

The Role of Pinch Analysis for Industrial ORC Integration

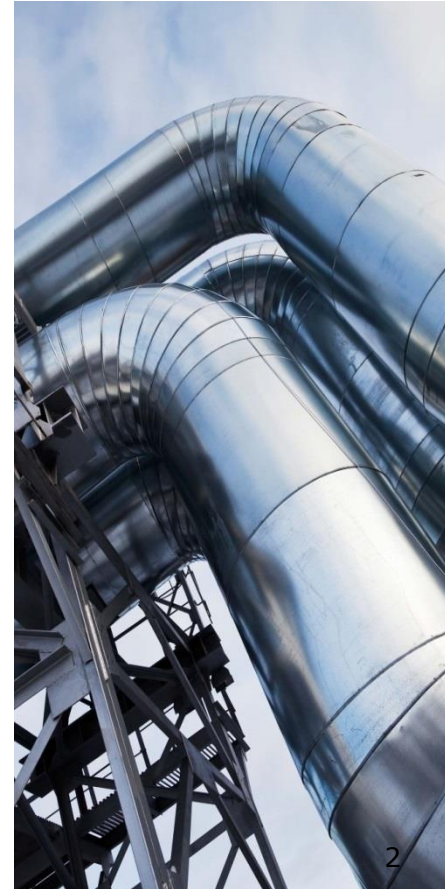
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Outline

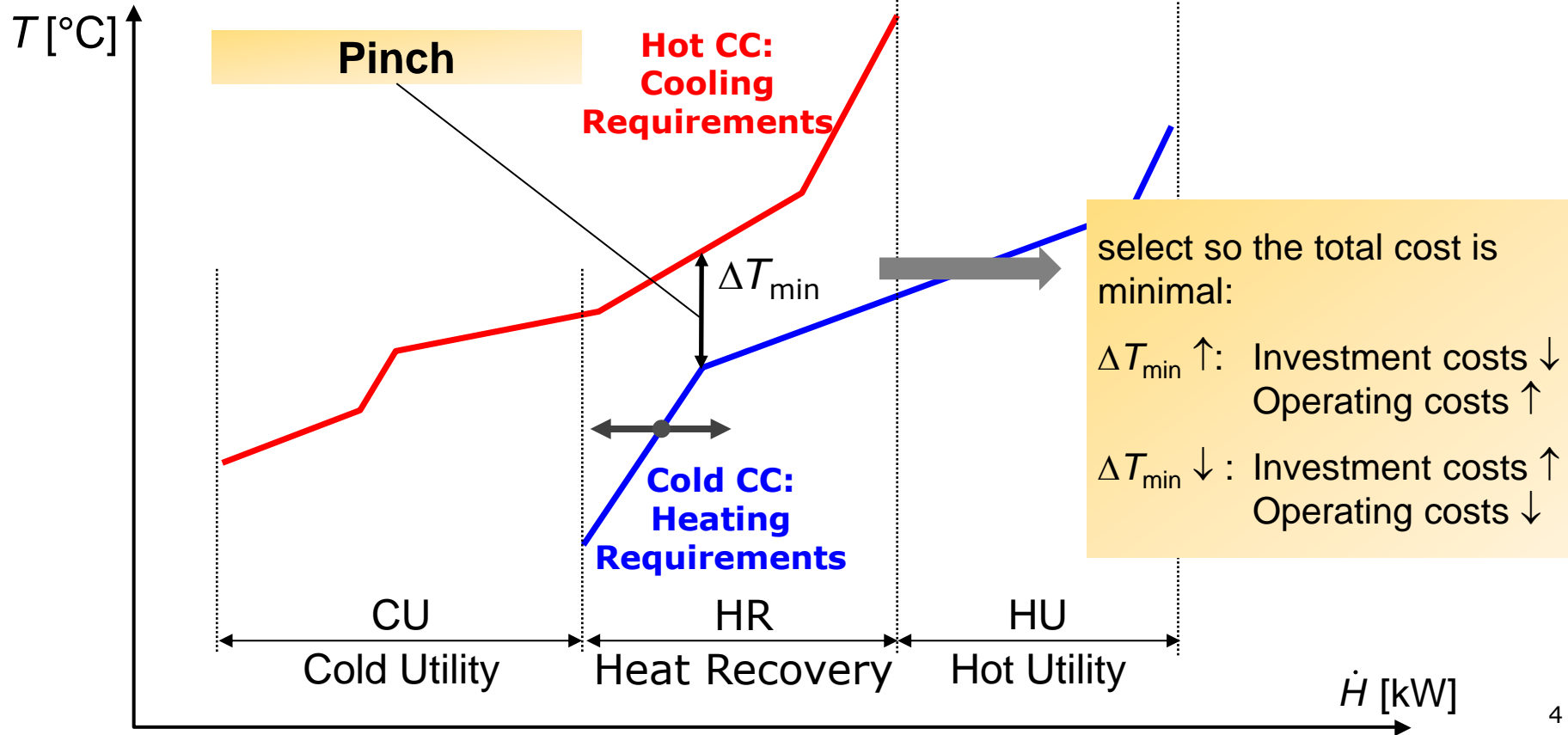
1. What is pinch analysis?
2. Integration of ORCs with pinch analysis
3. Mineral Processing Industry Case study



What is a «Pinch Analysis»?

- A **different perspective** on production plants and infrastructure
- A **system orientated method** for the determination of the optimal use of energy and plant design under the constraint of minimal cost (investment and operation)
- «Energy optimization based on a **systematic approach** instead of Trial-and-Error»

Principle of Pinch Analysis: Composite Curves (CCs)

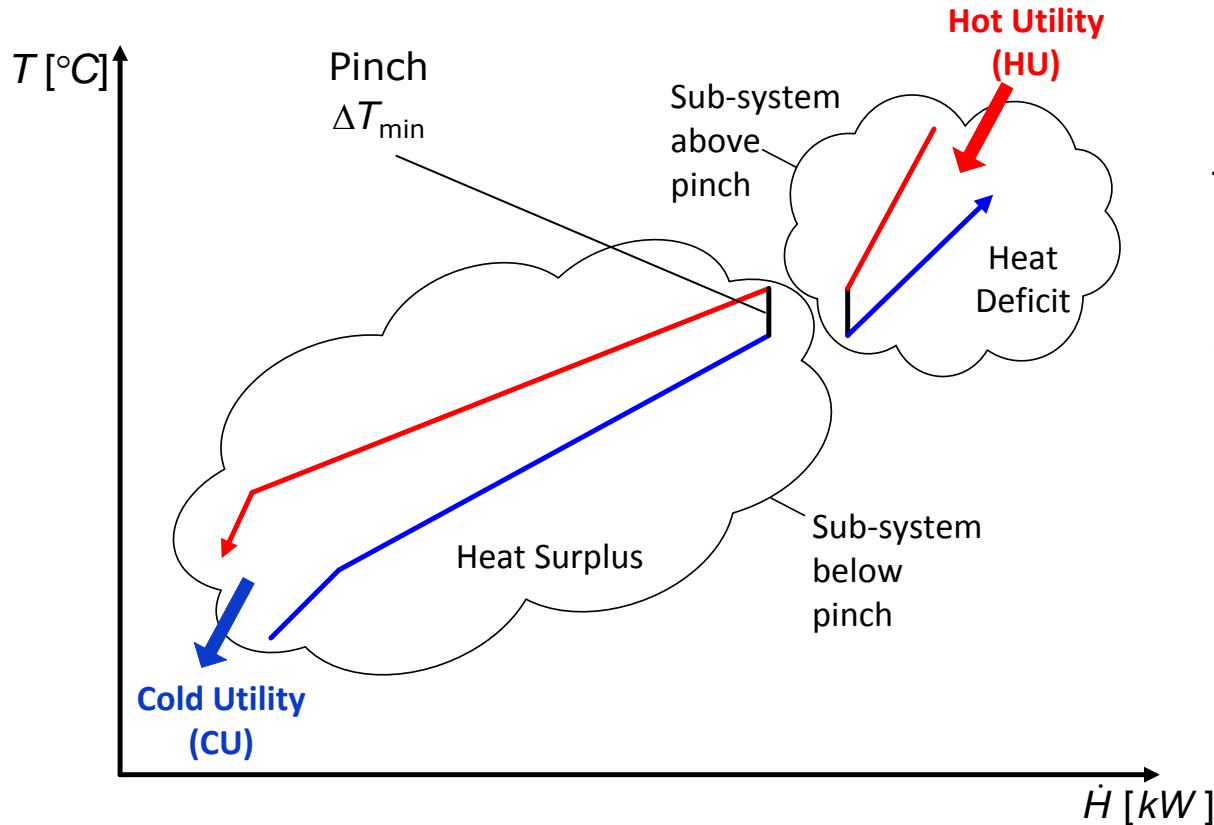


Benefits of a Pinch Analysis

- Holistic optimization of
 - Plant design, utility system
 - Energy efficiency
 - Investment and operating costs
- Quantification of the *absolute* energy savings potential
- Strategic planning of proposed optimization measures
- Reduction of the energy demand typically 10-40%



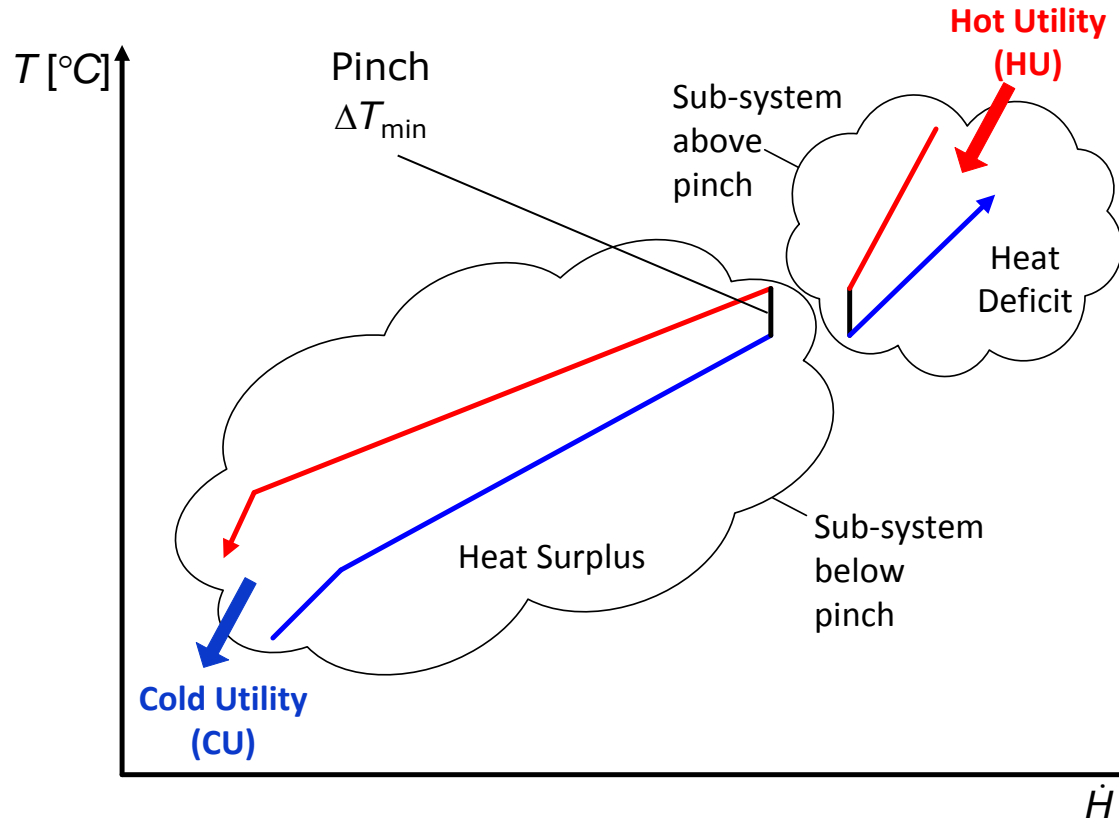
Special Characteristics of the Pinch Point



The pinch divides the entire system typically into two subsystems with

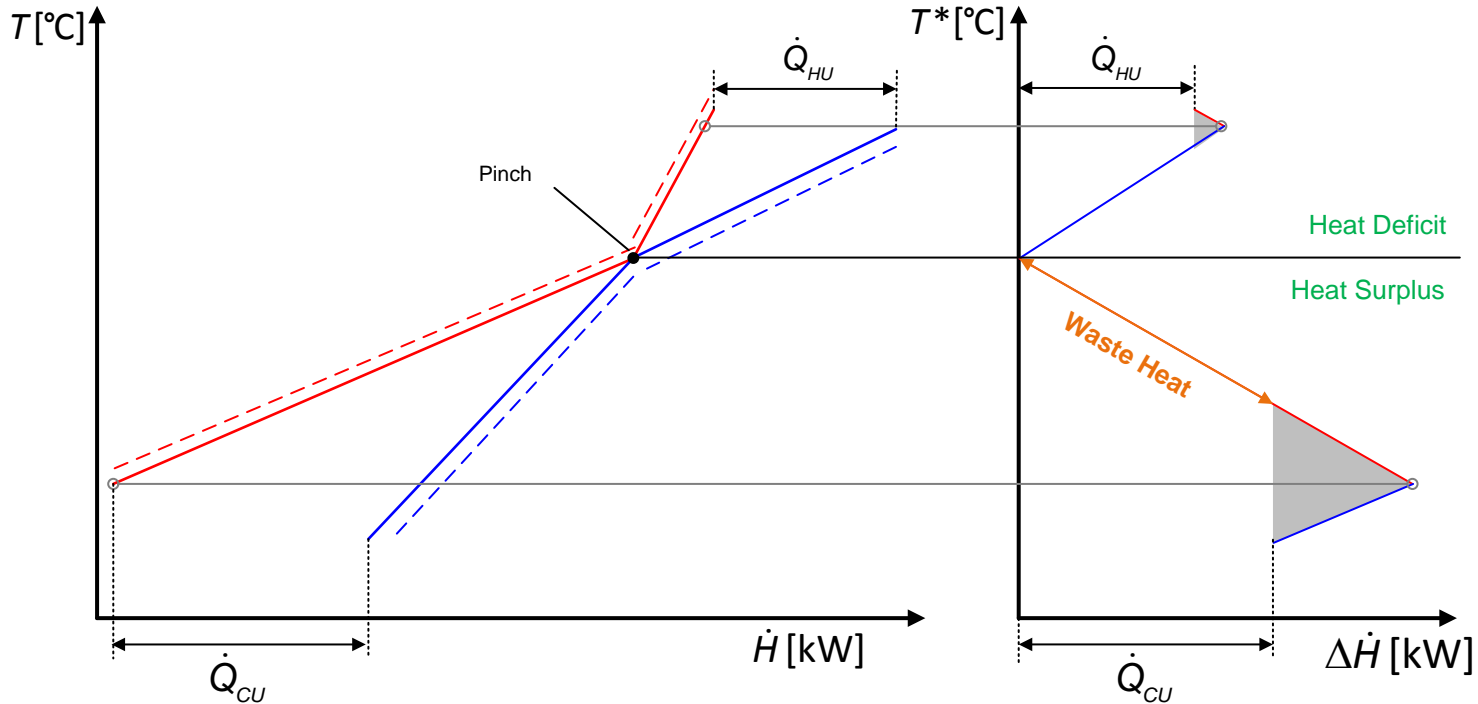
- **heat deficit** above the pinch and
- **heat surplus** below the pinch.

The «3 Golden Rules» of Pinch Analysis



- No external cooling above the pinch
- No heat transfer over the pinch
- No external heating below the pinch

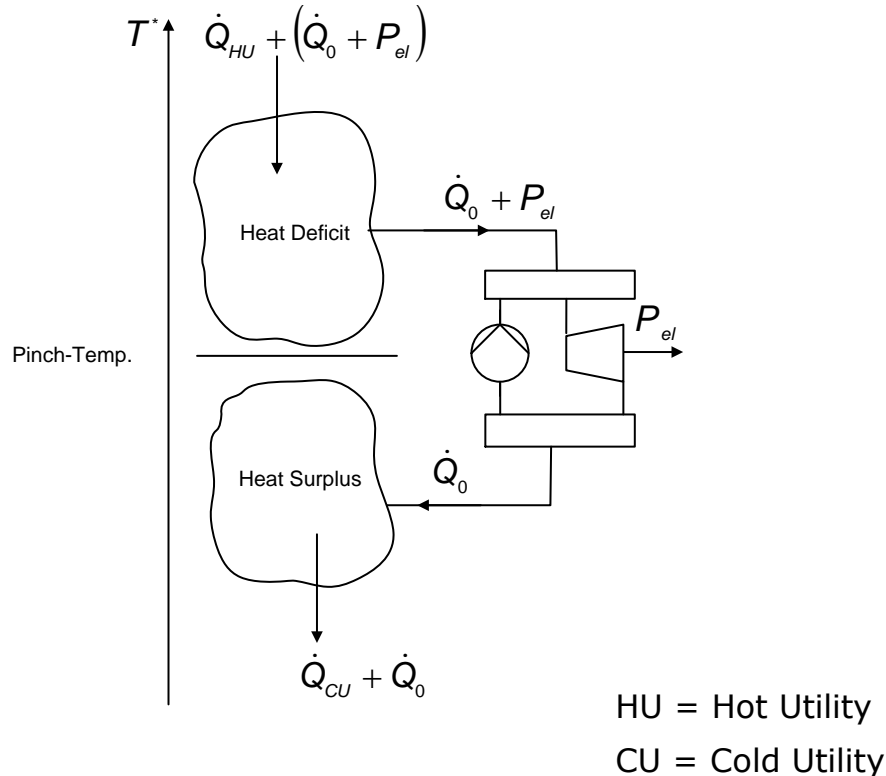
Grand Composite Curve (GCC)



- Heat deficit and surplus are shown in relation to temperature
- Enables the determination of the amount of **waste heat**

How does one integrate an ORC?

A first option:



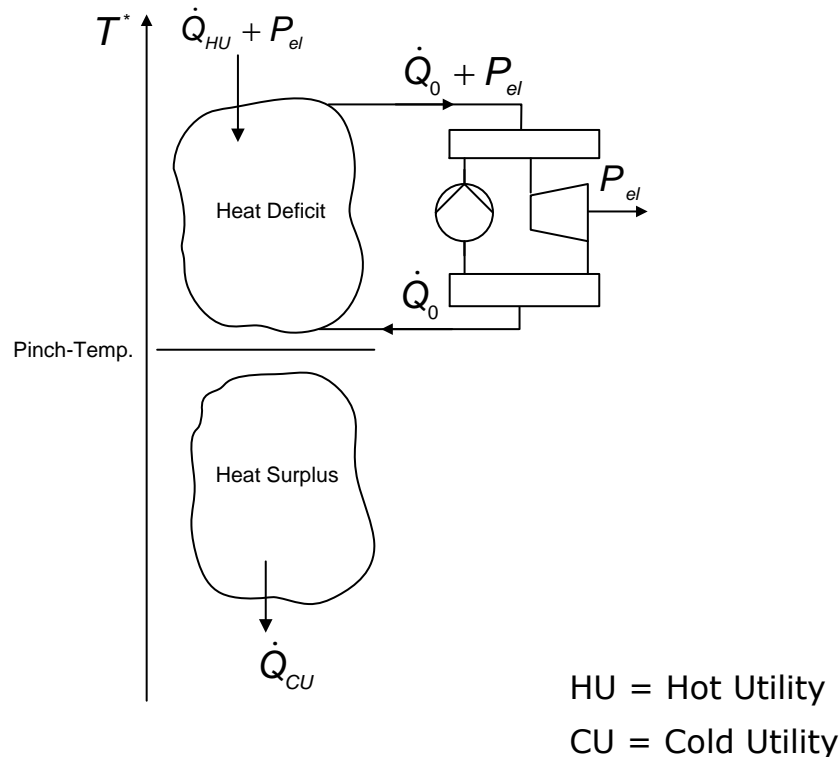
ORC operates over the pinch

«False» Integration:

The heat deficit is increased by the amount of electrical power generated and condenser heat. The heat surplus is increased by the amount of condenser heat. Both a higher heating and cooling requirement results.

How does one integrate an ORC?

A second option:



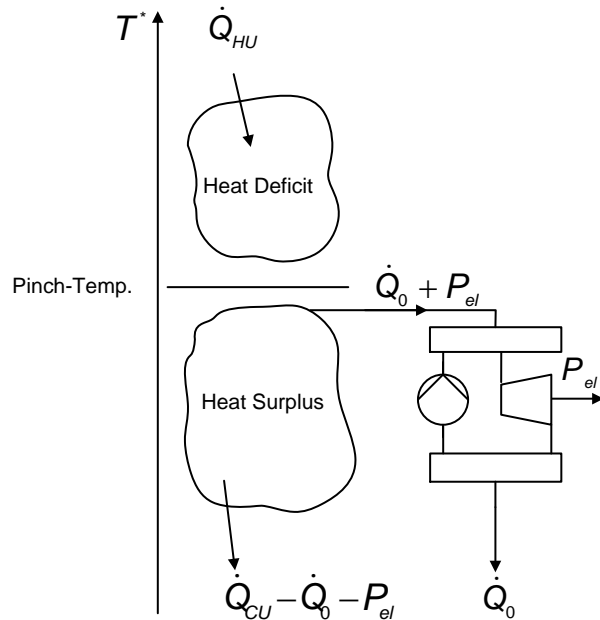
**ORC operates
above the pinch**

«Suboptimal» Integration:

The heat deficit is increased by the amount of electrical power generated leading to a higher heating requirement

How does one integrate an ORC?

A third option:



**ORC operates
below the pinch**

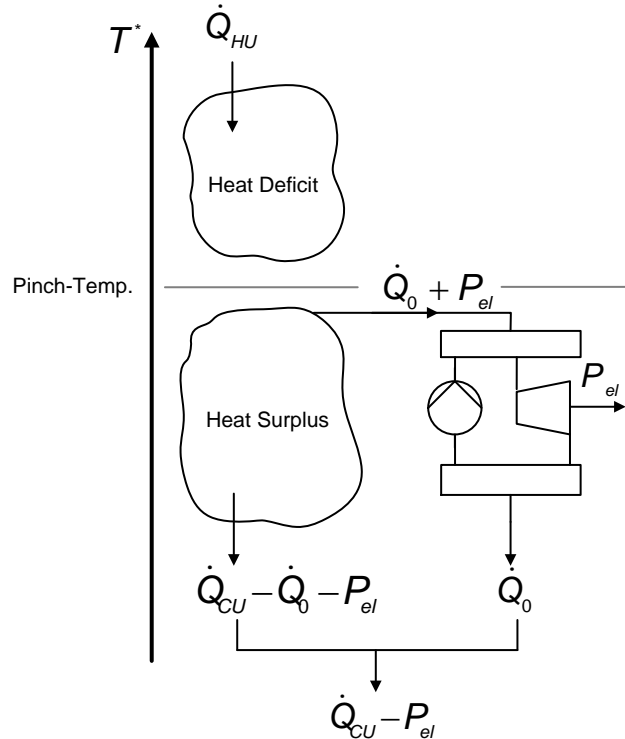
«Correct» Integration:

The ORC reduces the cooling demand of the process and the associated operating costs.

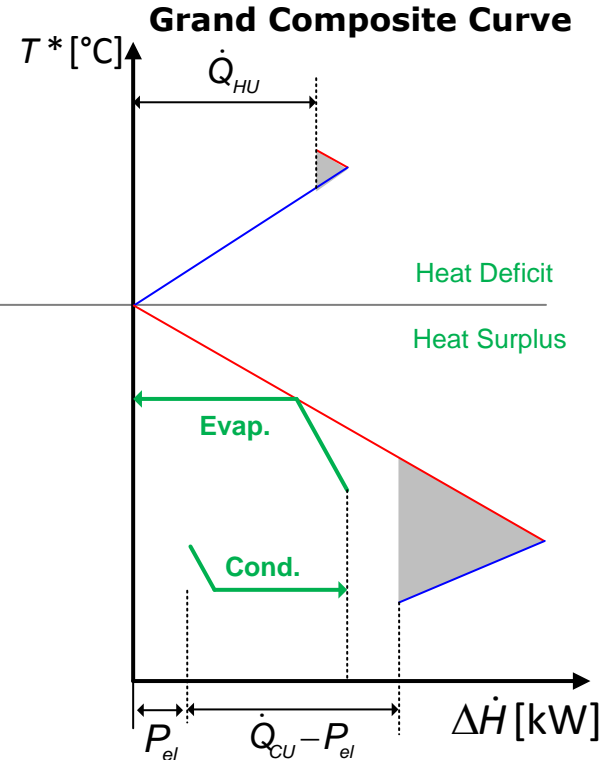
HU = Hot Utility
CU = Cold Utility

How does one integrate an ORC?

«Correct» Integration:

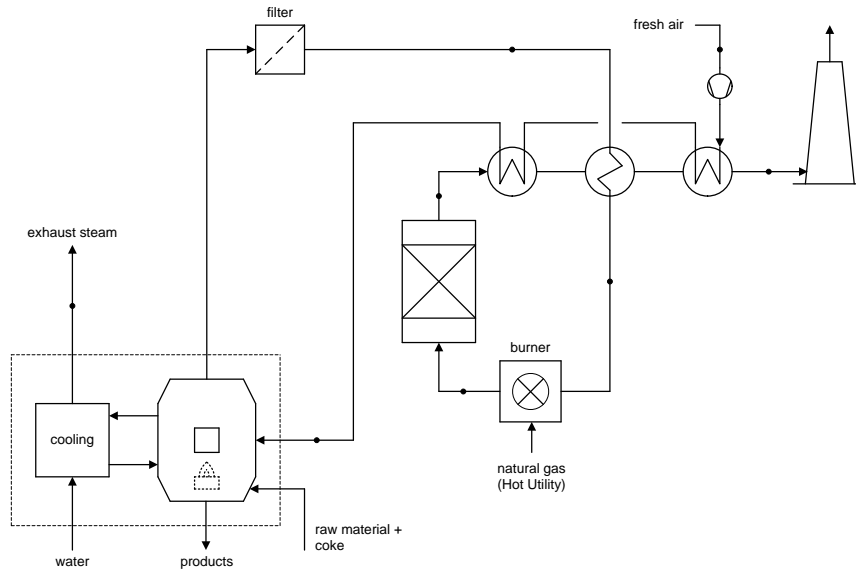


HU = Hot Utility
CU = Cold Utility



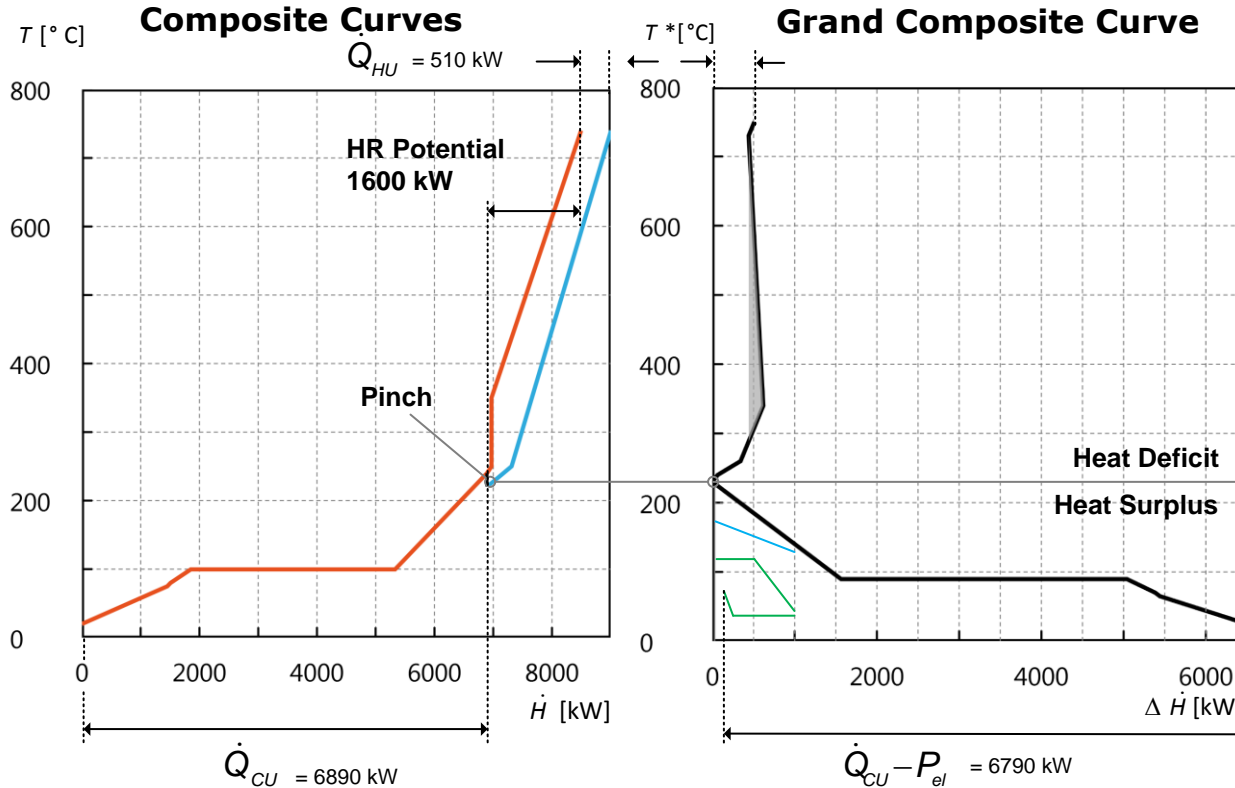
Mineral Processing Industry Case Study

Energy optimization project in European company:



- Mineral processing using furnances and after burners
- Heating a Cooling Requirements dominated by air and water streams
- Continuous operation (5500 h/y)

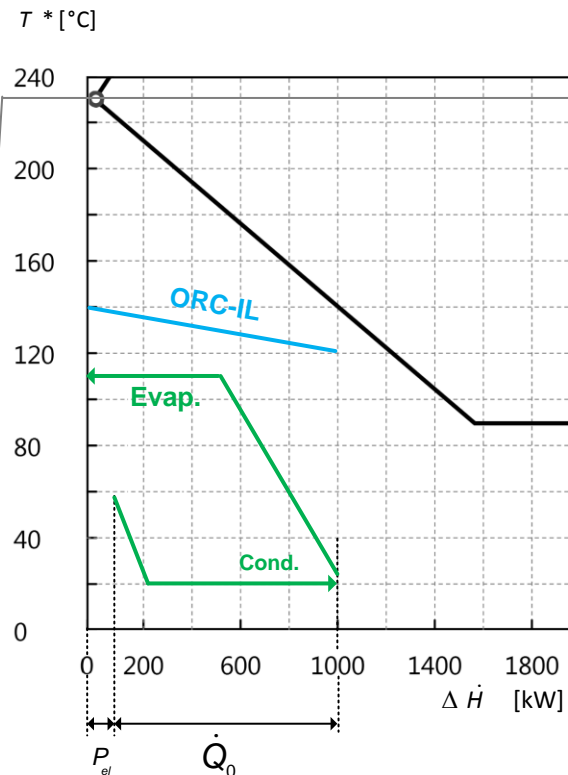
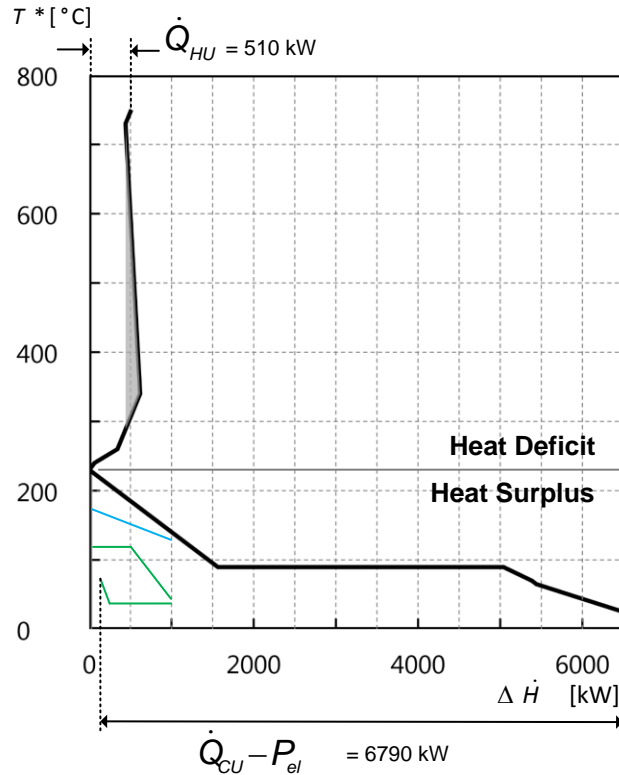
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ORC «operates **under** the pinch»
(correct integration)

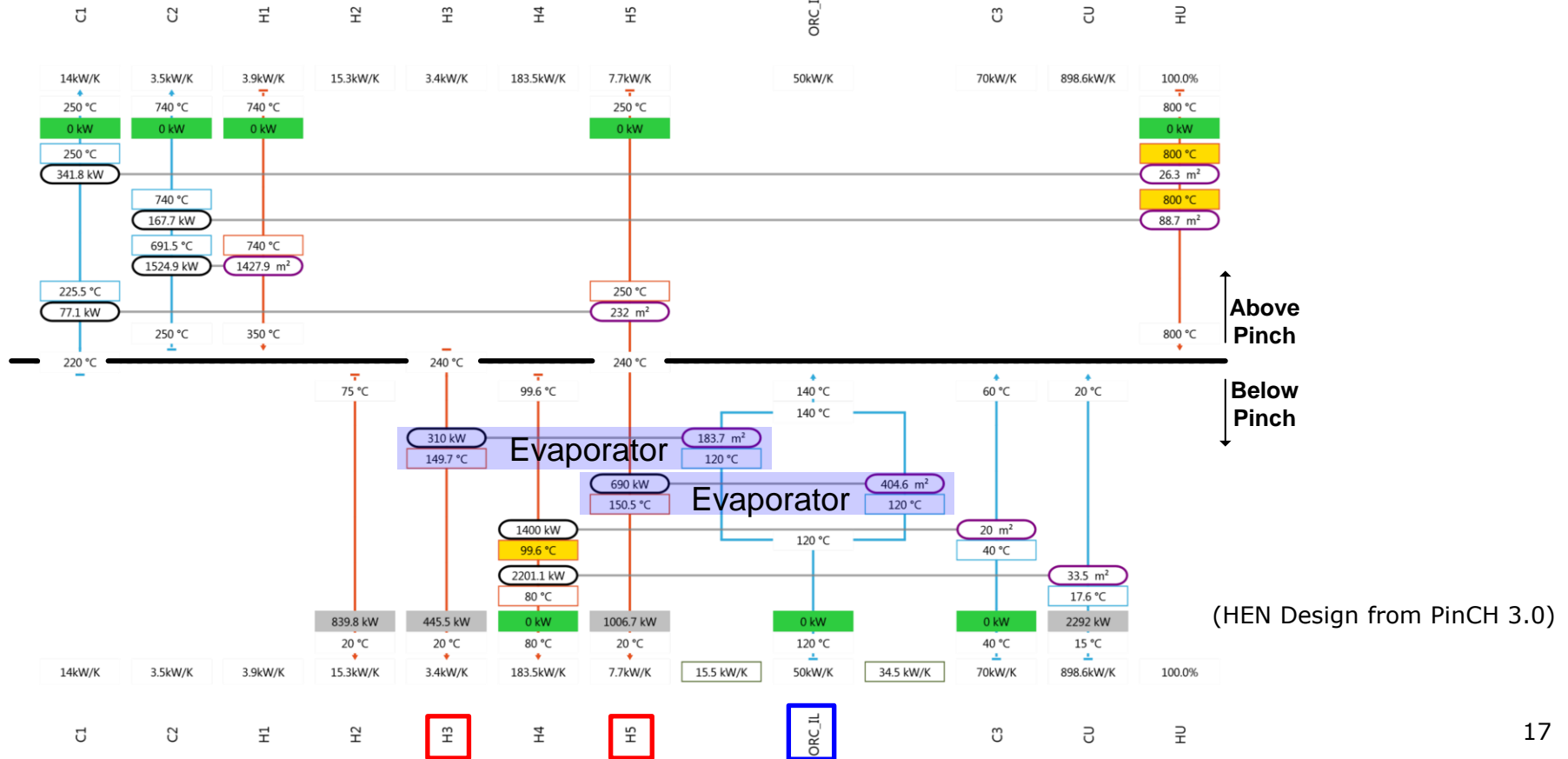
Mineral Processing Industry Case Study

Integration of an ORC: combustion gases as source



- Integration of ORC produces 105 kW electrical energy
- Reduction of the CU demand to approx. 6790 kW

Mineral Processing Industry Case Study



Mineral Processing Industry Case Study

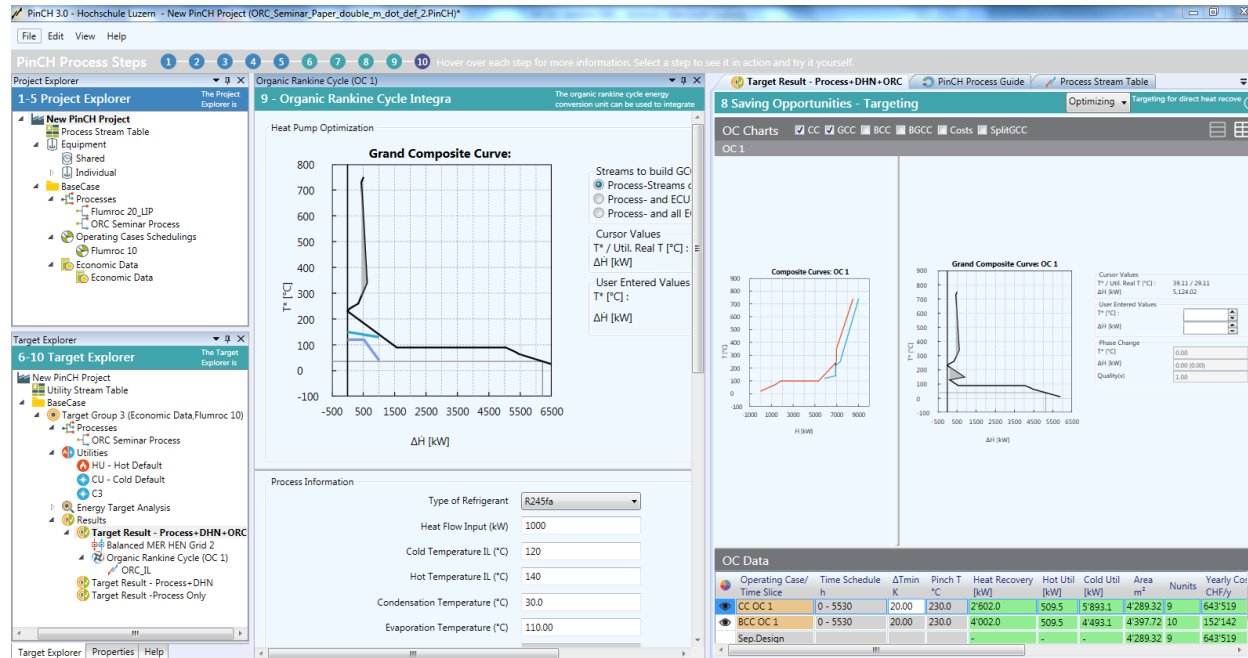
Cost Analysis for ORC Integration

ORC Installed Cost (special heat exchanger material)	1'600'000 Euro
Maintenance Cost	40'000 Euro/y
Total Cost Savings	65'000 Euro/y

The results show more applied research and development is needed along with additional support to promote development and application of ORC technology in industry.

Conclusions

- «Correctly» integrated ORC operate below the pinch to produce electricity and reduce CU demand - Heat recovery measures to be considered first
- Mineral processing case study shows the proper integration of an ORC
- Over the last years, a dedicated engineering tool (PinCH 3.0) has been developed to support the application of the pinch method incl. ORC integration



Workbench of
PinCH 3.0

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Thank you for your attention!

