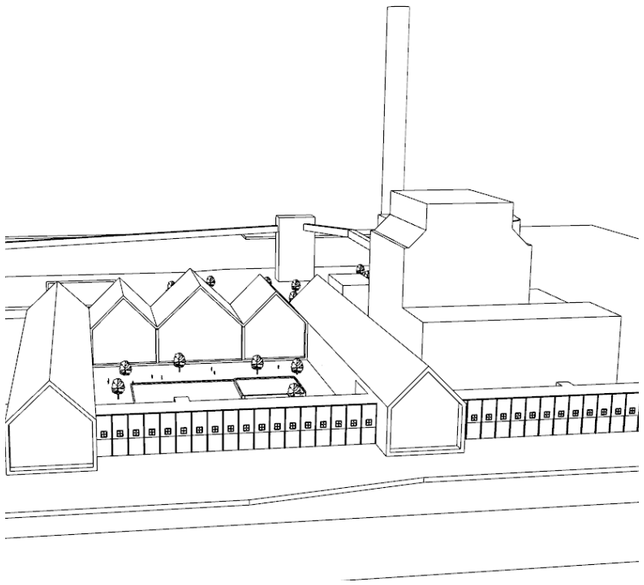
WATERSIDE



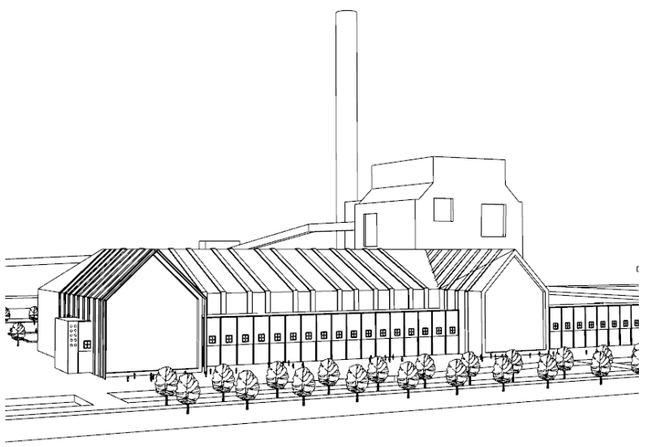
ACCENT POINT



MODERN ARCHES



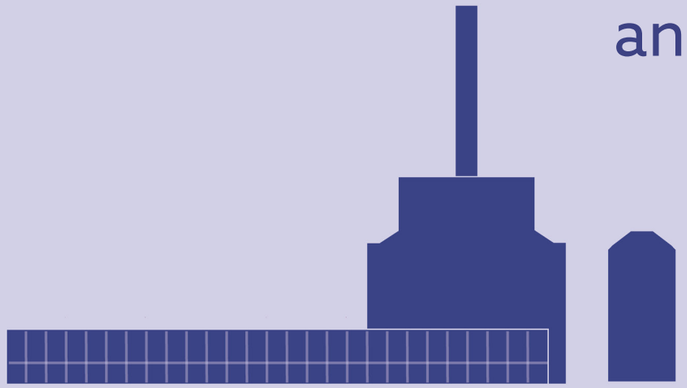
COUTYARD



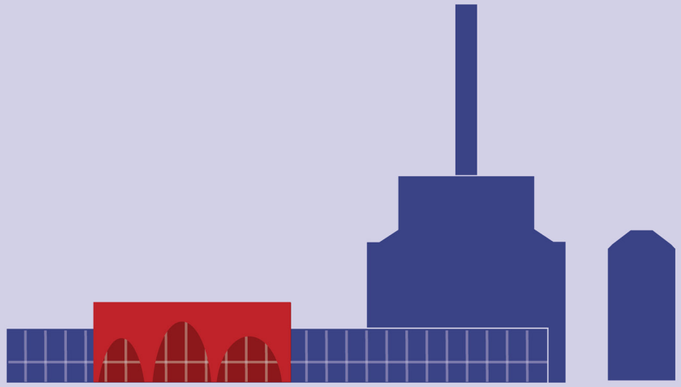
HOUSE

DESIGN | ADDING TO THE SILHOUET

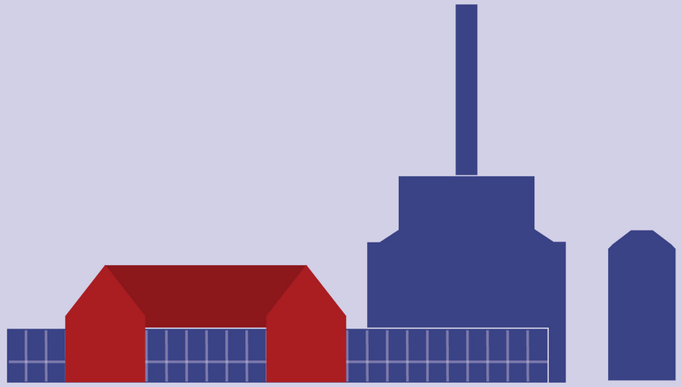
Use the **iconicity** of an existing **landmark**, changing the **identity** and adding to the **composition**.



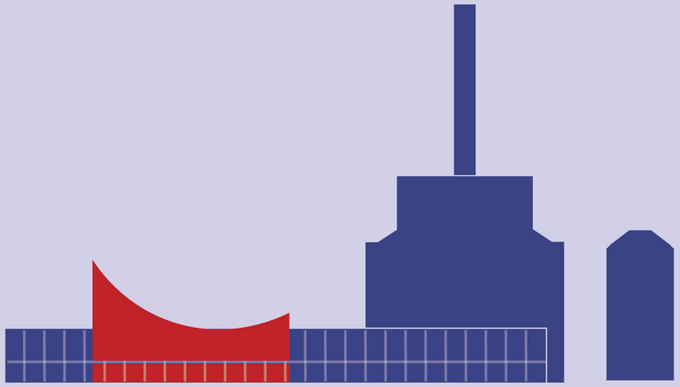
THE EXISTING



ACCENT



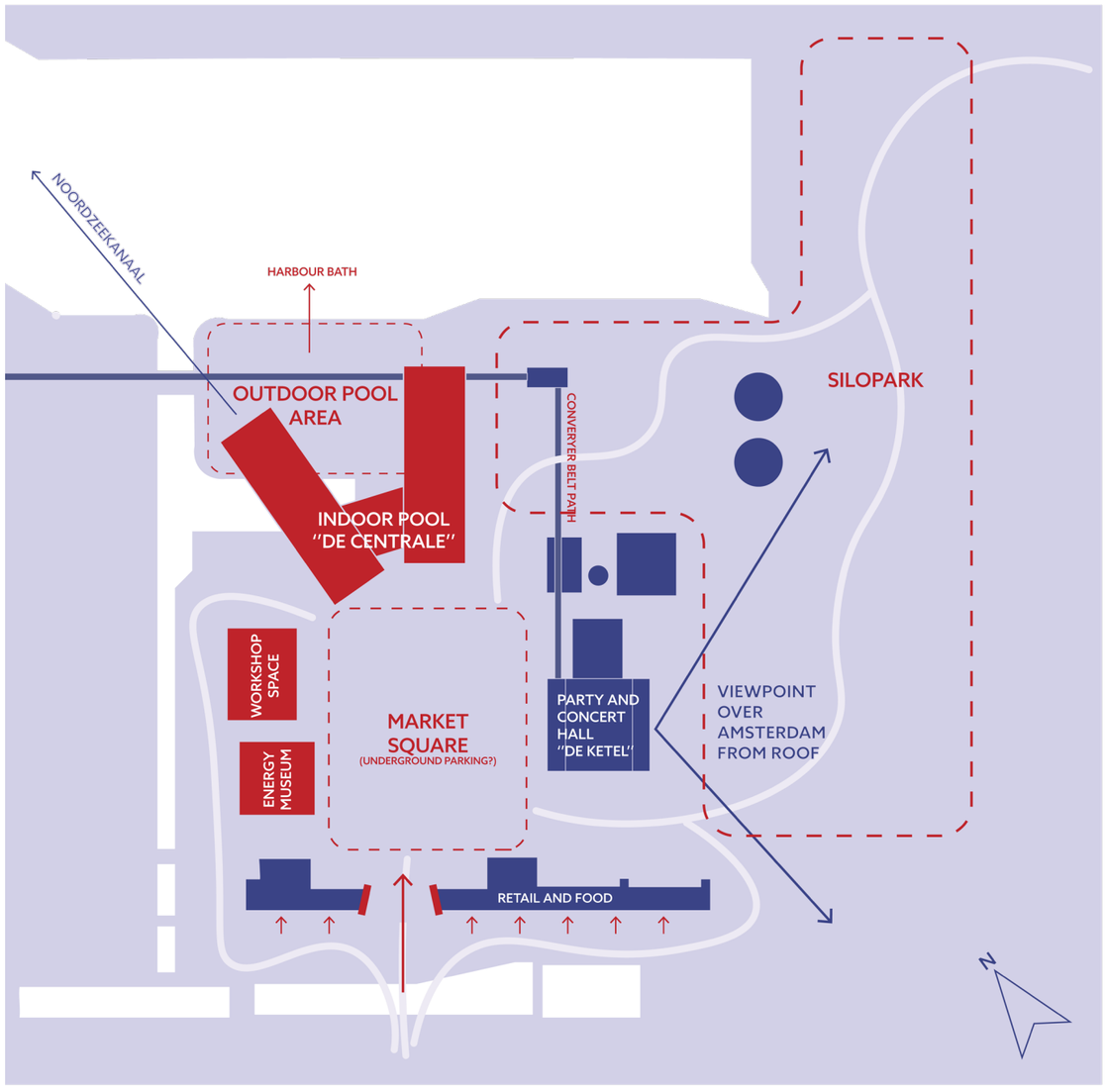
NEW SILHOUET



CONTRAST

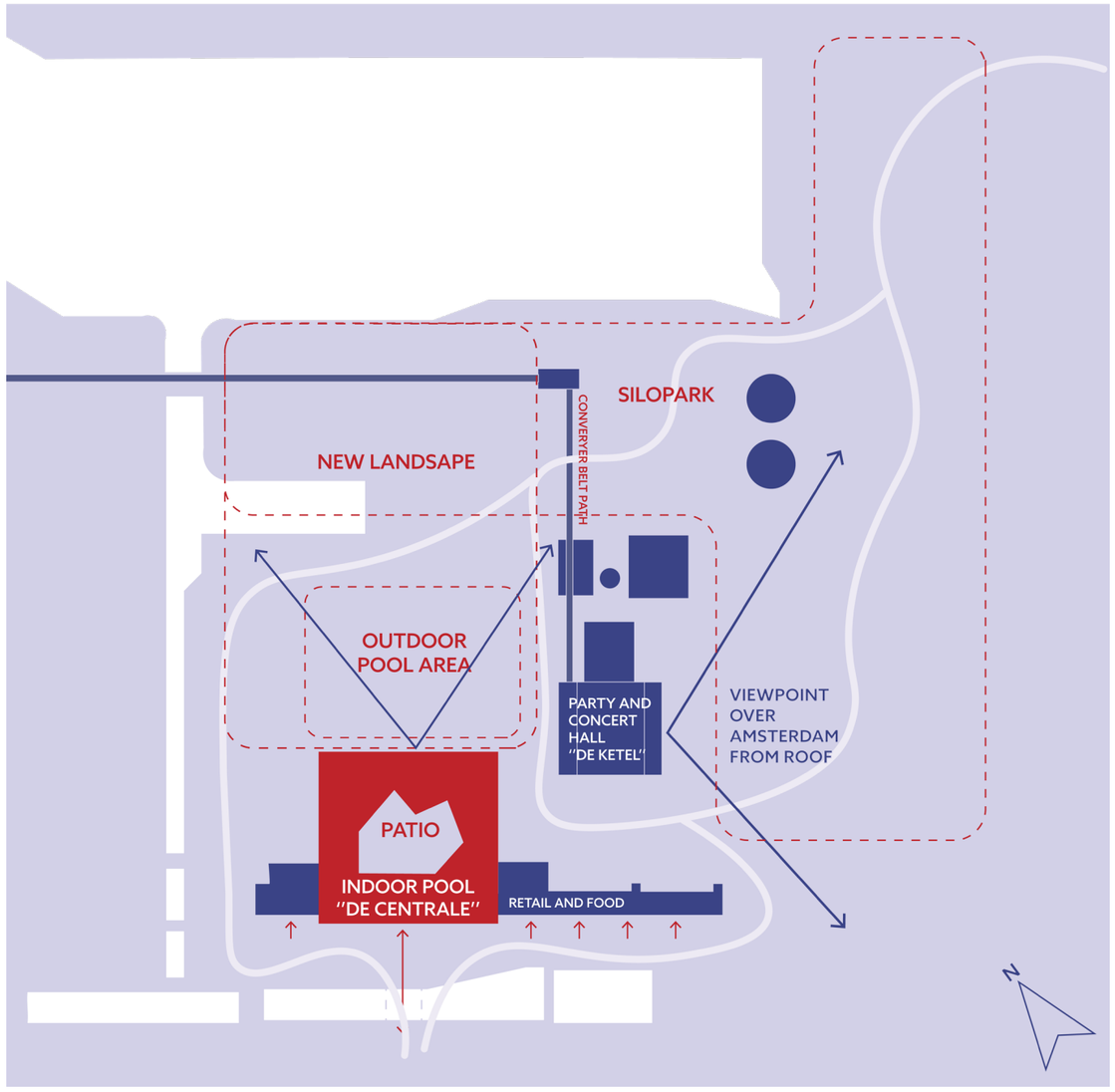
A new entrance along the road breaks the closed horizonatlity of the schakelgebouw.

DESIGN | STRATEGY



New
Old

CLUSTER
Westergasterrein
Hembrugterrein
NDSM



SINGLE STATEMENT
Eye museum
Boijmans Depot

DESIGN | PROGRAM

PUBLIC POOL

Lobby/Entrance
Changing rooms individual and family
Lockers
Showers
Toilets
Cafe/Restuarant (also out-side access)

Storage space
Offices/staffroom
Installation space

Indoor:
25m pool
Recreational/tropic pool
Healing pool
Toddler pool
Hot tubs
Slide

Outdoor:
25m pool
Recreational pool
Toddler pool
Slide

DATACENTRE

Lobby/Entrance
Coffee corner
Workspace
Secuirity
Control room
Staff room/kitchen
Toilets

White space servers
Installation space for heat exchange and pumps

Sustainable energy supply (solar panels / wind / alter-native?)

DESIGN

3000m² indoor pool
800m² outdoor pool
1000m² datacentre
± 4800m² total

RECREATIONAL PARK

Helophyes
Biodiverse plant selection
Possible sound barrier
Conveyor belt bridge 24/7

CONCERT/FESTIVAL HALL

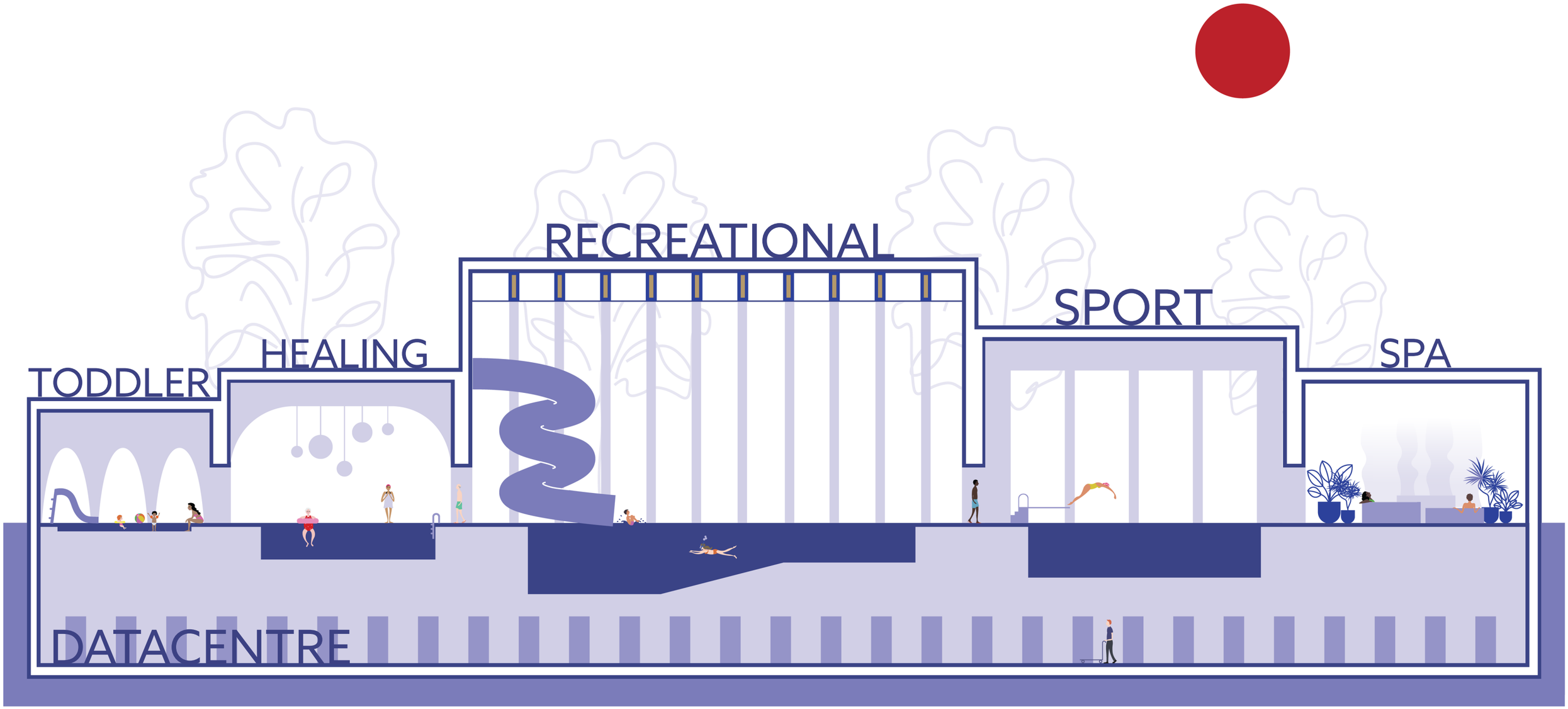
Only conceptual design
Connection to bridge

RETAIL & FOOD

Only conceptual design
Visual strong relationship with Hemweg

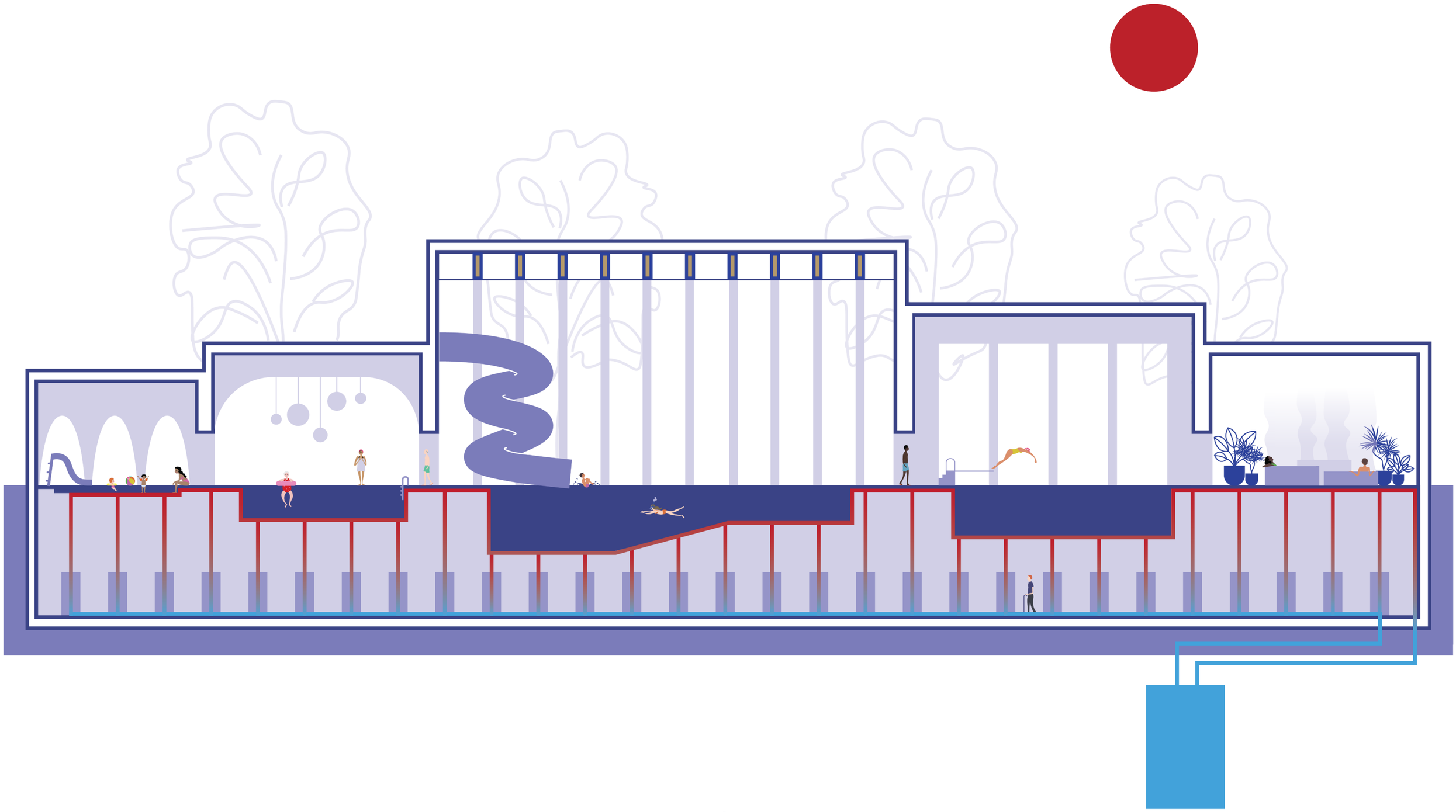
OTHER POSSIBLE PROGRAMS

Energy Museum
Workshops
Ateliers
Local Market
Outdoor Cinema



Pool rooms of different atmosphere arranged as sequence.

DESIGN | HEAT EXCHANGE



DESIGN | FRONT FACADE IDEA

TOWARDS P5

DESIGN GOALS

GRADUATION PLANNING

BUILDING, LANDSCAPE AND HERITAGE

- Upgrading the industrial area, close the loop.
- Multiple scale design (Masterplan concept, landscape design concept, building design, building details, interior design concept).
- Reuse and appreceiation for new industrial heritage.
- Large span wood constructions.

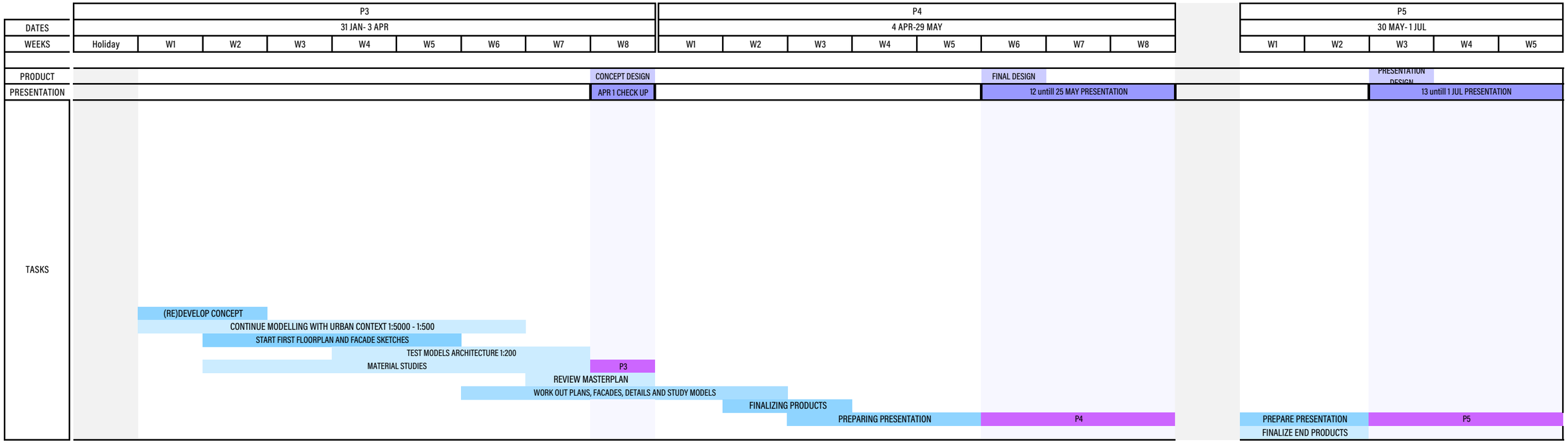
CLIMATE

- Energy footprint to zero.
- Generate energy for datacentre on site sustainably.
- Heat demand of pool fully supplied by datacentre and flexible per season.
- Sustainable and ecological deisgn (Passive climate design, ecological material choice, biodiversity).

SOCIAL

- Connecting the Energy hub to the citizens and raising awareness (educate).
- Inclusive design.
- Mixed program.

TOWARDS P5 | GRADUATION PLANNING



REFERENCES




[photograph 1-4] Maria Svarbova *Pool without Water series https://www.yatzer.com/maria-svarbova-swimming-pool*

[Image] *56% CO2-reductie in Amsterdam in 2020* https://www.vattenfall.nl/producten/stadsverwarming/co2-reductie/amsterdam-totaal/

Ruijs, T. (2019). *Het Amsterdamse bronnenboek; Warmtebronnen van nu en straks*. Ruimte en Duurzaamheid. Gemeente Amsterdam. Retrieved Dec 2021, from https://issuu.com/gemeenteamsterdam/docs/het_amsterdamse_bronnenboek_online_versie

Andersen, J., Clarke, H., Luo, Y., Maroto-Valer, M., & Rajendra, M. (2019). https://www-sciencedirect-com.tudelft.idm.oclc.org/science/article/pii/S0306261919308827

[Image] Equinix AM3-4 *https://www.benthemcrouwel.com/projects/data-centers-equinix*

[Image] Zeewolde datacenter META *https://www.telegraaf.nl/nieuws/1838648650/pas-op-plaats-met-besluit-grootste-datacenter-zeewolde*


SHARING
ARTS
EI 8907