

Pinch-Based Assessment of Industrial Heat Pump Integration Potential in Swiss Industry

Student: Stefan Kozul

Supervisors: Dr. Benjamin, Ong
Navdeep, Bhadbhade

Expert: Dr. Mercedes, Rittman

Industry Partner: Dr. Timothy, Walmsley

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Heating Demand of Industry in Switzerland

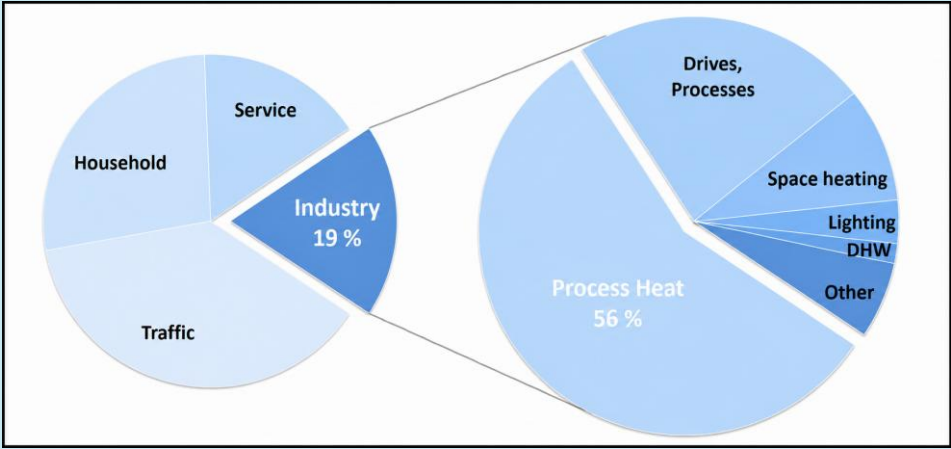


Figure 1: Share of industry in total final energy demand and share of process heat within industrial energy use. (Wellig & Olsen, 2025)

Motivation and Objectives

Industrial process heat is still largely supplied by fossil fuels, although many heat demands are suitable for electrification through heat pumps. This thesis assesses the integration of

- (i) Standard heat pumps and
- (ii) high-temperature heat pump

in selected Swiss industrial cases using pinch analysis targeting. The objectives are to identify (i) suitable heat pump opportunities and (ii) recurring temperature patterns that may support modular solutions for industrial decarbonization.

Method Overview Flowchart

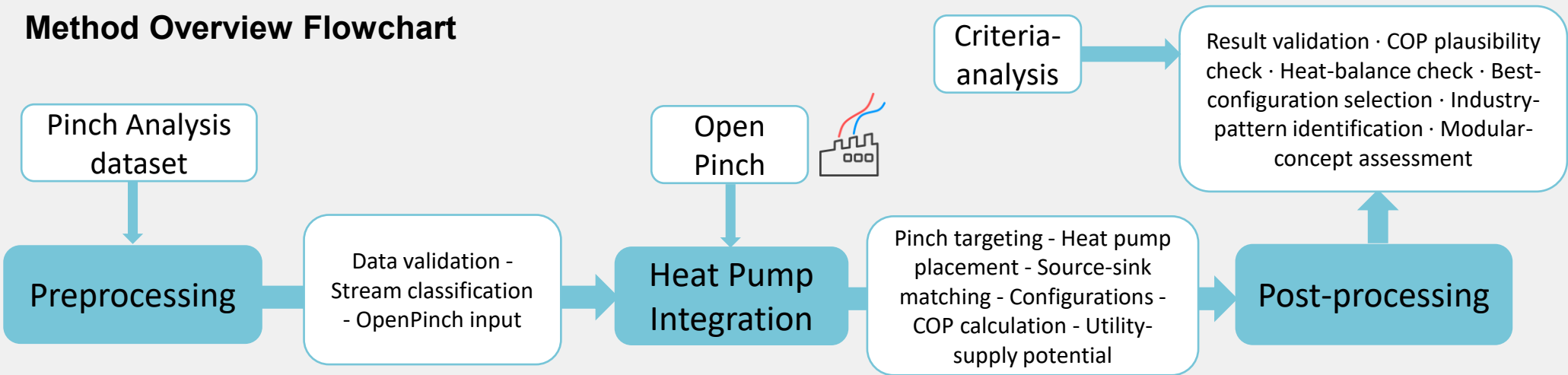


Figure 2: Methodological workflow

Results and Conclusion

Table 1: Results of heat pump integration for Paper Industry.

Company	Condenser Duty (MW)	Coverage (%)	COP	HP Condenser Temperature	HP Evaporator Temperature
1	32.65	55.3	2.32	148 °C	ca. 64.4 °C, 30.0 °C, 17.5 °C
2	6.1	45.6	2.18	159 °C	ca. 30 °C
3	21.06	89.6	2.18	159 °C	ca. 30 °C

The paper-industry cases showed the clearest recurring heat pump pattern, upgrading low-temperature heat near 30 °C to a steam-related utility level near 159 °C. Similar temperature combinations were also identified in selected cases from other industries. This indicates that repeatable heat pump concepts are best defined by recurring source and sink temperatures rather than by sector classification alone.

Table 2: Cross-industry recurring heat pump integration patterns.

Temperature levels	Cases supporting the pattern	Modular potential
Evaporator 30 °C Condenser 159 °C	- Paper industry, - Meat company, - Chocolate company, - Fruit company, - Textile company, - Food company	Strongest modular concept, developed for the paper industry and transferable as a temperature concept to other industry
Evaporator 69 °C Condenser 209 °C	- Chemical companies - Pharma companies 2 Metal companies	Repeated cluster with a suitable current high-temperature technology reference
Evaporator 70 °C Condenser 100 °C sink supply	- Dairy industry - Food & Beverage industry - Packaging company - Chemical company - Metal company	Broad lower-temperature modular application field, strongest in dairy-related processes

Conclusions

A modular high-temperature heat pump concept was proposed for the paper industry using scalable 3 MW HP, condenser-side heating capacity modules. Additional recurring temperature patterns indicate further modular potential, but require more case data and technology-specific validation. Pinch-based targeting provides a structured basis for identifying industrial heat pump opportunities and supporting process heat decarbonization

References

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Walmsley, T. G. (2026). OpenPinch: An open-source Python library for advanced pinch analysis and total site integration. *Process Integration and Optimization for Sustainability*. <https://doi.org/10.1007/s41660-026-00729-6>