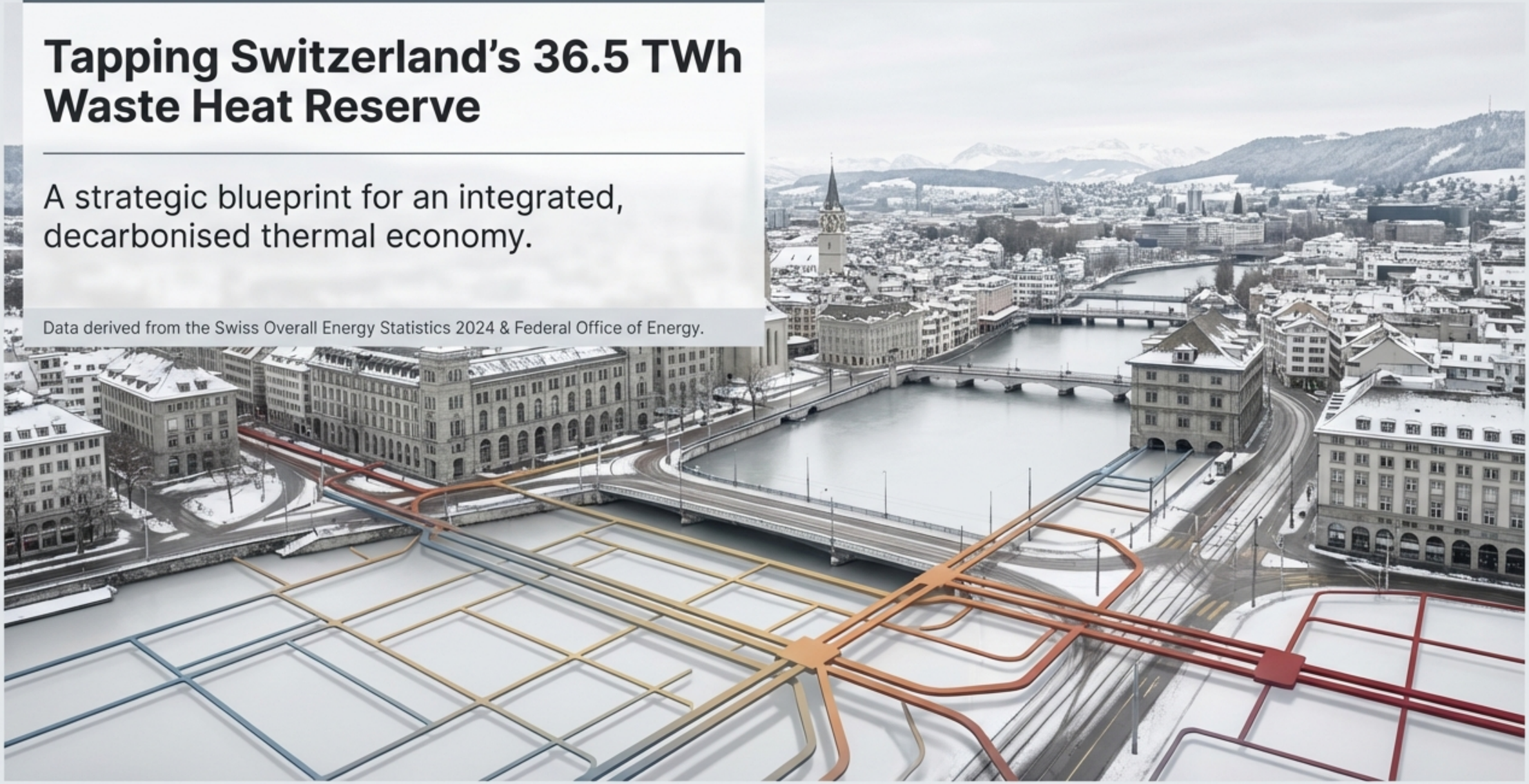
Tapping Switzerland's 36.5 TWh Waste Heat Reserve

A strategic blueprint for an integrated, decarbonised thermal economy.

Data derived from the Swiss Overall Energy Statistics 2024 & Federal Office of Energy.



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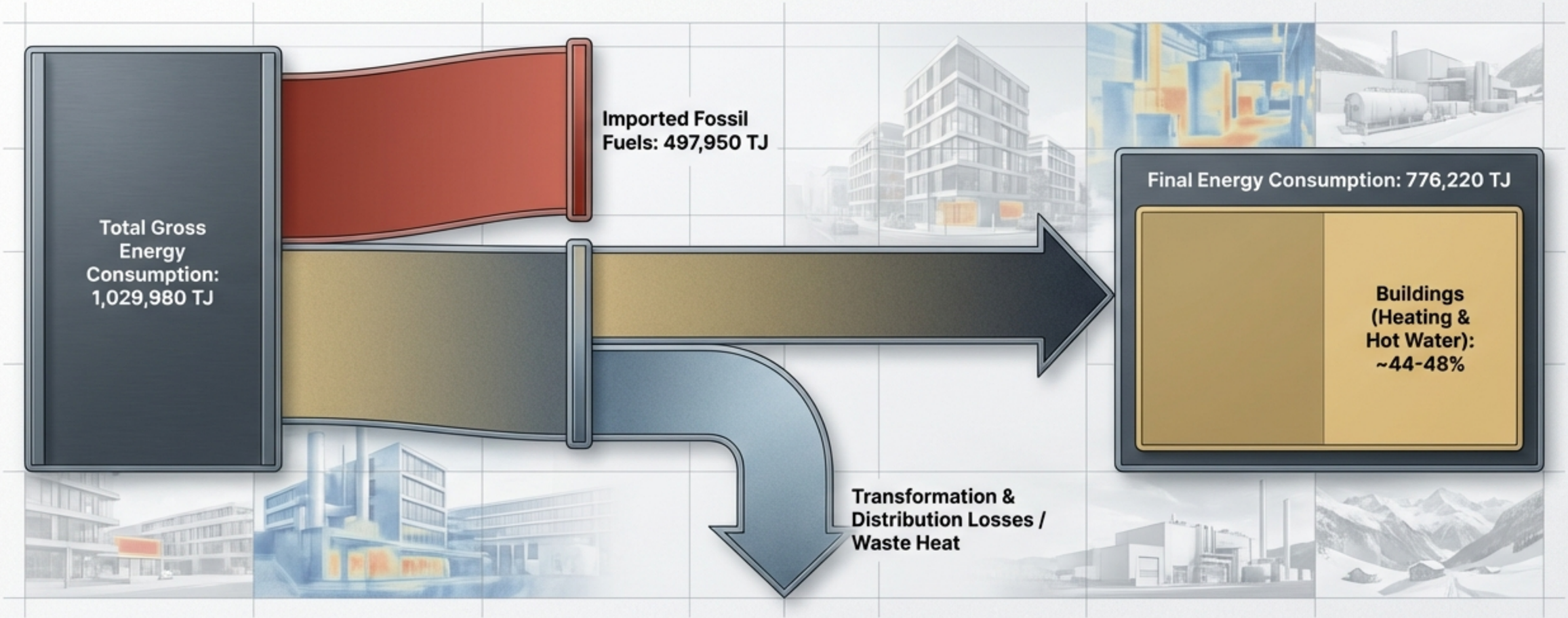
The Primacy of Thermal Energy in Final Consumption

Flow and Loss



The Core Driver

Buildings consume nearly half of Switzerland's final energy, fundamentally driving national demand.

The Fossil Dependency

In 2023, the residential sector required 168.6 PJ for heating—over half supplied directly by imported heating oil and natural gas.

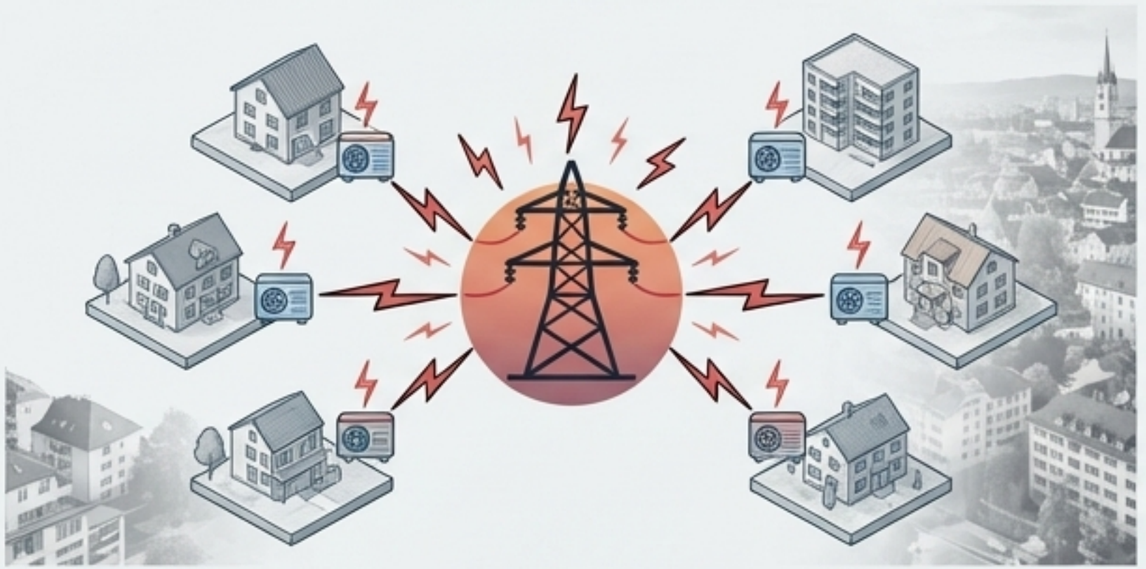
The Inefficiency

Energy transformation processes create immense streams of waste heat currently dissipated into the atmosphere as pure loss.

The Danger of the Decentralised Default

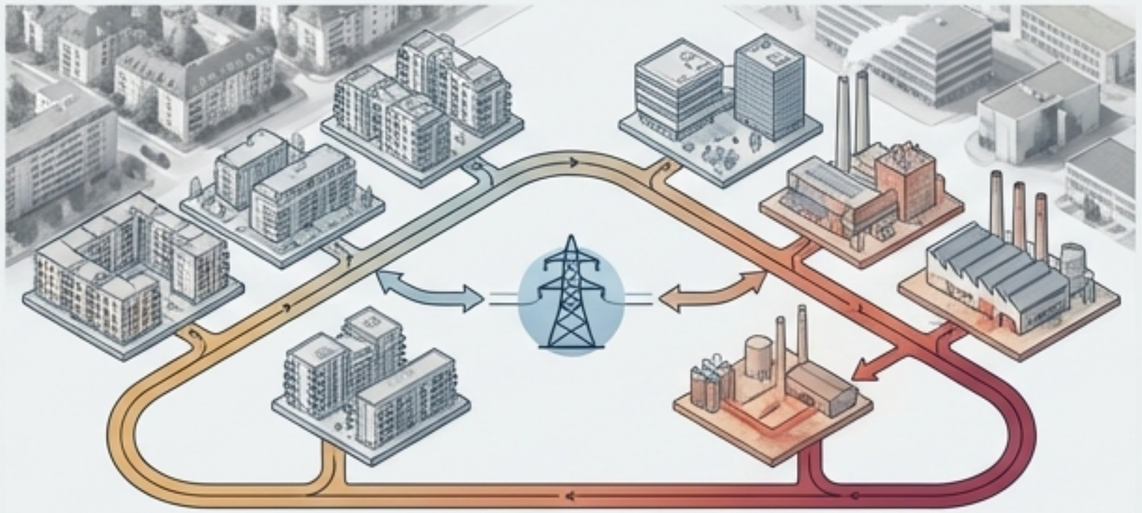
Paradigm Matrix

Path A: Uncoordinated Electrification



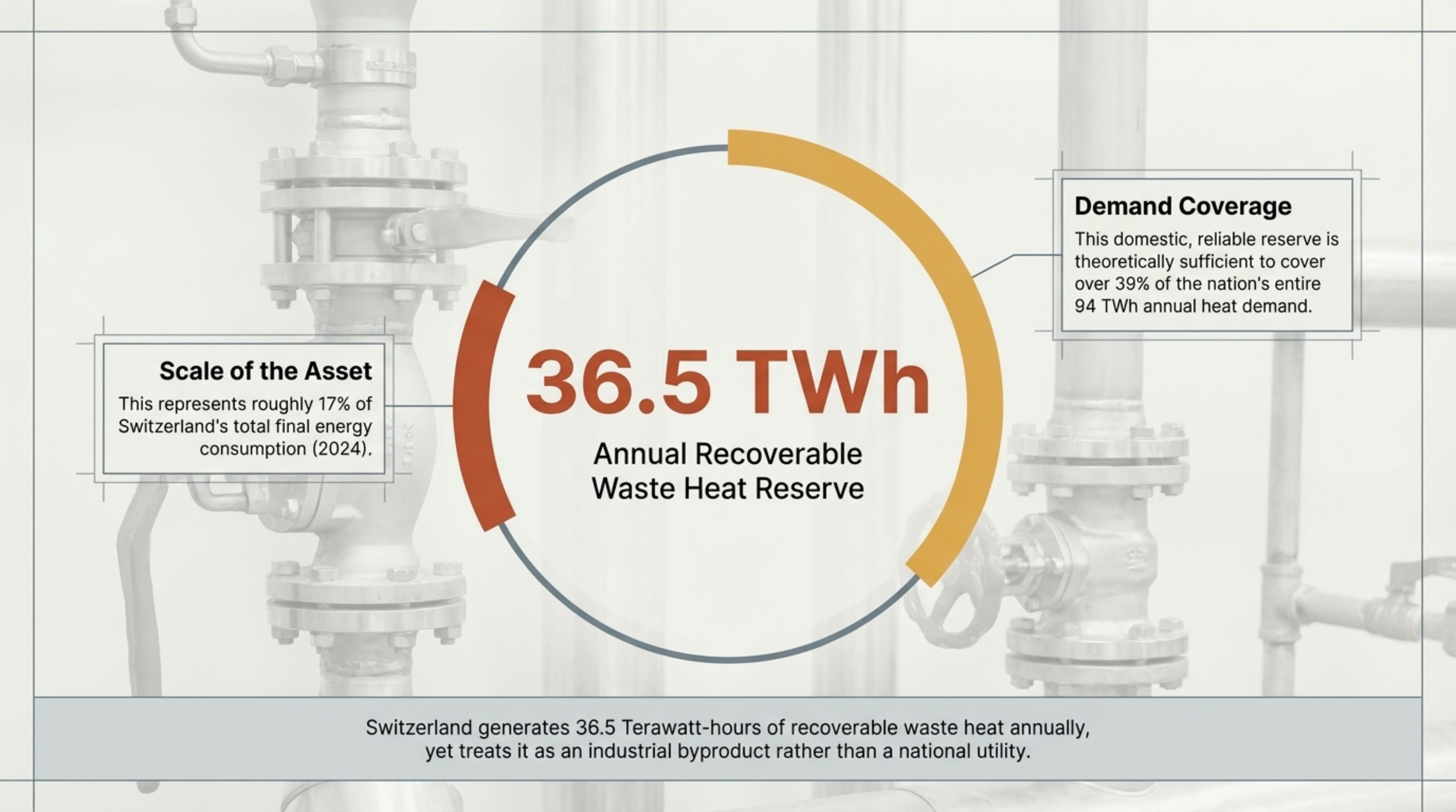
- **Technology Adoption**: Individual heat pumps now heat 21.3% of homes (a 460% increase since 2000).
- **Systemic Risk**: Millions of uncoordinated heat pumps create severe winter peak loads, demanding massive electrical grid over-dimensioning.
- **The Lock-in Effect**: Every isolated unit installed destroys the future economic viability of collective thermal infrastructure.

Path B: Systemic Thermal Integration



District Heating and Cooling (DHC)

- **Technology Adoption**: District heating remains stagnant, serving only 3.8% of the residential market.
- **Strategic Alternative**: DHC physical infrastructure aggregates diverse local waste heat sources, decoupling thermal demand from instantaneous electrical load.
- **Capital Efficiency**: Built once at scale, reducing individual residential CAPEX and long-term grid vulnerability.



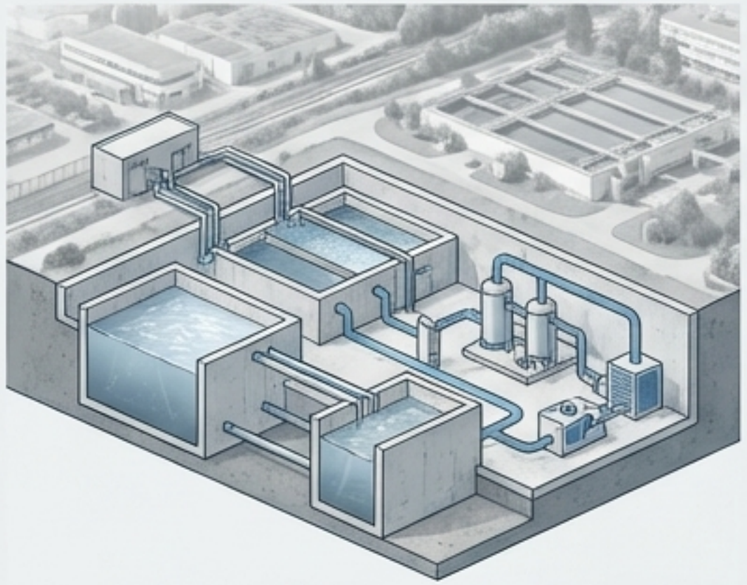
Switzerland generates 36.5 Terawatt-hours of recoverable waste heat annually, yet treats it as an industrial byproduct rather than a national utility.

Mapping the Urban Furnace: A 36.5 TWh Inventory

Wastewater Treatment (WWTPs)

15.0 TWh (41%)

- Temperature Range: <45°C
- A continuous, ubiquitous low-temperature resource available in virtually every Swiss municipality.

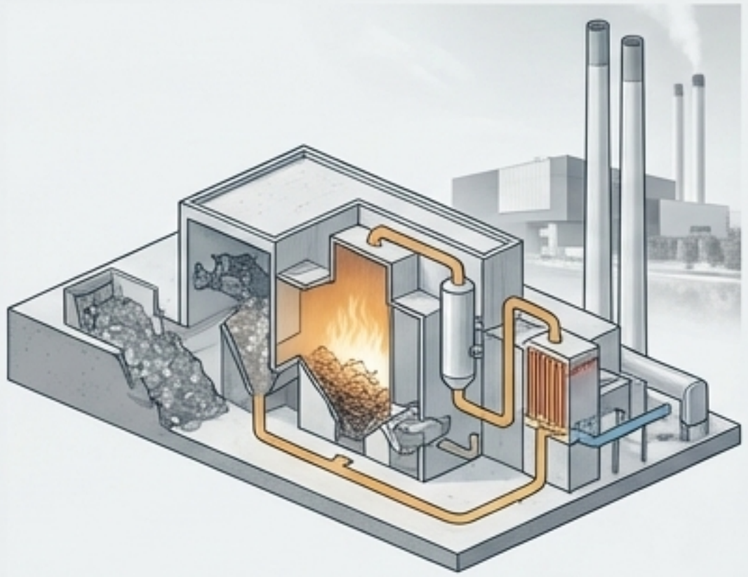


- **Temperature Range:** <45°C
- A continuous, ubiquitous low-temperature resource available in virtually every Swiss municipality.

Municipal Waste Incinerators (MSWIs)

10.7 TWh (29%)

- Temperature Range: 45–70°C
- A highly reliable, medium-temperature thermal engine strategically co-located near dense urban demand centres.

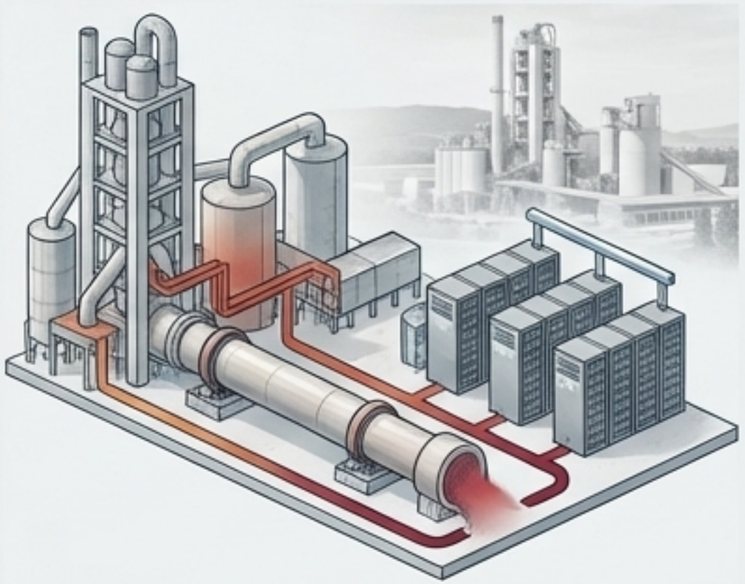


- **Temperature Range:** 45–70°C
- A highly reliable, medium-temperature thermal engine strategically co-located near dense urban demand centres.

Industrial & Cement Facilities

10.6 TWh (29%)

- Temperature Range: >70°C
- High-grade process heat suitable for direct industrial application or integration into high-temperature loops.



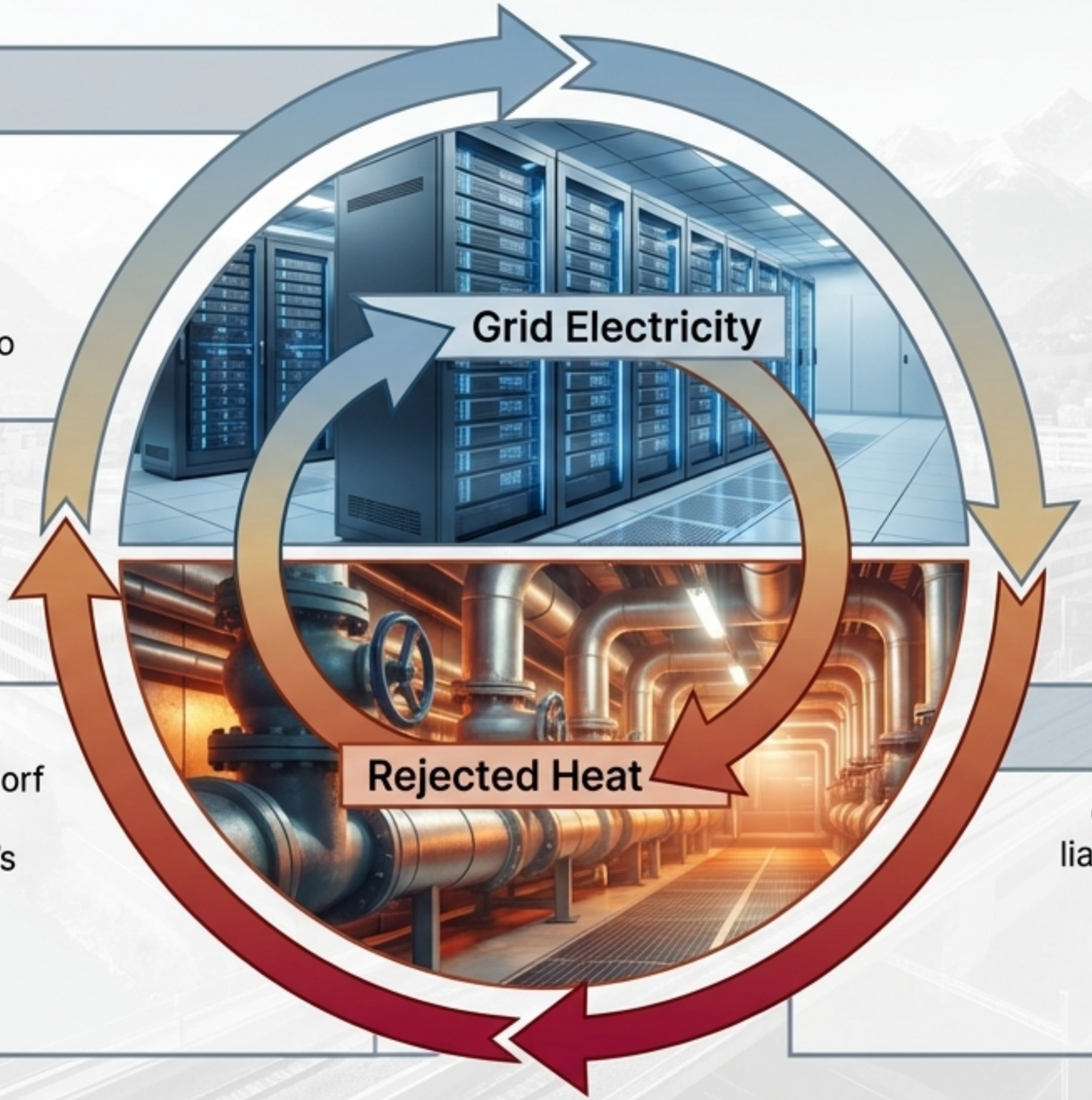
- **Temperature Range:** >70°C
- High-grade process heat suitable for direct industrial application or integration into high-temperature loops.

The Cooling Paradox: A Circular Symbiosis

The Emerging Demand

Cooling and ventilation now consume nearly 11% of Switzerland's electricity.

Data centre electricity use alone is projected to reach 2.7 to 3.5 TWh by 2026.



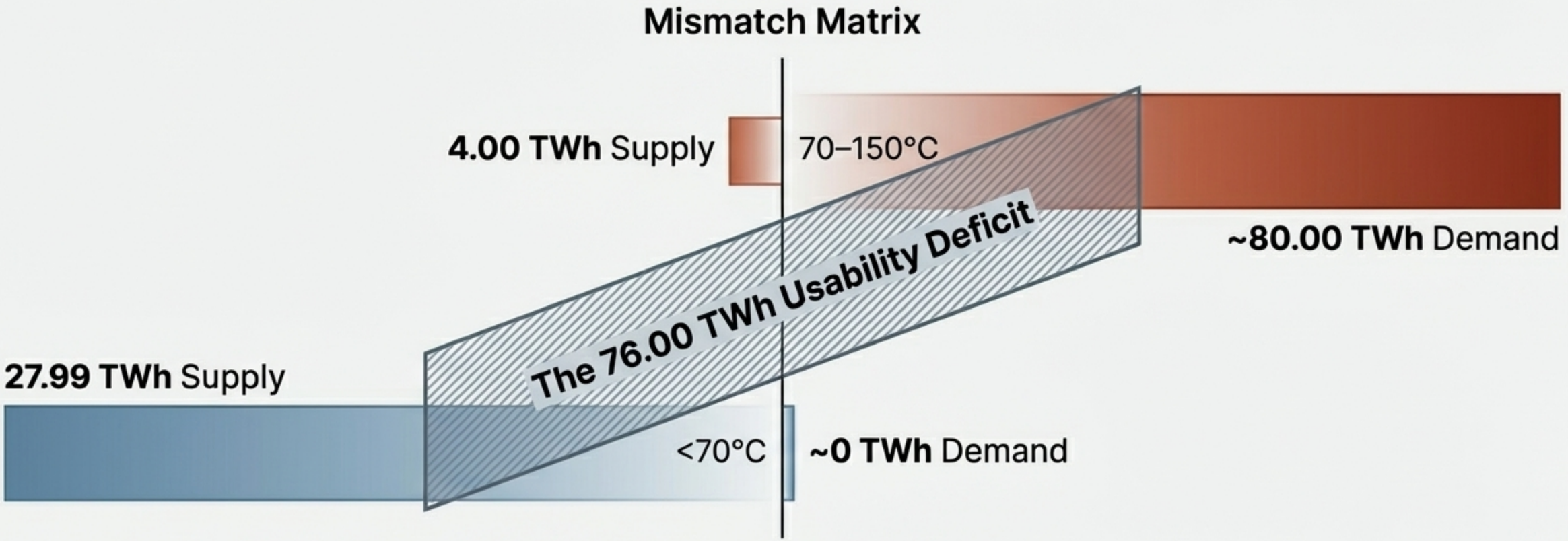
The Circular Opportunity

Facilities like Swisscom's Wankdorf already feed up to 15 GWh of rejected heat annually into Bern's local district heating network, transforming a summer cooling problem into a winter heating solution.

The Symbiosis

Cooling is not merely an energy liability; it is a predictable thermal engine. Every kilowatt-hour used for cooling rejects usable heat into the environment.

Barrier I: The Temperature Gap



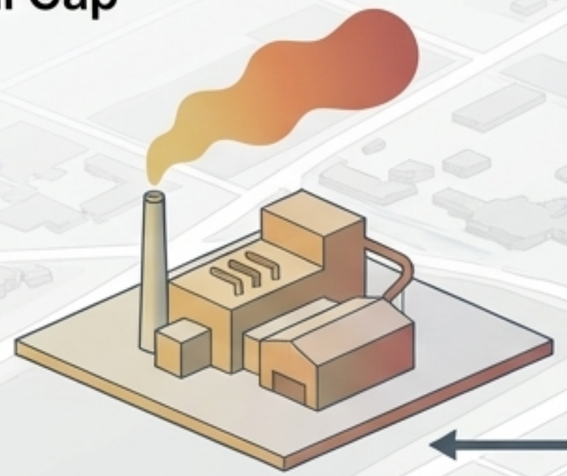
The Low-Temp Surplus	The High-Temp Deficit
77% of available waste heat is generated at temperatures below 70°C, yielding a 27.99 TWh oversupply in this bracket.	The existing Swiss building stock primarily requires space heating between 70–150°C, creating a severe structural deficit in usable, direct-supply heat.

Barrier II & III: The Spatio-Temporal Disconnect

The Spatial Gap

Inter Medium

Waste heat sources are geographically co-located near urban demand, but remain isolated without comprehensive district heating networks connecting supply to users.



MSWI Waste Heat Source

Missing Physical DHC Infrastructure

Residential Heat Demand

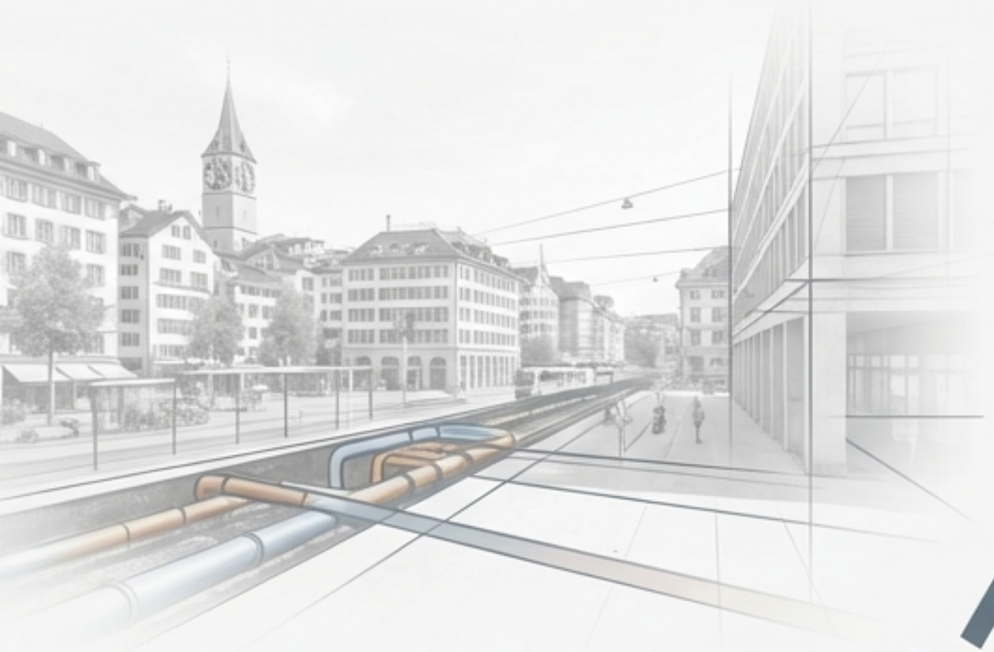
The Temporal Gap

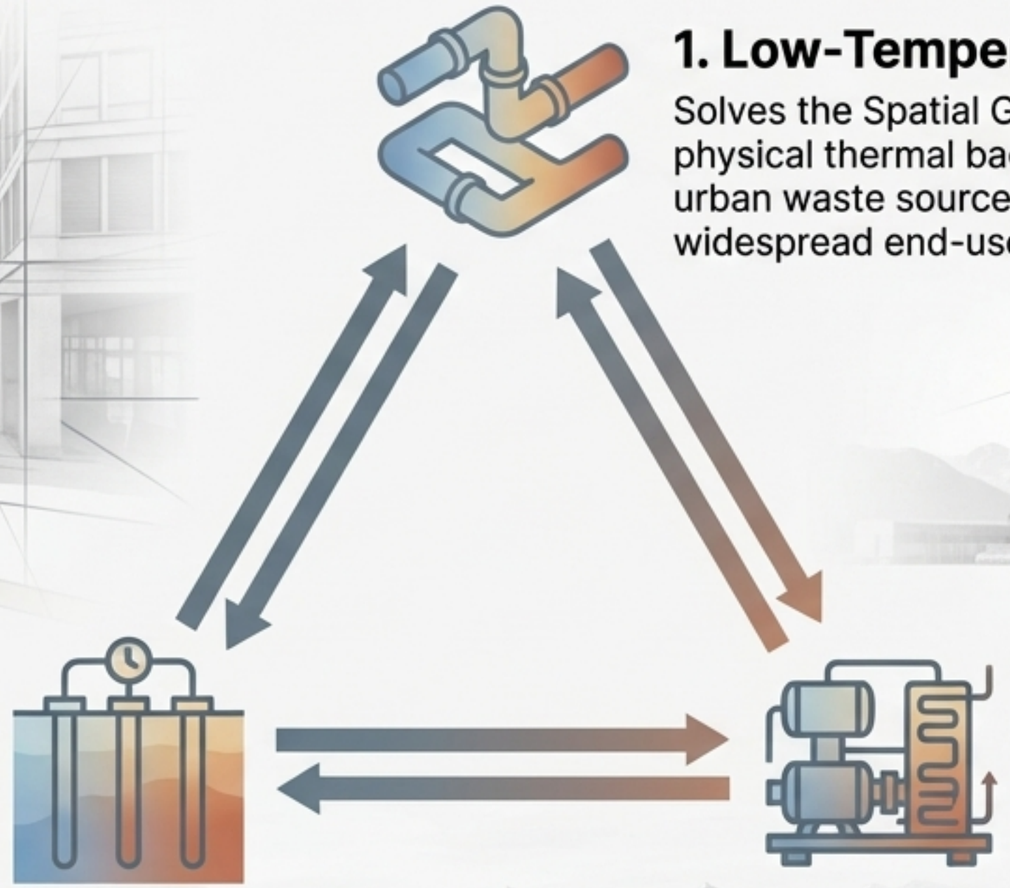
Inter Medium

Over 300 municipalities possess a net summer heat surplus, while face:ane facing massive winter deficits. Without seasonal storage, the system cannot balance itself over time.

The Systemic Blueprint: The Technical Trinity

A single technology cannot solve a systemic mismatch. Unlocking the 37 TWh reserve requires a rigidly interdependent infrastructure triad.





1. Low-Temperature DHC

Solves the Spatial Gap by acting as a physical thermal backbone, connecting urban waste sources directly to widespread end-users.

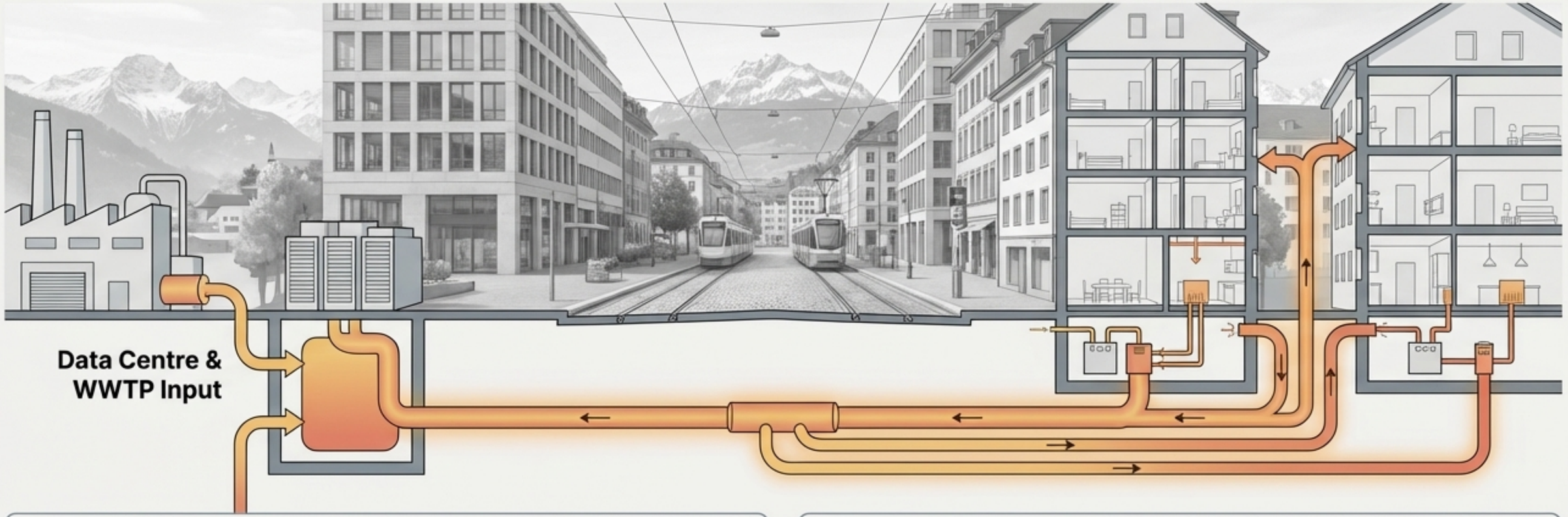
3. Seasonal Thermal Energy Storage

Solves the Temporal Gap by physically banking the vast summer industrial heat surplus in subterranean reservoirs for extraction during the winter peak.

2. Large-Scale Heat Pumps

Solves the Temperature Gap by thermodynamically upgrading high volumes of low-grade 15°C ambient heat to the 70°C required for older building stock.

Pillar 1: Low-Temperature District Heating



The Thermal Backbone

Inter Megular

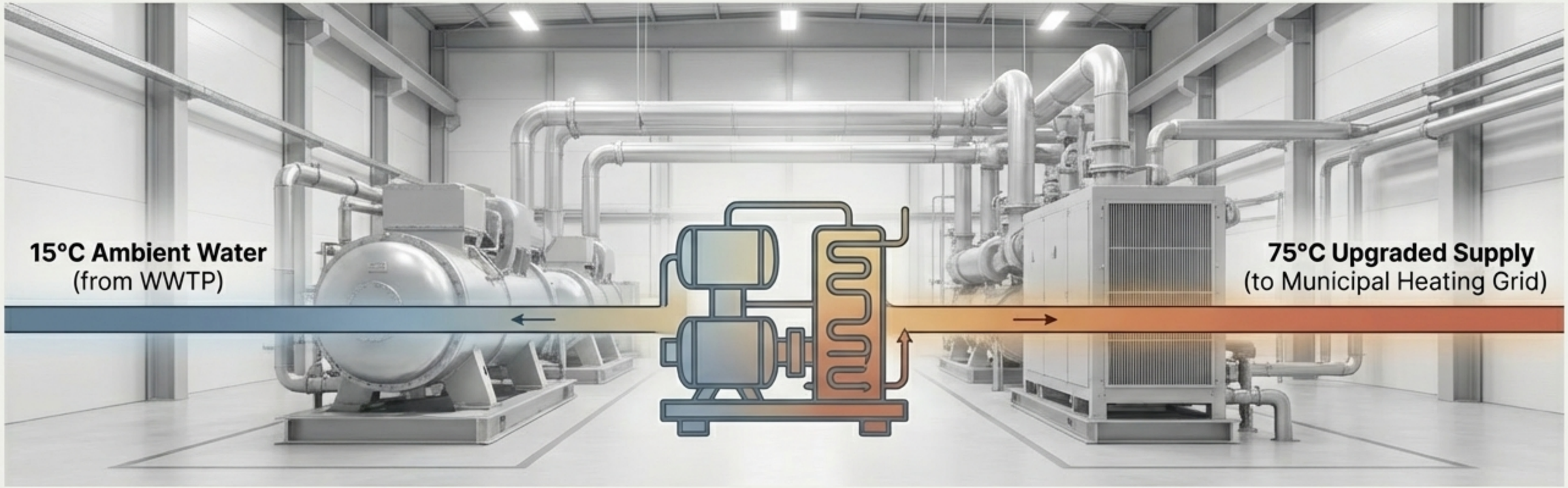
Modern networks operate efficiently at lower temperatures (40-70°C). This distinct engineering parameter uniquely enables the integration of the 77% of Switzerland's waste heat that falls precisely into the low-temperature bracket.

Integration Platform

Inter Megular

DHC moves beyond simple point-to-point delivery. It acts as an open aggregator, seamlessly combining industrial waste heat, geothermal probes, and biomass into a single, highly resilient municipal energy grid.

Pillar 2: Large-Scale Heat Pumps



Bridging the Temperature Gap

Inter Megular

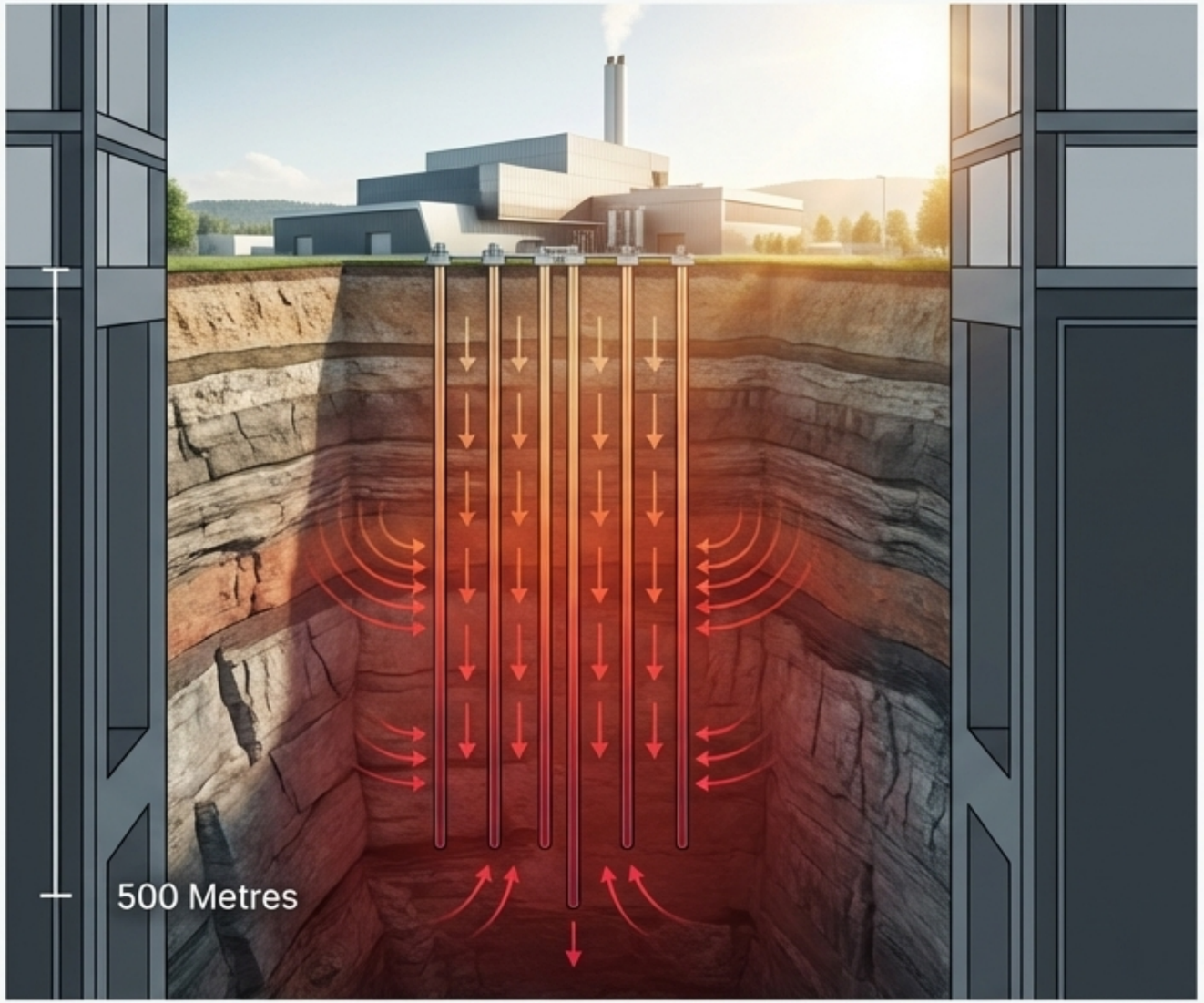
Sited directly at major waste heat nodes, centralized heat pumps efficiently upgrade immense volumes of low-grade ambient heat to the 60-80°C parameters strictly required for retrofitting older, legacy building stock.

Grid Superiority

Inter Megular

Industrial-scale systems offer vastly superior Coefficients of Performance (COP) and economies of scale compared to thousands of individual residential units, while providing critical, aggregated demand-side management services to stabilize the national electrical grid.

Pillar 3: Seasonal Thermal Energy Storage (STES)



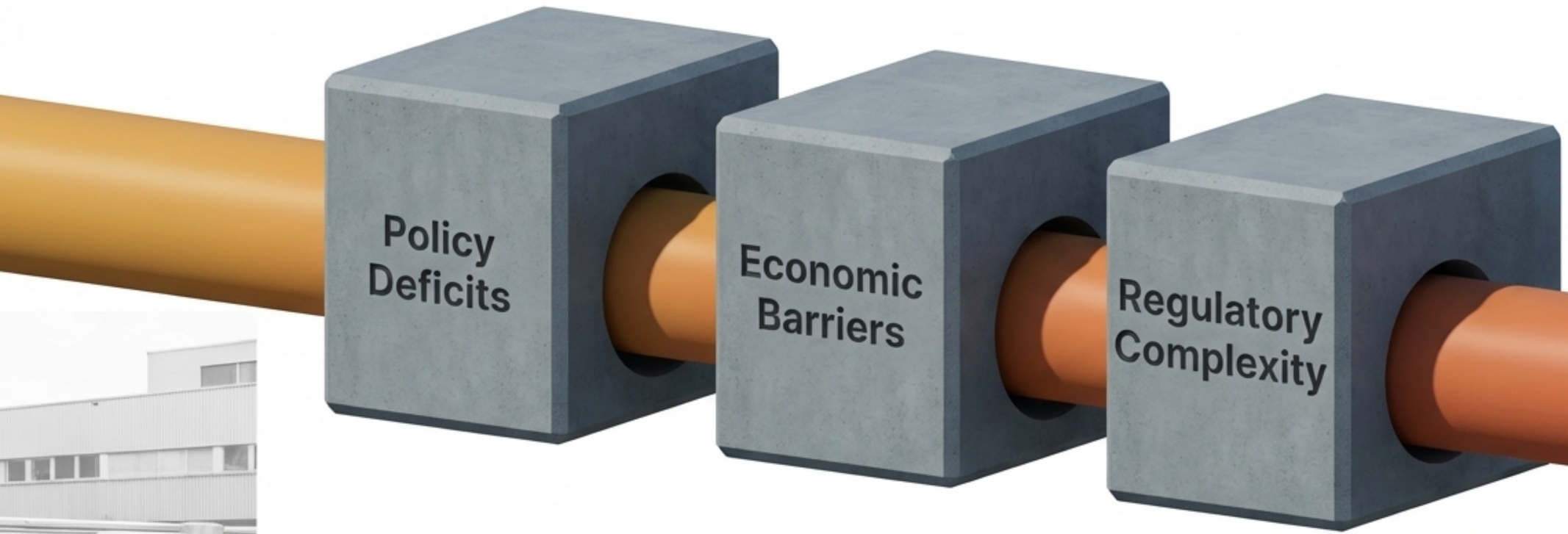
Shifting Time

STES physically banks the vast summer heat surplus in geological reservoirs, aquifers, or deep pits. This thermal energy is stored for months, ready for extraction during the winter peak to entirely offset seasonal grid strain.

Proven Viability

The pilot project in Bern—actively storing excess MSWI heat in a geological reservoir 500 metres underground—demonstrates the operational reality and physical feasibility of this technology within the Swiss geotechnical context.

The Inertia of the Status Quo



A 'silo approach' to planning. Gas, electricity, and thermal infrastructure are developed independently without legally binding, integrated spatial energy plans at the municipal level.

DHC requires intensive upfront capital expenditure (CAPEX) with long payback periods, competing unfavourably in the short term against fully amortised legacy natural gas grids.

Project development is stifled by perceived risks in long-term industrial heat supply and the sheer complexity of multi-stakeholder municipal negotiations.

The Policy Roadmap for Thermal Integration

1. Mandate Spatial Planning

Adopt a federal framework requiring municipalities over 20,000 to enact binding priority zones for district district heating and clear gas phase-out schedules.

2. Cadastre & Capital

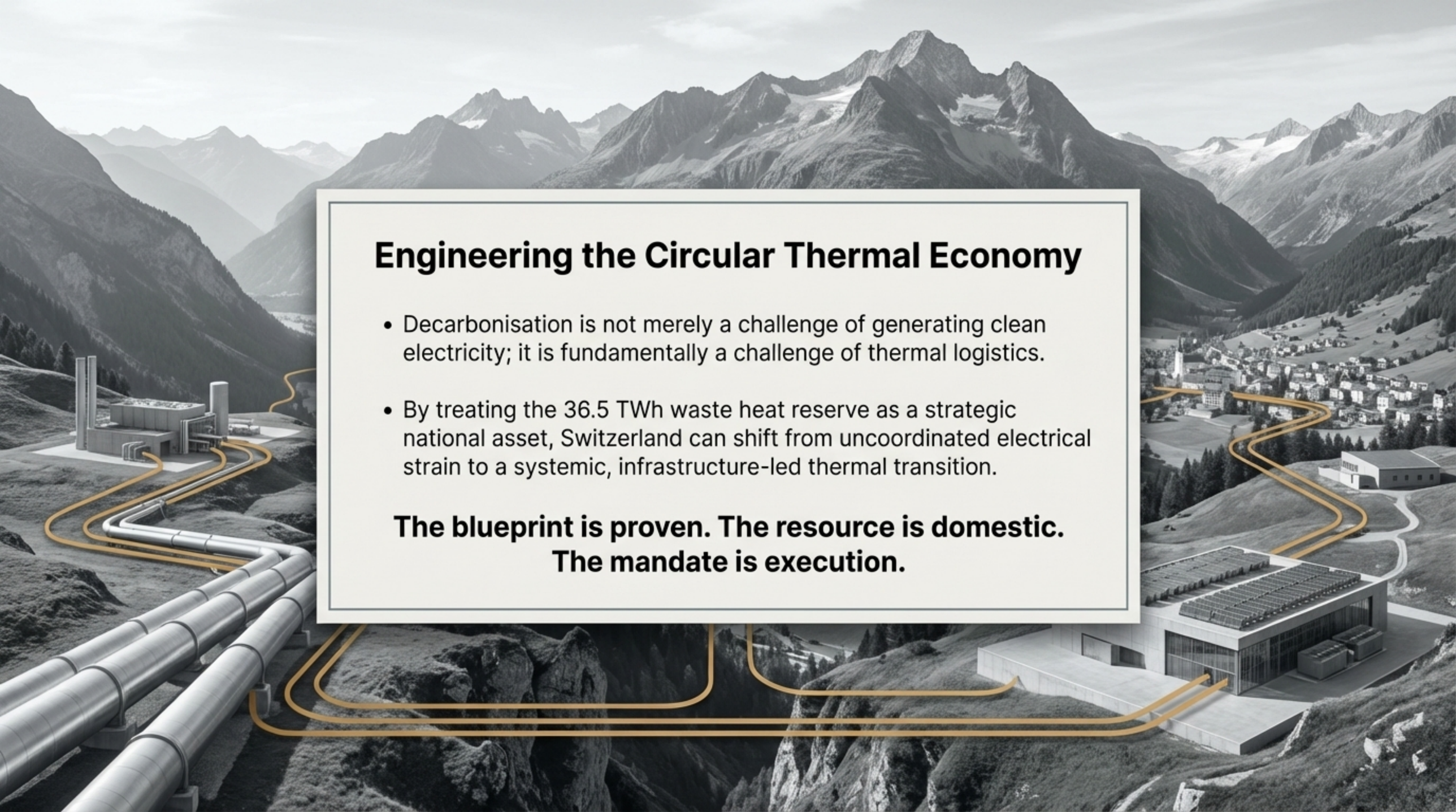
Deploy a public GIS 'National Waste Heat Cadastre' paired with a federal Thermal Infrastructure Fund to de-risk high-CAPEX networks and seasonal storage.

3. Regulatory Reform

Grant DHC networks distinct 'utility' status, ensure priority land access, and eliminate legal obligations connecting new builds to natural gas.

4. Competence Centres

Establish national hubs to provide technical assistance, standardized planning methodologies, and neutral facilitation for public-private partnerships.



Engineering the Circular Thermal Economy

- Decarbonisation is not merely a challenge of generating clean electricity; it is fundamentally a challenge of thermal logistics.
- By treating the 36.5 TWh waste heat reserve as a strategic national asset, Switzerland can shift from uncoordinated electrical strain to a systemic, infrastructure-led thermal transition.

The blueprint is proven. The resource is domestic.
The mandate is execution.