

INCREASING INDUSTRIAL ENERGY EFFICIENCY USING PINCH ANALYSIS

BACKGROUND

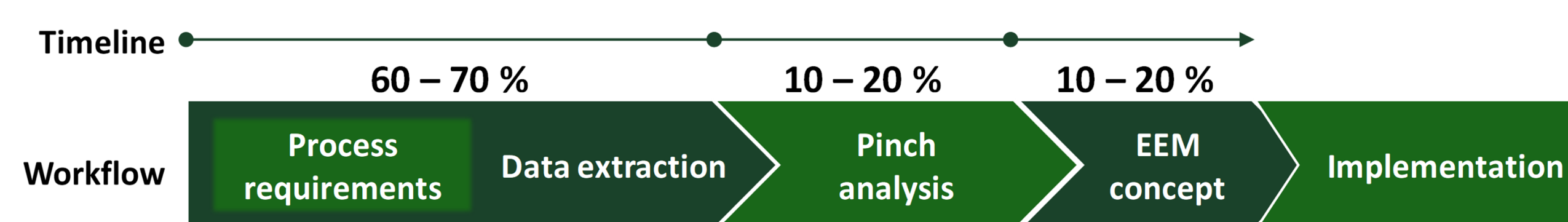
Swiss industry uses approx. 42 TWh/a, of which 24 TWh/a is used for process heating. In praxis, there is a growing need for a holistic view and to allow the systematic planning of industrial thermal energy systems to decarbonise the Swiss industry.

MOTIVATION

The estimated savings potential in Switzerland based on the implementation of **economically feasible energy efficiency (EE) measures (EEMs)** are:

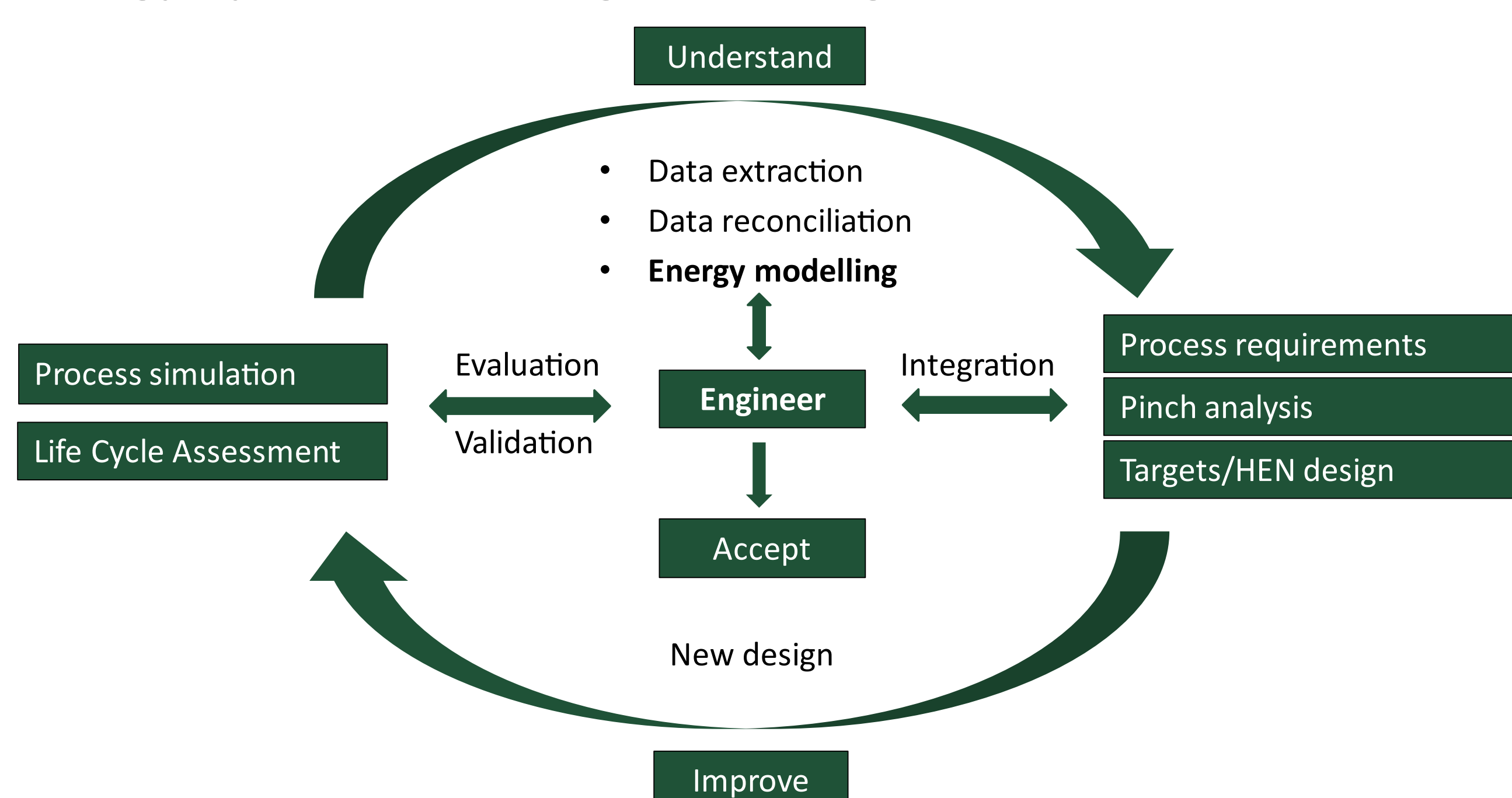
Category	EE potential (of 42 TWh/a)	Energy savings (TWh/a)	CO ₂ savings (Mt CO ₂ -eq)
EE Improvements	6 – 7 %	2.5 – 2.9	0.45 – 0.52
Process Integration and Heat Recovery	9 %	3.9	0.71
Multiple Benefits	+ 1.5 – 3.2 %	+ 0.6 – 1.4	+ 0.12 – 0.25
Total	≈ 16.5 – 19 %	7.0 – 8.2	1.27 – 1.47

However, the typical challenge that industry faces in order to increase their energy efficiency is **understanding the energy perspective of the process**, hence the effort required for data extraction is large, which translates to an increase in cost.



RESULTS

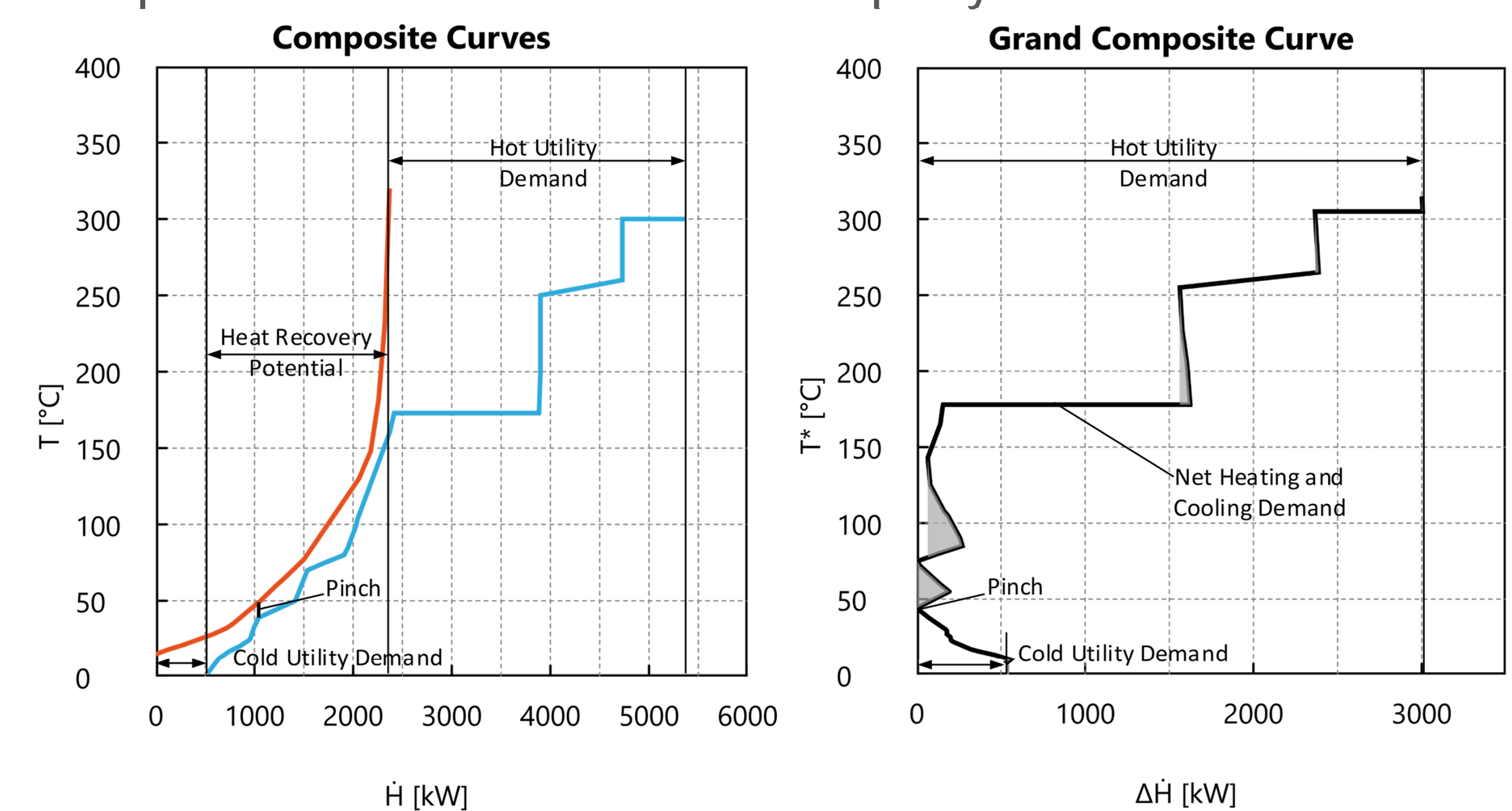
The research work developed a **general workflow** to design effective industrial EEMs by accelerating data extraction, energy system modelling, and design validation.



The novel iterative method incorporates and extends **process simulation tools**, PA, costs optimization and **ecological considerations** (life cycle assessment LCA), and heat exchanger network (HEN) design. The key to this workflow is keeping the engineer central.

PINCH ANALYSIS

A key to greater **energetic understanding** of industrial processes is to use pinch analysis (PA). The method is holistic in its approach leading to the optimization of energy efficiency, energy supply, and investment and operating costs. The basis of the analysis are the composite curves and grand composite curves. They provide a **clear visualization** of the potential for heat recovery as well as the minimum heating and cooling demand from utility systems. The following figure shows the composite curves of a textile company in Switzerland:



In addition to heat recovery, the curves provide insight into other energy efficiency measures such as **heat pump integration** as well as the potential for **renewable energies** and **excess heat**.

Pinch analysis is supported financially by the SFOE in industry and is the foundation for the approach used in this work.

CONCLUSIONS

- Implementation of methods and tools** to support industry in increasing their energy efficiency and profitability; more PA projects needed in the future to exploit the potential.
- Workflow forms a solid basis for **optimal integration of EEMs and facilitates their implementation** – directly supporting the realization of industrial savings potential.
- The workflow reduces data extraction duration by at least 25%, **making PA faster and cheaper**, and enlarges the economically feasible potential for PA in industry.
- The workflow gives the stakeholders the **flexibility** to decide the extent of their financial commitments for CO₂ reduction to achieve the company's climate goals.
- This is not just for the large energy consumers: **SMEs** benefit most by streamlining the PA evaluation and reducing costs, **lowering financial barriers** for them to engage in energy efficiency improvement; their inclusion is crucial for meeting the stringent goals of the Energy Strategy 2050.