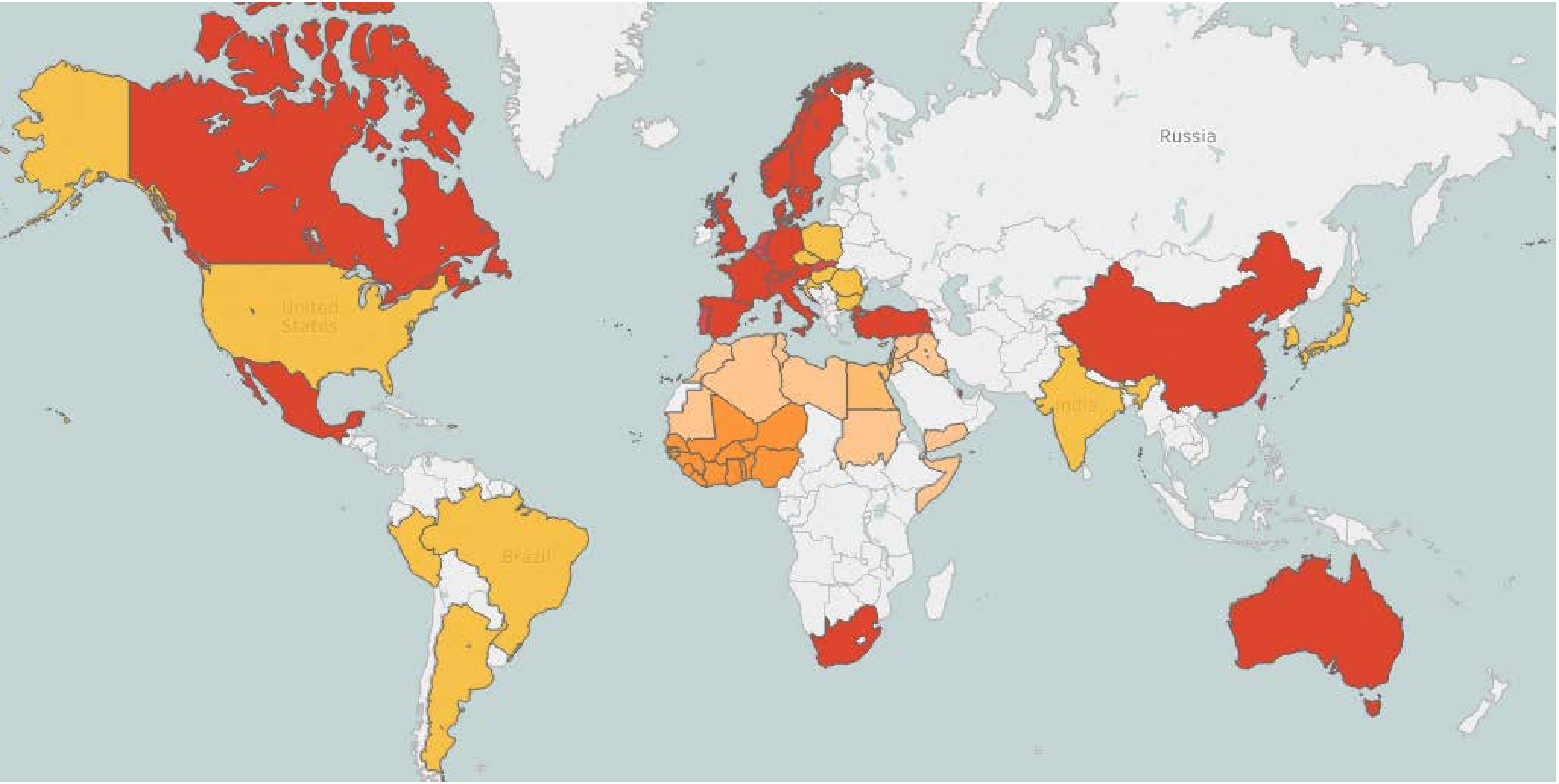
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Task 54 Webinar

Price Reduction of Solar Thermal Systems

TASK 54

IEA SHC is a project focused international research programme



20 Member Countries + EC + 5 Sponsor Organizations

Sponsors – 47 additional Countries

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Map is without prejudice to status of or sovereignty over any territory, to delimitation of international frontiers/boundaries and to name of any territory/area.

Sharing what we've learned

Why an academy?

To share our work and support R&D and implementation of solar heating and cooling projects worldwide.

How can you participate?

- **Webinars** held quarterly hosted by ISES
- **Videos** highlighting our work and other ST issues
    - Interviews with 12 presenters at SHC 2017
    - Videos showcasing 11 presentations from Qatar's Green Expo 2016
- **National Days** are country specific events held in conjunction with IEA SHC meetings for the exchange of information between national experts and IEA SHC experts.
- **Onsite Training** provided by IEA SHC experts at the request of IEA SHC member countries.

Where you can find more information

- Visit our website – www.iea-shc.org
- Follow us on social media

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IEA Solar Heating and Cooling Programme (group 4230381)

TA$K 54 Webinar

Price Reduction of Solar Thermal Systems

1. **Solar thermal value chain and cost reduction potential**
2. **LCoH calculation method**
3. **Practical examples:**
    - Cost reduction by standardization
    - Reduction of production costs – Potential of process cost optimization
    - Cost reduction by temperature limitation
    - Cost reduction potential of polymeric materials
    - Cost competitiveness of multi-family-house systems
4. **Wrap-up**
5. **Q&A**

Solar Thermal Value Chain and Cost Reduction Potential

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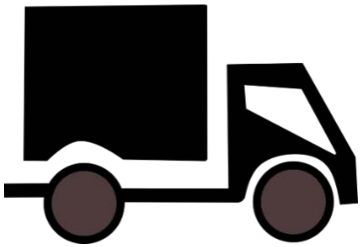
Price reduction of solar thermal systems

Solar Thermal Value Chain



1. Architect, Planner, Energy Consultant
2. Production
3. Distribution
4. Installation
5. Installed System
6. Operation and Maintenance
7. Cost of kWh solar (LCoHs)

Solar Thermal Value Chain Production

Energy, Machinery, Labor, Operation Costs, Profit

2.1 Raw materials

- Copper
- Aluminium
- Steel
- Sand
- Oil
- …

2.2. Materials Semi-finished parts

- Copper Pipe
- Aluminium sheet
- Steel sheet
- Glass
- Polymer
- …

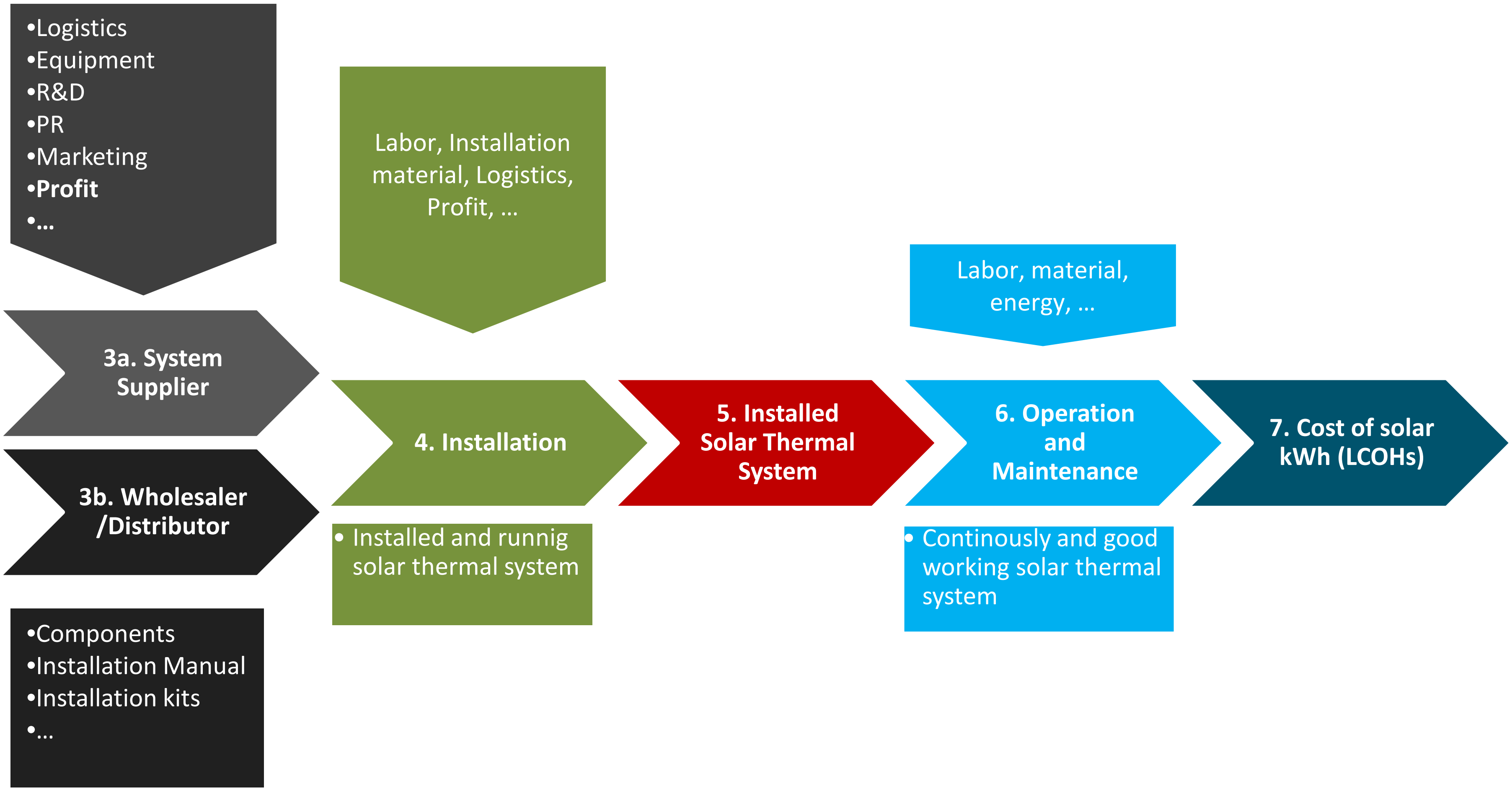
2.3 Sub-components

- Absorber
- Insulation
- Glass cover
- Heat exchanger
- Collector frame
- …

2.4 Components

- Collector
- Heat storage
- Controller
- Mounting system
- Fittings
- …

Solar Thermal Value Chain
Distribution – Installation – Operation and Maintenance



Potentials

- Materials
  - use of different materials, system designs
- Production costs
  - process cost analysis, standardisation, economy of scales
- Installation
  - process cost analysis, reduction of stagnation temperature, standardisation
- Operation
  - standardisation
- Maintenance
  - reduction of stagnation temperature, standardisation
- Service life time
  - reduction of stagnation temperature, standardisation

Thank you for your attention!

Research and Testing Centre for Thermal Solar Systems (TZS) / Institute of Thermodynamics and Thermal Engineering (ITW) / University of Stuttgart
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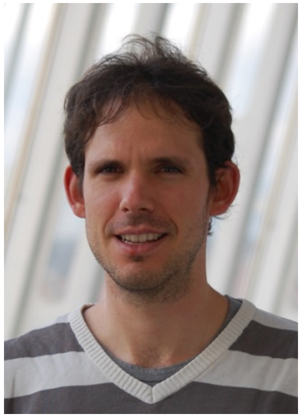
LCoH Calculation Method

Heat Cost Calculations Applied to Solar Thermal Systems

Yoann Louvet



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TASK 54

Price reduction of solar thermal systems

Introduction

- Price reduction assessment in Task 54 requires:
  - Reference systems
  - Common **indicator** and methodology

- Levelized Cost of Heat (**LCoH**):
  - Often used in power sector (LCoE)
  - Growing usage in the heat sector
  - Assess the impact on heat costs of
    - **costs reduction** along the value chain (production to decommissioning)
    - system **performance improvements**

LCoH Equation

Initial investment (€) ?

Subsidies (€)

O&M costs (€/a)

$LCoH$

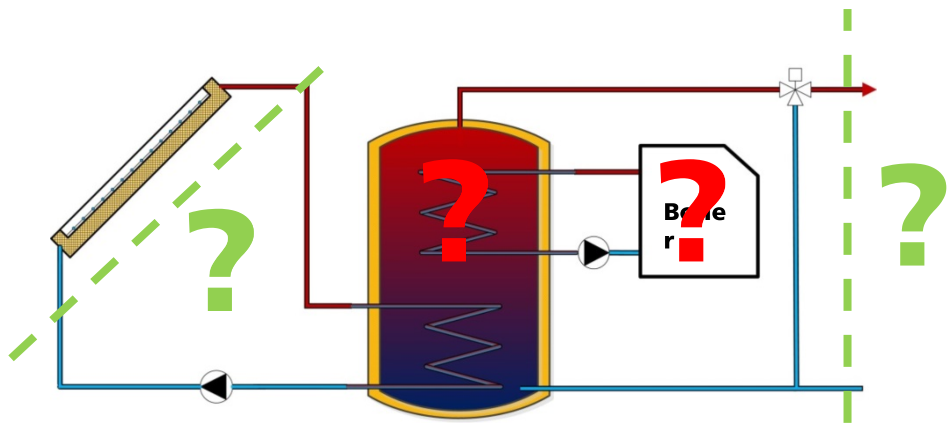
$\frac{€}{kWh}$

Period of analysis (years)

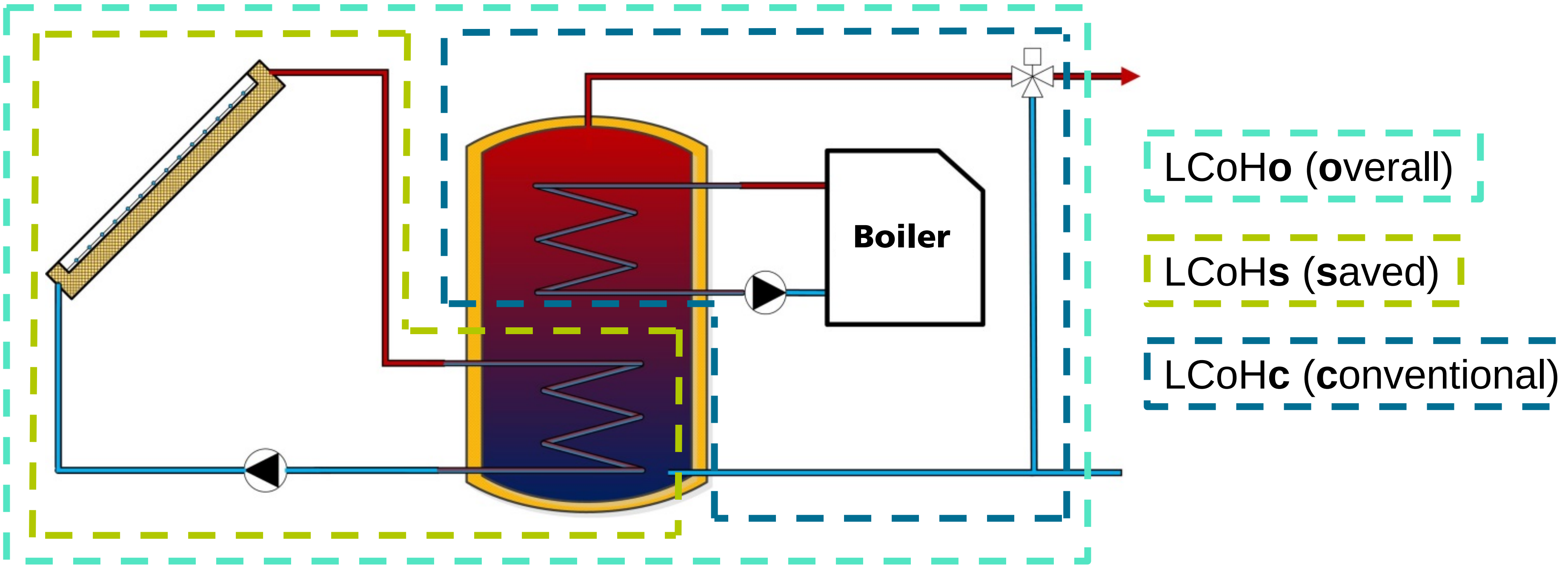
Discount rate (%)

Reference energy (kWh/a) ?

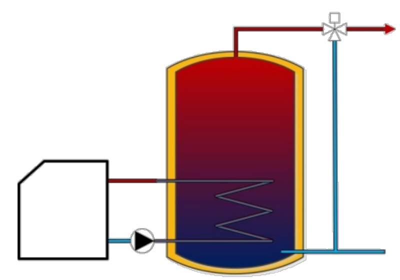
- Task 54:
  - $r = 0$
  - $S_0 = 0$
  - All costs excluding VAT



System Boundaries and LCoH



	LCoHs
I_0	Solar components – Store credit
E_t	Saved final energy



Reference conv. system

Example: Reference SDHW System in Germany (SFH)

- 5 m² FPC (gross), 300 l store, back-up: gas condensing boiler
- Saved final energy: 2.2 MWh/a
- Final energy demand: 13.4 MWh/a
- T = 20 years

	Conventional	Solar
Investment I_0 [€]	6500	3850
O&M C_t [€/a]	1280	117

$$LCoH = \frac{I_0 + \sum_{t=1}^{T} C_t}{\sum_{t=1}^{T} E_t}$$

LCoHs	13.9 €ct/kWh

Summary

- LCoH is a sensitive indicator: detailed assumptions necessary!
- Depends for solar thermal systems on
  - System design
  - Customer behaviour
  - Climatic situation
  - Service life time and maintenance

- 10 **reference systems** (5 countries) defined in Task 54

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Thank you for your attention!

Cost Reduction by Standardization

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TASK 54

Price reduction of solar thermal systems

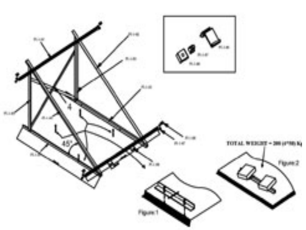
Standards in Everyday Life

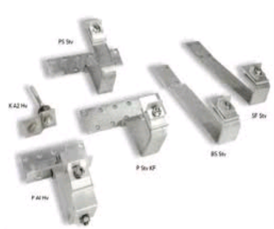
GSM™

Global System for Mobile Communications

Standardisation can make life easier and cheaper

Standards for Solar Thermal?!





Collector

- different sizes/dimensions even if gross area is the same
- different connections
- different location for temperature sensor
- different interface to mounting system
- etc.

Mounting system

- different roof hooks
- different mounting rails
- different clamps
- etc.

Standards for Solar Thermal?!

Hot water storage

- different dimensions even if volume is the same
- different connections
- different location for temperature sensor
- etc.

Other componets

- same situation

Standardisation for solar thermal needed!

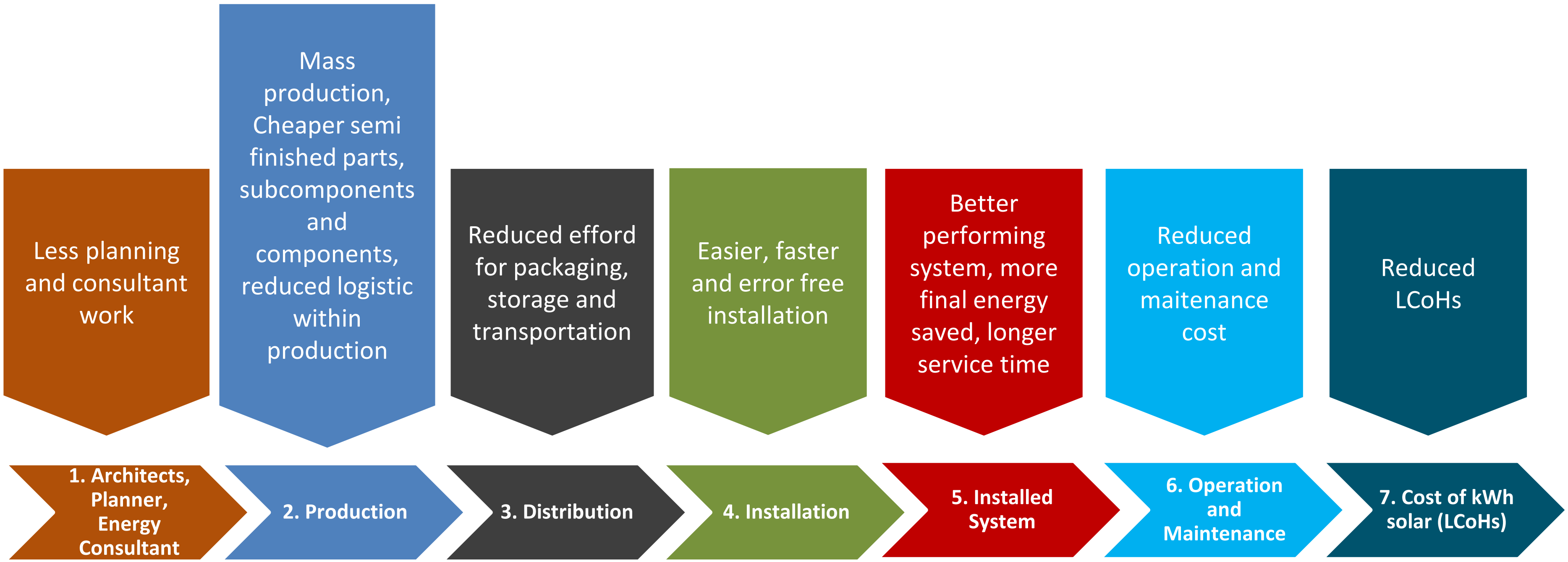
Benefits of standards for solar thermal

- Cheaper semi finished parts, subcomponents and components
  ➡ reduction of investments costs

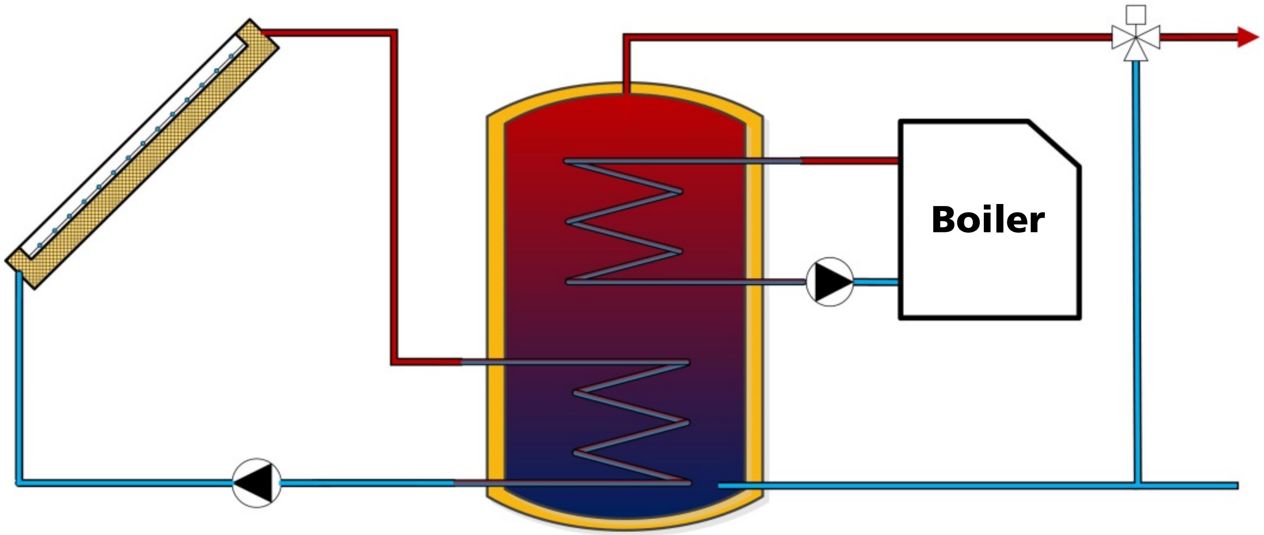
- Cheaper and error free installation
  ➡ reduction of investments costs
  ➡ reduction of maintenance costs
  ➡ extension of life time of the system

- Better performing systems
  ➡ increase of saved final energy

Standardisation
Impact on the Solar Thermal Value Chain

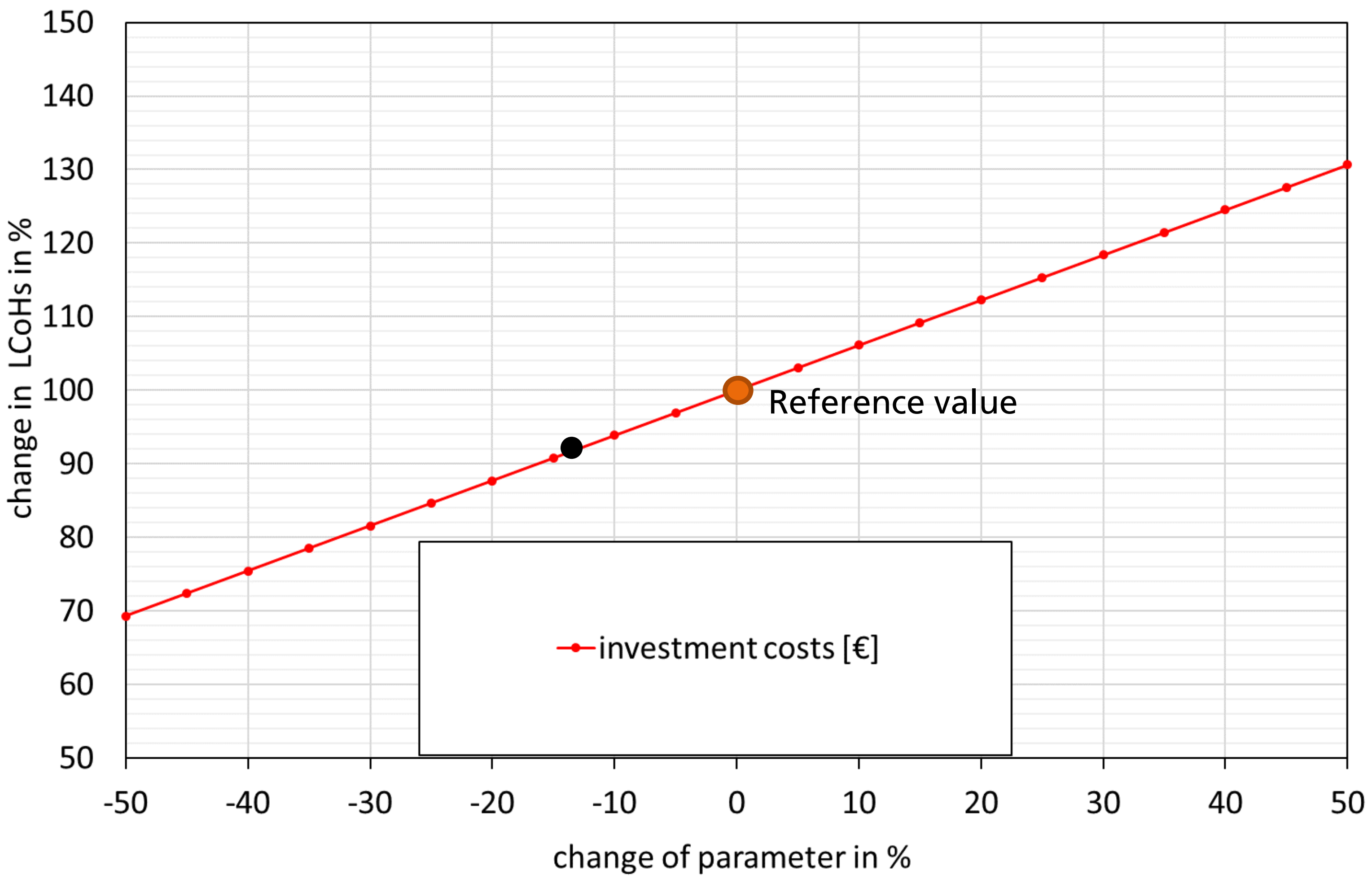


Standardisation
Impact on LCoHs of SDHW system

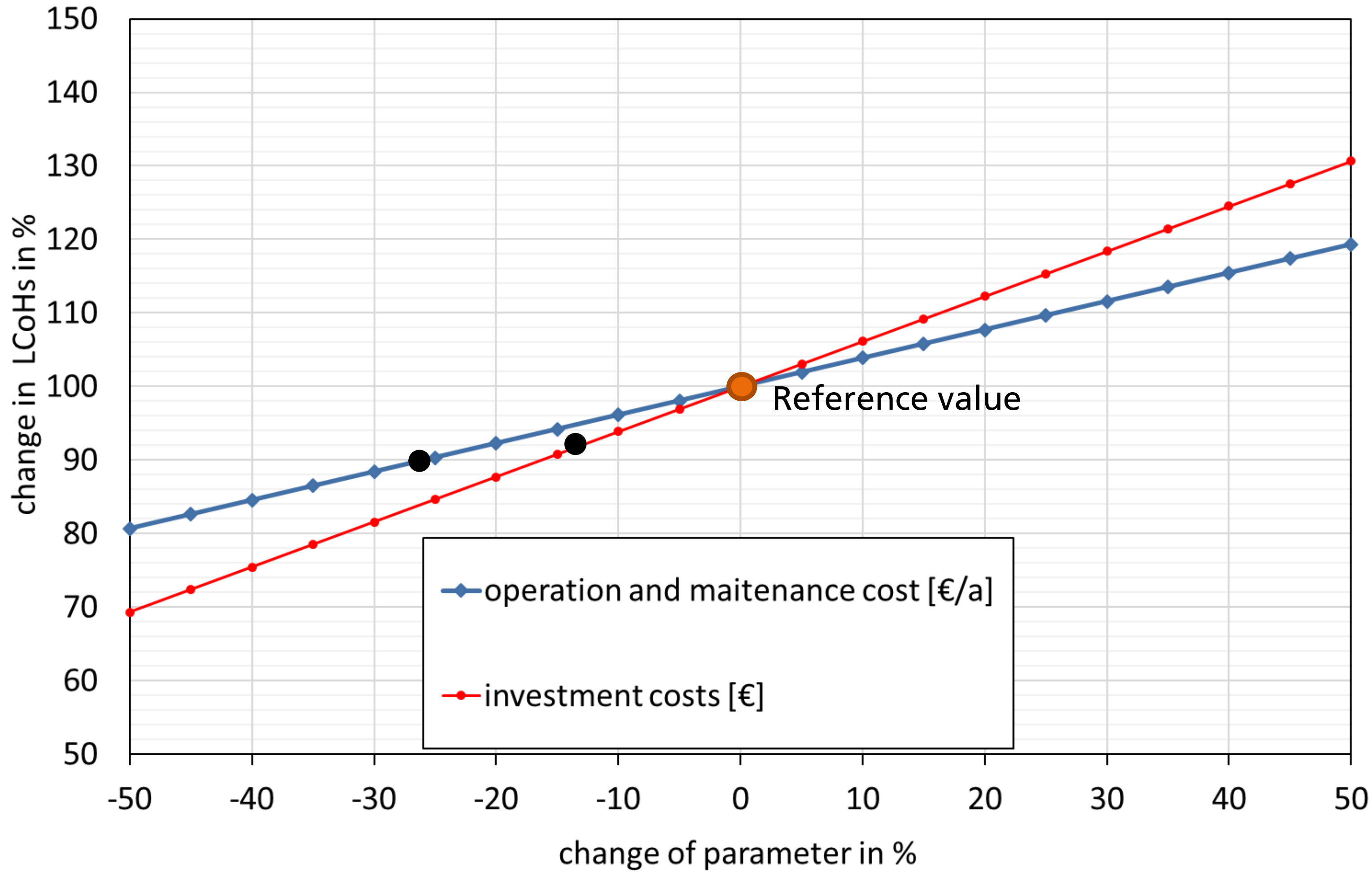


	value	reduction	new value
Investment components $I_{0,c}$ [€]	2600	- 10 %	2340
Investment installation $I_{0,i}$ [€]	1250	- 20 %	1000
O&M C_t [€/a]	117	- 26 %	87
Saved final energy E_t [kWh/a]	2226	+ 10 %	2449
service time t [a]	20	+ 10 %	22

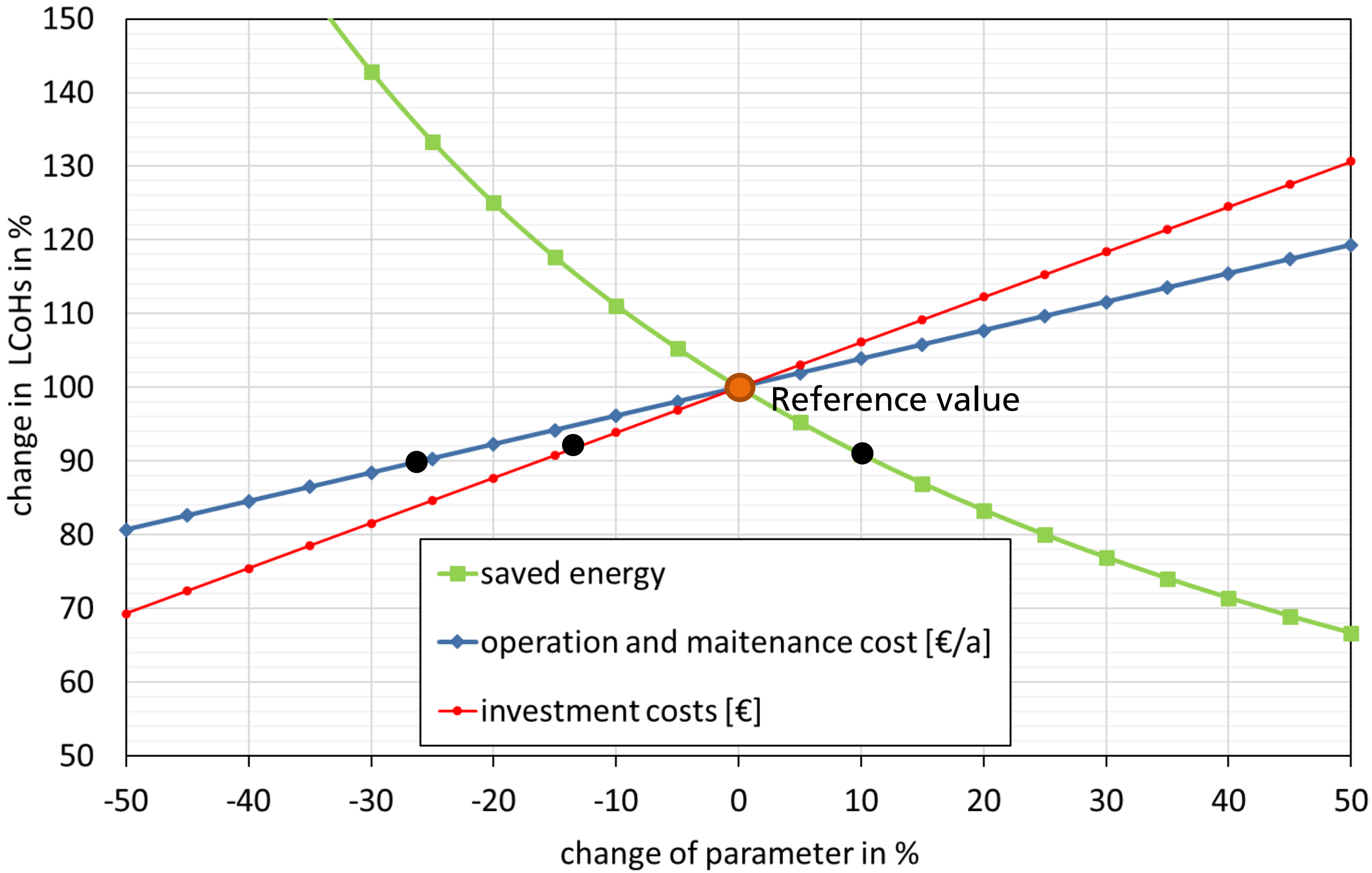
Standardisation
Impact on LCoHs of SDHW system



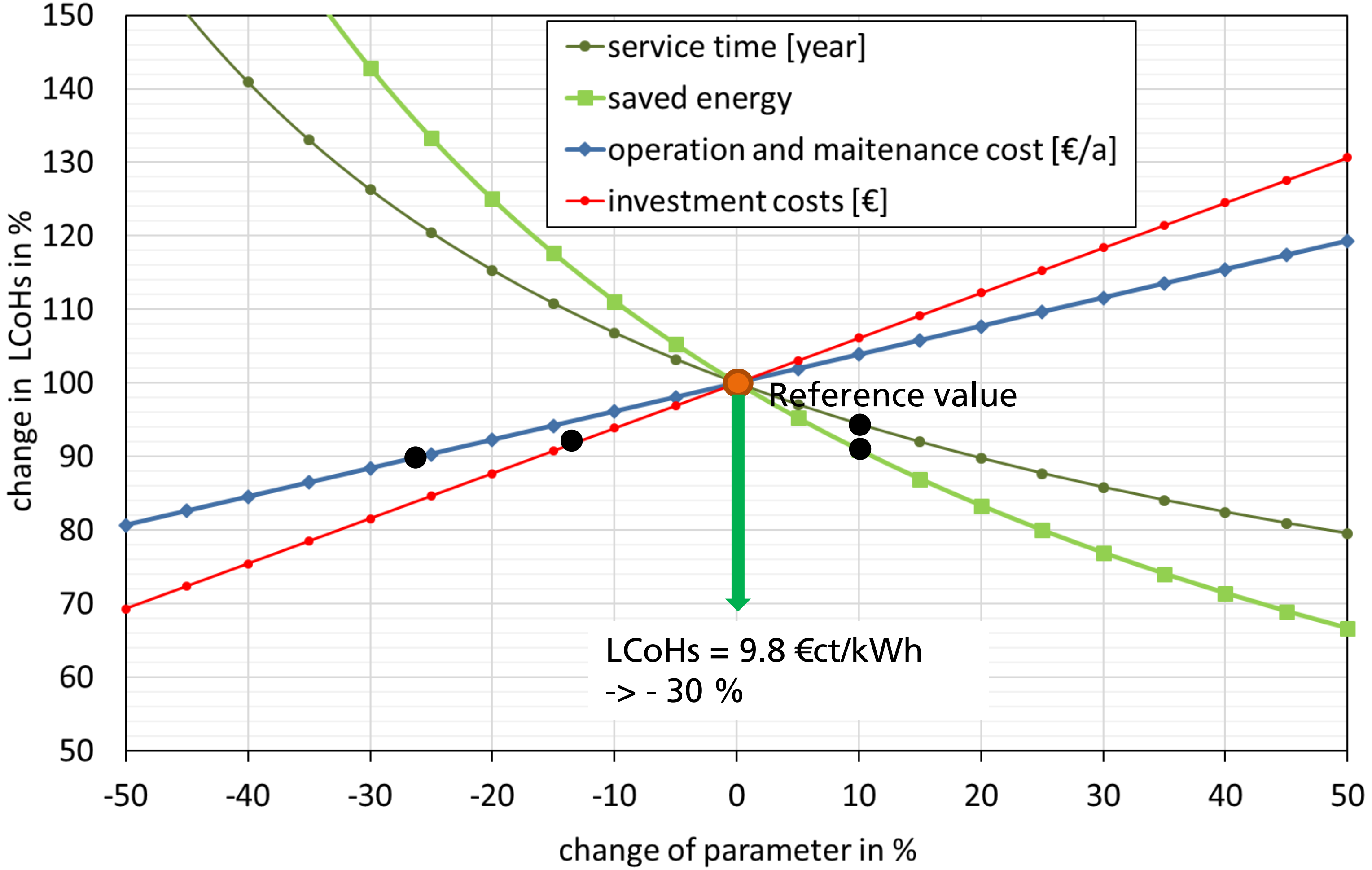
Standardisation
Impact on LCoHs of SDHW system



Standardisation
Impact on LCoHs of SDHW system



Standardisation
Impact on LCoHs of SDHW system



Cost Reduction by Standardization
Summary

- Standardisation required for solar thermal
- Standardisation leads to easier to install, more reliable and more efficient solar thermal systems
- Cost for kWh produced by solar in a standard SDHW system can be reduced by standardisation from 13.9 to 9.8 € ct
  → cost reduction of 30 %
  → costs now up to 13 % lower compared to conventional DHW system (11.4 €ct)

Thank you for your attention!

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Reduction of Costs

Application of Methods for Process Cost Analysis in the Heating Industry

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FOR HEATING & COOLING IN BUILDINGS & INDUSTRY

TASK 54

Price reduction of solar thermal systems

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INTERNATIONAL ENERGY AGENCY

Targets of the Project TEWIsol

- Common activity of industry, craft and research targeting **cost reduction** in solar thermal installations
- Actors:
  - Manufacturers of solar thermal systems
  - Component suppliers
  - Installers
  - Research institutes
- Approach: **combined economic technical method development for cost reduction** considering the complete value chain starting from development to installation

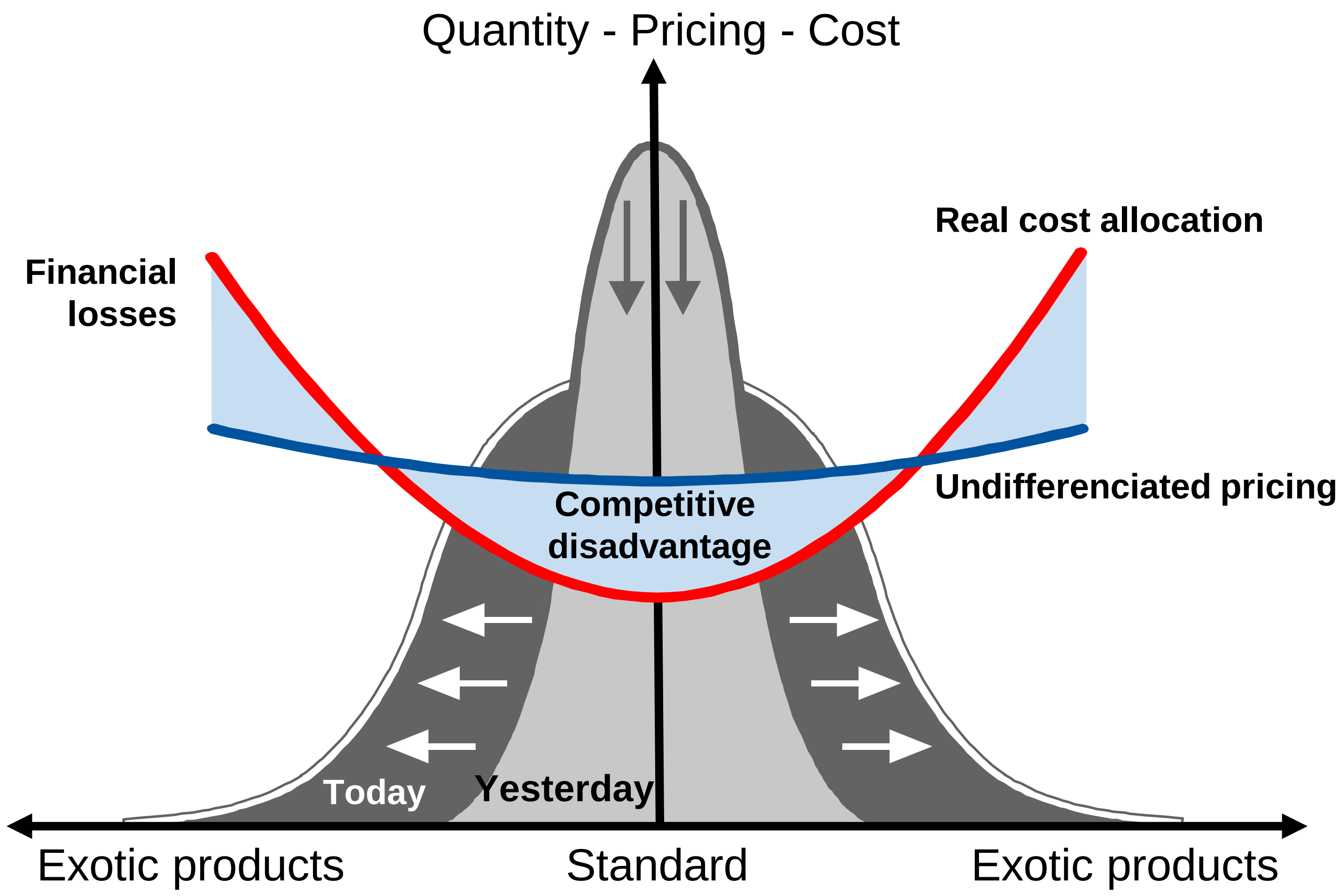
Content of the Project
Methods of Cost Optimization

1. Complexity analysis
   - Determination of needed diversity with regard to the market expectations (external complexity)
   - Complexity of the existing product structure (internal complexity)
   - **Reduction of complexity and management of diversity**
2. Process chain analysis
   - Identification of indirect cost drivers
   - Quantification of cost effects based on product complexity
   - **Cost reduction in the processes (indirect cost)**
3. Value analysis
   - ABC-analysis concerning production cost
   - Cost of function analysis
   - **Cost reduction of the product (direct cost)**

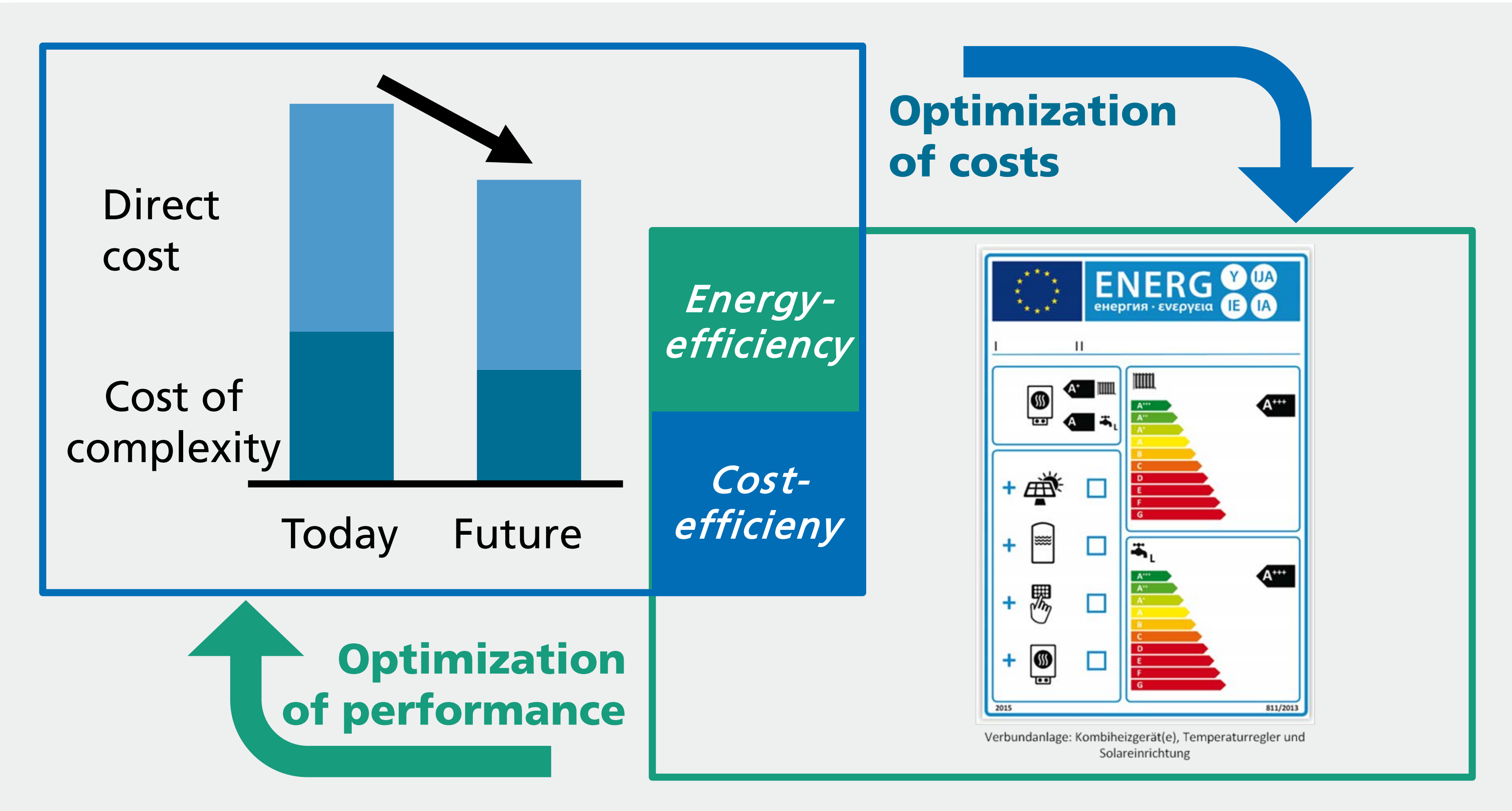
Content of the Project
Methods of Performance Optimization

1. Identification of solar yield of system
   - Measurements of components conforming to standards.
   - Identification of solar yield of the system
   - ➢ **Benchmarking of systems**
2. Simulation based analysis of systems
   - System simulation of combi-systems
   - Modelling of innovative components and systems
   - ➢ **Performance optimized product and system design**

Cost Analysis
Approach of Over-Head Cost vs. Process Cost Analysis



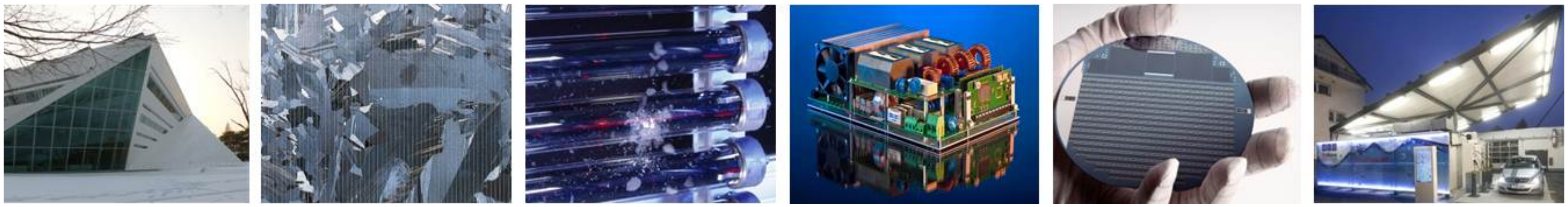
Integrated Performance and Cost Optimization



Outcome of the Project

- New integrated method for combined technico-economic optimization of solar thermal systems including the **complete value chain** from product development to installation
- **Approval** of the method with **industrial and craft partners**
- **Identification** of a first **optimization** potential for some **individual partners** and in the solar thermal sector

Thank You for Your Attention!



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COST REDUCTION BY TEMPERATURE LIMITATION

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Price reduction of solar thermal systems

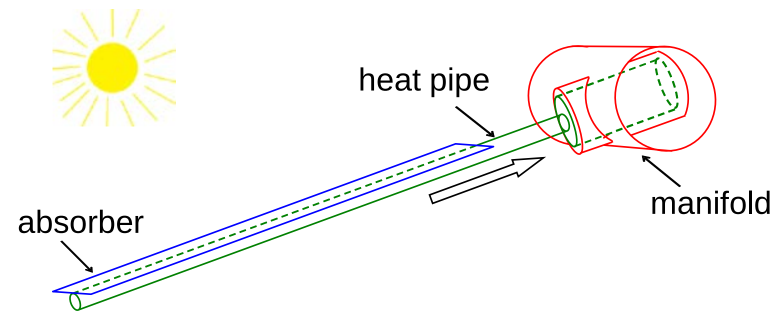
Approaches for temperature limitation

- Cooling system
- Drain back
- Shades

Additional system components needed

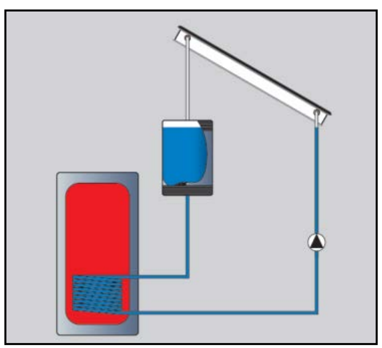
- Increasing collector heat losses (coatings, valves, …)
- Heat Pipes

Heat Pipes



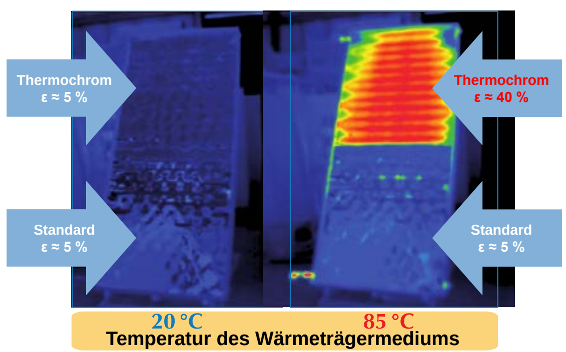
[1] Institute for Solar Energy Research Hamelin ISFH

Drain Back



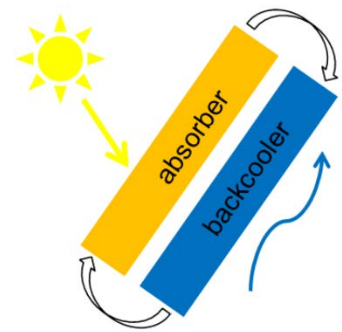
[2] Solar Technologie International GmbH

Thermochromic Absorber Coatings



[3] Institute for Solar Energy Research Hamelin ISFH

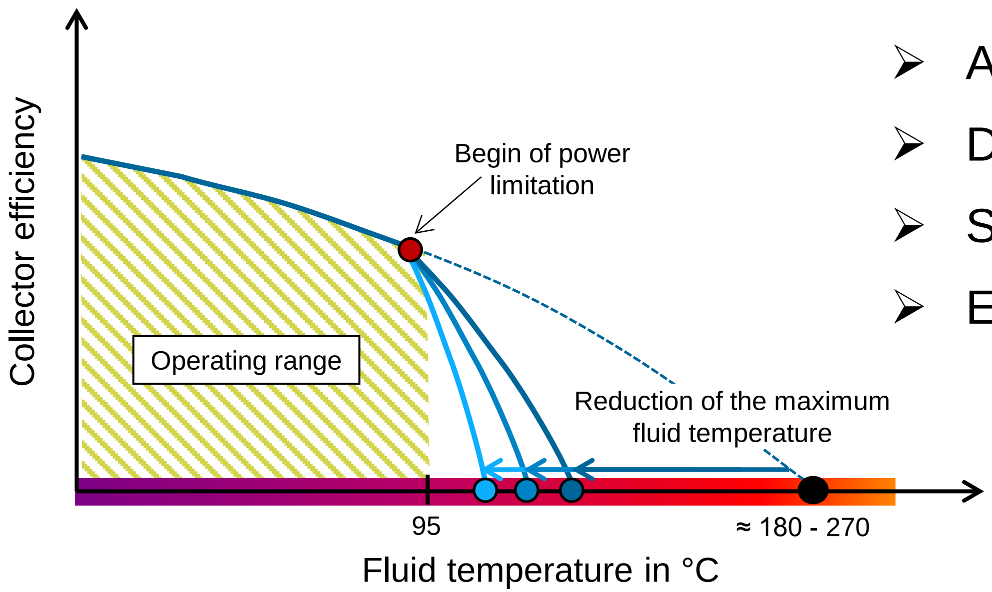
Thermomechanical Valves



[4] University of Innsbruck

Collectors with inherently temperature limitation

- Focus on inherently safe systems
- “Automatically” power shut off / increase of heat losses
- Reduction of stagnation temperature



Gains:

- Avoiding vaporization of solar fluid
- Decrease of thermomechanical stress
- Simplification of solar system
- Extended lifetime of the components

Collectors with temperature limitation in IEA TASK 54

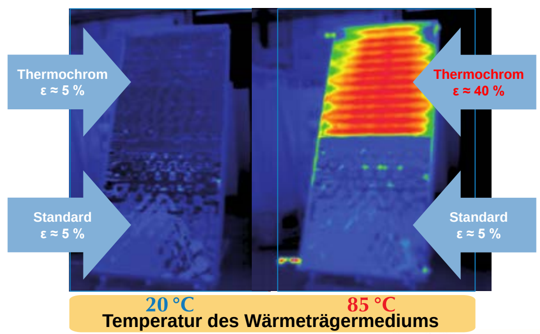
Heat Pipes

- Physical effects inside the heat pipe limit the heat transfer at high temperatures
- Applicable in FPC & ETC

[1] Institute for Solar Energy Research Hamelin ISFH

Thermochromic Absorber Coatings

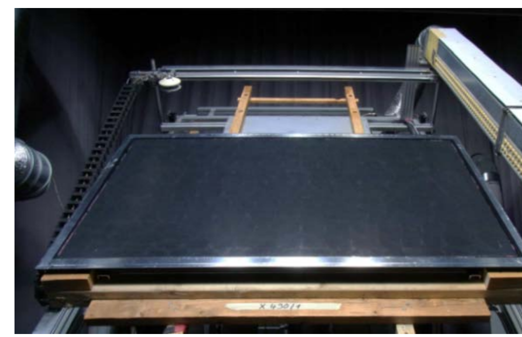
- Emissivity switches from 5 to 40 % at high temperatures
- Applicable in FPC (& ETC)



[3] Institute for Solar Energy Research Hamelin ISFH

SPF-Approach

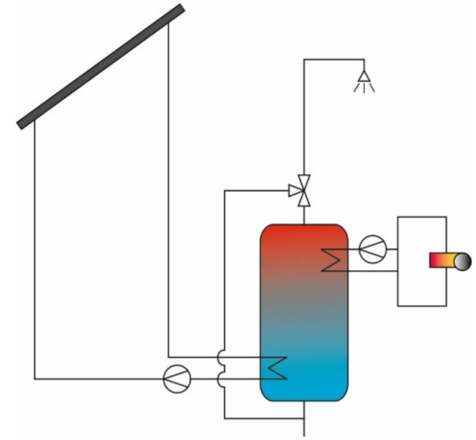
- Absorber blade is shifted to the front glazing
- Applicable in FPC



[5] HSR University of Applied Science Rapperswil

ETC … evacuated tube collectors / FPC … flat plate collector

Cost optimized system design



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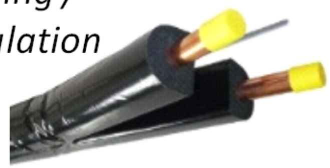
IEA TASK 54 reference solar domestic hot water (SDHW) system
5 m² FPC (gross), 300 l store
Germany

Possible simplifications:

Metal Piping / EPDM-Insulation

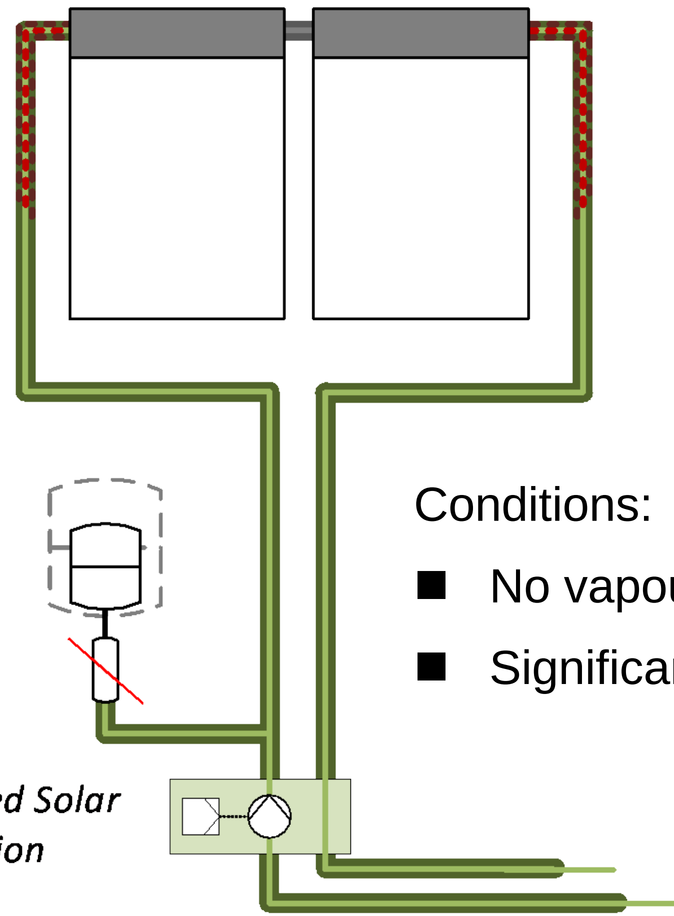
> 95 °C



Pre-Insulated Polymeric Piping

< 95 °C

for short times up to 110°C



Conditions:

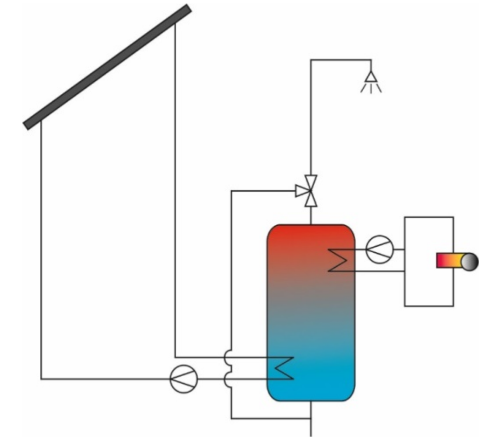
- No vapour
- Significant temperature limitation

Cost optimized installation

Cost reductions compared to the reference system:

Solar systems without stagnation load (no vapour, temperature limitation)	General system	Heat pipe system
Less solar fluid is needed	0 €	25 €
Smaller expansion vessel / no ballast vessel	100 – 140 €	100 – 140 €
Pre-insulated pipes (PEX, PE) Amount of alternative piping	60 – 200 € 50 – 100 %	96 – 200 € 75 – 100 %
Optimized solar station	20 – 100 €	20 – 100 €
Easier installation (pipe laying and bleeding)	100 – 190 €	100 – 250 €
Total reduction of investment costs	**280 – 630 €**	**341 – 715 €**
Relative benefit of investment costs	**7 – 16 %**	**9 – 19 %**

- General: independent of technology for temperature limitation
- Heat pipe: using heat pipe collectors for temperature limitation



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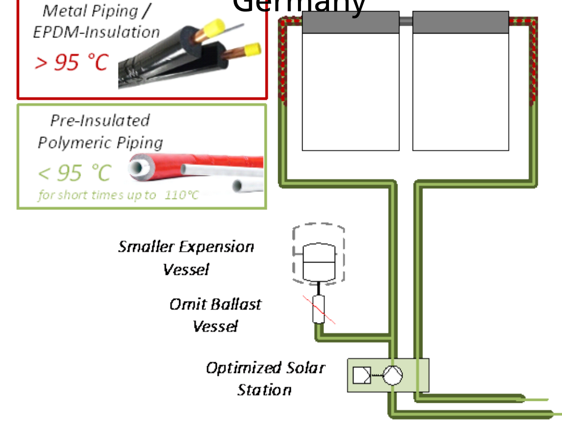
5 m² FPC (gross), 300 l store
Germany



Optimized solar circuit without stagnation load

Cost optimized installation

Cost reductions compared to the reference system:

Solar systems without stagnation load (no vapour, temperature limitation)	**General system**	**Heat pipe system**
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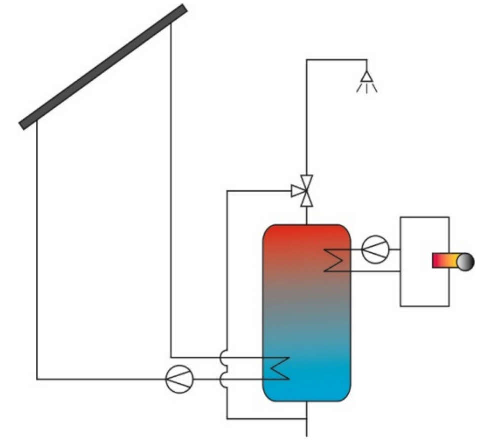
Note: It's difficult to determine costs with high accuracy!



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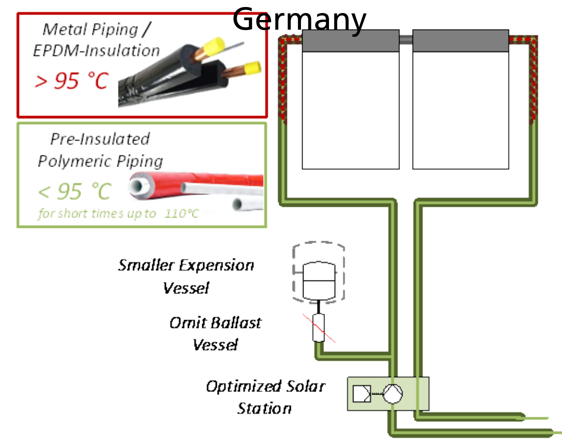
IEA TASK 54 reference solar domestic hot water (SDHW) system
5 m² FPC (gross), 300 l store
Germany



Optimized solar circuit without stagnation load

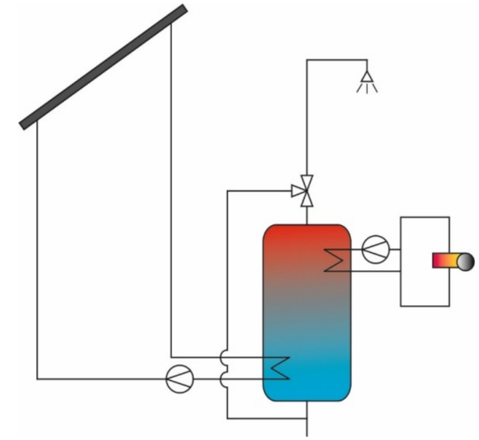
ISFH

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY TASK 54

Reduction of maintenance costs

Thermal and mechanical stress is significantly reduced

- Longer life time of components
- Extension of general maintenance intervals
- Estimation of the maintenance effort for each component (in conformity to VDI 2067)
- Focus on solar fluid



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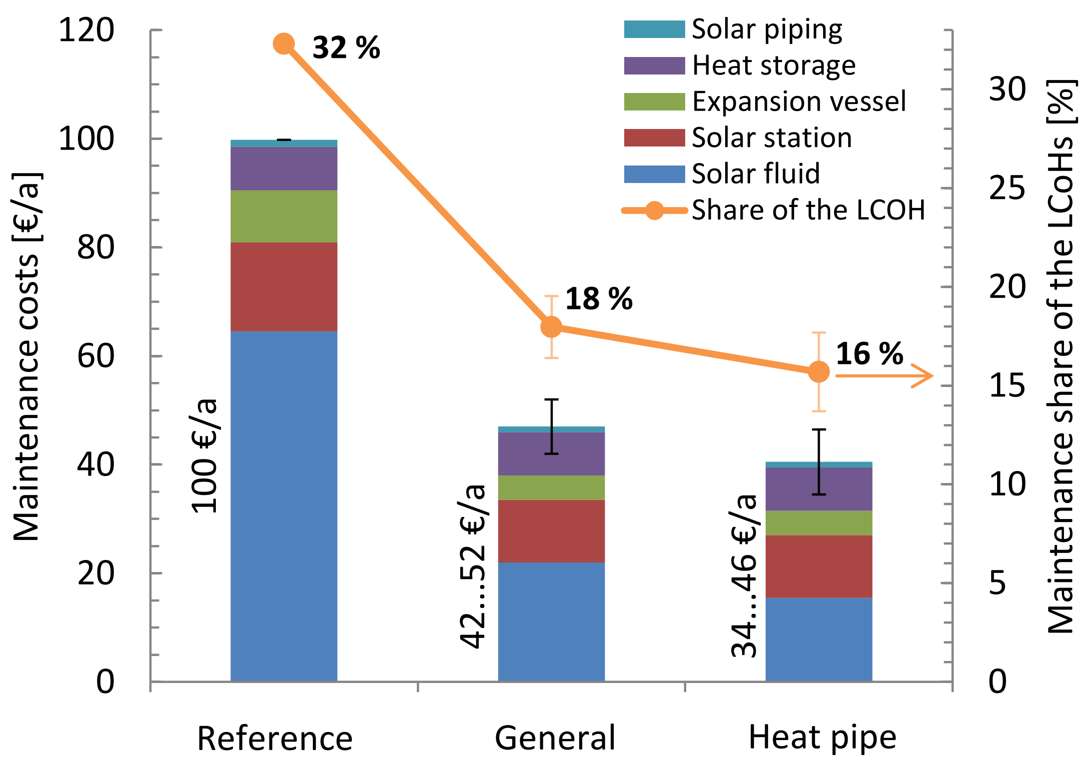
IEA TASK 54 reference solar domestic hot water (SDHW) system
5 m² FPC (gross), 300 l store
Germany

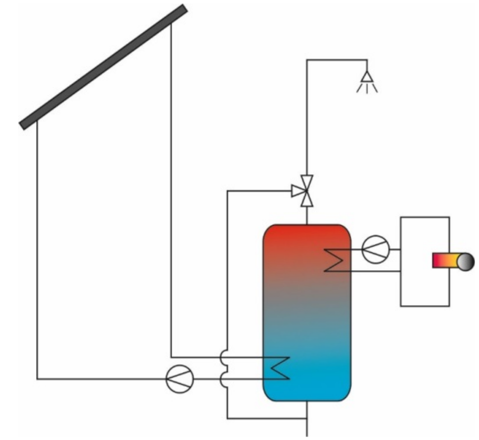
Life time (statement by producer)	Reference system	General system	Heat pipe system
Solar fluid	5 – 7a	≥ 10a	≥ 10a + easier to change + less fluid needed

Reduction of maintenance costs

Thermal and mechanical stress is significantly reduced



Individual maintenance effort for each component (in conformity to VDI 2067)



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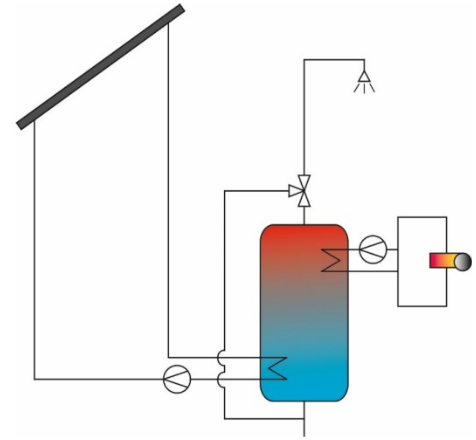
5 m² FPC (gross), 300 l store
Germany

➢ **Reduction of the average maintenance share from 32 % to 18 – 16 %**

LCoH for SDHW-System

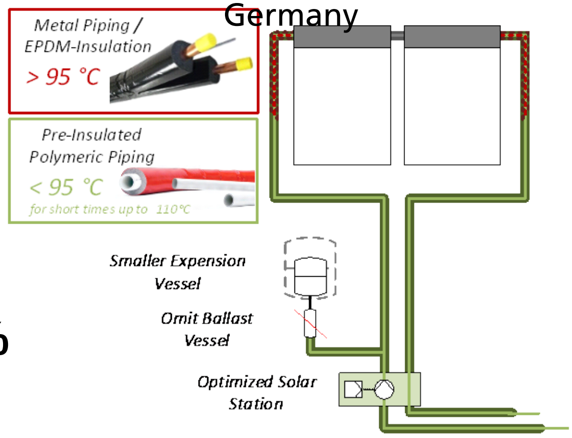
	Reference system	General system	Heat pipe system
Solar investment [€]	3 850	3 220 – 3 570	3 135 – 3 509
Annual maintenance [€/a]	100	42 – 52	34 – 46
Annual yield [kWh/a]	2 226	2 226	2 226
LCoH solar [ct/kWh]	**13.9**	**9.9 – 11.1**	**9.3 – 10.7**
Cost reduction [%]	**-**	**21 – 30**	**24 – 34**

➢ **Reduction of the overall solar system costs up to 34 %**

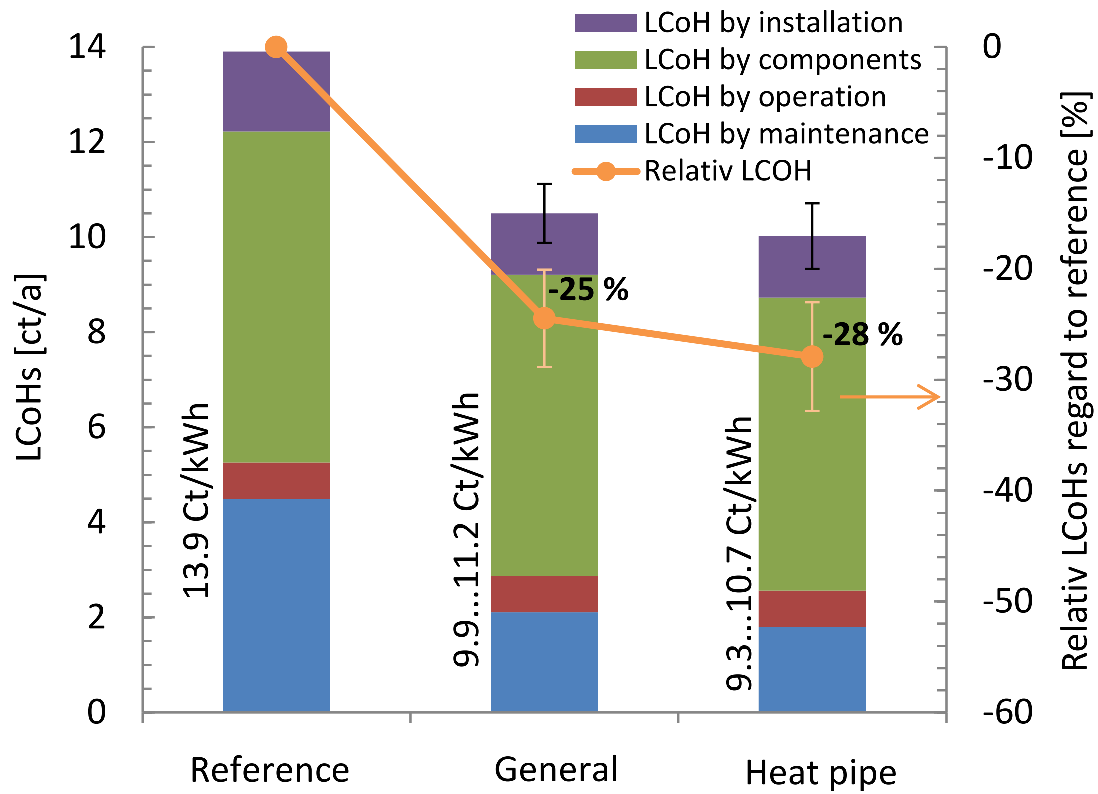


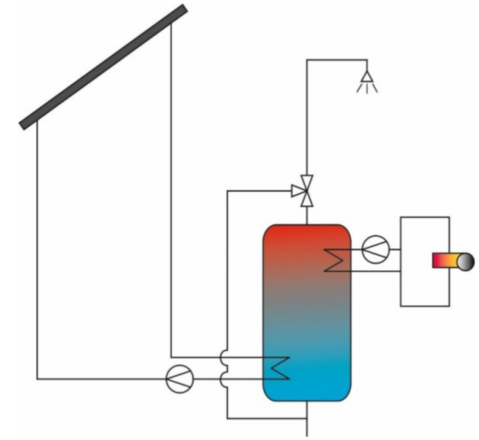
TASK 54

IEA TASK 54 reference solar domestic hot water (SDHW) system
5 m² FPC (gross), 300 l store
Germany



LCoH for SDHW-System





TASK 54

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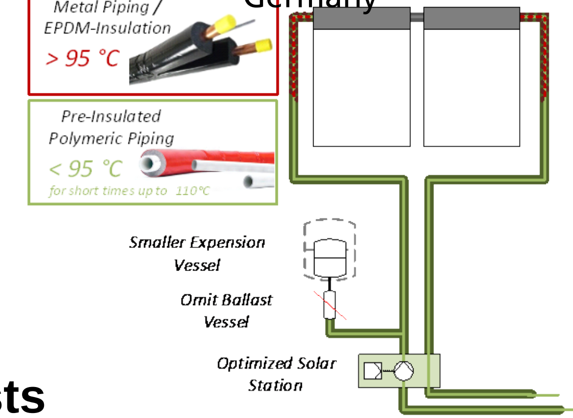
Germany



- Most important effect in reduction of maintenance costs

Coming soon …

- IEA TASK 54 Info Sheets
  - B.3: Maintenance costs of solar systems without stagnation load
  - B.5: Installation costs of solar systems without stagnation load

TASK 54

Maintenance Costs by Avoiding Stagnation Load **INFO** Sheet D xx

Description:	*Maintenance costs of solar systems without stagnation load*
Date:	tba
Authors:	Bert Schiebler, Federico Giovannetti, Stephan Fischer
Download possible at:	http://task54.iea-shc.org/

Introduction

In order to avoid stagnation loads in solar circuits, different approaches are usually distributed. Most of them are based on additional cooling systems or draining (drainback), which require more complex hydraulic installations and control technology respectively. It's also possible to prevent overheating directly in the collector by heat pipes (see figure 1 left), thermochromics' absorber coatings or thermal actuated

TASK 54

Installation Costs of Heat Pipe Collectors **INFO** Sheet D xx

Description:	*Optimized installation costs of heat pipe collectors with inherent temperature limitation*
Date:	tba
Authors:	Bert Schiebler, Federico Giovannetti, Stephan Fischer
Download possible at:	http://task54.iea-shc.org/

Introduction

Heat pipes in solar thermal collectors are state-of-the-art devices for the heat transfer from the absorber plate to the solar circuit. Beside the simplified collector hydraulic the use of heat pipes provides the advantage of decoupling the absorber plate from the fluid circuit. If the two-phase flow inside the heat pipe is suppressed beginning from a certain temperature, the heat transfer ability from the absorber plate to the

Thank you for your attention!

Institute for Solar Energy Research Hameln (ISFH)

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Cost Reduction Potential of Polymeric Collectors

Dr. Michaela Meir

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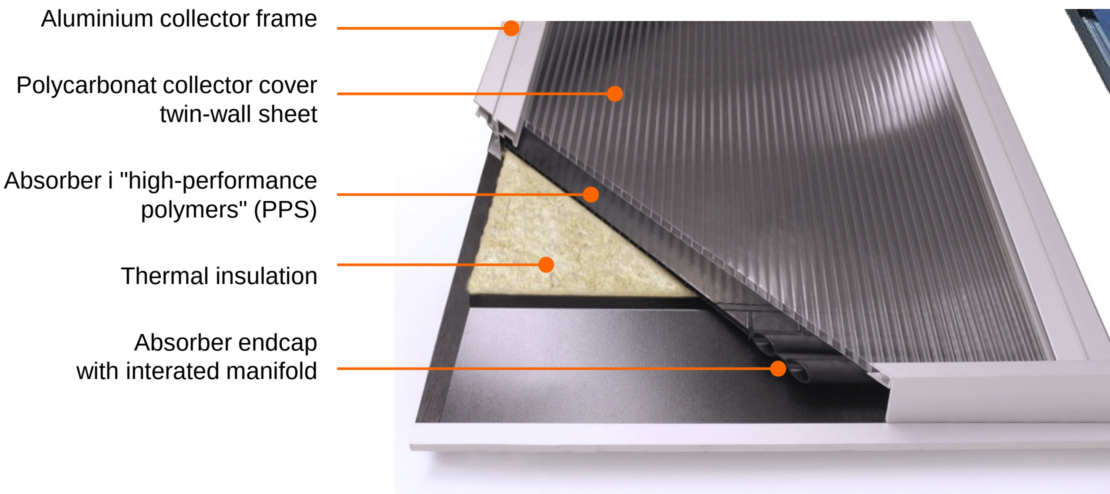
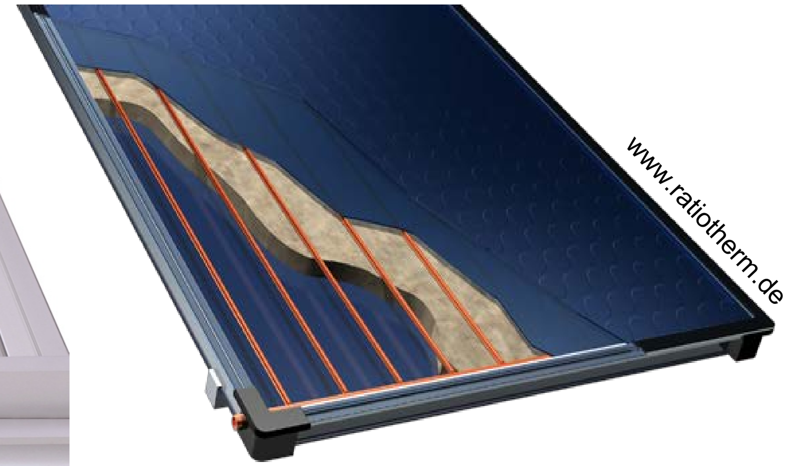
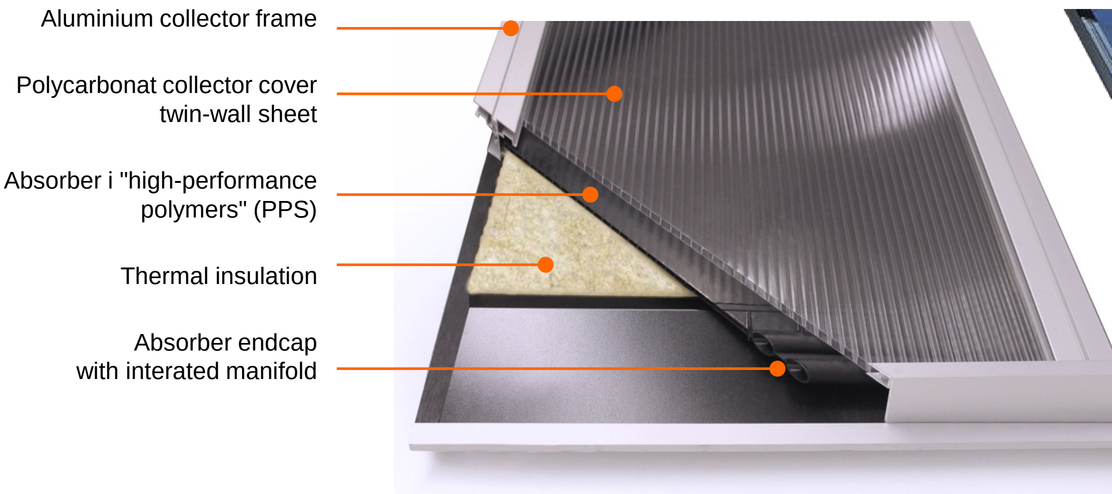
Price reduction of solar thermal systems

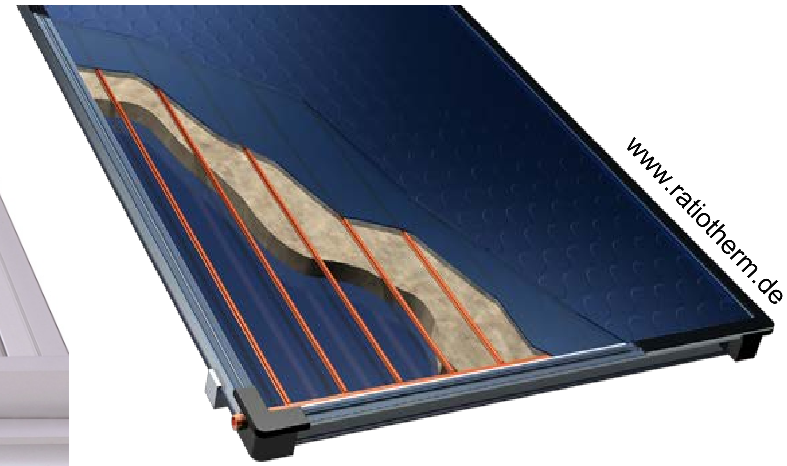
Main differences to solar heating systems with conventional flat plate collectors





Main differences to solar heating systems with conventional flat plate collectors

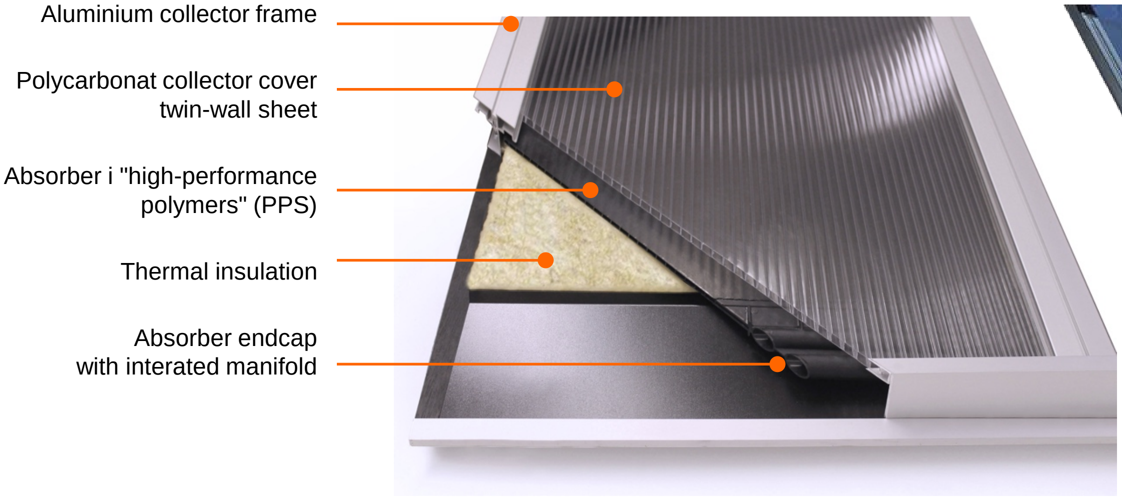


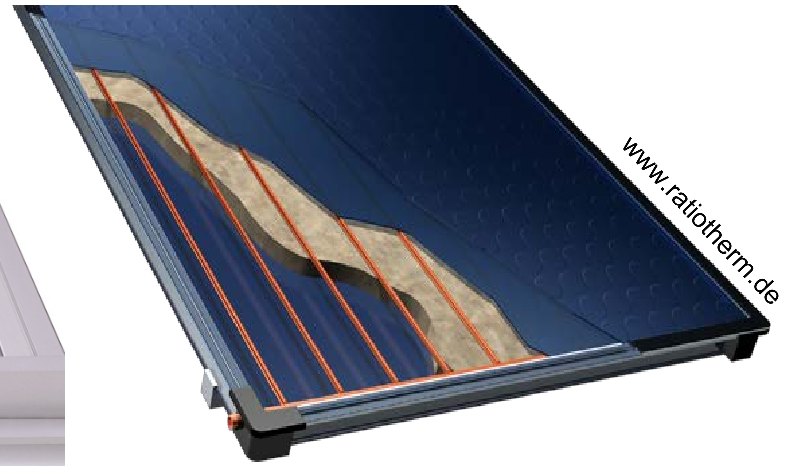


Collector

- High-temperature performance polymers
- Flexible lengths
- Light-weight building modules (8 kg/m^2)
- Replacing conventional building envelopes (roofs & facades)

Main differences to solar heating systems with conventional flat plate collectors





Collector

- High-temperature performance polymers
- Flexible lengths
- Light-weight building modules (8 kg/m^2)
- Replacing conventional building envelopes (roofs & facades)

System

- Water as heat carrier
- High-flow system
- Drain-back technology
- Non-pressurized collector loop (installation)

Major Production Steps

- The number of production steps is significantly reduced compared to conventional solar collector production.

Structured sheet extrusion

Cutting

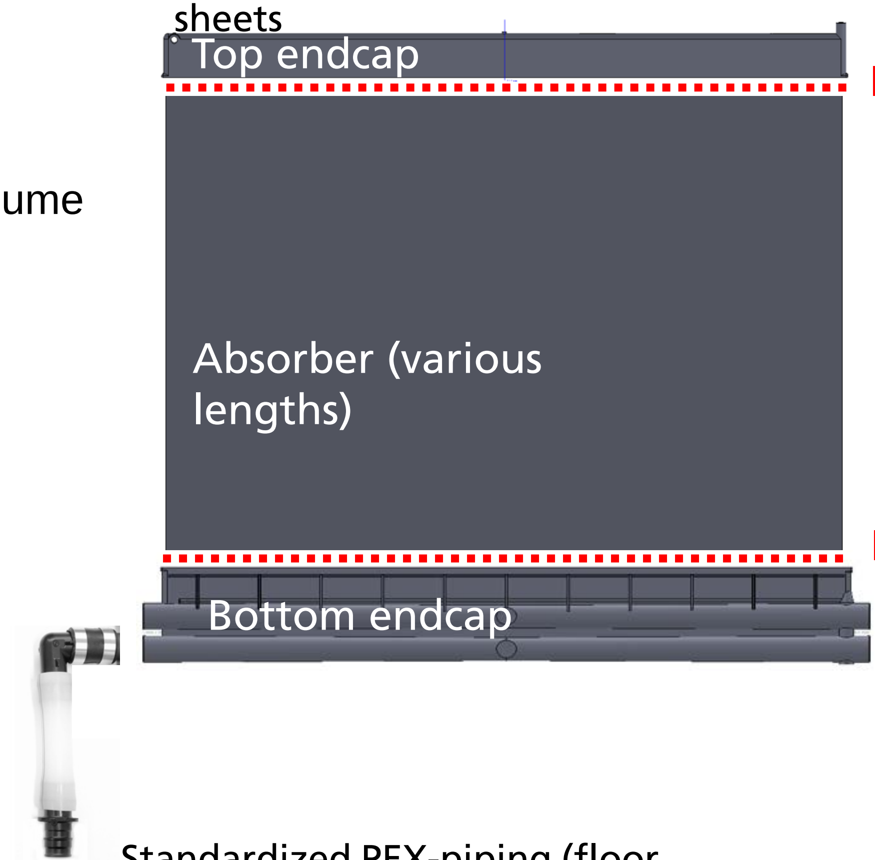
End-cap assembly and coating

Cutting of other sub-components

Transport & installation

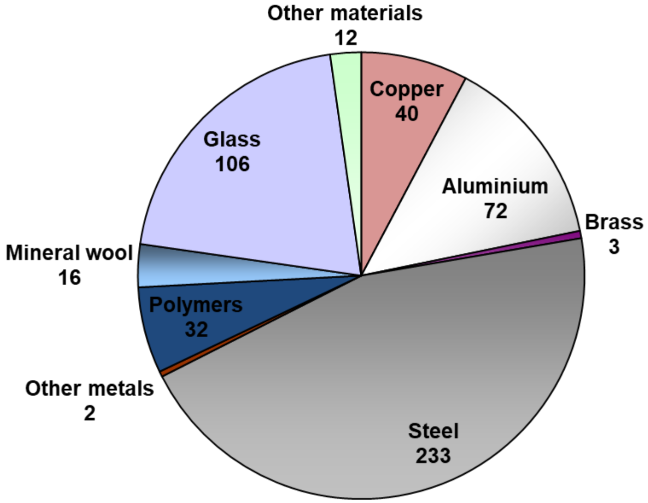
Absorber production

- Highly-industrialised processing
- Very few production steps
- Low production costs with high volume
- Integrated design

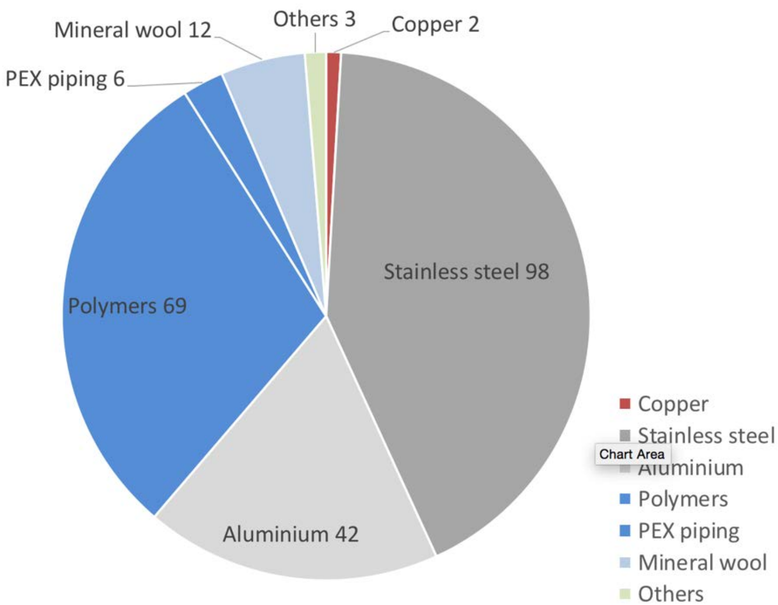


Weight of components, Solar combisystem

Average value of material (kg)
"Combisystems 2008" with
Conventional flat-plate collector

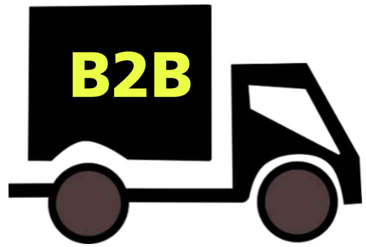


Material weight comparison (in kg)
Combisystem, Housing Estate Oslo:
Polymeric AventaSolar collector



Solar Thermal Value Chain

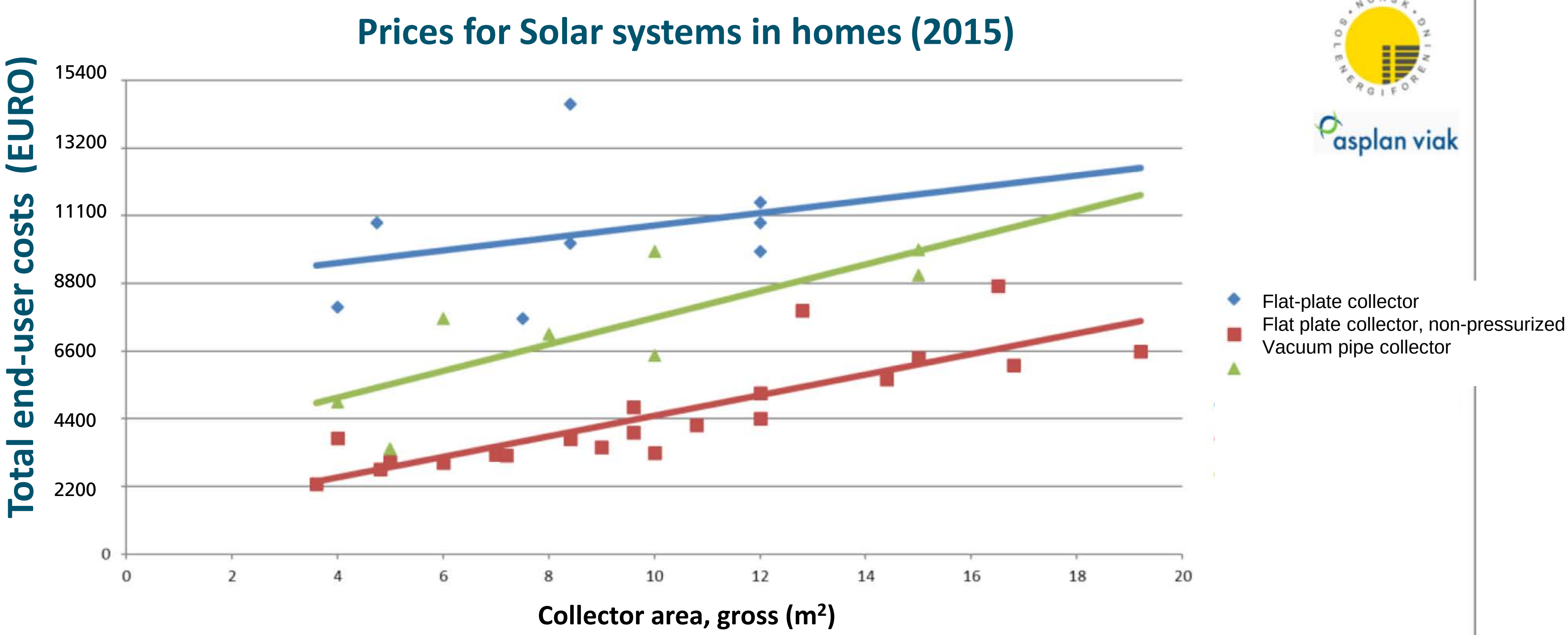
No wholesaler / distributor!



1. Architecture + Energy Consultant → 2. Production → 3. ~~Distribution~~ Transport → 4. Installation → 5. Installed System → 6. Operation and Maintenance → 7. LCOHs

Prices of solar heating systems in private homes

- Total end-user costs incl. solar collector system and heat store, reported by the customers, include installation, but exclude VAT and subsidies.



Savings due to replacement of other building envelope materials for building integration is not subtracted.

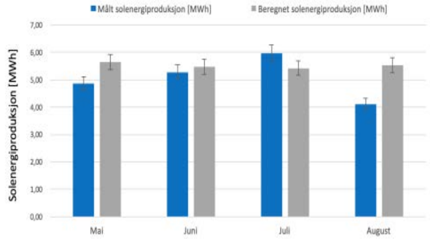
Cost examples: Medium-sized projects (1)

Ilseng State Prison

Costs:

Solar collector, heat store, pumps, control system, pipes, removal of tiles, installation, engineering and administration.

SUM: 433 €/m² collector area



8.4 m³ heat store,
divided in 6 separate units

SDHW-system with 237 m² solar collectors

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INTERNATIONAL ENERGY AGENCY

Cost examples: Medium-sized projects (2)

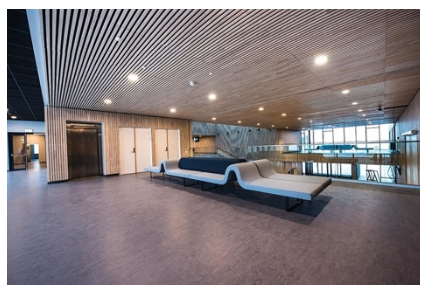
Bjørkelangen Elementary School

Solar heating system for domestic hot water preparation.
105 m^2 facade integrated solar collectors
5.6 m^3 heat buffer store

Costs

Solar collector, heat store, pipes and controller, incl. installation: **SUM: 370 €/m^2 collector area**

Savings due to replacement of other materials/components are not included.



Cost examples: Solar combisystem (3)

Housing Estate Oslo with 34 passive houses

34 houses with totally 480 m^2 roof integrated solar collectors, decentralized with 0.8 m^3 heat stores, incl.100 liters DHW preheater and piping, operation control of the auxiliary heat supply and solar heating system, installation- and start-up support.

Costs

SUM: 370 €/m^2 collector area

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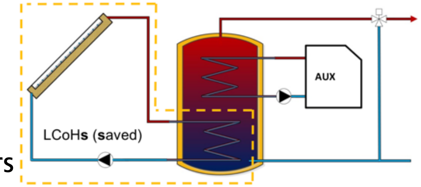
Examples, Norway

Lifetime 20 years



Ilseng State Prison

Retrofit, DHW preparation
237 m² Collector area
8.4 m³ Heat store
1100 kWh/(m² a) solar irradiance*

Bjørkelangen Elementary School

New-built, DHW preparation
105 m² Collector area
5.6 m³ Heat store
889 kWh/(m² a) solar irradiance*

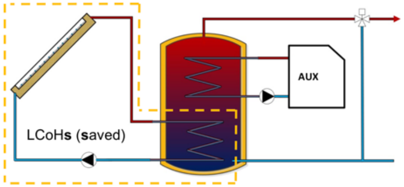
Housing Estate Oslo, 34 passive houses

New-built, Solar combisystems with each
14 m² Collector area
0.8 m³ Heat store
1210 kWh/(m² a) solar irradiance*

* Solar irradiance on tilted collector surface.

Examples, Norway

Lifetime 20 years



		
Ilseng State Prison Retrofit, DHW preparation 237 m² Collector area 8.4 m³ Heat store 1100 kWh/(m² a) solar irradiance*	**Bjørkelangen Elementary School** New-built, DHW preparation 105 m² Collector area 5.6 m³ Heat store 889 kWh/(m² a) solar irradiance*	**Housing Estate Oslo,** 34 **passive houses** New-built, Solar combisystems with each 14 m² Collector area 0.8 m³ Heat store 1210 kWh/(m² a) solar irradiance*
LCoHs_retrofit = 0.099 €/kWh LCoHs_new built = 0.073 €/kWh	LCoHs = 0.035 €/kWh	LCoHs = 0.082 €/kWh
Electricity costs = 0.115 €/kWh		
Comments: • Retrofit: roof tiles had to be removed • Building is oriented towards east • High solar fraction	Comments: • Good planning, infrastructure	Comments: • Passive houses: designed for high solar fraction • Installation partly included

* Solar irradiance on tilted collector surface.

Thank you for your attention!

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Cost Competitiveness of Multi-family-house Systems

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Price reduction of solar thermal systems

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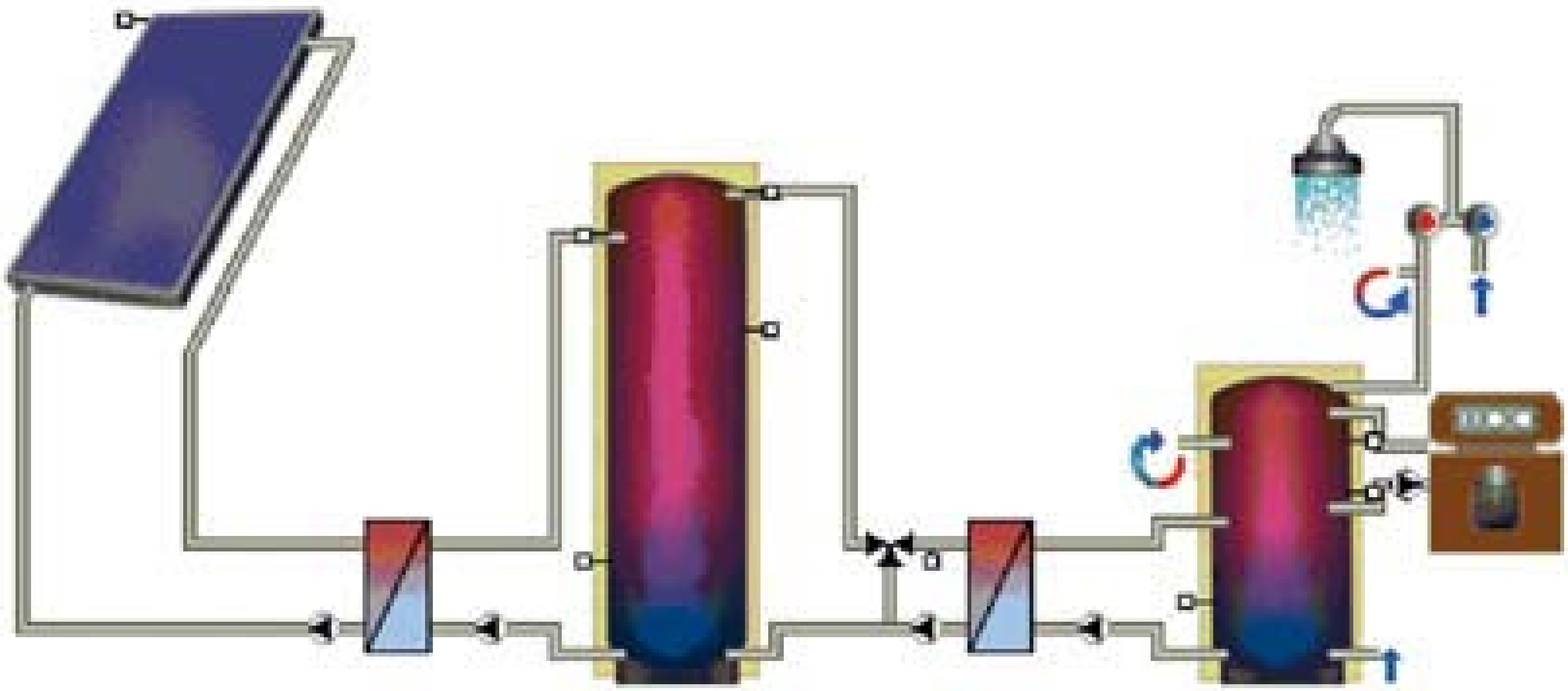
Overview

- Levelized Costs of solar Heat (LCoH) in multi family houses
- How to ensure low solar heat costs?
- Further cost reduction potential of solar heat in multi family houses
- Key messages

Levelized Cost of Heat in Multi-Family-House Reference systems for Domestic Hot Water preparation

- Example of simplified Hydraulic circuit for the reference systems
- $LCOH = \frac{I_0 + \sum_{t=0}^{T} C_t}{\sum_{t=1}^{T} E_t}$



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Levelized Cost of Heat in Multi-Family-House Reference systems for Domestic Hot Water preparation

- Comparison of Levelized Costs of Heat for reference cases:
  - multi family house (MFH) vs. single family house (SFH)
  - solar heat vs. conventional heat (natural gas)
  - in different countries

	Austria			France			Germany			Switzerland	Denmark	
	MFH	SFH	variation	MFH	SFH	variation	MFH	SFH	variation	MFH	SFH	
System characteristics												
Surface solar collectors (S)	50	6		50	4.5		33	5		15.5	2.36	m²
Volume storage tanks (V)	4000	300		3000	300		1500	300		1500	255	L
Specific solar yield (Et/S)	575	432	33%	880	635	39%	339	445	-24%	563	744	kWh/m²
Specific initial investment (Io/S)	535	838	-36%	900	1044	-14%	642	770	-17%	1250	1589	€/m²
Specific yearly maintenance cost (Ct/Io)	2.4%	2.4%		1.6%	1.4%		2.1%	3.0%		0.6%	0.9%	%
Life time (T)	25	25		20	20		20	20		30	30	a
Estimated LCoHs of solar heat	6.0	12.5	-52%	6.7	10.5	-36%	10.5	13.9	-24%	8.8	9.1	€ct/kWh
Estimated LCoH of conventional heat	7.3	10.5	-30%	5.9	7.3	-20%	9.3	11.9	-22%	8.8	17.1	€ct/kWh
Natural gas cost	6.6	6.6		3.0	4.6		5.1	6.6		7.9	13.4	€ct/kWh

Levelized Cost of Heat in Multi-Family-House Reference systems for Domestic Hot Water preparation

- Observations:
  - Significant variation in costs between the countries (solar resource, technical practices, legal framework)
  - Note: band width of systems costs (as illustrated in Solar Heat World Wide)

	Austria			France			Germany			Switzerland	Denmark	
	MFH	SFH	variation	MFH	SFH	variation	MFH	SFH	variation	MFH	SFH	
System characteristics												
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Natural gas cost	6.6	6.6		3.0	4.6		5.1	6.6		7.9	13.4	€ct/kWh

Levelized Cost of Heat in Multi-Family-House Reference systems for Domestic Hot Water preparation

- Key factors and outcomes:
  - Higher solar yield per collector surface in most reference cases
  - Economy of scale in investment costs and maintenance costs
    - Significantly lower in MFH than in SFH
  - Solar LCoH similar or lower than conventional LCoH
  - LCoH more stable over the life time for solar installation than for fossil fuels

	Austria			France			Germany			Switzerland	Denmark	
	MFH	SFH	variation	MFH	SFH	variation	MFH	SFH	variation	MFH	SFH	
System characteristics												
Surface solar collectors (S)	50	6		50	4.5		33	5		15.5	2.36	m²
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Natural gas cost	6.6	6.6		3.0	4.6		5.1	6.6		7.9	13.4	€ct/kWh

How to ensure low solar heat costs?

- Sharing Experience from existing systems
- Imposing good practices in all steps of the projects
  - Design
    - proven hydraulic concepts
      (domestic hot water storage / buffer storage + fresh water station…)
    - good sizing of components
    - standardized hydraulic components and concepts
  - Implementation in the building
    - easy access and installation on roof, fast hydraulic connections…
  - Dynamic commissioning
  - Monitoring of Operation and Maintenance

See for example the work of the **SOCOL initiative** (France): gathering 2500 members, professionals and contractors, to set up the conditions for efficient and sustainable **solar thermal in multi family houses**. www.solaire-collectif.fr

Further cost reduction potential of solar heat in multi family houses

- Emerging approaches
  - Combi systems: Combined domestic hot water and space heating
    - Activation of the building thermal mass (using thermal inertia)
    - Centralised solar storage integrated in a 2 pipes distribution network for space heating + decentralised hot water preparation
  - Solar and heat pumps
    - Low temperature solar collectors as source for the heat pump
    - PVT collectors
  - Business models
    - How is the system financed, who owns the system, who operates it, who garanties the efficiency, who pays and how…

Key messages about solar thermal in multi-family houses

- Reference systems show attractive costs of solar heat (LCoHs)
  - Significant economy of scale (advantage over SFH)
  - Often lower LCoH than conventional heat costs (natural gas)
  - Definitely more stable and predictible costs than fossil fuels
- How to ensure low solar heat costs?
  - Sharing Experience from existing systems
  - Imposing good practices in all steps of the projects
- Emerging approaches for possibly further cost reduction
  - Combi systems activating thermal mass
  - Solar thermal and heat pumps
  - Business models

Thank you for your attention!

AEE - Institute for Sustainable Technologies

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Reduction of Costs

What Could Be Achieved?

Dr. Michael Köhl

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TASK 54

Price reduction of solar thermal systems

Fraunhofer ISE

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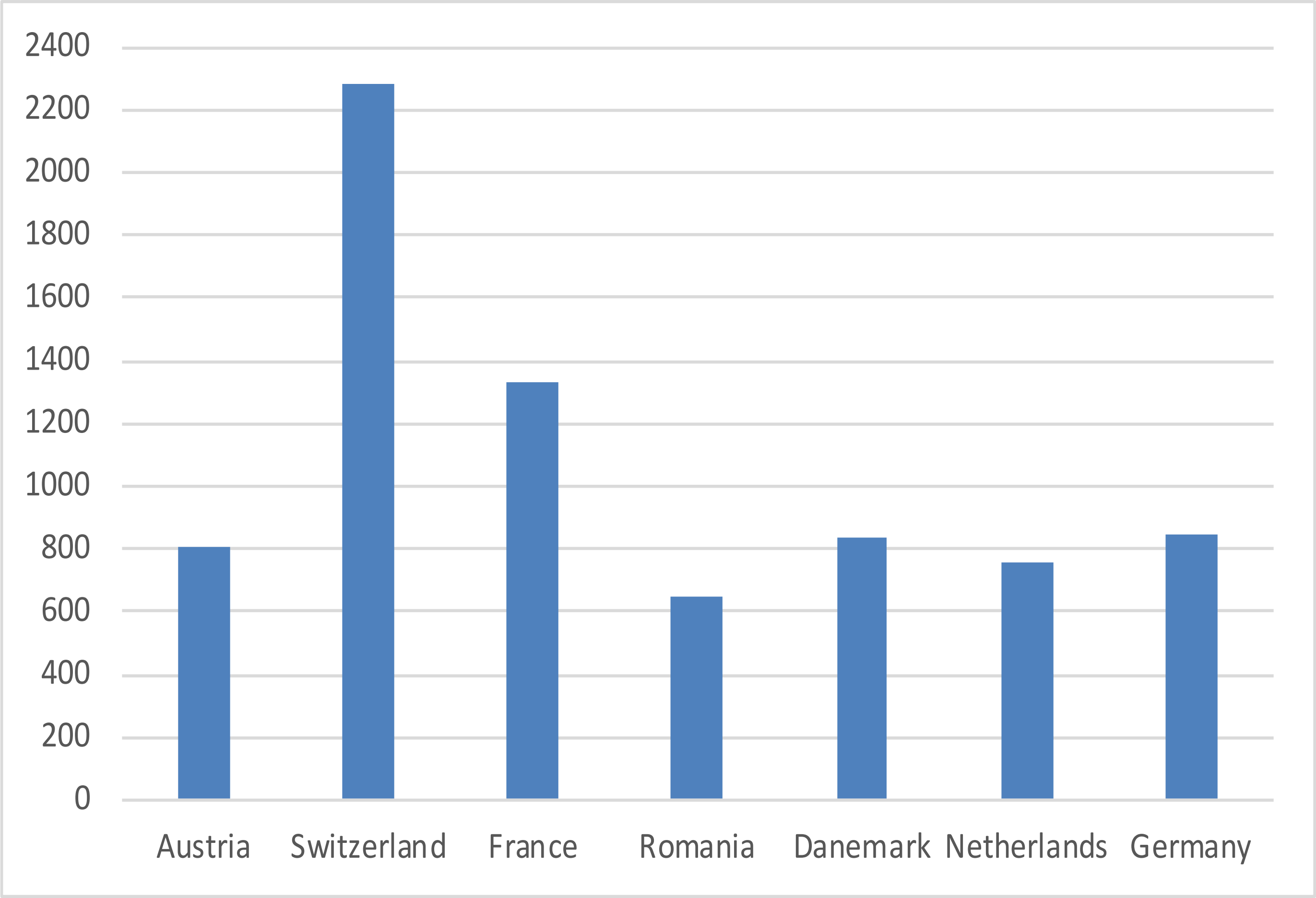
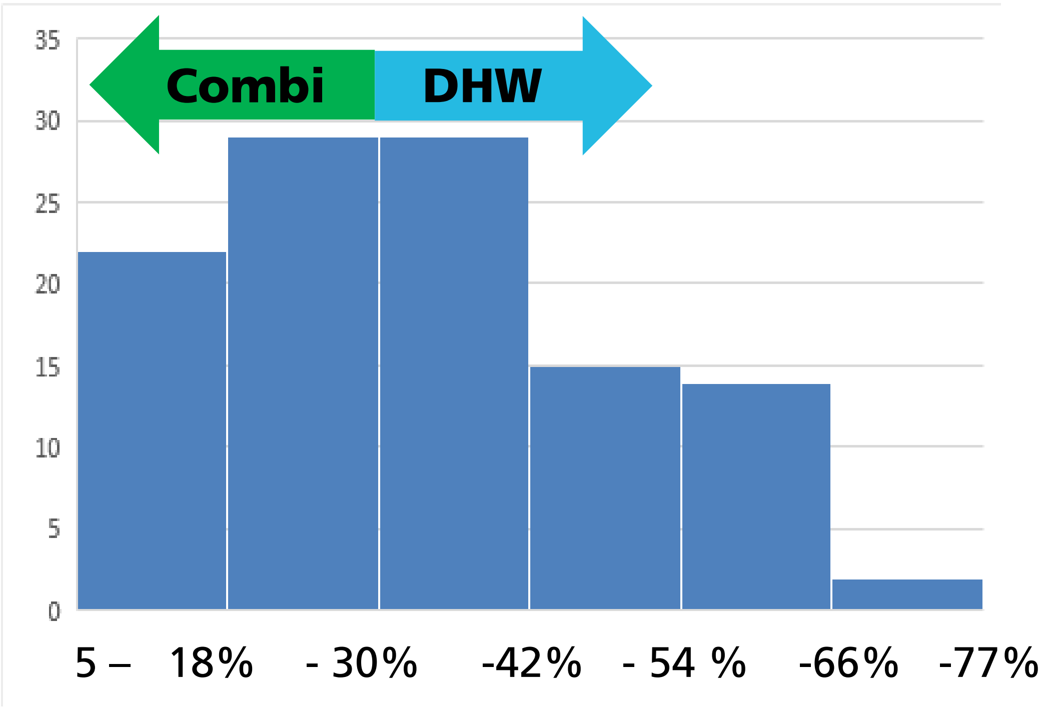
Present system price

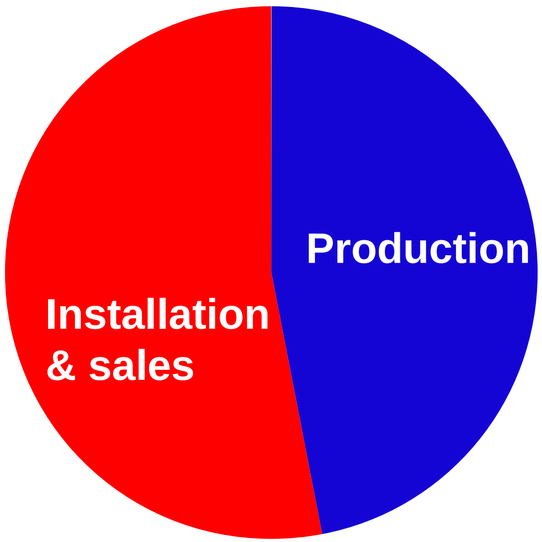
- Average system price (€/m²) without tax (Source: Task54)



Installation costs

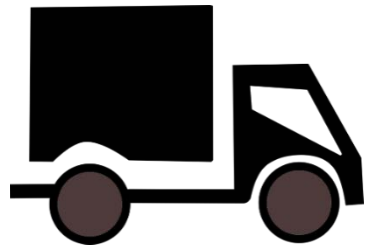
- Number of systems in Germany with relative installation costs in the bins





Typical solar DHW system:
5 m² collector, 300 l DHW tank

Solar Thermal Value Chain

1. Architect, Planner, Energy Consultant	2. Production	3. Distribution	4. Installation	5. Installed System Sales	6. Operation and Maintenance	7. Cost of kWh solar (LCoHs)
10	38	12	16	24	percentage of total invest cost	**0.139€/kWh**
50	30	50	20	50	Maximum relative reduction of cost [%]	

< 10% better energy yield by increased lifetime

Temperature limitation	**- 30%**	**- 50%**	**0.093 €/kWh**
Standardised components		**- 20%**	**0.098 €/kWh**
Multifamily houses	**- 50%**		**0.06 - 0.09** €/kWh
Innovative polymer concept			**0.035 - 0.1** €/kWh

TA$K 54

Feel free to inform yourselves & contact us:

Homepage: http://task54.iea-shc.org/
Twitter: @IEA_SHC_Task54
Email: sandrin.saile@ise.fraunhofer.de

Join us in Sophia Antipolis!

Event: Public Workshop at ADEME
Date: 26 April 2018
More info: http://task54.iea-shc.org//event?EventID=4954
Email: ph.papillon@neuf.fr