SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Efficient solar district heating systems
SHC Task 68

2nd Task Status Report
92 ExCo Meeting, Stellenbosch, South Africa

Viktor Unterberger
Task Duration: 01.04.2022 – 31.03.2025
Collaborative Task with Annex TS5 (planned)

Significant Developments & Results
Since Last ExCo Meeting – Overview

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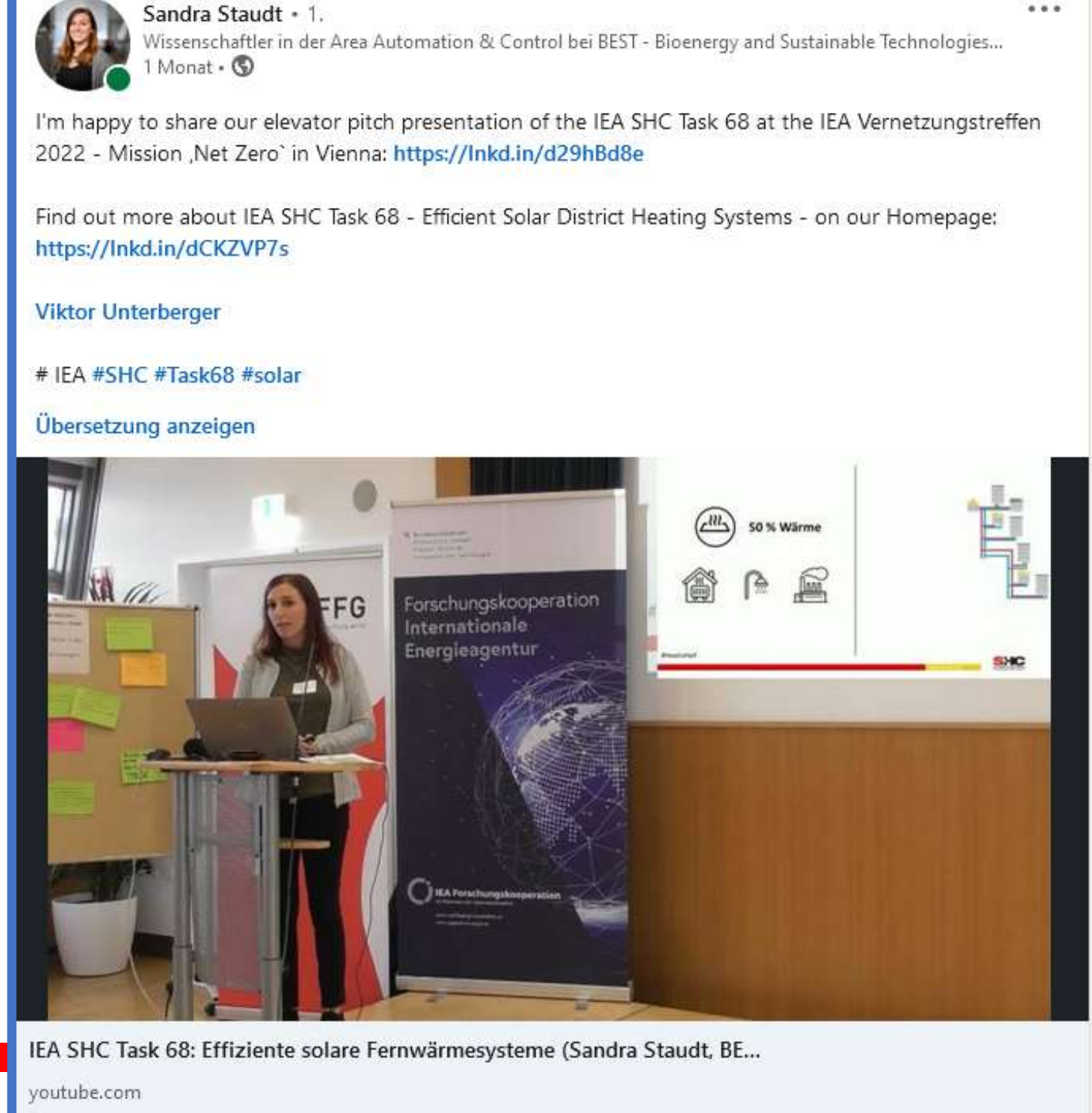

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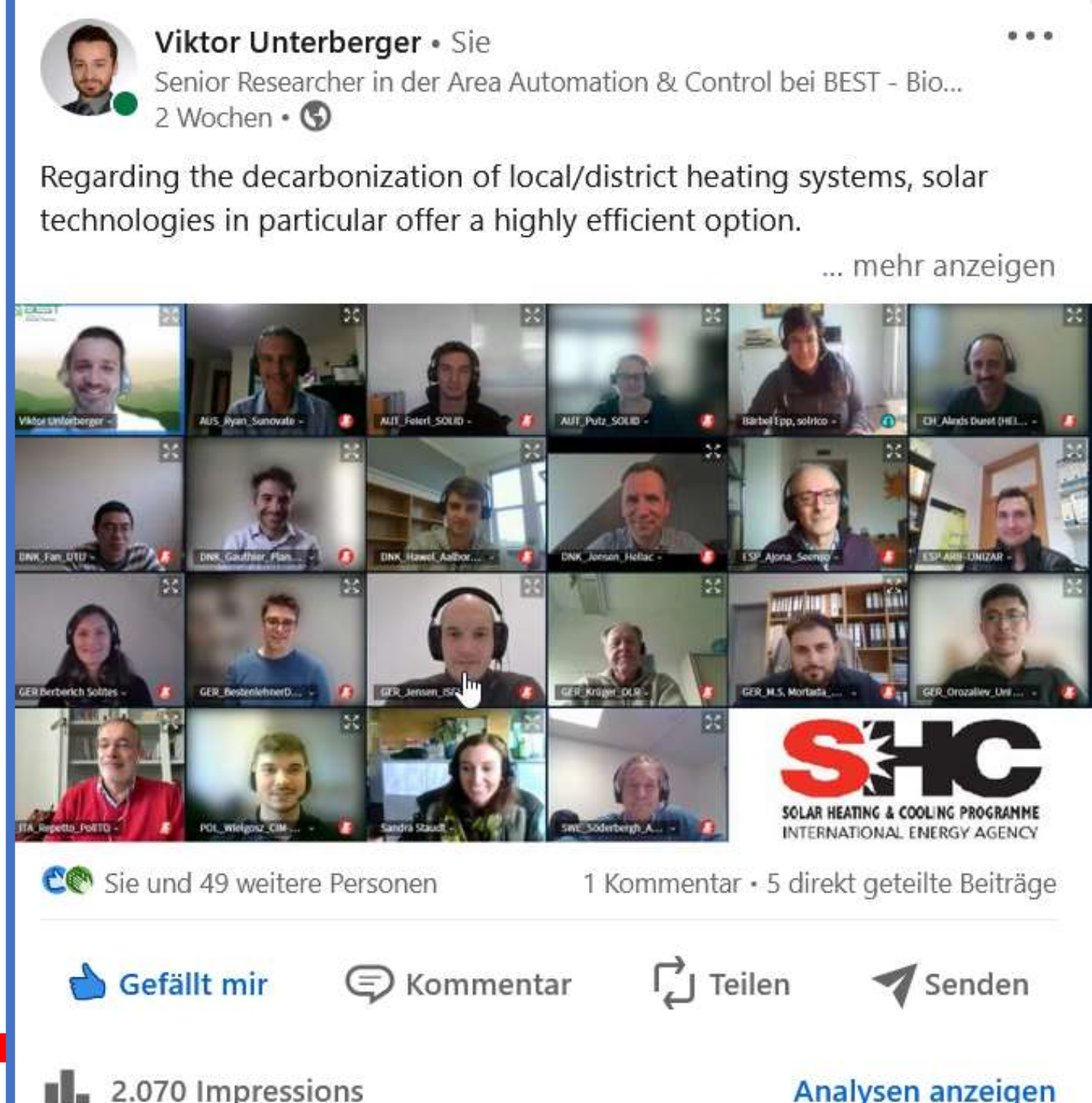
2nd Task meeting, fully online *(LinkedIn Post)*



2nd Task meeting – statistics

- **51 registered participants**
  (➔ lessons learned from Andreas Haeberle: link only to registered participants)
- **16 different countries**
- **1.3 Average Number of persons per Institution**
  (➔ little more than 1 person participated per company)
- **~50 % industry**

Ideas /take aways for other Task Managers

- **Ask for registration** of the expert (see comment Andreas Haberle, Task 64), could provide additional benefit to ask:
  - … in which subtask they are especially interested ➔ important information for Subtask leaders
  - … what they can provide ➔ project names etc.
  - … if they want to present something
  - … if they are interested in specific topics ➔ e.g. standardization, research paper, joint proposal

- **Introduction of Participants by slides**
  - Collected 2 Slides per each institution ➔ ~ 100 Slides !!
  - However, worked very well, people send in time, kept the limit ➔ useful “data basis” for new participants
  - Design: 1. slide = clear structure / 2. slide = free to design by participants

- **Actively use the benefits of online tools:** e.g. extract chat inputs as .txt files, use online surveys, …

- **Personal vision for the task:** actively provide relevant benefit for researchers and companys, e.g. joint research papers, joint projects ➔ try to focus on that within the task

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- **16th Nov.** Presentation at the IEA DHC Exco Meeting

Presentation of the Task at the IEA DHC Exco Meeting

IEA SHC
Task 68
"Efficient solar district heating systems"

IEA DHC
EXCO

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IEA SHC
Task 68
"Efficient solar district heating systems"

IEA HPT
Annex 56
"IOT - Internet of Things"

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- **4th Dec.** Journal Paper submitted regarding "Fault Detective" after revision

Paper submitted into Journal of "*Solar Energy Advances*" regarding "Fault Detective" after revision

Fault Detective: Automatic Fault-Detection for Solar Thermal Systems based on Artificial Intelligence

Lukas Feierl[1], Viktor Unterberger[2], Claudio Rossi[3], Bernhard Geradts[1], and Manuel Gaetani[3]

[1] SOLID Solar Energy Systems, Graz (Austria)

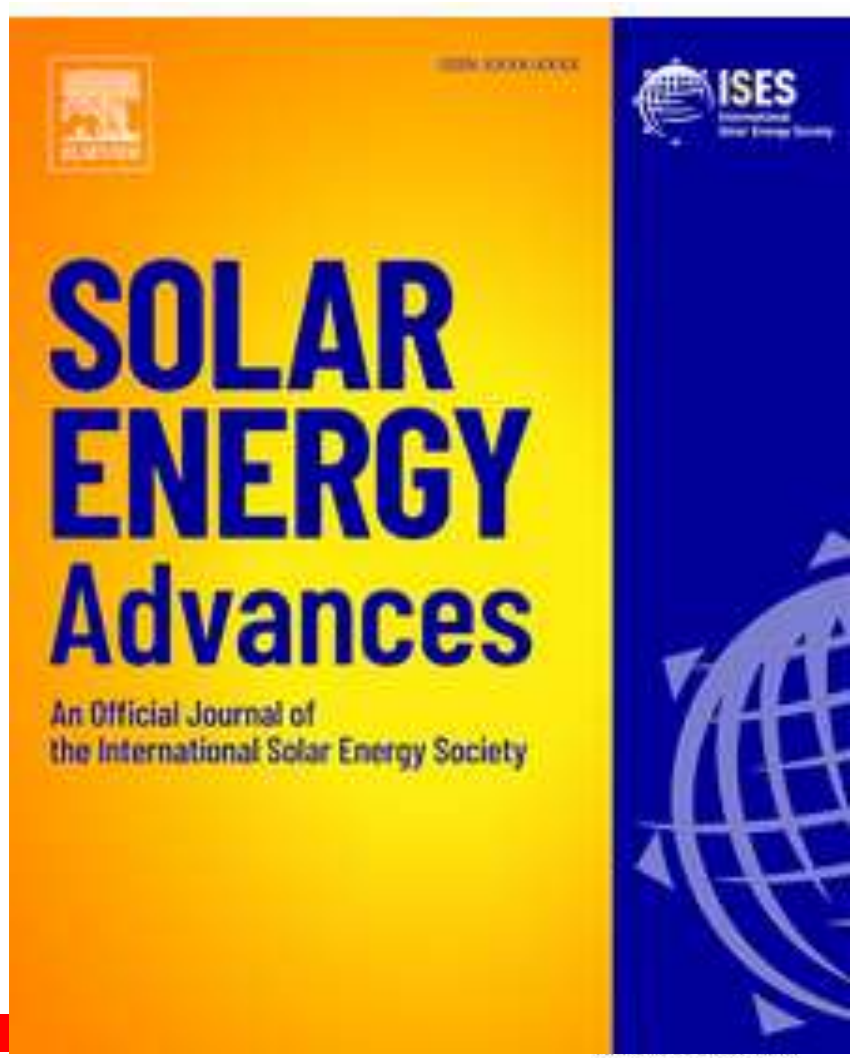
[2] BEST Bioenergy and Sustainable Technologies GmbH, Graz (Austria)

[3] Links Foundation, Torino (Italy)

Abstract

Fault-Detection (FD) is essential to ensure the performance of solar thermal systems. However, manually analyzing the system can be time-consuming, error-prone, and requires extensive domain knowledge. On the other hand, existing FD algorithms are often too complicated to set up, limited to specific system layouts, or have only limited

EuroSun2022



Industry Involvement & Market Activities

(great article from Solrico here: LINK)

Industry Involvement & Market Activities – GERMANY

- **STATUS DISTRIC HEATING:** 77% of the heat networks operate at temperatures 80 – 120°C (21% even above)
- **STATUS SOLAR DISTRICT HEATING (SDH) PLANTS :**
  - … running: 48 plants / ~ 142,500 m²
  - … planned: 9 plants / ~ 31,200 m²
  - … in preparation: 50 plants / ~ 286,400 m²
- **SPECIFIC SDH PLANTS FOR MEDIUM-HIGH TEMPERATURES:**
  - Lemgo, northern Germany / vacuum tube collector / 9,181 m² / focus on heat at 90°C
  - Sondershausen, central Germany / vacuum flat plate collectors / 6,086 m² / heat at 85°C (even in winter) up to 160°C (planned)
- **BOTTLENECKS:**
  - availability of land ➔ region Baden-Württemberg is discussing how to integrate areas for solar thermal into the regional planning routines to simplify obtaining permissions.
  - long permission procedures ➔ e.g. funding scheme needs implementation within four years, permission to build it, took 2.5 years
- **GOAL/POTENTIAL/INSIGHT:**
  - Potential for SDH by 2050 of 13.5 THh ➔ would mean 30 mio. m² ➔ 1 million m² SDH collector area per year until 2050 to fulfil climate goals
  - Challenging goal considering currently 142,500 m²

Industry Involvement & Market Activities – (THE) NETHERLANDS

- **STATUS SOLAR DISTRICT HEATING (SDH) PLANTS :** Not many running yet, newly built plant 2023 with 37 MW / 48 000 m² (vacuum flat plate collectors), not many planned (➔ see BOTTLENECK)
- **INFO REGARDING FUNDING SCHEME:**
  - 2022 also concentrating solar thermal collectors are eligible for the subsidy scheme.
  - SDE++ is a performance-based incentive pays a feed-in premium for each kilowatt-hour produced by collector fields
  - The feed-in premium is annually revised and the net subsidy amount is determined by the difference between the cost of solar heat and the cost of heat produced by a gas boiler. (details here ***LINK***)
- **BOTTLENECK:**
  - Solar heat is below the radar of Dutch policy makers ➔ attention on renewable electricity
  - Latest Dutch Climate and Energy Outlook (November 2022), not even mention solar heat as an option for decarbonising district heating by 2030.
- **GOAL/POTENTIAL/INSIGHT:**
  - Large multi-MW SDH system with daily heat storage were found to be profitable when revenues from the SDE++ premium (= funding scheme) and the emission trading system (ETS) are considered in the calculation
  - Over a period of 15 years, SDE++ and ETS may provide up 60 % of the total cost of ownership, leading to a payback period of 9 years (example see . ***LINK***)

Participating Countries / Sponsors

Country/Sponsor	National Participation Letter (Y/N)	Number of Research Institutes	Number of Universities	Number of Companies
Austria	Y	3	1	2
Denmark	Y		1	3
UK	Y			1
Spain	Y		1	1
Switzerland	N		2	1
Germany	Y/N	4	3	3
Sweden	N		1	2
China	Y	**1**	1	1
France	N	1		
Netherlands	N	1		
Israel (in discussion)	N			1
Finland	**N**			**1**
Italy	**N**	**1**	**1**	
Australien	**N**			**1**
South Africa	**N**			**1**
Poland (in discussion)	**N**			**1**
TOTAL		**11 (+1)**	**11 (+2)**	**19 (+5)**

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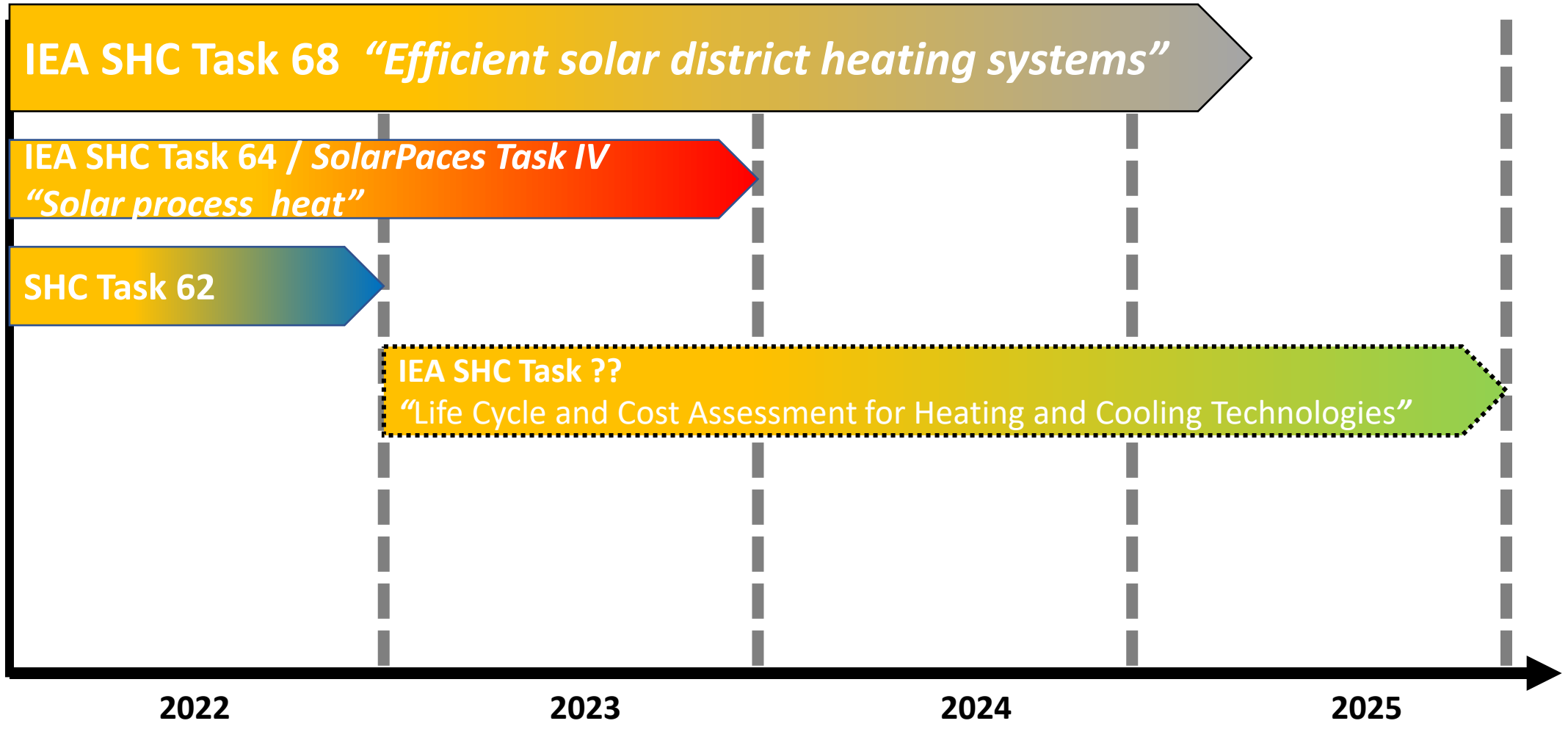
Switzerland	N		2	1
Germany				3
Sweden				2
China				1
France				
Netherlands				
Israel (in discussion)				1
Finland				1
Italy				
Australien	N			1
South Africa	N			1
Poland (in discussion)	N			1
TOTAL		11 (+1)	11 (+2)	19 (+5)

So far good and quick response from the ExCos (Austria, Denmark, UK, Spain, Germany, China)
➔ thank you ☺

Collaboration with other SHC Tasks, IEA TCPs, outside organizations/institutions

Collaboration with other IEA SHC Tasks

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY



Collaboration with other IEA SHC Tasks

SOLAR HEATING & COOLING PROGRAMME
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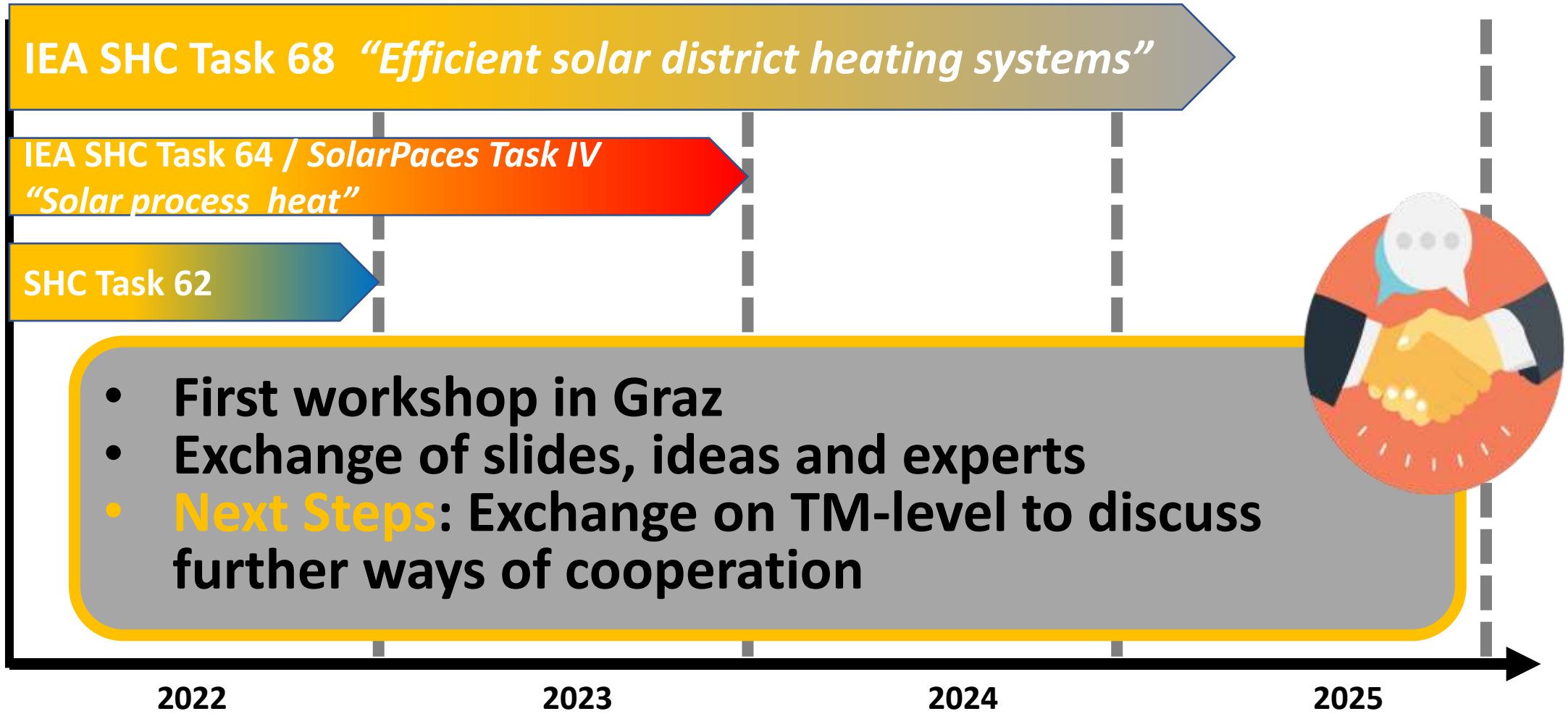
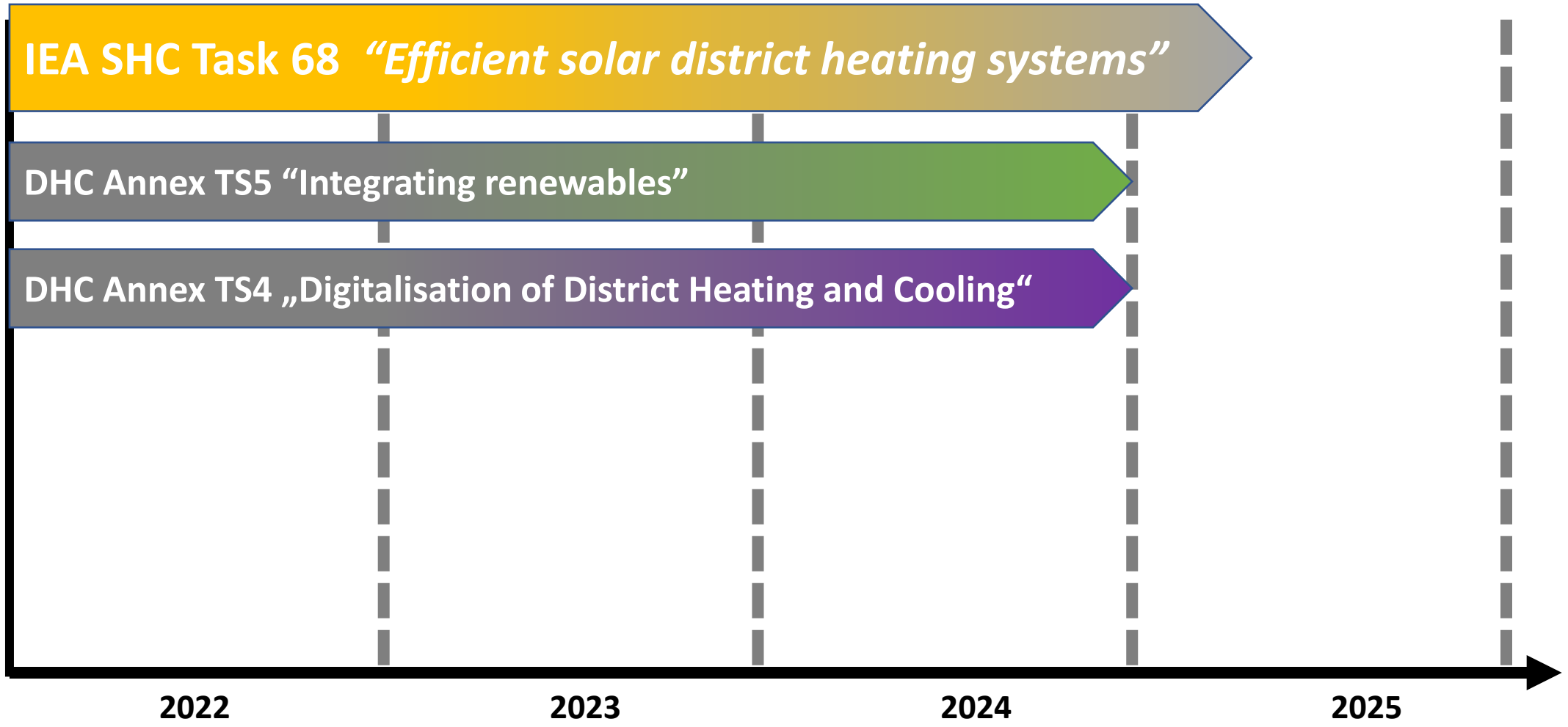


Collaboration with IEA DHC Annexes



Collaboration with IEA DHC Annexes

IEA DHC|CHP

IEA SHC Task 68 *"Efficient solar district heating systems"*

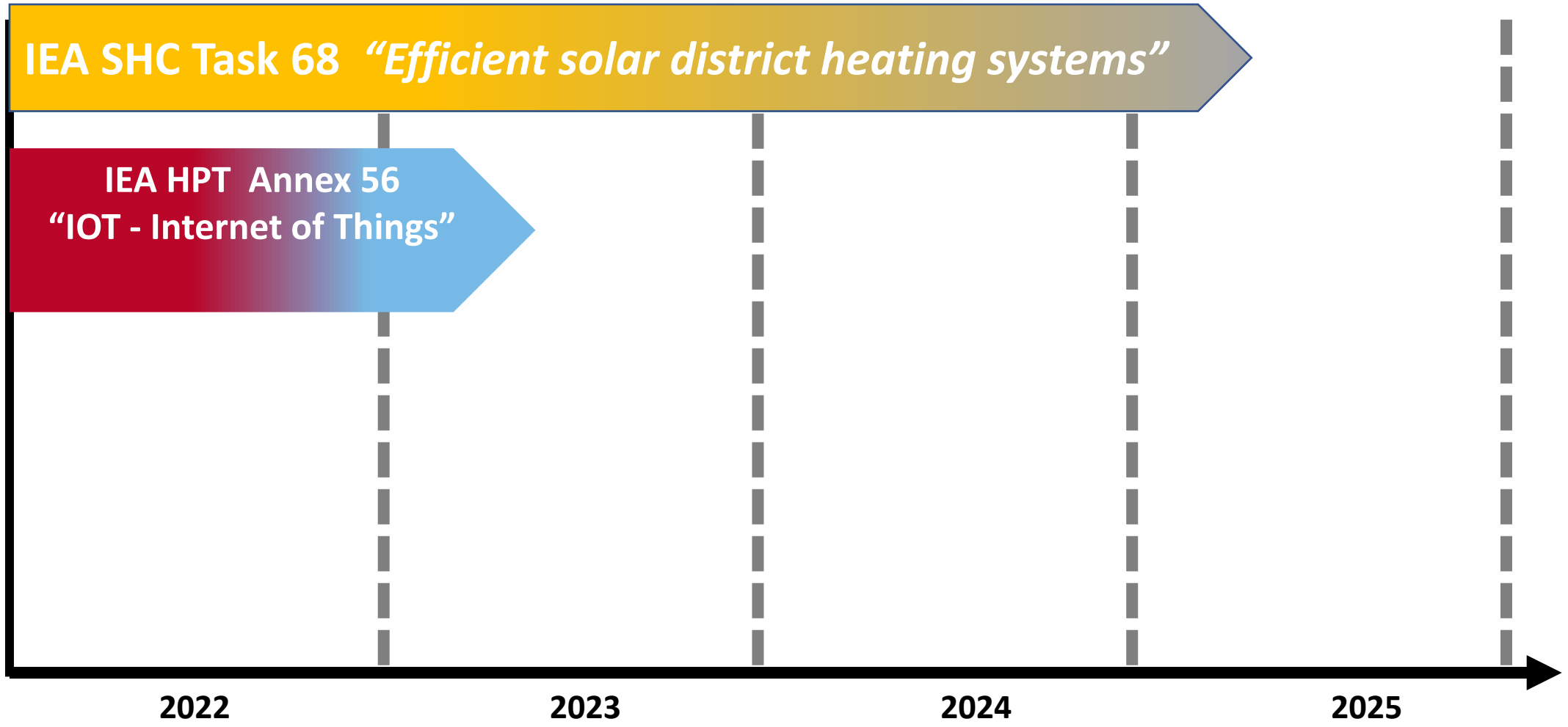
DHC Annex TS5 "Integrating renewables"

DHC Annex TS4 „Digitalisation of District Heating and Cooling"

- TS 5 :
  - Cooperate regarding technology factsheets
  - No cooperation regarding simulation tools
  - Exchange about planned dissemination activities
- TS4 & TS5: joint IEA related workshop in January at the CEBC (https://www.cebc.at/)

2022 2023 2024 2025

Collaboration with IEA HPT Annex



Collaboration with IEA HPT Annex

IEA SHC Task 68 *"Efficient solar district heating systems"*

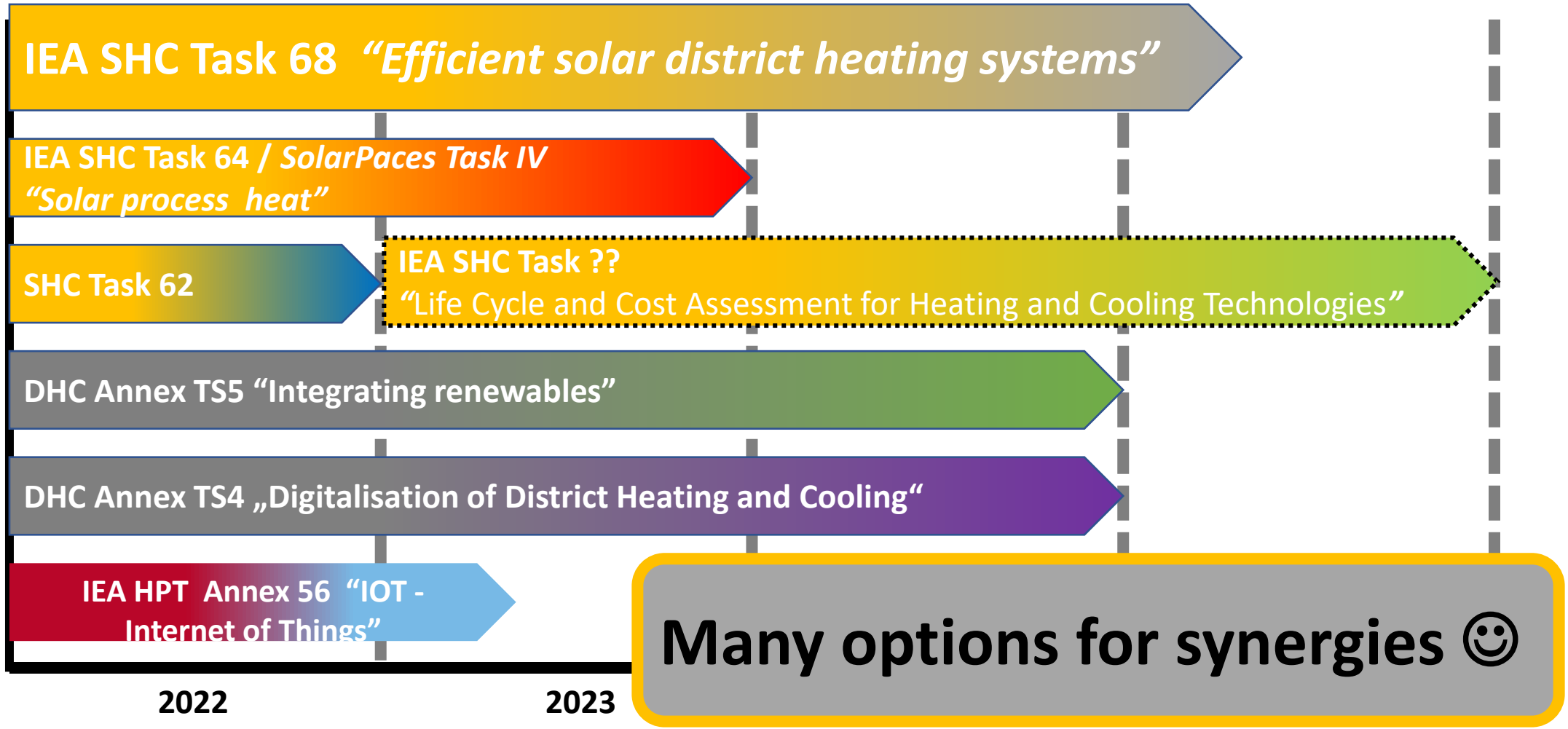
IEA HPT Annex 56
"IOT - Internet of Things"

Next Steps:

- Presentation of Annex 56 at next Task 68 meeting
- Build on their work done regarding *"Analysis of business models for IoT-capable heat Pumps and market opportunties"*
  ➔ regarding *Subtask C – new business models and cost reduction*

2022 2023 2024 2025

Collaboration with other SHC Tasks, IEA TCPs, outside organizations/institutions



Issues for the ExCo

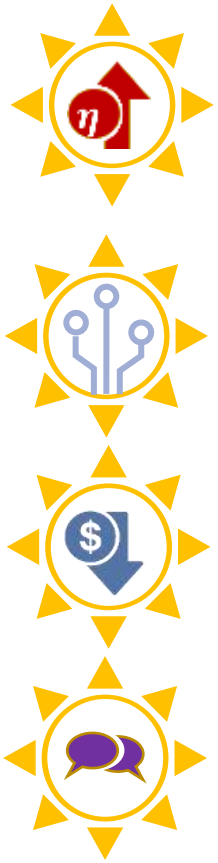
Issues for the ExCo

- **SUGGESTION:**
  - SHC provide all currently relevant information of the program (e.g. webinars, conferences, databases, …) in a central, continuously-updated place (e.g. in shared excel list).
  - Task managers can add it to their presentation for their task meeting, with the advantage:
    - Consistent (each TM tells the same info from the SHC)
    - All SHC related information is mentioned by the Task Manager

    ➔ I myself presented the *SHC in general*, *solar superstars database* and the *SHC linkedIn group …* but e.g. didn't mentioned the webinars ☹
- **Likely delay of Deliverable: *RD1*** – *Overview of efficient solar thermal plants* ➔ planned for March 2023 ➔ in the retrospect, it is not well scheduled to have it at the beginning since currently interesting plants are build (e.g. Netherlands) ➔ see at the end

Status and progress of the Task

Task Structure



Subtask A: Concepts
- Requirements | Planning | Configuration | Modelling

Subtask B: Data preparation & utilization
- Gathering/Storing data | Auto. Monitoring/Evaluation | Control

Subtask C: Business models
- Financing & Investment schemes | Risks & Barriers | Cost red.

Subtask D: Use Cases and Dissemination
- Demos | Awareness | Market overview | Best practice

Technologies /Components

Systems
- Medium to high temperature SDH – directly by solar
- Medium to high temperature SDH – indirectly by solar (e.g. solar + heatpump / biomass / …)

Task Structure

Subtask A: Concepts
•

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•

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Techn... s

• Medium to hig... ly by solar
• Medium to high ... ectly by solar (e.g. solar + heatpump / biomass / …)

Task 68 has great passionate Task leaders from Germany, Austria, (the) Netherlands and Sweden doing a great job !!!

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Subtask A: Concepts for efficiently providing solar heat at medium-high temperature level

Germany / Magdalena Berberich (SOLITES)

Insights from market for heat:

- ~10% of global energy demand is heat <200C
- solar thermal solutions provide much less than 0.1% of this heat…

Overview of the suppliers of concentrated solar thermal

Analysis ➔ complexity is the main challenge for the potential off-takers

Work on Activity A1 & A2: Comparison of different collector technologies

- Template to collect information from different collector manufactures.
- Information from the template will be used to make appealing documents for each technology.
- Discussed with community, received good and important input will be send out to collector manufacturers

IEA SHC Task 68 – Subtask A Concepts – Template A1 1

Version 1, 10.11.2022

Manufacturer	
Name	
Location	
Year of foundation	
Website	
Collector main features	
Model	
Technology	
Used materials	
Receiver environment	
Specific weight [kg/m²]	
Thermal power [W/m²] for the following conditions: Gb = 850 [W/m²]; Gd = 150 [W/m²]; v_{wind} = 1.3 [m/s]; Tm-Ta = 0 [K]	
Tracking type (single or two axes)	
Tracking precision [°]	
Power consumption of the tracking [kWh$_{el}$/m²a]	

Subtask A: Concepts for efficiently providing solar heat at medium-high temperature level

Deliverables

DNK

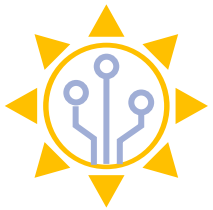
AUS

POL

No.	Deliverable	Month
RA1	Report 1 for activity A1 and A2: *Comparison of different collector technologies especially considering medium-high temperature heat and best practice examples*	Jul.23
RA2	Report 2 for activity A3: *Analysis of existing simulation tools for the simulation of medium-high temperature SDH systems, if necessary, creation of a new easy to use calculation tool*	Mär.25
RA3	Report 3 for activity A4: *Performance and efficiency measures for efficient SDH systems, especially considering medium-high temperature heat*	Mär.25
RA4	Report 4: *Subtask report with management issues*	Mär.25

Task Structure

Subtask A: Concepts
- Requirements | Planning | Configuration | Modelling



Subtask B: Data preparation & utilization
- Gathering/Storing data | Auto. Monitoring/Evaluation | Control

Subtask C: Business models
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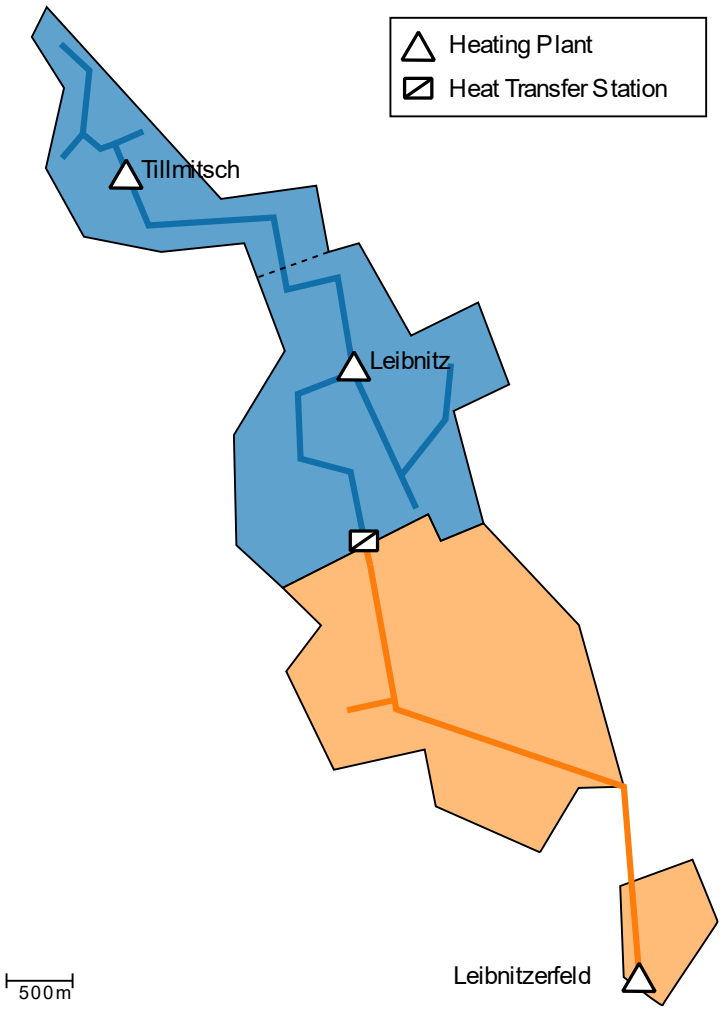
Subtask B: Data preparation & utilization

Austria / Sabine Putz

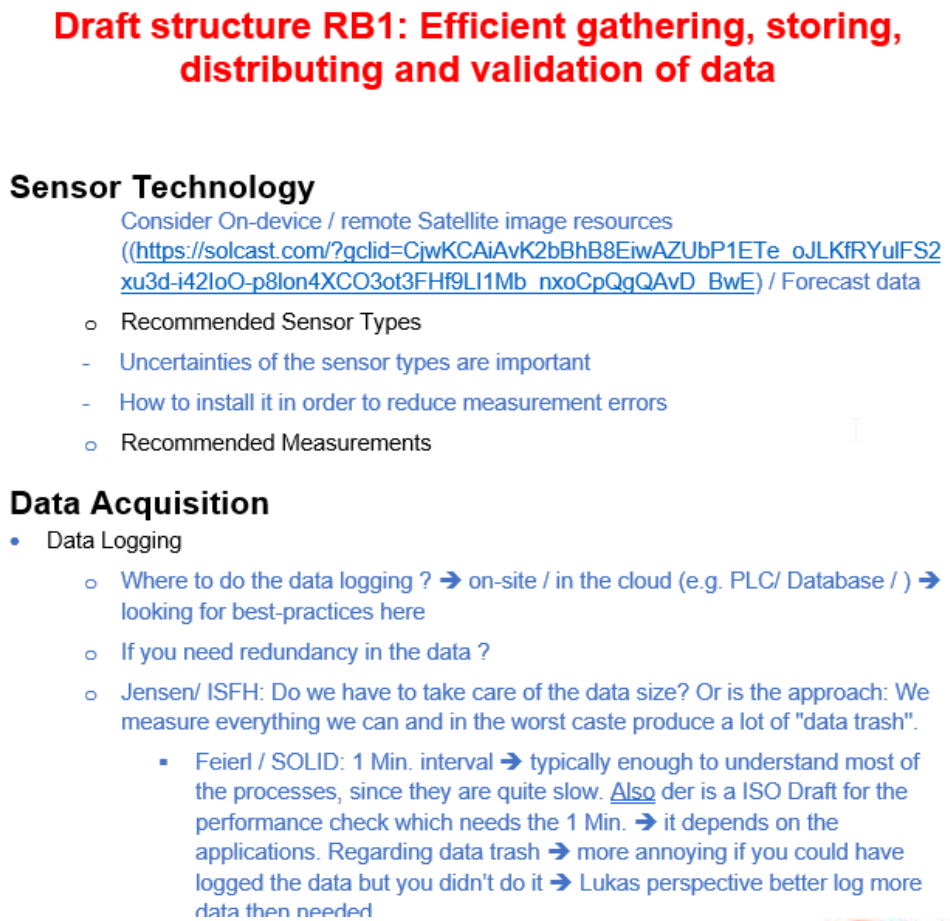
Operation of coupled multi-owner district heating networks via distributed optimization

- As (solar) district heating (DH) networks grow, they often grow together
  ➔ OPPORTUNITY: connect them directly/indirectly
  ➔ CHALLENGE: different Owners, optimal operating strategy ?
- **SOLUTION** Optimization-based energy management systems (EMS) are high-level controllers that solve optimization problems in real-time and compute optimal operation schedules for all production units, considering available solar heat.
- The presented idea evaluated on the real-world example in Austria for 3 DH networks, operated by 2 owners all controlled by an EMS.
- Results from real-world implementation show a reduction in **CO2-emissions by 35 %** and a reduction in **fuel costs by 7 %.**



Work on Activity B1 & B2: Efficient gathering, storing, distributing and validation of data

- Structure for the deliverable was discussed by Task community
- Inputs directly collected online during the meeting in the file
- Work on inputs, update structure and form a concrete author team.



Draft structure RB1: Efficient gathering, storing, distributing and validation of data

Sensor Technology

Consider On-device / remote Satellite image resources ((https://solcast.com/?gclid=CjwKCAiAvK2bBhB8EiwAZUbP1ETe_oJLKfRYulFS2xu3d-i42IoO-p8Ion4XCO3ot3FHf9LI1Mb_nxoCpQgQAvD_BwE) / Forecast data

- Recommended Sensor Types
- Uncertainties of the sensor types are important
- How to install it in order to reduce measurement errors
- Recommended Measurements

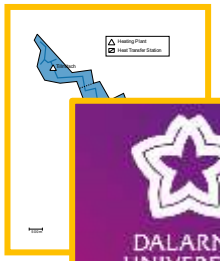
Data Acquisition

- Data Logging
  - Where to do the data logging ? ➔ on-site / in the cloud (e.g. PLC/ Database /) ➔ looking for best-practices here
  - If you need redundancy in the data ?
  - Jensen/ ISFH: Do we have to take care of the data size? Or is the approach: We measure everything we can and in the worst caste produce a lot of "data trash".
    - Feierl / SOLID: 1 Min. interval ➔ typically enough to understand most of the processes, since they are quite slow. Also der is a ISO Draft for the performance check which needs the 1 Min. ➔ it depends on the applications. Regarding data trash ➔ more annoying if you could have logged the data but you didn't do it ➔ Lukas perspective better log more data then needed

Subtask B: Data preparation & utilization

Deliverables

AUT



SWE

DALARNA UNIVERSITY

ITA

No.	Deliverable	Month
RB1	Report 1 for activity B1 & B2: *Efficiently gather/store/distribute data together with validation measures*	Sep.23
RB2	Report 2 for activity B3: *Techniques for analysis, monitoring and fault detection of data*	Mär.25
RB3	Report 3 for activity B4*: Comparison of state-of-the-art and advanced control strategies on sub- (component level) and superordinate level (=system level)*	Mär.25
RB4	Report 4 for activity B5: *Open data approaches*	Mär.25
RB5	Report 5: Subtask report with management issues	Mär.25

Task Structure

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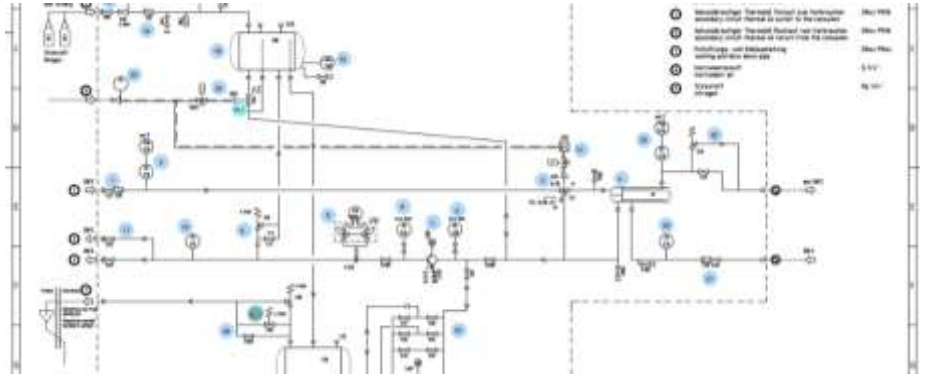
Subtask C: Business models
(the) Netherlands/ Luuk Beurskens

Great session, full focus on topic of COST REDUCTION, insights from

- **Project Modulus** "Modular Heat Transfer Station" ➔ cost reduction through standardisation of BoP (=Balance of Plants) ➔ see also **Task 64**
- **WeSSun - Tracking Concentrator for Fixed Tilt solar thermal Collectors** ➔ cost reduction through innovation
- **Status and cut costs on solar heating in China** ➔ cost reduction through intelligent control strategy and multiple energy sources



Work on Activity C1 & C3: Efficient gathering, storing, distributing and validation of data

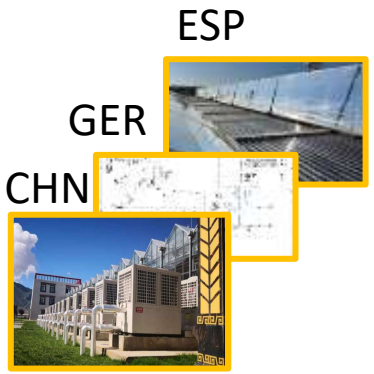
- Template for accessing the costs of different solar systems were presented
- Author team was formed for the next upcoming deliverables C1, C3

			2023			2030			2050		
			< 1 MW	1 - 10 MW	> 10 MW	< 1 MW	1 - 10 MW	> 10 MW	< 1 MW	1 - 10 MW	> 10 MW
Investment costs total	Concentrating solar	[EUR/m2]	a ··· b	c ··· d	e ··· f						
	Vacuum tubes	[EUR/m2]	g ··· h	i ··· j	k ··· l						
	Flat plate high efficient	[EUR/m2]	m ··· n	o ··· p	q ··· r						
	Flat plate standard	[EUR/m2]	s ··· t	u ··· v	w ··· x						
... of which collector	Concentrating solar	[EUR/m2]									
	Vacuum tubes	[EUR/m2]									
	Flat plate high efficient	[EUR/m2]									
	Flat plate standard	[EUR/m2]									
... of which balance of plant	Concentrating solar	[EUR/m2]									
	Vacuum tubes	[EUR/m2]									
	Flat plate high efficient	[EUR/m2]									
	Flat plate standard	[EUR/m2]									
... of which installation costs	Concentrating solar	[EUR/m2]									
	Vacuum tubes	[EUR/m2]									
	Flat plate high efficient	[EUR/m2]									
	Flat plate standard	[EUR/m2]									
Fixed O&M costs	Concentrating solar	[EUR/m2/year]									
	Vacuum tubes	[EUR/m2/year]									
	Flat plate high efficient	[EUR/m2/year]									

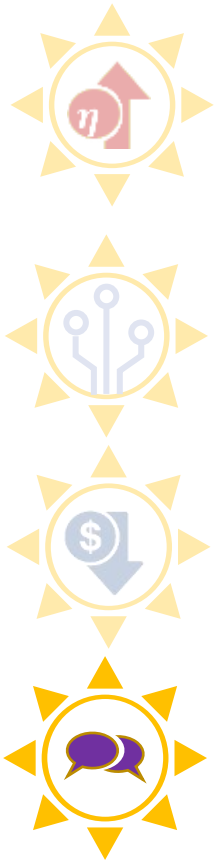
Subtask C: Business models

Deliverables

No.	Deliverable	Month
RC1	Report 1 for activity C1 & C2: *Overview of financing and investment schemes and possible new business models*	Mär.24
RC2	Report 2 for activity C3: *Standards and quality criteria for planners and designers of SDH systems*	Mär.25
RC3	Report 3 for activity C4: *Measures and possibilities to reduce the costs of SDH systems*	Mär.25
RC4	Report 4: *Subtask report with management issues*	Mär.25



Task Structure



Subtask A: Concepts
- Requirements | Planning | Configuration | Modelling

Subtask B: Data preparation & utilization
- Gathering/Storing data | Auto. Monitoring/Evaluation | Control

Subtask C: Business models
- Financing & Investment schemes | Risks & Barriers | Cost red.

Subtask D: Use Cases and Dissemination
- Demos | Awareness | Market overview | Best practice

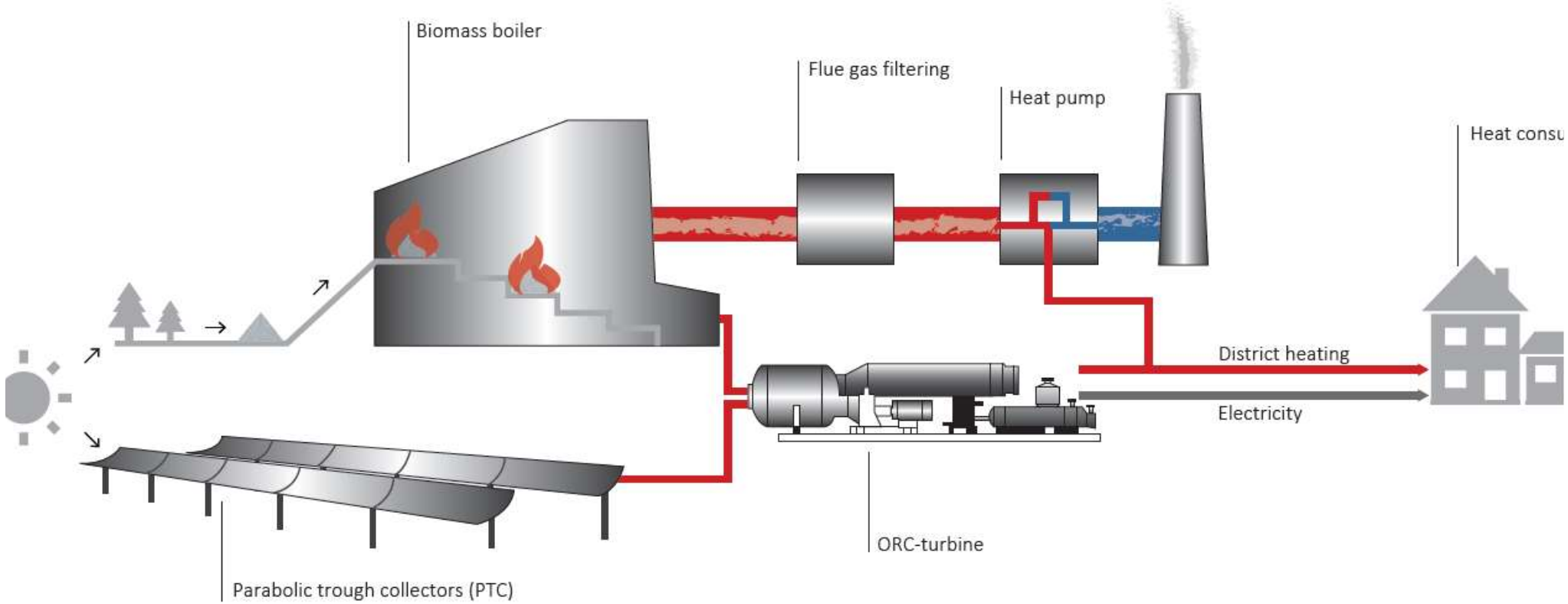
Technologies /Components

Systems
- Medium to high temperature SDH – directly by solar
- Medium to high temperature SDH – indirectly by solar (e.g. solar + heatpump / biomass / …)

Subtask D: Use Cases and Dissemination

Sweden / Joakim Byström (1)

- Case Study Brønderslev
- Separate or parallel production! ➔ High sun it's possible to run only on sun / Winter only on biomasss
- Displacing biomass consumption ➔ maintain dispatchable power and heat generation!



Subtask D: Dissemination activity regarding

Task 68 – **additional website** regarding the **dissemination activity** (follow-up of the information brochure)
➔ **live Demo**

Benefits of Solar District Heating

Reduces CO_2 emissions

Keep heat Affordable

Increase energy security

Create local jobs

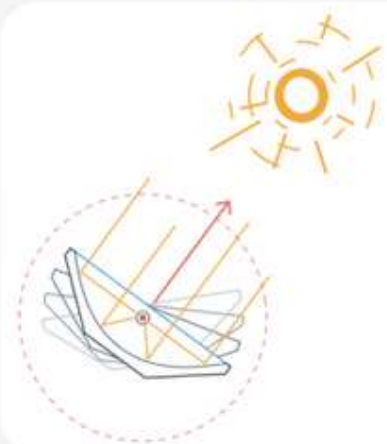
How does it work?

With solar heat, cost saving will be made in reduced fuel consumption and maintenance.

It's time to start the transition towards a renewable and cost effective district heating network.

Follow the link to see the video explanation from company Absolicon

Revolutionizing energy supply



Since the heat is captured without any energy conversion, the efficiency is very high.

Solar Thermal Collectors have a record high optical efficiency and captures 76% of the solar energy.

Have question? Contact our subtask D manager

First name

Last name

E-mail

Type of organisation

- ✓ Manufacturer
- Research & Academia
- National Association
- Service Provider

Message

Solar District Heating for 100 cities is possible today

According to Solar Heat Europe, solar district heating can replace 1/3 of all the gas used in traditional district heating with solar thermal and seasonal heat storage.

EU has selected 100 cities as model cities to have zero CO_2 by 2030. See how solar heat can reduce the burning of fossil fuels in those cities.

Haag	Zaragoza	Dunkerque	Leipzig
Klagenfurt	Torino	Suceava	Bratislava
Krakow	Vilnius	Riga	Tartu

Be a part of renewable Europe: Explore the roadmap provided by Solar Heat Europe

District heating demand

Annual residential and service sector heat demands of Haag, MWh/a	4 815 737

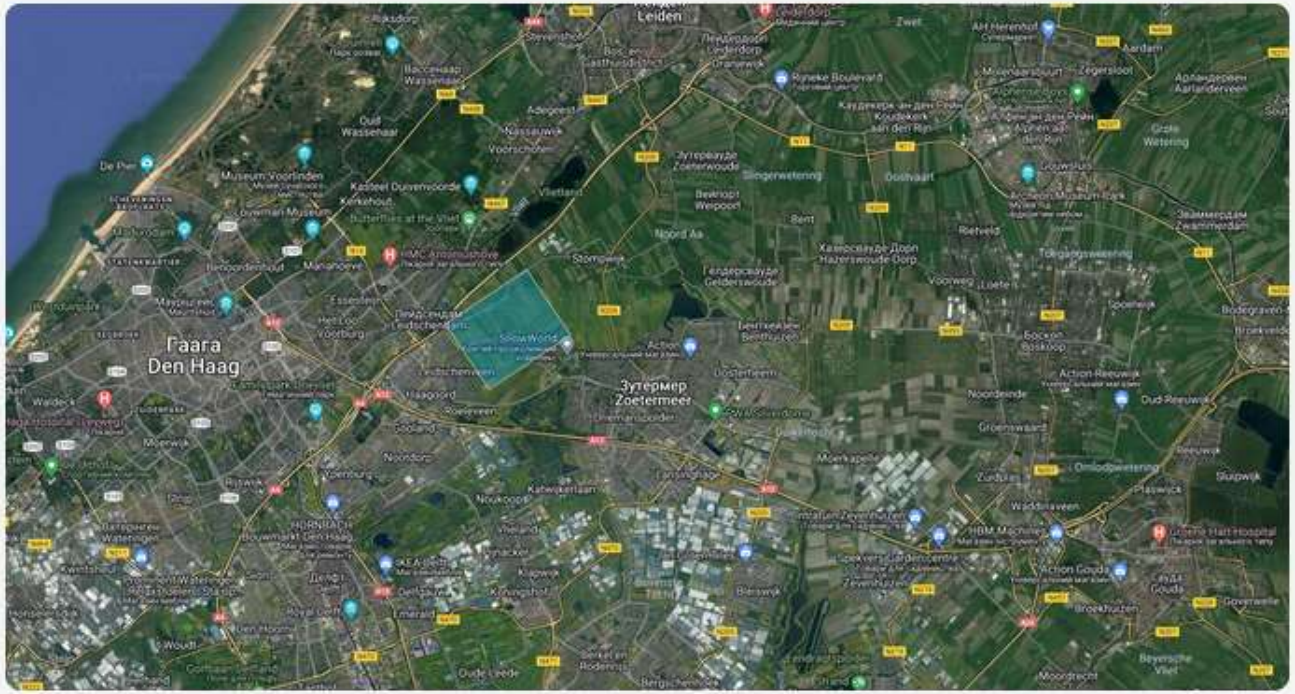
Want to calculate your saving on your own?

It is easier than you might thought!

Interested how solar technology will have an impact on your life?

To cover 20% of annual heat demand of Haag city, you would need to build solar field 6 381 056 m^2 area, which will produce 958 447 MW/h every year.

Also, this field will reduce 7 639 799 tons of CO_2 emissions and provide city with affordable heat price for the next 30 years!

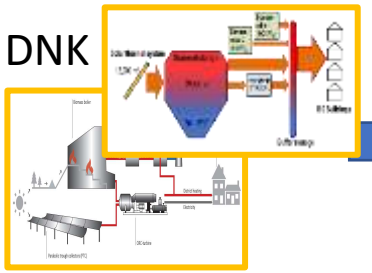


Subtask D: Business models

Deliverables

GER

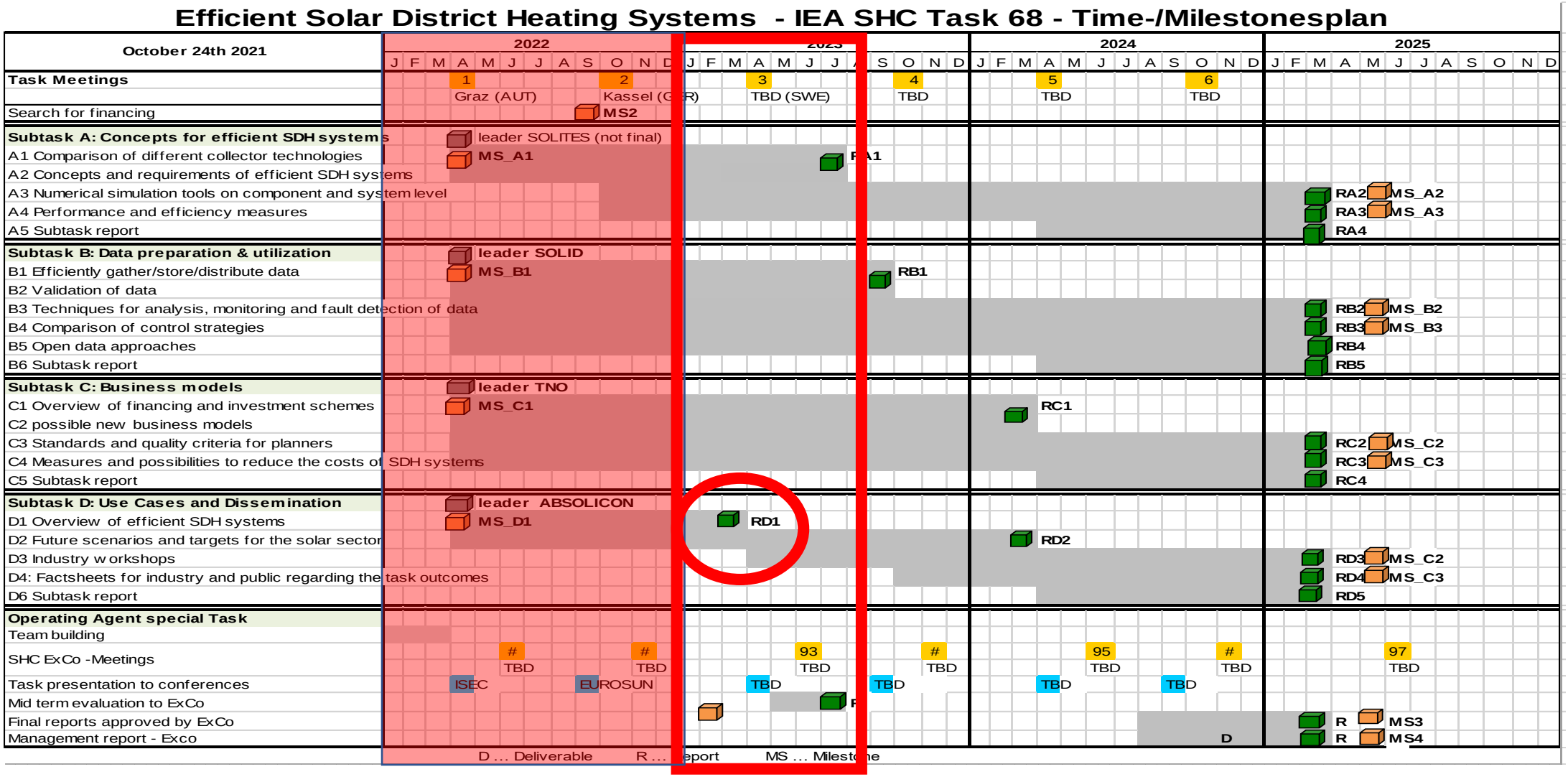
DNK



SWE

No.	Deliverable	Month
RD1	Report 1 for activity D1: *Overview of efficient SDH systems especially providing medium-high temperatures*	Jun.23
RD2	Report 2 for activity D2: *Future scenarios and targets for the solar sector*	Mär.24
RD3	Report 3 for activity D3*: Industry workshops*	Mär.25
RD4	Report 4 for activity D4: *Factsheets for industry and public regarding the task outcomes*	Mär.25
RD5	Report 5: *Subtask report with management issues*	Mär.25

Overview next steps until next ExCo Meeting



Task Meetings

Meeting #	Date	Location	Number of Participants & Countries/Sponsors
1	4. – 5. April, 2022	Graz, Austria	55 participants (virt.: 28 / phys.: 27) 12 countries/sponsors
2	9. – 10. November, 2022	ONLINE	51 Participants 15 countries/sponsors
3	Tbd (March / April 2023)	Likely in Sweden	

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Efficient solar district heating systems
SHC Task 68

2nd Task Status Report
92 ExCo Meeting, Stellenbosch, South Africa

Viktor Unterberger
Task Duration: 01.04.2022 – 31.03.2025
Collaborative Task with Annex TS5 (planned)