

# Sol-Ind Swiss

## Solar Thermal in Industry



## Overview solar process heat

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## Potential and promising sectors in Switzerland

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SWISSOLAR 



heig-**vd**

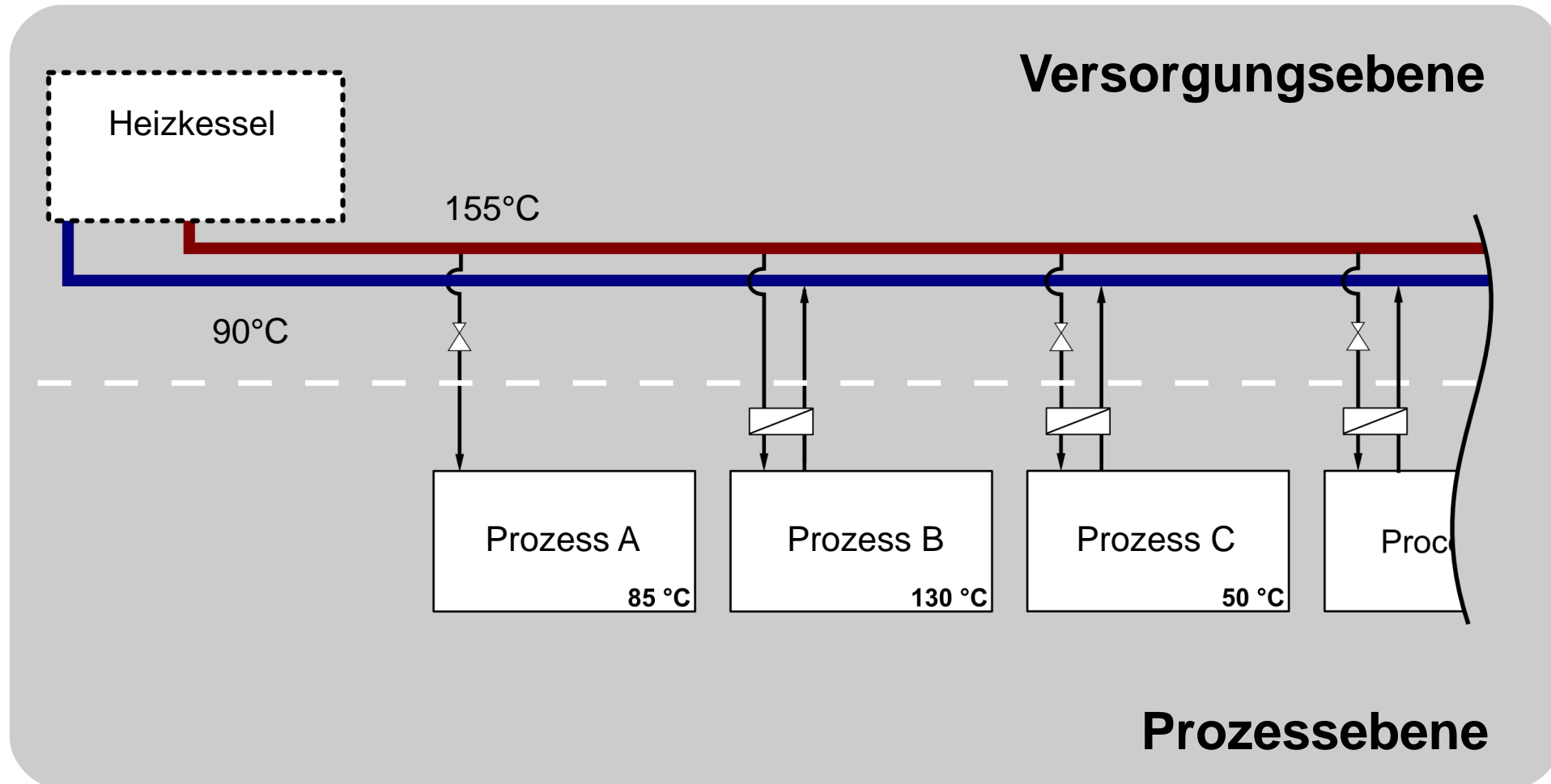
HAUTE ÉCOLE  
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# Solare Prozesswärmetechnologien

## ■ Bereitstellung von Wärme mit Solarthermischen Kollektoren

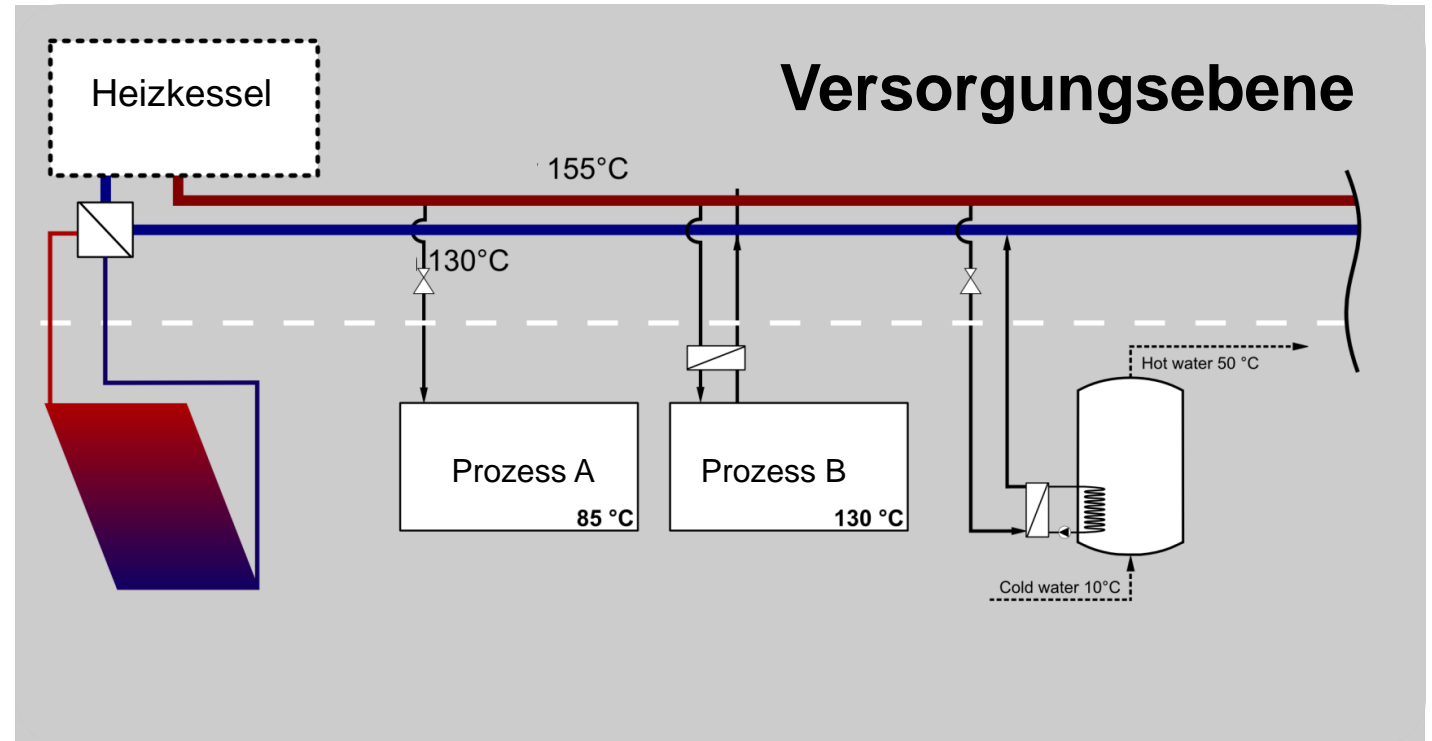




Quelle: B. Schmitt, Uni Kassel

# Integration auf Versorgungsebene

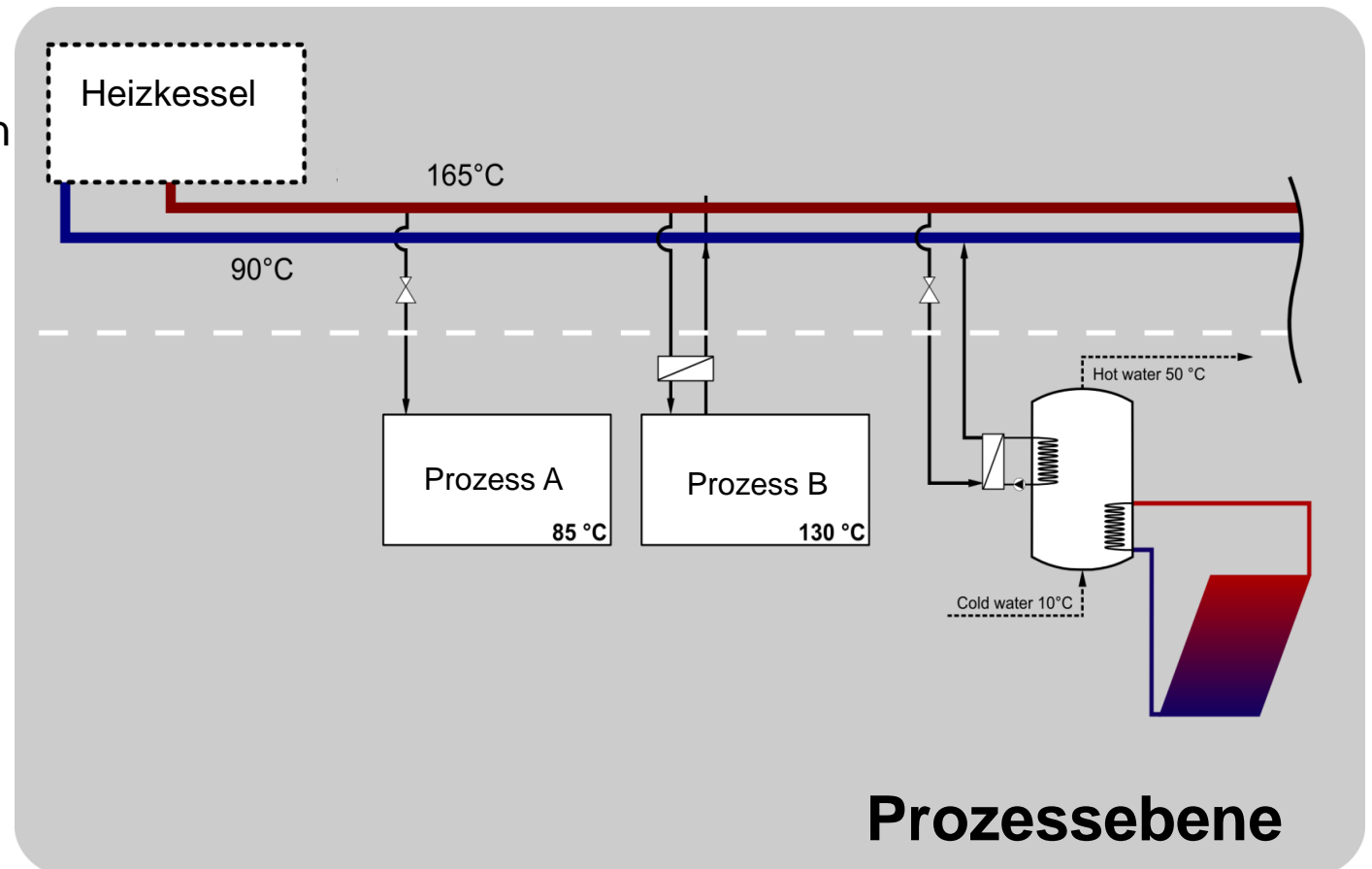
- Einfache Einbindung
- Beliefert verschiedene Prozesse
- Höhere Temperaturen



Quelle: B. Schmitt, Uni Kassel

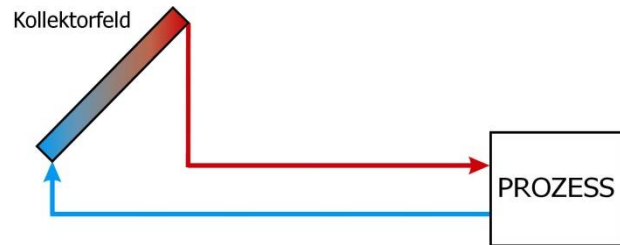
# Integration auf Prozessebene

- Komplexere Einbindung
- Mehrere Einbindungsmöglichkeiten
- Tieferen Temperaturen möglich
- Höhere solare Deckungsrate möglich

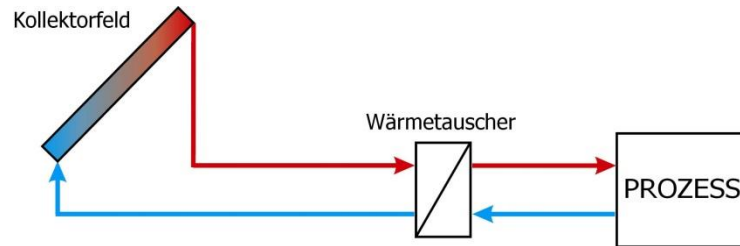


Quelle: B. Schmitt, Uni Kassel

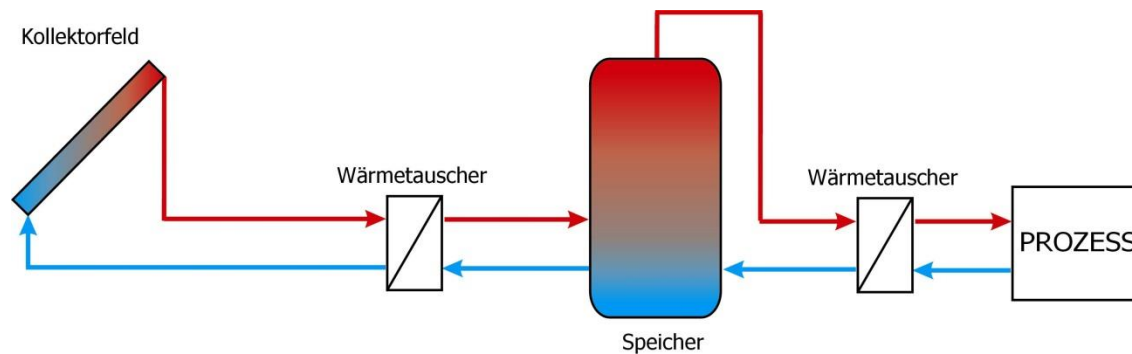
# Integration auf Prozessebene



- Direkte Einbindung  
Kontinuierlicher Prozess



- Indirekte Einbindung  
Kontinuierlicher Prozess



- Indirekte Einbindung (üblich)  
Diskontinuierlicher Prozess

Quelle E. Frank, Frank Energy



# Vorteile Solare Prozesswärme

- CO<sub>2</sub> neutrale Energiequelle
- Nutzt die freiverfügbare Sonnenenergie
- Feste Wärmepreise für 20 Jahre
- Grosse Sichtbarkeit und positives Image



# Sol-Ind Swiss Project

## Focus and goals



Push the deployment of solar process heat in Switzerland focussing on the heat demand at low temperature levels ( $<130^{\circ}\text{C}$ )

- ✓ Identify the potential and suitable industrial sectors
- ✓ Audits and feasibility study in selected companies
- ✓ Feasibility tool



## 6 systems already implemented in Switzerland

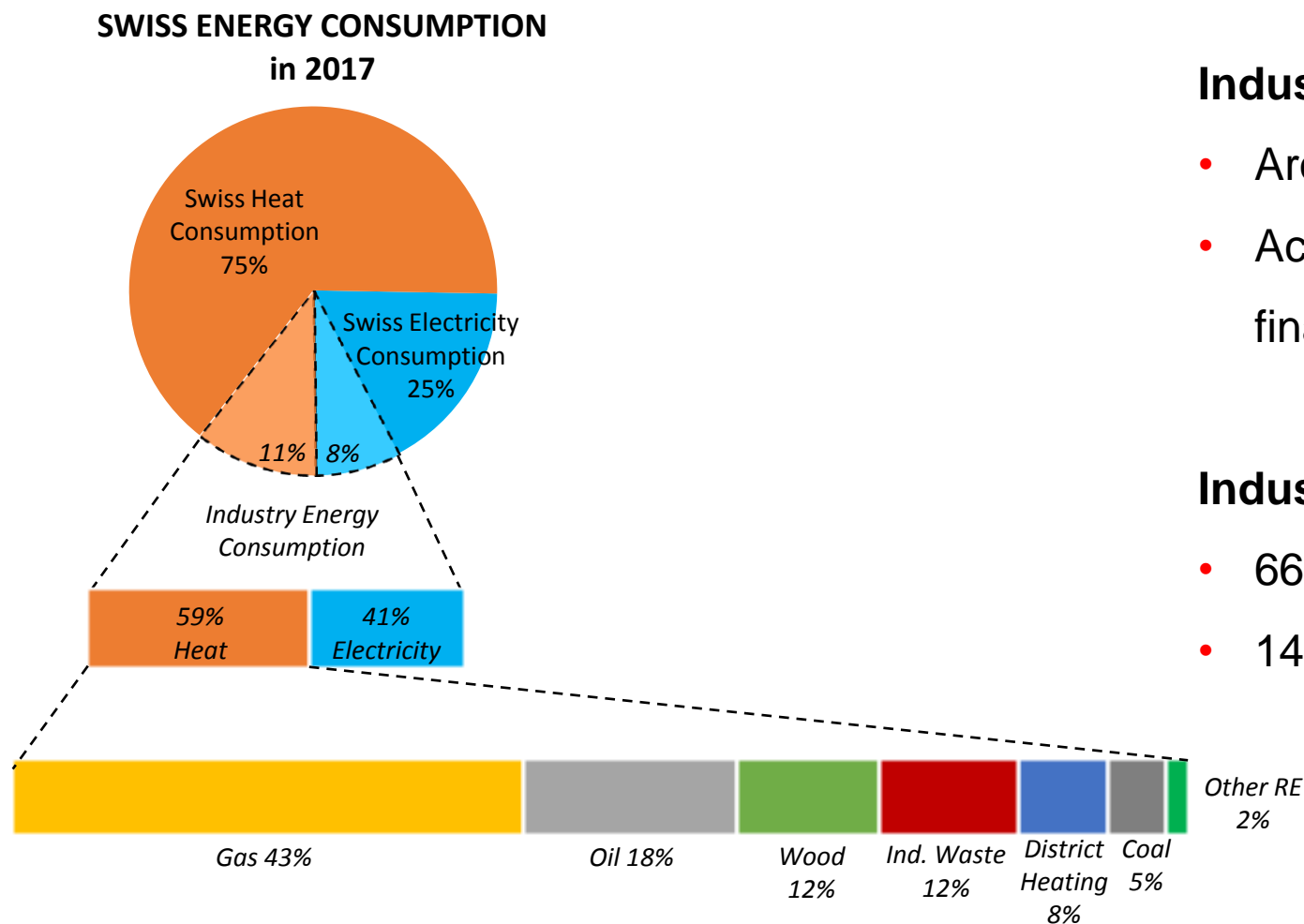
- Dairy products manufacturing
- Machinery products manufacturing
- Bitumen production





# Swiss Industry Energy Consumption

## Industry Energy Consumption by Energy Vectors



### Industry energy consumption

- Around 43 TWh
- Accounting for 19% of the total Swiss final energy consumption

### Industry heat consumption

- 66% from fossils fuels
- 14% from renewable energies

Source: based on OFEN, 2018. Statistique globale Suisse de l'énergie 2017

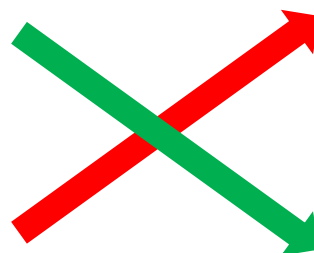
# Swiss Industry Energy Consumption

## Energy Costs in Swiss Industry

- The three most used energy vectors
- CO<sub>2</sub> tax impacting the energy price
- Fossil energies price VS Solar price

Energy vector	Prix (CHF/MWh)
Electricity	60 - 200
Gas	40 - 90
Oil	40 - 80

Source: Sol-Ind Swiss Project, Sondage auprès de 4 secteurs de l'industrie Suisse

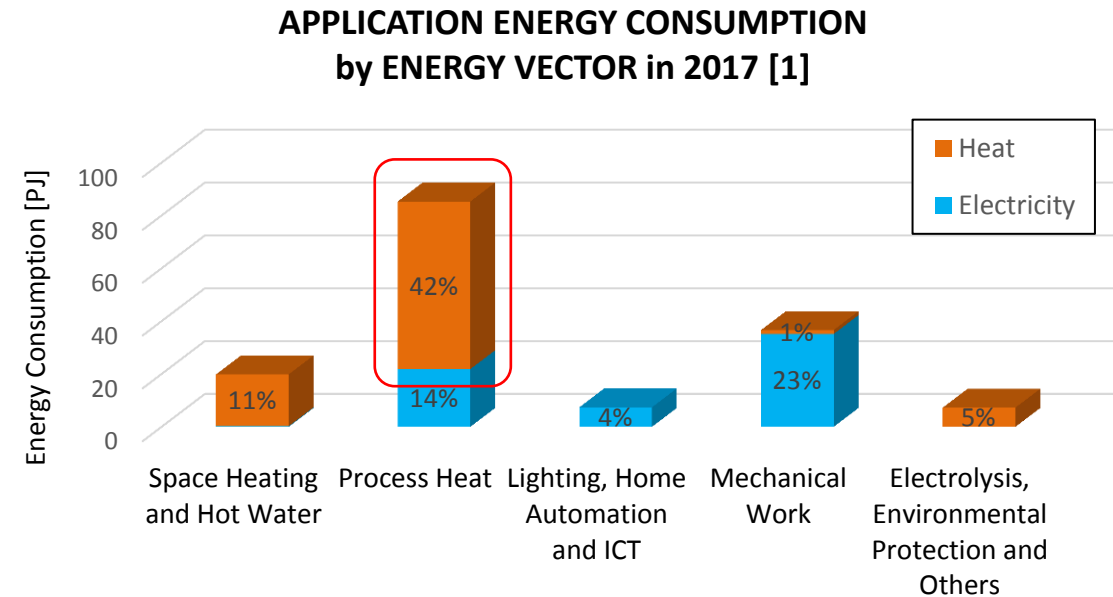


# Process Heat Consumption

## Industry Energy Consumption by Application

### Process Heat Application

- 24 TWh (56% of the industry consumption)
- 75% from heat and 25% from electricity
- 70% of the thermal energy consumption in the industry



**Potential considering → 18TWh**

[1] Source: based on Kemmler et al., 2017. Analyse des schweizerischen Energieverbrauchs 2000-2016 nach Verwendungszwecken

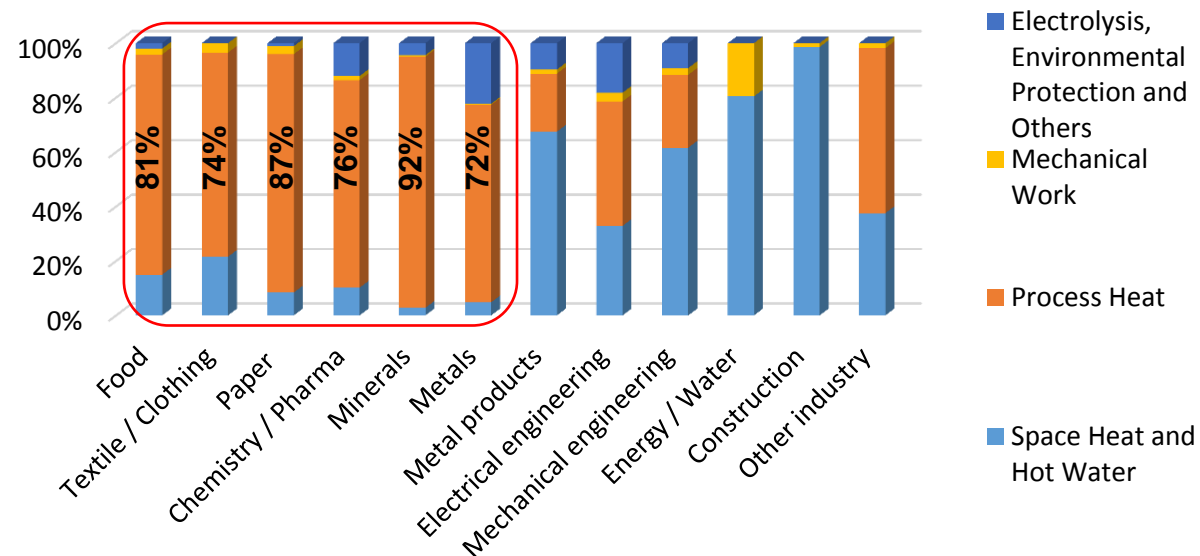
# Process Heat Consumption

## Process Heat Consumption by Industrial Sector

### Industrial sectors considered

- Food
- Textile/Clothing
- Paper
- Chemistry/Pharma
- Minerals
- Metals

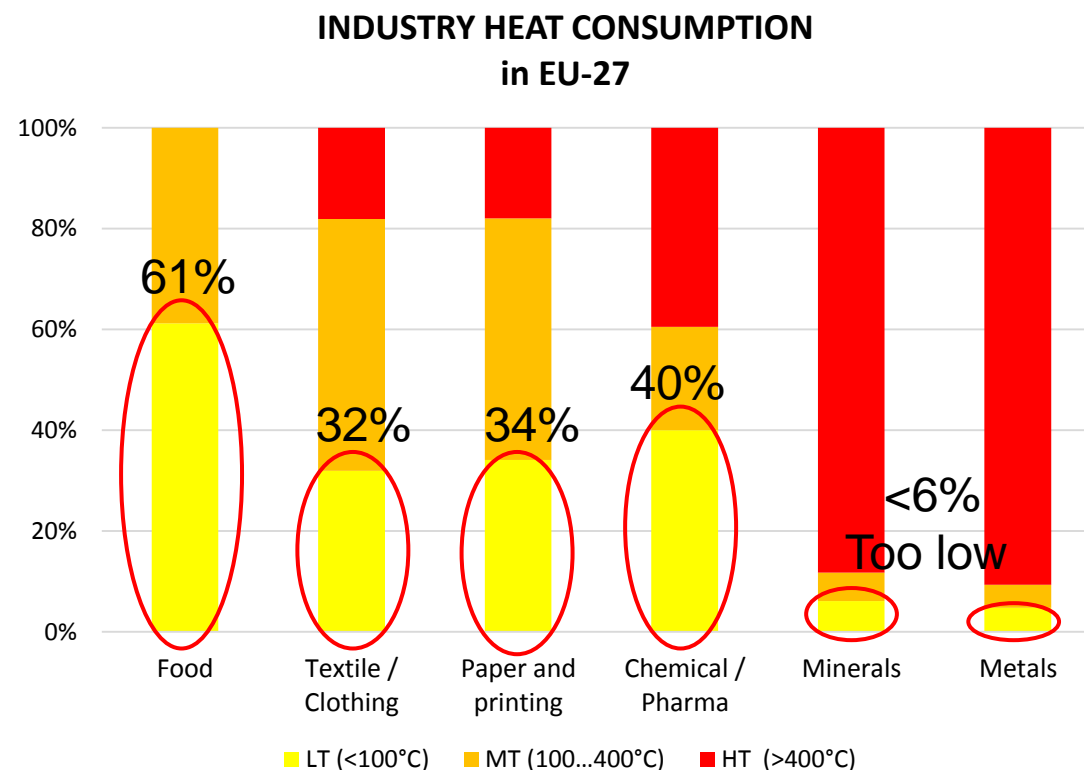
INDUSTRIAL SECTORS THERMAL ENERGY CONSUMPTION  
by APPLICATION in 2017



# Solar Heat Potential for Industrial Processes

## Promising Industrial Sectors

- Distribution is assumed to be similar to that of other European countries
- LT demand includes Process Heating, Space Heating (SH) and Hot Water (HW)
- Promising industrial sectors are:
  - ✓ Food
  - ✓ Textile/Clothing
  - ✓ Paper
  - ✓ Chemical/Pharma



Based on Pardo et al. (2012)



# Solar Heat Potential for Industrial Processes

## Theoretical Potential in Swiss Industry

<i>Industrial Sector</i>	Thermal Energy Consumption		Low Temperature Demand (<100°C)	Low Temperature Heat Demand [PJ]	Theoretical Potential [PJ]
	SH and HW [PJ]	Process Heating [PJ]			
<i>Food</i>	1.7	9.0	61%	6.5	<b>4.8</b>
<i>Textile/Clothing</i>	0.2	0.6	32%	0.3	<b>0.1</b>
<i>Paper</i>	0.6	5.8	34%	2.2	<b>1.6</b>
<i>Chemistry/Pharma</i>	2.5	18.0	40%	8.2	<b>5.7</b>

Theoretical potential for low temperature SHIP systems in these four industrial  
3.4 TWh

- ➔ 19% of the process heat consumption in the industry
- ➔ 8% of the industry energy consumption

# Conclusions

- Theoretical potential for 4 selected industrial sectors → 3.4 TWh

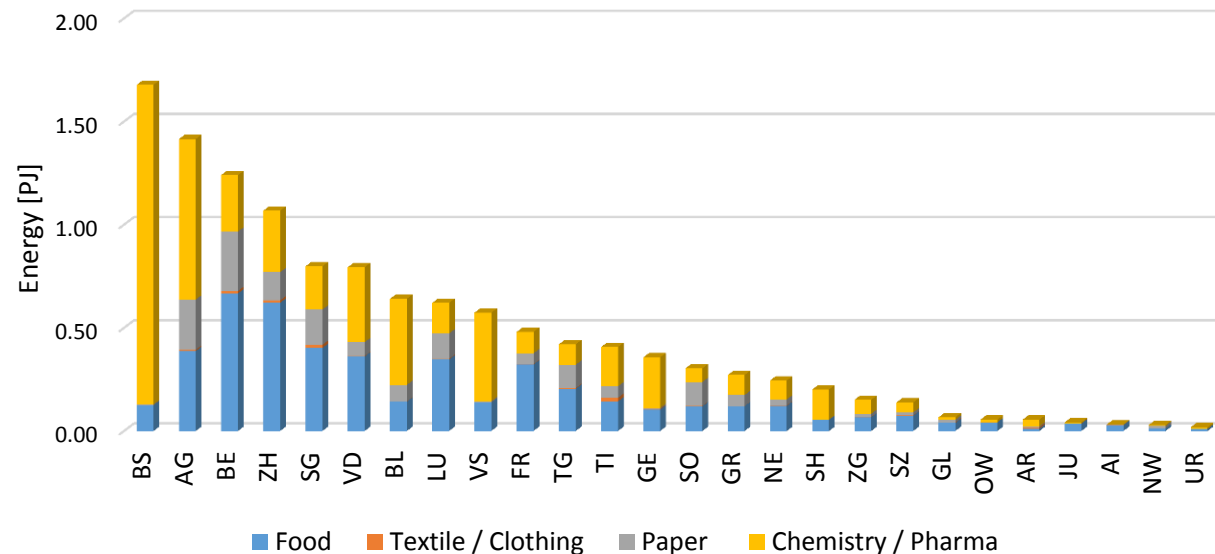


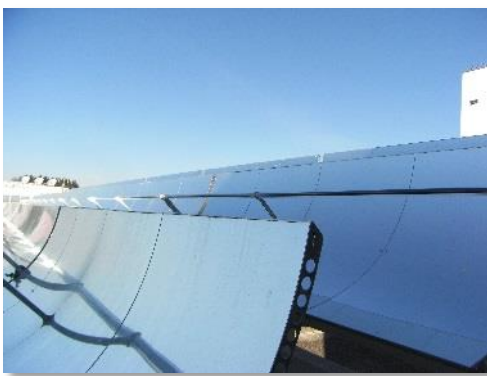
(Fs 40% ; 400 kWh/m<sup>2</sup>)

**equivalent to more than 3 Million m<sup>2</sup> installed ST collectors**

- Better if we consider:
  - ✓ SH and DHW applications
  - ✓ Process Heating electricity consumption
  - ✓ Others industrial sectors

**THEORETICAL POTENTIAL FOR LOW TEMPERATURE SHIP SYSTEMS  
by CANTON**





**Thank you for you attention**

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