Supplementary Information

Mapping Local Synergies: Spatio-Temporal Analysis of Switzerland's Waste Heat Potentials vs. Heat Demand

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A. Methods

A.1 Cement plants

Table S1. Annual cement production and specific heat demand per tonne of produced cement of the six Swiss cement plants.

Cement Plant	Cement Production [Mt]	Specific Heat Demand [MJ/t]
Holcim Untervaz	800 [1]	2493 [2]
Holcim Siggenthal	900 [3]	2567 [2]
Jura-Cement	800 [4]	2700 [5]
Ciments Vigier	900 [6]	2631*
Juracim	300 [7]	2631*
Holcim Ecl´epens	700 [8]	2764 [2]

* Average value of the other cement plants

Table S2: Waste heat sources within a cement plant and their average temperatures as reported by [9].

Heat Source	Inlet exhaust gas temperature	Outlet exhaust gas temperature	Heat output
Furnace exhaust heat exchanger	420°C	180°C	3930 kW
Chimney exhaust heat exchanger	150°C	120°C	2110 kW
Total heat provision from exhaust waste heat			**6040 kW**
Heat Source	Inlet air temperature	Outlet air temperature	Heat output
Rotary kiln	18.6°C	92.9°C	1300 kW
Drying plant	92.9°C	56.6°C	**A**

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A.2 Municipal solid waste incinerators

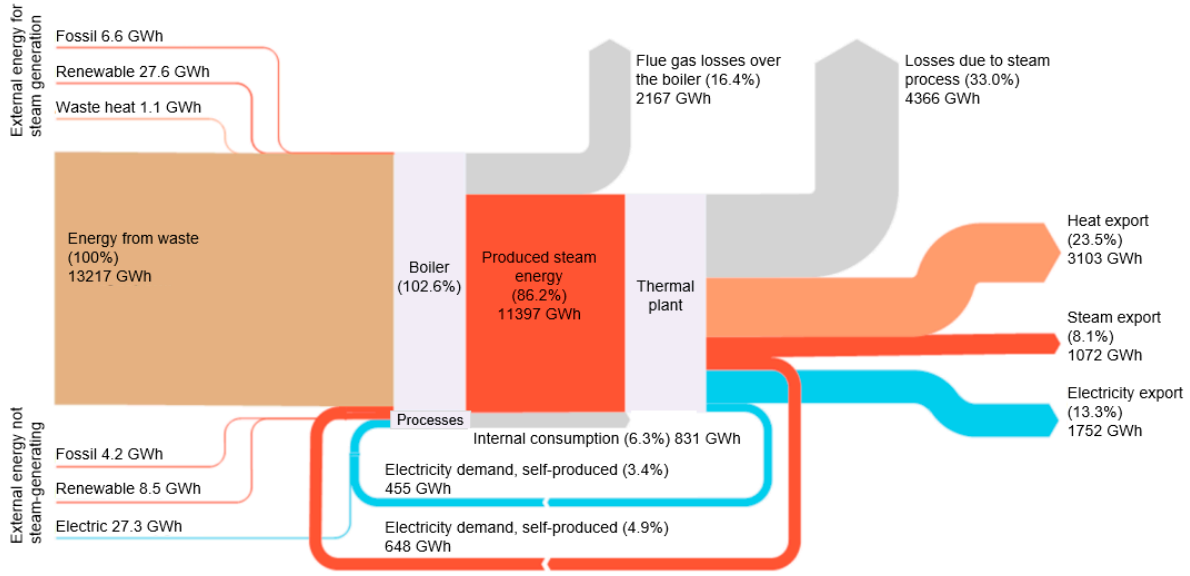

Figure S1: Representation of the energy flow of an average Swiss KVA in the year 2021, translated from [10].

A.3 Biogas plants

Table S3: Average fermenter's own thermal energy demand depending on the output of the CHP plant, translated from [11].

Type and power of the biogas plant	Annual capacity (tonnes of fresh substance / year)	Input type	Temperatur-level	Fermenter's own thermal energy consumption (in % of the heat of the CHP)
Small agricultural biogas plant (30-60 kW_{el})	<5000	Mainly liquid manure	Mesophil	40-60%
Medium-sized agricultural biogas plant (150-200 kWel)	8000-15000	80% manure 20% co-substrates	Mesophil	30-40%
Large agricultural biogas plant (300-500 kW_{el})	15000-30000	80% manure 20% co-substrates	Mesophil	25-35%
Industrial biogas plant (400-1000 kW_{el})	20000-30000	Greenwastes and organic industrial wastes	Thermophil	10-30%

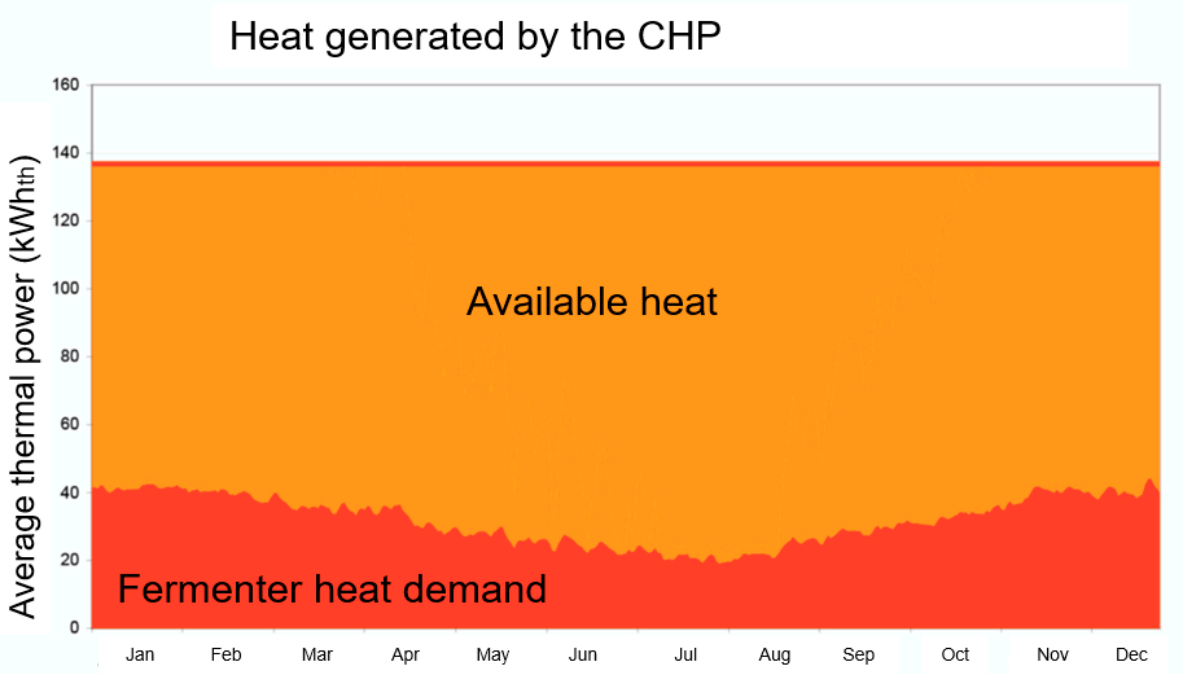

Figure S2: Heat demand of the fermenter during the year, translated from [10].

B. Results

B.1 Heat balance

Figure S3 illustrates Switzerland's annual heat balance at the municipal level, revealing a significant heat deficit in most areas, indicated by the negative balance in yellow–red. Thus, certain municipalities, shown in dark green, display significant surplus waste heat, often due to the presence of MSWIs or industries in those regions.

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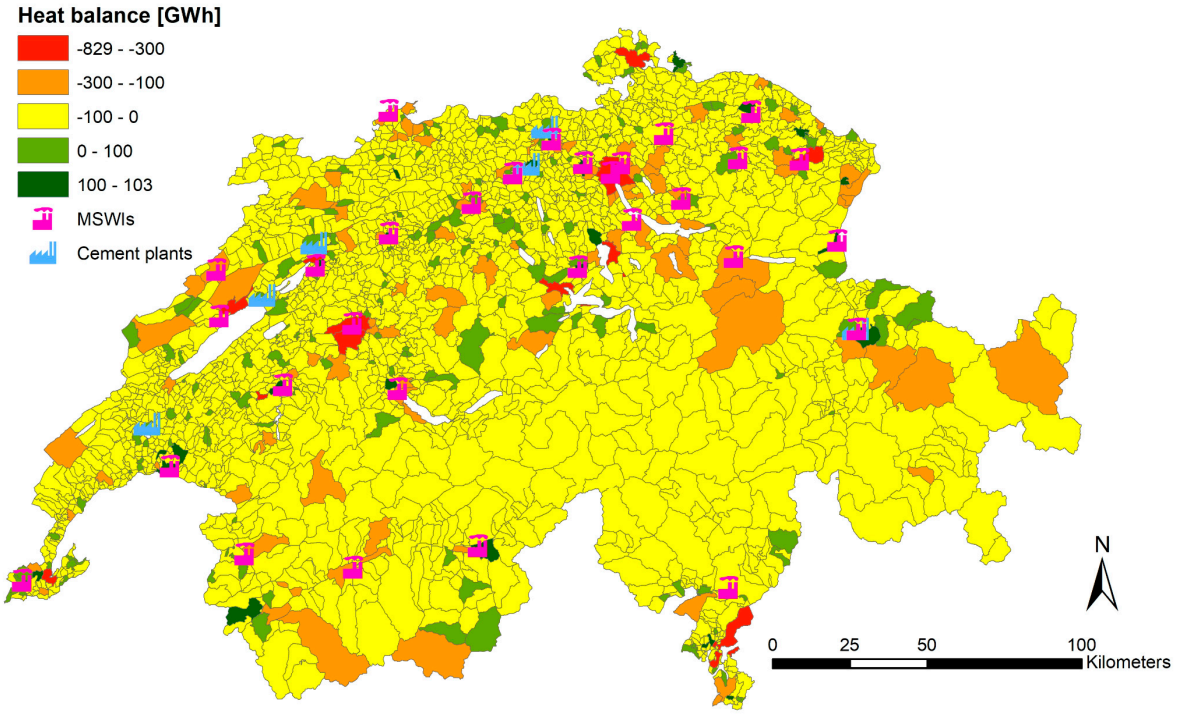

Figure S3. Total annual heat balance across all Swiss municipalities, along with municipal solid waste incinerators (MSWIs) and cement plants.

Within the temperature range below 45°C, no significant current heat demand was identified. Consequently, the heat balance in this range directly aligns with the waste heat within this temperature bracket, estimated at approximately 16.8 TWh. WWTPs contribute around 89%, and the industrial sector accounts for the remaining 11%. Regions with substantial waste heat below 45°C include major cities like Zurich, Basel, and Lausanne, as depicted in Figure S4, where significant WWTPs are located. The co-location of WWTPs and residential buildings holds potential for waste heat utlization.

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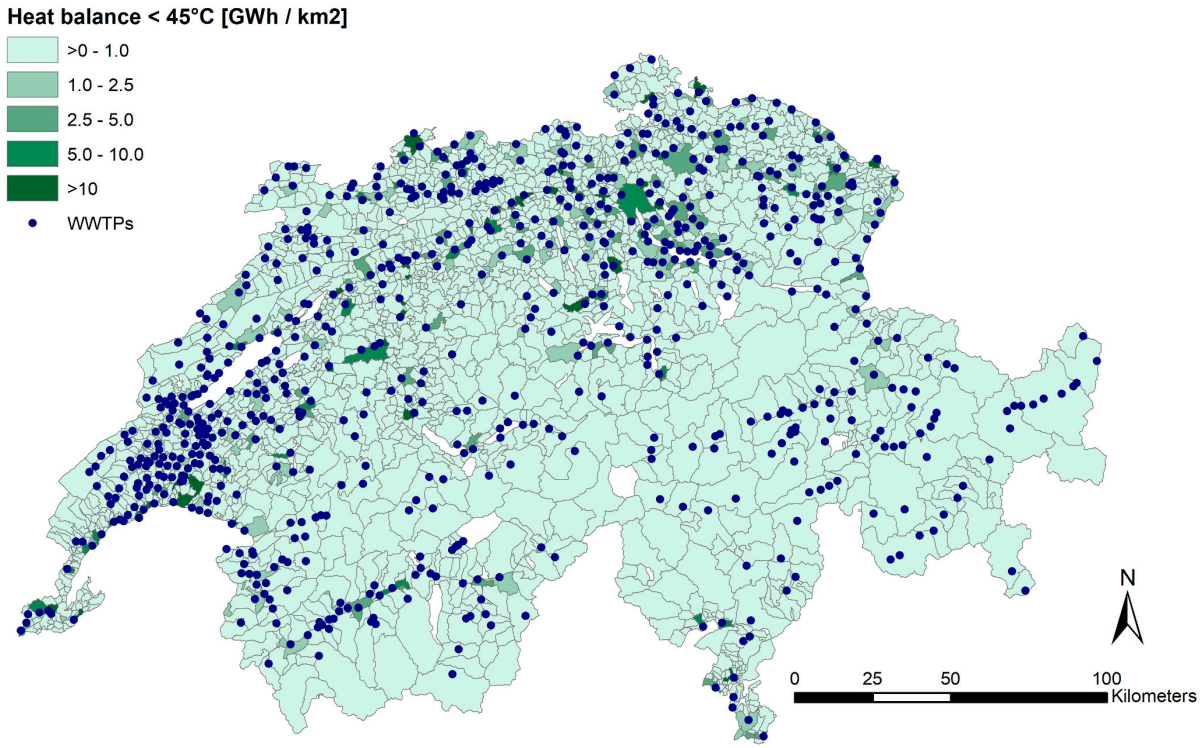

Figure S4: Total annual heat balance with temperatures below 45°C, per km² across all Swiss municipalities (= waste heat potential within this range, given the absence of quantifiable heat demand within this bracket), along with wastewater treatment plants (WWTPs).

Within the temperature range of 45°C to 70°C, a current heat demand was also not identified in this study, and the heat balance also corresponds to the waste heat potential. Waste heat within the temperature range of 45°C to 70°C is generated by various sources including industries and waste-to-energy facilities. This temperature range contributes 11.2 TWh of waste heat annually, making it the second-largest fraction after the waste heat below 45°C. Interestingly, the combined share of waste heat produced by biogas plants and cement plants is relatively small, accounting for less than 2%. The predominant contributor in this range is MSWIs, responsible for approximately 70% of the waste heat. Consequently, municipalities with MSWIs exhibit the highest waste heat potential within this category (see Figure S5).

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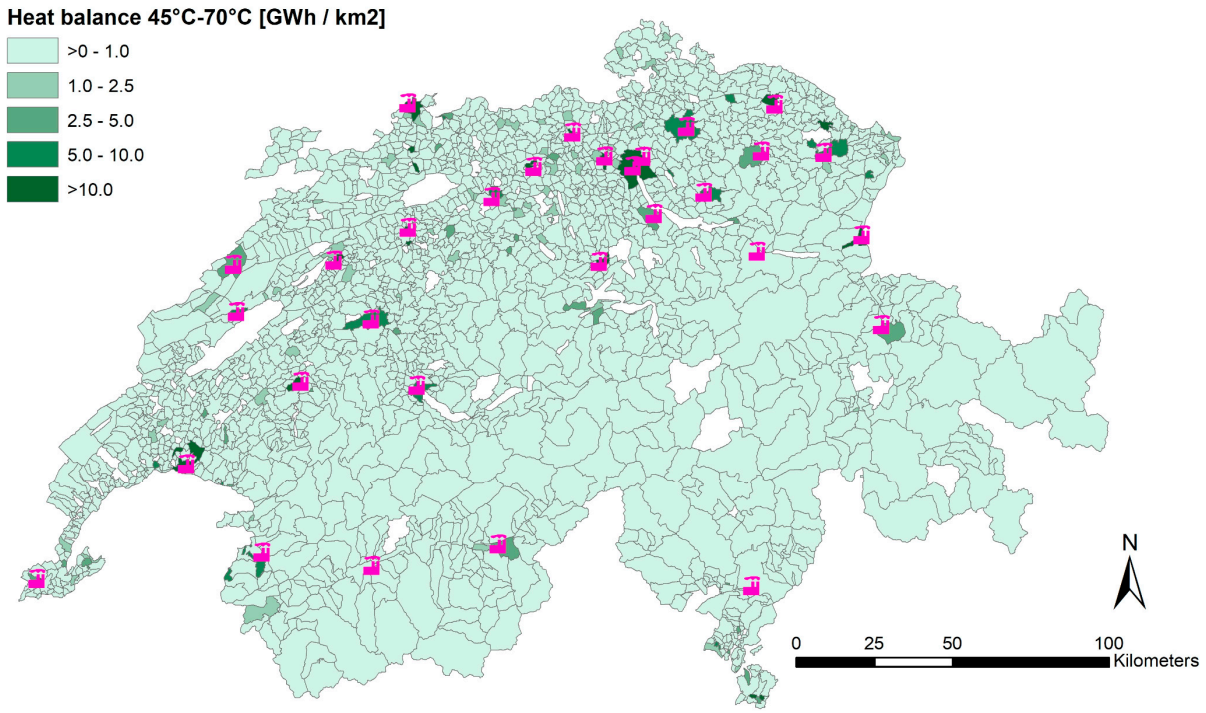

Figure S5: Total annual heat balance with temperatures between 45°C and 70°C, per km² across all Swiss municipalities (= waste heat potential within this range, given the absence of quantifiable heat demand within this bracket), along with municipal solid waste incinerators (MSWIs).

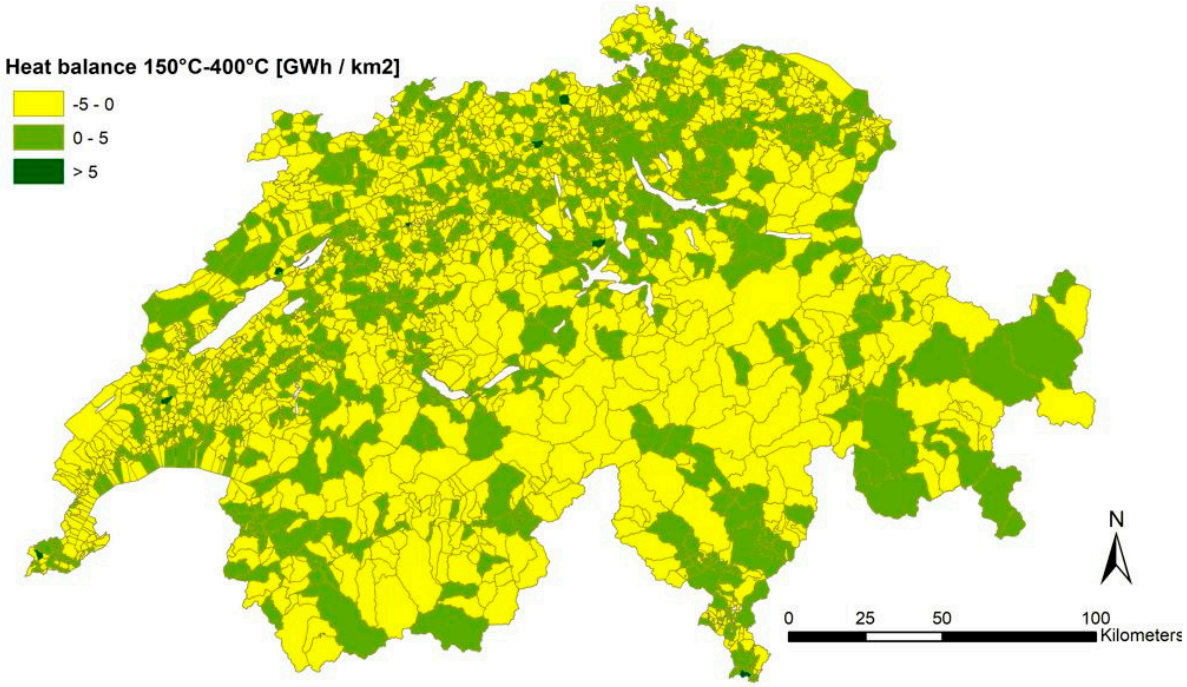

Figure S6: Total annual heat balance with temperatures between 150°C and 400°C, per km² across all Swiss municipalities.

Supplementary Information

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