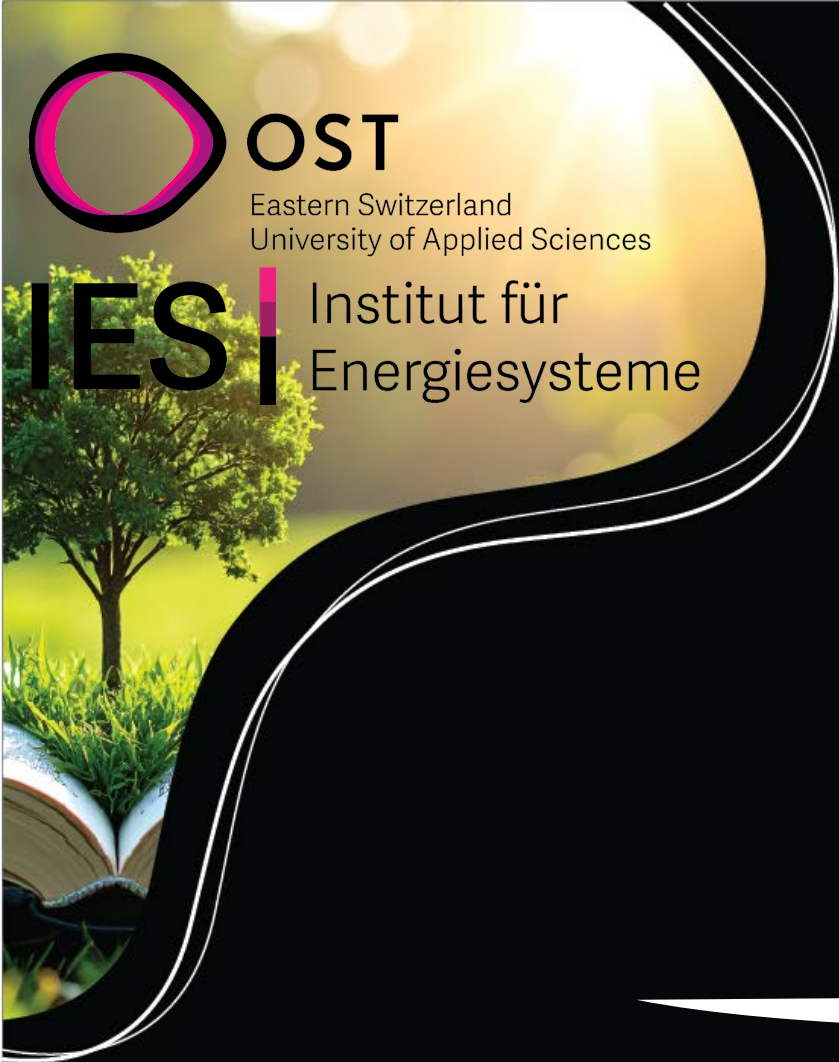




2025

Increasing the spread of Steam Generating Heat Pumps

Presented by OST
Prof. Stefan Bertsch, PhD



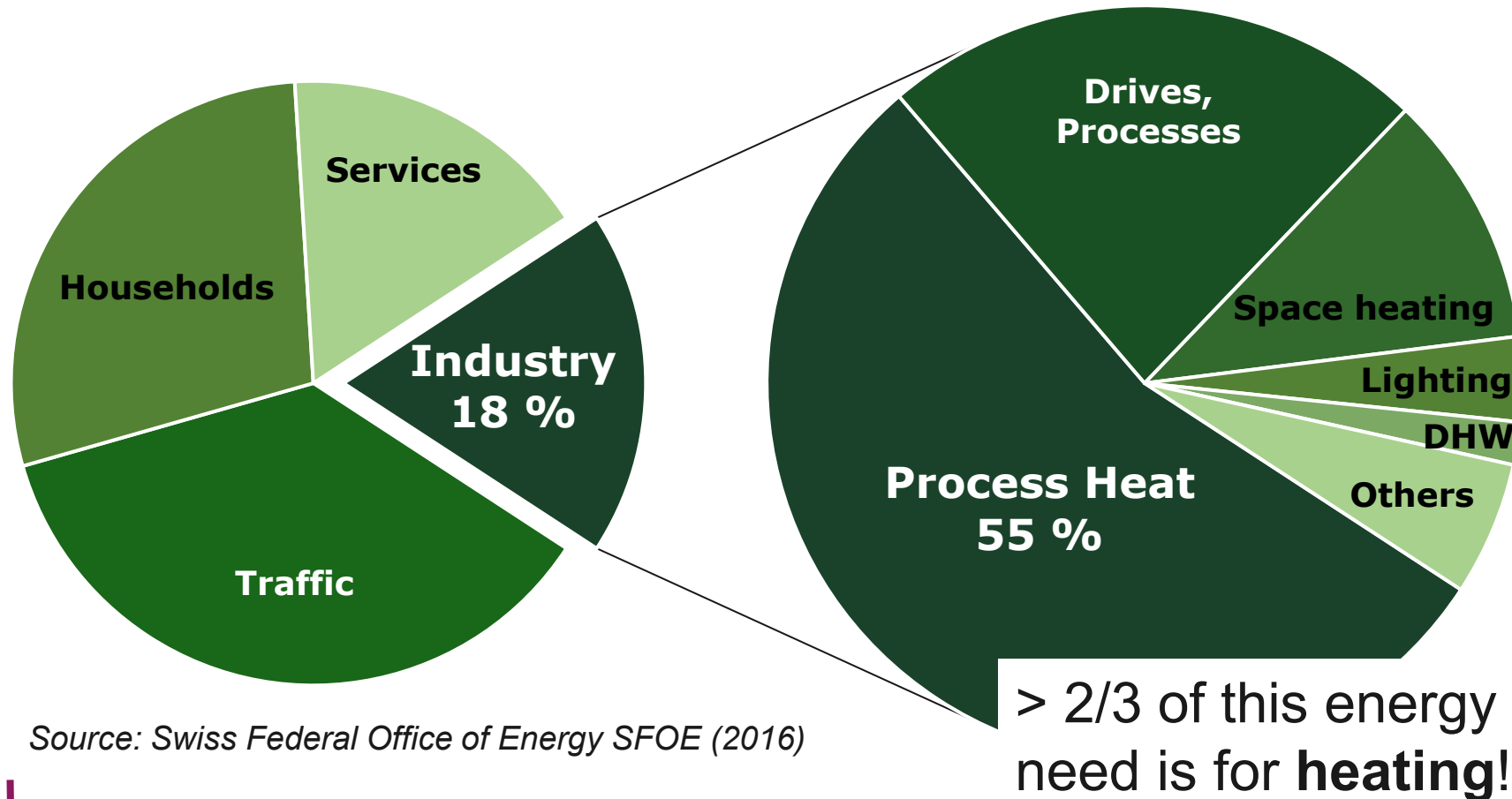
Motivation

- Industrial **process heat electrification** is required for decarbonisation
- Industrial and **steam generating heat pumps** will be **key component** in this task
- **Implementation** of new technologies is **always difficult**



Energy consumption of Swiss industry

~ 18% of the Swiss energy demand is for industrial use.



Currently approx.
80% of the heat is
from fossil fuels

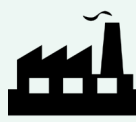
Source: Swiss Federal Office of Energy SFOE (2016)

Why do we need to push heat pumps in industry?

Biomass to heat



71 PJ/a sustainable (CH)
(19.7 TWh/a)



82 PJ/a Process heat
(22.8 TWh/a)

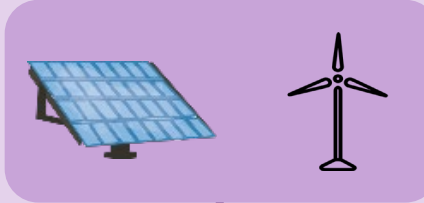


Important raw material

Only for
High temperature heat

Wherever
possible!

Power to heat



1 kWh

heat
pumps



2 bis 4 kWh

direct
electricity



1 kWh

synthetic
fuels

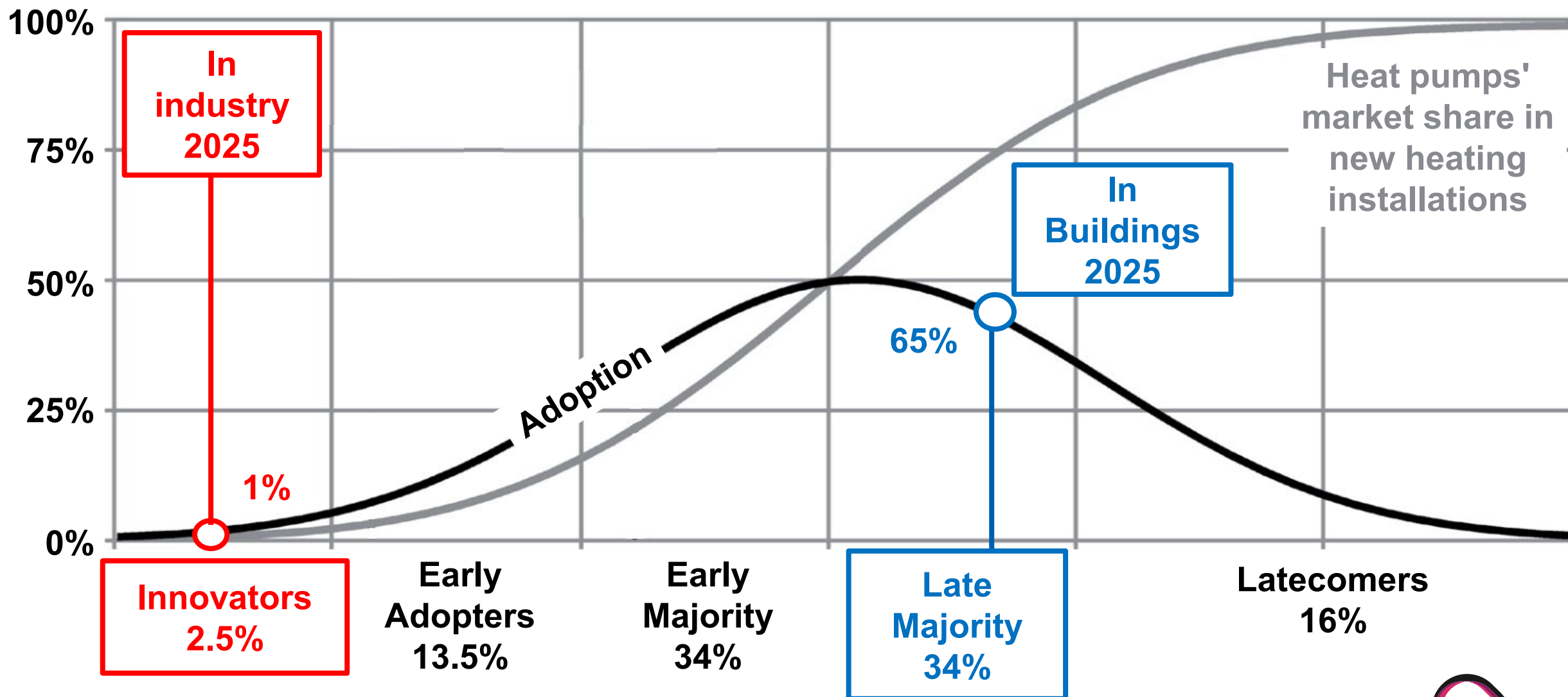


0.5 bis 0.7 kWh

Increasing temperature

Market Analysis – Distribution of Innovation

Technology Adoption of Heat Pumps (Switzerland) – As of 2025

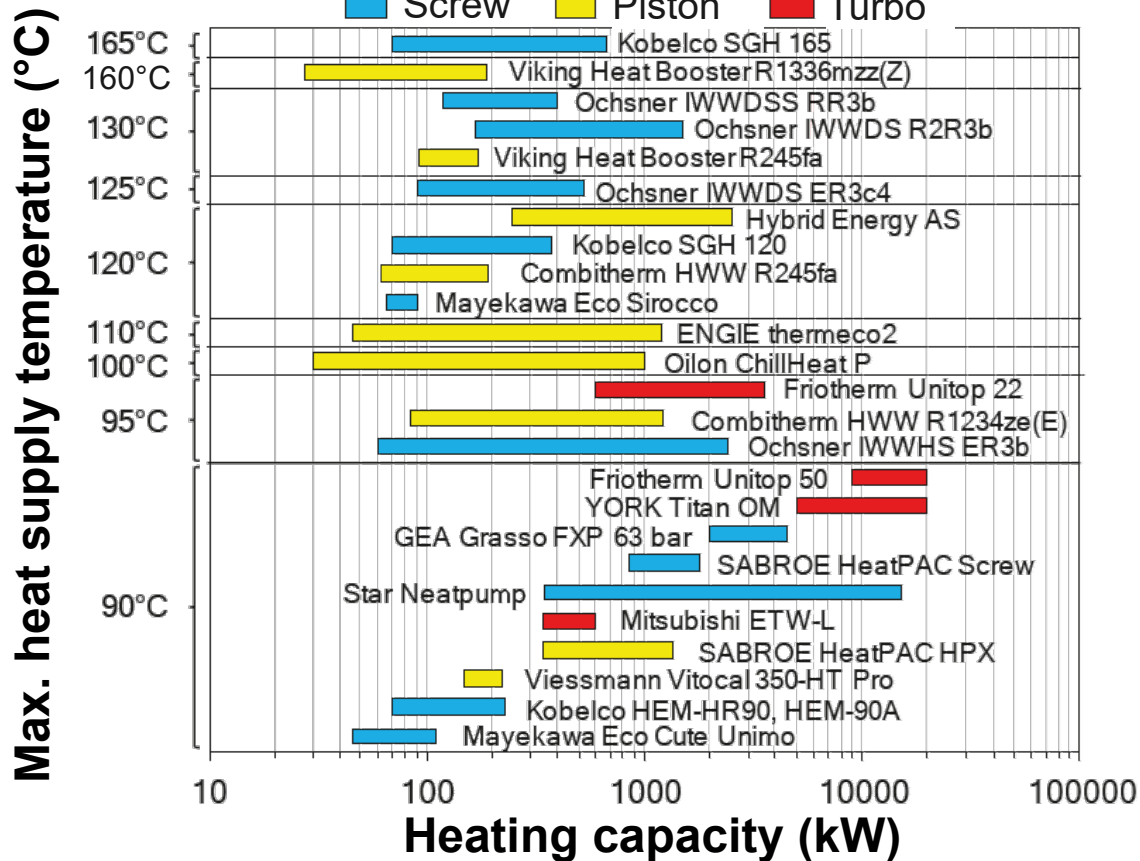


Steam-Generating Heat Pumps

Evolution of the HTHP market

2018

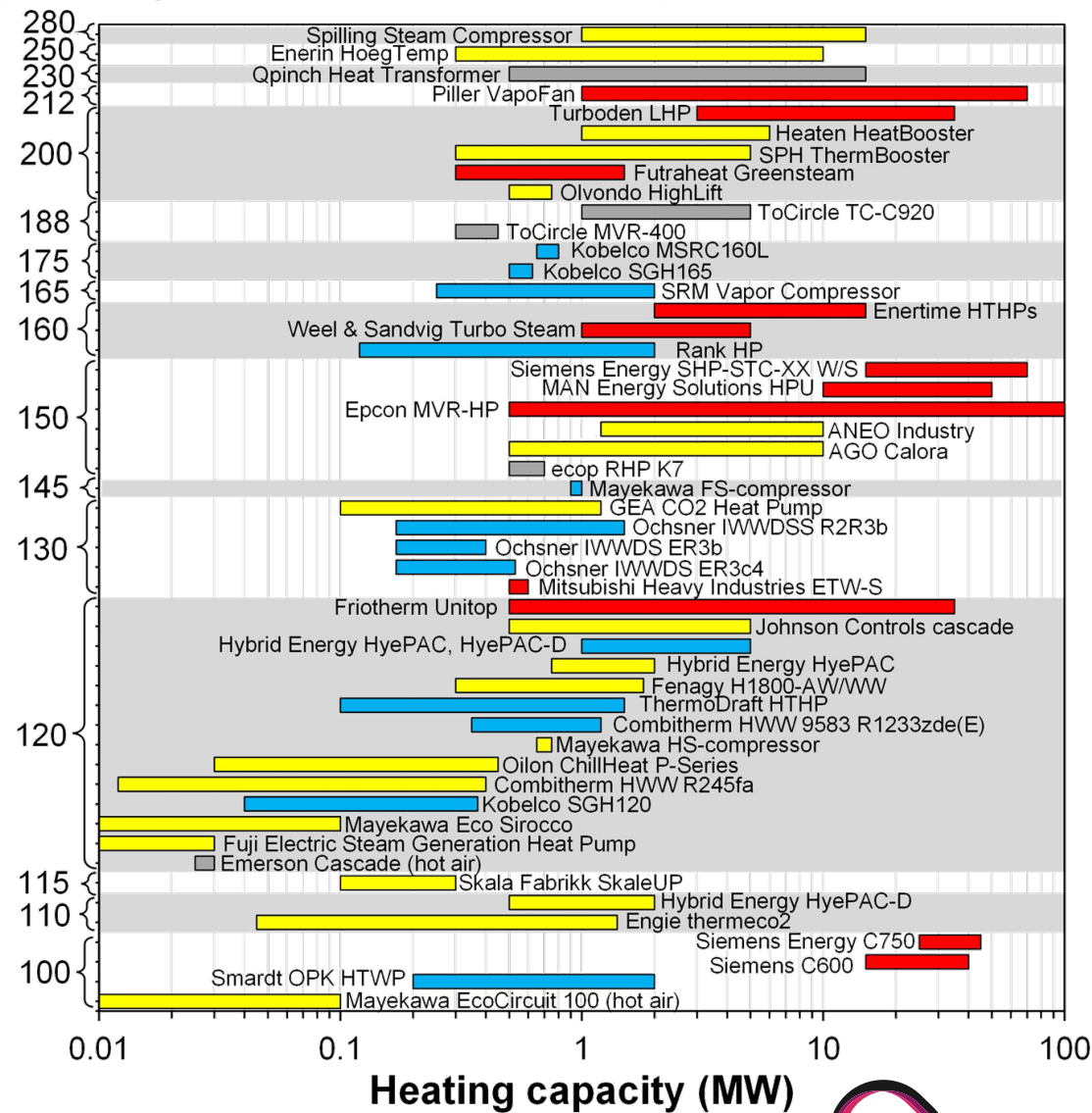
25 HTHPs > 90 °C



50 HTHPs > 100 °C

Compressor type: ■ Screw ■ Piston ■ Turbo ■ Other

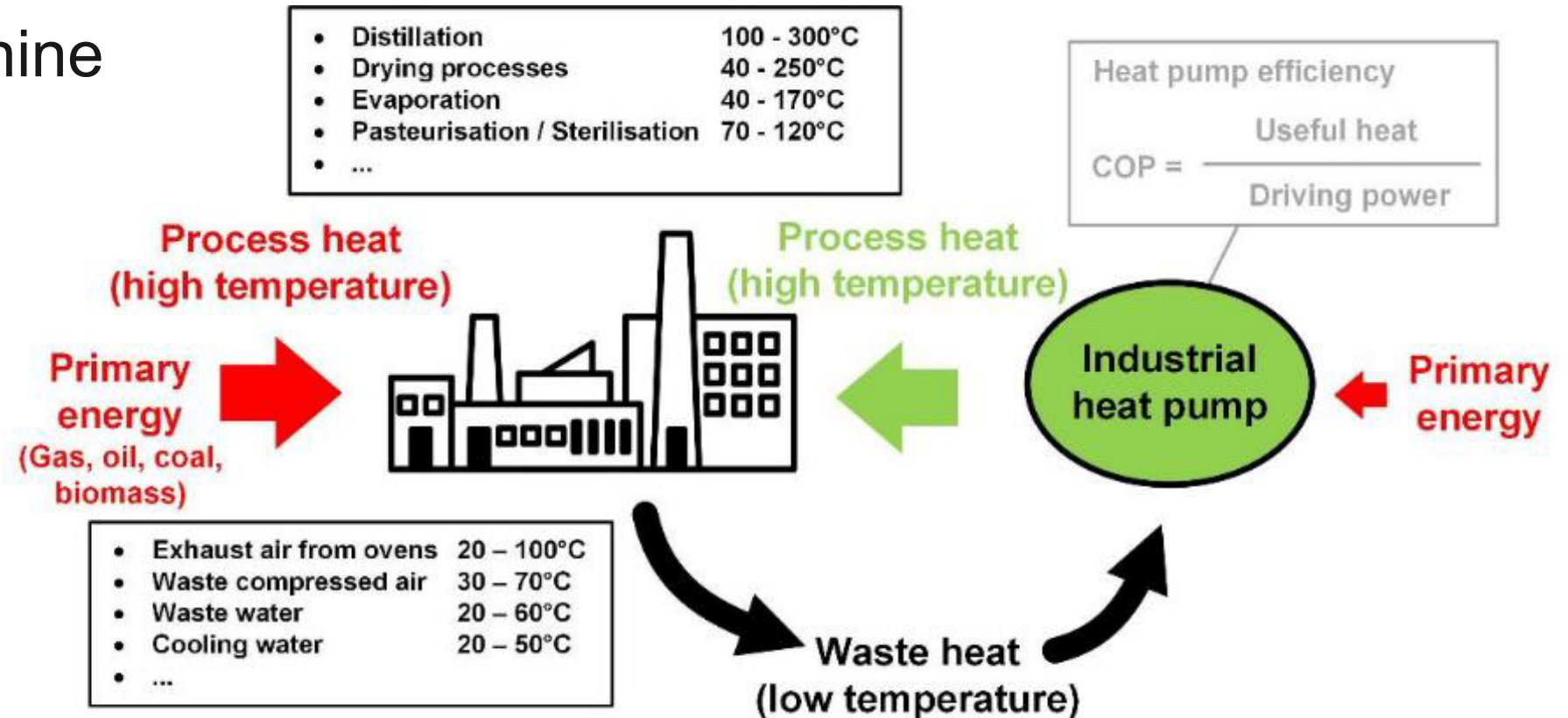
Max. heat supply temperature (°C)



Solution

Integration level of heat pumps

- Process / machine
- Building
- Plant



Larger system boundaries lead to greater potential, but also to increasing complexity.

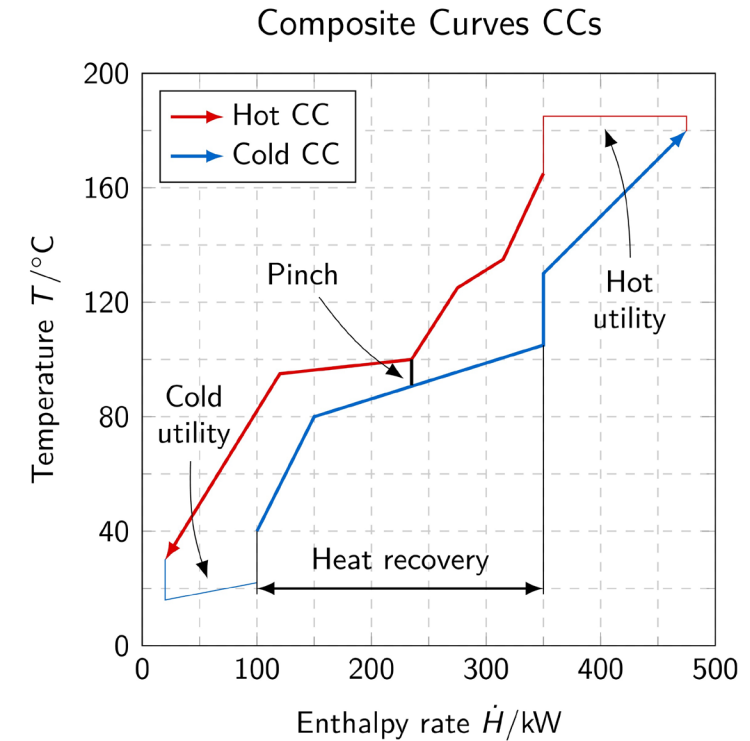
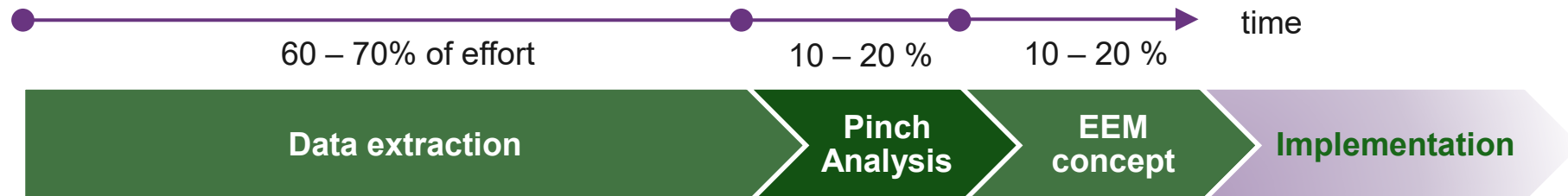
Solution

Ways to decarbonize industry

- **Collect energy data**
 - Power, energy, temperatures
- **Energy analysis**
 - Pinch analysis or similar tools
- Concept development
- Implementation
- Monitoring
- Optimization

Herausforderung

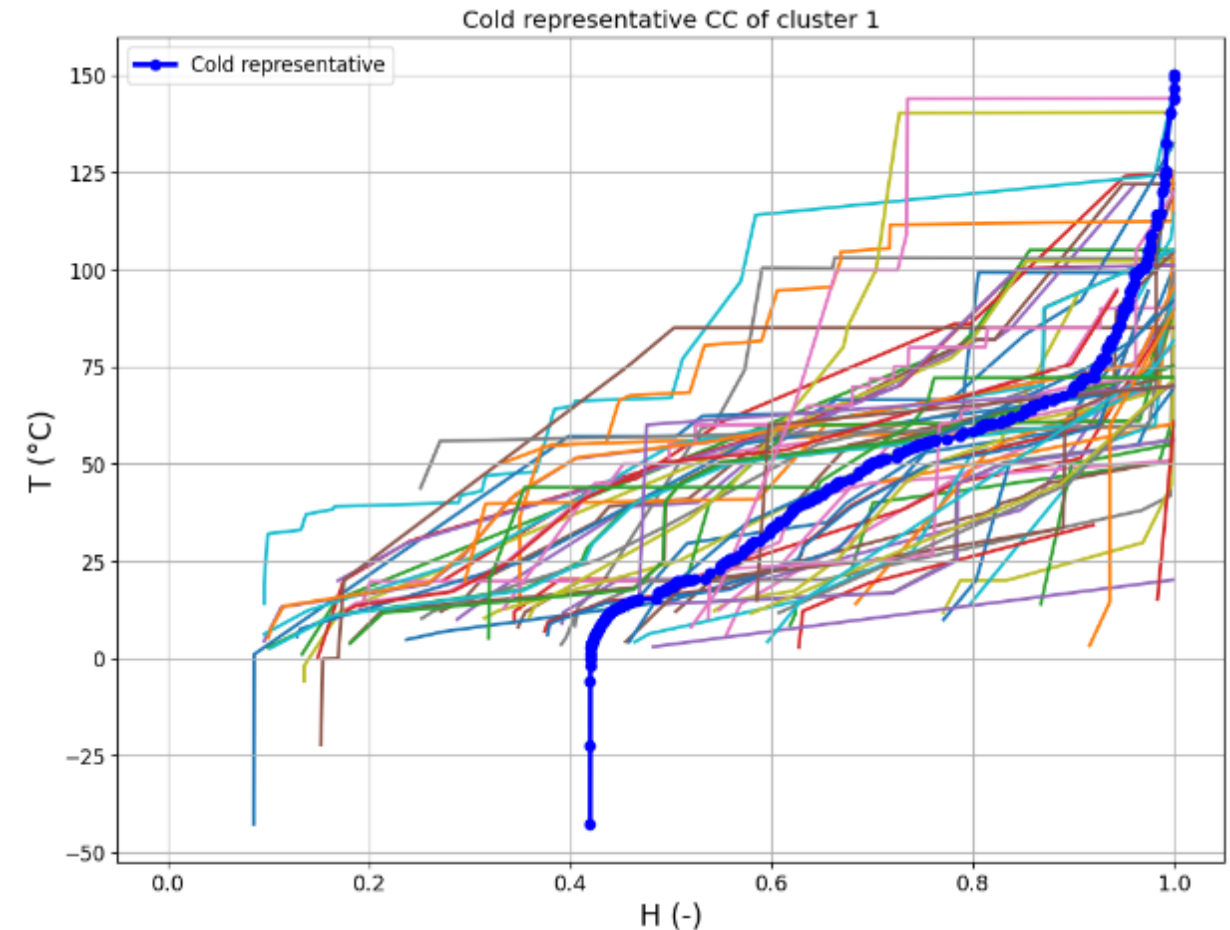
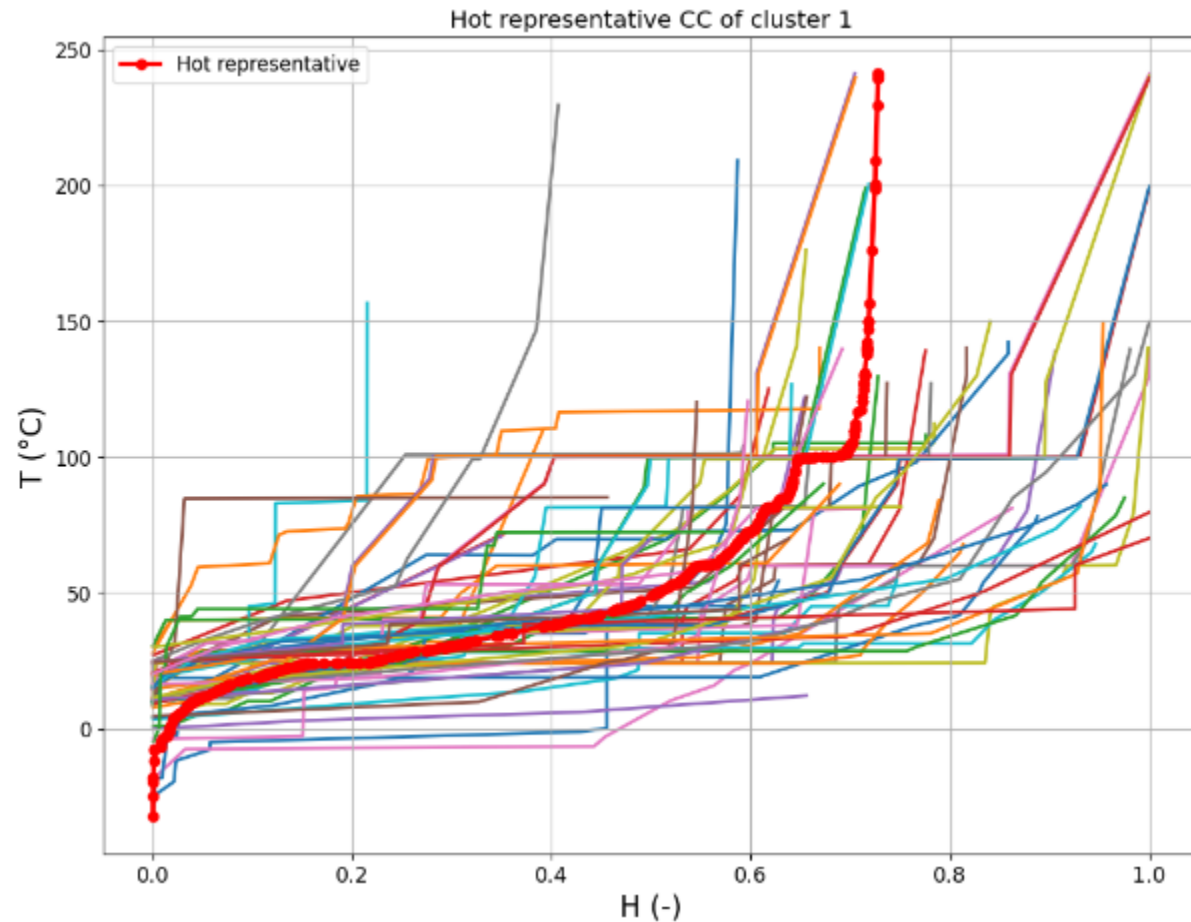
Cost and time
Data often not available



Graphic: Beat Wellig (HSLU)

Creation of representative CCs

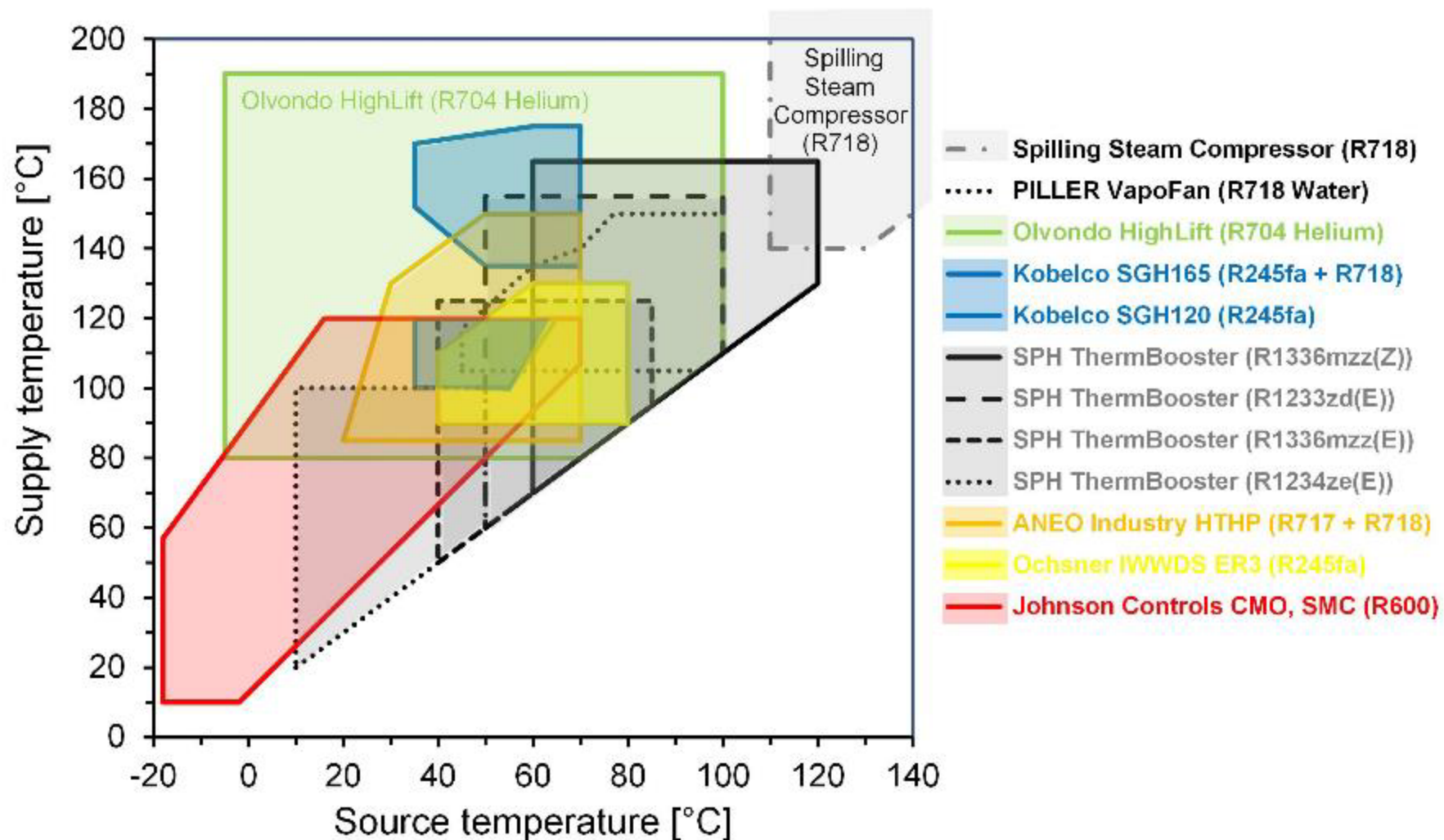
Standardized “composite curves” are created using the **pinch method**



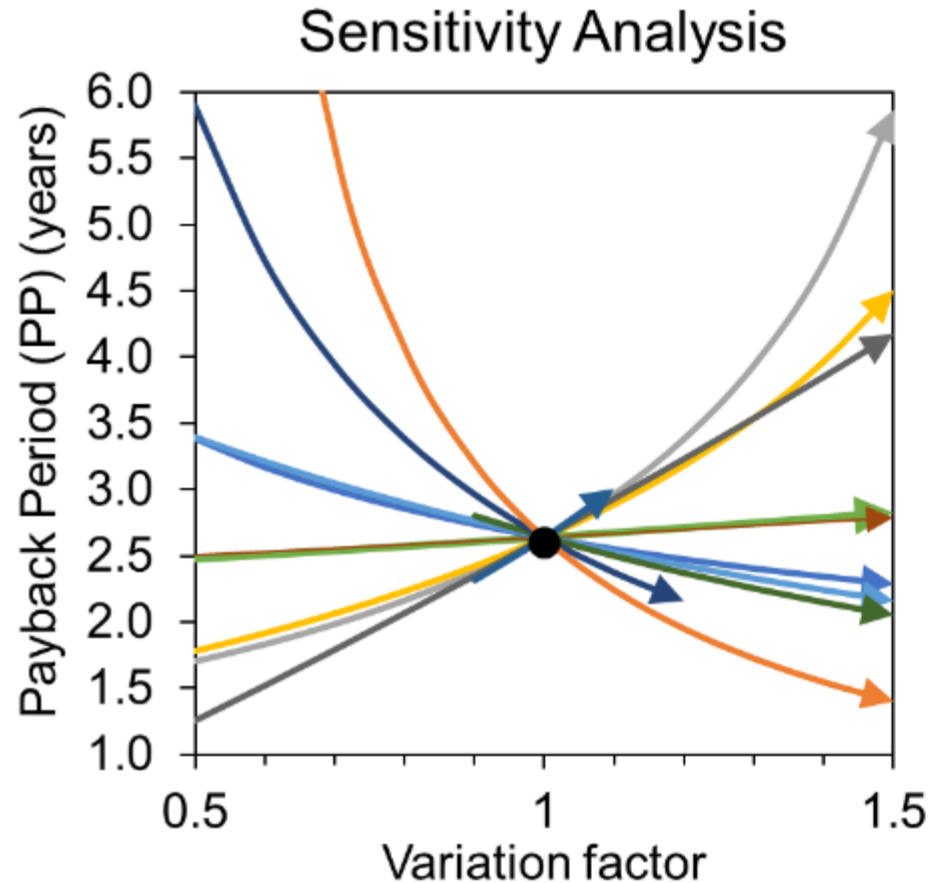
Source: Mahmoudan, A., Ong, B.H.Y., Bhadbhade, N., Olsen, D.G., Wellig, B., Patel, M.K.: A grey-box approach for constructing generic industrial thermal profiles, Energy Conversion and Management, 343, 2025, <https://doi.org/10.1016/j.enconman.2025.120246>

Solution

Industrial heat pumps



Payback time for an application at 45/115°C with 1 MW



- Electricity price
- Temperature lift
- Cost factor planning & integration
- Efficiency of fuel boiler
- CO₂ emissions factor of electricity
- Maintenance factor
- Heating capacity
- CO₂ tax
- CO₂ emissions factor of fuel
- Annual operating time
- Fuel price (gas, oil)

PP ↑

PP ↓

● Reference Case (Ref)

1'000 kW, 45 °C/115 °C (Heat source/sink), COP = 2.53

PP = 2.6 years, DPP = 3.2 years

-	Ref	+	
0.05	0.10	0.15	EUR/kWh
35	70	105	K
1.0	2.0	3.0	-
0.85	0.90	0.95	-
0.064	0.128	0.192	kgCO ₂ /kWh
0.02	0.04	0.06	-
500	1'000	1'500	kW
46	92.5	139	EUR/tCO ₂
0.181	0.201	0.302	kgCO ₂ /kWh
3'600	7'200	8'640	h/a
0.029	0.057	0.086	EUR/kWh
-	Variation	+	

What do we need for faster implementation?



• Technical

- More **standardized** systems
- **Steam compressors** at different sizes
- System solutions including **storage** and **optimized control**
- **Data** from successful installations



• Policy

- Derisking of **pilot installations** (grants or credit without interest)
- Clear an definitive pathway regarding **energy regulations**
- **Demonstration** projects

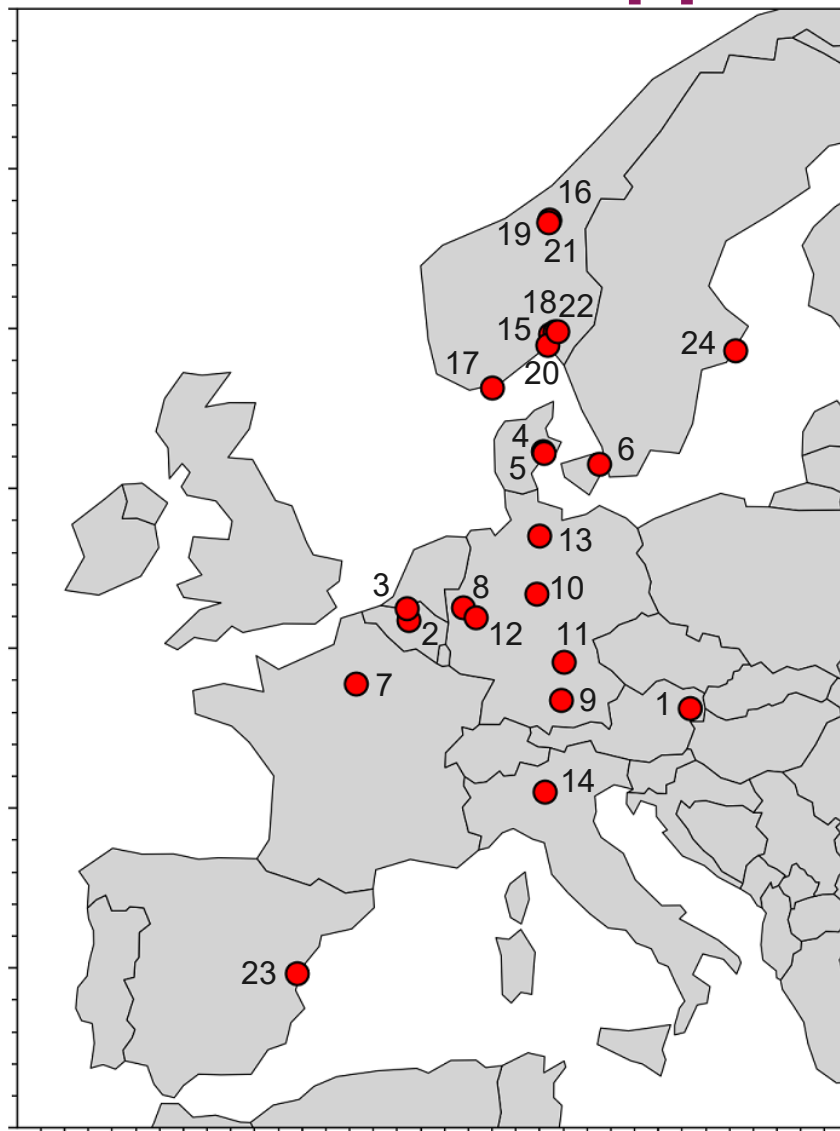
What do we need for faster implementation?

• Education / Training / open data

- **Pilot and Demonstration** - results
- **Education** of energy consultants, planners, manufacturers
- **Database** of show-cases and products
- Calculation and assessment **tools**
- **Match making events**

Latest Developments & Products for Supply Temperatures > 100 °C

Headquarters of HTHP Suppliers in Europe and Japan



- 1 Ecop (AT)
- 2 Mayekawa MYCOM (BE)
- 3 Qpinch (BE)
- 4 Fenagy (DK)
- 5 Johnson Controls (DK)
- 6 Weel and Sandvig (DK)
- 7 Enertime (FR)
- 8 GEA (DE)
- 9 MAN (DE)
- 10 Piller (DE)
- 11 Siemens (DE)
- 12 SPH (DE)
- 13 Spilling (DE)
- 14 Turboden (IT)
- 15 Enerin (NO)
- 16 Epcon (NO)
- 17 Heaten (NO)
- 18 Hybrid Energy (NO)
- 19 Ohmia (NO)
- 20 Olvondo (NO)
- 21 Skala Fabrikk (NO)
- 22 ToCircle (NO)
- 23 Rank (ES)
- 24 SRM (SE)

- 25 Fuji (JP)
- 26 KOBELCO (JP)
- 27 Mitsubishi (JP)



Based on data from
IEA HPT Annex 58:

<https://heatpumpingtechnologies.org/annex58/task1>

Steam-Generating Heat Pumps

HTHP database

High-Temperature Heat Pump Database

A collaborative project between University of Bayreuth and OST (Eastern Switzerland University of Applied Sciences). Visualize and analyze heat pump efficiency with our interactive performance diagram.

[FAQ](#)[Start Tool](#)[Learn More](#)

Powered by:



UNIVERSITÄT
BAYREUTH

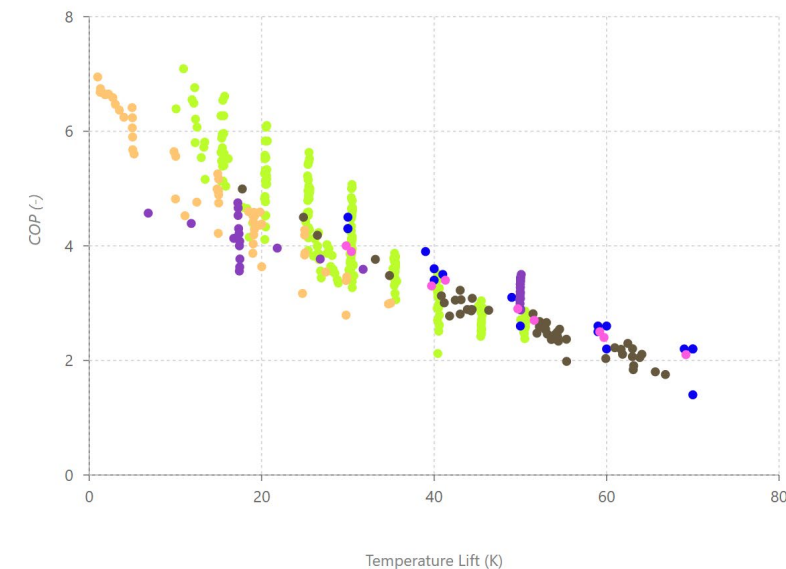


OST
Eastern Switzerland
University of Applied Sciences

<https://high-temperature-heat-pumps.com>

[Home](#)[Dashboard](#)[Upload Data](#)[Unselect All](#)

- ☒ Weitzer et al., 2024 >
- ☒ Arpagaus et al., 2019 >
- ☒ Jessberger et al., 2024 >
- ☒ Miguel Ramirez et al., 2024 >
- ☒ Jessberger et al., 2024 >
- ☒ Kaufmann et al., 2024 >



Source: Heberle, F., Jeßberger, J., Arpagaus, C., Brendel, L., Bertsch, S., Brüggemann, D.: Collaborative online tool for high-temperature heat pumps: [www.high-temperature-heat-pumps.com](https://high-temperature-heat-pumps.com), 8th International Seminar on ORC Power Systems, September 9-11, 2025, Lappeenranta, Finland

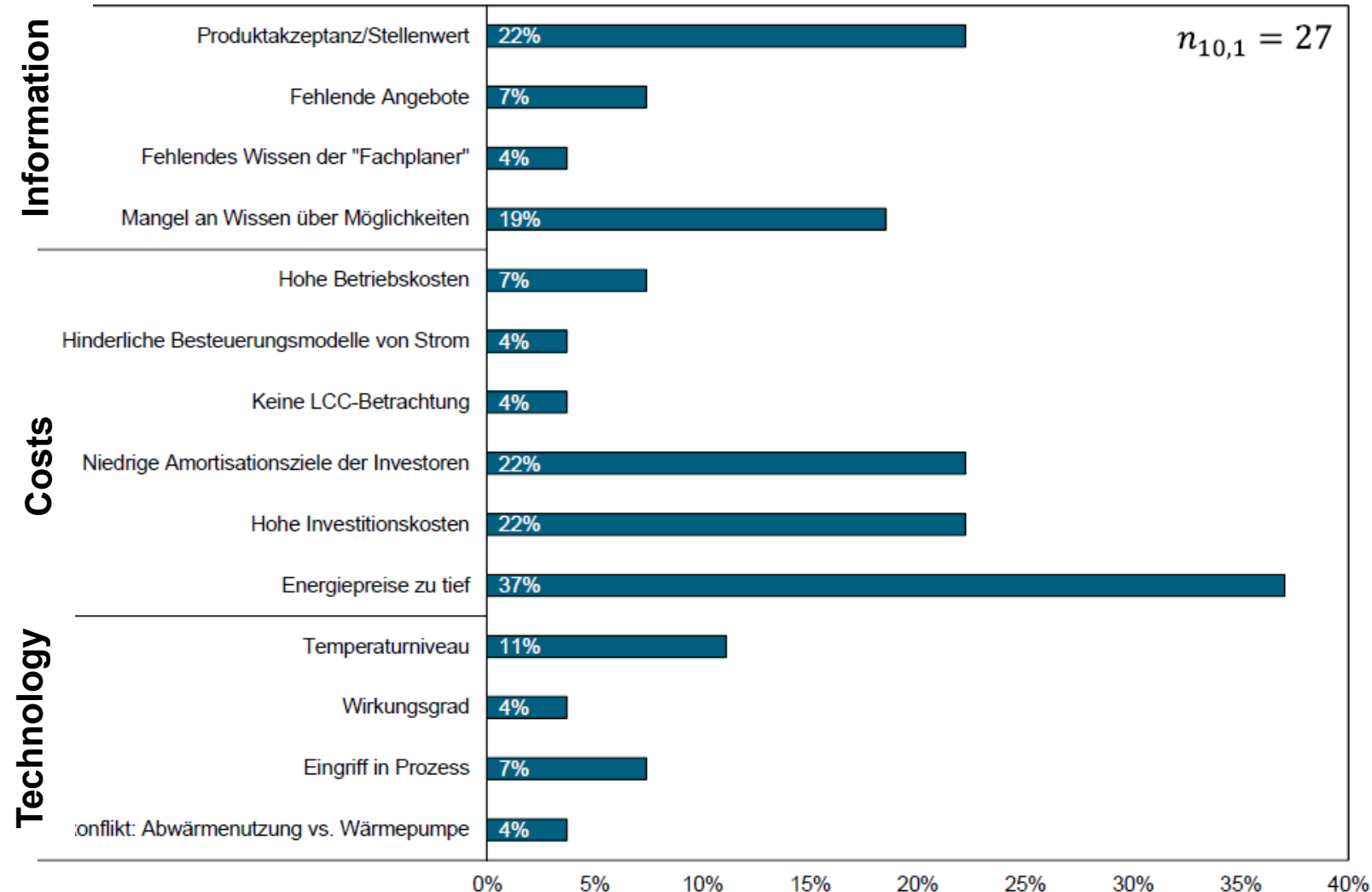
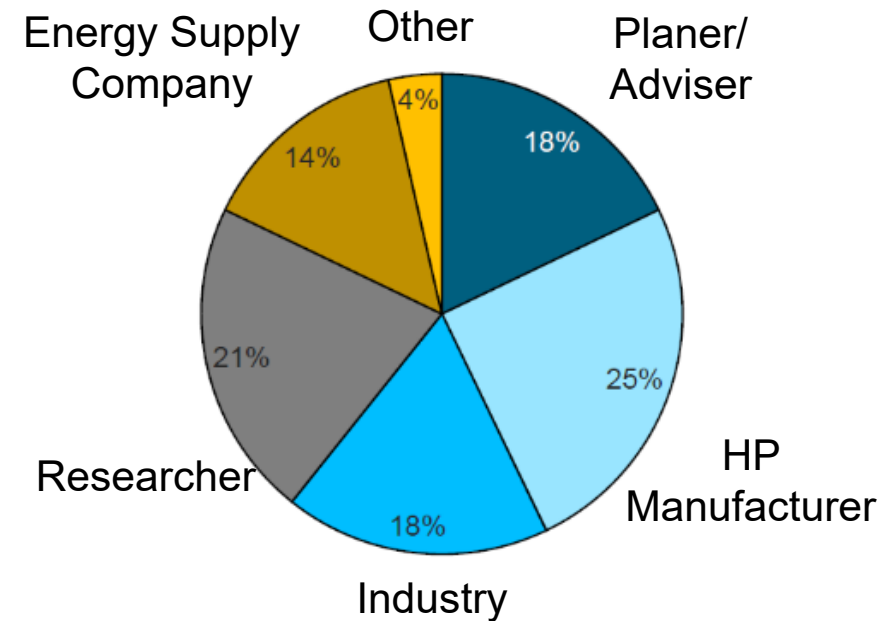
Steam generating heat pumps, OST Webinar, 21 October 2025



Implementation

Industrial Heat Pumps – Barriers

Survey of 27 experts on heat pumps and heat recovery.



[Wolf et al. \(2017\): Systematische Anwendung von Großwärmepumpen in der Schweizer Industrie, Endbericht, 10. Mai 2017](#) and [Wolf \(2020\): Rahmenbedingungen und Märkte für Industriewärmepumpen, ETV Online Tagung 2020, Industrielle Gross- und Hochtemperaturwärmepumpen im Energiesystem, 22. Juli 2020](#)

Steam generating heat pumps, OST Webinar, 21 October 2025

Tools for Estimating Costs

Heat pump economical calculator



Download

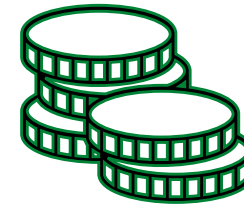
https://www.sweet-decarb.ch/fileadmin/downloads/Tools/HeatPump_IntegrationCalculation_Example.xlsx



Online version

<https://www.sweet-decarb.ch/further-info/heating-system-comparison-cost>

Payback calculator with country comparison



Online version

<https://www.sweet-decarb.ch/further-info/heat-pump-tool>

OPEX vs COP

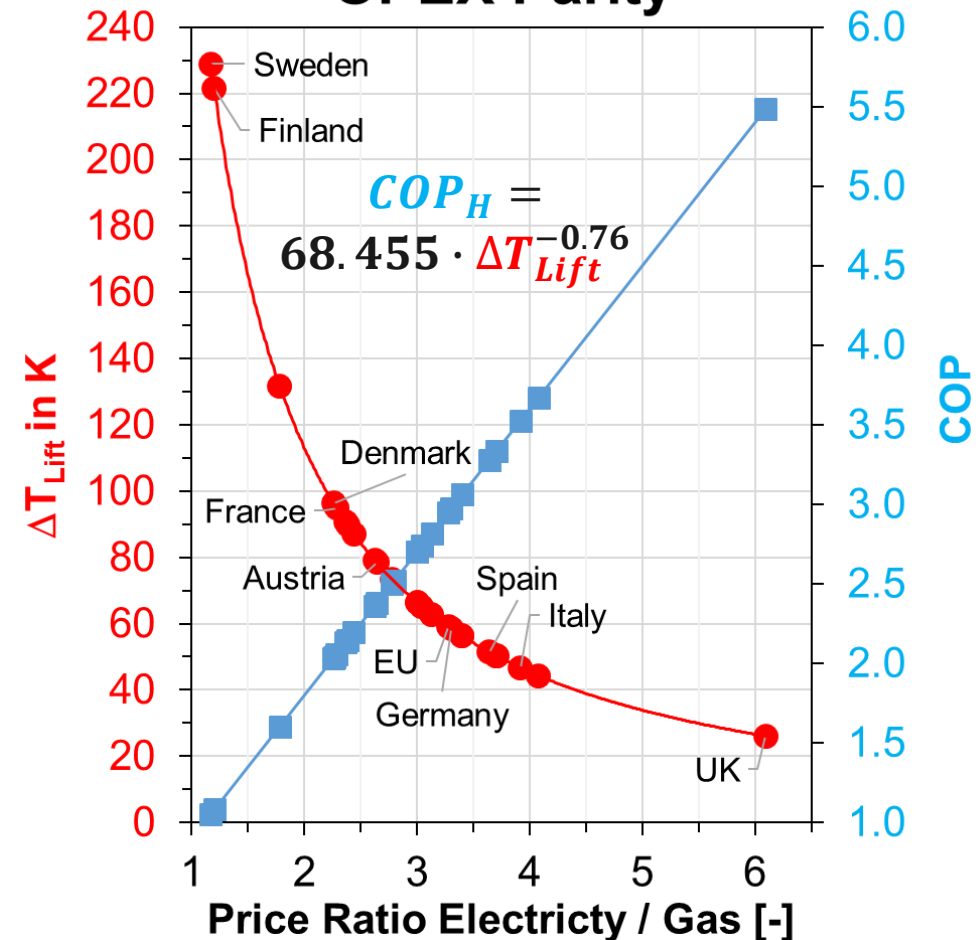
Market Attractiveness by Country

Country	Prices without refundable			OPEX Parity	
	Gas	Electricity	Price Ratio	COP	ΔT_{Lift}
Sweden	4.1	4.8	1.17	1.1	229
Finland	4.5	5.4	1.20	1.1	222
Luxembourg	2.3	4.1	1.78	1.6	132
Lithuania	3.0	6.8	2.27	2.0	96
Denmark	3.1	7.0	2.26	2.0	96
France	2.8	6.4	2.29	2.1	95
Netherlands	2.6	6.2	2.38	2.1	90
Slovenia	2.5	6.1	2.44	2.2	87
Estonia	3.0	7.1	2.37	2.1	91
Czech Republic	2.4	6.3	2.63	2.4	79
Austria	2.8	7.4	2.64	2.4	78
Latvia	2.7	7.5	2.78	2.5	73
Hungary	2.5	7.0	2.80	2.5	73
Greece	2.5	7.5	3.00	2.7	66
Poland	2.4	7.2	3.00	2.7	66
Romania	2.3	7.0	3.04	2.7	65
Croatia	2.3	7.2	3.13	2.8	63
Belgium	2.0	6.8	3.40	3.1	56
Germany	2.6	8.6	3.31	3.0	58
Bulgaria	2.0	6.8	3.40	3.1	56
Spain	2.5	9.1	3.64	3.3	51
Portugal	2.4	8.9	3.71	3.3	50
Ireland	2.7	10.0	3.70	3.3	50
Italy	2.4	9.4	3.92	3.5	47
Slovakia	2.5	10.2	4.08	3.7	44
UK	2.1	12.8	6.10	5.5	26
EU	2.5	8.2	3.28	3.0	59



$$COP = \frac{Price_{Electricity}}{Price_{Gas}} \cdot \eta_{Gas\ Boiler}$$

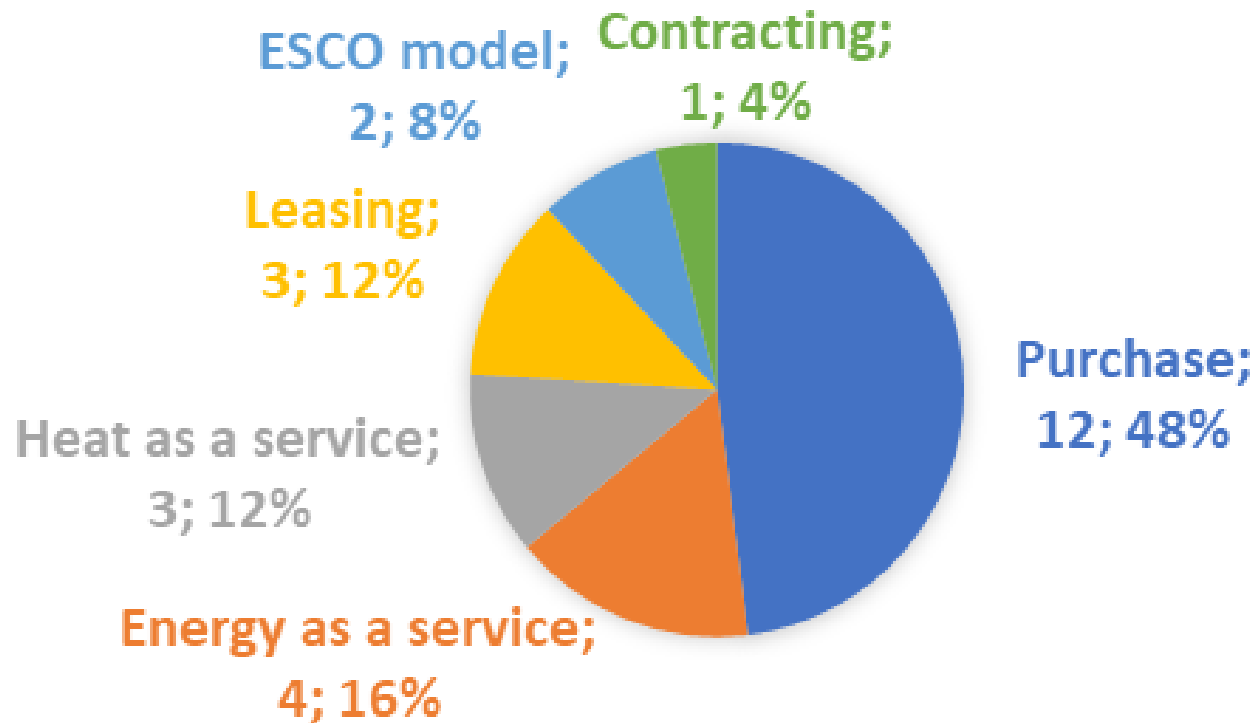
Heat Pump vs. Gas Boiler (90% efficiency) OPEX Parity



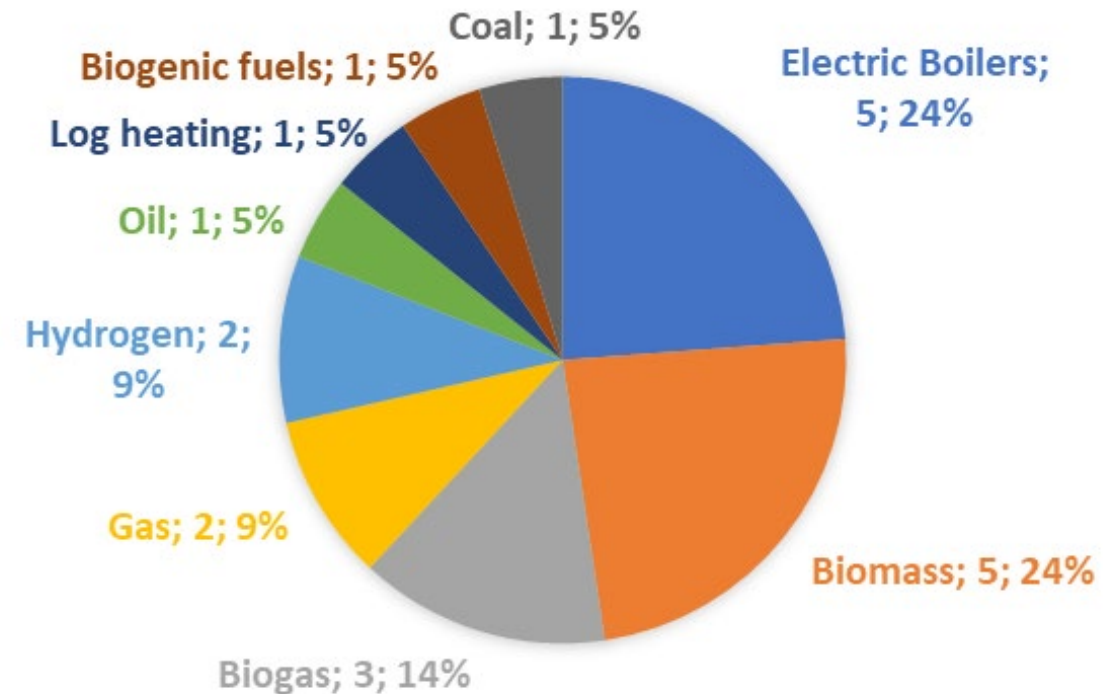
Steam-Generating Heat Pumps

Business Models – Interview results with 16 HTHP manufacturers (in Q4/2023)

PROMISING BUSINESS MODELS



POSSIBLE SUBSTITUTING TECHNOLOGIES



Sources: Arpagaus, C., Paranjape, S., Nertinger, S., Tietz, R., Bertsch, S.S.: Business models for high-temperature heat pumps, HTHP Symposium, January 23-24, 2024, Copenhagen, Denmark, [Link to Book of Presentations](#)
Arpagaus, C., Paranjape, S., Nertinger, S., Tietz, R., Bertsch, S.: [Review of Business Models for Industrial Heat Pumps](#), 36th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems (ECOS 2023), 25-30 June 2023, Las Palmas de Gran Canaria, Spain, <https://doi.org/10.52202/069564-0068>

Industrial heat pumps for industry

Continuing education courses



**TRAINING COURSE
INDUSTRIAL HEAT PUMPS**

A 4 day
Course at OST
Campus Buchs

WO WISSEN WIRKT.

OST
Ostschweizer
Fachhochschule

Focus Areas

Day 1

Module 1: General Overview

Module 2: Economic Viability and Market

Day 2

Module 3: Technology

Module 4: Integration and Case Studies

Day 3

Practical Training in the Laboratory (Lab Modules I-IV)

Day 4

Excursion

Duration

1 to 4 days, each from 8:30 to 16:00

Next dates

Day 1: 23. April 2026

Day 2: 24. April 2026

Day 3: 1. October 2026

Day 4: 2. October 2026

More information

[Continuing Education Course «Industrial Heat Pumps» | OST](#)

IHW Forum - Marktplatz für Industrie- und Hochtemperaturwärmepumpen

Sie wollen Ihr Unternehmen dekarbonisieren – und wissen, dass gerade die Wärmeerzeugung dabei entscheidend ist? Das IHW Forum bietet Ihnen die Chance, Ihre Pläne zu beschleunigen und konkrete Lösungen kennenzulernen.

Sie verkaufen Industriewärmepumpen oder bieten Leistungen im Bereich Planung, Consulting oder Fördermittel an? Lernen Sie auf dem IHW Forum Ihre Kunden von morgen kennen.

Ob Industrie, Gewerbe oder Fernwärmeerzeuger: Der Druck zur Dekarbonisierung wächst – und mit ihm die Bedeutung effizienter Wärmeerzeugung. Ein erheblicher Anteil der CO₂-Emissionen entsteht um Wärme im Bereich von 80 bis 150 °C bereitzustellen. Genau hier kommen modernste Industrie-, Hochtemperatur-, Dampf- und Grosswärmepumpen ins Spiel: Sie liefern zuverlässig die benötigte Energie – und senken gleichzeitig den CO₂-Fußabdruck.

Das *IHW Forum* richtet sich an große wie kleine Unternehmen, Energieversorger und Netzbetreiber. Hier erfahren Sie aus erster Hand, wo die Technik heute steht, welche Lösungen bereits verfügbar sind und wie sich Projekte konkret umsetzen lassen.

- **Am Vormittag:** Keynotes bringen Sie kompakt auf den neuesten Stand der Technik und 2 Minuten Pitches verschiedenster Hersteller und Sachverständiger geben Ihnen einen Überblick über die erhältlichen Leistungen.
- **Am Nachmittag:** Im interaktiven Block treten Sie an Stehtischen direkt mit Herstellern und Experten in den Dialog und haben reichlich Zeit zu Netzwerken.

Ob Dampf, Prozesswärme oder Fernwärme – beim *IHW Forum* finden Sie Antworten und Partner für Ihre Dekarbonisierungsstrategie.

Forum is in **German only**

A purple rectangular poster with white text. At the top, it says 'Veranstaltungen'. Below that is the title 'IHW Forum - Marktplatz für Industrie- und Hochtemperaturwärmepumpen'. The date and time 'Mittwoch, 18. März 2026, 09:00 - 16:00Uhr,' and the location 'OST – Ostschweizer Fachhochschule, Campus Buchs' are listed. A white button with the text 'Termin eintragen' is at the bottom.

Veranstaltungen

IHW Forum - Marktplatz für Industrie- und Hochtemperaturwärmepumpen

Mittwoch, 18. März 2026, 09:00 - 16:00Uhr,
OST – Ostschweizer Fachhochschule, Campus Buchs

Termin eintragen



Summary – 3 key recommendations for broader market adoption

- 1) **Better knowledge transfer (information sharing)** about capabilities, design, control, integration and suitable applications
- 2) **A higher level of standardization** to reduce costs and planning efforts, resulting in more practical implementation examples (learn from experience, reduce implementation risks, and multiply application potential)
- 3) **Create guidelines and train qualified personnel** able to integrate industrial heat pumps optimally

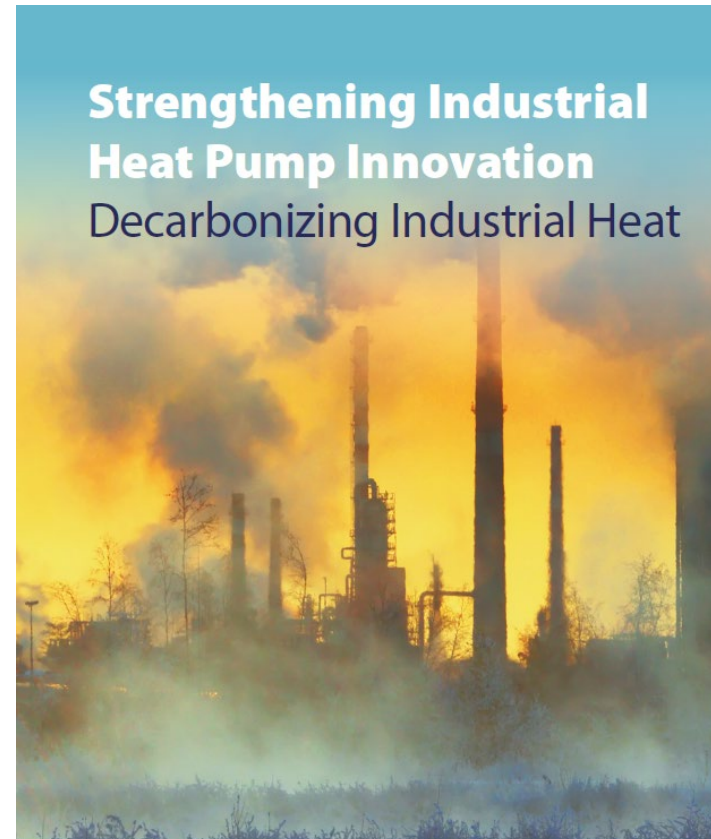
Bertsch and Arpagaus (2023): High-temperature heat pumps are on the rise Why is their market uptake slow? HPT Magazine Vol.41 No 1/2023, <https://heatpumpingtechnologies.org/column-high-temperature-heat-pumps-are-on-the-rise-why-is-their-market-uptake-slow/>

More information

www.ost.ch/ies

www.wpz.ch

<https://www.sweet-decarb.ch/>



Time for questions!
Thank you very much!