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The Production of Cloud
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Decentralised Cloud in Existing Infrastructure: A Modular Approach for Heating with Data Centres

Tinka de Leeuw, Leandro Gohl, Lena Nydegger, Marlon Etter, and Till Moosberger



The increased use of data has led to a growing data centre market. This energy-intensive infrastructure is taking up an increasingly large amount of space. This raises the question of how data centres can be designed and located to add value to society. The Swiss cloud computing firm Infomaniak is collaborating with the cooperative La Bistoquette, located in Plan-les-Ouates, in the Canton of Geneva. The collaboration enables the firm to use space efficiently and creates benefits for the inhabitants of La Bistoquette as the waste heat from the servers heats their homes. Based on this case study, we developed a concept that could lower living costs by enabling people to own a micro data centre and reuse waste heat directly. Decentralising data centres in existing infrastructure increases redundancy.

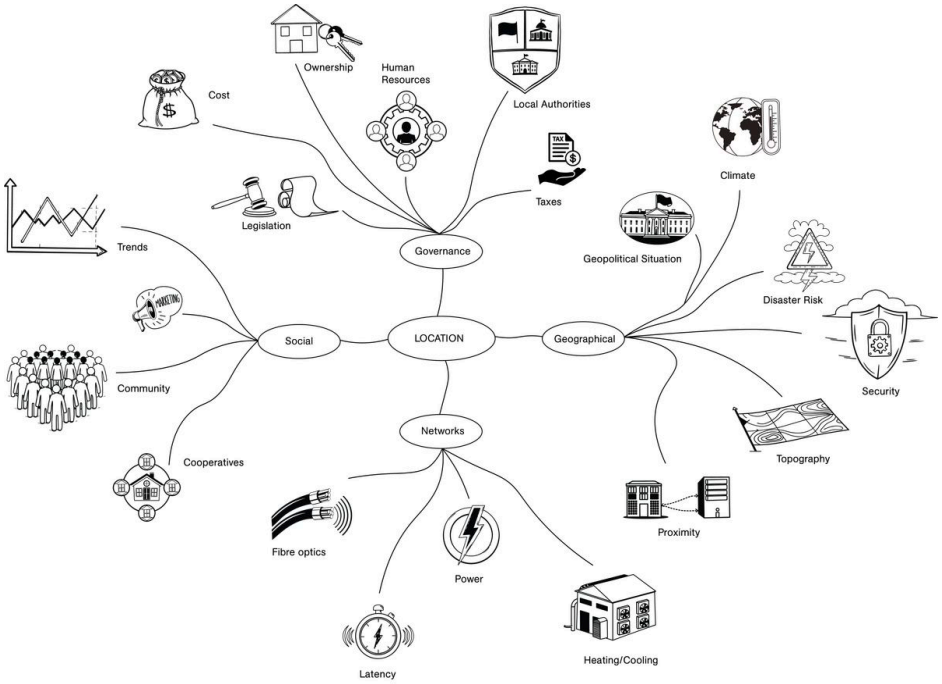
Unlocking the Human Factor



“The best data center is the one that is not done (…) but if it is done, it is better to do it in a better way,” Jean-Yves Genoud, vice-president of La Bistoquette, 2025.

The collaboration between Infomaniak and La Bistoquette seems like a best-case scenario for a data centre development. In this chapter, we analyse the stakeholders and how the collaboration works. What can we learn from this example for future data centres?

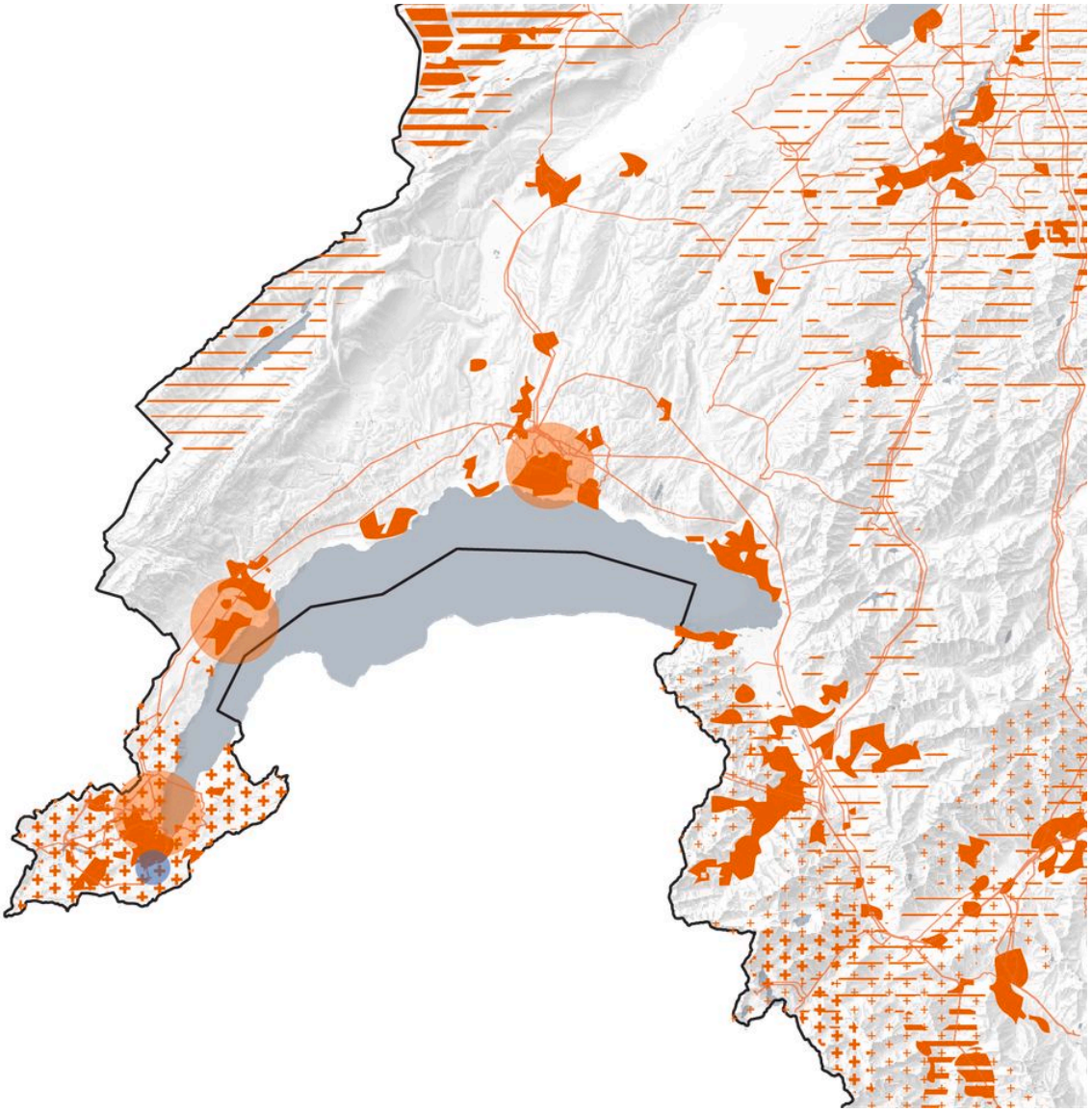
Location Factors:
the Potential of Social Factors



MINDMAP OF LOCATION FACTORS
Drawing: the authors, 2025.

In the first phase of this project, we analysed the factors that influence the location of a data centre as part of the Atlas research [https://topalovic.arch.ethz.ch/Courses/Student-Projects/HS25-Location-Factors-Projecting-The-Cloud]. We found out that social factors can't be quantitatively defined—but that the human aspect should be given more consideration in general. How can data centres add social value to society? With the increased growth of the number and size of data centres, a new approach for building more socially responsible data centres is necessary.

Infomaniak and La Bistoquette
A Case Study



LOCATION FACTORS GENEVA. Source: map.geo.admin [https://map.geo.admin.ch/#/map?lang=de&center=2709346.07,1179775.8&z=2.026&topic=ech&layers=&bgLayer=ch.swisstopo.pixelkarte-farbe&catalogNodes=ech], 2025.

- Location of the data centre Infomaniak D4
- Energy price low
- Energy price lower
- Energy price lowest
- Tax low
- Tax lower
- Tax lowest
- Land rent price low
- Land rent price lower
- Land rent price lowest
- Highest upload speeds
- Energy grid
- Housing cooperatives

When looking at the Canton of Geneva, the rather high energy and rent prices and high taxes would suggest that it is an economically unattractive location. But the Canton is actually situated close to the internet backbone, close to the energy grid, and has a high density of cooperatives around. Considering these location factors for Geneva, it shows that the commune of Plan-les-Ouates, quantitatively seen, does not have the best conditions in comparison to other communes. Therefore, there must have been other important factors that lay in the social aspects.

The Housing Cooperative
La Bistoquette



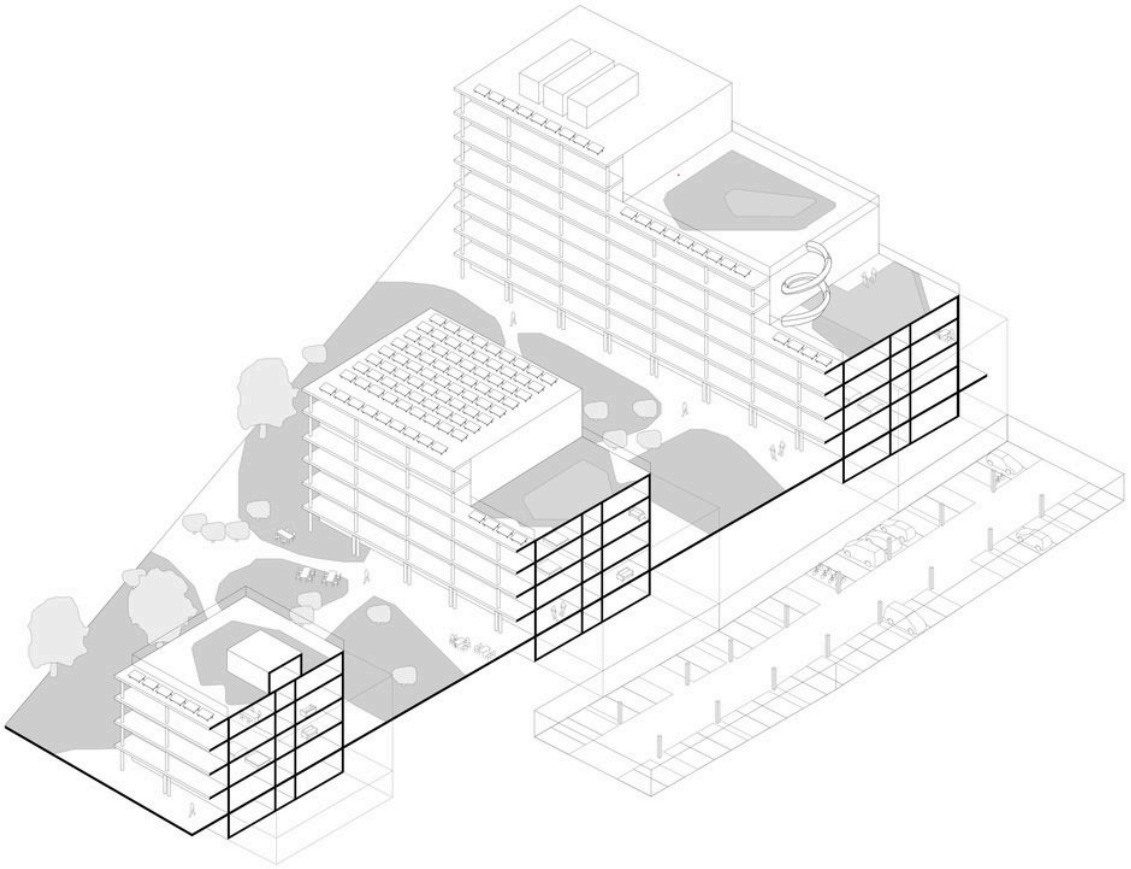
HOUSING COOPERATIVES GENEVA. Source: “Wohnbaugenossenschaften Schweiz” Regionalverband Winterthur-Schaffhausen [https://www.wbg-wish.ch/wohnungssuche/karte], 2025.

Existing housing cooperatives

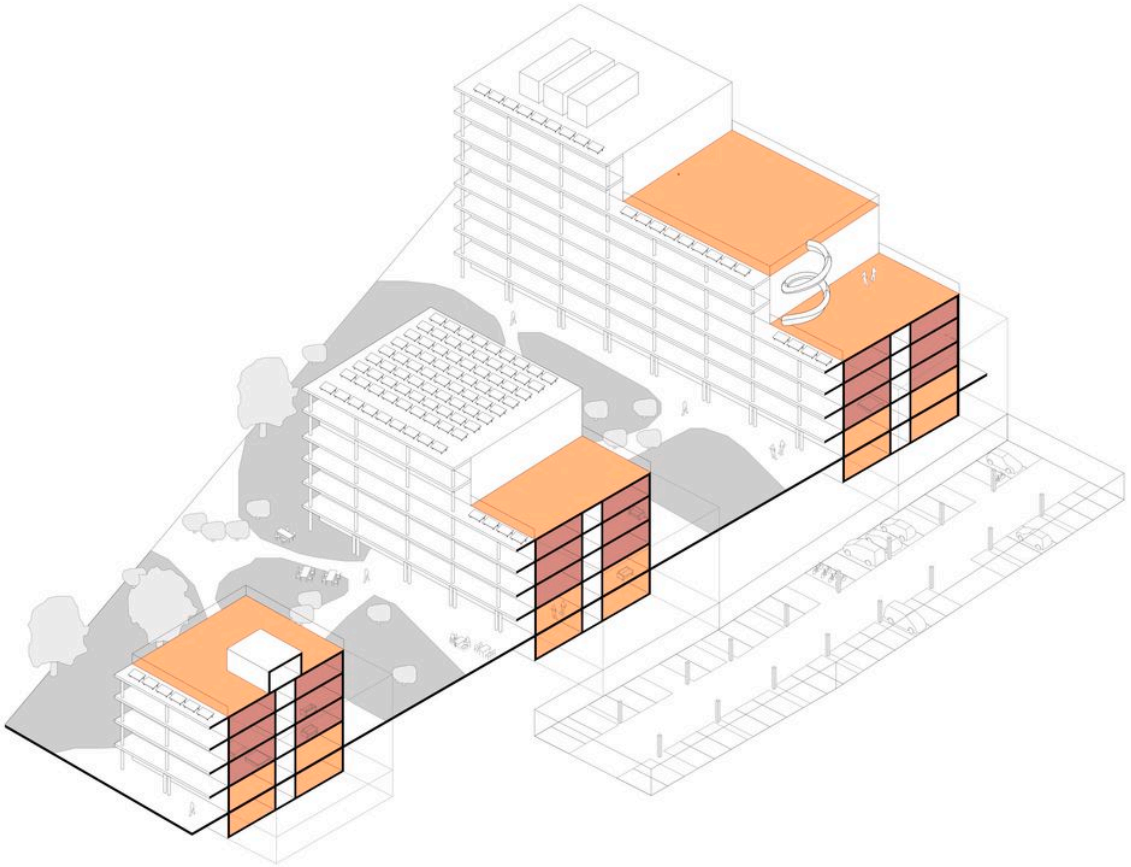
La Bistoquette is located in Plan-les-Ouates, at the southern end of Geneva. There is an existing district heating infrastructure in Plan-les-Ouates. Residents moved in in June 2025, but the data centre had been in use earlier.



LA BISTOQUETTE, GENEVA. Photograph: the authors, 2025.



AXONOMETRY HOUSING COOPERATIVE LA BISTOQUETTE. Source: “502 / Plan-les-Ouates – La Bistoquette – Coopérative d’habitation et commerces” atba. [https://atba.ch/realisations/plan-les-ouates-cooperative-dhabitation-et-commerces/]; drawing: the authors, 2025.



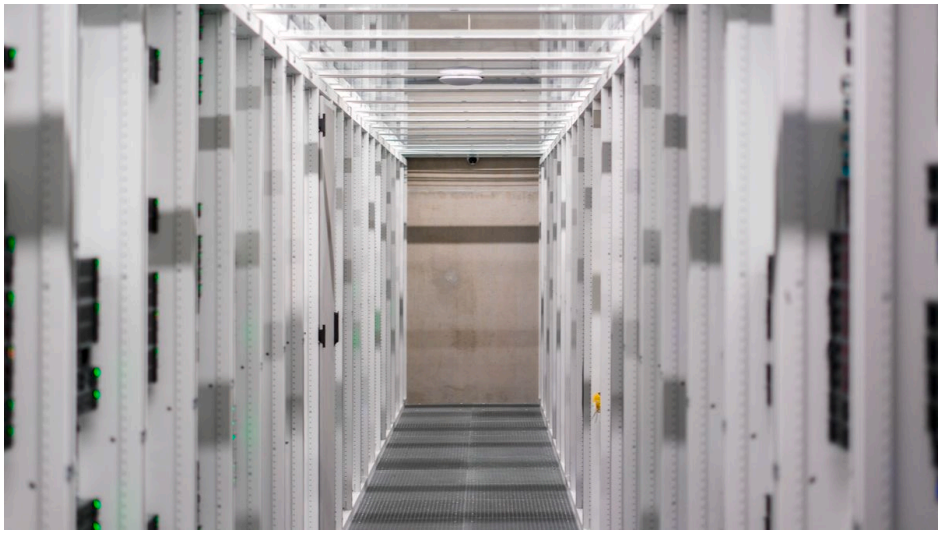
AXONOMETRY SHOWING PRIVATE AND SHARED/COMMUNITY SPACES AT LA BISTOQUETTE. Source: “502 / Plan-les-Ouates – La Bistoquette – Coopérative d’habitation et commerces” atba. [https://atba.ch/realisations/plan-les-ouates-cooperative-dhabitation-et-commerces/]; drawing: the authors, 2025.

shared/community spaces

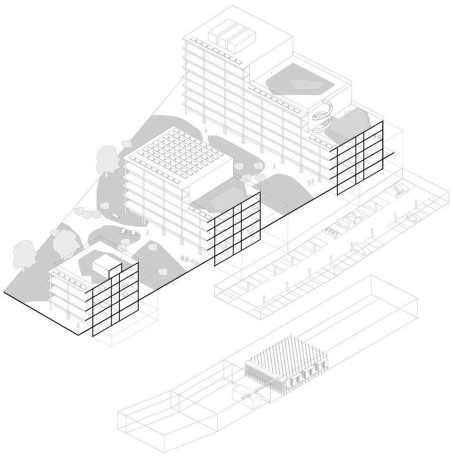
private spaces

La Bistoquette is a housing cooperative that introduces itself as an eco-responsible and participatory cooperative. The cooperative consists of 3 buildings, around 100 housing units, and around 1000 m^2 of commercial space. The cooperative is organised in a participatory way. The residents are part of different committees, that come up with propositions for the cooperative which are then discussed at plenary sessions with all the residents. The goal is to be completely self-sufficient.

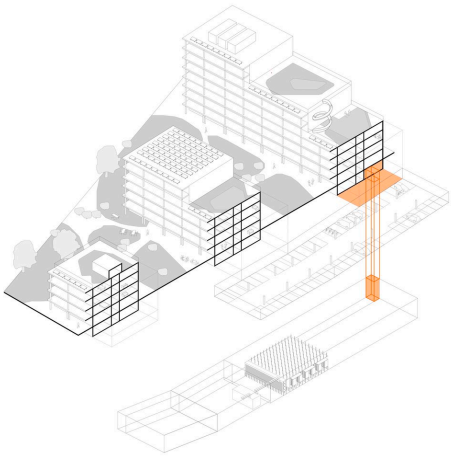
Infomaniak D4



INFOMANIAK DATA CENTRE, GENEVA. Photograph: film still from *Close Encounters: Bits with Benefits?*, the authors, 2025.

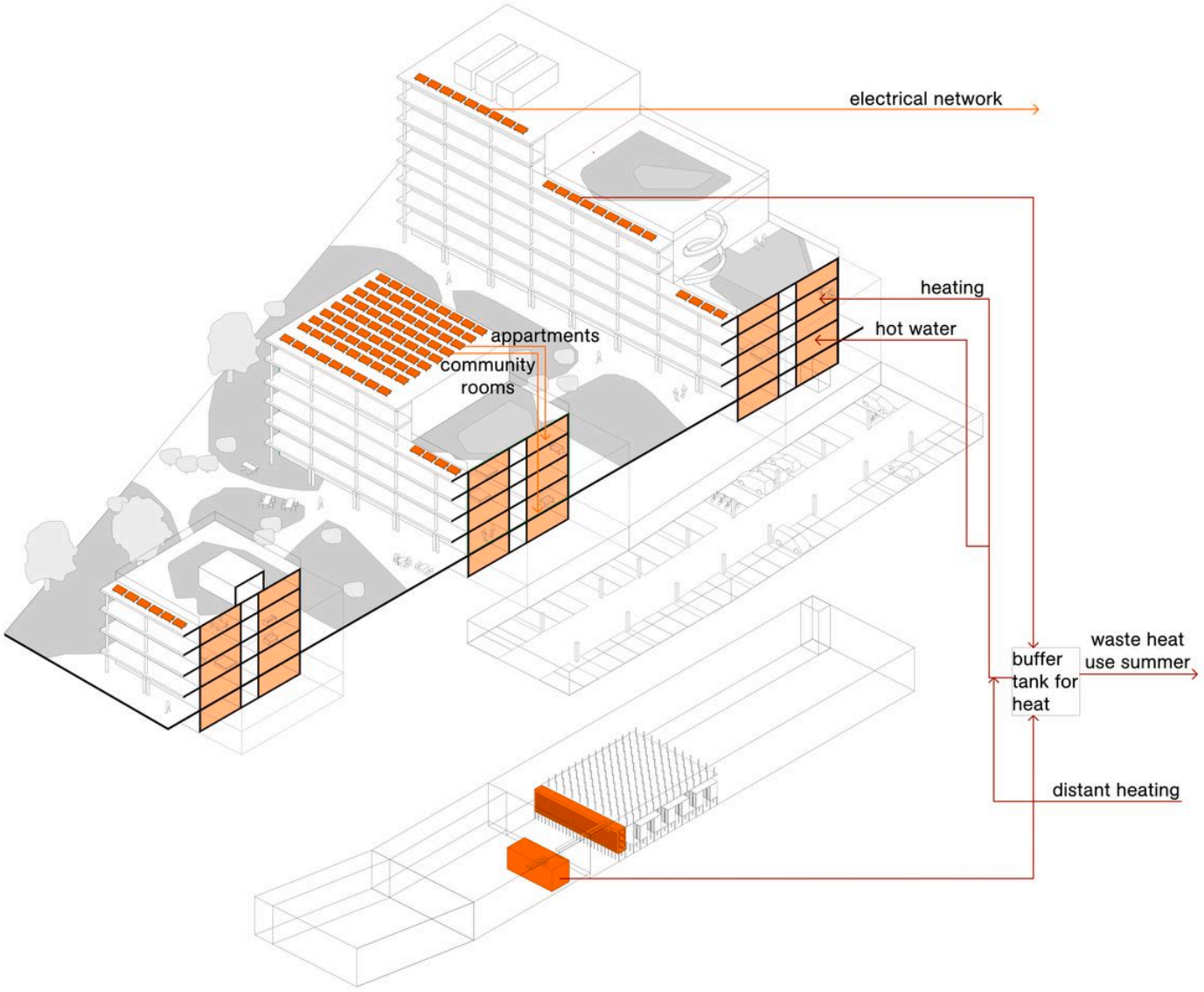


AXONOMETRY HOUSING COOPERATIVE LA BISTOQUETTE AND DATA CENTRE D4 INFOMANIAK. Source: "infomaniaknews" infomaniak [https://news.infomaniak.com/en/infomaniak-inaugurates-a-revolutionary-data-center-that-recovers-100-of-its-energy-for-building-heating/]. Drawing: the authors, 2025.



AXONOMETRY HOUSING COOPERATIVE LA BISTOQUETTE AND ACCESS POINT DATA CENTRE D4 INFOMANIAK. Drawing: the authors, 2025.

Infomaniak's data centre D4 is located below the building blocks of the housing cooperative. It covers around 1800 m^2 and has a capacity of about 1.7 megawatt (MW) per year. With the waste heat coming from the cooling circuit, 6000 households can be heated. Out of this amount, only 100 households are part of La Bistoquette. The rest of the heat goes into the district heating network of Plan-les-Ouates to heat other 5900 households. Residents of La Bistoquette don't have access to the data centre D4. This leads to the assumption that the two parties are strongly divided, which will be proved later in the research.



AXONOMETRY HOUSING COOPERATIVE LA BISTOQUETTE AND DATA CENTER D4 INFOMANIAK HEAT AND ENERGY CYCLE. Source: “502 / Plan-les-Ouates – La Bistoquette – Coopérative d’habitation et commerces” atba. [https://atba.ch/realisations/plan-les-ouates-cooperative-dhabitation-et-commerces/]; drawing: the authors, 2025.

Energy

Warmth

Looking more closely at the energy and heat system, the data centre produces waste heat, which is stored in a buffer tank. From there, it is directly distributed via heat pumps to the apartments of La Bistoquette and the distant heating network. Solar panels on the roofs of the cooperative generate energy and supplementary heat for the housing cooperative.

Close Encounters: Bits with Benefits? A Video Reportage

After introducing La Bistoquette and Infomaniak, there are still open questions about social location factors and the societal value of data centres. To dive deeper into the different perspectives of the cooperative and the data centre firm, we made a video reportage including interviews with the following parties:



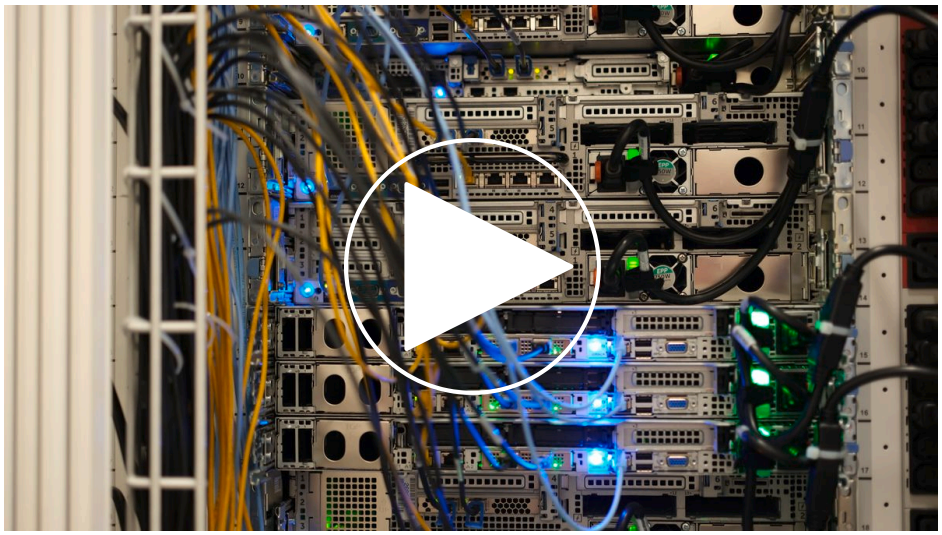
LEA PÖNITZ, PRESIDENT OF LA BISTOQUETTE. Photograph: film still from *Close Encounters: Bits with Benefits?*, the authors, 2025.



JEAN-YVES GENOUD, VICE-PRESIDENT OF LA BISTOQUETTE. Photograph: film still from *Close Encounters: Bits with Benefits?*, the authors, 2025.



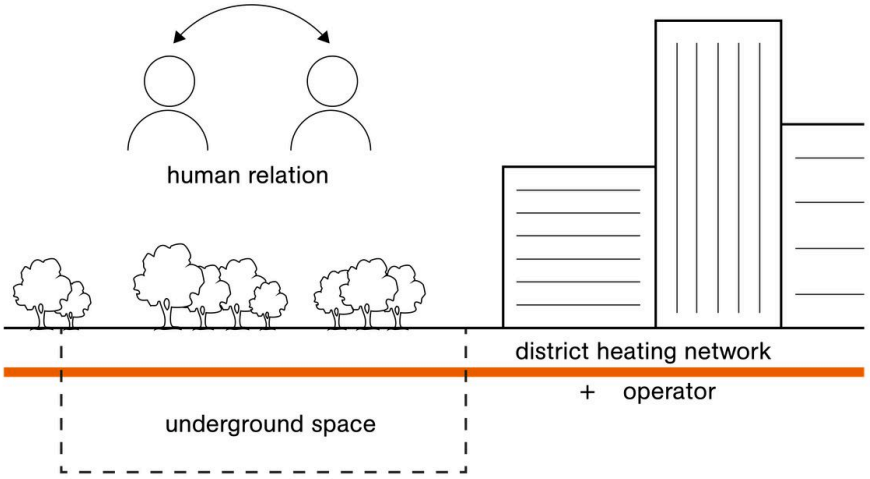
THOMAS JACOBSEN, COMMUNICATION & MARKETING MANAGER OF INFOMANIAK.
Photograph: film still from *Close Encounters: Bits with Benefits?*, the authors, 2025.



VIDEO REPORTAGE *CLOSE ENCOUNTERS: BITS WITH BENEFITS?*. Video: the authors, 2025.

https://www.youtube.com/watch?v=9gybxx0CGgE

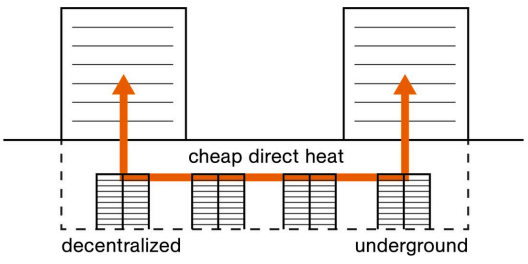
Lessons Learned



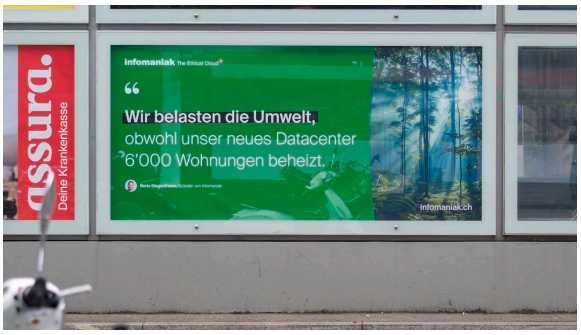
NEEDS FOR THE PROJECT INFOMANIAK AND LA BISTOQUETTE. Drawing: the authors, 2025.

Requirements

Interviews with Lea Pönitz and Jean-Yves Genoud from the cooperative, and Thomas Jacobsen from Infomaniak, revealed several insights into what is required for a successful collaboration between a housing project and a data centre. Firstly, their collaboration was the result of a coincidence that depended on human relations. Secondly, the location of the data centre is determined by specific requirements. Additionally, their ecological values aligned. Furthermore, the data centre required secure infrastructure and ideally underground space so as not to disturb the housing above. Finally, a district heating network and operator were needed to enable the transfer of the data centre's waste heat that cannot be absorbed by the cooperative.



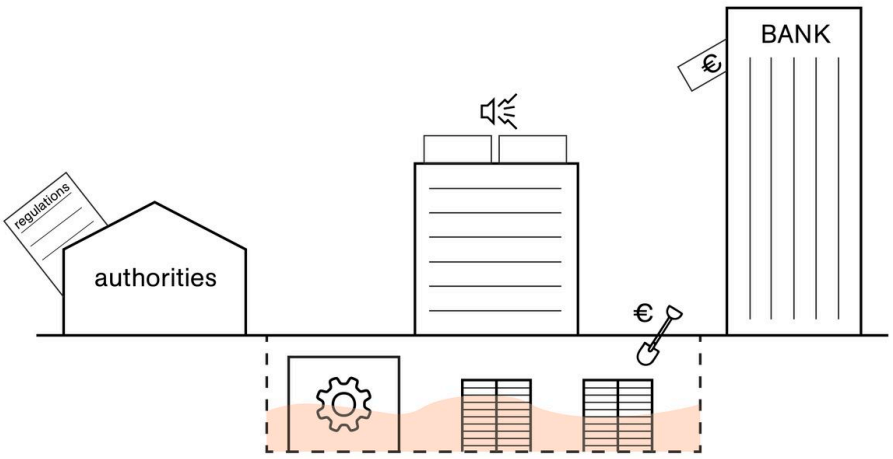
TAKE AWAYS OF THE PROJECT INFOMANIAK AND LA BISTOQUETTE. Drawing: the authors, 2025.



ADVERTISEMENT INFOMANIAK. Photograph: the authors, 2025.

Takeaways

The first point to note is the direct use of waste heat. This reduces the length and complexity of the heating network. Furthermore, this heat is inexpensive for residents because it is a by-product of Infomaniak's operations. Decentralising its data into multiple smaller data centres also leads to redundancy for Infomaniak. Using the existing infrastructure of the parking garage is also cheaper and more space-efficient than building on new land. The project also promotes itself through marketing, which benefits Infomaniak, the city and the canton. In its advertisements, Infomaniak is transparent about the negative environmental impact of data centres. It could be argued that they have set a good example. However, as the data centre is invisible to the inhabitants of La Bistoquette, awareness of energy and data usage remains low.



DIFFICULTIES IN THE PROJECT INFOMANIAK AND LA BISTOQUETTE. Drawing: the authors, 2025.

Challenges

There were also some challenging aspects to this project. For example, La Bistoquette and Infomaniak had to find a bank willing to lend a large amount of money. In addition, an exception to the zoning regulations was required to allow an industrial function in a residential zone. To appropriate the space for the data centre in the former parking garage, the parking standards were also adapted. Another regulatory issue was that data centres cause noise due to testing of the diesel generator backup. These have to be tested every couple of months. As this is a residential area, some regulations restrict noise. Because of this, adaptations were made to the infrastructure layout. This presented a challenge due to the lack of space in an urban environment. Lastly, the underground location increases the risk of flooding.

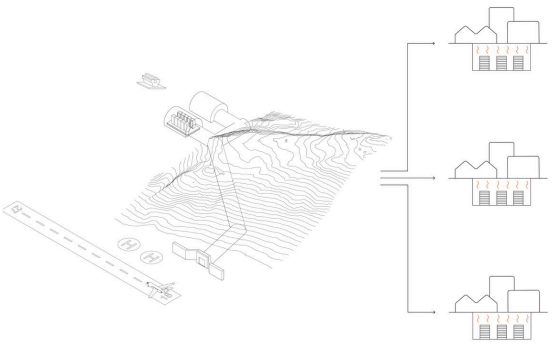
From Hyperscalers to Decentralised Data Centres



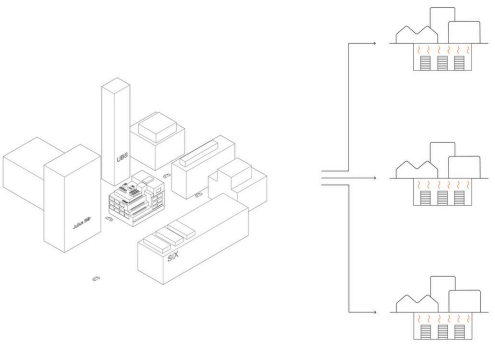
Many small data centres rather than a few large ones would allow to re-use the waste heat from data centres to heat residential areas. Where should the data centres be placed and what should they look like? What actors and services would be needed to spread ownership and raise awareness?

Based on our case-study research of La Bistoquette, we developed the concept of scaling down data centres by decentralising them. There are four main benefits to scaling down, the first of which is redundancy. It is safer to store data at different, smaller locations than to store everything in one place. Secondly, by spreading the data centres, the waste heat is distributed as well. This means that the waste heat can be used directly to lower living costs. Thirdly, giving ownership of the data centre and waste heat to residents raises awareness. Lastly, downsizing enables data centres to be implemented in existing urban infrastructure, making better use of space.

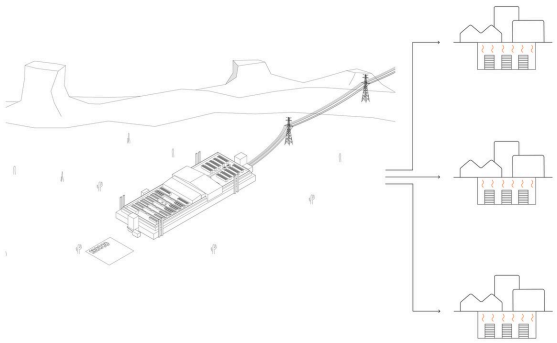
Decentralisation as a Solution for Whom?



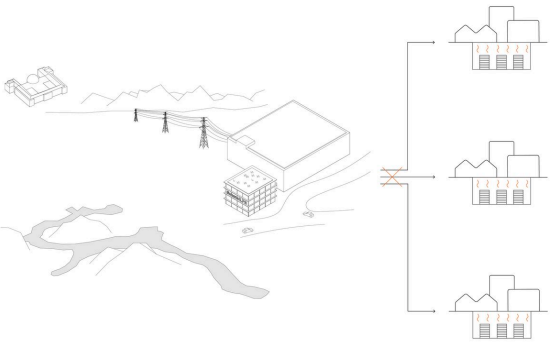
DECENTRALISING A STORAGE DATA CENTRE. Drawing: the authors, 2025.



DECENTRALISING AN EDGE DATA CENTRE. Drawing: the authors, 2025.



DECENTRALISING A HYPERSCALE DATA CENTRE. Drawing: the authors, 2025.



DECENTRALISING A SUPERCOMPUTER DATA CENTRE. Drawing: the authors, 2025.

What types of data centres is this a solution for? Based on our Atlas research on different types of data centres [https://topalovic.arch.ethz.ch/Courses/Student-Projects/HS25-Location-Factors-Projecting-The-Cloud] (see chapter “From Edge to Core: Classifying Digital Architectures”), We learned that, for storage data centres, location and size are irrelevant. This type is therefore particularly suited to smaller companies. Edge data centres must be located close to their customers to minimise latency. By spreading smaller data centres widely, distance is not likely to be a problem. Hyperscale data centres can be decentralised into multiple smaller data centres. This concept could work for this type, but it is unlikely that they will shift towards multiple smaller data centres due to efficiency concerns. Data centres with high computing capacity, or “supercomputers,” would not be suitable for this concept, because high-capacity computing power is difficult to achieve in a small data centre.

Where to Place the Micro Data Centres?

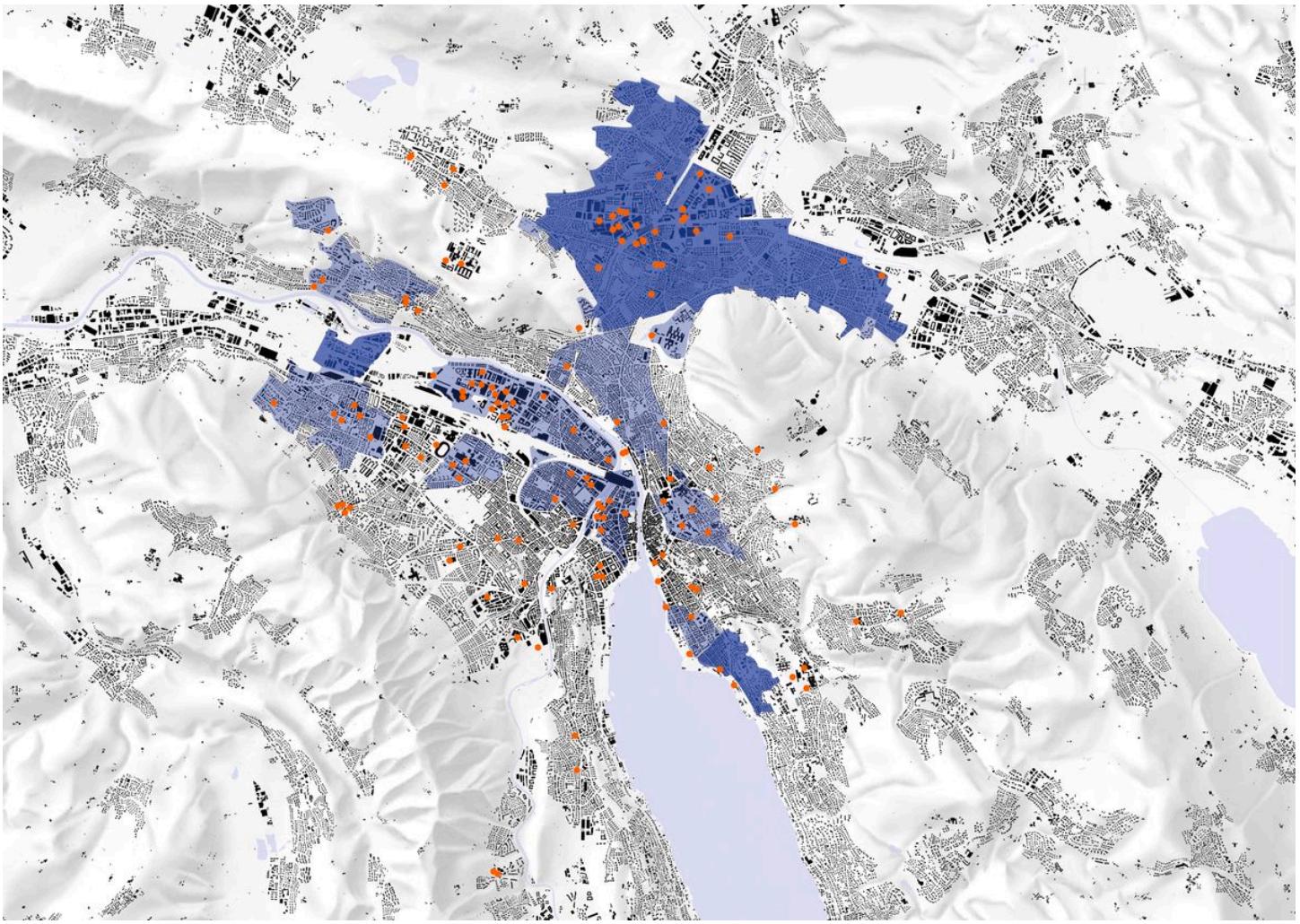


FUTURE TRANSFORMATION OF BAHNHOFBRÜCKE AND CENTRAL IN ZURICH. Source: "Stadtraum Hauptbahnhof 2050" Stadt Zürich, Dome Visual GmbH [https://www.stadt-zuerich.ch/de/planen-und-bauen/projekte-und-ausschreibungen/gebiete-areale/stadtraum-hb.html], 2025.

“The urban planning complexity of the main station area involves pedestrians and cyclists sharing the space with buses and trams. Fewer cars also benefit the social environment and the urban climate.” Source: *Stadtraum Hauptbahnhof 2050*. Stadt Zürich, 2025.

“Fossil fuel heating systems must be replaced with climate-friendly solutions at the end of their service life. They may only be newly installed under certain conditions and subject to restrictions.” Source: *Revidiertes Energiegesetz des Kantons Zürich*. Kanton Zürich, 2022.

Where to position these small data centres? This question leads to the search for existing infrastructure projects to which a micro data centre could be connected. The are two interesting and potentially fitting infrastructure projects from the City of Zurich: Firstly, their gas replacement plans, and secondly, their mobility strategy, which focuses on reducing the number of cars in the city. Our concept could contribute to gas replacement by providing an alternative heating solution. Additionally, it can utilise the parking garages that will become vacant following the reduction in cars.

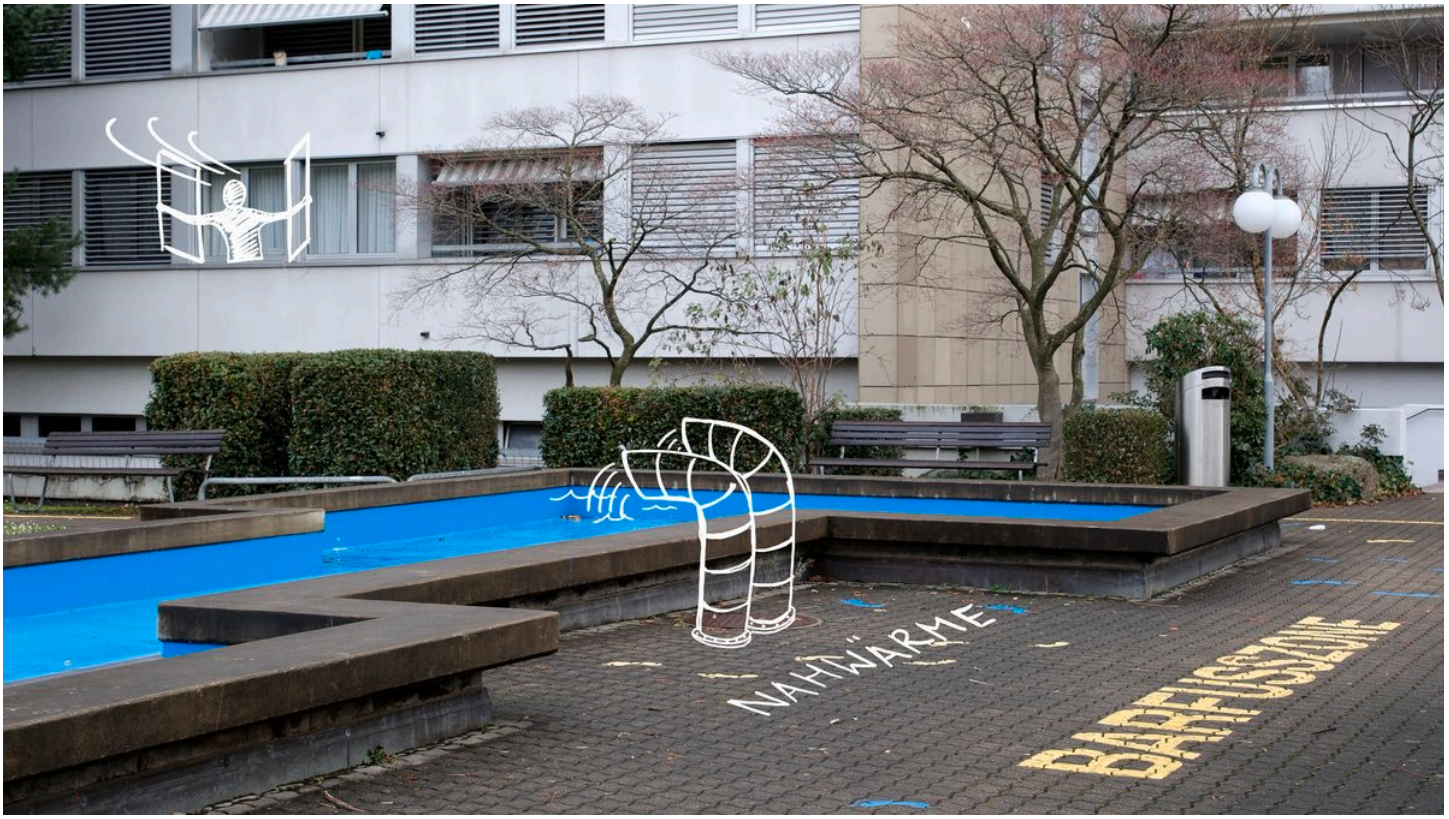


FOSSIL FUEL REPLACEMENT AND PARKING GARAGES ZURICH
The City of Zurich has a plan for replacing gas heating with renewable energy systems. The blue areas in the map show zones where the replacement is already decided and where it is under review to be decommissioned between 2030 and 2034. The proposal for an alternative heating system via small-scale data centres could contribute to this energy transition plan of the city. Sources: “Fernwärme Ersetzt Gasverteilnetz,” City of Zurich [https://www.stadt-zuerich.ch/de/umwelt-und-energie/energie/abloesung-gasnetz.html] and “Map parking garages in Zürich,” open data Zurich [https://www.stadt-zuerich.ch/de/mobilitaet/parkieren/parkplaetze.html#oeffentliche_parkplaetze].

- Replacement of gas distribution network underway/decided
- Replacement of gas distribution network under review
- Car parks

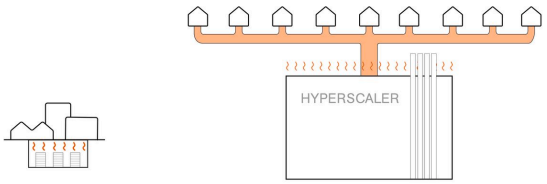
Our concept of decentralising data centres will make use of existing infrastructure. In line with the city of Zurich's plans to reduce car usage, existing car parks are seen as potential locations. They are accessible and widespread, and are often located near housing. As the garages are distributed throughout the city, this fits well with the idea of decentralisation.

Rising Heat Against Rising Rents

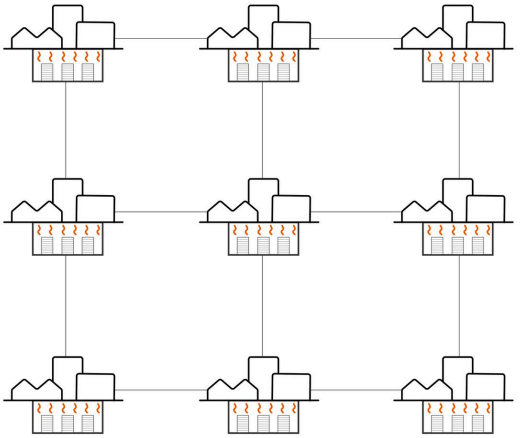


In Zurich, rising rents are making affordable living increasingly difficult. The energy bill is part of the problem. Using waste heat can reduce living costs.

Scaling Down the Heat Network



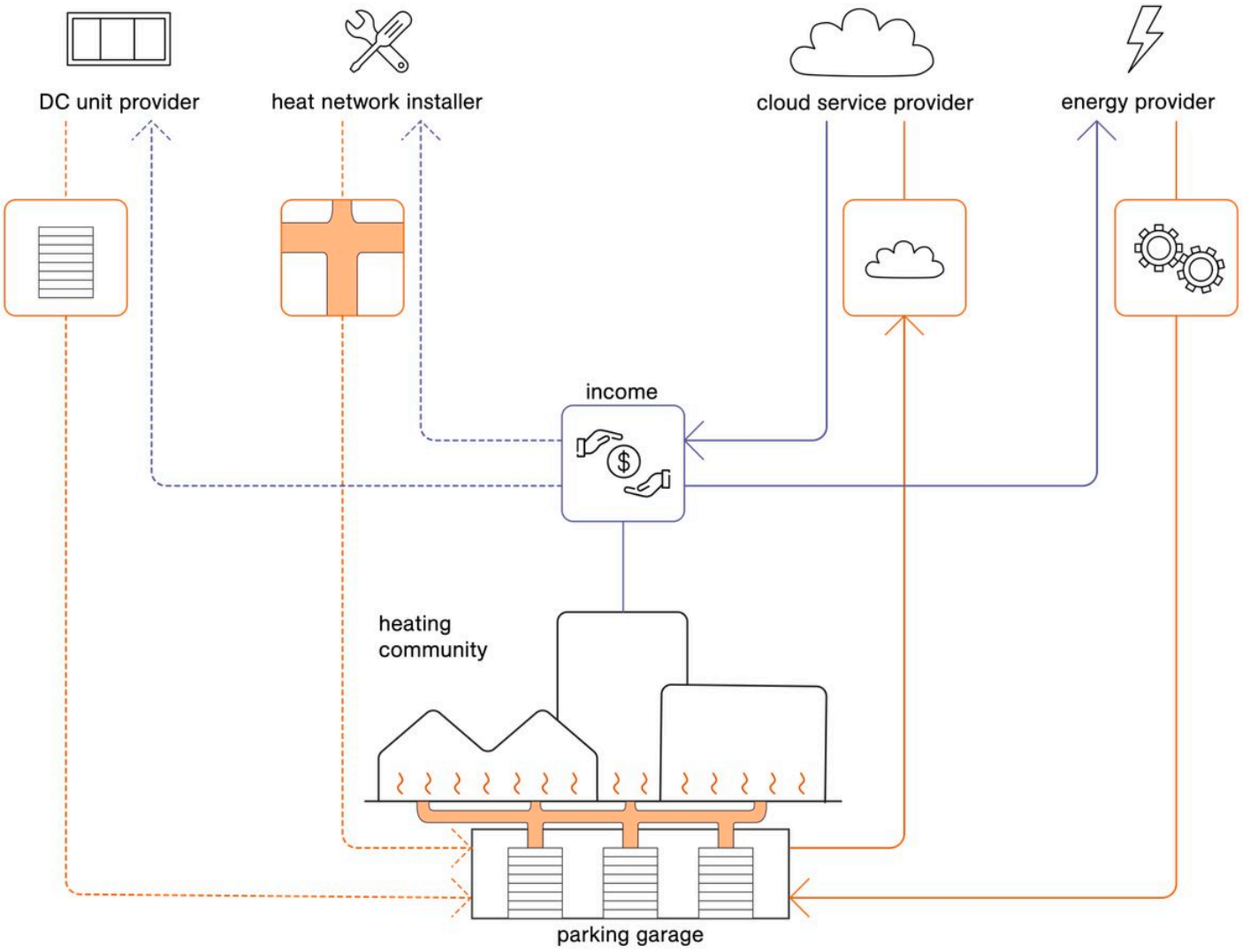
DECENTRALISATION CONCEPT
DIAGRAMME. Drawing: the authors, 2025.



DECENTRALISATION NETWORK
DIAGRAMME. Drawing: the authors, 2025.

Demand for data centres is rising today. Rather than developing new infrastructure for large data centres, this concept proposes creating multiple micro data centres within existing infrastructure. Reusing the waste heat of one large data centre requires the installation of an extensive and expensive heat network. The organisation and financing of this is so complicated that the waste heat is often not used at all. However, by scaling down a data centre, the heat can be used directly and only a small internal heat network is needed for the buildings above. These buildings form a heating community together. A micro data centre must be at least 50 m^2 to work efficiently. At this size, it can heat around 166 households, representing the minimum size for a heating community. These communities are connected to a fibre optic network. Several micro data centres can form a scalable data network.

Community Ownership to Lower the Rents



ORGANISATION MODEL. Drawing: the authors, 2025.

- Constant investment
- Constant service/connection
- One time investment (+ maintenance)
- One time service (+maintenance)
- Internal heat network
- Free heat

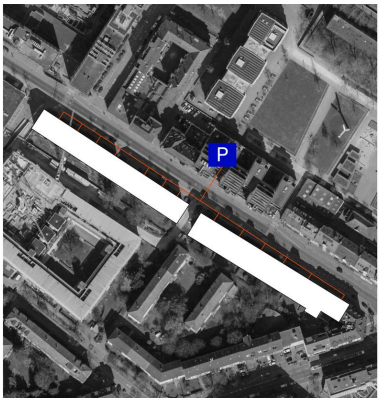
In Zurich, there is a trend of increasing rent prices. A micro data centre could have a positive impact on this trend by providing free waste heat. The first step is to establish a heating community in a housing community or a neighbourhood with garage space. Micro data centre units will be provided by a manufacturer of such units. They will be installed in the parking garage. In addition, a heat network installer will set up an internal heating network for the community. The heating community will pay for this initial investment. The community will generate income to refund these investments by offering the data centre units in their parking garage to a cloud service provider. Some of this income will go towards the energy supply, enabling the data centre to run the cloud service. By renting out micro data centre units to a data centre service provider, the heating community will generate an income that covers all costs. Consequently, heat would simply be a by-product and would be free for the heating community to use.

The Zusammenschluss zum Eigenverbrauch (ZEV) model serves as a reference for the heating community. ZEV is a concept for local energy grid production. Within an internal grid, they share energy and have an internal billing system. In the ZEV concept, there is just one connection per community to the public district heating network for excess energy and shortages. The above concept goes one step further by suggesting to not connect to the district heating network to achieve complete heating independence.

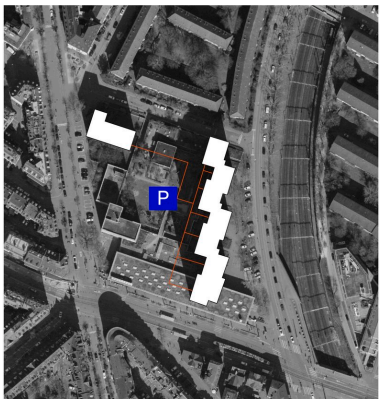
Urban Implementation



URBAN IMPLEMENTATION LOW RISE. Source: map.geo.admin [https://map.geo.admin.ch/#/map?lang=de&center=2660000,1190000&z=1&topic=ech&layers=ch.swisstopo.zeitreihen@year=1864,f;ch.bfs.gebaeude_wohnungs_register,f;ch.bav.haltestellen-oev,f;ch.swisstopo.swisstlm3d-wanderwege,f;ch.vbs.schiessanzeigen,f;ch.astra.wanderland-sperrungen_umleitungen,f&bgLayer=ch.swisstopo.swissimage], 2025.



URBAN IMPLEMENTATION BLOCK. Source: map.geo.admin [https://map.geo.admin.ch/#/map?lang=de&center=2660000,1190000&z=1&topic=ech&layers=ch.swisstopo.zeitreihen@year=1864,f;ch.bfs.gebaeude_wohnungs_register,f;ch.bav.haltestellen-oev,f;ch.swisstopo.swisstlm3d-wanderwege,f;ch.vbs.schiessanzeigen,f;ch.astra.wanderland-sperrungen_umleitungen,f&bgLayer=ch.swisstopo.swissimage], 2025.



URBAN IMPLEMENTATION HIGH RISE SLAB. Source: map.geo.admin [https://map.geo.admin.ch/#/map?lang=de&center=2660000,1190000&z=1&topic=ech&layers=ch.swisstopo.zeitreihen@year=1864,f;ch.bfs.gebaeude_wohnungs_register,f;ch.bav.haltestellen-oev,f;ch.swisstopo.swisstlm3d-wanderwege,f;ch.vbs.schiessanzeigen,f;ch.astra.wanderland-sperrungen_umleitungen,f&bgLayer=ch.swisstopo.swissimage], 2025.

The concept of a micro data centre can be applied to different urban typologies. The length of the internal network of the heating community varies depending on the urban typology. Nevertheless, it is widely applicable. The concept would be most efficient in a residential tower. This would be especially beneficial for towers that are currently heated with fossil fuels and have a parking garage. An example of this is the Lochergut residential complex in Zurich.

Lochergut as an Example



LOCHERGUT RESIDENTIAL COMPLEX. Photograph: film still from *Wohnsiedlung Lochergut*, video by the authors, 2025.

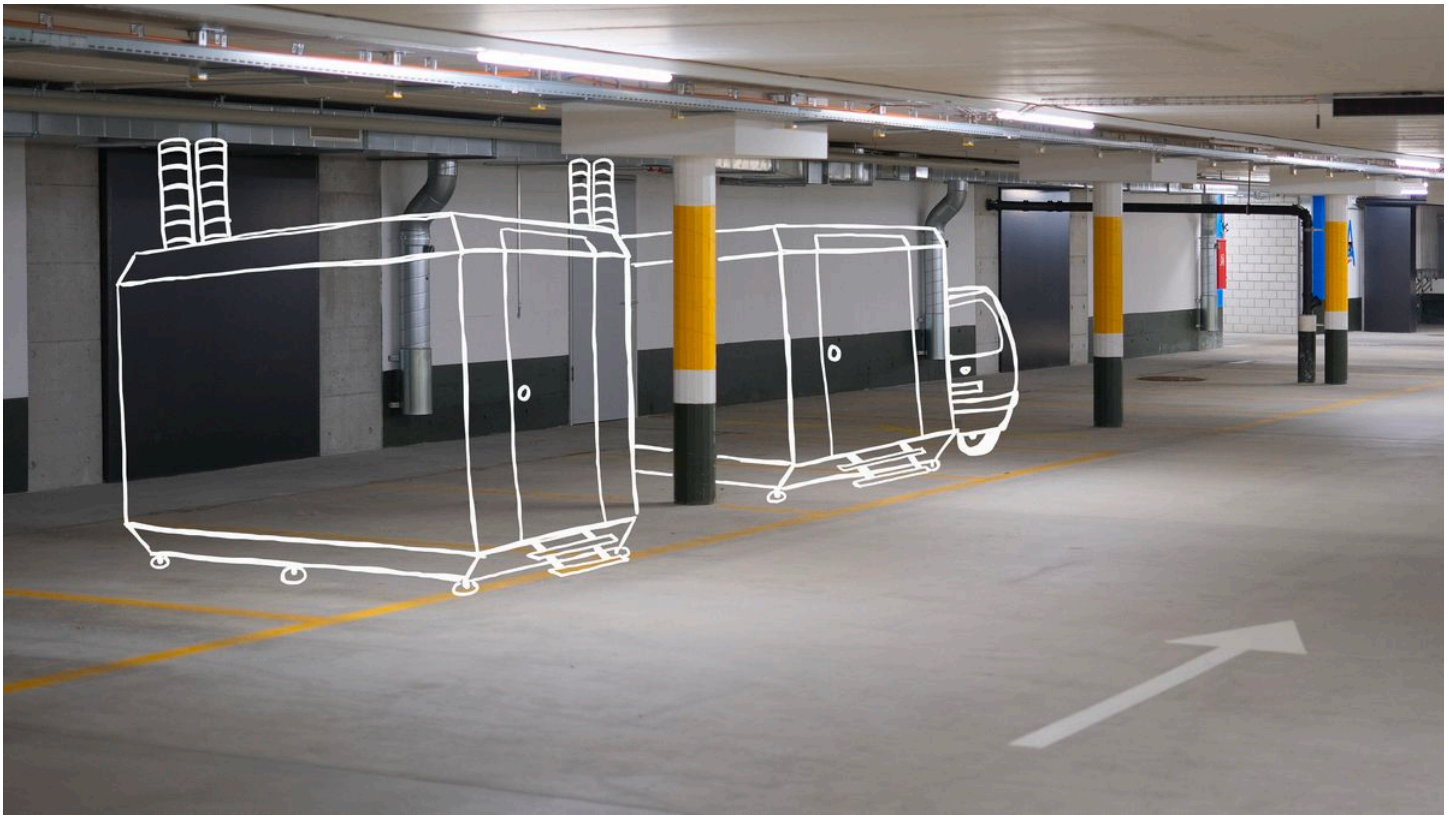
The Lochergut housing project was completed in 1966. This urban residential tower could be a case for an efficient implementation of a micro data centre. Owned by the city, the development consists of 345 subsidised apartments and a 297-space parking garage. It is currently heated with gas. A connection to the district heating system is planned for 2027. Replacing the heating system with two micro data centre modules (consisting of 100 m^2 and 20 racks) would enable the entire building, including the inner courtyard with a pool, to be heated.



VIDEO ESSAY *WOHNSIEDLUNG LOCHERGUT*, the authors, 2025.
https://www.youtube.com/watch?v=ScfEBNsiyNg

Rental prices in Zurich are already high and rising continuously, especially in the Aussersihl district (Kreis 4), where Lochergut is located. Although rent prices in Lochergut are subsidised, market development and necessary building renovations are making apartments increasingly unaffordable. Rising rents could be offset by low to zero heating costs, thereby preventing the displacement of lower-income individuals. By sharing ownership of the micro data centre, we aim not only to reduce living costs, but also to foster a stronger sense of community and raise awareness of the cloud.

A Prototype for a Micro Data Centre



The micro data centre unit is a key aspect of the concept of decentralised waste heat use. In the following chapter, we describe the prototype unit.

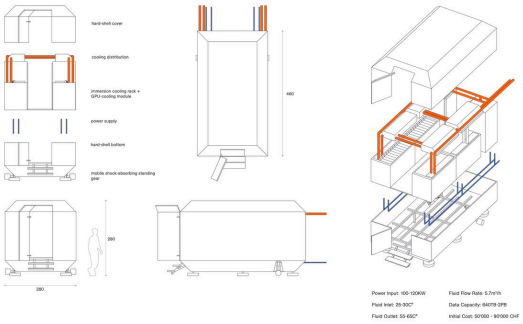
Data Modules Heating the Community



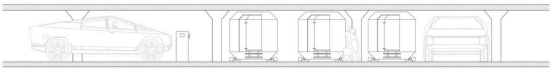
CONCEPTUAL SECTION OF MODULES HEATING THE COMMUNITY
The micro data centre modules located in an underground car park heat the buildings above via an internal grid. Drawing: the authors, 2025.

The Micro Data Centre Module

The micro data centre unit is imagined to be a standardised product with the size of 2.8 by 4.6 by 2.8 metres. These measurements make transport of the elements easy, and fit into a typical parking space. Multiple units can be connected. Four units together form a module of 50 m^2. The unit is separated and protected from the outside by a hard-shell cover. Contained within the cover are cooling distribution, cooling racks, and a power supply. The data centre equipment stands on shock-absorbing gears that are placed on the ground. According to calculations about the elements and the production, the initial costs for a micro data center unit would be around 50,000 to 90,000 Swiss francs.



STRUCTURE OF A MICRO DATA CENTRE MODULE. Drawing: the authors, 2025.



MICRO DATA CENTRE UNITS IN A GARAGE. Drawing: the authors, 2025.



MICRO DATA CENTRE UNIT IN A GARAGE. Rendering: the authors: 2025.

“That is the magical thing about the cloud, it is no more important where the data is based,” Thomas Jacobsen, 2025.

In this research, it has been shown that, by considering the needs of different actors and combining potentials, the transition towards decentralised data centres becomes possible. Spreading data leads to redundancy, thus improving data security. The waste heat of the data centre can be used directly for housing communities to lower living costs. With the model of shared ownership, awareness will be improved. No new built infrastructure is needed, and the existing urban fabric can be used more efficiently.

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