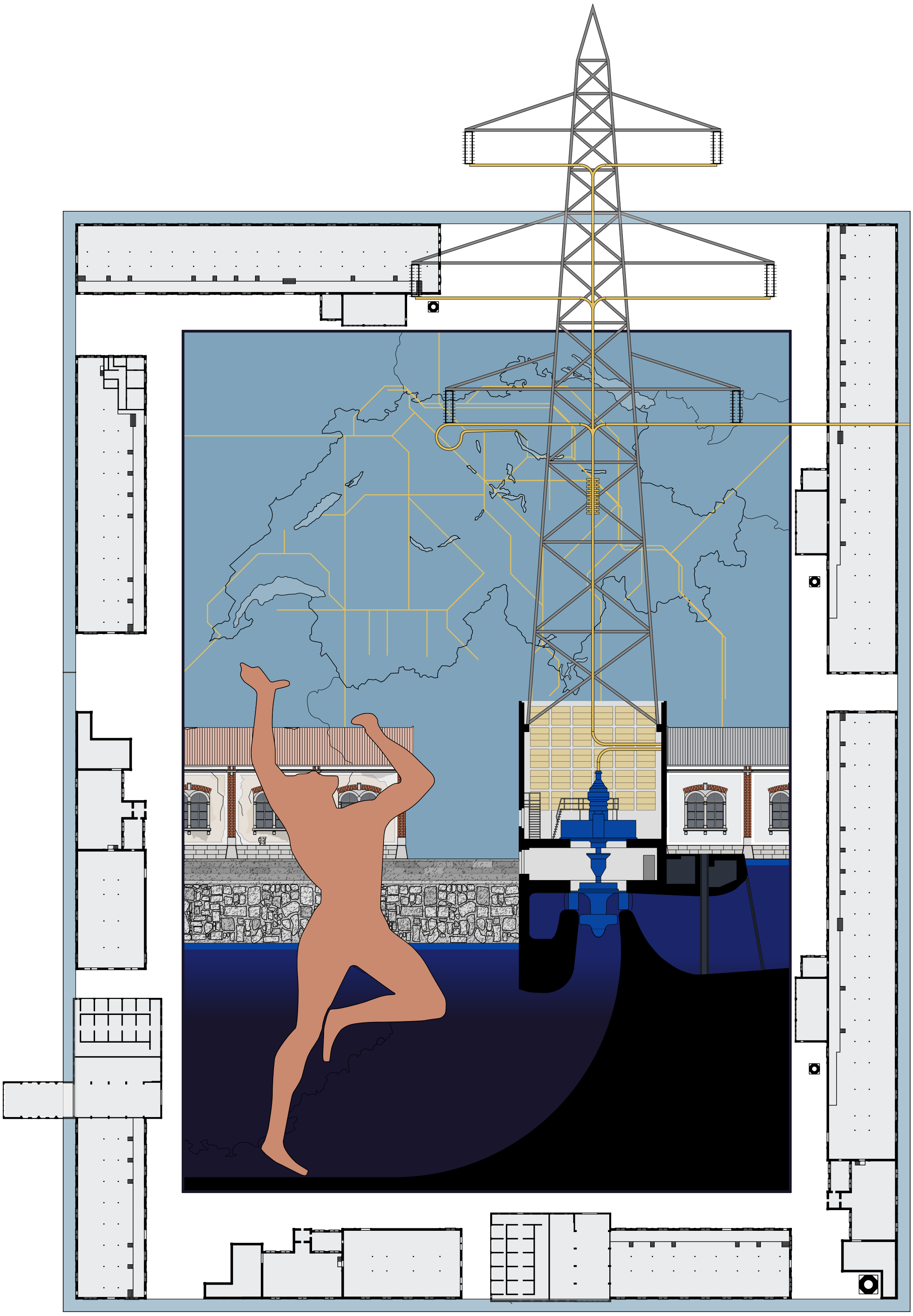


LAUFKRAFTWERK LETTEN
or
A LETTER TO ELEA

To Elea*

Tantalos was once a king,
born son to Zeus, god of high voltage;
born son to Plutos, goddess of earthly
wealth.

His castle close to a lake,
fruitful land to establish a kingdom
whose lands extended twelve days',
whose wealth was mined in the
mountains.

Welcomed to table with his father
he deceives him, steals nectar to
eternal life, but the gods became
aware.

Tantalos thrown out of the Olympus,
abandoned by his father, cut off,
was to stand in water,
below an apple tree, fruit of energy.
He was made to desire two things
without ever attaining them again:

water
energy

* Elea is the greek mythological
personification of mercy, clemency,
compassion

Laufkraftwerk Letten

The Laufkraftwerk Letten was initially built as a water supply station for Zürich. Extended in the same formal language, it became an electricity plant, based on hydropower and coal.

In the beginning of the twentieth century Zurich built up its energy network by connecting the city to the mountains of Graubünden. Electricity was transported from the dam in the mountain to the city.

Soon the demand for electricity increased drastically, calling for a more efficient way of production even in the Laufkraftwerk Letten. The cole driven steam engines were outdated and hydropower could be used better. With the construction of the Unterwerk the original extension was cut off to lower waters.

From this point on the Laufkraftwerk Letten took on two very different paths: one into the world and one into slow decay

This is its story, its reach, its architecture, its life:

from birth to abandonment

a chronographic history

EVOLUTION IN IMAGES

1878
Turbine-/ Waterpumphall
Canal/ Dam & Sluice
Cabletransmission

1893
Expansion into electricity plant
Extension turbine-/pumphall
Construction first boiler house
Construction first chimney

1896
Extension steam-engine part
Construction filterstation Silhquai

1898
Construction steam-boiler-house
Construction of second chimney
Connection filterstation Sihlquai
Deconstruction of first chimney

1911
End of drinking water distribution

1914
Turbine exchange (Francis)

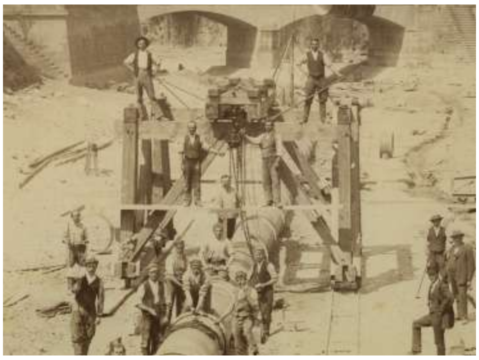
1937/38
New machine house (Unterwerk)
Deconstruction of machinehouse

1950/51
New machine house across river
+ 2 turbines + 2 generators
Nadelwehr replacement
Deconstruction of Männerbad

2003
Renewal of turbines

2016
Solar roof
Fish ladder


1878

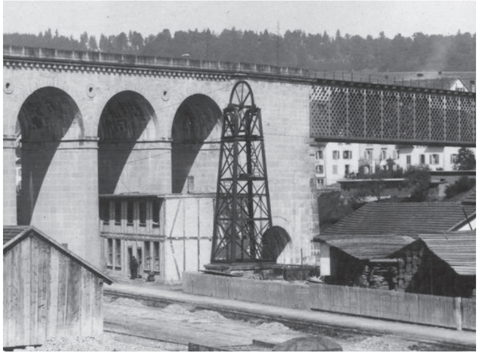

1895

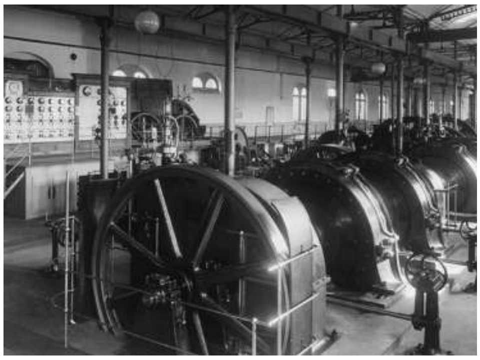

1898


1914

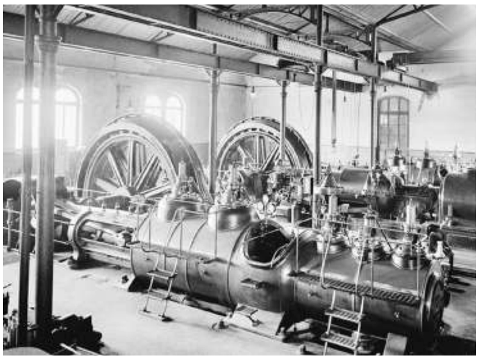

1950

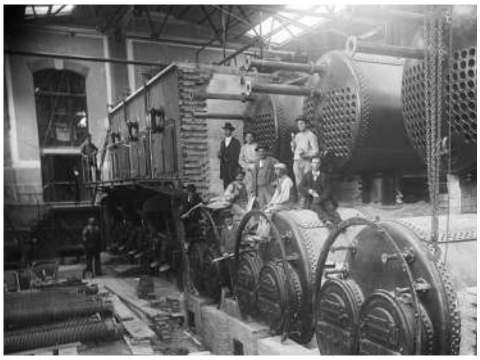

1878

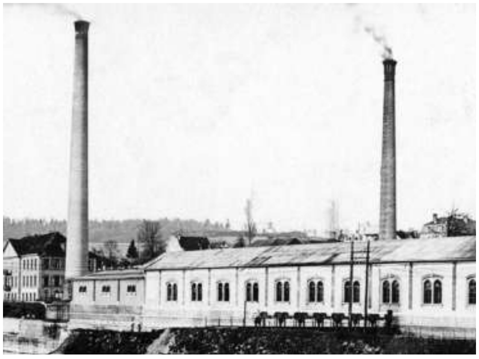

1878


1893

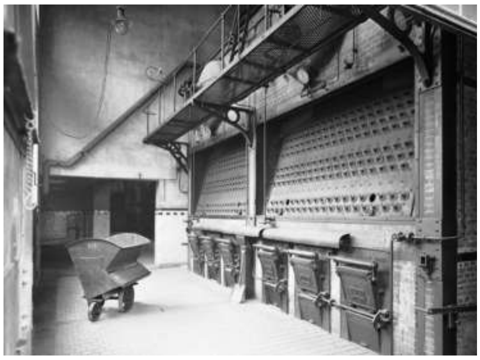

1896

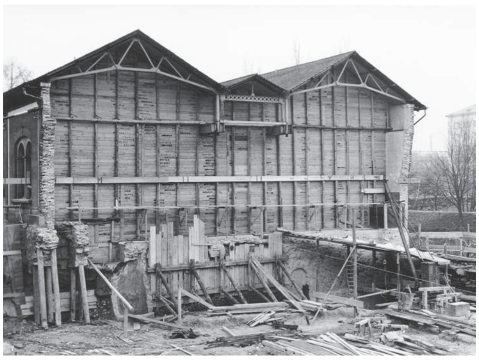

1896

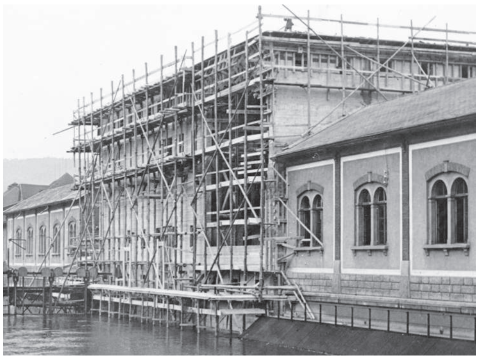

1898


1898

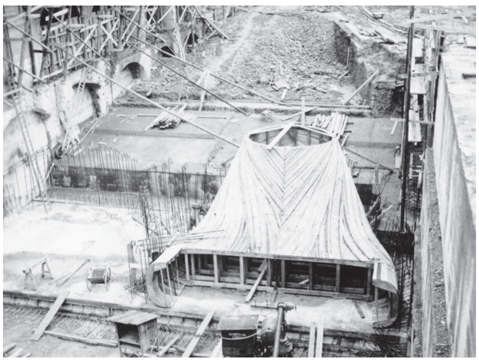

1898

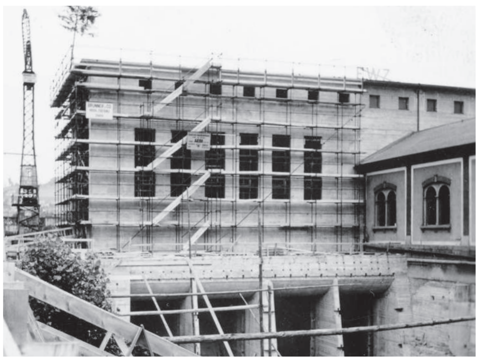

1898


1937


1938

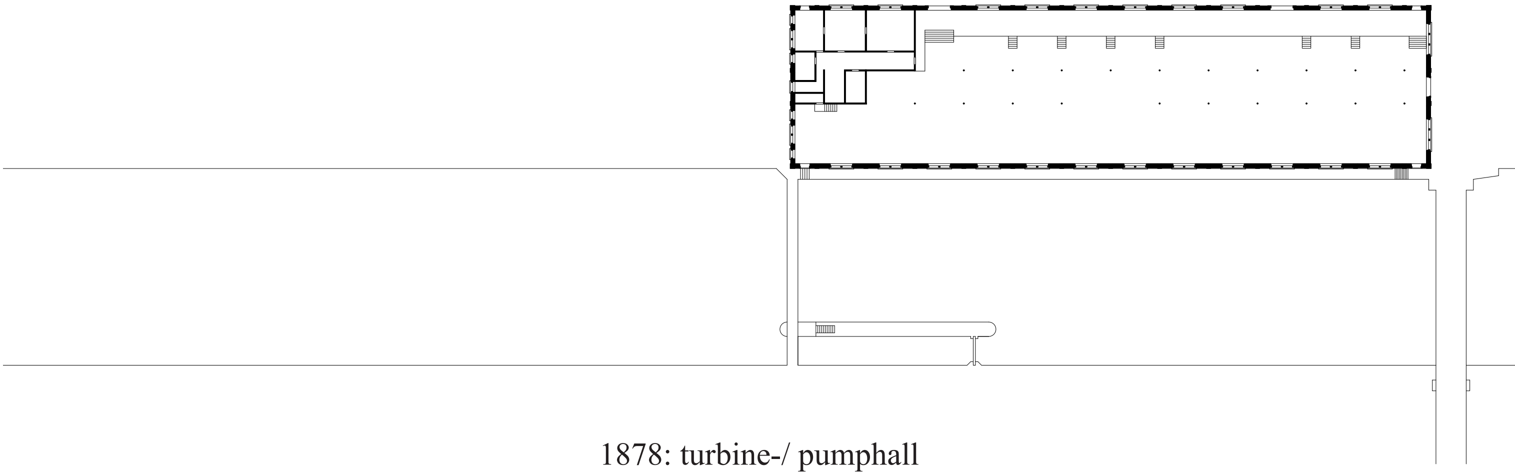
1938


1950

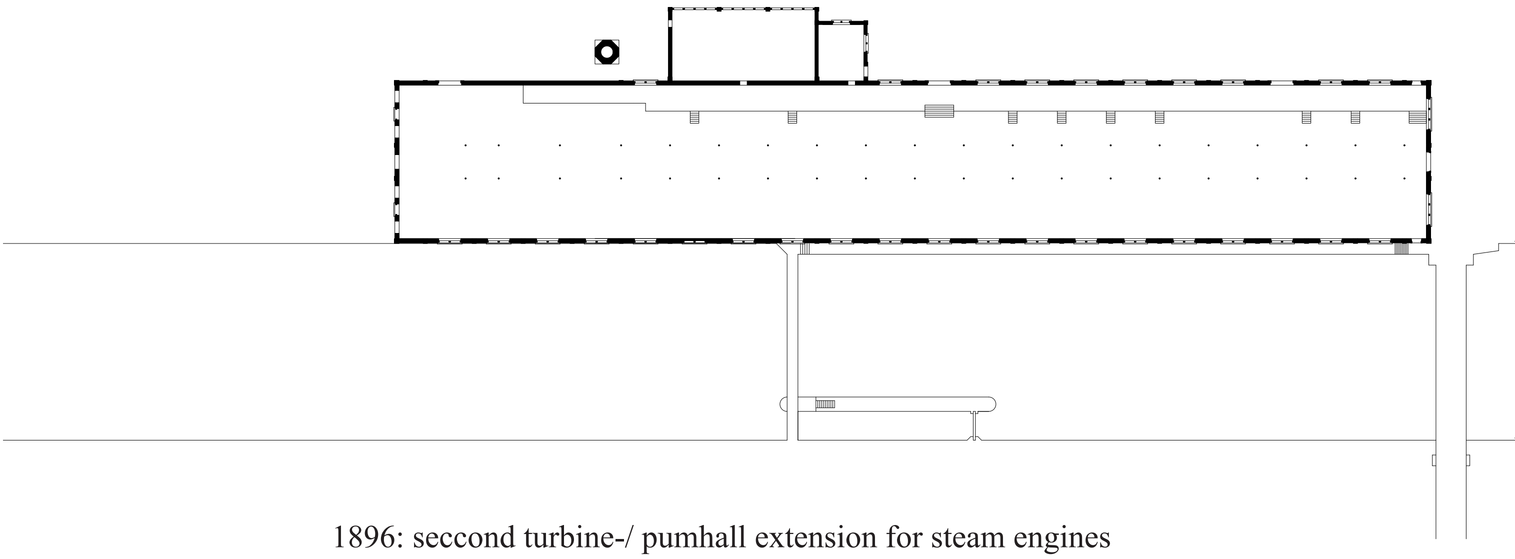

1951


1951

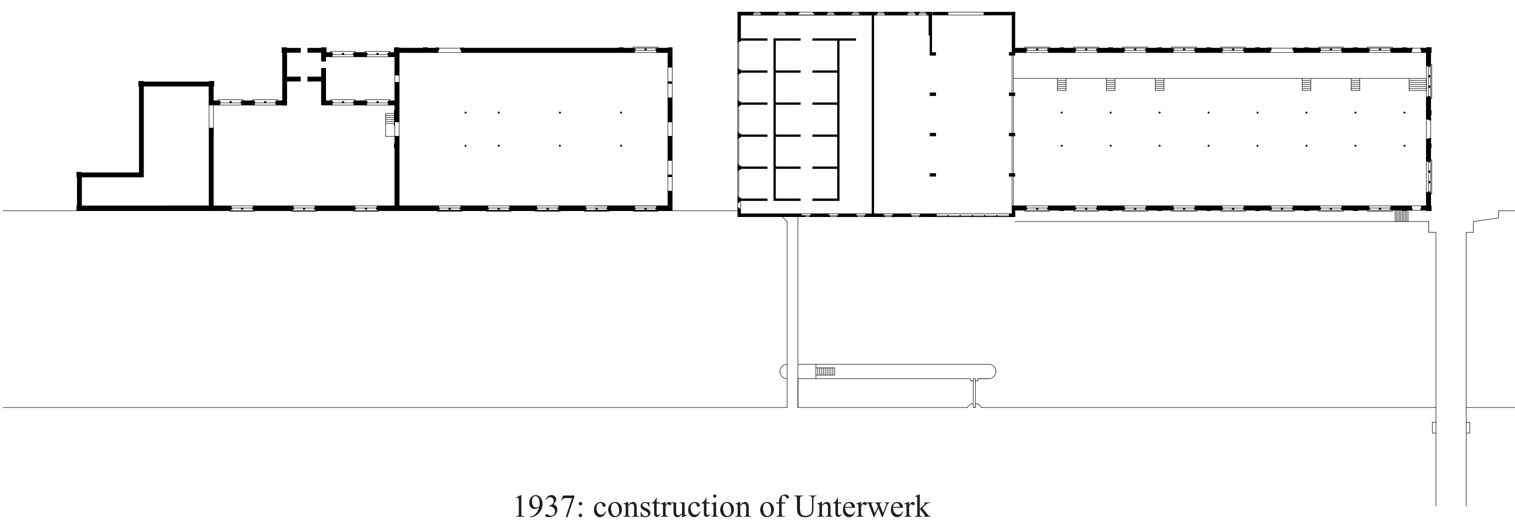
EVOLUTION IN PLAN



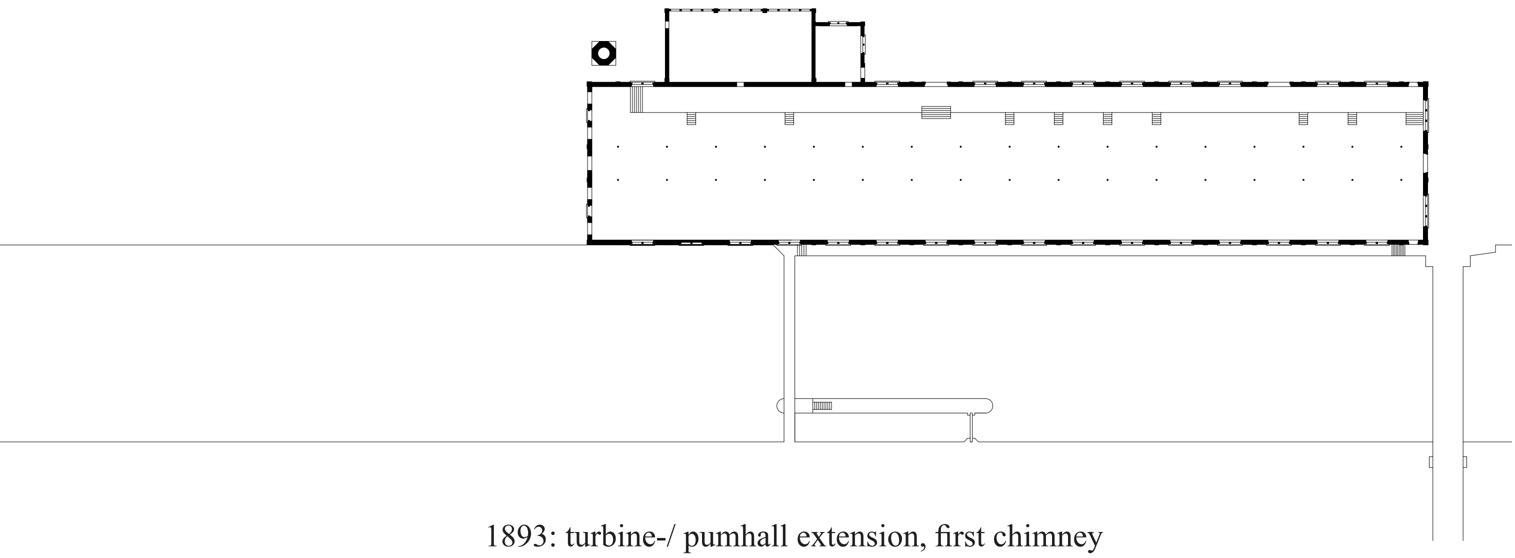
1878: turbine-/ pumphall



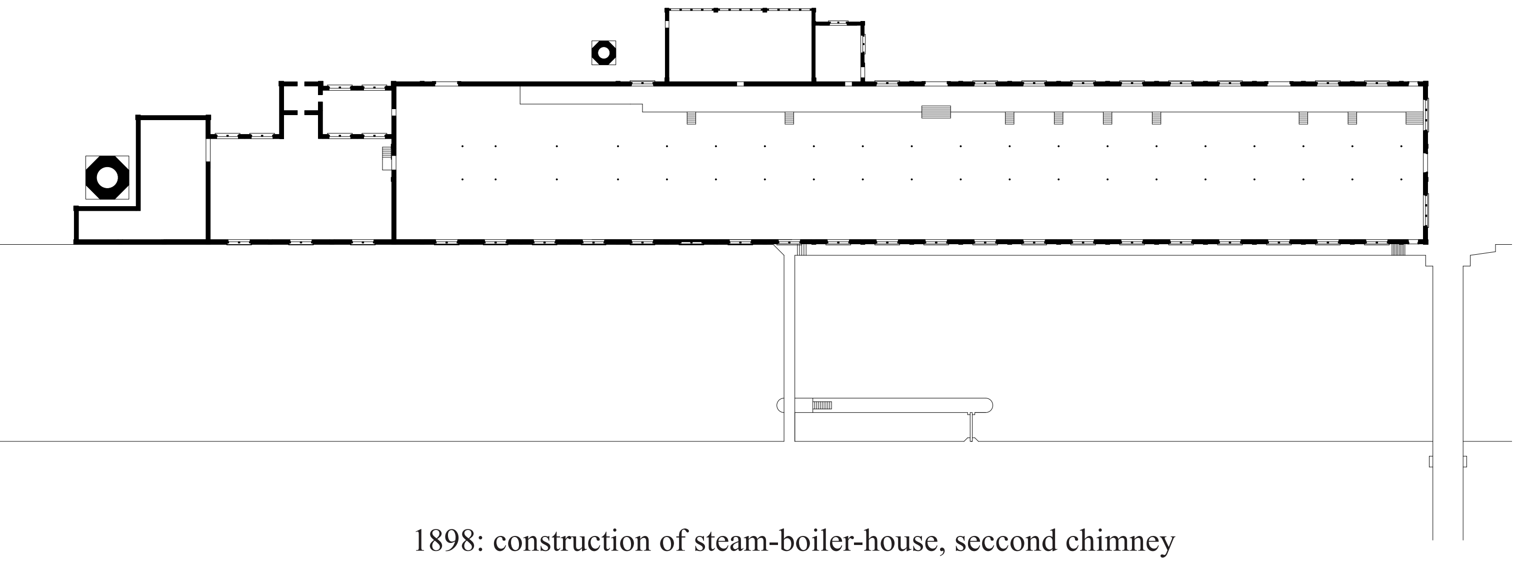
1896: seccond turbine-/ pumhall extension for steam engines



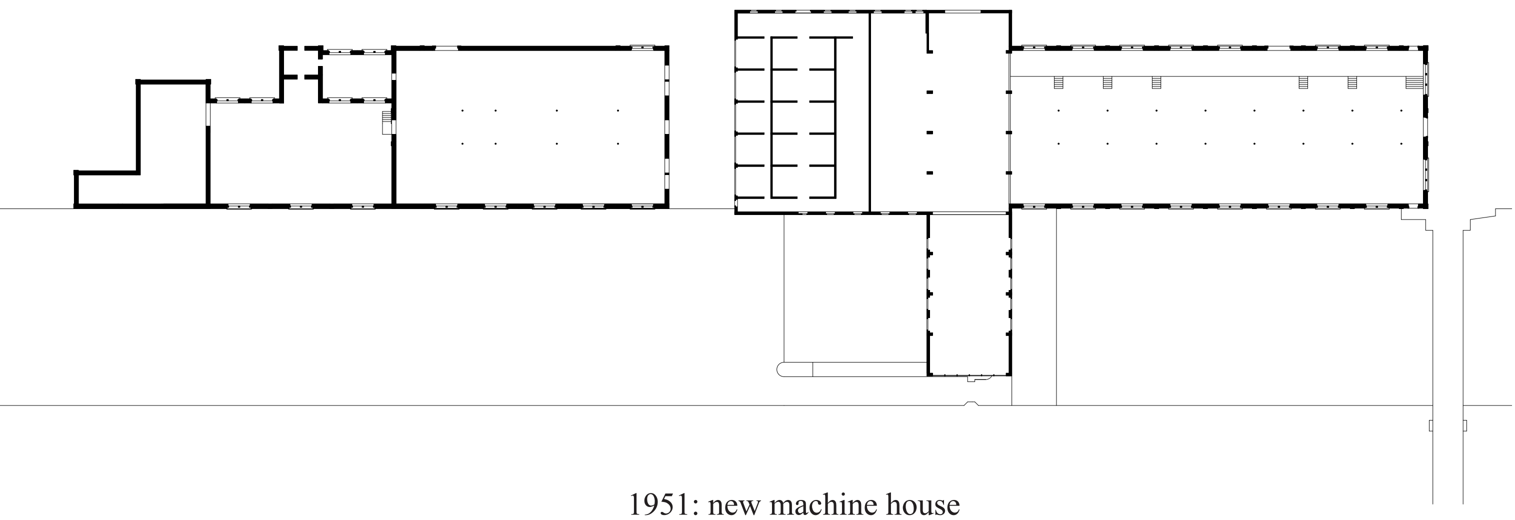
1937: construction of Unterwerk



1893: turbine-/ pumhall extension, first chimney



1898: construction of steam-boiler-house, seccond chimney



1951: new machine house

1937 CONSTRUCTION OF UNTERWERK: SPLIT IN TWO

split: destruction for construction of Unterwerk

wall of detached part

a kingdom whose lands extended twelve days’, whose wealth was mined in the mountains an evolution of a network

WATERSUPPLY ZURICH

The Laufkraftwerk Letten was built as a water supply station.
(1884 map)

At the beginning the distributed water was collected at the beginning of the Limmat, filtered and transported through underwater pipes.

With the construction of the Filterstation Sihlquai in 1898 the watercollection shifted towards the lake and was transported through the Schanzengraben (red).

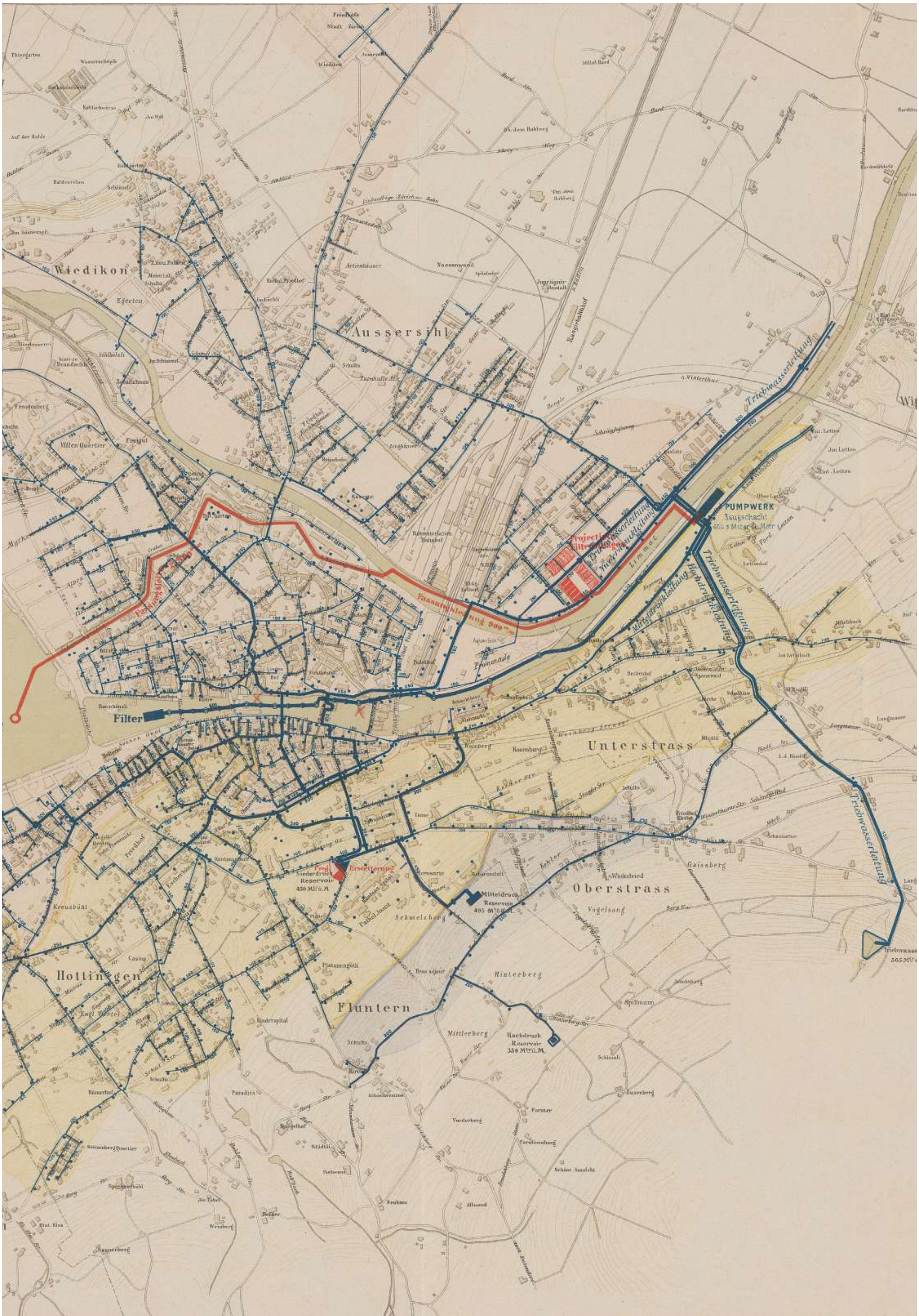
The water supply was distributed by three networks that included a reservoir each for over supply:

1. Low Pressure Network
(reservoir hospital meadow)

2. Medium Pressure Network
(reservoir near observatory)

3. High Pressure Network
(resi-pond)

It was used as a water supply station until 1911


Wiedikon
Aussersihl
Unterstrass
Oberstrass
Hottingen
Fluntern
PUMPWERK
Saugschacht
Filter
Triebwasserleitung
Fassungsleitung 900m
Projectirte Filteranlage
Niederdruck Reservoir 450 M.ü.M.
Proj. Erweiterung
Mitteldruck Reservoir 495 M.ü.M.
Hochdruck Reservoir 554 M.ü.M.
Limmat
Promenade
Schmelzberg
Hinterberg
Mittlerberg
Gaissberg
Vogelsang
Winkelried
Rosenberg
Weinberg
Platanengüetli
Kreuzbühl
Paradies
Vorderberg
Städtli
Schöne Aussicht
Sonnen Quai
Villen Quartier
Egerten
Schulhaus
Thiergarten

CABLETRANSMISSION

The cabletransmission was the additional function to the Laufkraftwerk Letten.

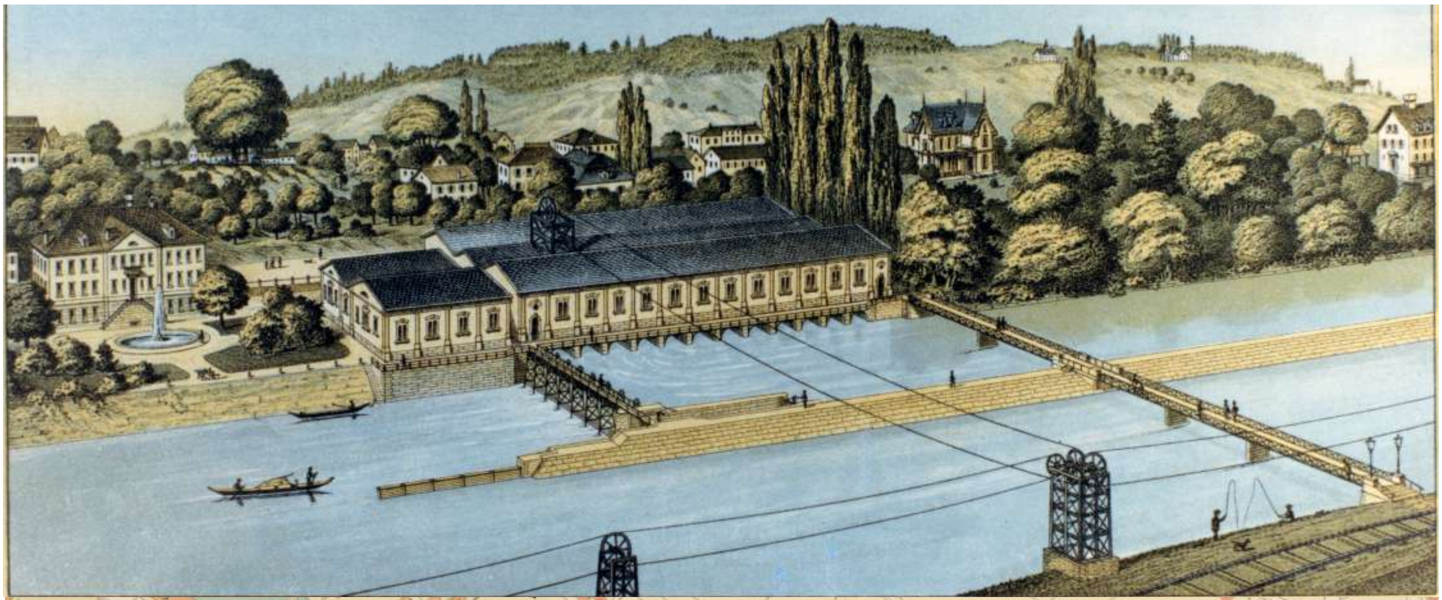
It served as a direct energy transmission via cable for the industry on the other shore. Therefore, twelve transmission towers were designated of which 9 have been built.

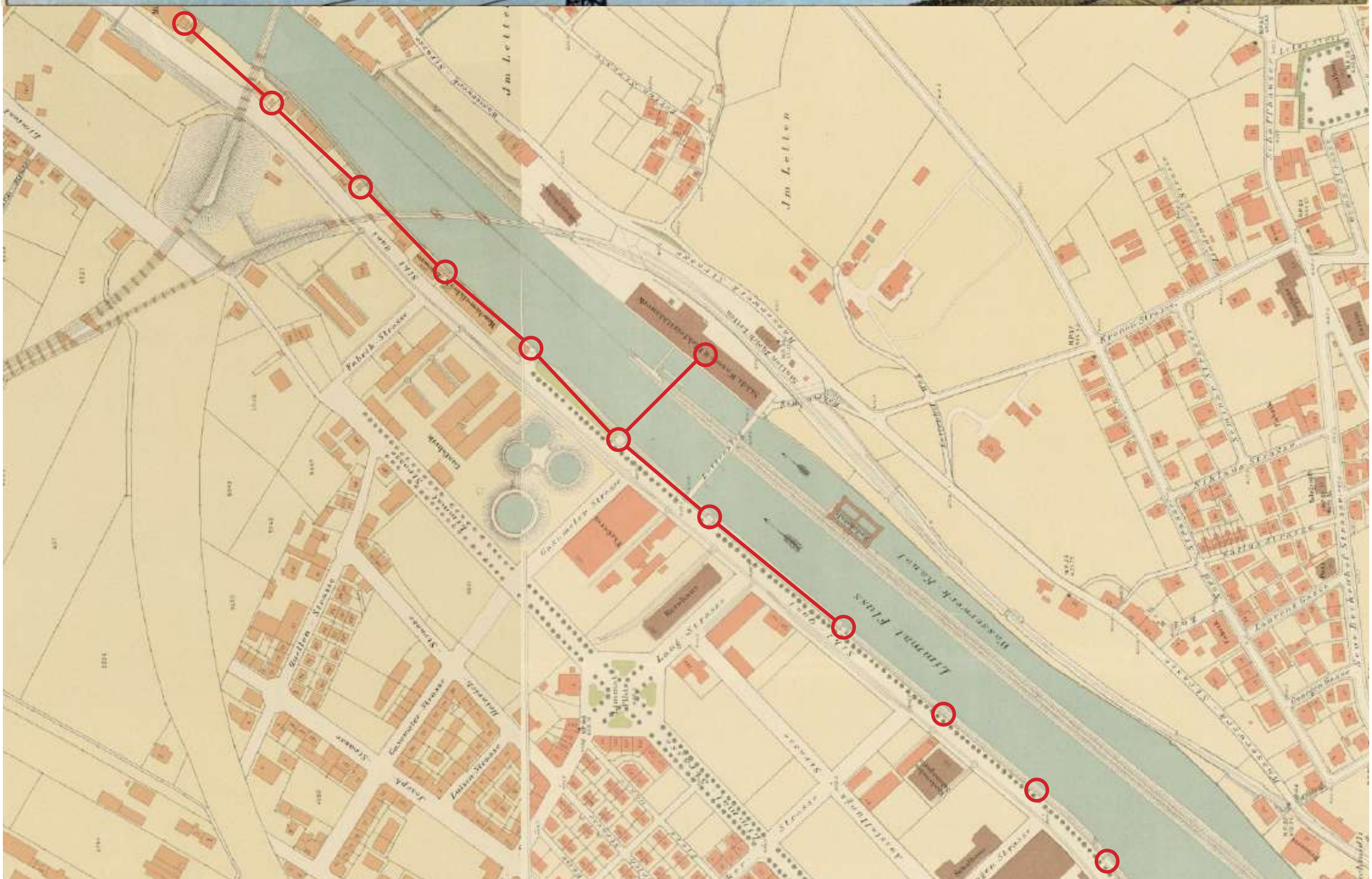
The energy was collected by the turbines, via wire cable transported over the water and distributed to where it was drawn of for industrial production.

Despite the cabletransmission there was as well high pressure watertransmission for the industry.

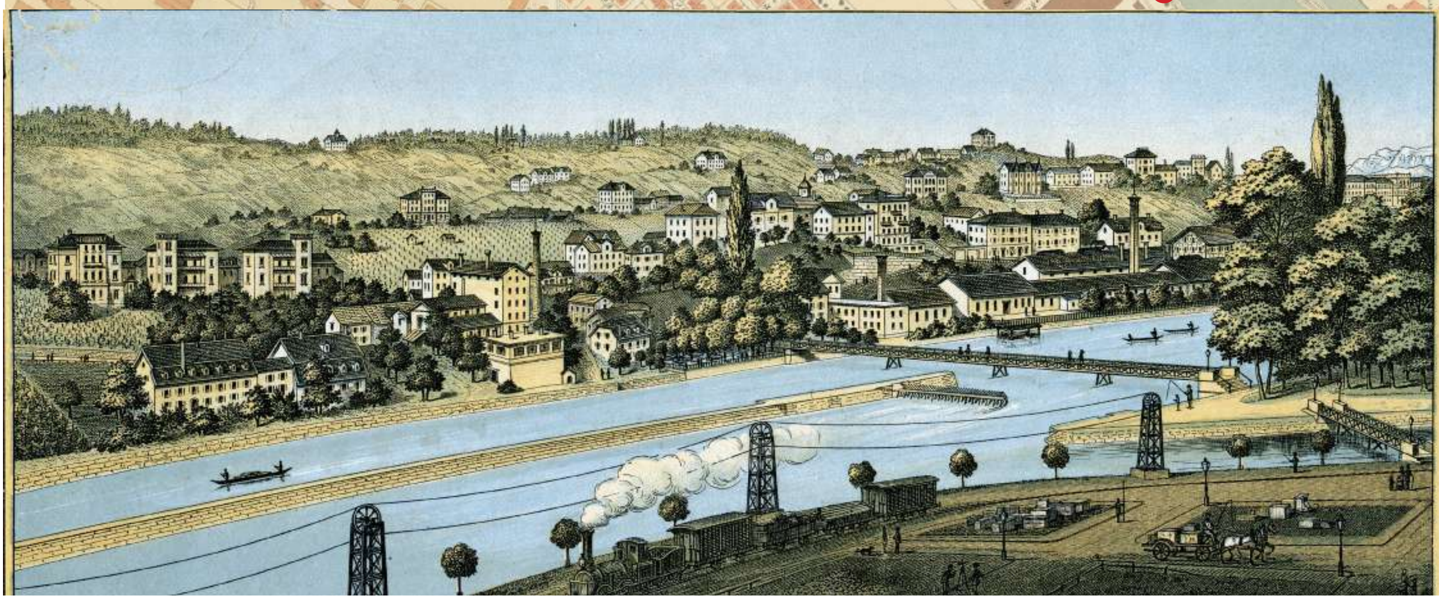
The cabletransmission was taken out of service in 1895.

Two fundaments of such towers still remain intact today.





Im Letten
Limmat Fluss
Wasserwerk Kanal



remaining fundament

remaining fundament

EWZ HYDROELECTRIC ENERGY SUPPLY

Kraftwerke Letten (1893)
Supply: 169GWh. (100% EWZ)

(Laufkraftwerk Letten (1893))
(Supply: 21GWh. - 7000 Households)

Kraftwerke Mittelbünden (1909)
Supply: 740 GWh. (100% EWZ)

Kraftwerke Wägital (1926)
Supply: 120GWh. (50% EWZ)

Kraftwerke Oberhasli (1932)
Supply: 2180GWh. (16.6% EWZ)

Kraftwerke Maggia (1956)
Supply: 1265 GWh. (10% EWZ)

Kraftwerke Bergell (1959)
Supply: 145GWh. (100% EWZ)

Kraftwerke Blenio (1963):
Supply: 835 GWh. (17% EWZ)

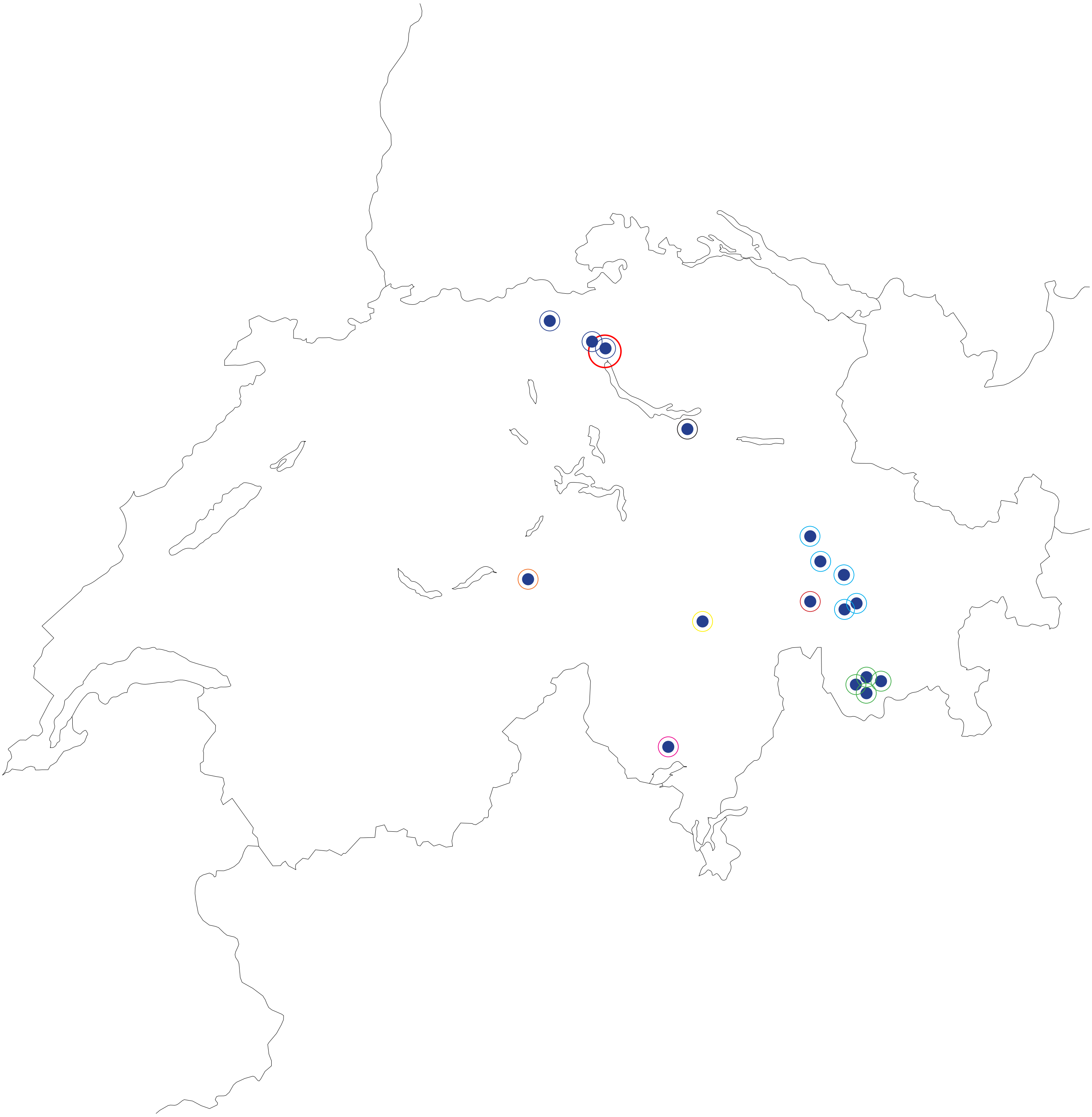
Kraftwerke Hinterrhein(1964):
Supply: 1500 GWh. (19.5% EWZ)

Total: ca 2037 GWh./ year

In 2020 the final electricity consumption of Zurich was 2’875 GWh. provided by:

hydro: 1959 GWh.
solar and wind: 202 GWh.
wood, rubbish: 73 GWh.
nuclear: 0 KWh.
mix Europe: 642 GWh.*

*Once the electricity consumption of an institution/ company surpasses 100’000 kWh they are free to choose the provider.

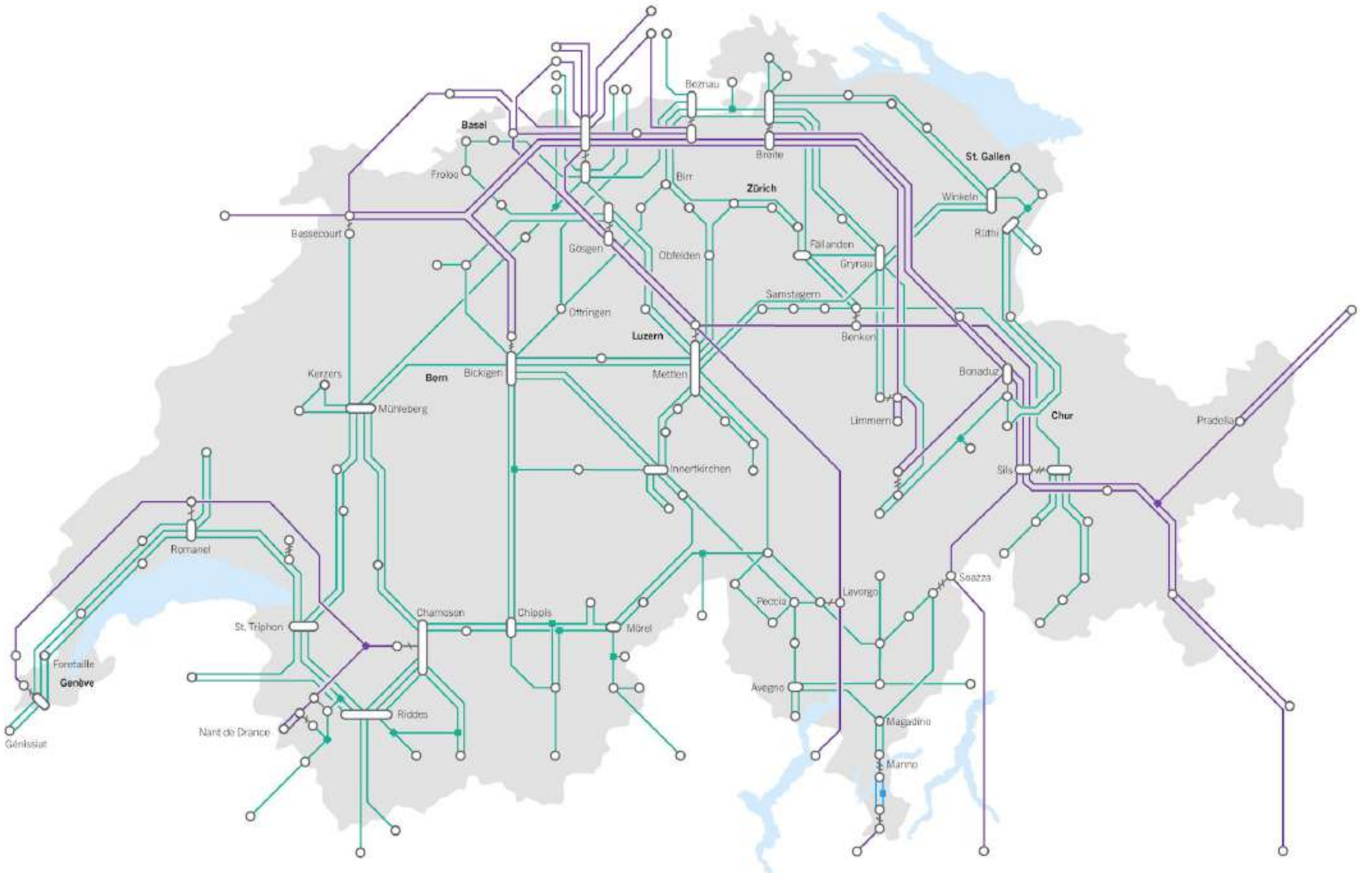


SWISSGRID

The transportation of electricity over long distance is granted by alternating current (AC). The energy loss is determined by voltage system:
110kV = 6% loss/ 100km
800kV = 0.5% loss/ 100km

If the distance increases to 600 to 800 km direct current (DC) becomes more lucrative due to higher efficiency (oversea).

Switzerland transports its electricity by 380kV (violet) and 220kV (green).

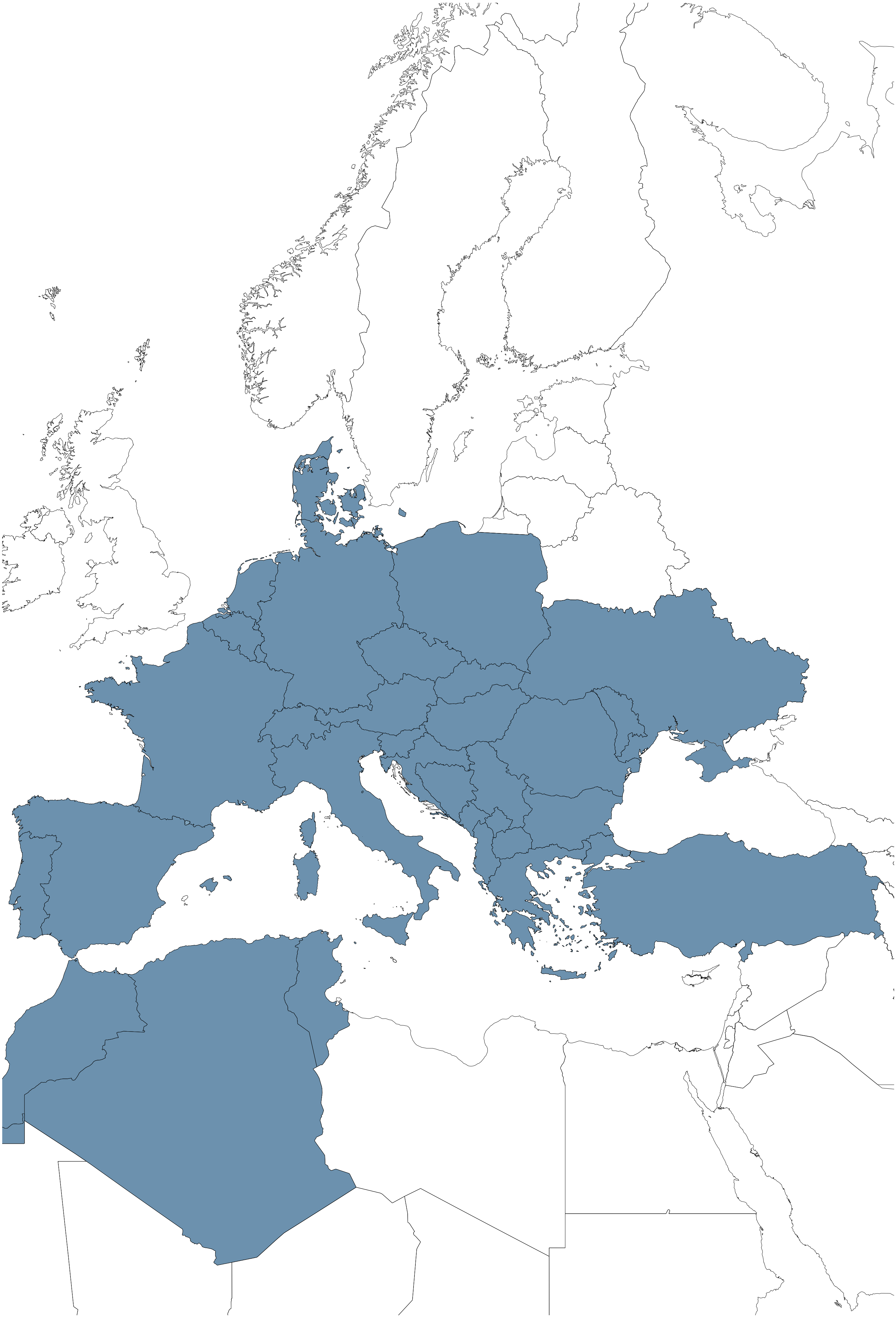

Beznau
Basel
Breite
St. Gallen
Froloo
Birr
Zürich
Winkeln
Rüthi
Bassecourt
Gösgen
Obfelden
Fällanden
Grynau
Samstagern
Oftringen
Luzern
Benken
Bonaduz
Kerzers
Bern
Bickigen
Mettlen
Mühleberg
Chur
Limmern
Pradella
Innertkirchen
Sils
Romanel
Soazza
Lavorgo
Peccia
St. Triphon
Chamoson
Chippis
Mörel
Foretaille
Genève
Avegno
Riddes
Nant de Drance
Magadino
Génissiat
Manno

SYNCHRONOUS GRID OF CONTINENTAL EUROPE

41 cables guarantee the border crossing of electricity in Switzerland.

Switzerland is part of the continental synchronous area. An interconnected electricity grid between 30 Countries for 510 million people.
It is built upon a coherent frequency of 50 Hz.

Control energy is bought internationally (contracts with power plants) to balance sudden inbalances of the frequency (if a power plant fails to provide).
With increasing risk the demand and as well the price of such increases.

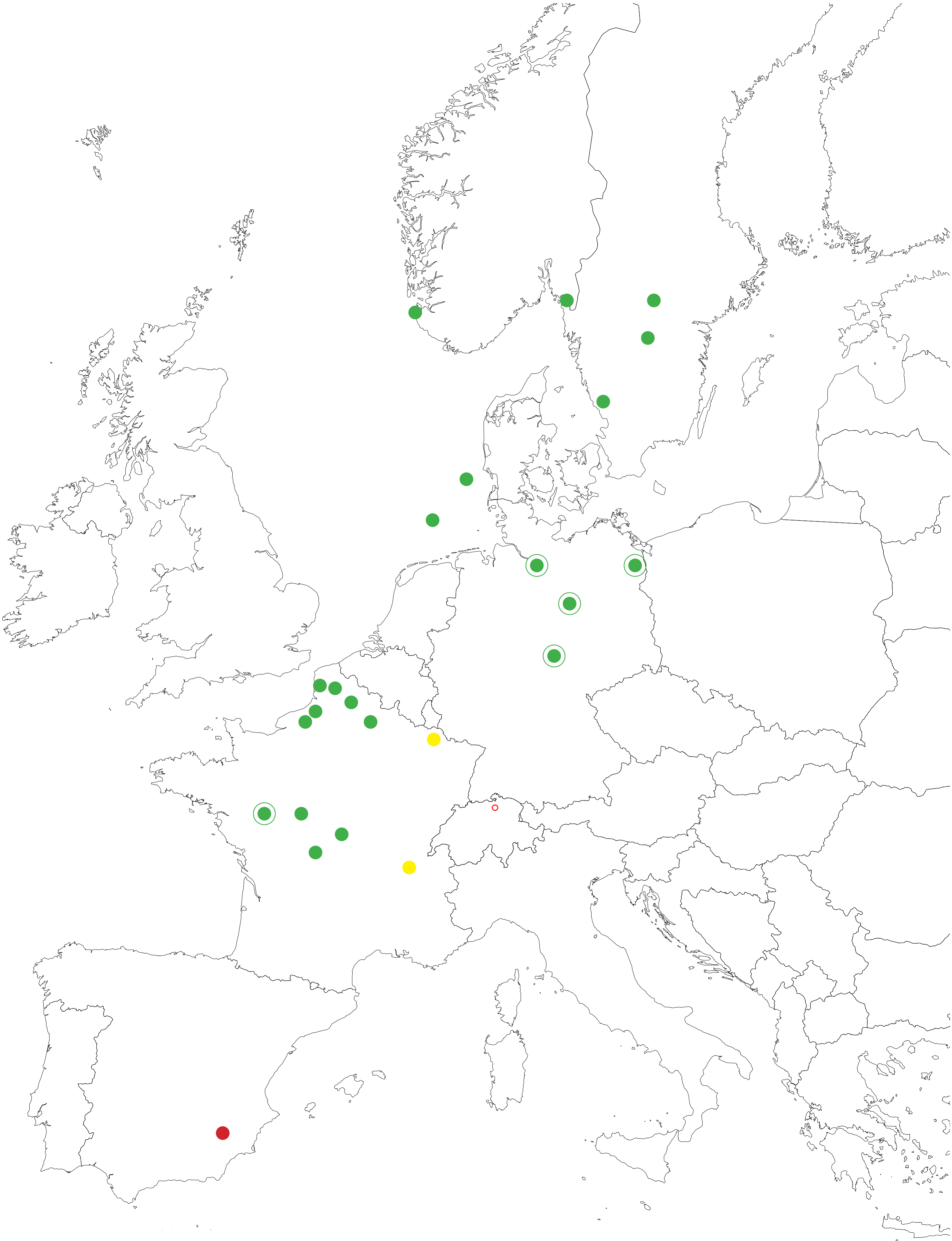


EWZ EUROPE ELECTRICITY SUPPLY

- WIND
- SOLAR
- NUCLEAR
- 100% EWZ

In 2020 Switzerland imports 31.5 TWh. from Germany, France, Austria and exports 29.1 TWh. to Italy as an electricity transit country.

In winter Switzerland imports 40% of its electricity.



ECONOMY OF ELECTRICITY

Merit Order (1)

The price of electricity is constituted by the merit order: The most expensive supplier defines the price for all supply.

Price for Energy source:
(from least to most expensive)

1. Solar
2. Wind
3. Water
4. Nuclear
5. Cole
6. Gas
7. Oil

Cole, Gas and Oil are marketable assets and therefore defined by market developer.

Daily Fluctuation (2)

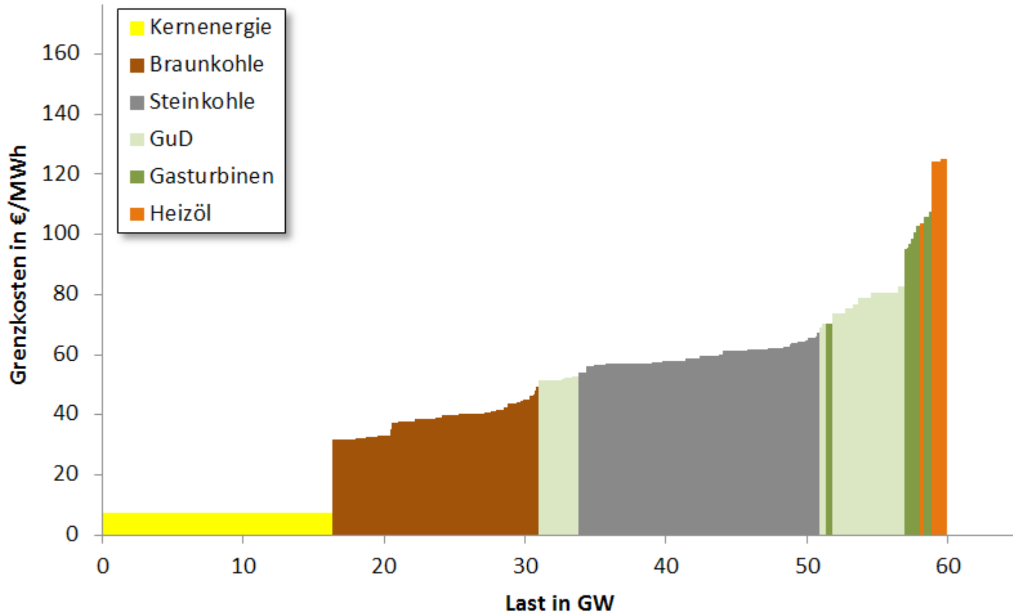
In Switzerland the price of electricity fluctuates due to the time of the day.

Hochtarif: 27.51 Rp./kWh
Monday to Saturday 6:00 - 22:00

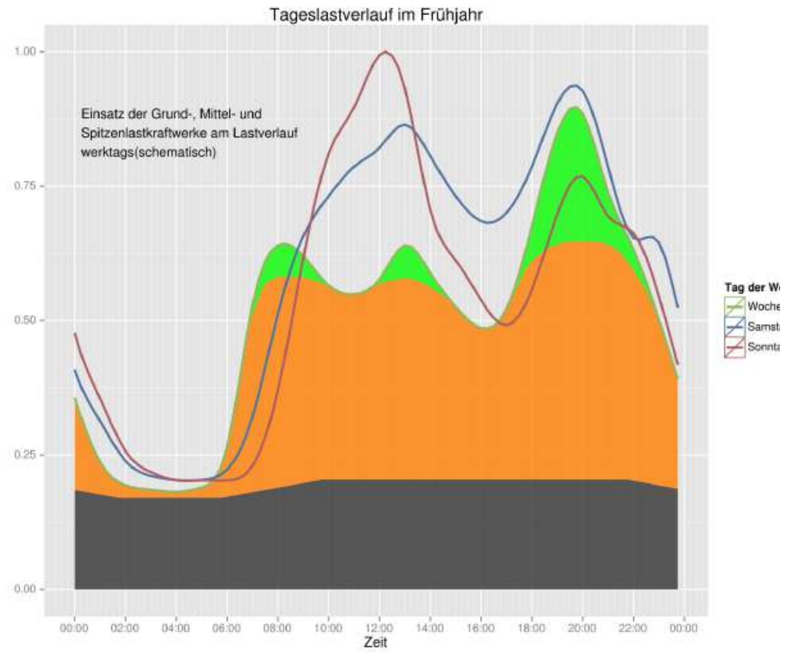
Niedertarif: 16.31 Rp./kWh
Monday to Saturday 22:00 - 6:00
Saturday 22:00 - Monday 6:00

Market Development: Solar (3)

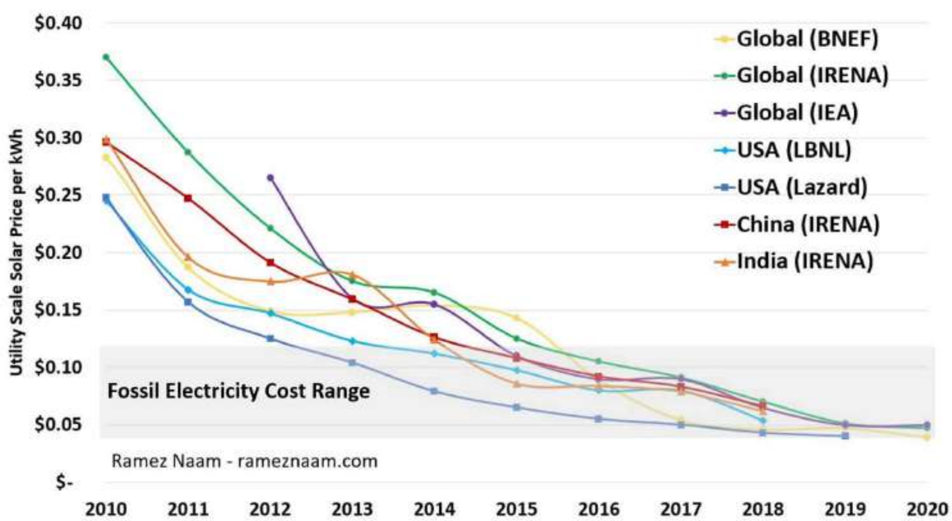
The tendencies of renewables are to decrease in costs per kWh due to increasingly cheaper production costs of such.



Kernenergie
Braunkohle
Steinkohle
GuD
Gasturbinen
Heizöl
Grenzkosten in €/MWh
0
20
40
60
80
100
120
140
160
0
10
20
30
40
50
60
Last in GW



Tageslastverlauf im Frühjahr
Einsatz der Grund-, Mittel- und Spitzenlastkraftwerke am Lastverlauf werktags(schematisch)
1.00
0.75
0.50
0.25
0.00
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00
Zeit



Global (BNEF)
Global (IRENA)
Global (IEA)
USA (LBNL)
USA (Lazard)
China (IRENA)
India (IRENA)
Utility Scale Solar Price per kWh
$0.40
$0.35
$0.30
$0.25
$0.20
$0.15
$0.10
$0.05
$-
Fossil Electricity Cost Range
Ramez Naam - rameznaam.com
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

he deceives him, steals nectar to eternal life, but the gods became aware.

an alternative and implied consequences

SOLAR EQUIVALENT ELECTRICITY

Solar panel
Supply: 200kWh/ m2/ year

Laufkraftwerk Letten
Supply 21 GWh/ Jahr

Solar Eqivalent Area
21’000’000 kWh/ year : 200 kWh/ year/ m2
= 105’000 m2
= 324m x 324m

Zurich electricity consumption
2875 GWh/ Year

Solar Equivalent Area
2’875’000’000 kWh/ Jahr : 200 kWh /year/ m2
= 14’375’000 m2
= 3791m x 3791m

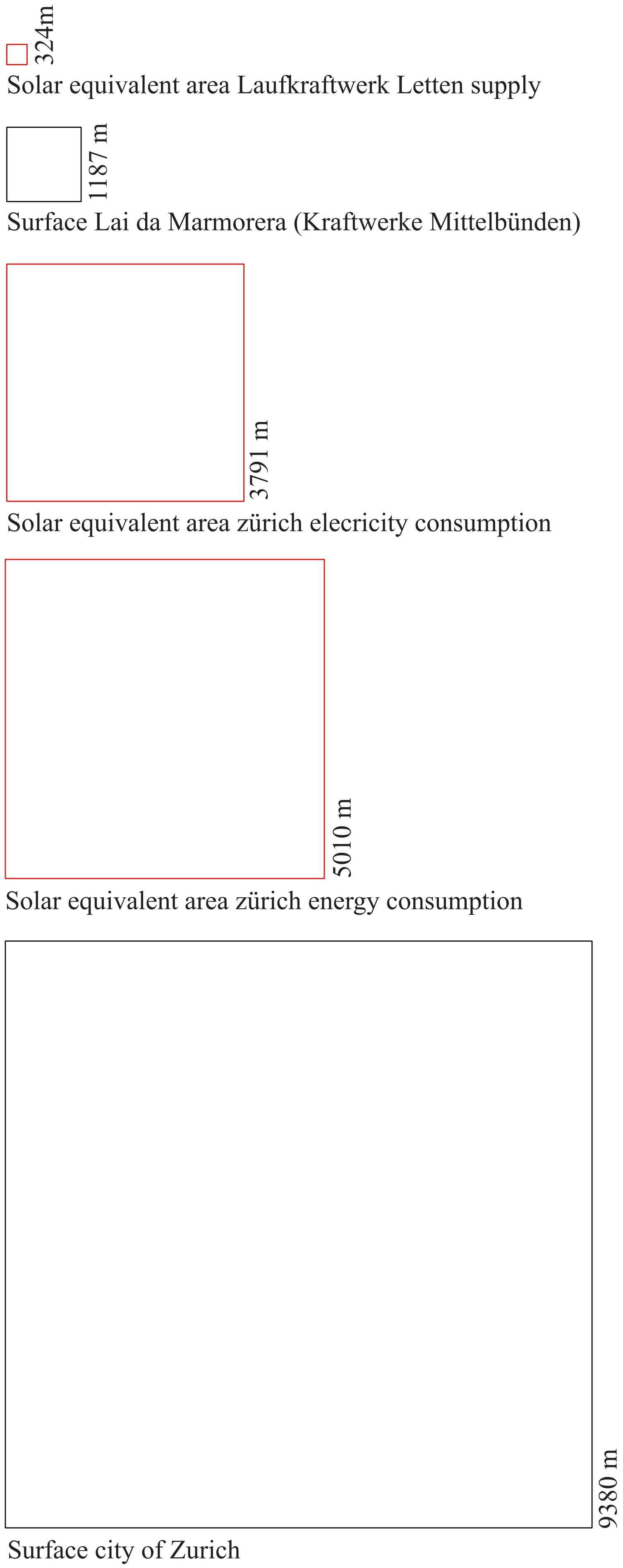
Solar Eqivalent Fossil Fuels

In 2020 the final energy consumption of the city of Zurich (excluding electricity) was constituted as follows:

Kerosin: 457 GWh
Diesel: 851 GWh
Benzin: 346 GWh
Gas: 1858 GWh
Oil: 793 GWh

Total: 5021 GWh/ year

Solar Equivalent Area
5’021’000’000 kWh/ year : 200 kWh/ year/ m2
= 25’105’000 m2
= 5010m x 5010m


324m
Solar equivalent area Laufkraftwerk Letten supply
1187 m
Surface Lai da Marmorera (Kraftwerke Mittelbünden)
3791 m
Solar equivalent area zürich elecricity consumption
5010 m
Solar equivalent area zürich energy consumption
9380 m
Surface city of Zurich

ENVIRONMENTAL CONSEQUENCES:

Linear logic of time

Consumption:
35% Resources
40% Energy
12% Water

Production:
39% Carbon Emssions
- 28% Operational,
- 11% Construction (8% Cement)
59% Landfill

Grey Energy - Embodied Energy

Laufkraftwerk Letten: Fragments

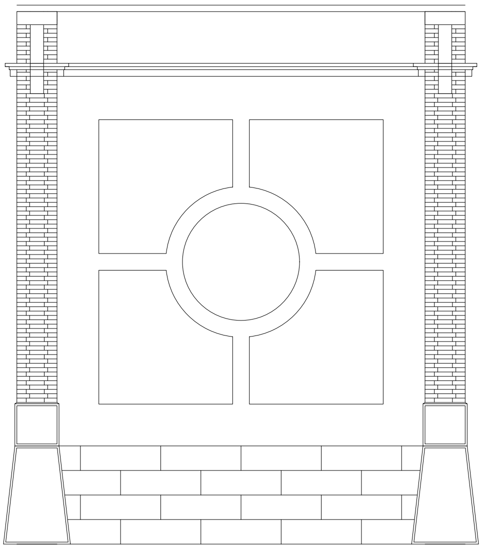
Part 1 (x 592m2)
146 kg CO2 pro m2 facade
brick: 0.6m3 x 900kg/m3 x 0.267kgCO2
plaster: 0.015m3 x 925kg/m3 x 0.158kgCO2

Part 2 (x 450m2)
171 kg CO2 pro m2 facade
brick: 0.71m3 x 900kg/m3 x 0.267kgCO2
wood: 0.004m3 x 436/m3 x 0.29kgCO2

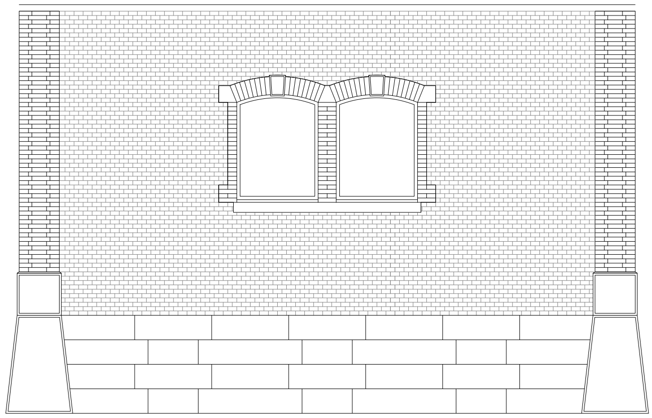
Part 3/5 (x 1931m2)
122 kg CO2 pro m2 facade
brick: 0.46m3 x 900kg/m3 x 0.267kgCO2
plaster: 0.019m3 x 925kg/m3 x 0.158kgCO2
glas: 0.003m3 x 2500kg/m3 x 1.14kgCO2
wood: 0.0014m3 x 436/m3 x 0.29kgCO2

Part 4 (x 3700m2)
562 kg CO2 pro m2 facade
concrete: 0.36m3 x 2'300kg/m3 x 0.101kgCO2
steal: 0.04m3 x 7860kg/m3 x 1.52kgCO2

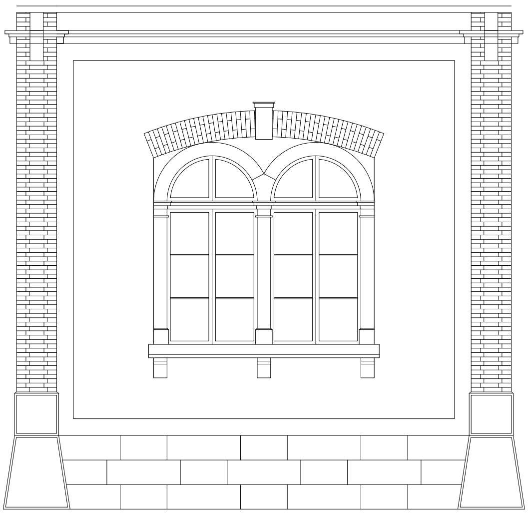
Total: ca. 2500t CO2



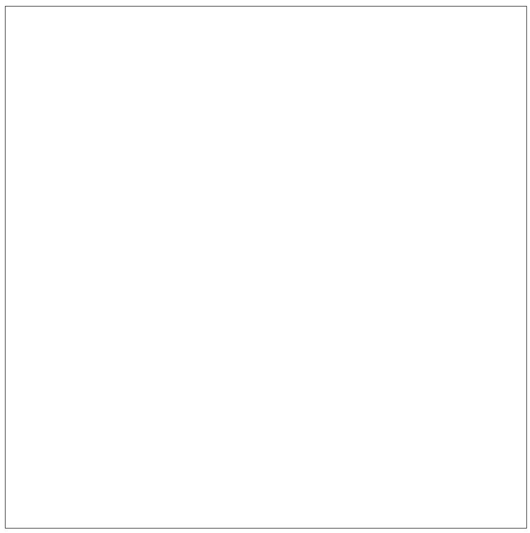
Part 1



Part 2



Part 3/5



Part 4

CONTEXT: CO_2

CO_2 emssions by the City of Zurich 2020 (estimation without construction materials, including transport)

Values in gram

Kerosin: 257 CO_2/ kWhpe
Diesel: 267 CO_2/ kWhpe
Benzin: 250 CO_2/ kWhpe
Gas: 201 CO_2/ kWhpe
Oil: 279 CO_2/ kWhpe

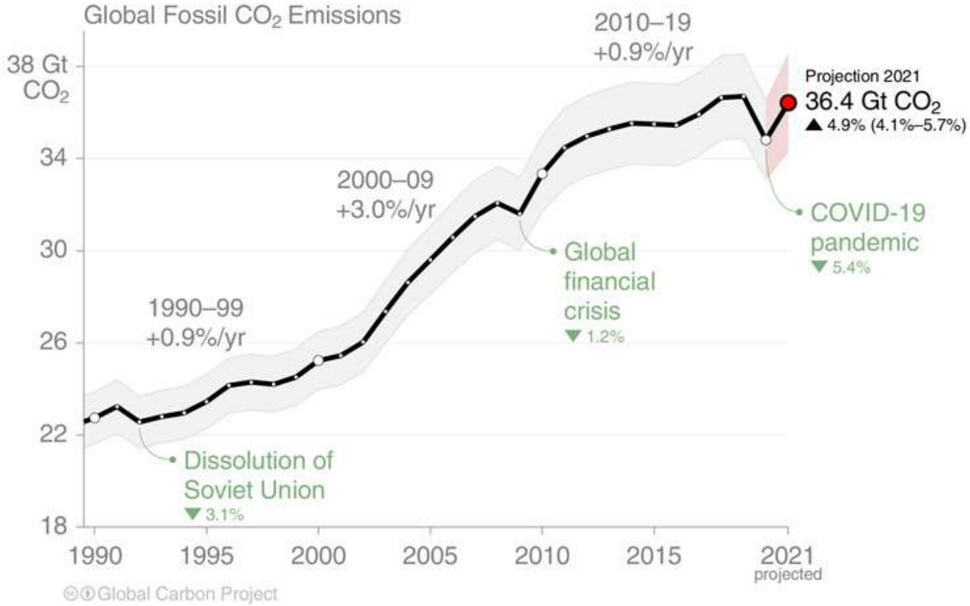
(pe: primary energy including mining, processing, transport)

Kerosin = 117’449 t CO_2
457’000’000 kWh x 257 CO_2/ kWhpe
Diesel = 227’217 t CO_2
851’000’000 kWh x 267 CO_2/ kWhpe
Benzin = 86’500 t CO_2
346’000’000 kWh x 250 CO_2/ kWhpe
Gas = 373’458 t CO_2
1’858’000’000 kWh x 201 CO_2/ kWhpe
Oil = 221’247 t CO_2
793’000’000 kWh x 279 CO_2/ kWhpe

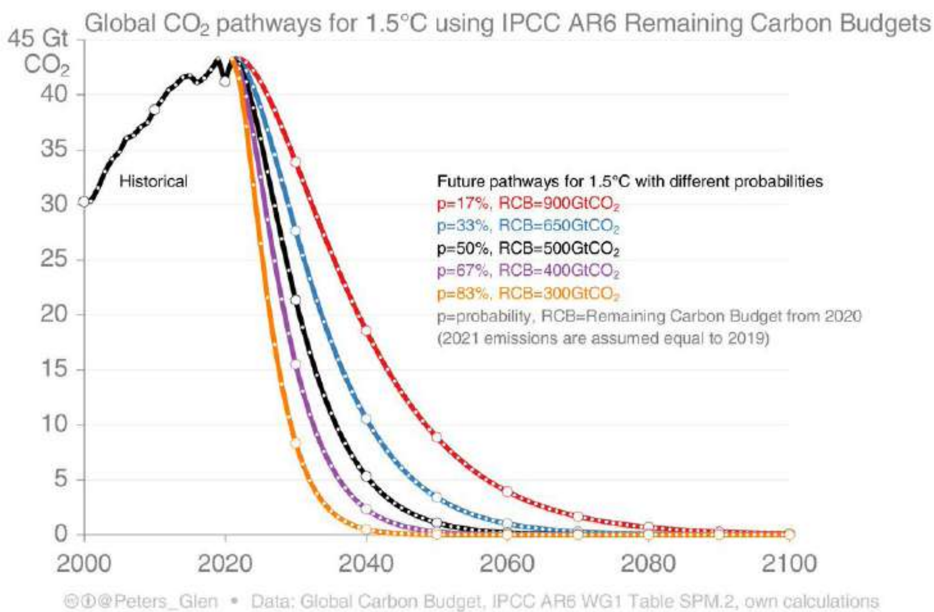
Total = 1’025’786 t CO_2

(= 25 Cruise Ships (t = 500 m3))

The goal should be to strive for a circular logic of time, a circular economy that includes a regenerative logic of space.
late 14c., regeneratif, of a medicine “having the power to cause flesh to grow again.”

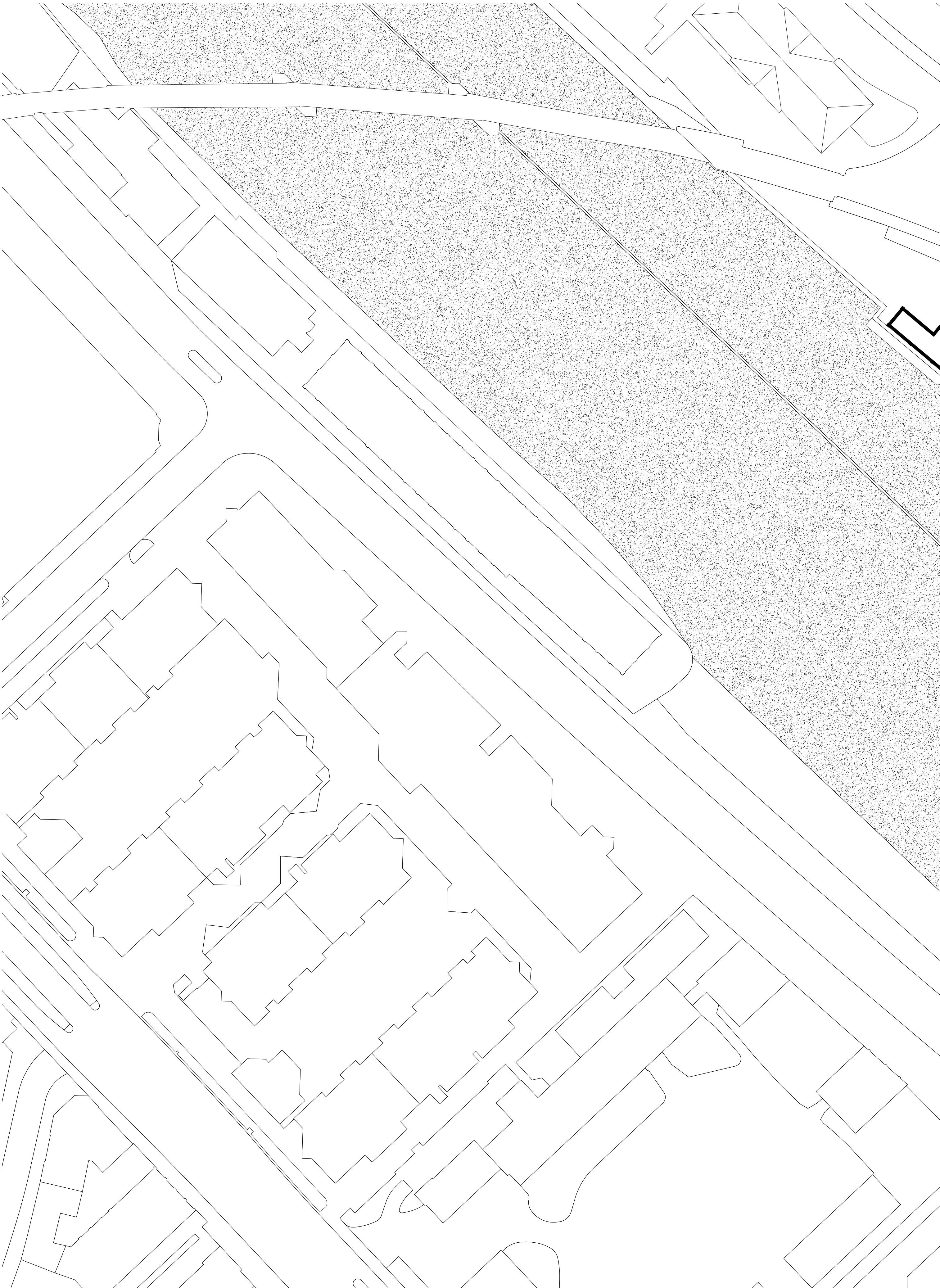


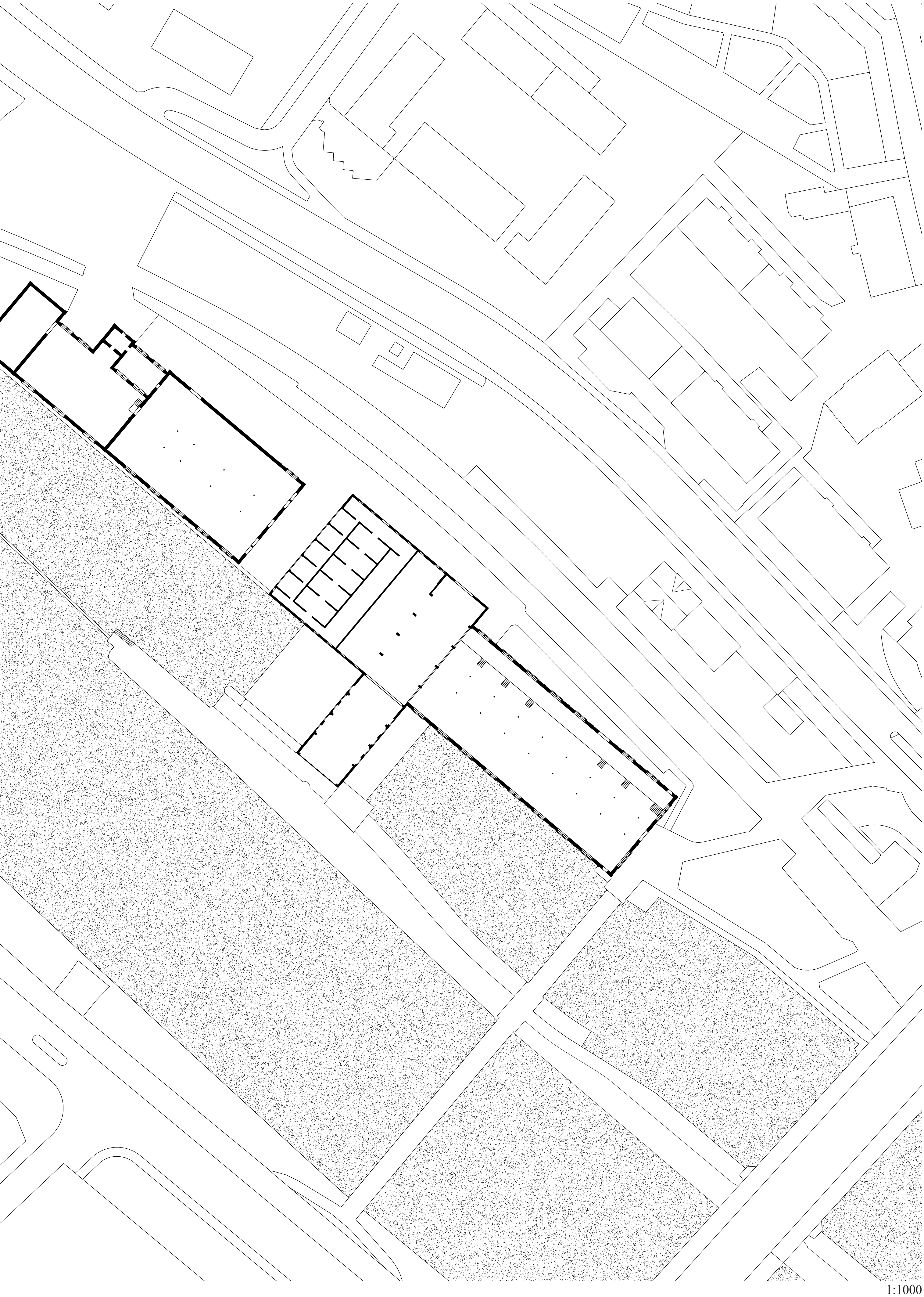
Global Fossil CO_2 Emissions
38 Gt CO_2
34
30
26
22
18
1990–99
+0.9%/yr
2000–09
+3.0%/yr
2010–19
+0.9%/yr
Projection 2021
36.4 Gt CO_2
▲ 4.9% (4.1%–5.7%)
Dissolution of Soviet Union
▼ 3.1%
Global financial crisis
▼ 1.2%
COVID-19 pandemic
▼ 5.4%
1990
1995
2000
2005
2010
2015
2021
projected
Global Carbon Project

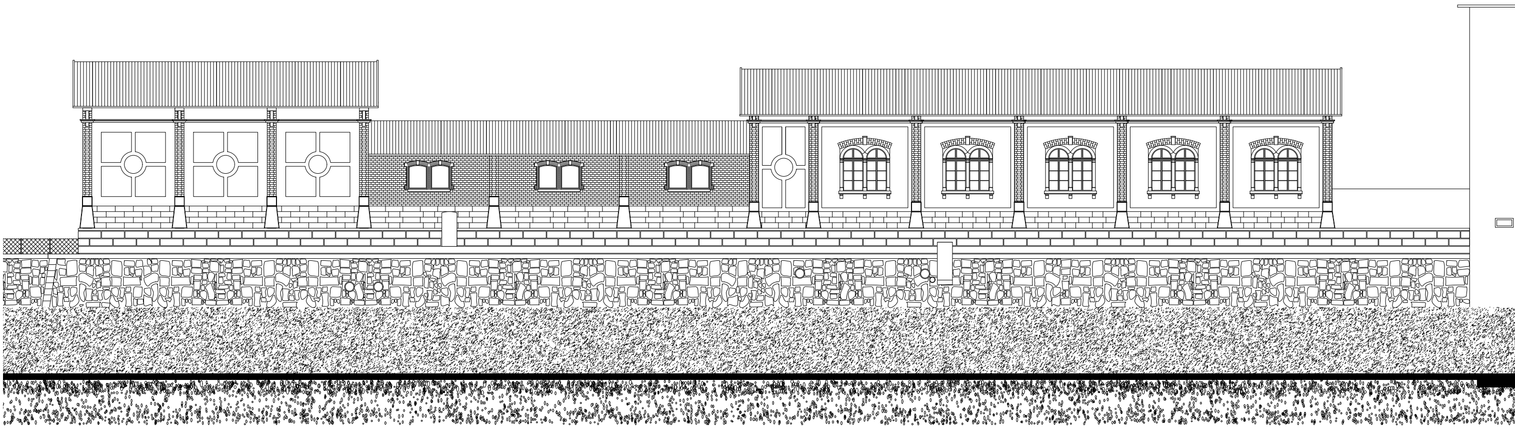


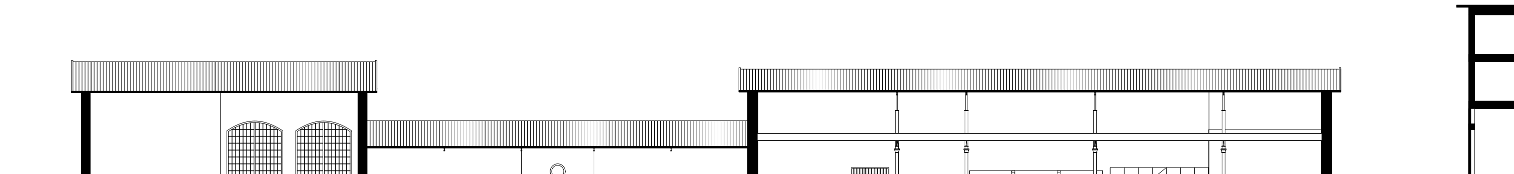
Global CO_2 pathways for 1.5°C using IPCC AR6 Remaining Carbon Budgets
45 Gt CO_2
40
35
30
25
20
15
10
5
0
Historical
Future pathways for 1.5°C with different probabilities
p=17%, RCB=900GtCO_2
p=33%, RCB=650GtCO_2
p=50%, RCB=500GtCO_2
p=67%, RCB=400GtCO_2
p=83%, RCB=300GtCO_2
p=probability, RCB=Remaining Carbon Budget from 2020
(2021 emissions are assumed equal to 2019)
2000
2020
2040
2060
2080
2100
@Peters_Glen • Data: Global Carbon Budget, IPCC AR6 WG1 Table SPM.2, own calculations

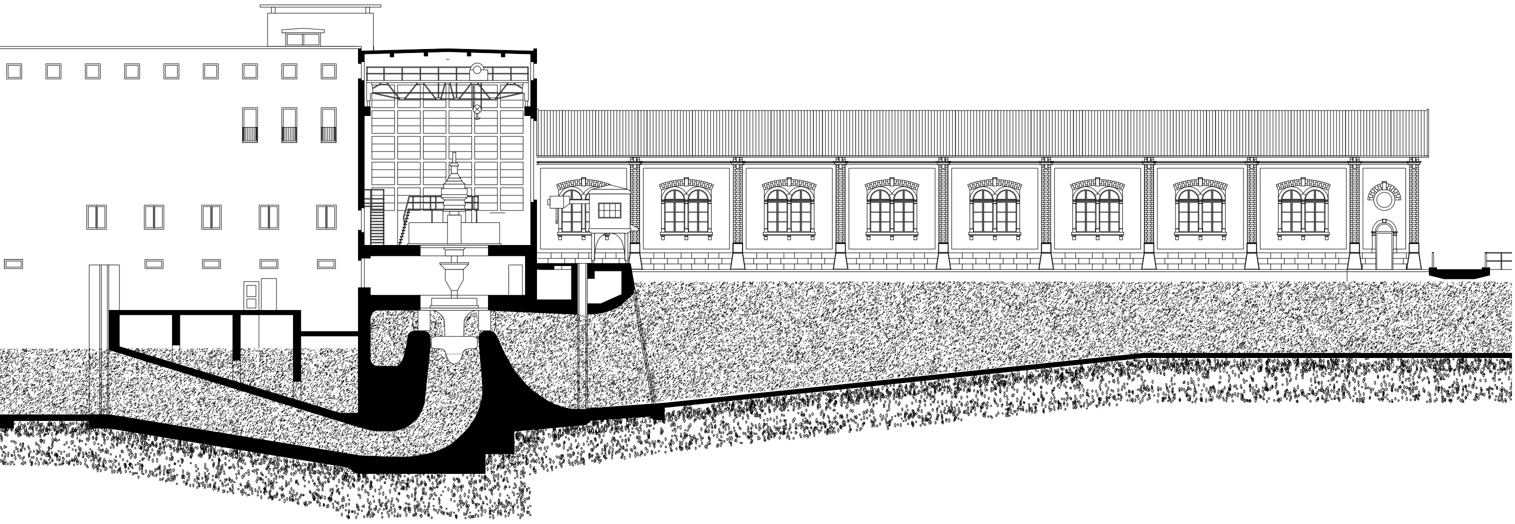
his castle close to a lake was made to desire two things without ever attaining them again: energy and water a current representation of the Laufkraftwerk Letten

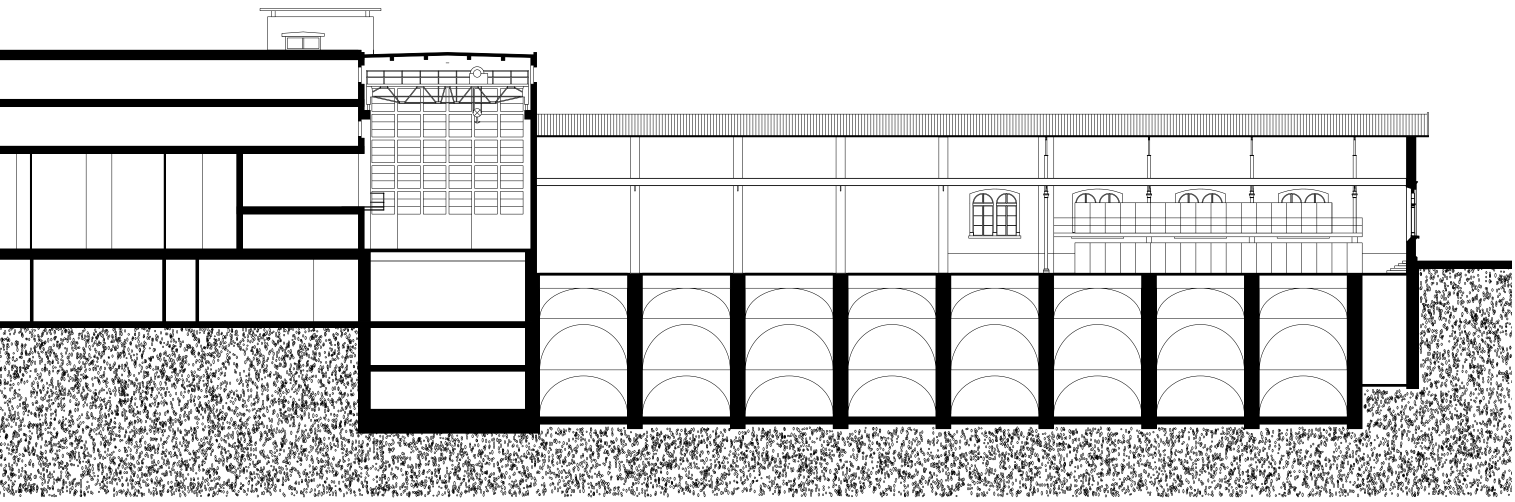


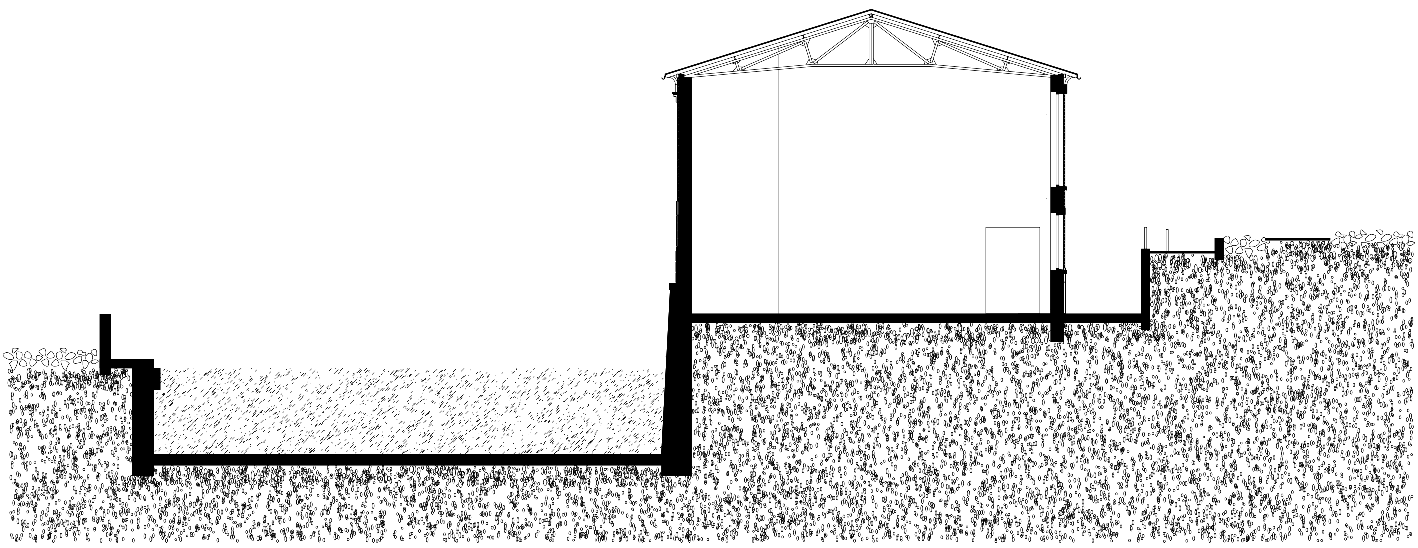


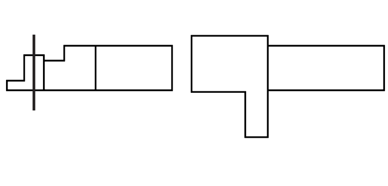


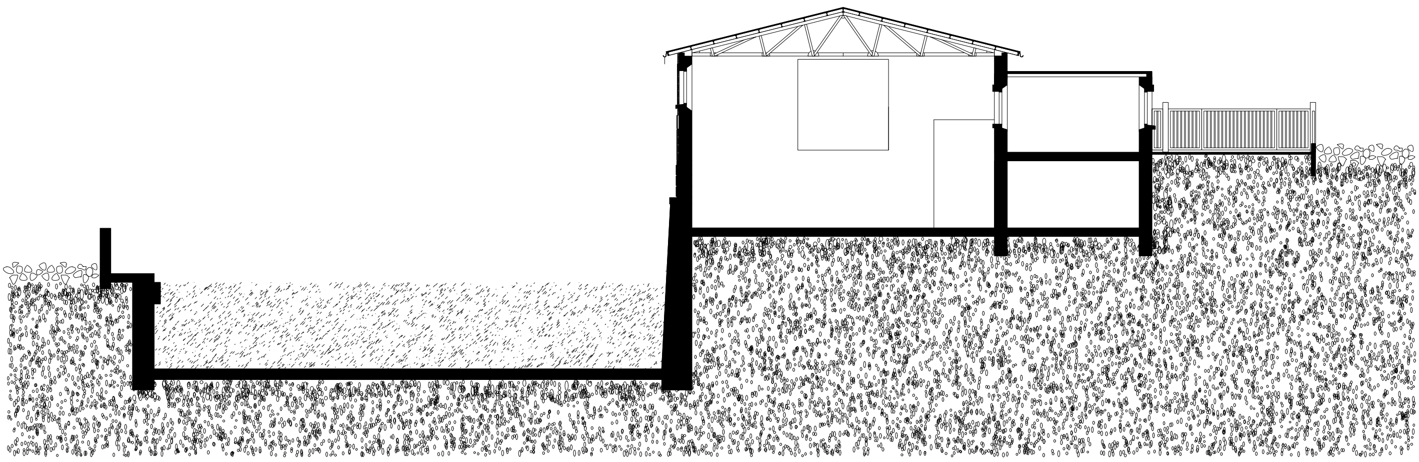


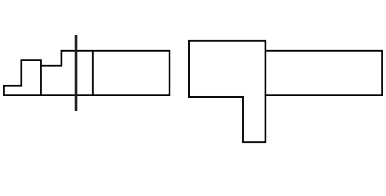












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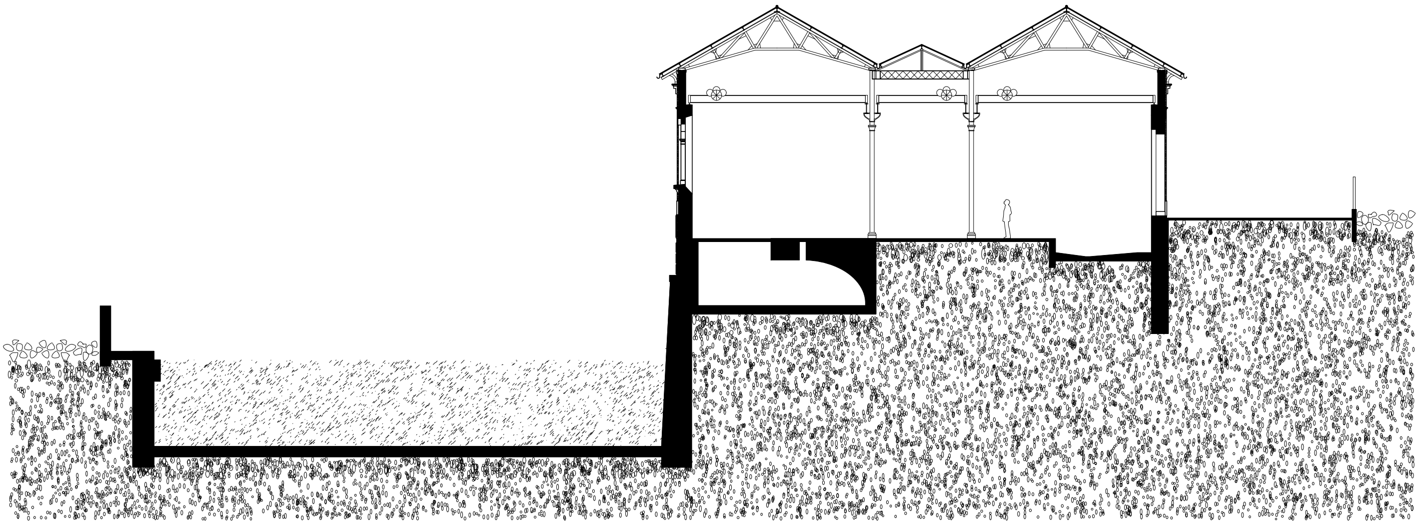

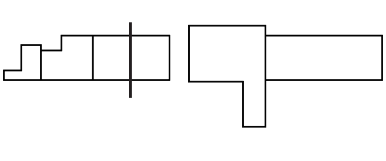

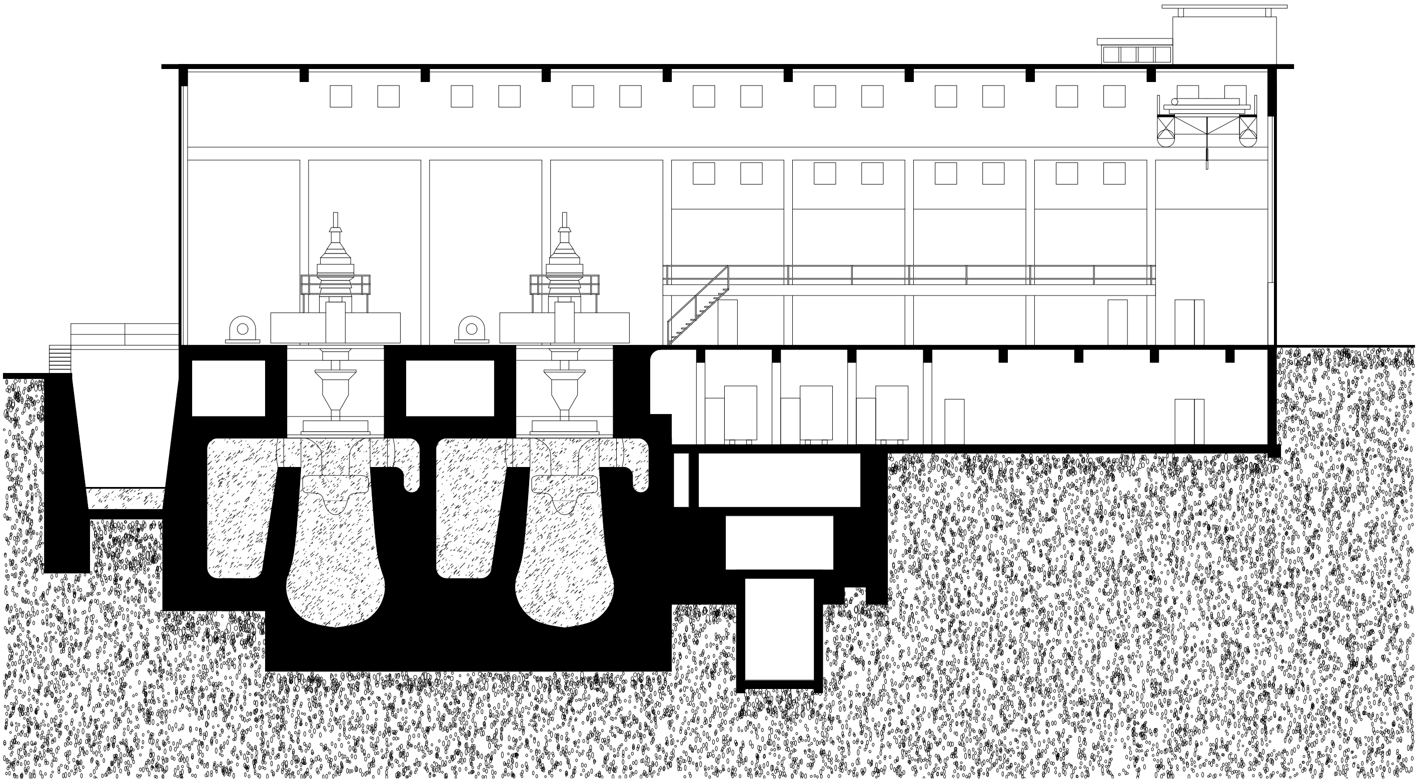

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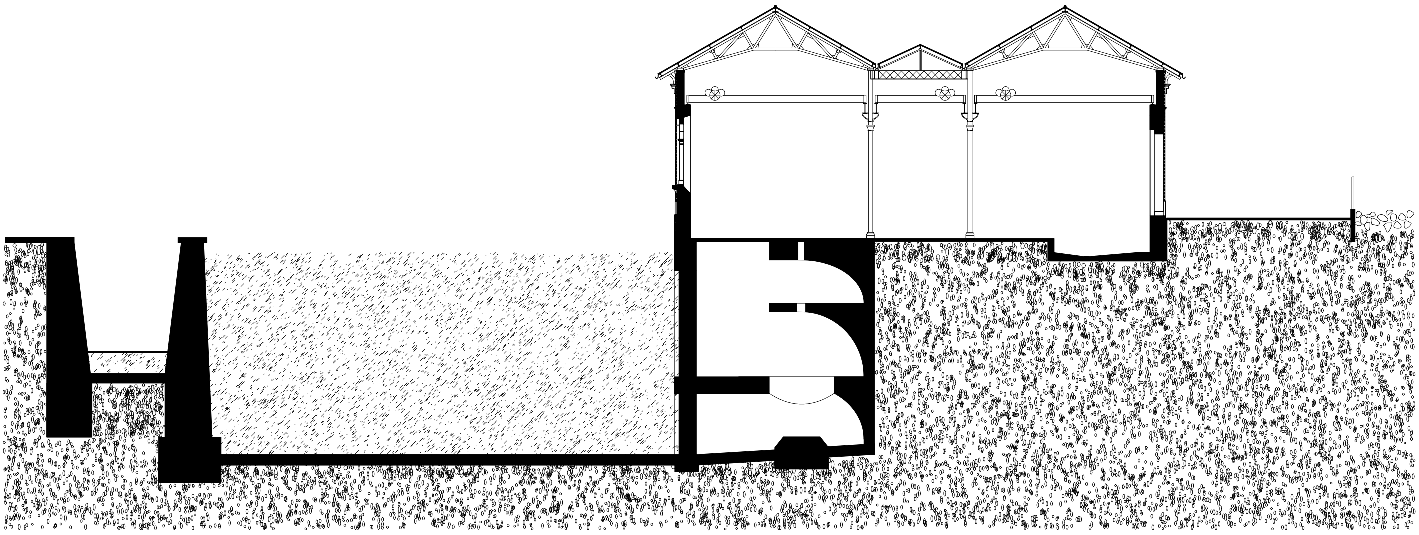
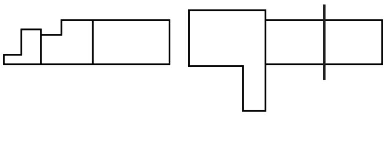
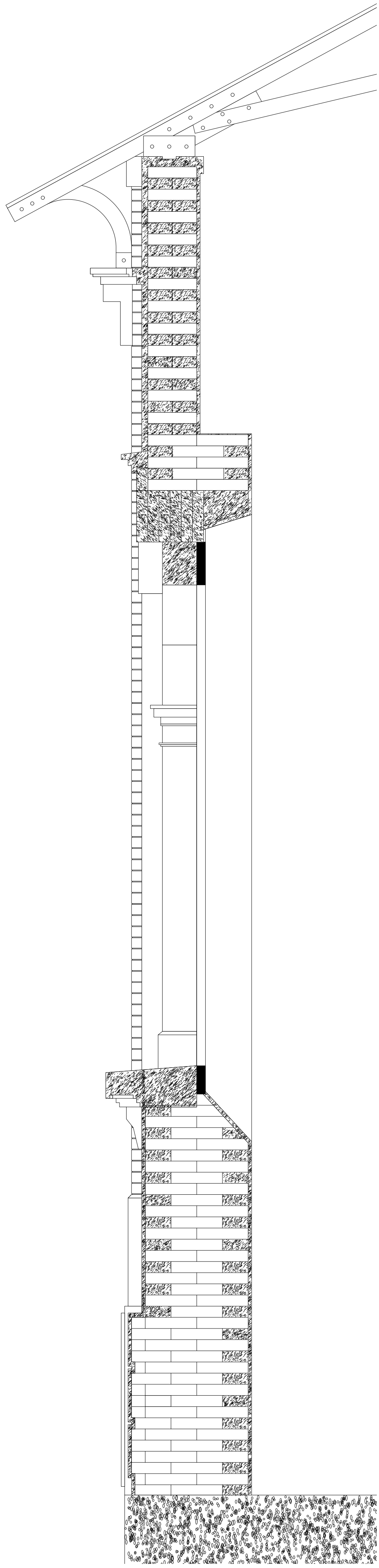
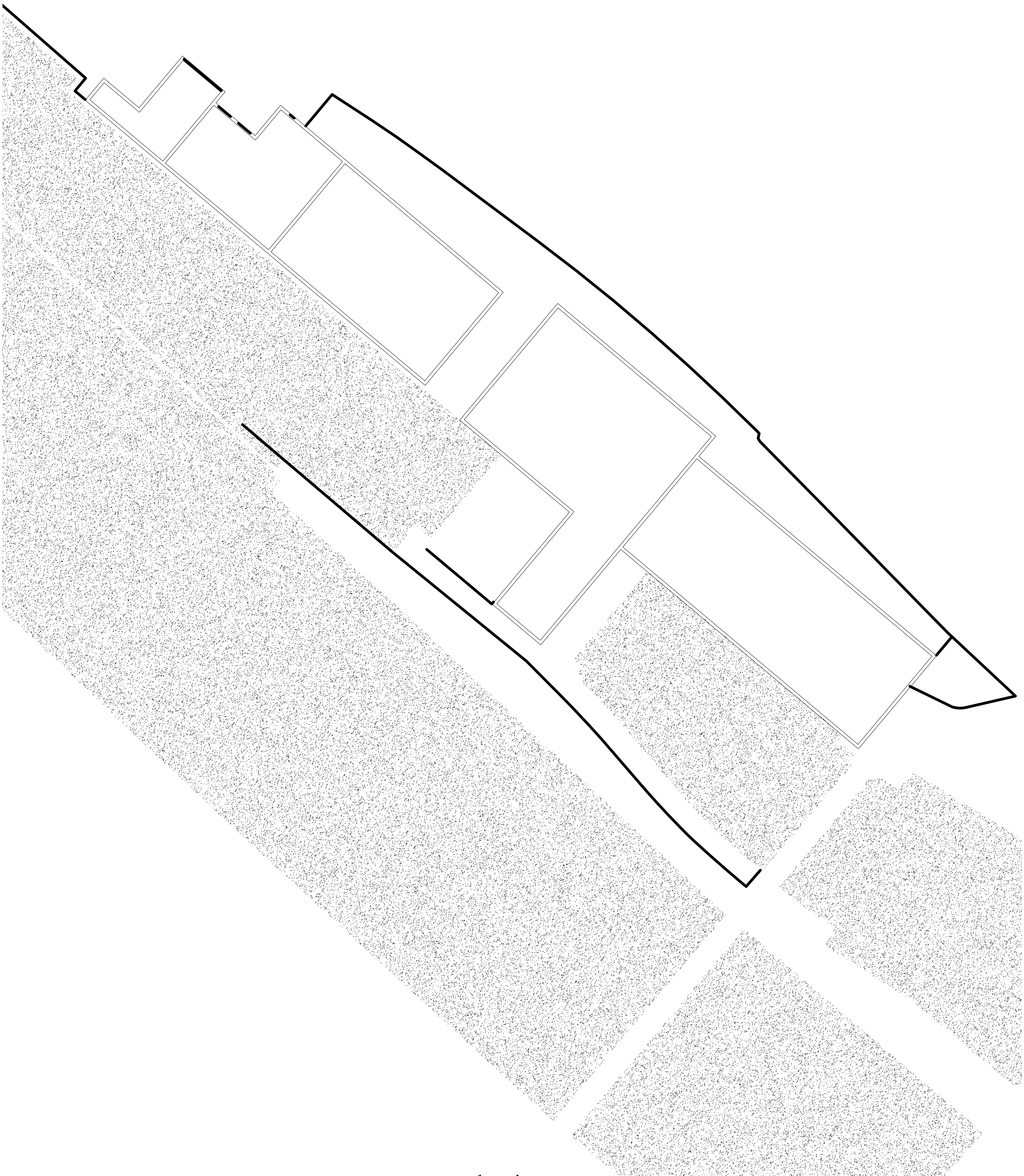






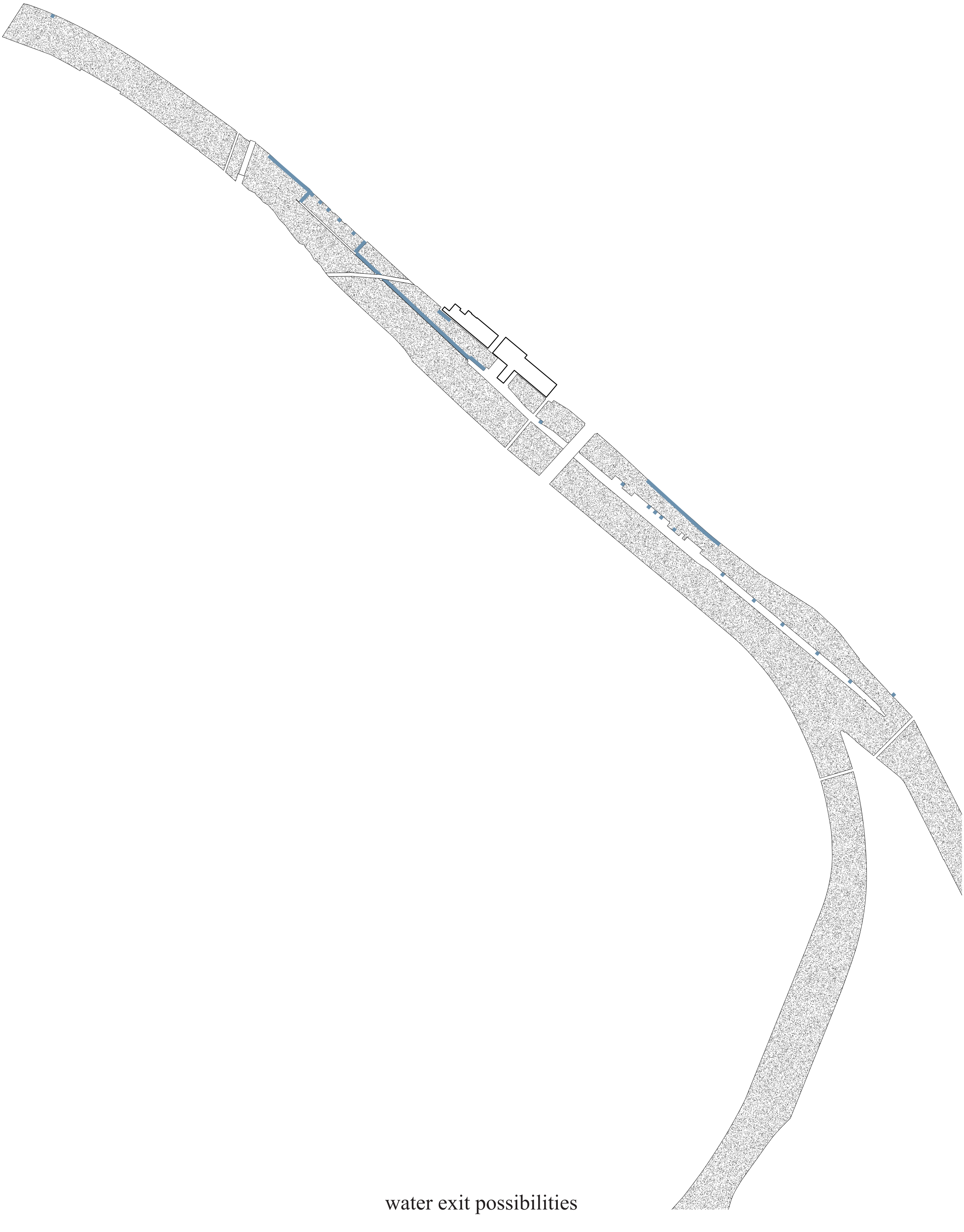
1:350 / 1:33


VERBOT

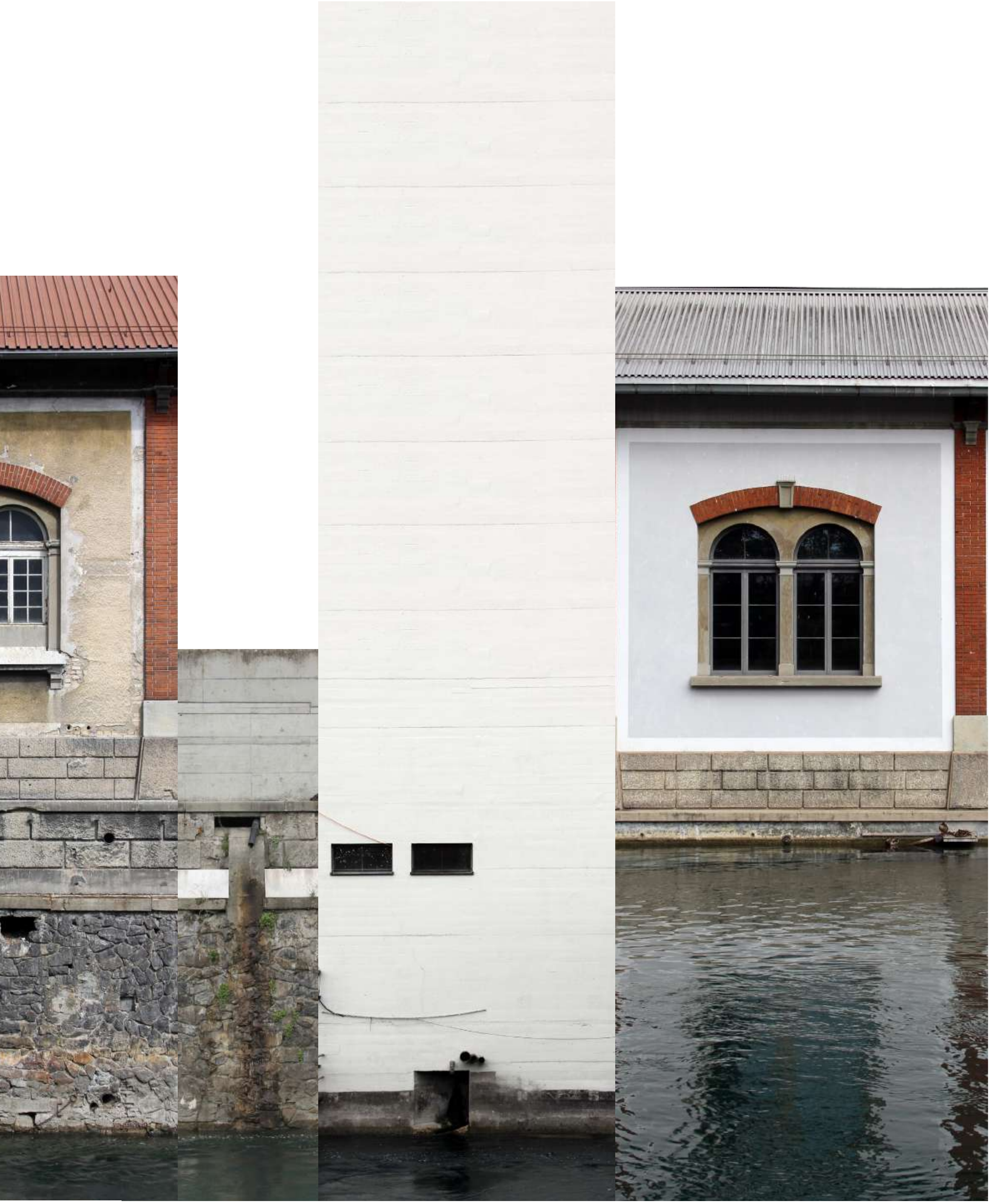


barriers


by christian senti



water exit possibilities



by flavio emanuel gisler