# ATLANPOLE

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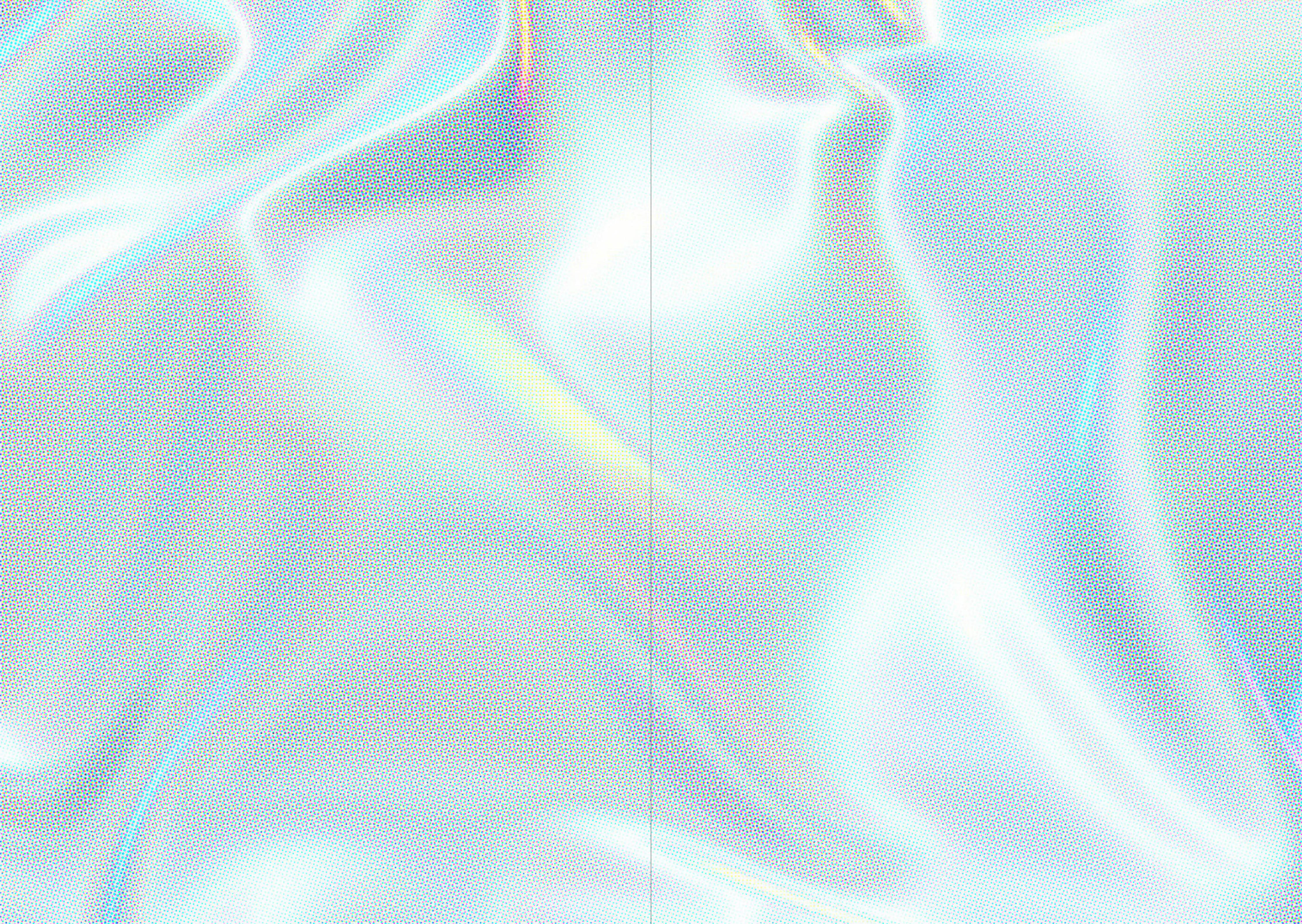
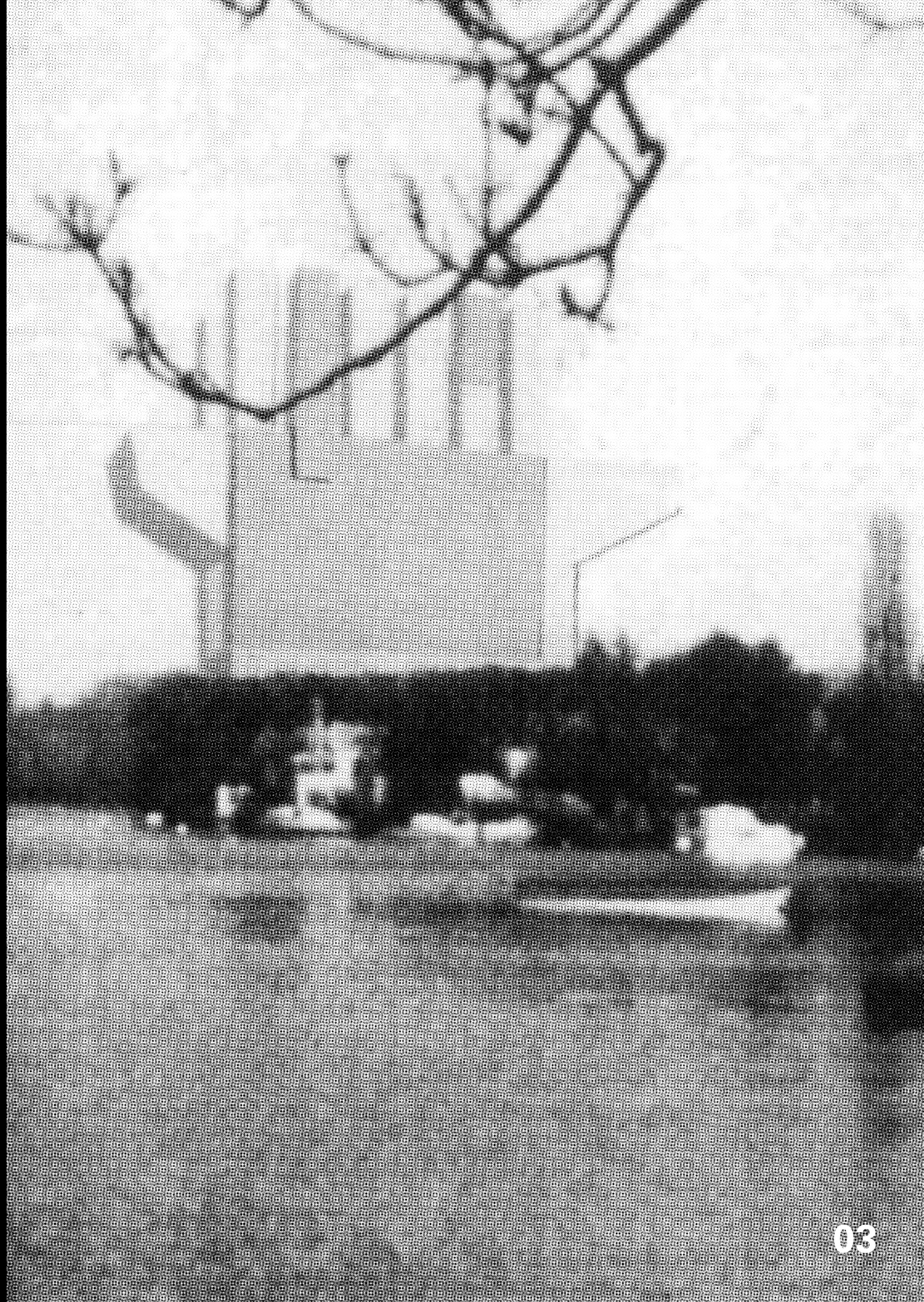
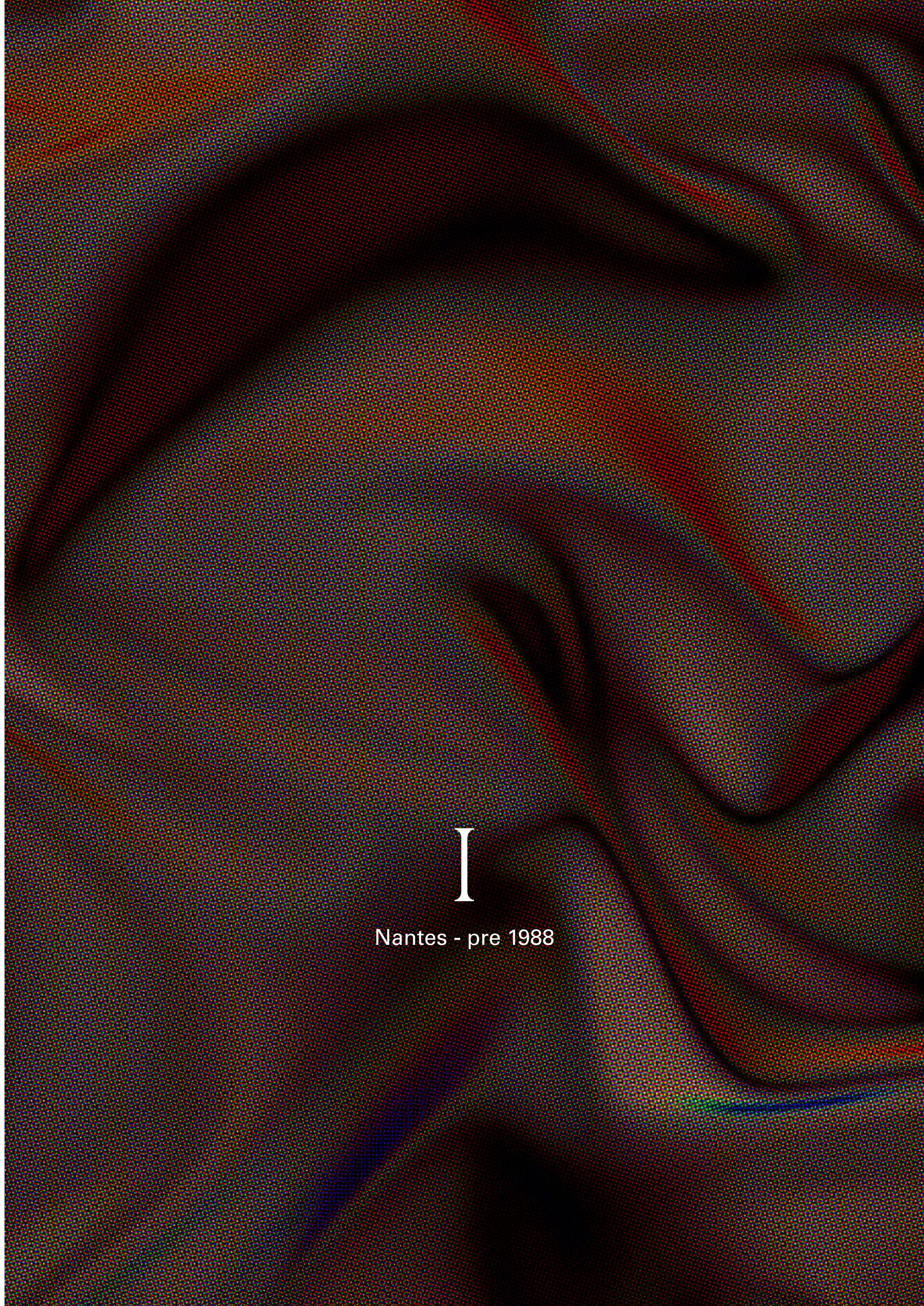


The compact city of Atlanpole is a design proposal by Hans Kollhoff for an urban planning competition held in 1988. The invitation of six international architects has been organized by the association Atlanpole Development Group to expand the Nantes metropolitan area with a science and technology park in the northern outskirts of the city. Unlike his competitors, Hans Kollhoff left the green landscape of La Chantrerie, the building site of the competition, completely untouched. Instead, he proposed a single 170-metres tall building featuring all the functions of a new neighbourhood.

None of the competition entries have been realized, and the very concept of the compact city of Atlanpole is questionable in many ways nowadays. In this report, I will critically reflect on the project's feasibility in light of contemporary social, political, and environmental concerns globally and for the city of Nantes.

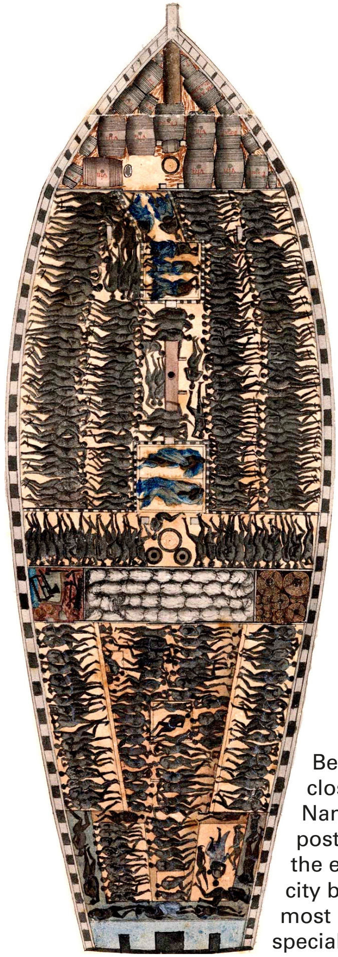
Fig. 1
Atlanpole
Visualisation





# I

Nantes - pre 1988



Because of its location close to the Atlantic Ocean, Nantes has been a trading post for centuries. Then, in the eighteenth century, the city became one of Europe's most important harbours specialising in the slave trade. Four-hundred-fifty-thousand enslaved people passed through the city in a period of two-hundred years[1], most from the bay of Guinea and the Caribbean.

Fig. 2 (l)
Shipping Slaves, 1730

Fig. 3 (r)
Harbor in Nantes, around 1800

[1] cf. Thomas Weller, "Nantes", Leibniz Institut für europäische Geschichte (2016) http://en.ieg-differences.eu/on-site-in-time/thomas-weller-nantes/

The infrastructure of Nantes' harbour grew steadily every year. By the nineteenth century, both the square footage devoted to industrial facilities and the city population had doubled. The industrial revolution de facto turned Nantes into France's largest shipyard manufacturer, contributing to a quarter of all the ships produced in France annually. [2] The prosperities of five centuries of almost uninterrupted economic growth are clearly visible in the splendor of the old town.

[2] cf. Guidet Thierry, "Zurück an den Fluss : zur städtebaulichen Geschichte von Nantes ", Werk, Bauen + Wohnen vol.97 n° 7-8, 2010 (8)

Fig. 4
Harbor of Nantes, around 1900

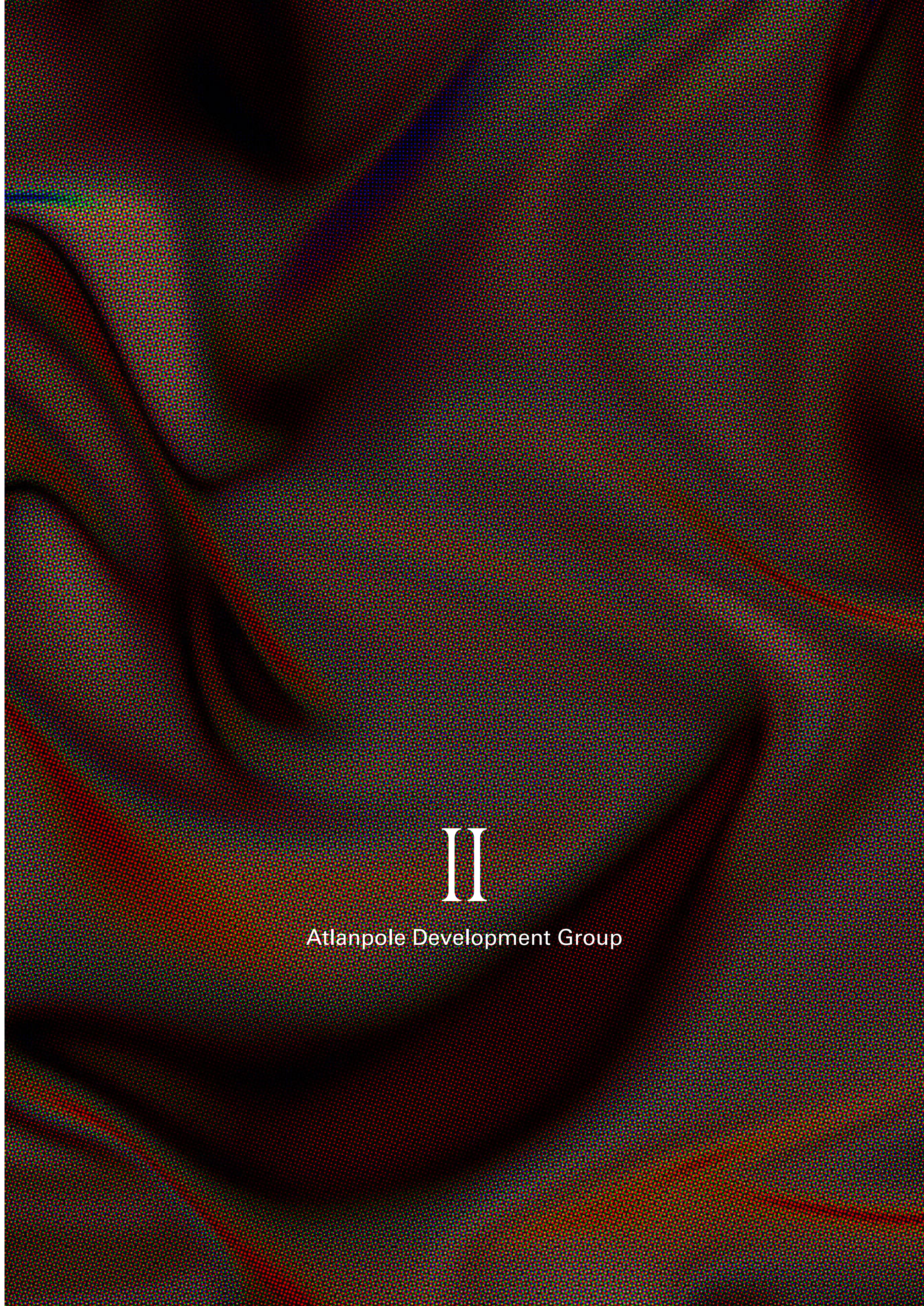
However, in the second half of the 19th century, Nantes's importance began to dwindle. The arrival of the train line marked the end of the economic significance of the Loire, the waterway that for centuries had been a central transport axis for most of France. Consequently, the city administration filled up two branches of the Loire River to generate more space to build on. Through the organization compagnie générale transatlantique, the harbor Saint Nazaire on the coast was strengthened in its infrastructure and location and eventually surpassed Nantes' importance as an international trade center. Then, in 1987, the last Shipyard of Nantes, Chantiers Dubegion, closed doors.[3] The time had come for another economic turnaround.

Fig. 5 (l)
Shipyard Industry,
Nantes 1967

Fig. 6 (r)
Île de Nantes,
1953

[3] cf. David Plouviez, "1987. Dubigeon, la fin de la Navale", Editions midi-pyrénéennes (2021)

Fig. 7
Chantiers Dubegion,
Nantes 1987



# II

## Atlanpole Development Group

Technopoles are three-dimensional relationships between innovative industries, cutting-edge research, and higher education centers. Several attempts have been to reactivate industrial agglomeration sites in France, all emulations of M.I.T.'s successful experiments Route 128 and Stanford Research Park.

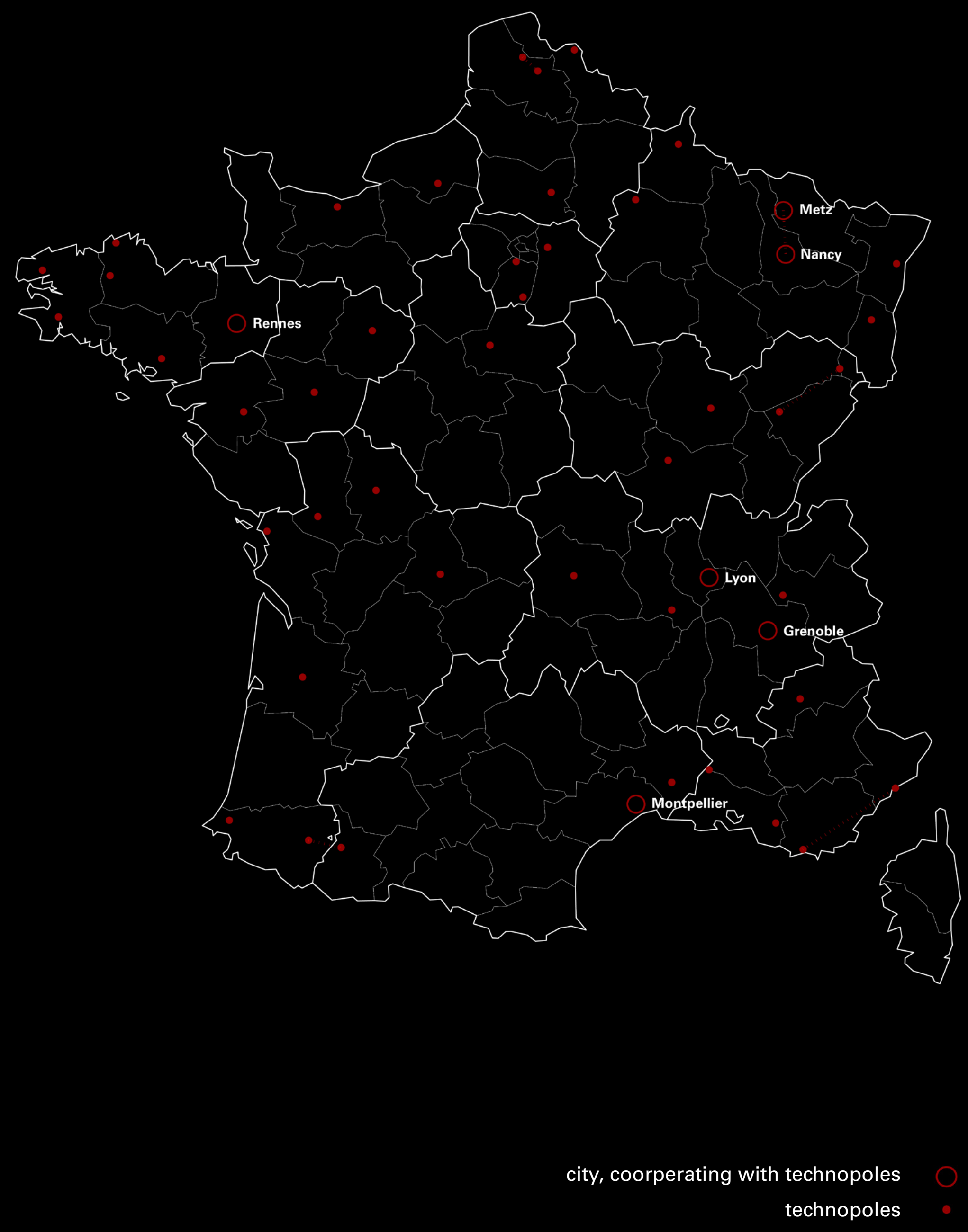



Fig. 8
Technopoles in France until 1988 [04]

[4] cf. Jean-Philippe Lucas, "Atlanpole ", Revue Plein ouest n° 44, 1988 (42)

In 1987, the City of Nantes merged with the Loire Atlantique Department and formed the Atlanpole Development Group (ADG). The idea behind ADG was to merge living and leisure, their so-called 4th dimension, in the concept of a technopole to create a more flexible and sustainable working environment to boost the individual level of performance.[5] Atlanpole is located along a north/south axis running from La Fleuryais to Île Saint Anne. It consists of seven sites where communication infrastructures and services are highly technical and meet modern companies' economic requirements. Facilitating exchanges between Atlanpole users was the aim of developing these sites.

[5] cf. Philippe Hervouët, "Atlanpole ", Nantes (2018) https://patrimonia.nantes.fr/home/decouvrir/themes-et-quartiers/atlanpole.html

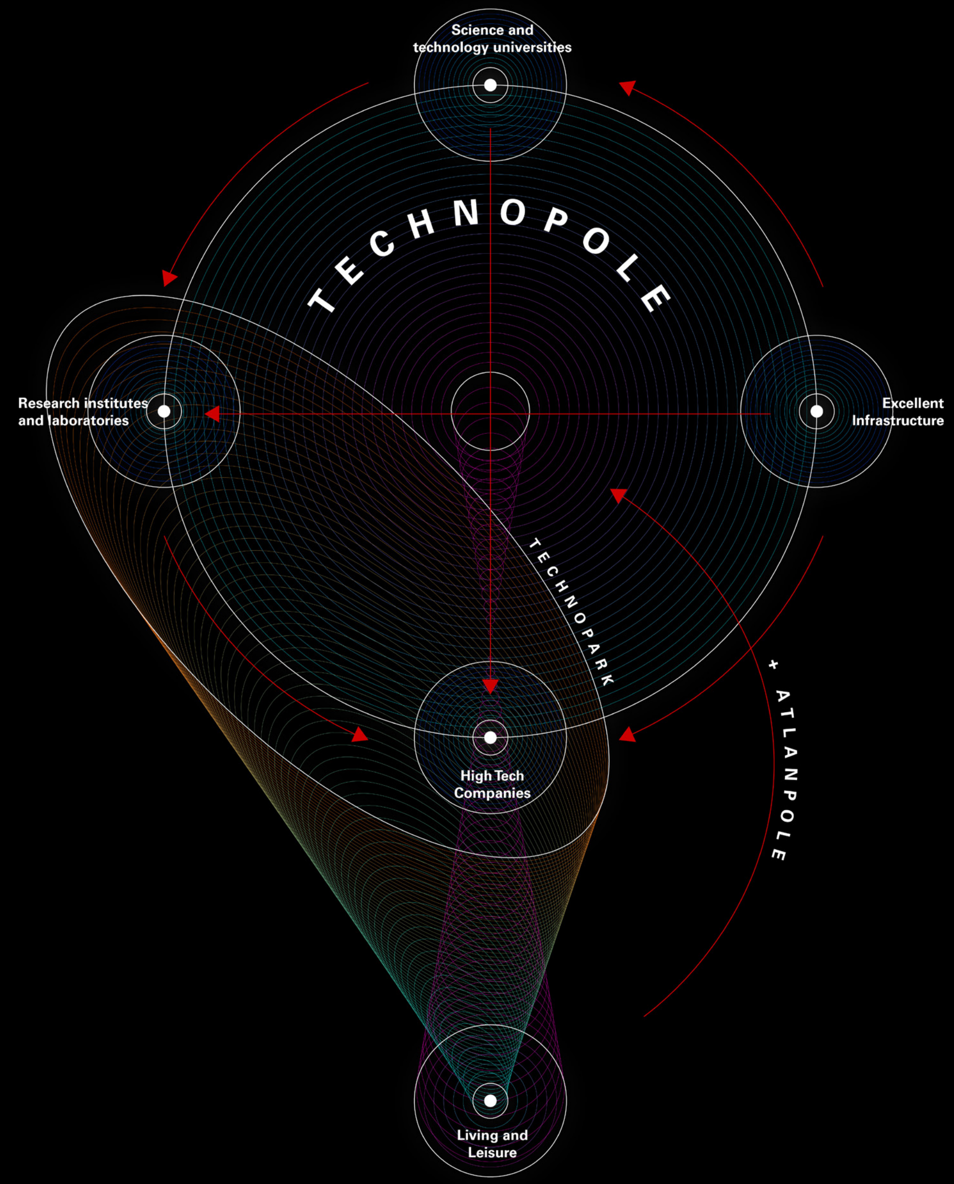
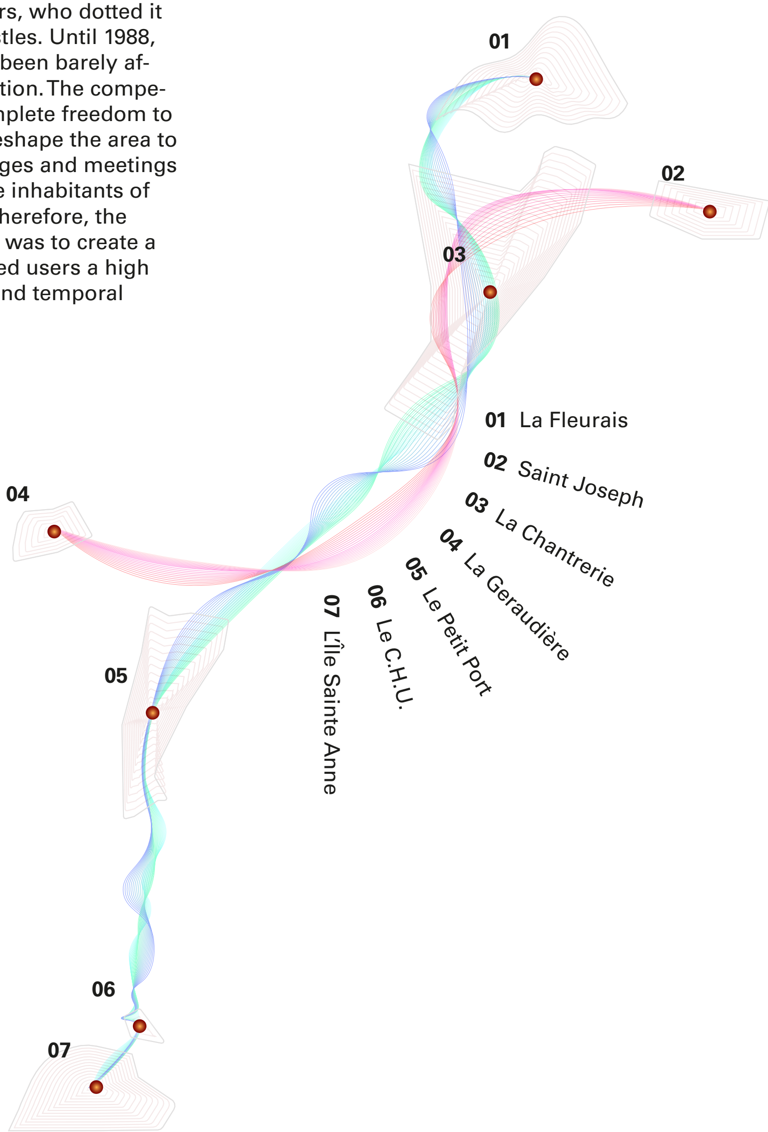



Fig. 9
Atlanpole
Organigram

ADG picked La Chantrerie as the location for its envisioned Technopolis. This area of hedged farmland was once owned mainly by Nantes' wealthy shipowners, who dotted it with parks and castles. Until 1988, La Chantrerie had been barely affected by urbanization. The competition brief left complete freedom to the designers to reshape the area to encourage exchanges and meetings between the future inhabitants of this technopole.[6] Therefore, the competition's goal was to create a project that afforded users a high degree of spatial and temporal flexibility.



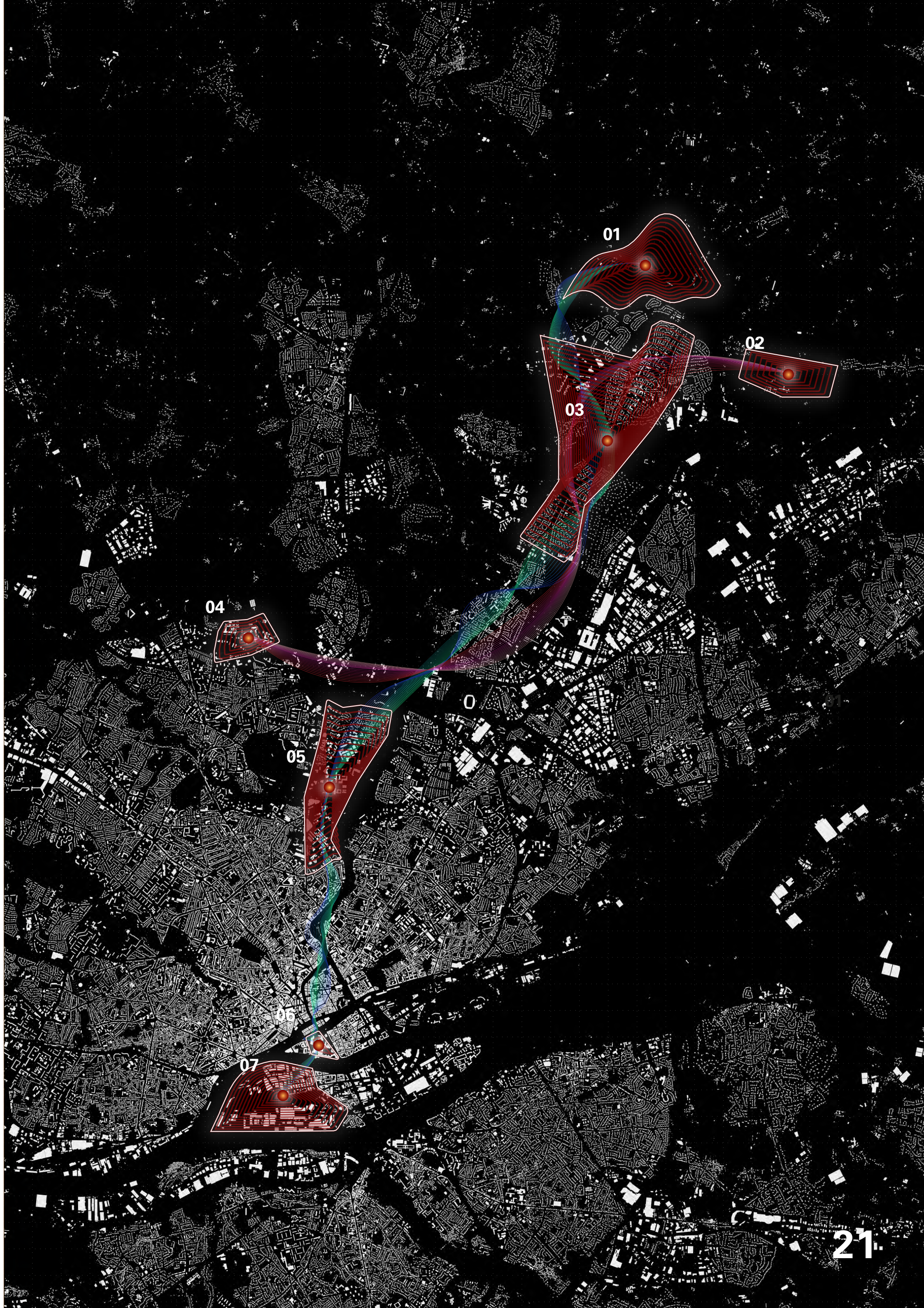



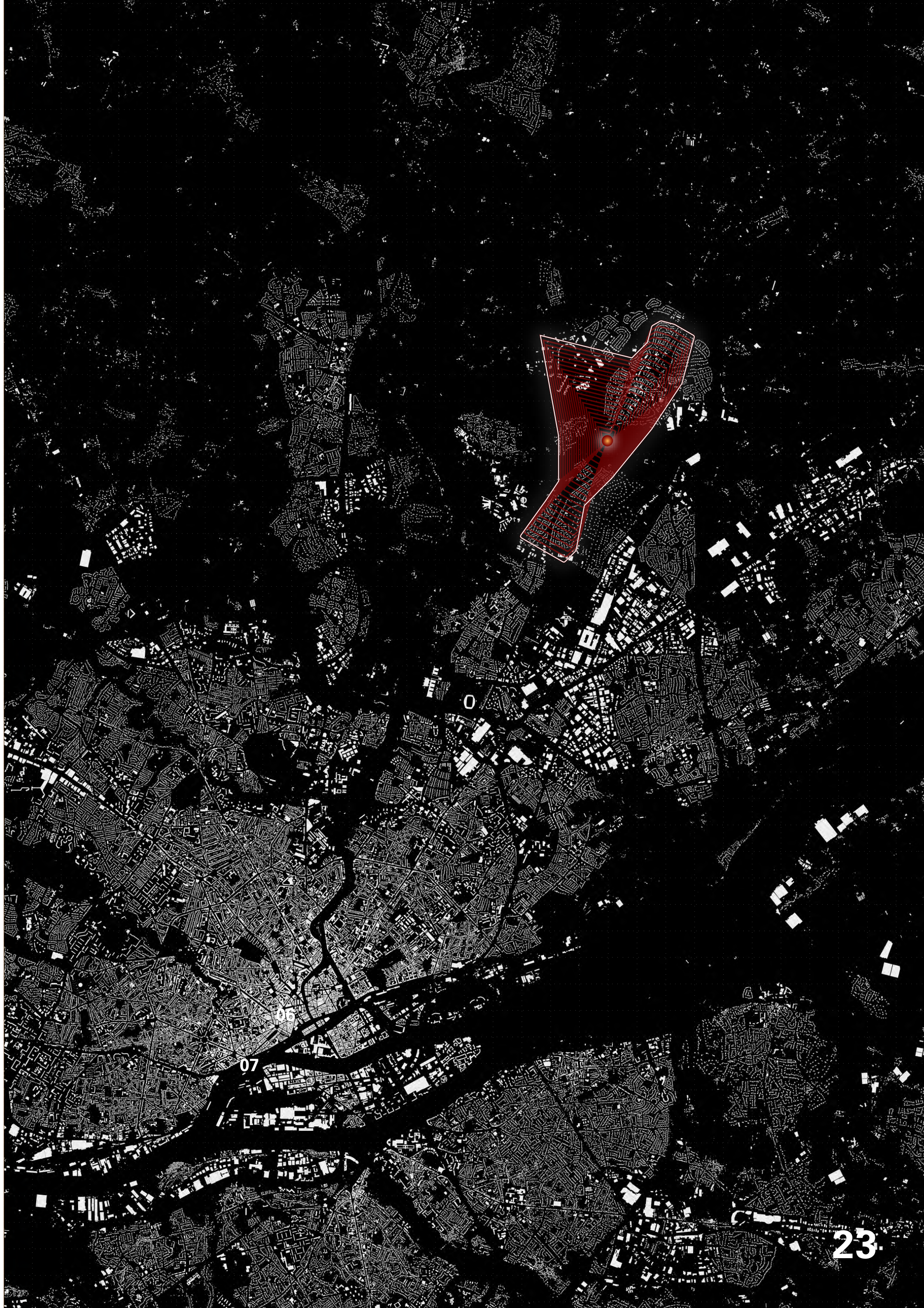

Fig. 11 (l+r)
Atlanpole
Distribution Map

[6] cf. Jean-Philippe Lucas, "L'urbanisme du futur ", Revue Plein ouest n° 44, 1988 (35)

The invitations for the Competition were sent to and accepted by six European firms, namely:

**Alessandro Anselmi**
**Boris Podrecca**
**Christian de Portzamparc**
**Hans Kollhoff**
**Javier Valles**
**Peter Ahrends**

Fig. 12
La Chantrerie, Nantes



# III

## The Compact City of Atlanpole

## THE COMPACT CITY OF ATLANPOLE

The submissions of all the participants were transforming the landscape of la Chantrerie to a parc d'activite scientific with rules and tools from contemporary urbanist knowledge of that time.


Fig. 13
Atlanpole Development Group, 1988

The Italian architect was looking for a geometrical scheme to solve the questions of coherence and identification of functions and built areas, which were very important in modern cities as he proposes a clear layout open to the possibilities of extension.
The hyperbola, the chosen form, allowed to develop a geometrical and dynamic image and scheme. Articulating with curves, asymptotes, axes, parallels and diagonals, the project determined lots with a labile repartition but fitting in a functionalist scheme of zoning.

# ALESSANDRO ANSELMI

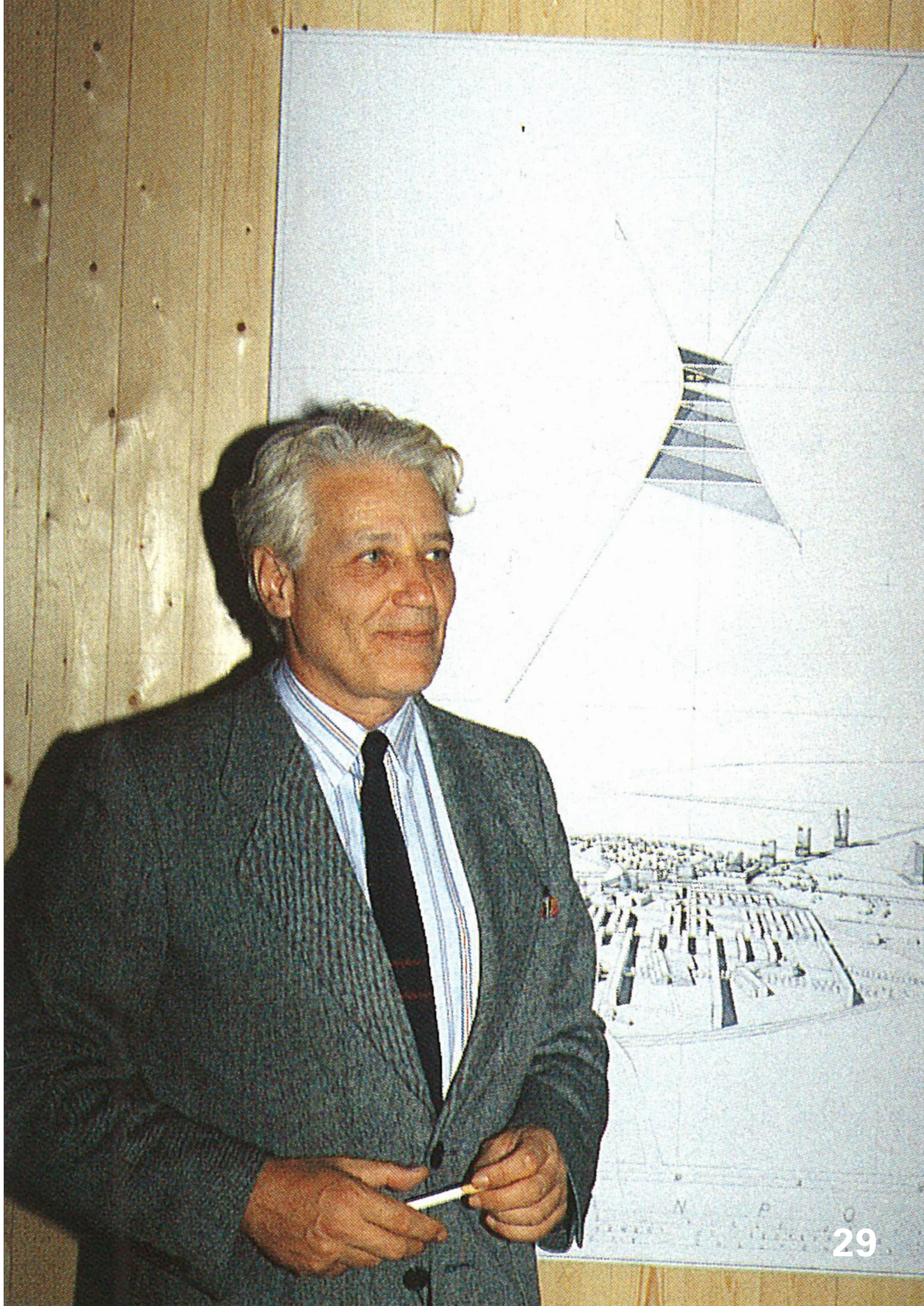
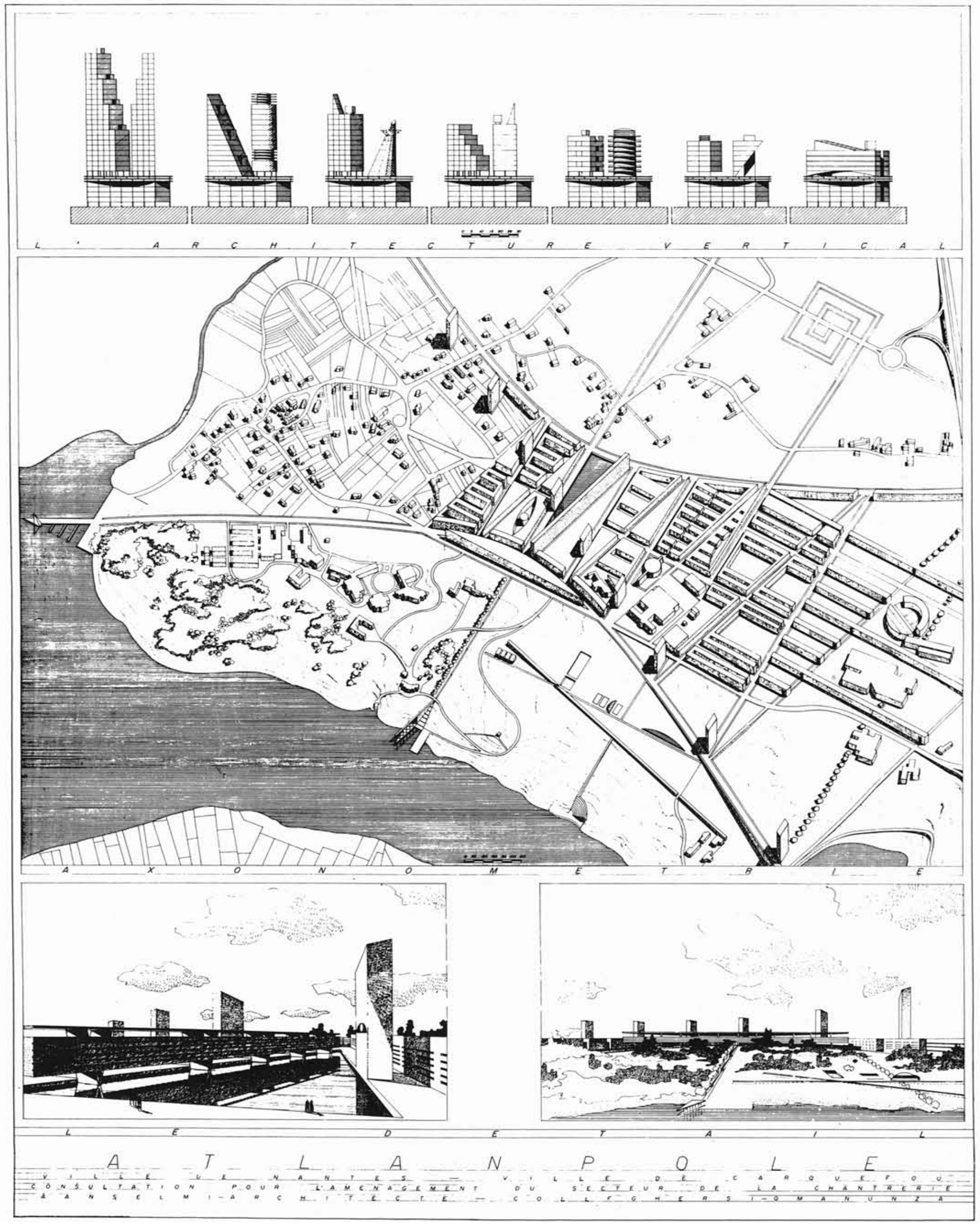


Fig. 14
Alessandro Anselmi,
1988



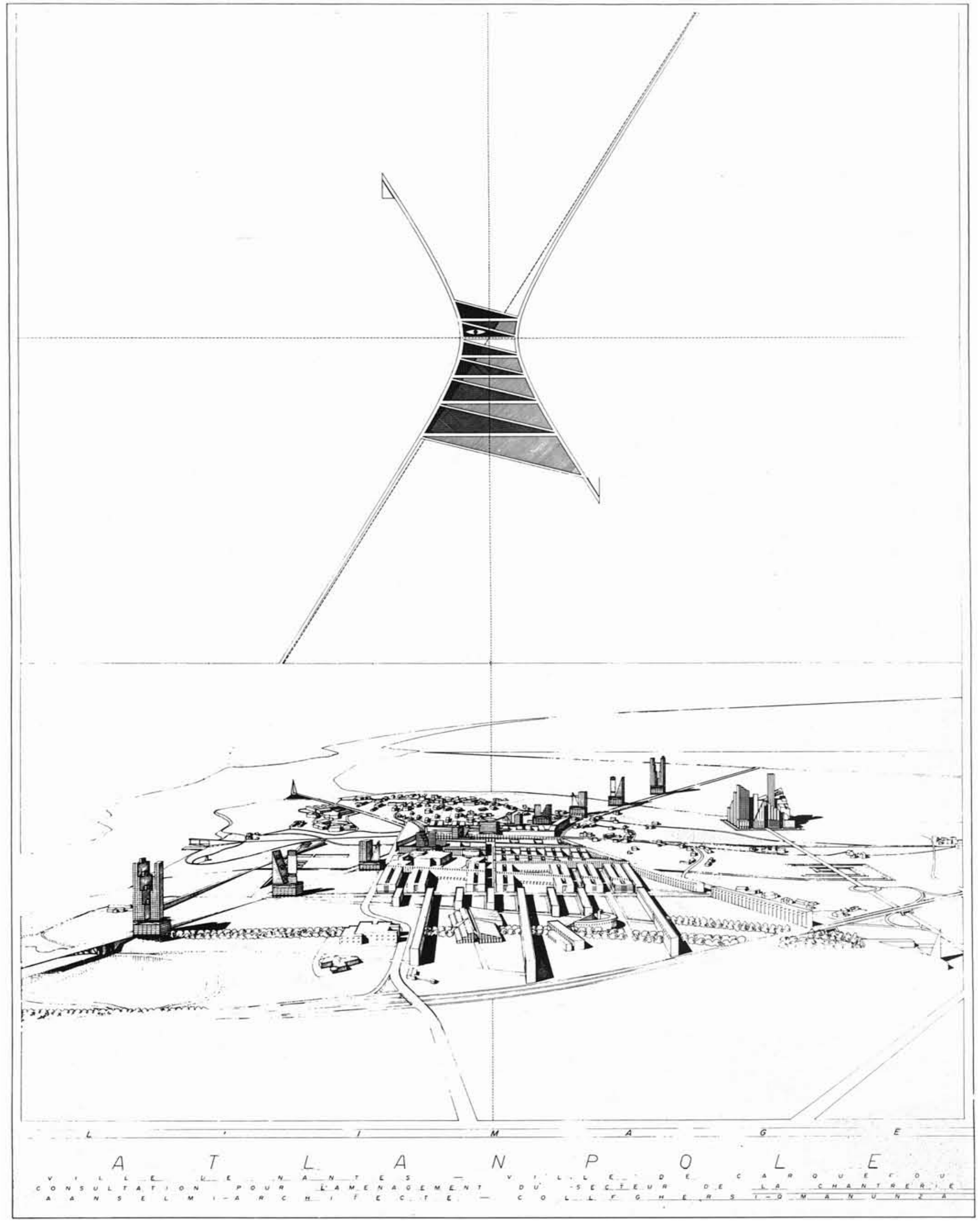



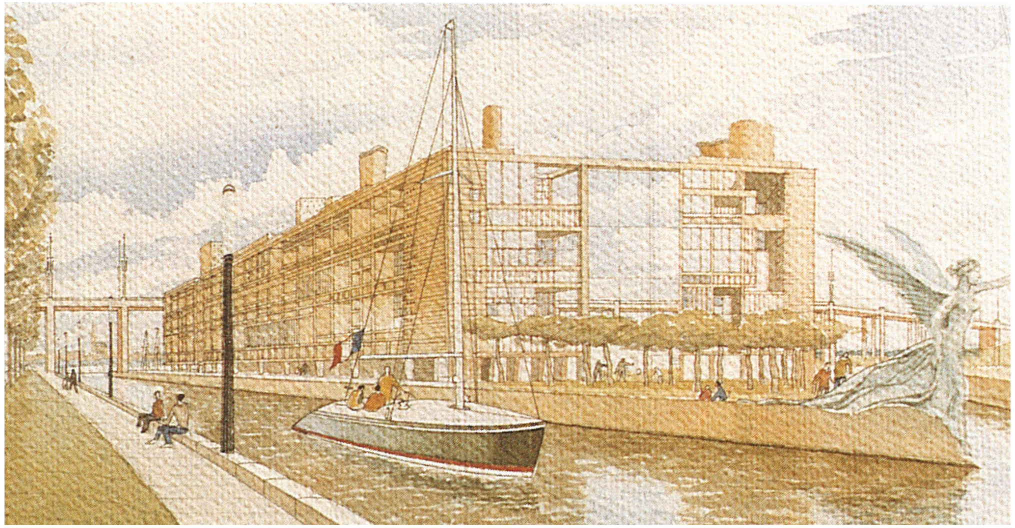

Fig. 15 (l)
Alessandro Anselmi,
1988

Fig. 16 (r)
Alessandro Anselmi,
1988

# JAVIER VELLÉS, MARIA CASARIEGO, ANTON CAPITEL

Fig. 17
Vellés, Casariego, Capitel, 1988

The urban project of the Spanish architects was based on the traces of the old plot of land and the agricultural exploration and on the topographic reality of the area. The Charbonneau stream, the southern limit of the project, became a strong axis, a canal projected as a linear river park that articulates two strongly architectural proposals: the Puerto Grande on an island as an allusion to the Feydeau Island whose layout reinterpreted the design of the Place Dauphine in Paris, and the Puerto Chico which organized two buildings around a basin on a square section, point of articulation between the urbanization area of the Fleuryais and the town of Carquefou.



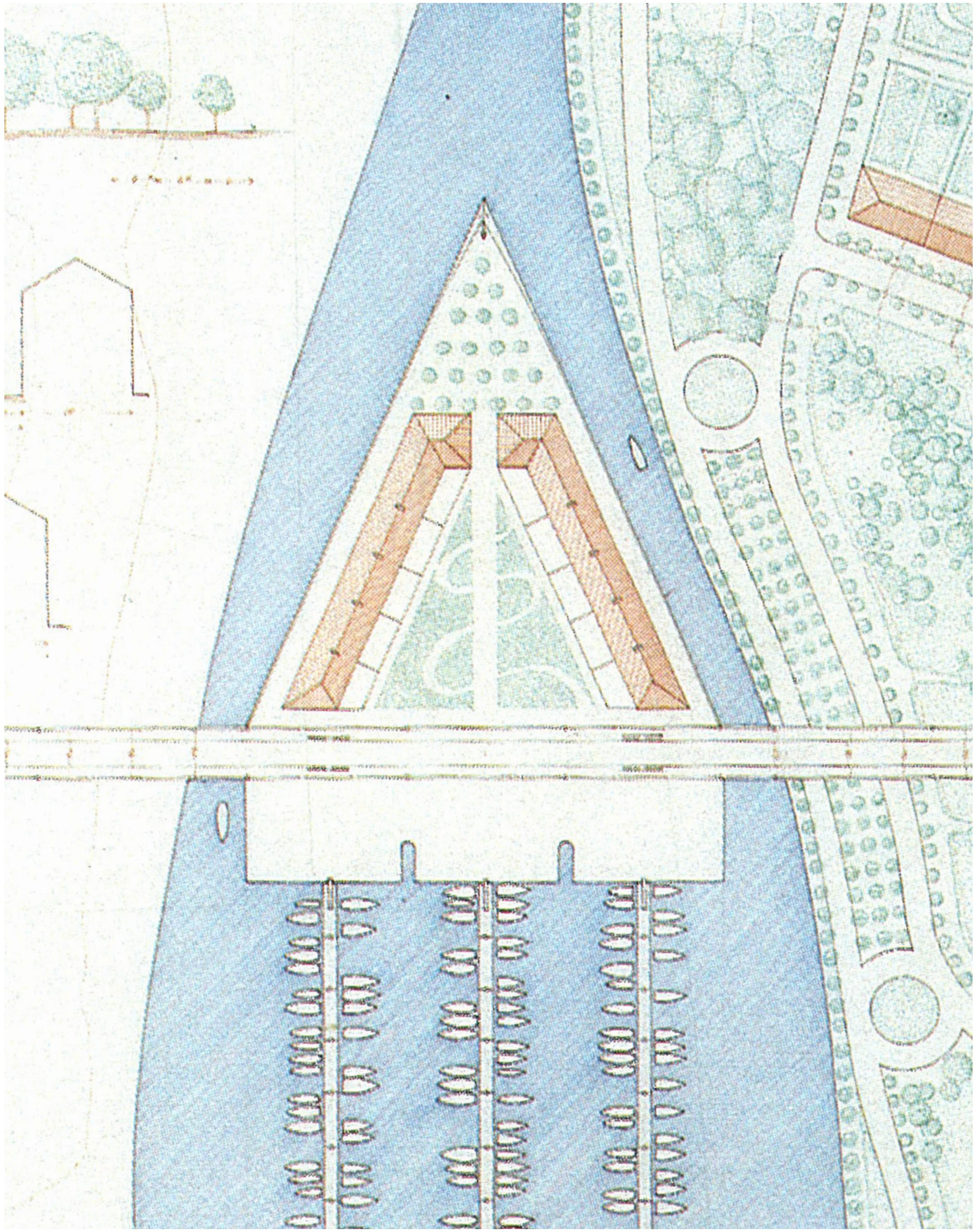
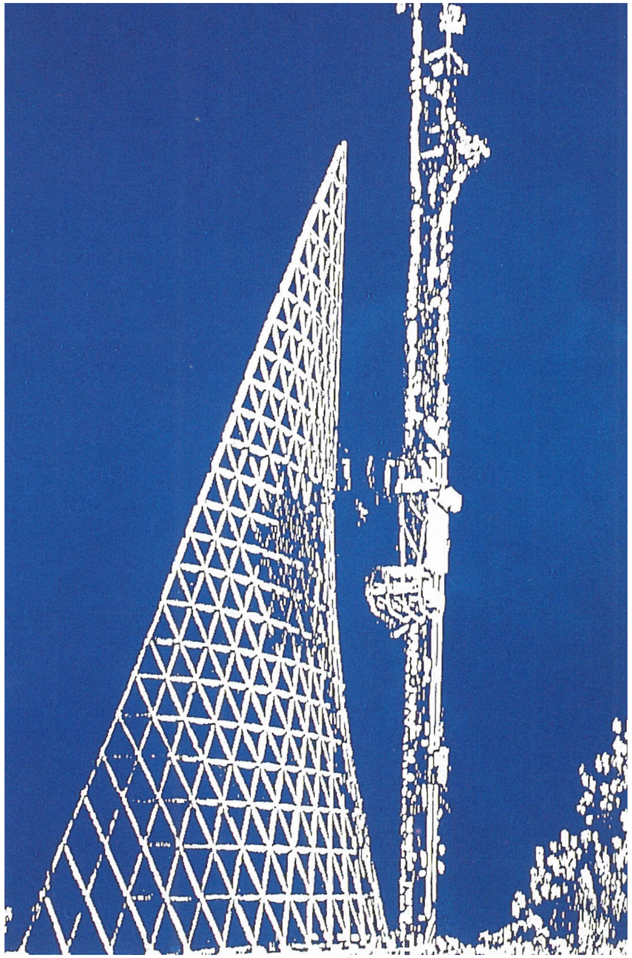


Fig. 18 (l)
Vellés, Casariego, Capitel, 1988

Fig. 19 (r)
Vellés, Casariego, Capitel, 1988



# PETER AHRENDS

The intervention of Peter Ahrends showed an articulation between nature protection and a highly technological image. The reflection on the distribution of the built environment, the construction of a new landscape was fed by a fascination for the existing landscape.
The diaglogue between the built landscape and the natural setting is based on the theme of waves: the sinusoid symbol of communication and high technology is related to the natural waves of the Charbonneau stream and the erdre.

Fig. 20 (l)
Peter Ahrends,
1988

Fig. 21 (r)
Peter Ahrends,
1988

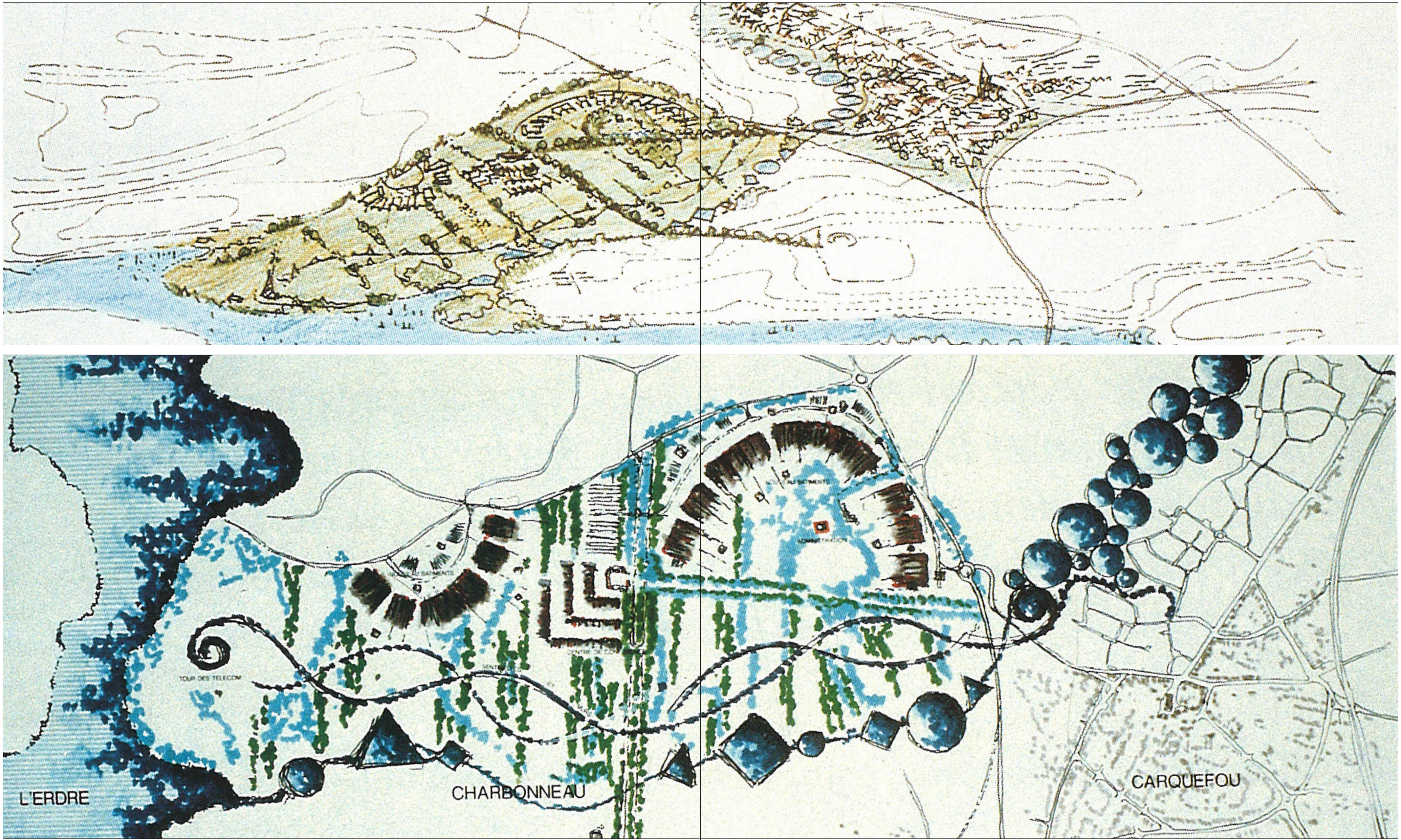



Fig. 22
Peter Ahrends,
1988

Boris Podrecca worked on a project giving an image of coherence while preserving a relationship of transparency, of visibility between the built and the unbuilt, the place of production (material, intellectual) and nature.

# BORIS PODRECCA


Fig. 23
Boris Podrecca, 1988

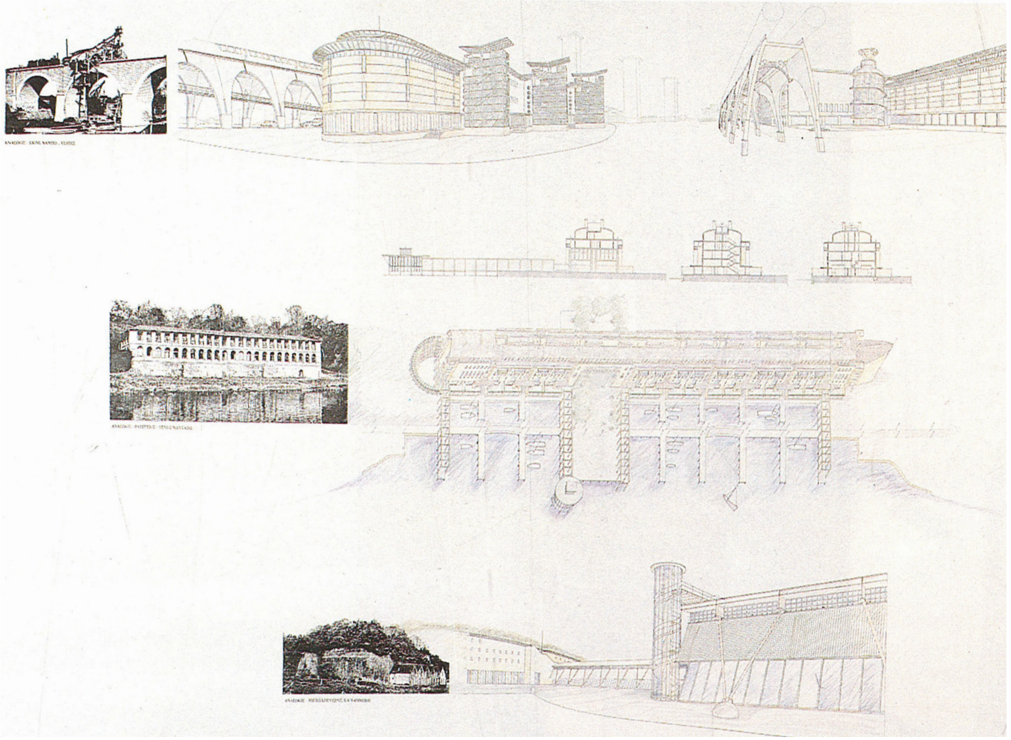


Fig. 24 (l)
Boris Podrecca,
1988

Fig. 25 (r)
Boris Podrecca,
1988

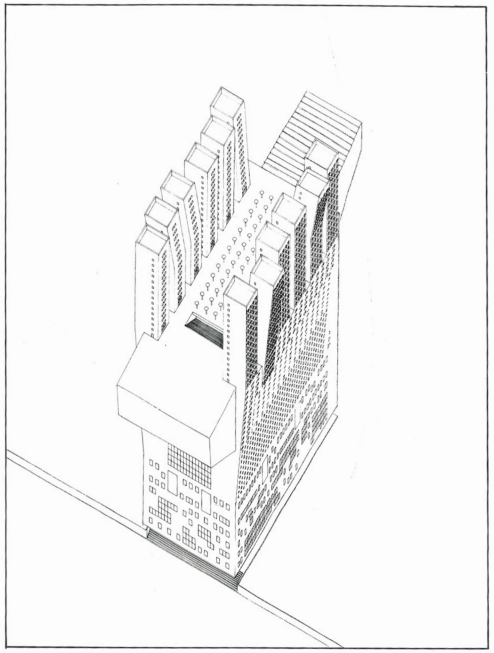
Portzamparc wanted to invest this area by creating a clear aesthetic scheme from the outset, while allowing for openness and further development, i.e. by laying down some progressive principles for the orientation of the project.

# CHRISTIAN DE PORTZAMPARC

Fig. 26
Christian de Portzamparc,
1988

Fig. 27 (l)
Christian de Portzamparc, 1988

Fig. 28 (r)
Christian de Portzamparc, 1988



# HANS
# KOLLHOFF

Fig. 29 (l)
Hans Kollhoff,
1988

Fig. 30 (r)
Hans Kollhoff,
1988

One of the entries left the landscape of la Chantrerie completely untouched: Hans Kolhoof's. In his proposal, there is no soil sealing and no streets, nothing but 170 meters high, 90 meters wide, and 60 meters deep building connected to the city with an underground, tube-like, futuristic train. The compact city of Atlanpole was chosen as the manifesto of the development group's vision of hyper-fast reachability to all facilities, a mix of leisure and entertainment, and a pristine park at the footsteps of the building.

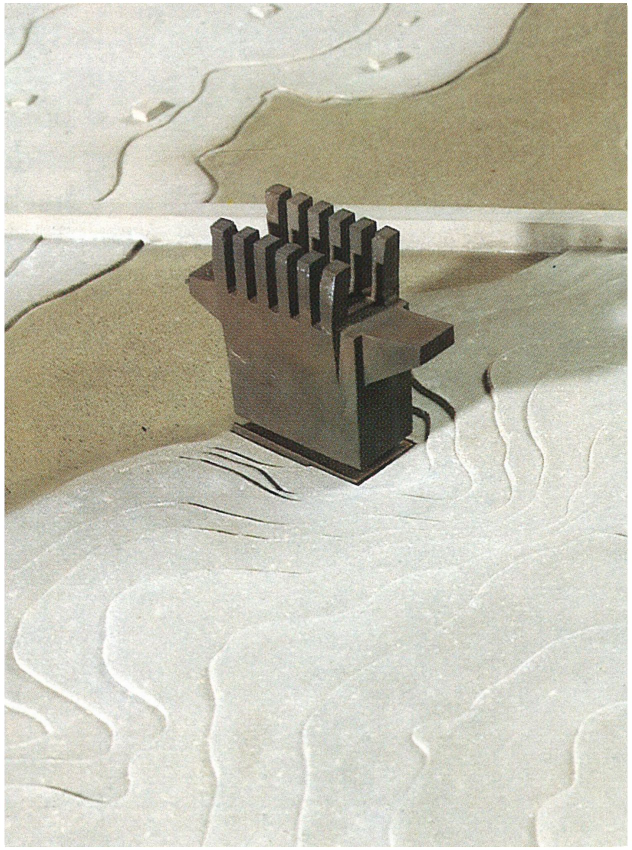
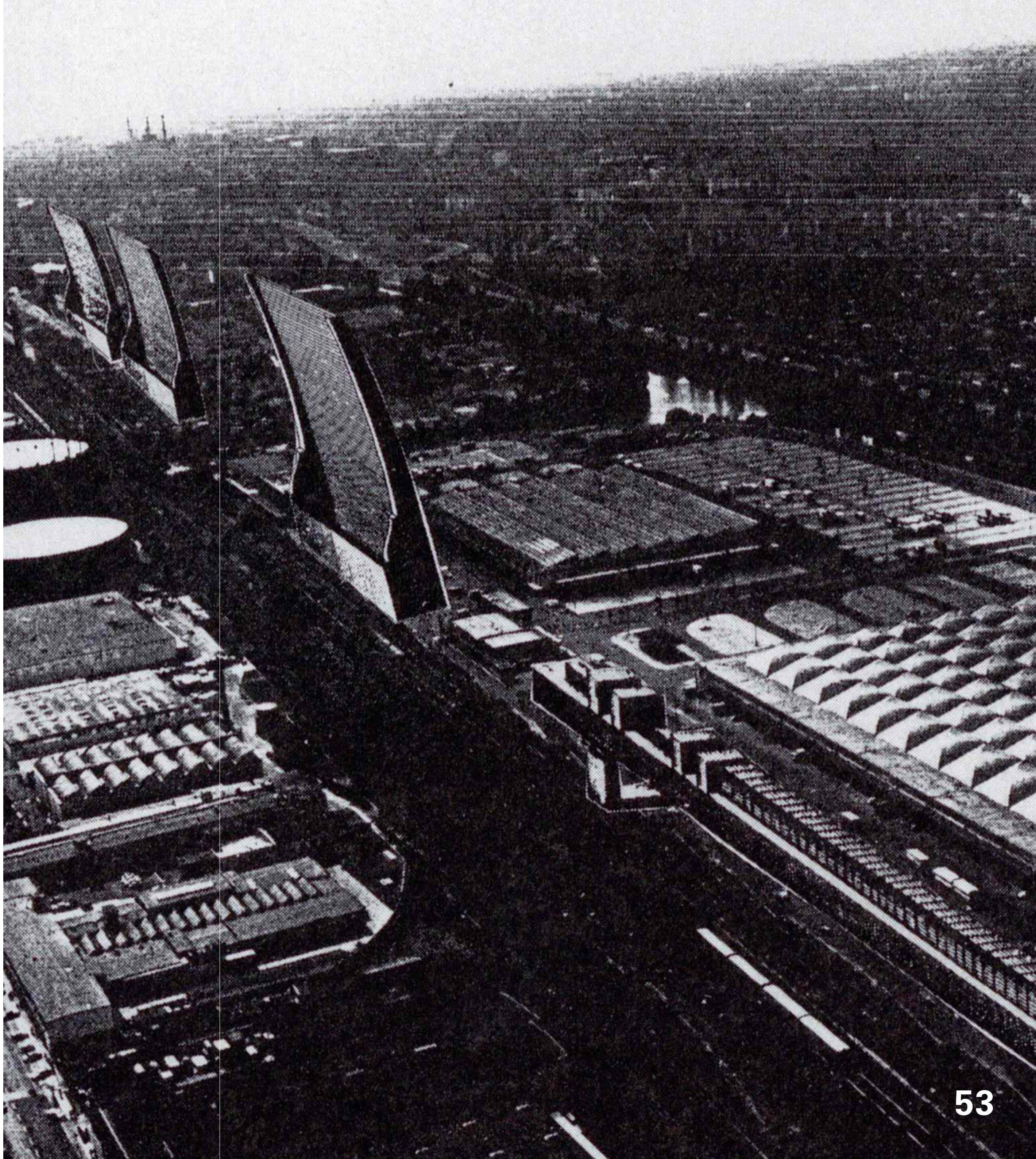


Fig. 31 (l)
Hans Kollhoff,
1988

Fig. 32 (r)
Hans Kollhoff,
1988

At the same time, the project emerged out of the frustration of Hans Kollhoff to contemporary urban planning, which, in his opinion, had tragically detached from architecture. As a student of Oswald Mathias Ungers, his early works from the 1970s and 80s reflected their mindset of expressionistic and sculptural building designs. 1987, one year ahead of the Atlanpole Competition, Hans Kollhoff held an architecture summer school in Berlin. Already being a person with great public recognition of his statements at that time, he clarified his opinion on conservative urbanism and the contemporary issue with it. In Architektur kontra Städtebau, the opening essay of the publication that came out of his summer school, he stated that "everything that has urban relevance in Berlin is not based on the realization of an urban design, but on architectural achievements, which in most cases could only be implemented with superhuman effort against common urban planning schemes."[7]

[7] Hans Kollhoff, "Architektur kontra Städtebau", Grossstadtarchitektur: City-Achse Bundesallee / Sommerakad. für Architektur 1987, Gebr. Mann Verlag, 1989 (93)



With six-hundred-twenty-four inhabitants and forty-six stories, several functions were envisioned between the housing towers and the ground floor. The "five-minute city", as Kollhoff called it, embodied an isolated satellite on the north-south axis of the Atlanpole Development Group. Arriving to the compact city of Atlanpole was planned via a rapid transit line that stops in the third basement level of the complex. From there, the path leads vertically up the building through two access cores in the corners of the floor. The ground floor is thermally decoupled from the rest of the building and is supported by four rows of columns. Following the access cores further up, one finds commercial exhibition space on the first nine stories. Floors ten to fourteen contain space for production facilities, laboratories, and technological research facilities. The design of the next ten floors includes a hotel for temporary living with a lobby that runs vertically across all floors, creating visual relationships between every hotel room within the thermally enclosed courtyard. This is followed by five floors designed for the Technological University of Nantes, equipped with seminar rooms and lecture halls. On story number thirty-one, there are various sports and recreational facilities. Above, one finds a communal roof terrace from which ten solitary residential towers reach towards the sky. In contrast to the hotel, the openings of the six-hundred-twenty-four residential units face out into nature and away from the other apartments.

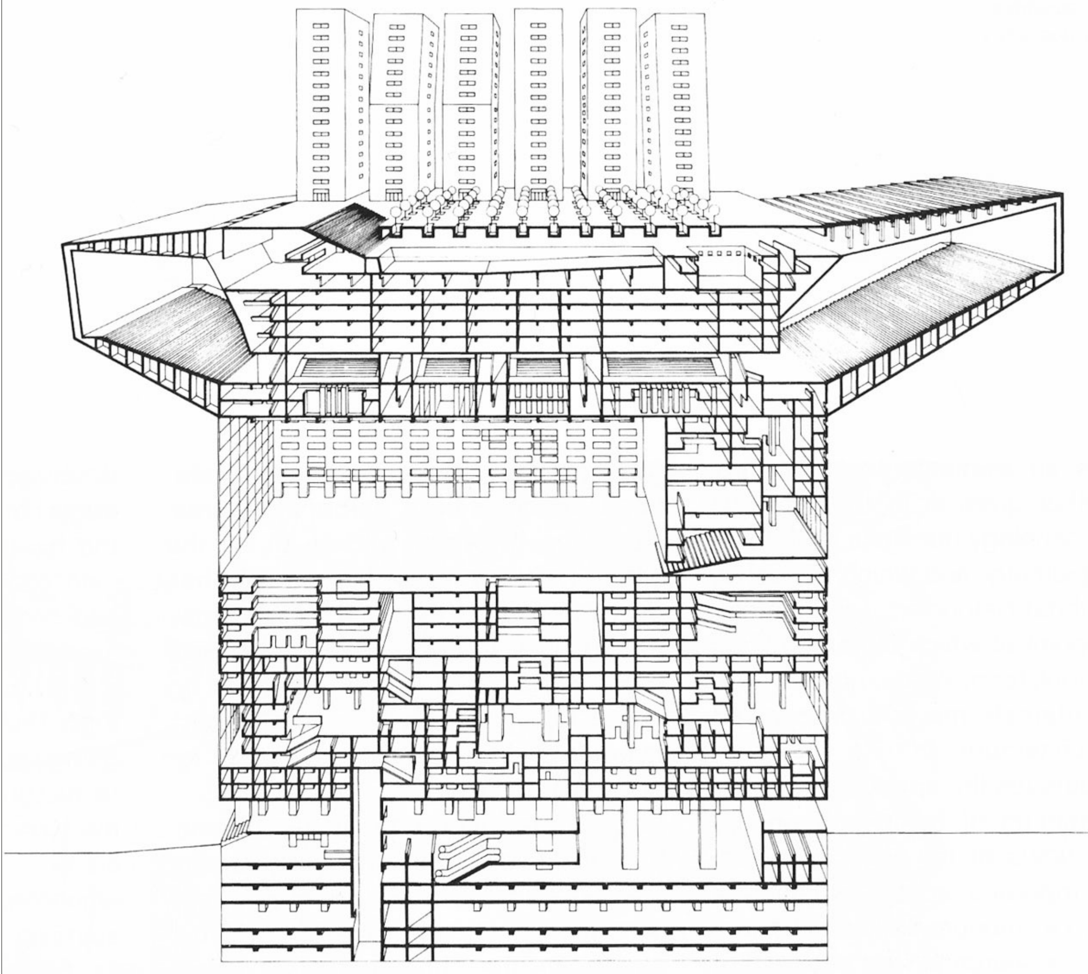


Fig. 34
Atlanpole,
programatic Section, 1987

# EXCURSUS

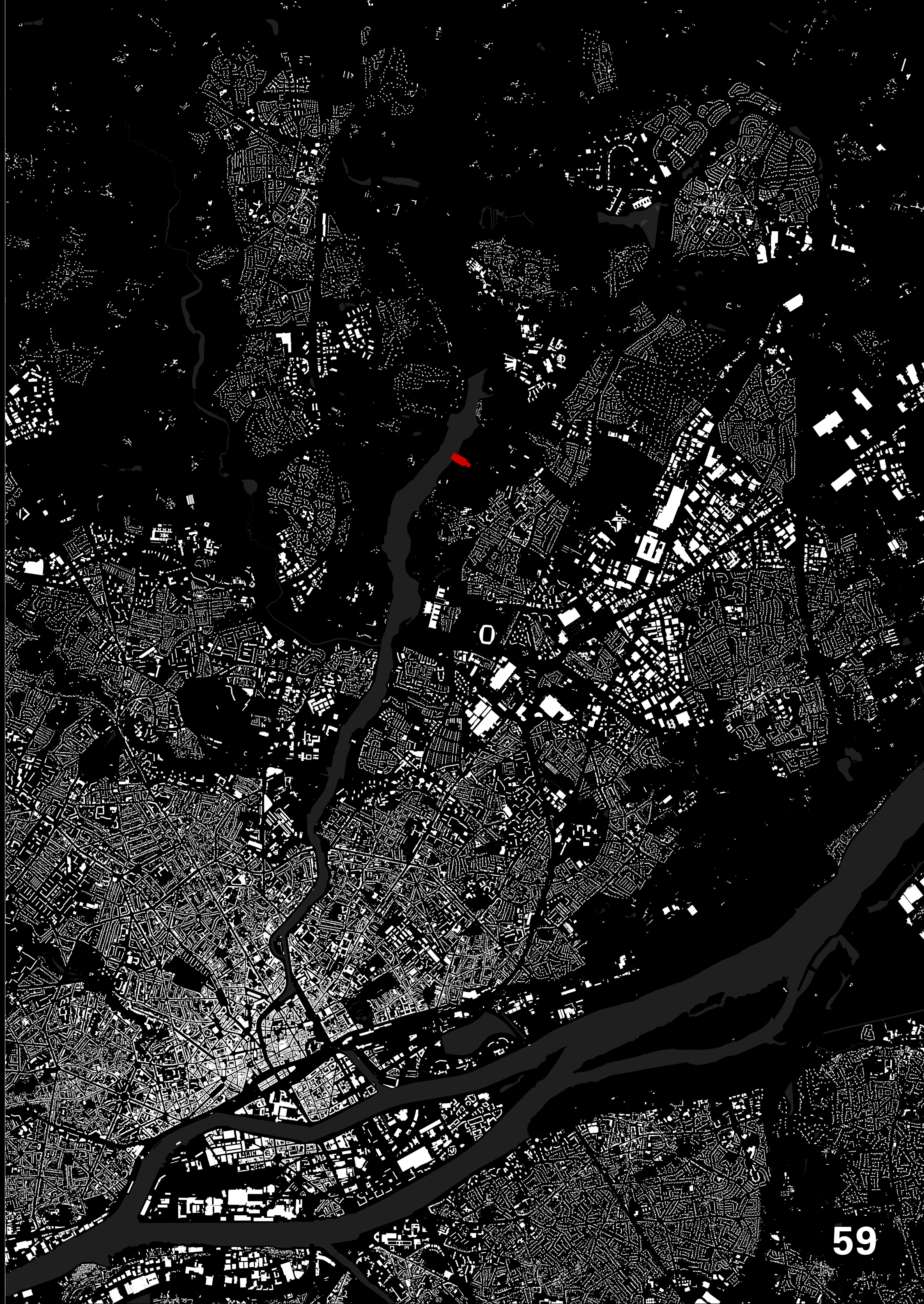
A comprehensive data analysis of
Hans Kollhoff's compact city of Atlanpole:

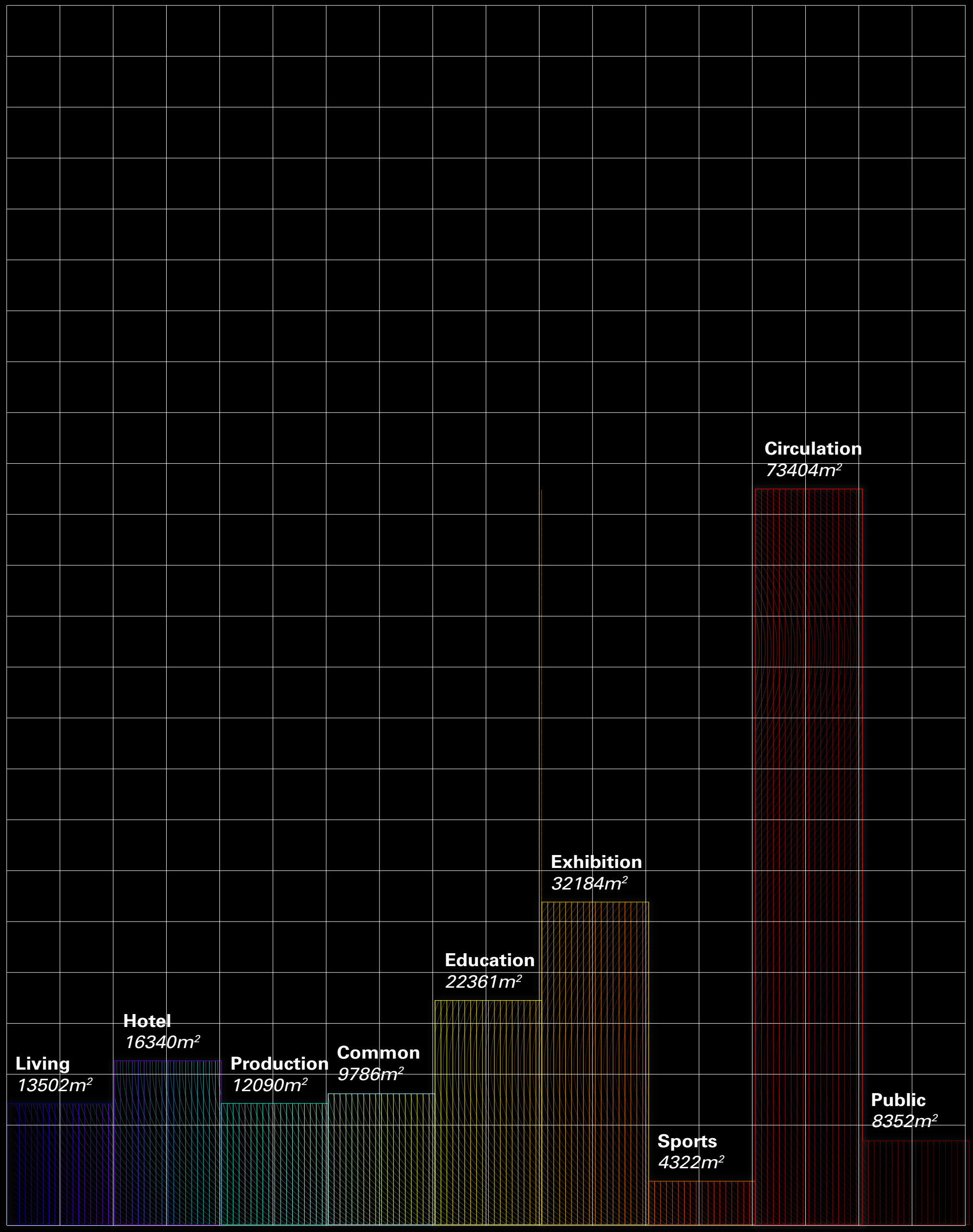
**programmatic distribution**
**material emissions**
**energy consumption**

60m x  90m x 170m

**Total GFA**
232341m²

Fig.35
Atlanpole,
Siteplan





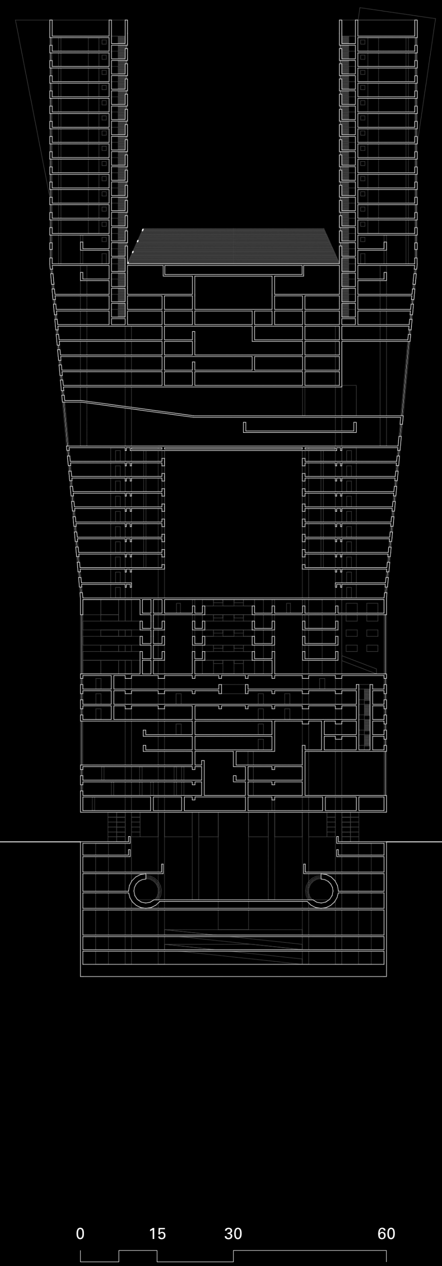




Fig. 36 (l)
Atlanpole,
programatic Distribution

Fig. 37 (r)
Atlanpole,
Section

## 01 Roof [8]

| | |
|---|---|
| Concrete panels | 50 mm |
| PP membrane | 5 mm |
| XPS insulation | 175 mm |
| Glass wool | 215 mm |
| Concrete C30/37 | 400 mm |

## 02 Ext. Wall, Tower

| | |
|---|---|
| Concrete panels | 50 mm |
| Glass wool | 300 mm |
| Concrete C30/37 | 250 mm |
| Glass pane | 30 mm |
| Window Frame, Wood | 45 mm |

## 03 Ceiling, Tower

| | |
|---|---|
| PVC | 2 mm |
| Screed | 50 mm |
| Mineral wool | 40 mm |
| Concrete C30/37 | 200 mm |

## 04 Ext. Wall, Core

| | |
|---|---|
| Concrete panels | 50 mm |
| Glass wool | 300 mm |
| Concrete C30/37 | 450 mm |
| Glass pane | 30 mm |
| Window Frame, Wood | 45 mm |

## 05 Ceiling, Core

| | |
|---|---|
| PVC | 2 mm |
| Screed | 50 mm |
| Mineral wool | 40 mm |
| Concrete C30/37 | 400 mm |

## 06 Ceiling, Entrance

| | |
|---|---|
| PVC | 2 mm |
| Screed | 50 mm |
| Concrete C30/37 | 400 mm |
| Mineral wool | 120 mm |
| XPS Insulation | 215 mm |

## 07 Ceiling, Groundfloor

| | |
|---|---|
| Concrete panels | 50 mm |
| PP membrane | 5 mm |
| Concrete C30/37 | 200 mm |

## 08 Ceiling, Basement

| | |
|---|---|
| Screed | 50 mm |
| Mineral wool | 40 mm |
| Concrete C30/37 | 200 mm |

## 09 Ext. Wall, Basement

| | |
|---|---|
| PP membrane | 5 mm |
| Concrete C30/37 | 450 mm |

## 10 Foundation

| | |
|---|---|
| Screed | 50 mm |
| Concrete C30/37 | 2300 mm |
| PP Membrane | 5 mm |

[8] ref. IBO – Österreichisches Institut für Bauen und Ökologie, "Gebäude der 1980er Jahre", Passivhaus-Bauteilkatalog: Sanierung, Birkhäuser Verlag GmbH, 2017 (173)

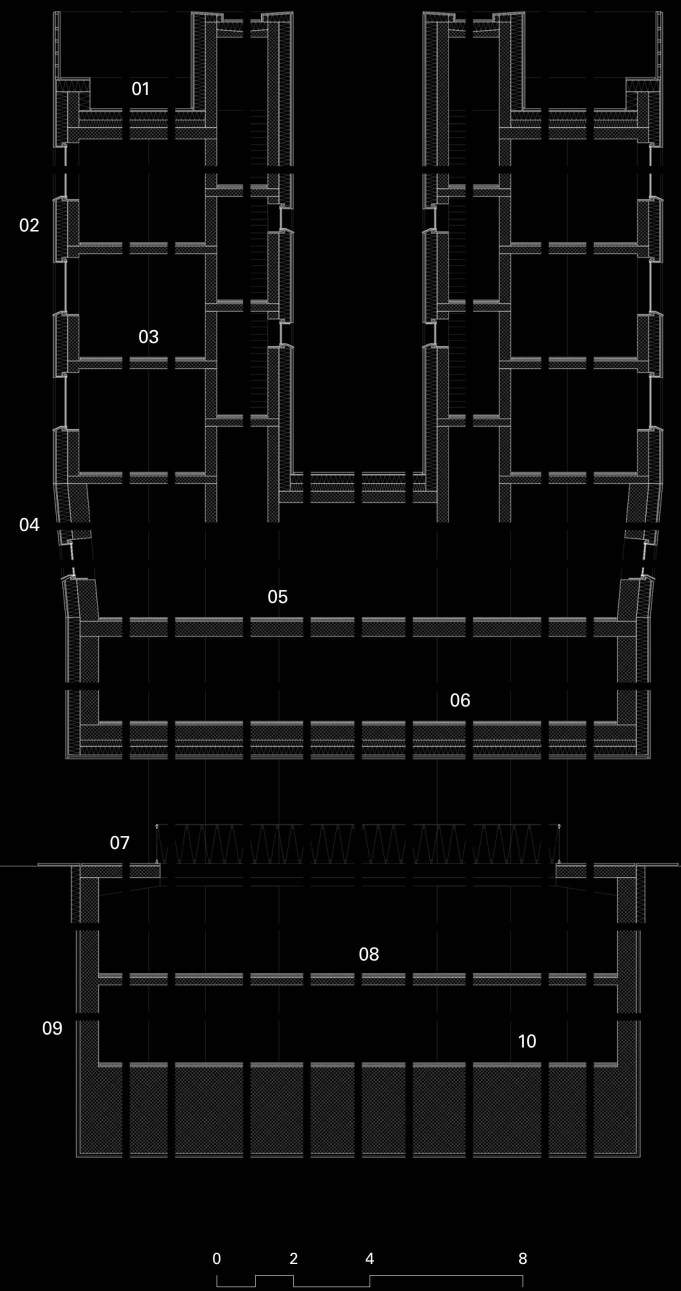



Fig. 38
Atlanpole,
Detail Section

| | |
|---|---|
| **Concrete panels** [9] | 180.0 $kgCO_2/m^3$ |
| **Glass wool** | 12.8 $kgCO_2/m^3$ |
| **Concrete C30/37** | 288.0 $kgCO_2/m^3$ |
| **Glass pane** | 266.1 $kgCO_2/m^3$ |
| **Window Frame, Wood** | 474.1 $kgCO_2/m^3$ |
| **Gypsum board** | 169.6 $kgCO_2/m^3$ |
| **Stairs, Concrete C20/25** | 229.0 $kgCO_2/m^3$ |
| **Doors, Wood** | -519.0 $kgCO_2/m^3$ |
| **PVC** | 4095.5 $kgCO_2/m^3$ |
| **Mineral wool** | 70.4 $kgCO_2/m^3$ |
| **XPS insulation** | 96.3 $kgCO_2/m^3$ |

The construction of the building has never been defined, as the project itself hasn't been further developed after the concept phase. The following assumptions were approximated for the building to use a material composition that was made from a composite thermal insulation system with load-bearing elements out of reinforced concrete in a solid construction.

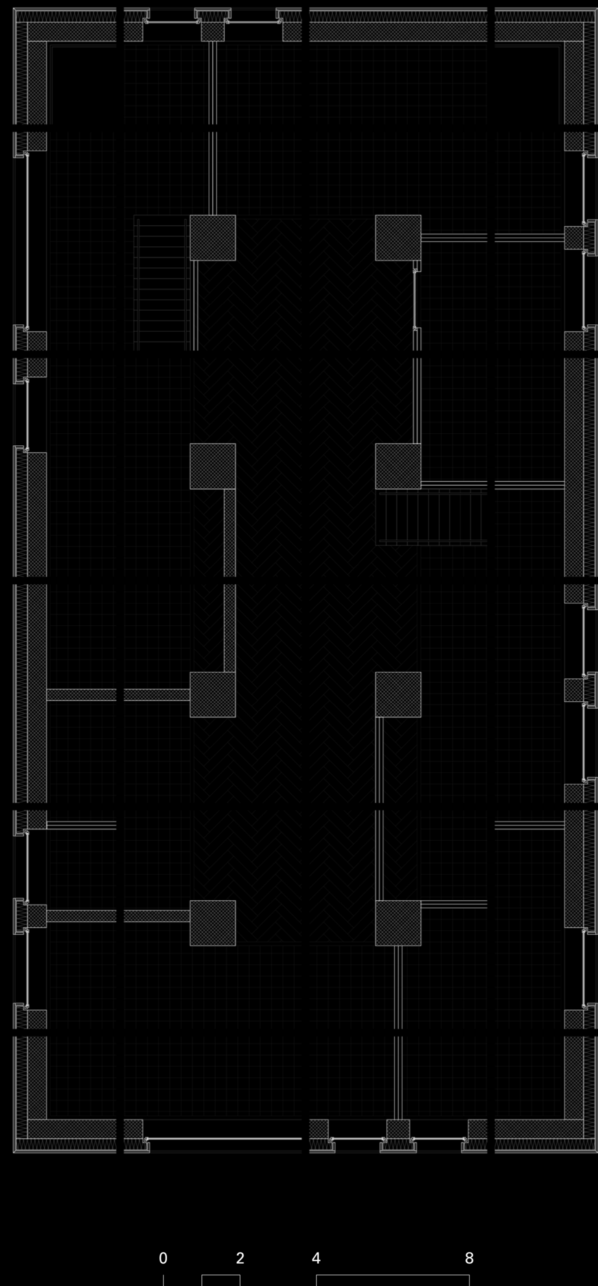
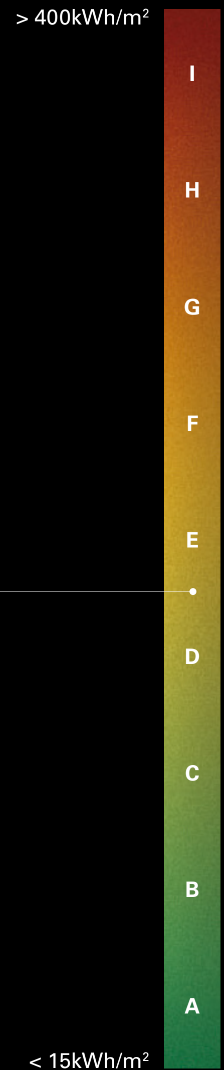



Fig. 39
Atlanpole,
Typ. Floorplan Detail

[9] ref. CINARK – Centre for Industrialised Architecture, The Royal Danish Academy, Materialpyramiden (2019) https://www.materialepyramiden.dk/




**50 kWh/m²**

public building
1980's;

composite thermal
insulation system

simplified estimated
numeric value

**Heating Energy Demand**

$$Q_H = (Q_T + Q_V) - \eta_g * (Q_i + Q_s)$$

| | |
|---|---|
| Heating energy demand | $Q_H$ |
| Transmission heat losses | $Q_T$ |
| Ventilation heat losses | $Q_V$ |
| Utilization rate for heat gains | $\eta_g$ |
| Internal heat gains | $Q_i$ |
| Solar heat gains | $Q_s$ |

**13,5 kWh/m²**

yearly consumption
public building

SIA 2024
standartized
numeric values

**Domestic Hot Water Heat Demand**

$$Q_w = V + p - c_p * (T_1 - T_2)$$

| | |
|---|---|
| Domestic Hot Water Heat Demand | $Q_w$ |
| Domestic Hot Water Demand | $V$ |
| Density of Water | $p$ |
| specific heat capacity | $c_p$ |
| water temperature after heat injection | $T_1$ |
| water temperature before heat injection | $T_2$ |

**Electricity Demand of Devices**

$$E_A = P * T$$

**14,2 kWh/m²**

yearly consumption with

$t$ = 1780 h
$P$ = 8 W/m²

SIA 2024
standartized
numeric values

full load hour $t$

power at full load $P$

**3,9 kWh/m²**

yearly consumption with

$t$ = 1450 h
$P$ = 2,7 W/m²

SIA 2024
standartized
numeric values

**Electricity Demand of Lighting**

$$E_B = P * T$$

full load hour $t$
power at full load $P$

**1,2 kWh/m²**

yearly consumption with

$t$ = 6130 h
$P$ = 1,2 W/m²

SIA 2024
standartized
numeric values

**Electricity Demand of Ventilation**

$$E_L = P * T$$

full load hour $t$
power at full load $P$

# Train Station

Floor -07
to -01

| | |
|---|---|
| **GFA** | 5022 m$^2$ |
| **Outer walls** | 240 m$^2$ |
| **Inner walls** | 640 m$^2$ |

| | | | | |
|---|---|---|---|---|
| **Outer walls** | Concrete panels | 180.0 kgCO$_2$/m$^3$ | | |
| | Glass wool | 12.8 kgCO$_2$/m$^3$ | | |
| | Concrete C30/37 | 288.0 kgCO$_2$/m$^3$ | 672 m$^3$ | 193.536 kgCO$_2$ |
| | Glass pane | 266.1 kgCO$_2$/m$^3$ | | |
| | Window Frame, Wood | 474.1 kgCO$_2$/m$^3$ | | |
| **Inner walls** | Gypsum board | 169.6 kgCO$_2$/m$^3$ | 422 m$^3$ | 71.706 kgCO$_2$ |
| | Concrete, C30/37 | 288.0 kgCO$_2$/m$^3$ | 1209 m$^3$ | 348.364 kgCO$_2$ |
| | Stairs, Concrete C20/25 | 229.0 kgCO$_2$/m$^3$ | 9 m$^3$ | 2.152 kgCO$_2$ |
| | Doors, Wood | -519.0 kgCO$_2$/m$^3$ | 20 m$^3$ | -10.380 kgCO$_2$ |
| **Ceilings** | Concrete C30/37 | 288.0 kgCO$_2$/m$^3$ | 3013 m$^3$ | 867.801 kgCO$_2$ |
| | PVC | 4095.5 kgCO$_2$/m$^3$ | 1 m$^3$ | 3.686 kgCO$_2$ |
| | Mineral wool | 70.4 kgCO$_2$/m$^3$ | 200 m$^3$ | 14.142 kgCO$_2$ |
| | XPS insulation | 96.3 kgCO$_2$/m$^3$ | | |

Emission per Floor 1.491.017 kgCO$_2$

**Total** 10.437.119 kgCO$_2$

| | | | |
|---|---|---|---|
| **Heating** | Floor Heating | | |
| | Water Heating | | |
| **Electricity** | Devices | 28,4 kWh/m$^2$ | 998.373 kWh |
| | Lightning | 7,8 kWh/m$^2$ | 274.201 kWh |
| | Ventilation | 2,4 kWh/m$^2$ | 84.369 kWh |

**Total** 1.356.943 kWh

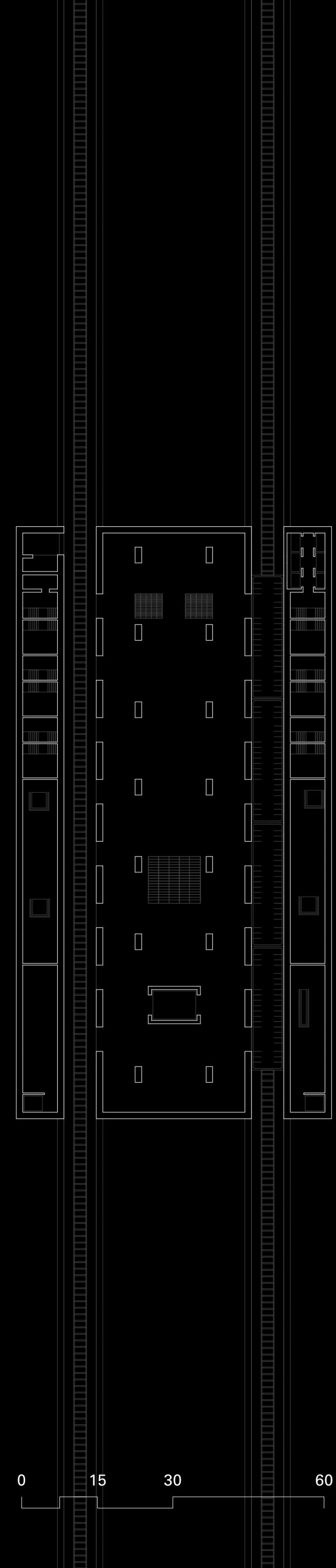



Fig. 40
Atlanpole,
Train Station

# Entrance

Floor 00

**GFA** 6318 m²
**Outer walls**
**Inner walls** 176 m²

| | | | | |
|---|---|---|---|---|
| **Outer walls** | Concrete panels | 180.0 kg$CO_2$/m³ | | |
| | Glass wool | 12.8 kg$CO_2$/m³ | | |
| | Concrete C30/37 | 288.0 kg$CO_2$/m³ | | |
| | Glass pane | 266.1 kg$CO_2$/m³ | | |
| | Window Frame, Wood | 474.1 kg$CO_2$/m³ | | |
| **Inner walls** | Gypsum board | 169.6 kg$CO_2$/m³ | 30 m³ | 5.088 kg$CO_2$ |
| | Concrete, C30/37 | 288.0 kg$CO_2$/m³ | 912 m³ | 262.656 kg$CO_2$ |
| | Stairs, Concrete C20/25 | 229.0 kg$CO_2$/m³ | 3,4 m³ | 778 kg$CO_2$ |
| | Doors, Wood | -519.0 kg$CO_2$/m³ | 2 m³ | -1.038 kg$CO_2$ |
| **Ceilings** | Concrete C30/37 | 288.0 kg$CO_2$/m³ | 2527 m³ | 727.833 kg$CO_2$ |
| | PVC | 4095.5 kg$CO_2$/m³ | | |
| | Mineral wool | 70.4 kg$CO_2$/m³ | 1358 m³ | 95.629 kg$CO_2$ |
| | XPS insulation | 96.3 kg$CO_2$/m³ | 1421 m³ | 136.895 kg$CO_2$ |
| | Concrete panels | 180.0 kg$CO_2$/m³ | 315 m³ | 56.862 kg$CO_2$ |

**Total** 1.284.703 kg$CO_2$

| | | | |
|---|---|---|---|
| **Heating** | Floor Heating | | |
| | Water Heating | | |
| **Electricity** | Devices | | |
| | Lightning | 3,9 kWh/m² | 24.640 kWh |
| | Ventilation | | |

**Total** 24.640 kWh

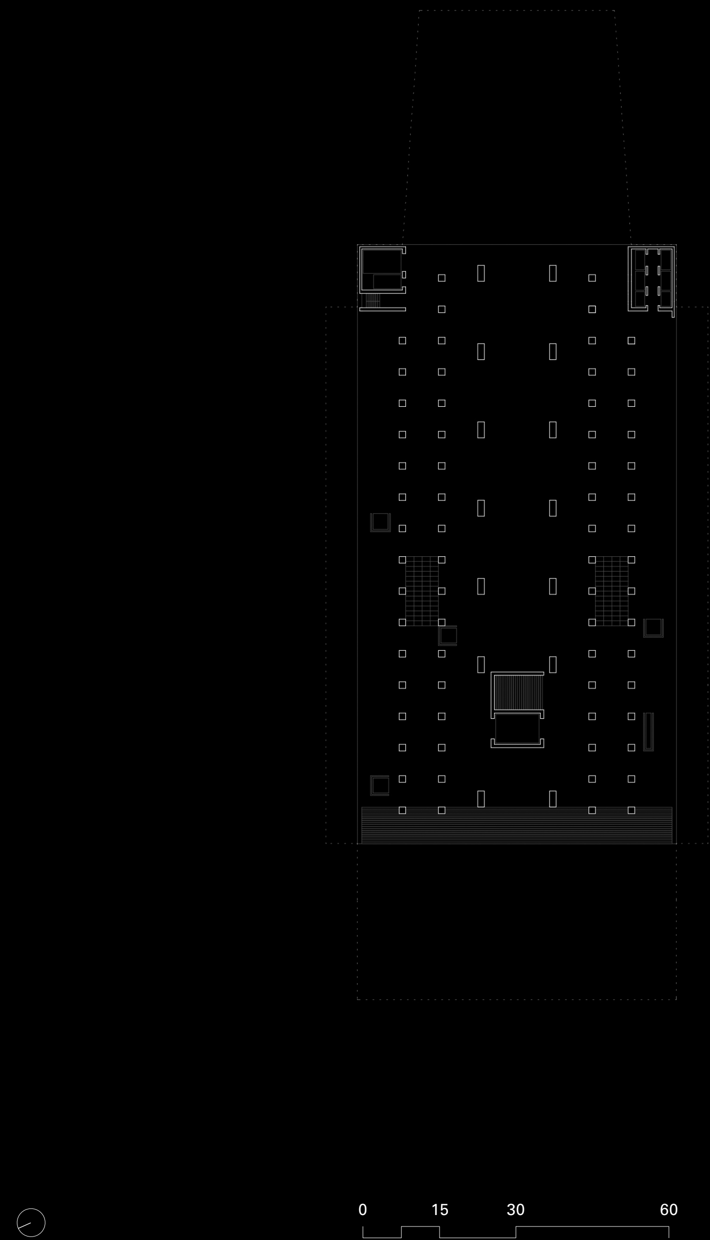



Fig. 41
Atlanpole,
Entrance

# Exhibition

Floor 01
to 09

| | |
|---|---|
| **GFA** | 6318 m$^2$ |
| **Outer walls** | 187 m$^2$ |
| **Inner walls** | 490 m$^2$ |

| | | | | |
|---|---|---|---|---|
| **Outer walls** | Concrete panels | 180.0 kg$CO_2$/m$^3$ | 33 m$^3$ | 6.048 kg$CO_2$ |
| | Glass wool | 12.8 kg$CO_2$/m$^3$ | 210 m$^3$ | 2.688 kg$CO_2$ |
| | Concrete C30/37 | 288.0 kg$CO_2$/m$^3$ | 280 m$^3$ | 80.640 kg$CO_2$ |
| | Glass pane | 266.1 kg$CO_2$/m$^3$ | 8 m$^3$ | 2.128 kg$CO_2$ |
| | Window Frame, Wood | 474.1 kg$CO_2$/m$^3$ | 0,8 m$^3$ | 397 kg$CO_2$ |
| **Inner walls** | Gypsum board | 169.6 kg$CO_2$/m$^3$ | 532 m$^3$ | 90.227 kg$CO_2$ |
| | Concrete, C30/37 | 288.0 kg$CO_2$/m$^3$ | 700 m$^3$ | 201.600 kg$CO_2$ |
| | Stairs, Concrete C20/25 | 229.0 kg$CO_2$/m$^3$ | 8 m$^3$ | 1.969 kg$CO_2$ |
| | Doors, Wood | -519.0 kg$CO_2$/m$^3$ | 14 m$^3$ | -7.266 kg$CO_2$ |
| **Ceilings** | Concrete C30/37 | 288.0 kg$CO_2$/m$^3$ | 2527 m$^3$ | 727.833 kg$CO_2$ |
| | PVC | 4095.5 kg$CO_2$/m$^3$ | 12 m$^3$ | 51.750 kg$CO_2$ |
| | Mineral wool | 70.4 kg$CO_2$/m$^3$ | 252 m$^3$ | 17.791 kg$CO_2$ |
| | XPS insulation | 96.3 kg$CO_2$/m$^3$ | | |

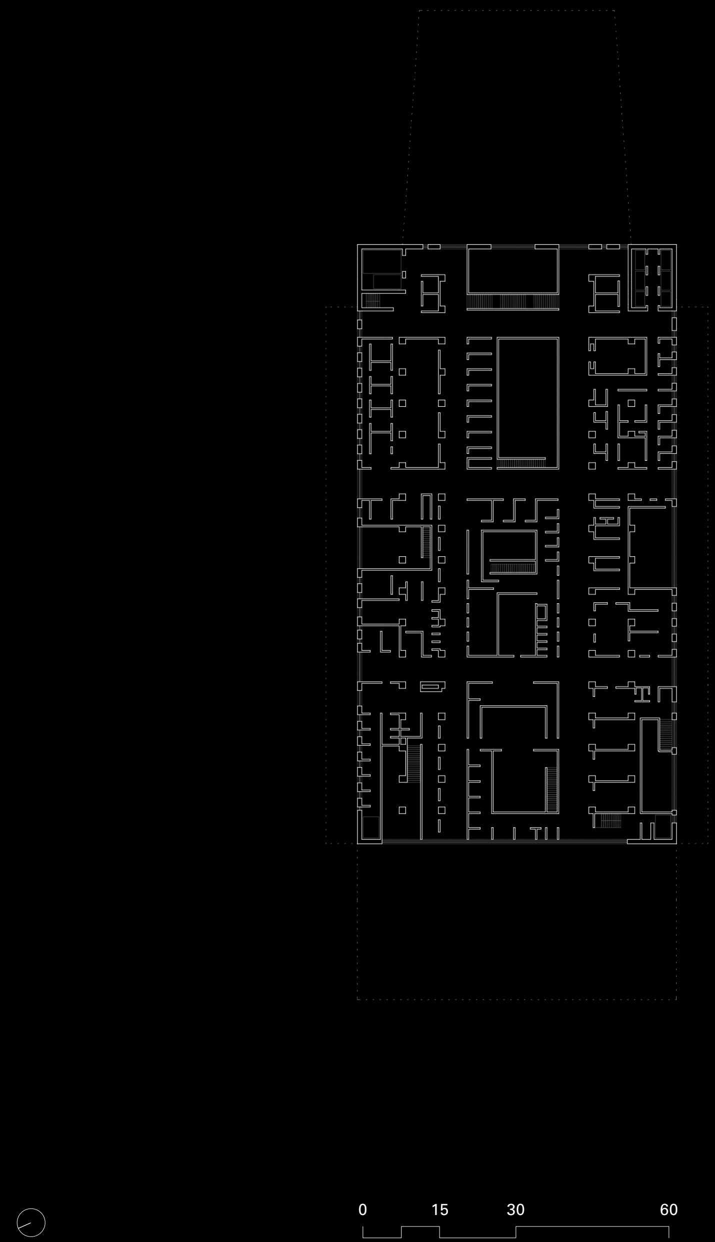
Emission per Floor 1.175.805 kg$CO_2$

**Total** 10.582.245 kg$CO_2$

| | | | |
|---|---|---|---|
| **Heating** | Floor Heating | 50 kWh/m$^2$ | 2.843.100 kWh |
| | Water Heating | 13,5 kWh/m$^2$ | 767.637 kWh |
| **Electricity** | Devices | 14,2 kWh/m$^2$ | 807.440 kWh |
| | Lightning | 3,9 kWh/m$^2$ | 221.761 kWh |
| | Ventilation | 1,2 kWh/m$^2$ | 68.234 kWh |

**Total** 4.708.272 kWh

Fig. 42
Atlanpole,
Exhibition



# Production

10
to 14

| | |
|---|---|
| **GFA** | 6318 $m^2$ |
| **Outer walls** | 214 $m^2$ |
| **Inner walls** | 585 $m^2$ |

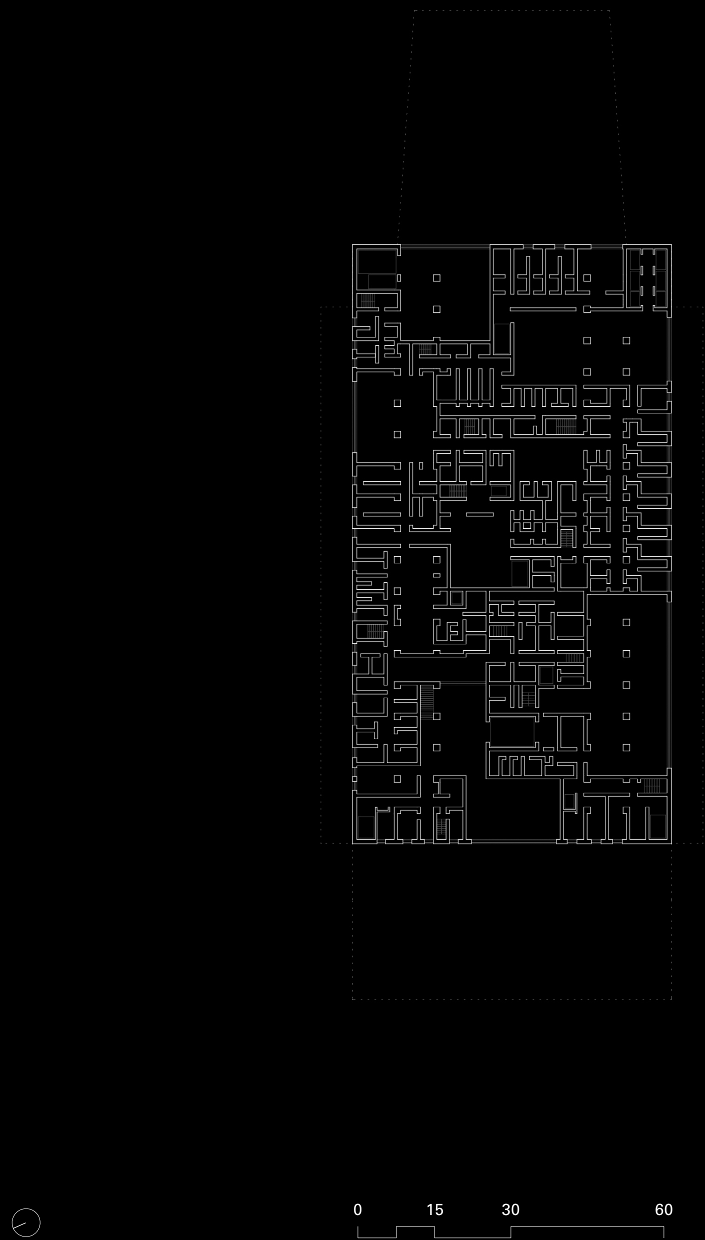
| | | | | |
|---|---|---|---|---|
| **Outer walls** | Concrete panels | 180.0 $kgCO_2/m^3$ | 56 $m^3$ | 10.080 $kgCO_2$ |
| | Glass wool | 12.8 $kgCO_2/m^3$ | 235 $m^3$ | 3.010 $kgCO_2$ |
| | Concrete C30/37 | 288.0 $kgCO_2/m^3$ | 308 $m^3$ | 88.704 $kgCO_2$ |
| | Glass pane | 266.1 $kgCO_2/m^3$ | 7 $m^3$ | 1.862 $kgCO_2$ |
| | Window Frame, Wood | 474.1 $kgCO_2/m^3$ | 0,7 $m^3$ | 331 $kgCO_2$ |
| **Inner walls** | Gypsum board | 169.6 $kgCO_2/m^3$ | 635 $m^3$ | 107.797 $kgCO_2$ |
| | Concrete, C30/37 | 288.0 $kgCO_2/m^3$ | 820 $m^3$ | 236.275 $kgCO_2$ |
| | Stairs, Concrete C20/25 | 229.0 $kgCO_2/m^3$ | 11 $m^3$ | 2.564 $kgCO_2$ |
| | Doors, Wood | -519.0 $kgCO_2/m^3$ | 18 $m^3$ | -9.342 $kgCO_2$ |
| **Ceilings** | Concrete C30/37 | 288.0 $kgCO_2/m^3$ | 2527 $m^3$ | 727.833 $kgCO_2$ |
| | PVC | 4095.5 $kgCO_2/m^3$ | 12 $m^3$ | 51.750 $kgCO_2$ |
| | Mineral wool | 70.4 $kgCO_2/m^3$ | 252 $m^3$ | 17.791 $kgCO_2$ |
| | XPS insulation | 96.3 $kgCO_2/m^3$ | | |

| | |
|---|---|
| Emission per Floor | 1.238.655 $kgCO_2$ |
| **Total** | 6.193.275 $kgCO_2$ |

| | | | |
|---|---|---|---|
| **Heating** | Floor Heating | 50 $kWh/m^2$ | 1.579.500 kWh |
| | Water Heating | 13,5 $kWh/m^2$ | 426.465 kWh |
| **Electricity** | Devices | 14,2 $kWh/m^2$ | 448.578 kWh |
| | Lightning | 3,9 $kWh/m^2$ | 123.201 kWh |
| | Ventilation | 1,2 $kWh/m^2$ | 37.908 kWh |

| | |
|---|---|
| **Total** | 2.615.652 kWh |

Fig. 43
Atlanpole,
Production



# Hotel

Floor 15
to 24

| | |
|---|---|
| **GFA** | 6318 $m^2$ |
| **Outer walls** | 234 $m^2$ |
| **Inner walls** | 563 $m^2$ |

| | | | | |
|---|---|---|---|---|
| **Outer walls** | Concrete panels | 180.0 $kgCO_2/m^3$ | 58 $m^3$ | 10.584 $kgCO_2$ |
| | Glass wool | 12.8 $kgCO_2/m^3$ | 260 $m^3$ | 3.333 $kgCO_2$ |
| | Concrete C30/37 | 288.0 $kgCO_2/m^3$ | 336 $m^3$ | 209.664 $kgCO_2$ |
| | Glass pane | 266.1 $kgCO_2/m^3$ | 16 $m^3$ | 4.257 $kgCO_2$ |
| | Window Frame, Wood | 474.1 $kgCO_2/m^3$ | 1,6 $m^3$ | 758 $kgCO_2$ |
| **Inner walls** | Gypsum board | 169.6 $kgCO_2/m^3$ | 680 $m^3$ | 115.395 $kgCO_2$ |
| | Concrete, C30/37 | 288.0 $kgCO_2/m^3$ | 728 $m^3$ | 96.768 $kgCO_2$ |
| | Stairs, Concrete C20/25 | 229.0 $kgCO_2/m^3$ | 6,4 $m^3$ | 1.465 $kgCO_2$ |
| | Doors, Wood | -519.0 $kgCO_2/m^3$ | 44 $m^3$ | -22.836 $kgCO_2$ |
| **Ceilings** | Concrete C30/37 | 288.0 $kgCO_2/m^3$ | 2527 $m^3$ | 727.833 $kgCO_2$ |
| | PVC | 4095.5 $kgCO_2/m^3$ | 12 $m^3$ | 51.750 $kgCO_2$ |
| | Mineral wool | 70.4 $kgCO_2/m^3$ | 252 $m^3$ | 17.791 $kgCO_2$ |
| | XPS insulation | 96.3 $kgCO_2/m^3$ | | |

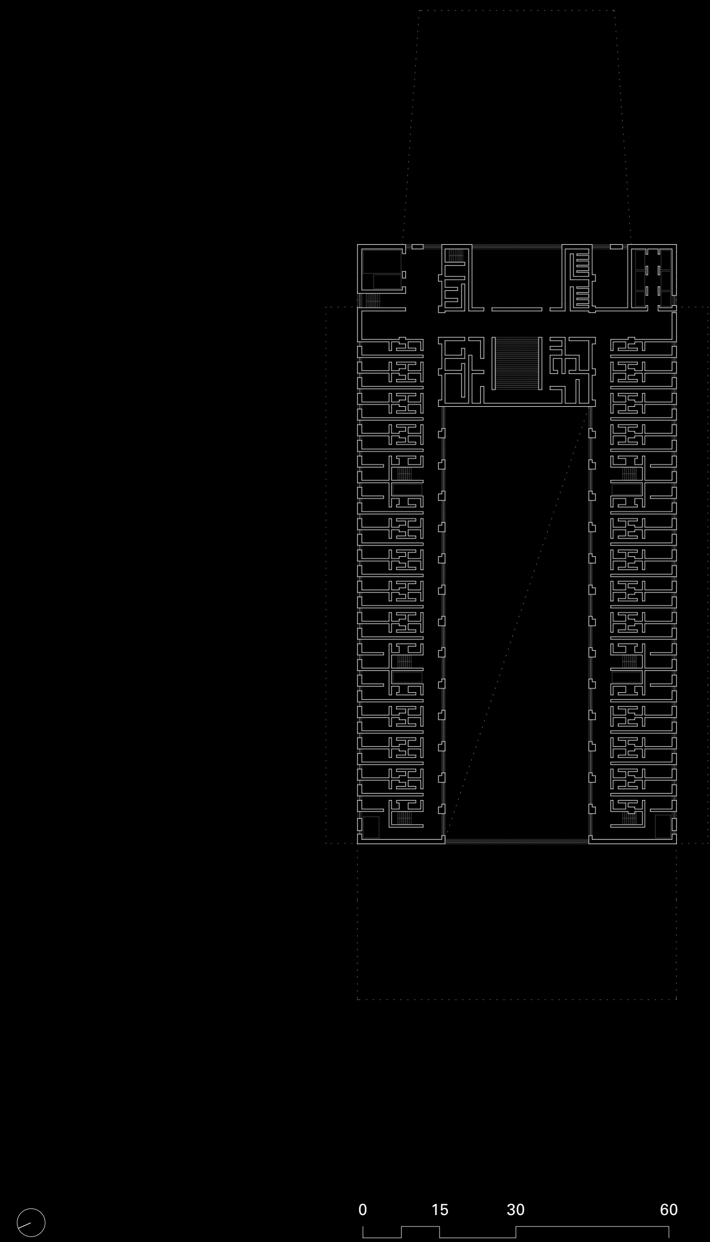
Emission per Floor 1.216.762 $kgCO_2$

**Total** 12.167.620 $kgCO_2$

| | | | |
|---|---|---|---|
| **Heating** | Floor Heating | 50 $kWh/m^2$ | 3.159.000 kWh |
| | Water Heating | 13,5 $kWh/m^2$ | 852.930 kWh |
| **Electricity** | Devices | 14,2 $kWh/m^2$ | 897.156 kWh |
| | Lightning | 3,9 $kWh/m^2$ | 246.402 kWh |
| | Ventilation | 1,2 $kWh/m^2$ | 75.816 kWh |

**Total** 5.231.304 kWh

Fig. 44
Atlanpole,
Hotel



# Education

Floor 25
to 30

**GFA** 7316 $m^2$
**Outer walls** 345 $m^2$
**Inner walls** 532 $m^2$

| | | | | |
|---|---|---|---|---|
| **Outer walls** | Concrete panels | 180.0 $kgCO_2/m^3$ | 89 $m^3$ | 16.128 $kgCO_2$ |
| | Glass wool | 12.8 $kgCO_2/m^3$ | 394 $m^3$ | 5.053 $kgCO_2$ |
| | Concrete C30/37 | 288.0 $kgCO_2/m^3$ | 481 $m^3$ | 138.700 $kgCO_2$ |
| | Glass pane | 266.1 $kgCO_2/m^3$ | 68 $m^3$ | 18.094 $kgCO_2$ |
| | Window Frame, Wood | 474.1 $kgCO_2/m^3$ | 6,8 $m^3$ | 3.223 $kgCO_2$ |
| **Inner walls** | Gypsum board | 169.6 $kgCO_2/m^3$ | 490 $m^3$ | 83.104 $kgCO_2$ |
| | Concrete, C30/37 | 288.0 $kgCO_2/m^3$ | 879 $m^3$ | 253.209 $kgCO_2$ |
| | Stairs, Concrete C20/25 | 229.0 $kgCO_2/m^3$ | 6 $m^3$ | 1.465 $kgCO_2$ |
| | Doors, Wood | -519.0 $kgCO_2/m^3$ | 18 $m^3$ | -9.342 $kgCO_2$ |
| **Ceilings** | Concrete C30/37 | 288.0 $kgCO_2/m^3$ | 2926 $m^3$ | 842.803 $kgCO_2$ |
| | PVC | 4095.5 $kgCO_2/m^3$ | 14 $m^3$ | 59.925 $kgCO_2$ |
| | Mineral wool | 70.4 $kgCO_2/m^3$ | 292 $m^3$ | 20.601 $kgCO_2$ |
| | XPS insulation | 96.3 $kgCO_2/m^3$ | | |

Emission per Floor 1.432.954 $kgCO_2$

**Total** 8.597.724 $kgCO_2$

| | | | |
|---|---|---|---|
| **Heating** | Floor Heating | 50 $kWh/m^2$ | 1.829.000 kWh |
| | Water Heating | 13,5 $kWh/m^2$ | 493.830 kWh |
| **Electricity** | Devices | 14,2 $kWh/m^2$ | 519.436 kWh |
| | Lightning | 3,9 $kWh/m^2$ | 142.662 kWh |
| | Ventilation | 1,2 $kWh/m^2$ | 43.896 kWh |

**Total** 3.028.824 kWh

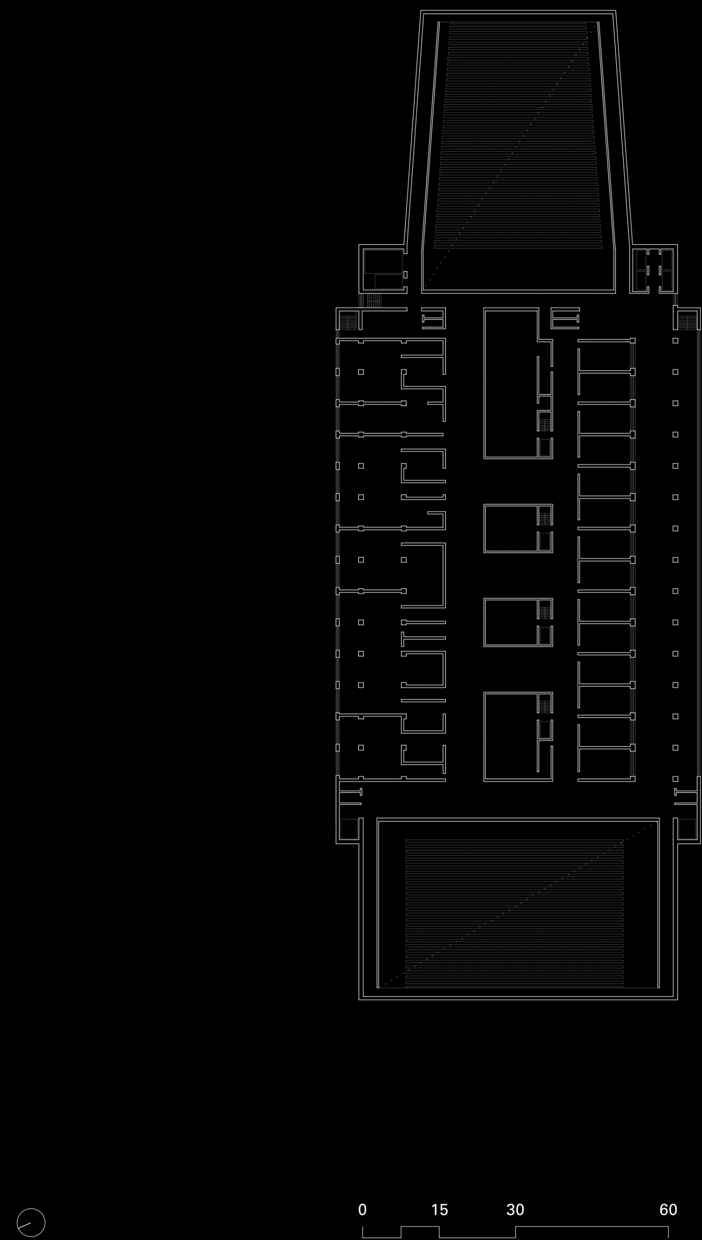



Fig. 45
Atlanpole,
Education

# Sports

Floor 31

| | |
|---|---|
| **GFA** | 9163 $m^2$ |
| **Outer walls** | 237 $m^2$ |
| **Inner walls** | 437 $m^2$ |

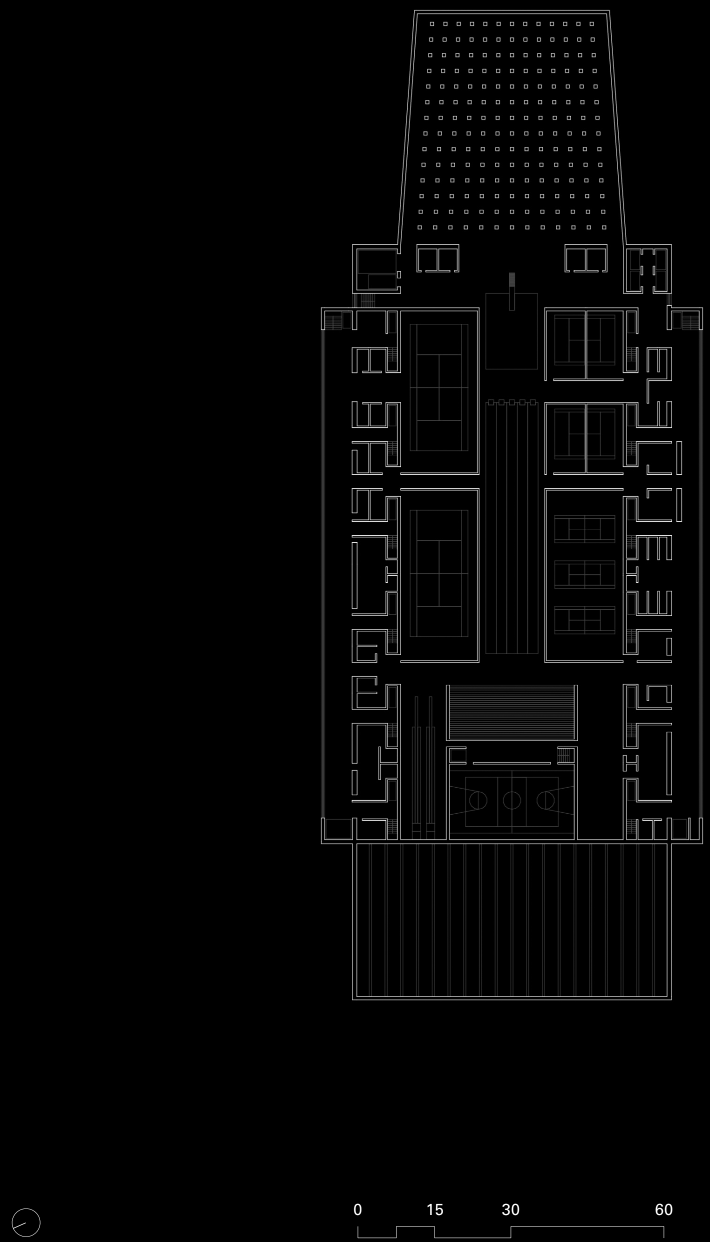
| | | | | |
|---|---|---|---|---|
| **Outer walls** | Concrete panels | 180.0 $kgCO_2/m^3$ | 61 $m^3$ | 11.088 $kgCO_2$ |
| | Glass wool | 12.8 $kgCO_2/m^3$ | 288 $m^3$ | 3.691 $kgCO_2$ |
| | Concrete C30/37 | 288.0 $kgCO_2/m^3$ | 313 $m^3$ | 90.316 $kgCO_2$ |
| | Glass pane | 266.1 $kgCO_2/m^3$ | 74 $m^3$ | 19.691 $kgCO_2$ |
| | Window Frame, Wood | 474.1 $kgCO_2/m^3$ | 7,4 $m^3$ | 3.508 $kgCO_2$ |
| **Inner walls** | Gypsum board | 169.6 $kgCO_2/m^3$ | 445 $m^3$ | 75.505 $kgCO_2$ |
| | Concrete, C30/37 | 288.0 $kgCO_2/m^3$ | 680 $m^3$ | 195.955 $kgCO_2$ |
| | Stairs, Concrete C20/25 | 229.0 $kgCO_2/m^3$ | 39 $m^3$ | 8.976 $kgCO_2$ |
| | Doors, Wood | -519.0 $kgCO_2/m^3$ | 28 $m^3$ | -14.532 $kgCO_2$ |
| **Ceilings** | Concrete C30/37 | 288.0 $kgCO_2/m^3$ | 3665 $m^3$ | 1.055.577 $kgCO_2$ |
| | PVC | 4095.5 $kgCO_2/m^3$ | 5 $m^3$ | 22.975 $kgCO_2$ |
| | Mineral wool | 70.4 $kgCO_2/m^3$ | 366 $m^3$ | 25.803 $kgCO_2$ |
| | XPS insulation | 96.3 $kgCO_2/m^3$ | | |

**Total** 1.498.553 $kgCO_2$

| | | | |
|---|---|---|---|
| **Heating** | Floor Heating | 50 $kWh/m^2$ | 458.150 kWh |
| | Water Heating | 13,5 $kWh/m^2$ | 123.700 kWh |
| **Electricity** | Devices | 14,2 $kWh/m^2$ | 130.114 kWh |
| | Lightning | 3,9 $kWh/m^2$ | 35.735 kWh |
| | Ventilation | 1,2 $kWh/m^2$ | 10.995 kWh |

**Total** 758.694 kWh

Fig. 46
Atlanpole,
Sports



# Rooftop

Floor 32

| | |
|---|---|
| **GFA** | 10730 $m^2$ |
| **Outer walls** | 162 $m^2$ |
| **Inner walls** | 150 $m^2$ |

| | | | | |
|---|---|---|---|---|
| **Outer walls** | Concrete panels | 180.0 $kgCO_2/m^3$ | 56 $m^3$ | 10.080 $kgCO_2$ |
| | Glass wool | 12.8 $kgCO_2/m^3$ | 179 $m^3$ | 2.293 $kgCO_2$ |
| | Concrete C30/37 | 288.0 $kgCO_2/m^3$ | 218 $m^3$ | 62.899 $kgCO_2$ |
| | Glass pane | 266.1 $kgCO_2/m^3$ | | |
| | Window Frame, Wood | 474.1 $kgCO_2/m^3$ | | |
| **Inner walls** | Gypsum board | 169.6 $kgCO_2/m^3$ | 95 $m^3$ | 16.145 $kgCO_2$ |
| | Concrete, C30/37 | 288.0 $kgCO_2/m^3$ | 285 $m^3$ | 82.252 $kgCO_2$ |
| | Stairs, Concrete C20/25 | 229.0 $kgCO_2/m^3$ | 4 $m^3$ | 1.007 $kgCO_2$ |
| | Doors, Wood | -519.0 $kgCO_2/m^3$ | 6 $m^3$ | -3.114 $kgCO_2$ |
| **Ceilings** | Concrete C30/37 | 288.0 $kgCO_2/m^3$ | 4292 $m^3$ | 1.236.096 $kgCO_2$ |
| | PVC | 4095.5 $kgCO_2/m^3$ | 4 $m^3$ | 16.259 $kgCO_2$ |
| | Mineral wool | 70.4 $kgCO_2/m^3$ | 429 $m^3$ | 30.215 $kgCO_2$ |
| | XPS insulation | 96.3 $kgCO_2/m^3$ | 2414 $m^3$ | 232.492 $kgCO_2$ |

**Total** 1.686.624 $kgCO_2$

| | | | |
|---|---|---|---|
| **Heating** | Floor Heating | | |
| | Water Heating | | |
| **Electricity** | Devices | 3,5 $kWh/m^2$ | 37.555 kWh |
| | Lightning | 1 $kWh/m^2$ | 10.730 kWh |
| | Ventilation | | |

**Total** 48.285 kWh

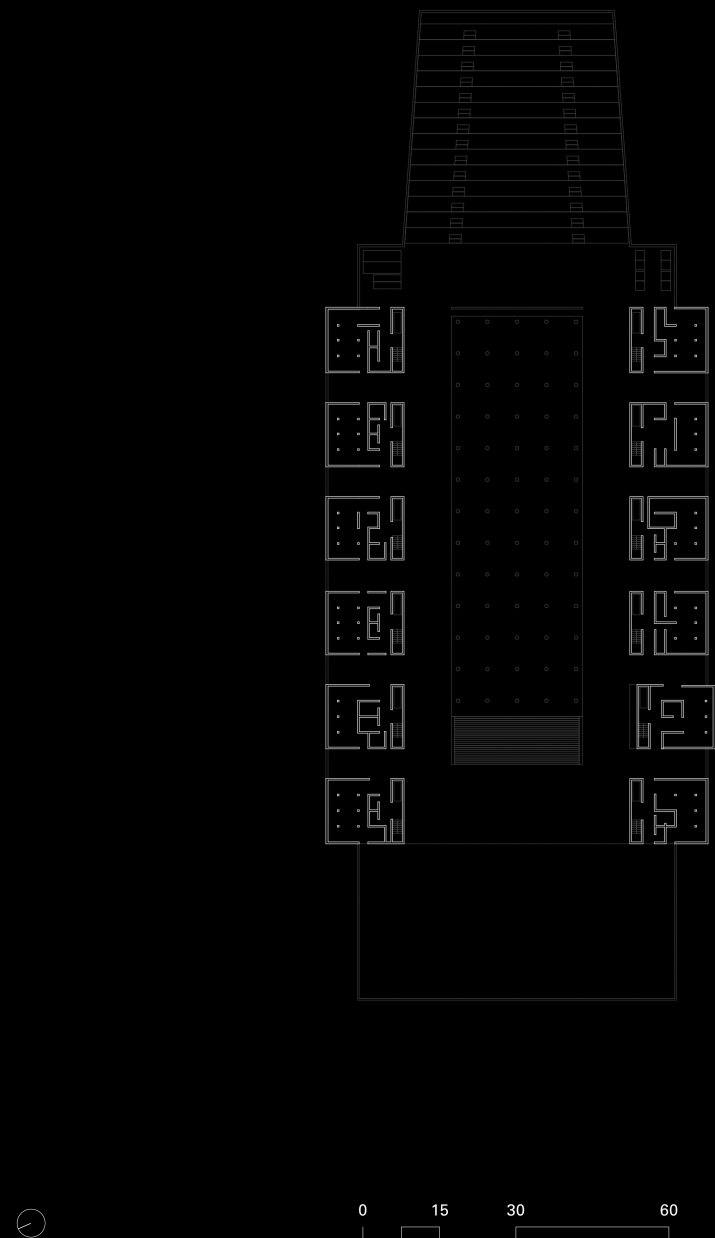



Fig. 47
Atlanpole,
Rooftop

# Housing

Floor 33
to 46

| | |
|---|---|
| **GFA** | 2028 $m^2$ |
| **Outer walls** | 162 $m^2$ |
| **Inner walls** | 210 $m^2$ |

| | | | | |
|---|---|---|---|---|
| **Outer walls** | Concrete panels | 180.0 $kgCO_2/m^3$ | 22 $m^3$ | 4.032 $kgCO_2$ |
| | Glass wool | 12.8 $kgCO_2/m^3$ | 190 $m^3$ | 2.437 $kgCO_2$ |
| | Concrete C30/37 | 288.0 $kgCO_2/m^3$ | 240 $m^3$ | 69.350 $kgCO_2$ |
| | Glass pane | 266.1 $kgCO_2/m^3$ | 14 $m^3$ | 3.725 $kgCO_2$ |
| | Window Frame, Wood | 474.1 $kgCO_2/m^3$ | 1 $m^3$ | 663 $kgCO_2$ |
| **Inner walls** | Gypsum board | 169.6 $kgCO_2/m^3$ | 190 $m^3$ | 32.291 $kgCO_2$ |
| | Concrete, C30/37 | 288.0 $kgCO_2/m^3$ | 364 $m^3$ | 104.832 $kgCO_2$ |
| | Stairs, Concrete C20/25 | 229.0 $kgCO_2/m^3$ | 2 $m^3$ | 549 $kgCO_2$ |
| | Doors, Wood | -519.0 $kgCO_2/m^3$ | 16 $m^3$ | -8.304 $kgCO_2$ |
| **Ceilings** | Concrete C30/37 | 288.0 $kgCO_2/m^3$ | 37 $m^3$ | 116.812 $kgCO_2$ |
| | PVC | 4095.5 $kgCO_2/m^3$ | 2 $m^3$ | 9.829 $kgCO_2$ |
| | Mineral wool | 70.4 $kgCO_2/m^3$ | 81 $m^3$ | 5.710 $kgCO_2$ |
| | XPS insulation | 96.3 $kgCO_2/m^3$ | 35 $m^3$ | 3384 $kgCO_2$ |

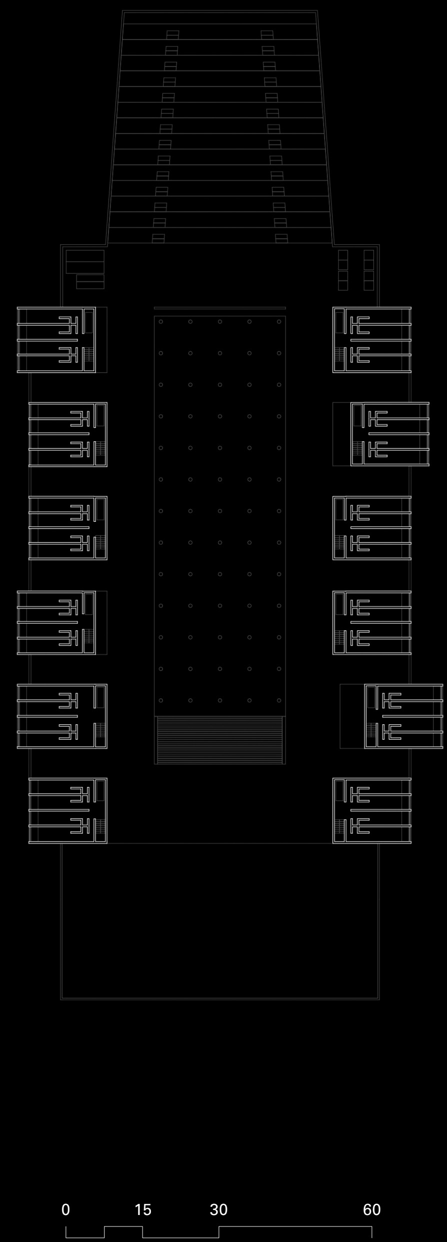
Emission per Floor 345.310 $kgCO_2$

**Total** 4.834.340 $kgCO_2$

| | | | |
|---|---|---|---|
| **Heating** | Floor Heating | 90 $kWh/m^2$ | 2.555.280 kWh |
| | Water Heating | 13,5 $kWh/m^2$ | 383.292 kWh |
| **Electricity** | Devices | 14,2 $kWh/m^2$ | 403.166 kWh |
| | Lightning | 3,9 $kWh/m^2$ | 110.728 kWh |
| | Ventilation | 1,2 $kWh/m^2$ | 34.070 kWh |

**Total** 3.486.536 kWh

Fig. 48
Atlanpole,
Housing



| | | |
|---|---|---|
| **Space** | public | 8.352m² |
| | common | 9.786m² |
| | private | 267.147m² |
| | heated | 233.082m² |
| | **total** | **285.285m²** |
| **Energy** | heating energy demand | 12.542.898 kWh |
| | domestic hot water heating demand | 3.401.464 kWh |
| | electrical demand for devices | 3.614.055 kWh |
| | electrical demand for lightning | 1.275.549 kWh |
| | electrical demand for ventilation | 425.183 kWh |
| | **total** | **21.259.150 kWh** |
| **Emissions** | **concrete panels** | 630.104 $kgCO_2$ |
| | **glass wool** | 114.564 $kgCO_2$ |
| | **concrete C30/37** | 50.981.160 $kgCO_2$ |
| | **glass pane** | 859.233 $kgCO_2$ |
| | **window frame, wood** | 120.292 $kgCO_2$ |
| | **gypsum board** | 2.157.462 $kgCO_2$ |
| | **stairs, concrete C20/25** | 343.693 $kgCO_2$ |
| | **doors, wood** | -134.199 $kgCO_2$ |
| | **PVC** | 1.202.926 $kgCO_2$ |
| | **mineral wool** | 642.712 $kgCO_2$ |
| | **XPS insulation** | 563.256 $kgCO_2$ |
| | **total** | **57.282.203 $kgCO_2$** |
| **Capita** | inhabitants | 624 |
| | users | 2633 |
| | usage density | 11416 U/km² |
| | **total** | **3257** |
| **distribution** | energy / capita | 6527 kWh |
| | emissions / capita | 17.587 $kgCO_2$ |

As the ecologic choice of construction material has not been a factor back then, the estimated emission of 57 millon kilograms of $CO_2$ to build the compact city would be unacceptable today. The Loire region, an area that is rich in biomass construction material, can provide regional products to balance the massive footprint due to it's outdated construction. As a consequence, a carbon neutral construction will be the ecological condition for the feasability of Atlanpole in 2023.

0 15 30 60

The estimated energy consumption of the compact city is listed at 21 million kWh, a suprisingly high value. This results out of the architectural composition of a "thermally seperated" neighbourhood, where every square meter of it is constantly heated and illuminated. The inefficient conception of heated floor areas in the building is causing an energy consumption that by todays standards is rated between D and E (very poor).
A high percentage of circulation area and large, hall-like spaces with low usage frequency require unnecessarily much heating. The architectural design creates building depths of at least 60 Meters; envisioned with average ceiling heights of less than three meters, the physical value of these rooms is unfortunately only limited. Their quality and adaptability will define its endurance and ultimately its probability as a realistic and useful typology.

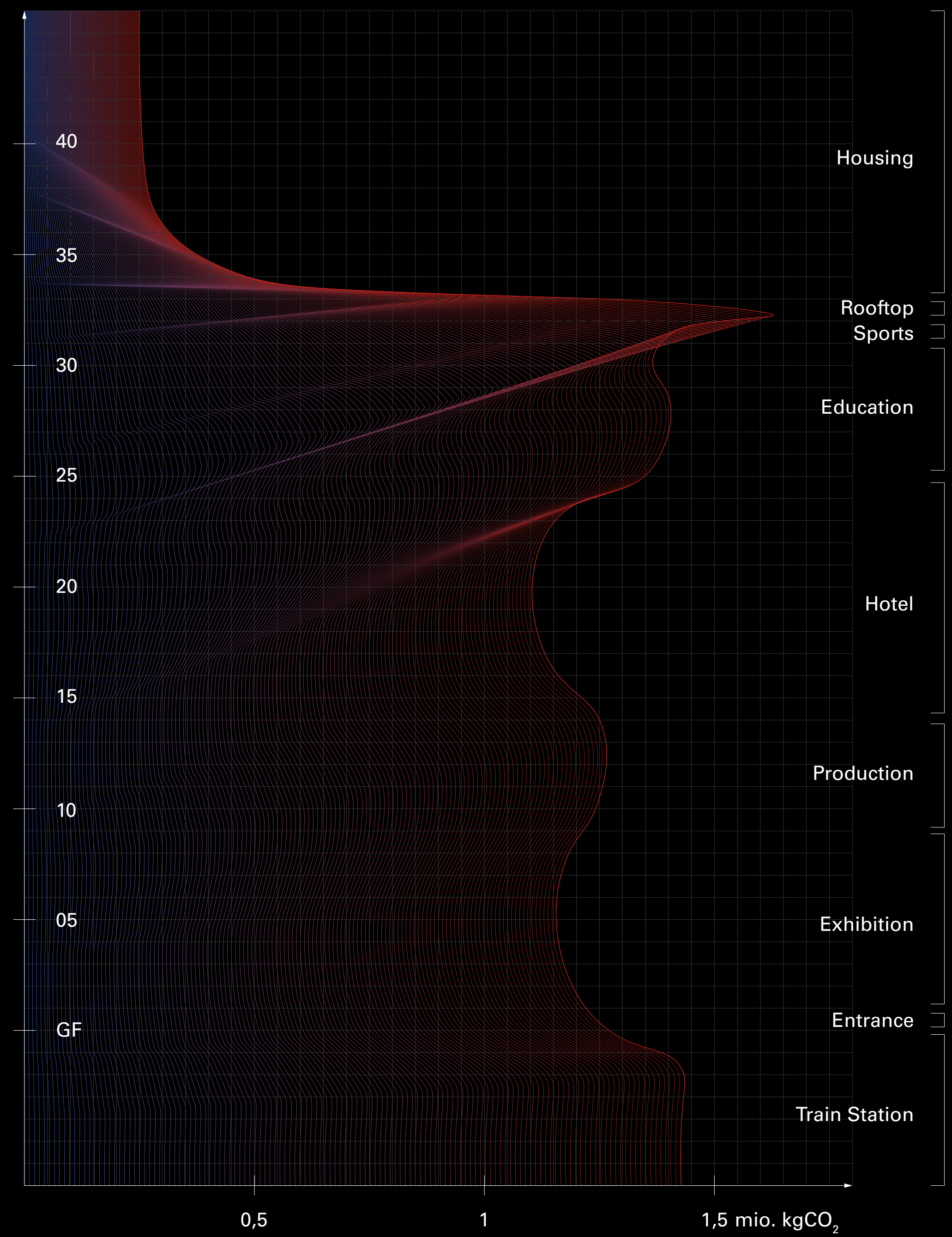



Fig. 49
Atlanpole,
Emission per Floor

The Competition has never been realized due to unexpected budget cuts.[10] Atlanpole still exists as an association of various technology companies and has realized some production factories, laboratories, and research institutes (among others) on the site of La Chantrerie over the years. However, this happened gradually and was not based on the design of a master plan for the area. 85% of the land remains undeveloped and La Chantrerie became a popular weekend getaway for people from the city.

Fig. 50
La Chantrerie, 2023

[10] cf. Jean-Philippe Lucas, "L'urbanisme du futur", Revue Plein ouest n° 44, 1988 (32)

La Chantrerie

Nantes

**Rezé /**
l'héritage

Fig. 51
Nantes,
2023

La Chantrerie

Nantes

**Île de Nantes /** transformations

Fig. 52
Nantes, 2023

La Chantrerie

Nantes

**Centre Ville /**
le noyau

Fig. 53
Nantes,
2023

La Chantrerie

Nantes

**France /**
la société divisée

Fig. 54
Nantes,
2023

La Chantrerie

Nantes

**L'Erdre /**
la vie pittoresque

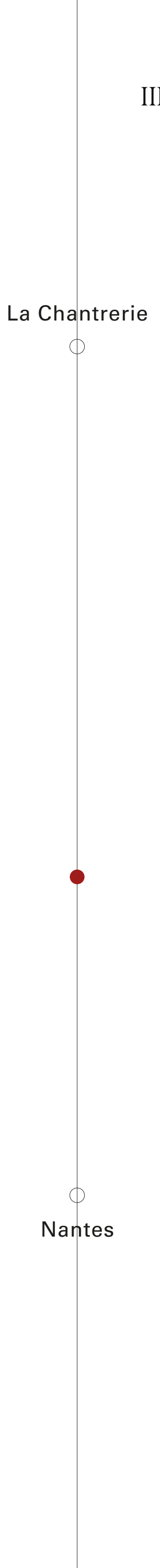
Fig. 55
Nantes,
2023

La Chantrerie

Nantes

**Le Rocher d'Enfer /**
l'imperméabilisation


Fig. 56
Nantes,
2023




**La Beaujoire /**
paysages urbains

Fig. 57
Nantes,
2023

La Chantrerie

Nantes

**St. Joseph de Porterie /**
au bord de l'eau, dans l'eau

Fig. 58
Nantes,
2023

La Chantrerie

Nantes

**Nantes sur l'Erdre /**
zones marécageuses

Fig. 59
Nantes,
2023

La Chantrerie

Nantes

**Cotalard /**
Vert

Fig. 60
Nantes,
2023

La Chantrerie

Nantes

**La Chantrerie /**
Le site

Fig. 61
Nantes,
2023

La Chantrerie

Nantes

**La Chantrerie /**
Le site

Fig. 62
Nantes,
2023

La Chantrerie

Nantes

**La Chantrerie /**
Le site

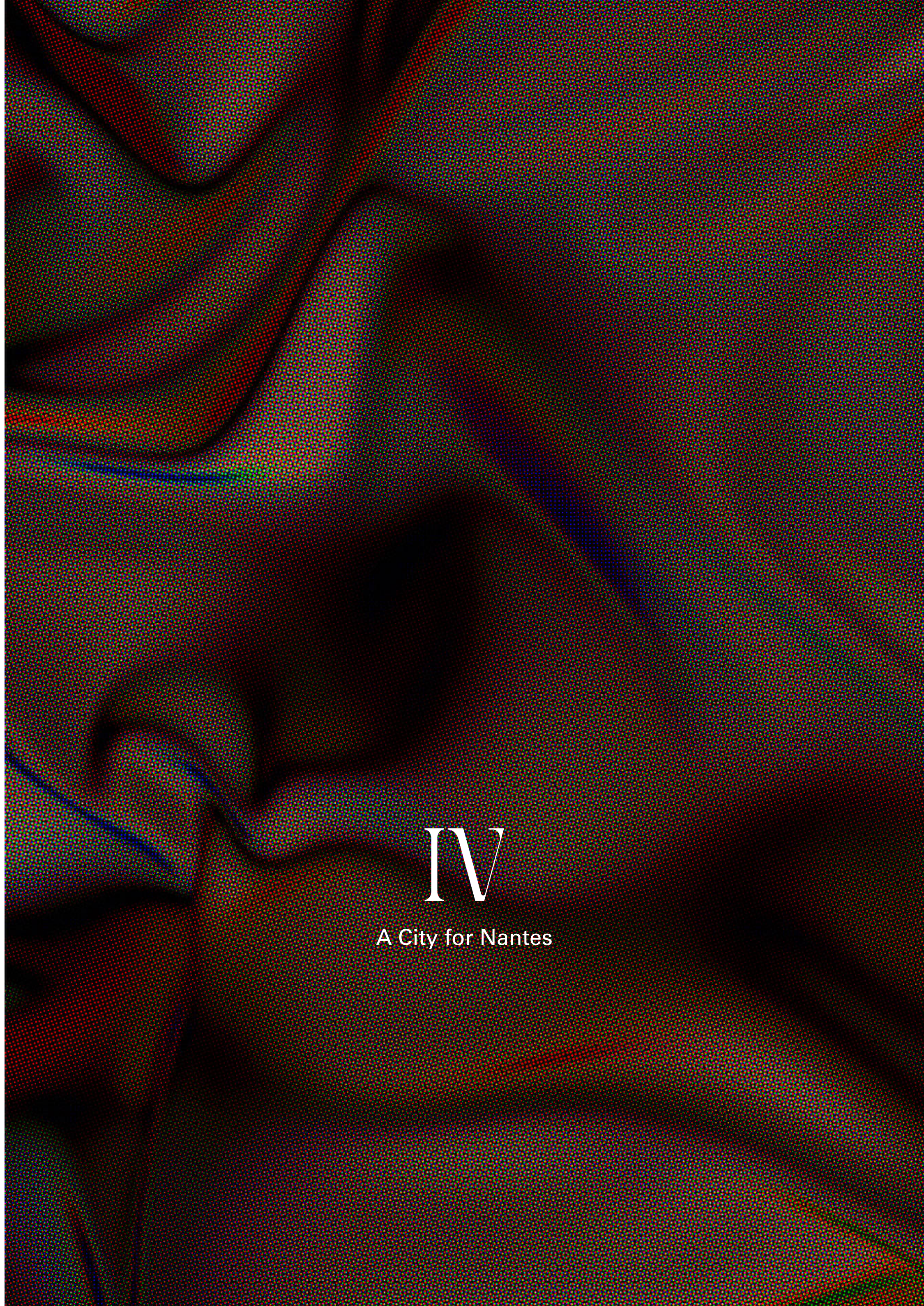
Fig. 63
Nantes,
2023

La Chantrerie

Nantes

**La Chantrerie /**
Le site

Fig. 64
Nantes,
2023



# IV

## A City for Nantes

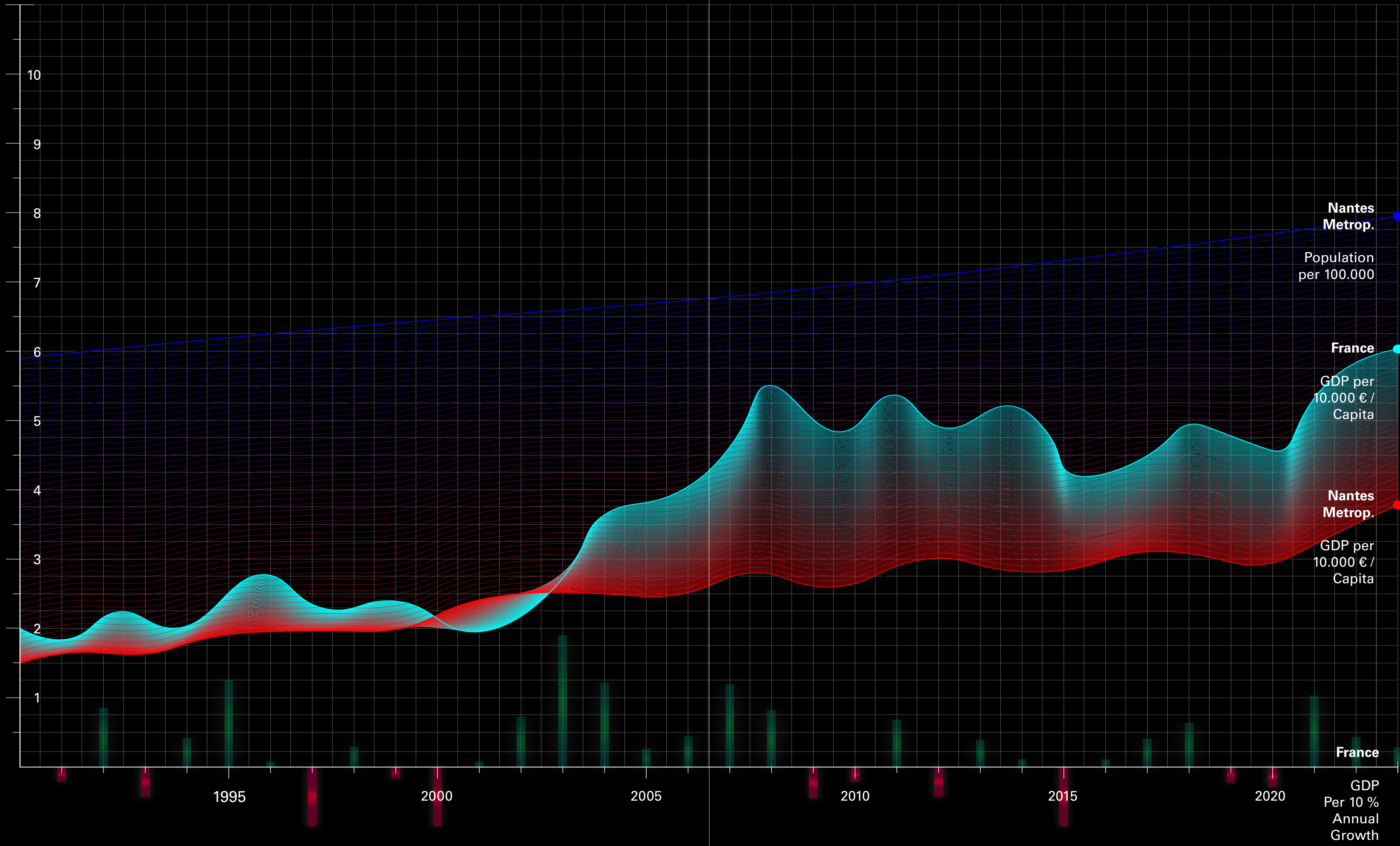



Fig. 65
Economics and Population,
Nantes and France


Nantes population continuously grows, as well as its economy. The steady population increase is a major challenge for Nantes in the coming decades; as the first French city to turn away from a car-based City Development in the nineties, it has been awarded the European green capital in 2013 and since then is an ecological flagship of the country. In 2019, a strict plan for sustainable urban growth has been developed and enacted governmentally. Six thousand new housing units are earmarked per year with a renaturation of urbanized areas within green spaces by 50% in the metropolitan area of Nantes.[11] The upcoming urban growth will implement the Aim of the new housing units, but from 2030 urban growth in Nantes will be executed without the loss of inner-city green spaces. The advancement of sustainable and alternative mobility is defining the composition of the city since more than three decades and further developing it will be a key factor for the future goals of Nantes.

[11] cf. Majors of Europe, "NANTES ADOPTS GREENER URBAN DEVELOPMENT RULES", Majors of Europe, (2023) https://mayorsofeurope.eu/news/nantes-adopts-greener-urban-development-rules/

Fig. 66
Pont Haudaudine,
Nantes, 2021

The governmental requirements for urban growth meet exactly the promises of Hans Kollhoff's multi-functional high rise. The biggest strength of the compact city - the small physical footprint - allows to create a novel neighborhood without the loss of valuable Land. An approximation of ninety-six percent of the grounds surface that will be saved from soil sealing will have both economic and ecologic benefits, as land prices in metropolitan areas all over France rapidly increase. Given that Nantes is regenerating soil sealed areas, there is less Interest in horizontal layouts of flat neighborhoods.

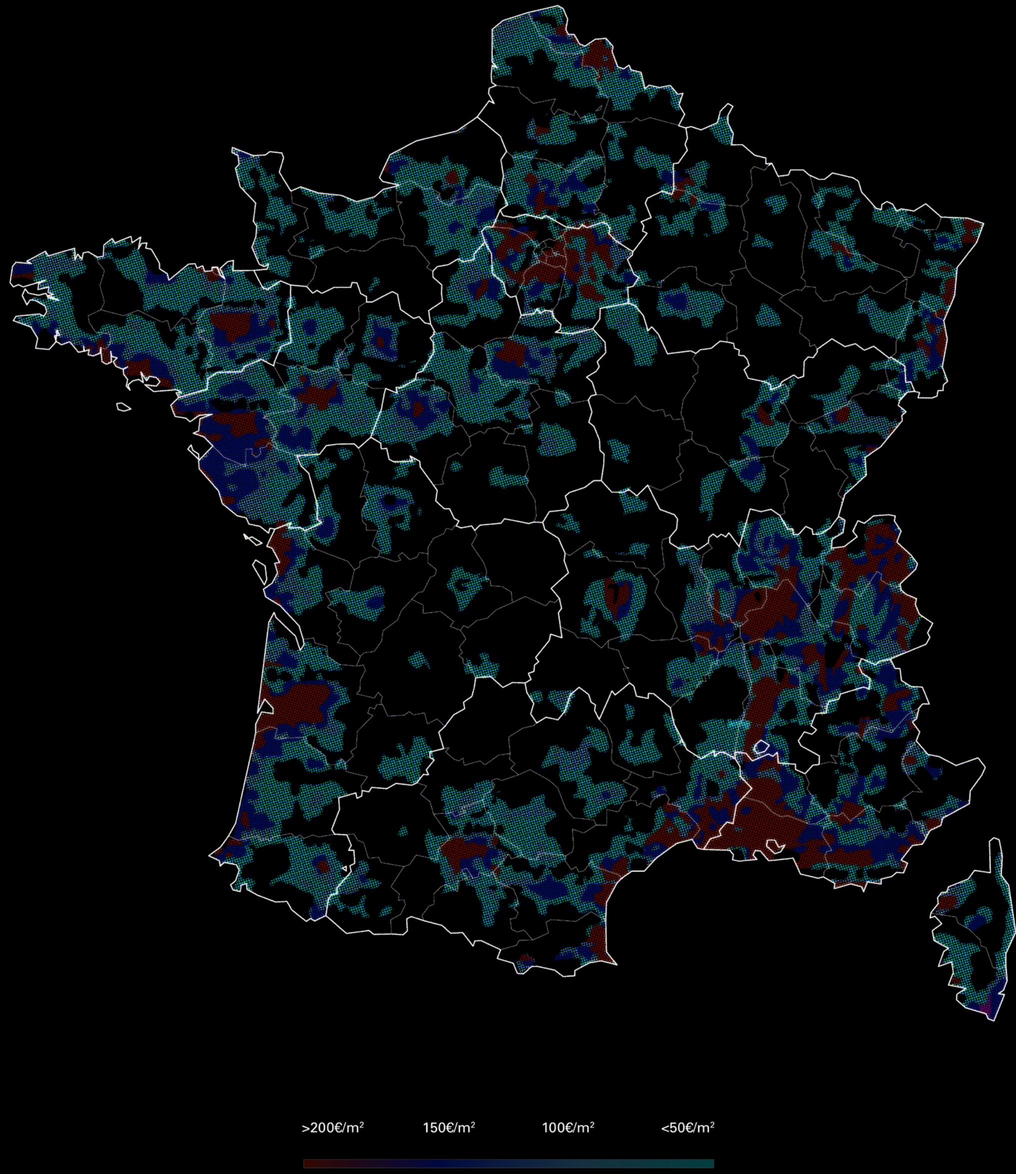



Fig. 67
Land Prices
in France, 2022 [12]

[12] cf. Kim Antunez, "Prix des terrains: une question de localisation ", commissariat général au développement durable, 2017 (14)

# URBAN DEVELOPMENT PLAN
# NANTES *2020 - 2050*

**6000** new housing units per year

**renaturation** of urbanized areas **by 50%**

urban expansion from **2030** without the loss of **inner-city green spaces**

the **advancement** of sustainable and **alternative mobility**

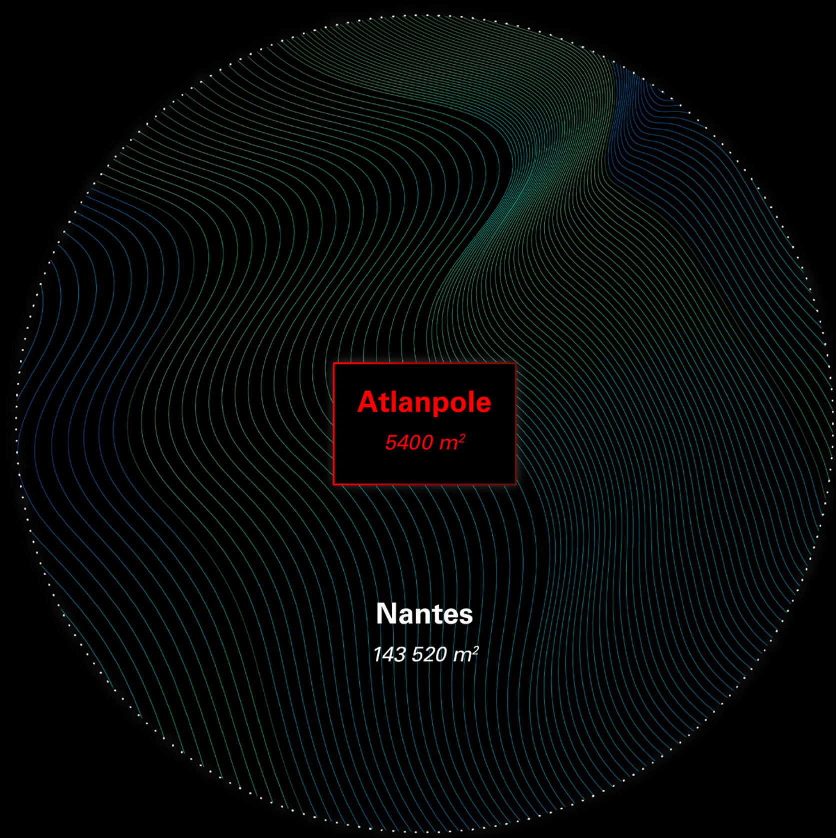



Fig. 68
Ground Surface Area
for 624 Inhabitants

La Chantrerie is located 5km from the Île de Nantes and still appears to be a possible site for the compact city. 152 housing units for the open market and 350 social housing apartments are planned for the following year. The circumstances of a serious demand for housing units together with Nantes' urban development regulations will underline the feasibility of the compact city to become a realistic project. The multifunctional program is therefore the potential for the typology and will manifest the progression in social urbanistic thinking.

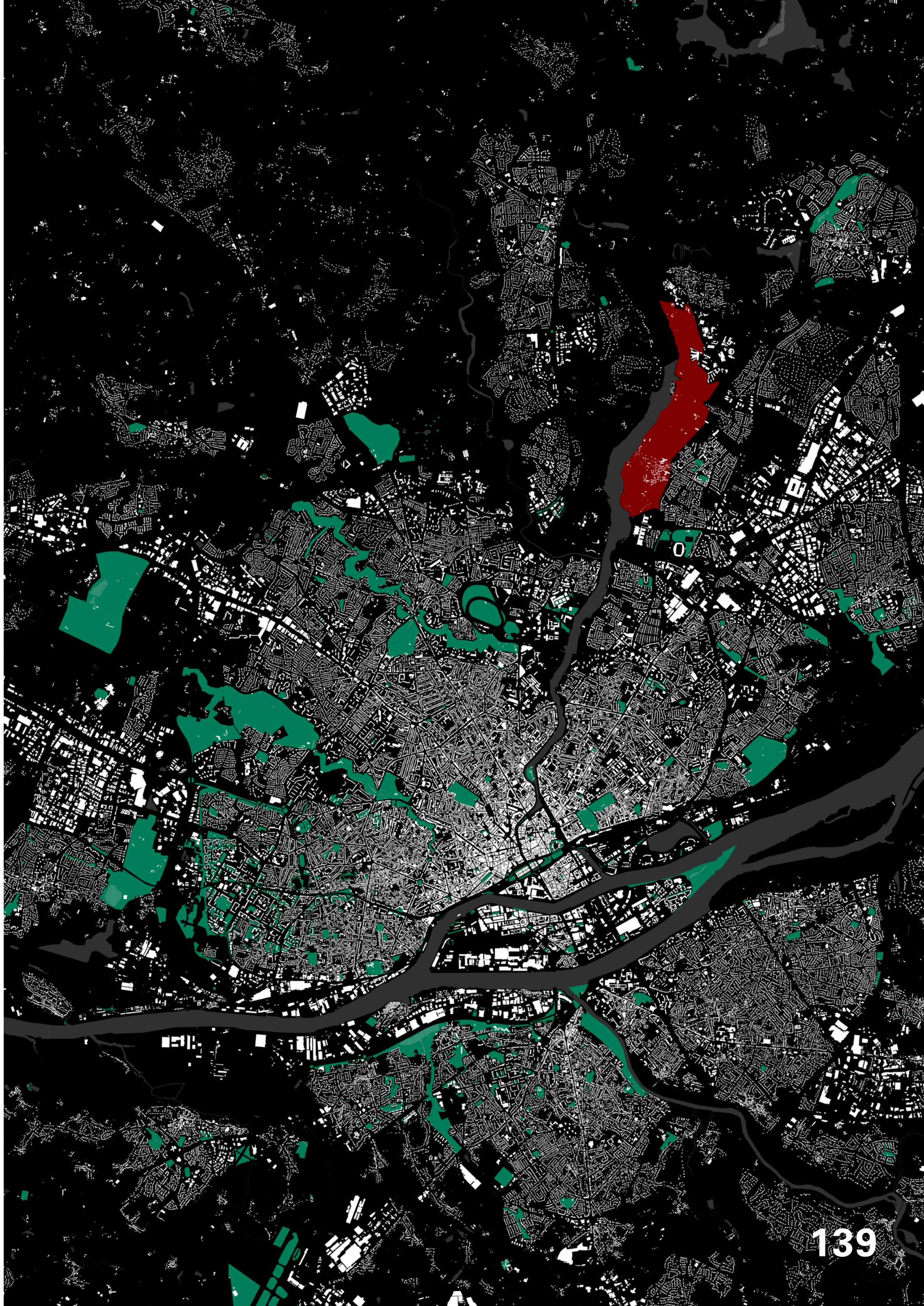


Fig. 69
Green Spaces
and La Chantrerie

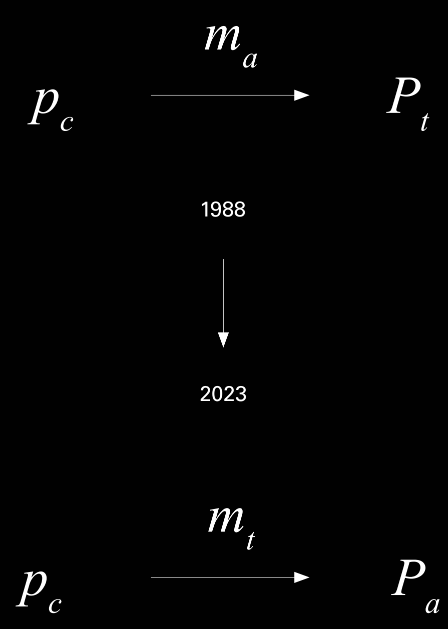
# V

## Restructuring the Foundation

In 1988 Atlanpole was planned as an innovative project at the time, which aimed to create progression in science and in the architectural discourse. The idea of a visionary typology for Nantes is still valuable, but it is necessary to restructure the focus of the basic principles.

According to previous analysis, the building design envisioned at the time targets a catastrophic carbon footprint, which must be prevented at all costs. However, environmental sustainability is not the main driver for the relevance of Atlanpole's typology today, but merely a condition for it's construction. The foundation of the project is social sustainability, which in the case of the 1988 model existed only to a limited extent: combining a science campus with a residential machine is daring, and promoting the social fabric through consumption and entertainment is a romantic notion that is now a relic of the past. Atlanpole is not the means for a purpose, but will only work if Atlanpole becomes the purpose itself. The quest for purpose is called for, and that includes rethinking the values of consumption and entertainment.

Only the purpose, which symbolizes the programmatic composition, will define the relevance of Atlanpole and make it a meaningful structure for Nantes, its inhabitants and its urban spirit.




Protagonist - Citizen Nantaise $p_c$
Means - Atlanpole $m_a$
Means - Technology $m_x$
Purpose - Technological Progression $P_t$
Purpose - Atlanpole $P_a$

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[3] cf. David Plouviez, "1987. Dubigeon, la fin de la Navale", Editions midi-pyrénéennes(2021)

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[7] Hans Kollhoff, "Architektur kontra Städtebau", Grossstadtarchitektur: City-Achse Bundesallee / Sommerakad. für Architektur 1987, Gebr. Mann Verlag, 1989 (93)

[8] cf. IBO – Österreichisches Institut für Bauen und Ökologie, "Gebäude der 1980er Jahre", Passivhaus-Bauteilkatalog: Sanierung, Birkhäuser Verlag GmbH, 2017 (173)

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[10] cf. Jean-Philippe Lucas, "L'urbanisme du futur ", Revue Plein ouest n° 44, 1988 (32)

[11] cf. Majors of Europe, "NANTES ADOPTS GREENER URBAN DEVELOPMENT RULES", Majors of Europe, (2023) https://mayorsofeurope.eu/news/nantes-adopts-greener-urban-development-rules/

[12] cf. Kim Antunez, "Prix des terrains: une question de localisation ", commissariat général au développement durable, 2017 (14)

## Table of Figures

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