HTHP-CH – Integration of High-Temperature Heat Pumps in Swiss Industrial Processes

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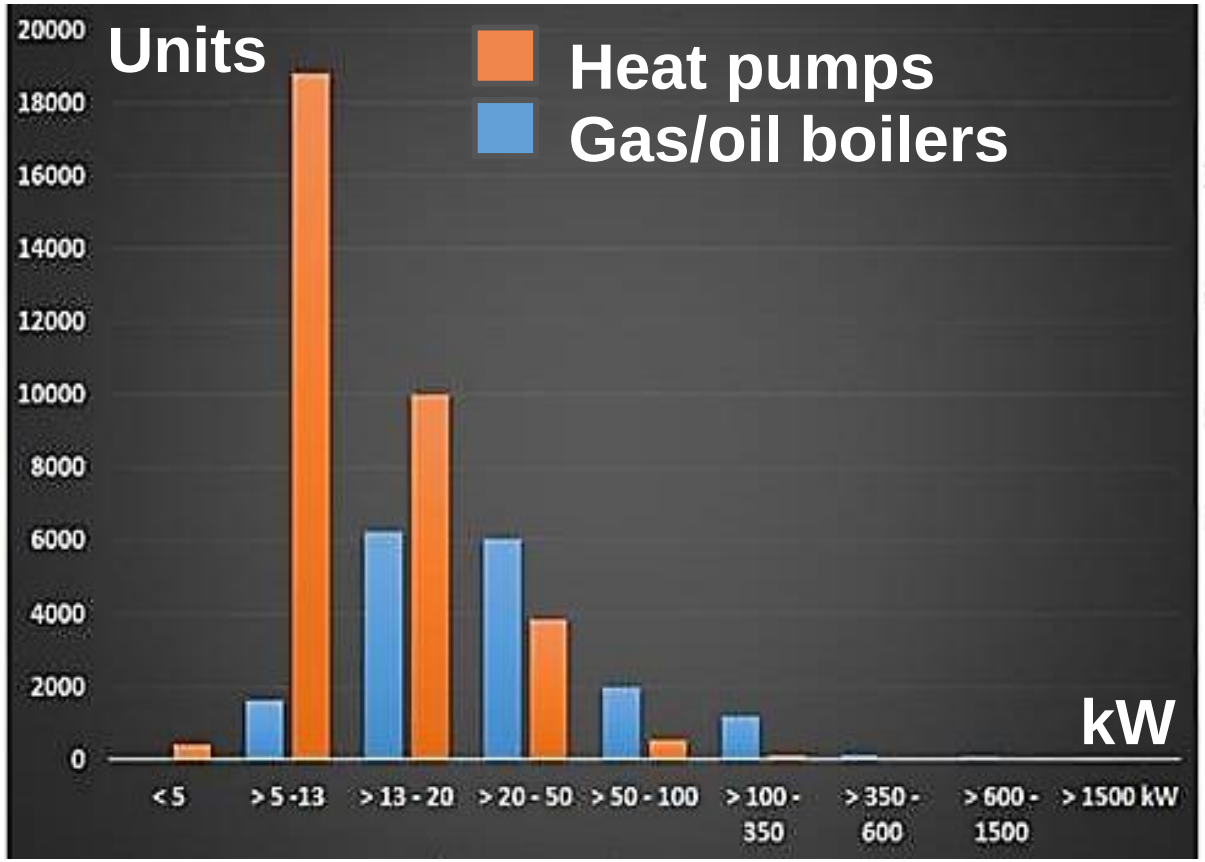
Agenda

- **Motivation and Background**
- **Project Team and Industrial Partners**
- **Project Objectives and Framework Conditions**
- **Status and Main Results**
- **Outlook – Next steps**

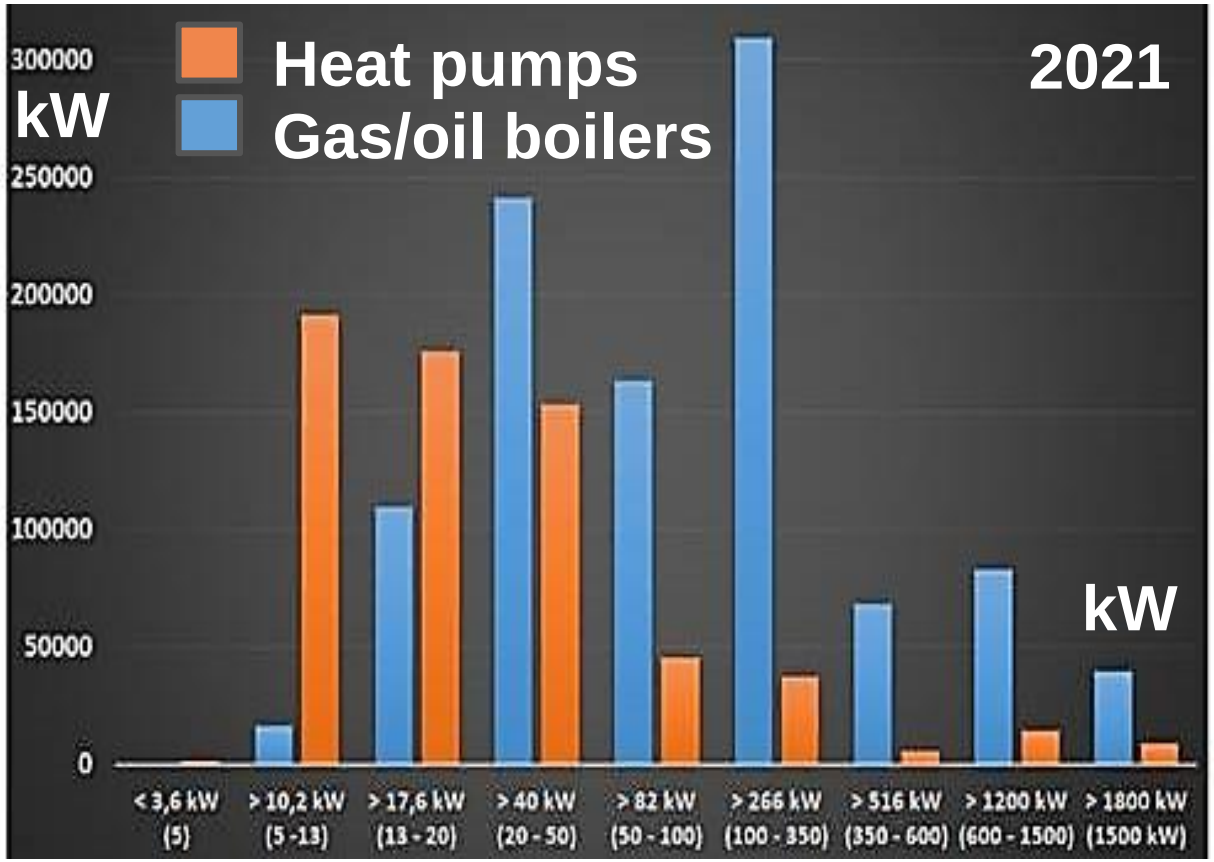
Motivation: Decarbonization of process heat by heat pumps

Units per heating capacity range



Heating capacity range

Distribution by total heating capacity



Heating capacity range

Data source: FWS (2021)

Approximate calculation of addressable potential through the use of HTHPs in the Swiss industry

Potential calculation for HTHPs in Switzerland				Data source, remarks
Swiss industry energy consumption	42‘972		GWh	154.7 PJ (as of 2018, SFOE)
Process heat demand	24‘107		GWh	56.1% (SFOE, 2019)[1]
Process heat demand < 150 °C	7’232		GWh	30% estimate, Heat Roadmap Europe[2]
Scenarios	**Pessimistic**	**Optimistic**		
Conversion change to HTHPs	10%	50%		Own estimate
Addressable process heat by HTHPs	723	3’616	GWh	
% of total process heat demand by HTHPs	3%	15%		
Heating capacity of installed HTHPs	145	723	MW	5’000 h/a operation, assumed average
Electrical need for HTHPs	241	1’205	GWh	COP = 3, own estimate
Energy savings by HTHPs use	482	2’411	GWh	
Investment volume min	69	347	Mio. CHF	480 CHF/kW (Wolf et al., 2017)
Investment volume max	108	542	Mio. CHF	750 CHF/kW (Wolf et al., 2017)
HTHP units	**145**	**723**	**Units**	**1 MW average size, own estimate**

[1] SFOE (2019): Analysis of energy consumption by specific use, 2000 – 2018, https://www.bfe.admin.ch/bfe/en/home/supply/statistics-and-geodata/energy-statistics/analysis-of-energy-consumption-by-specific-use.html

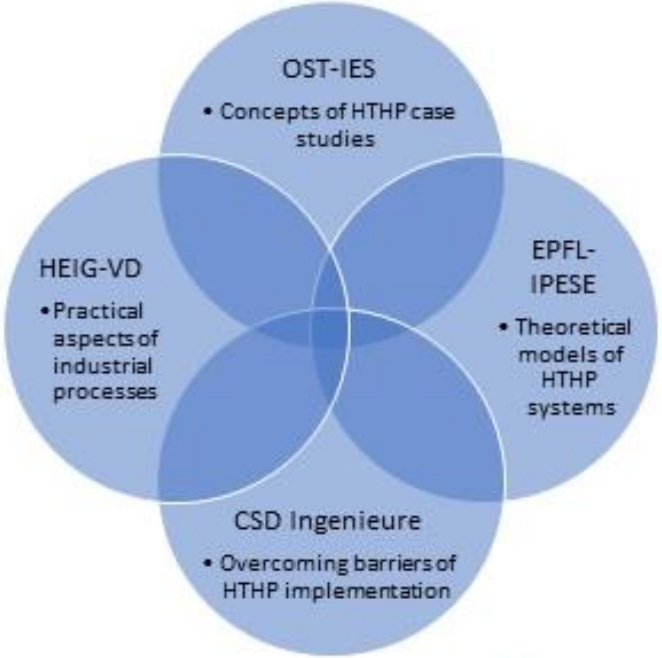
[2] Fleiter et al. (2017): Profile of Heating and Cooling Demand in 2015, Deliverable D3.1 Report, Heat Roadmap Europe, https://heatroadmap.eu/wp-content/uploads/2018/11//HRE4_D3.1.pdf

Why did we create this project?

- **Establish a larger joint Swiss project with multiple partners (joint forces)**
- **Integration of HTHPs in Swiss industry**
- **Participation in IEA HPT Annex 58 on HTHPs**

Industrial Swiss Partners

IEA HPT Annex 58 HTHPs



IEA: International Energy Agency
HPT: Heat Pumping Technologies

Objectives

The project aims to develop guidelines to accelerate the implementation of HTHPs with supply temperature above 100 °C in Swiss industrial applications with medium to large heat demand.

The **detailed objectives** are:

1) Overcome the technical, economic, and non-technical **barriers to HTHP integration**

2) Identify **suitable concepts for HTHP integration >100 °C based on case studies** (retrofit approach, use of results from IEA HPT Annex 58 on HTHPs)

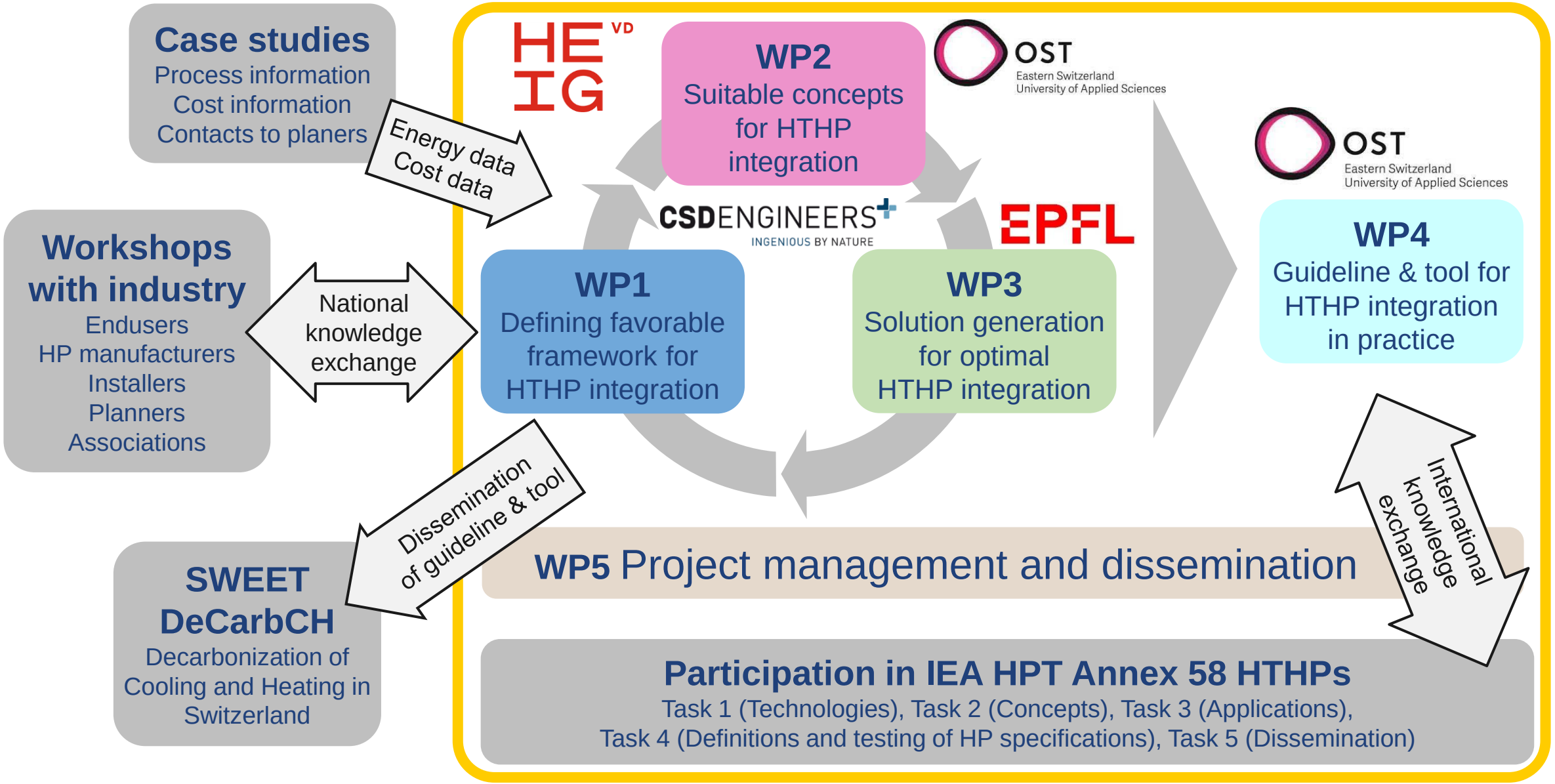
3) Characterization and clustering of typical **HTHP applications** suitable for this technology

4) Evaluation of synergies and multiplication potentials in Swiss industry (as potential extension of the present project named part B, i.e. future add-on projects)

5) Development of **guidelines** and **evaluation tool as a decision tool** to facilitate specifically the integration of HTHPs in practice (as compared to industrial HP supplying heat below 100 °C)

6) Dissemination of the project results through workshops to a broader audience of the Swiss industry and participation in the international IEA HPT Annex 58 on HTHPs

Structure of the project (3 years, Q4/2021 to Q1/2024)



Industrial Partners supporting with Case Studies

Industrial Sector	Dairy	Dairy	Food (meat)
Application/ Process Description	Several opportunities to **upgrade various heat sources** (e.g., waste heat from ammonia chillers, and from UP process) to **supply various heat sinks** (e.g, UP or UHT processes, or CIP processes).	A hot water loop operated at 105 °C to supply various processes currently being heated by a **district heating** supplied by a waste incineration plant. In case of a possible future decrease of the district heating supply temperature, a **HTHP** could be used to **upgrade the heat to 105 °C.** **HTHP integration in a milk permeate drying plant** supplied by 3 bar(g) steam and operated continuously could be another opportunity to analyze.	**Sausage cooking and smoking, steam demand at 115 °C.** Operation 12 h per day **Waste heat** is available as heat source from **ammonia refrigeration units at 40 °C to 50 °C**

Milestones

Milestone	Date	Description
M1	Q4/2021	Kick-off, go/no-go decision: Check whether project case studies from Switzerland are suitable for testing and validation the tool Check necessary data and information are available
M2	Q3/2022	Delivery of input data for HTHPs of the 3 Swiss case studies
M3	Q2/2023	Delivery of web-based tool for optimal heat pump integration in industrial processes
M4	Q4/2023	Delivery of design guidelines
M5	Q1/2024	All reports delivered

IEA HPT Annex 58 – HTHPs

Objective

Providing an overview of HP technologies, potentials and perspectives as well as developing concepts and strategies towards HP-based process heat supply

Scope

Heat pump technologies with supply temperatures above 100 °C
Technologies | Concepts | Applications | Testing | Dissemination

Project facts and partner group

2021 – 2023 | Annex of the IEA HPT TCP | https://heatpumpingtechnologies.org/
Austria/Belgium/Canada/**Denmark (Operating Agent)**/France/Germany/Japan/
Netherlands/Norway/**Switzerland** + potentially Finland/Italy/Sweden/UK/US

HTHP-CH Project status

- **Kick-off meeting on 16.12.2021 (online)**
- **Case studies ELSA, Cremo, Gustav Spiess: clarifications of industrial processes**
- **Student work: Cremo selected as case study for student from EPFL semester project**
- **Site visits at ELSA and Cremo on 31.5.2022**
- **Annex 58 Status:**
  - 8 meetings attended (online) and physical 31.3. in Copenhagen
  - National team description for Annex 58 homepage written (link to description)
  - National HTHP market and perspectives for Annex 58 Task 1 report completed and submitted
  - OST co-leads Task 2 with DTI on HTHP integration concepts (hot water, steam production, spray drying, other drying processes, evaporation, distillation, MVR specific concepts, …)

- **HTHP Symposium (Copenhagen, 29.-30.3.2022) participation of OST (link to program)**
- **Paper for WP-Tagung Burgdorf (22.6.) completed (oral presentation, link to program)**

Companies active in the HTHP market

Outlook – Next steps

- **ELSA, CREMO, Gustav Spiess AG:**
  - Sharing energy & process data (with time resolution, cost of energies, etc.)
  - Data analysis
  - Identifying potential HTHP integration points
  - Progress meetings
- **Participation in Annex 58 meetings**
- **Workshop with industry in Sept. 2022 (content and location tbd)**