ETH Zurich Department of Architecture
ARCHITECTURE OF TERRITORY
Chair of Architecture
and Territorial Planning
Professor Milica Topalović

The Production of Cloud
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Data Ecologies

Digital Commons: A Vision for Intermunicipal Data Labs

Etienne Fey, Lars Brunner, and Maurice Stucki

Rare earth minerals for server chips and other utilities are extracted under harsh conditions, often in regions marked by environmental destruction and political instability. Factory workers assemble devices within global production chains driven by speed and low costs. Massive logistics networks transport products across continents, while enormous data centers consume energy and water on an urban scale to sustain our constant demand for connectivity and storage. Underpaid content moderators and data annotators produce and maintain AI and digital platforms.

For most people, digital technology begins and ends with the seamless use of a smartphone, cloud service, or AI application. Yet behind this apparent simplicity lies a vast physical and human infrastructure involving countless lives, resources, and forms of labour.

To introduce a more democratic, sustainable, and socially integrated approach to data storage and data centres, we developed the Data Centre Labs: clustered municipalities that collectively operate their own local data centers. These labs not only store private and public municipal data, but also serve as social and educational spaces where children and citizens can engage with and learn about digital infrastructure. We invite you to explore our journey to the Data Centre Labs.

NAME DATA CENTRE: Vantage ZRH 1
COMMUNE: Winterthur, ZH
TYPE DATA CENTRE: Hyperscaler
CAPACITY: 40MW
OPERATOR: Vantage Data Centers
YEAR: 2020
STATUS: completed and under construction
WASTE HEAT USE: District heating in planning

Community Voices on Data Centre Clusters

Digital infrastructure isn’t an invisible cloud. It is an infrastructure defined by material, political, and ecological forces.

The US company Vantage Data Centers has positioned its data centers within the emerging district of Neuhegi in Winterthur. One facility is already in operation, while additional centres are currently under construction. Once completed, the complex is expected to consume as much energy as half of the city of Winterthur.

In the past, data storage was measured in bytes and consumed relatively little energy. Over the decades, however, storage demand has grown exponentially. Today, we have become accustomed to the illusion of unlimited storage, a development that has led to the massive expansion of data centers.

Within the Zurich region, a growing cluster of data centers now consumes enormous amounts of energy, measured in megawatts.

The chain of exploitation is barely visible to the consumer. For most people, digital technology begins and ends with the seamless use of a smartphone, cloud service, or AI application. Yet behind this apparent simplicity lies a vast physical and human infrastructure involving countless lives, resources, and forms of labor.

SSD prices are rising significantly, especially as demand for AI infrastructure, high-performance computing, and large-scale data storage continues to increase. As storage technologies become more expensive, private consumers are increasingly pushed toward subscription-based cloud services instead of owning and managing their own local storage.

This shift changes the relationship between users and their data. Rather than storing files physically on personal devices, data is increasingly outsourced to remote infrastructures operated by a small number of global technology companies. What appears convenient and limitless for the user is in reality dependent on vast networks of servers, energy-intensive cooling systems, and continuously expanding data centers.

As a result, personal data becomes less tangible and less autonomous. Consumers gradually lose control over where their information is stored, how long it is preserved, and how it is monetized. The economic pressure created by rising hardware costs therefore reinforces a broader dependency on centralized digital infrastructures and cloud-based ecosystems.

Voices from the People

Lukas, the Neighbour
"How about we turn on our brains and use less electricity?"

Fence, the Hacker
"I wish we had a controlled, state-run or collective digital future!"

Laurant, the Activist
"No one asked us!"

David, the Journalist
"The city was overrun and simply waved it through."



Video essay, *Community Voices on Data Center Clusters*, 2026.
https://youtu.be/0BZX0jzEQt0?si=ftHyDKvT1ayun4jX

How to Use Data More Resourcefully in Everyday Life

Through listening to the voices of the people we explored solutions to ensure a more sustainable data society.

Everyone can contribute to reducing energy consumption and lowering the dependence on cloud services. Many everyday habits, such as streaming music while showering, endlessly scrolling through social media during meals, or continuously syncing files to the cloud while working, generate invisible but significant amounts of data traffic and energy use.

More conscious digital behaviour can help reduce this demand. Speaking with others during a meal instead of using a smartphone, reading a book in the evening rather than constantly streaming videos, or limiting unnecessary online activity are small individual decisions that collectively have a large impact.

Cloud infrastructure is also heavily affected by peak usage times. Instead of performing constant live backups during the day, many synchronisation processes could take place at night, when network and server demand is lower. Distributing data traffic more intelligently would help reduce energy peaks and allow digital infrastructure to operate more efficiently.

Places with phone-use restrictions in Zurich.

Today, there are only a few phone-free zones in society, spaces such as restaurants, cafés, and schools where digital distraction is intentionally reduced. However, this concept could be expanded far beyond questions of concentration or social etiquette. It could also become part of a broader strategy to reduce unnecessary live data consumption and the continuous load placed on data centres.

Such zones would not represent a rejection of technology, but rather a more conscious and balanced use of it. They could promote direct social interaction, moments of silence, concentration, and awareness of the physical resources hidden behind digital convenience. In this way, reducing live connectivity becomes not only an ecological question, but also a cultural and social one.

Towards a Municipal Scale of Data Infrastructures

Neither hyperscale infrastructures nor completely private storage systems provide an ideal long-term solution for society. Large centralised data centres may operate efficiently, but they create strong dependencies on global corporations and invisible infrastructures far removed from everyday life. Fully private storage, on the other hand, offers autonomy but often leads to fragmented, inefficient, and energy-intensive systems.

Between these, the municipal scale emerges as a meaningful alternative. Shared local infrastructures allow communities to collectively manage data, energy, and digital services while maintaining a higher degree of democratic control and social transparency.

The Intermunicipal Cloud, an Alternative to Big Tech

We propose the introduction of Intermunicipal Data Labs as civic spaces that reconnect digital systems with local responsibility, education, and public participation.

Decentralised home servers
Hyperscalers
Municipality data labs per 20,000 residents

To determine the appropriate scale for inter-municipal data centers, we compared different infrastructure models were across factors such as energy consumption, costs, waste heat production, and social impact. The analysis showed that clusters of approximately 20,000 inhabitants provide the most balanced overall performance.

At this scale, Intermunicipal Data Labs remain locally embedded and socially accessible, while still achieving sufficient efficiency in terms of energy use, infrastructure sharing, and operational costs. The Data Lab model therefore represents a balance between decentralisation, sustainability, and collective public value.

Intermunicipal Data Labs and Their Services for the Community

Rather than remaining invisible infrastructure, the data labs are intended to become transparent and accessible civic spaces with an educational role for future generations.

At the scale of clustered municipalities, different types of digital services can be collectively organised and maintained.

The Data Labs would be collectively financed through contributions from citizens, municipalities, and local enterprises, creating a shared and democratically supported digital commons.

SERVICE 1: PERSONAL DATA STORAGE

This service focuses on personal data storage, allowing inhabitants to store private files and digital content within a locally managed infrastructure.

SERVICE 4: LOCAL LLM

Locally operated LLM (Large Language Model) enable citizens to efficiently access official information, communicate with public institutions, and interact with local knowledge systems.

SERVICE 3: LOCAL BUSINESS STORAGE

Local businesses are supported by offering regional digital infrastructure and storage services independent from global hyperscale providers.

SERVICE 2: CIVIC COMMON STORAGE

This type provides storage for civic common goods, including municipal archives, schools, healthcare institutions, and public administration.

Andelfingen: A Concrete Proposal for an Intermunicipal Data Lab

In intermunicipal data labs, a cluster of municipalities collectively operates its own digital infrastructure. Andelfingen, a typical rural village, serves as the ideal pilot site to test the idea in space. Our goal is to create a scalable architectural framework, that can be adapted to similar villages in Switzerland.

The Andelfingen Intermunicipal Data Lab

The Andelfingen cluster consists of around 28’613 inhabitants distributed across 11 municipalities. The model assumes that each citizen would have access to approximately 3 TB of personal storage, while local businesses and public institutions would also be integrated into the system according to their scale and digital needs.

The graphic demonstrates that the total storage demand of the cluster, approximately 227’000 TB, could theoretically be operated with only 12 server racks. This challenges the perception that digital infrastructure must always exist at the scale of gigantic hyperscale data centers.

Data storage is linked to measurable consequences: energy consumption, waste heat production, financial investment, and spatial requirements for renewable energy generation. The numbers show that such a system would require approximately 114 kW of continuous power and could be supported by relatively understandable renewable infrastructures such as local solar fields and wind energy. The size of the Data Lab delivers enough waste heat to supply up to 11’000 square meters of living space.

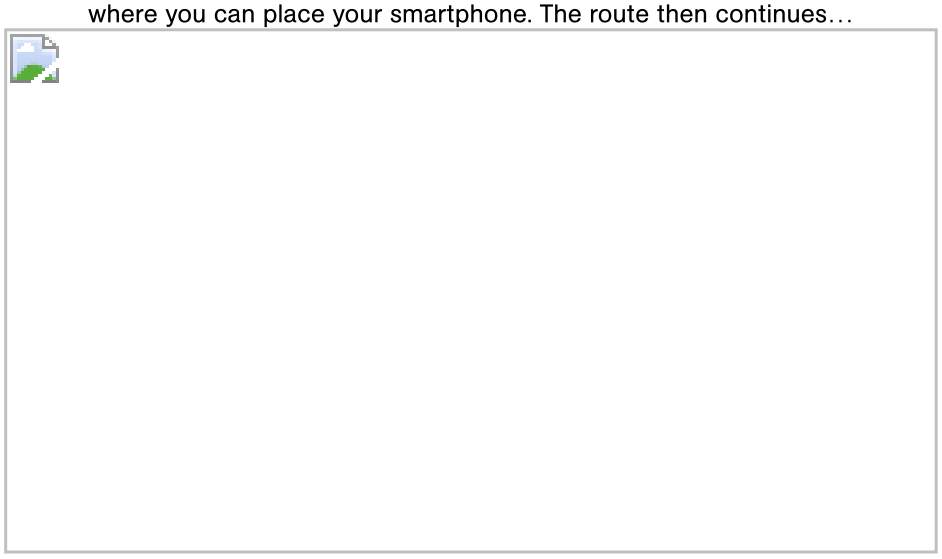
The hardware costs are estimated at approximately 7.6 million Swiss francs and would be collectively financed through municipal taxes and contributions from local stakeholders.

The Intermunicipal Data Lab Andelfingen consits of a civic strip, offering various uses to the inhabitants of the village. It starts at the train station, passes the church, flows into the historic centre near the castle, and extends down to the green park and the river.

+ Municipal data center
Data Lab Andelfingen
Railway
Street



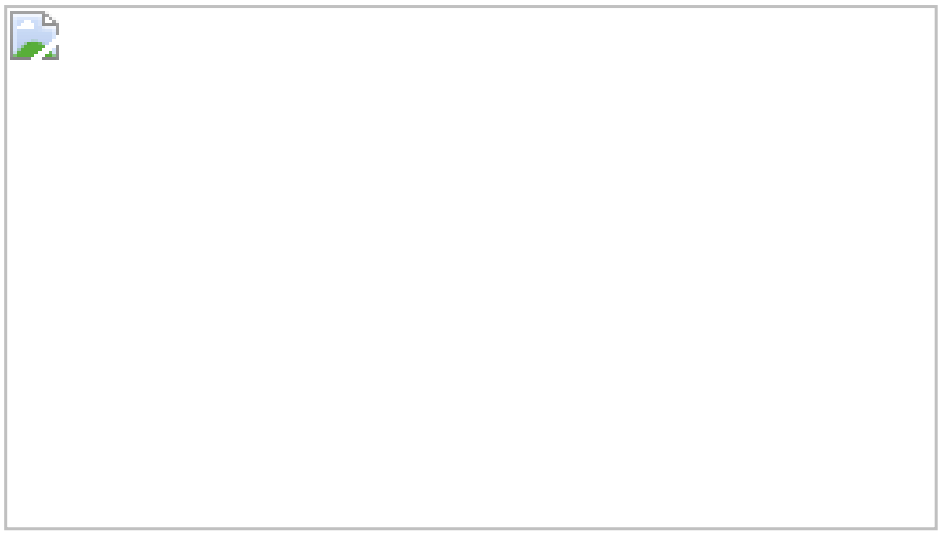
Station Arrival
The Data Lab starts at the train station. A physically drawn line runs through the park, representing a cable. Passing the info point, you reach the charging station, where you can place your smartphone. The route then continues…



Village Square
…to the village square, which offers numerous leisure activities as well as Café Datacino.



Data Tower Park
The highlight is located in the park: the Data Tower, featuring stacked racks. From here, you enjoy a view of the entire facility. In addition, the park features a greenhouse and a kiosk with a workspace.



Cable Path to the River Pool
Finally, the "Cable Path" which displays the inner structure of a cable, leads to

The Architecture of the Andelfingen Intermunicipal Data Lab

NON-EXTRACTIVE MATERIALS

We build with the future in mind. By prioritizing renewable resources like rammed earth and timber constructions, we actively minimize our environmental footprint and consciously avoid the use of concrete and steel.

PHONE-FREE GADGETS

We create spaces to disconnect. Through active sports areas and secure, designated charging stations, we invite visitors to unplug, leave their devices behind, and reconnect with their surroundings and each other.

EDUCATIONAL INFRASTRUCTURE

We bridge technology and community. By making our server racks visible from the outside, we demystify data infrastructure and promote digital literacy. To close the loop, the server’s waste heat is repurposed to power a community greenhouse, serving as a hands-on learning hub for local schools.

Potential for Intermunicipal Data Labs in the Canton of Zurich

We divided the Zurich cluster into intermunicipal units to explore how digital infrastructure could function on a more local scale. The proposal distributes the infrastructure across multiple regional clusters of municipalities, forming interconnected Data Labs.

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David Herter, journalist at the *Landbote*
Fence, hacker and member of the board of director at the Chaos Computer Club Zürich
Lukas, neighbour of the Vantage data centre in Winterthur
Laurent, activist at the Aufstände der Allmend movement

ChatGPT and Google Gemini was used for spelling correction.
All images by the authors if not otherwise stated.

SOURCES

- “Abwärme-Deal mit US-Firma hängt in der Luft”. *Tagesanzeiger*. Accessed April 20,2026. https://www.tagesanzeiger.ch/datacenter-in-winterthur-abwaerme-deal-mit-us-firma-haengt-in-der-luft-184861202355
- “2025 Annual Survey Report”. *Uptime Institute*. Accessed April 26, 2026. https://datacenter.uptimeinstitute.com/rs/711-RIA-145/images/2025\.Annual.Survey.Report.pdf
- “Backblaze Drive Stats for 2024”. *Backblaze*. Accessed May 2, 2026. https://www.backblaze.com/blog/backblaze-drive-stats-for-2024/
- “Businesses by Size”. *GIS Zürich*. Accessed May 15. https://zgz.statistik.zh.ch/publikation/betriebe-groesse?gc=1&tab=grafik&kgtc=3>c=1&metrik=64&kat2=76
- “DS224+ Product Specifications”. *Synology*. Accessed April 16, 2026. https://www.synology.com/en-us/products/DS224%2B
- hosting, Marius. “How much electricity / power does a Synology NAS use?”. Accessed April 22, 2026. https://mariushosting.com/how-much-electricity-power-does-a-synology-nas-use/
- “Ultrastar DC HC680 Data Sheet”. *Western Digital*. Accessed April 25, 2026. https://documents.westerndigital.com/content/dam/doc-library/en_us/assets/public/western-digital/product/data-center-drives/ultrastar-dc-hc600-series/data-sheet-ultrastar-dc-hc680\.pdf

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Architecture of Territory
Professor Milica Topalović

TEACHING TEAM
Dorothee Hahn
Martin Kohlberger
Yiqiu Liu
Milica Topalović
Jakob Walter
Jan Westerheide

Prof. Milica Topalović
ETH Zurich
ONA G41
Neunbrunnenstrasse 50
8093 Zurich
Switzerland
+41 (0)44 633 86 88
www.topalovic.arch.ethz.ch