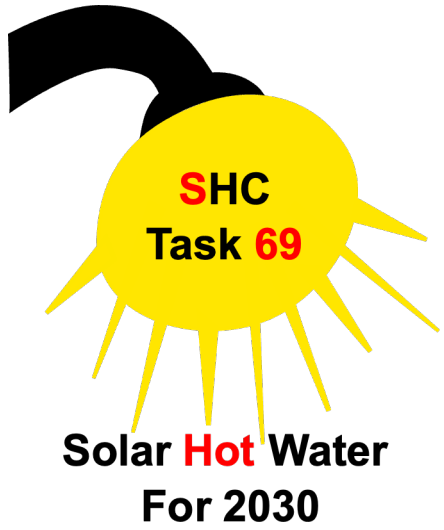
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Task 69:
Solar Hot Water for 2030



Robert A Taylor, UNSW & He Tao, CABR: Joint TMs
Presented at: June 2023 SHC ExCo Meeting & National Day

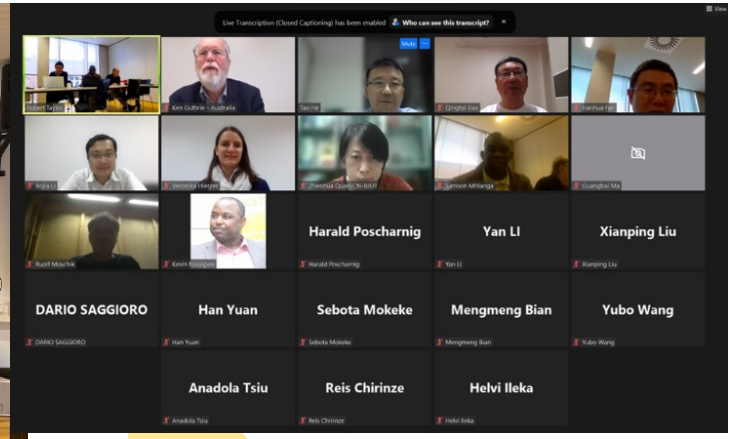
Scope

In this Task, we are focusing on **2** technologies:

- **Thermosyphons:** The most used solar heating system (~57% of domestic hot water systems in operation in 2019)
- **PV Hot Water:** Rapid PV growth! Can be simple (i.e., low cost) or advanced (i.e., soak up excess PV and power heat pumps).

Note: Both require very few moving parts, can be affordable and reliable, and provide opportunities for new products/components.

Timeline/Progression



91st Exco
Task 69
Approved
(June '22)

First Proposed
89th ExCo (May '21)

Update
90th ExCo
(Nov. '21)

Year 1

Year 2

Year 3

30 June 2025

TDW#1 (Sept. '21)

TDW#2 (April 22)

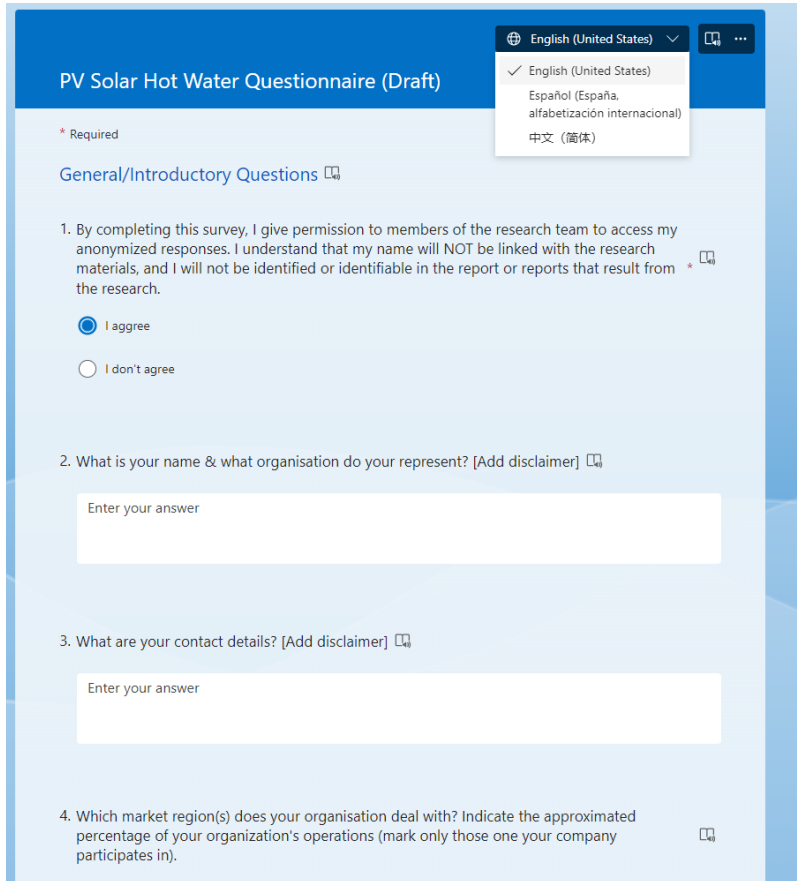
1st Task Metting Eurosun '22)

2nd Task Meeting s@ccess (Spain)

3rd Task Meeting 4 Dec. 2023 APRSC (Australia)

Significant Task Results (since last ExCo Meeting)

- Task Meeting #2 was held with the S@ccess in Spain (hybrid)
- SubTask B & C Questionnaires/Survey Prepared, Under Testing
- *Initial development of GHG reduction performance calculating tool, analysis and testing of different hot water systems are conducting in China.*
- *Test Bed between thermosyphon system and PV-to-Heat (PV2Heat) system in Namibia.*



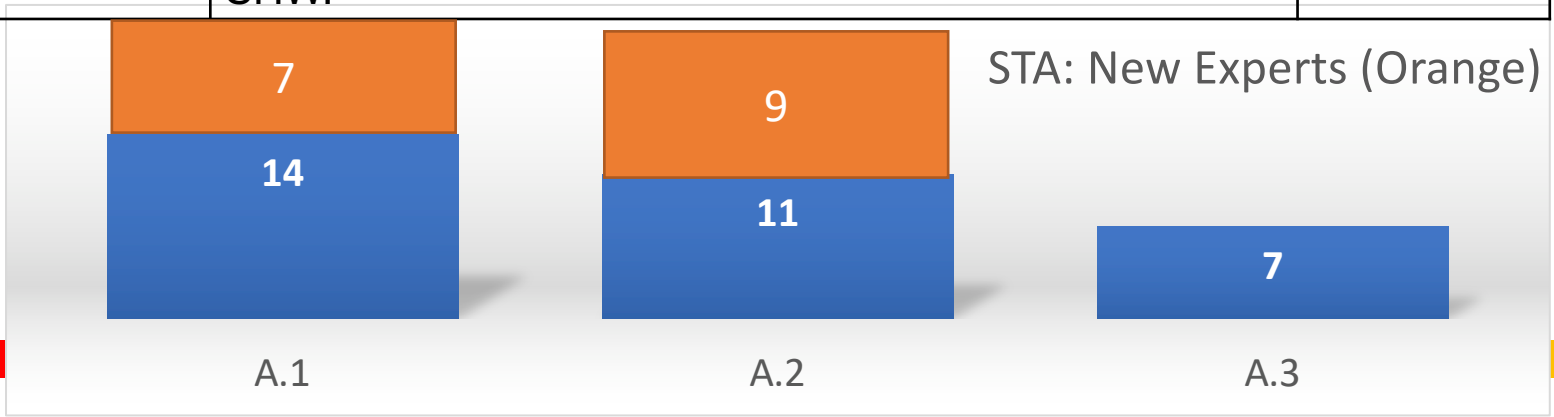
Subtask Work and Results
since last ExCo Meeting

Subtask A: State-of-the-art and operating environments. Lead: Daniel Tschopp, Austria

Aim: Analyze global solar hot water installation data, including the operating environment, trends, best practices, current regulations, and the major technical and non-technical barriers to adoption. Findings and results are brought into subtask B and C.

No.	Deliverable	Month
A.1	Report on most dominant solar water heating systems and state-of-the-art reviews for thermosyphon and PV hot water technologies, analysis of market regions and potential for solar water heating.	20
A.2	Documentation of success stories and market barriers in relevant regions.	30
A.3	Report on emerging products and research trends for SHW.	36

*Building upon Solar Heat Worldwide Data



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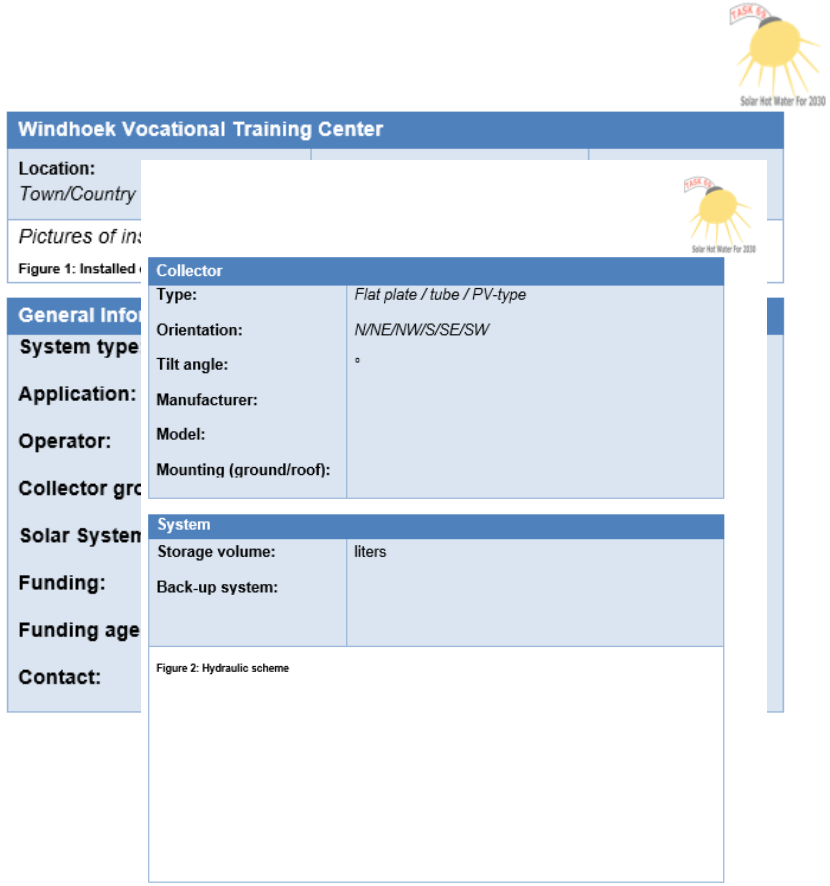
Questionnaires for Manufacturers of Thermosyphon Systems & Template for Best Practice examples

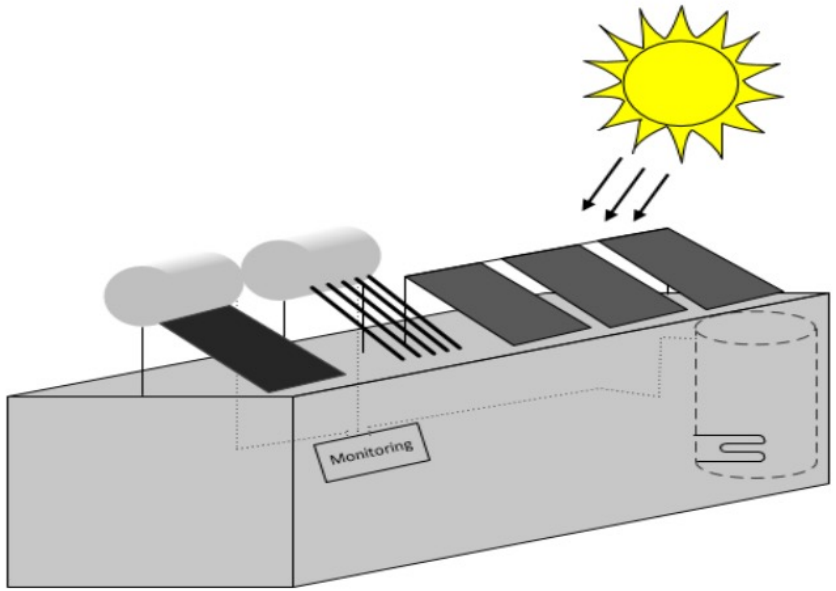
- Draft **Questionnaire for Manufacturers of Thermosyphon Systems** has been developed together with STB (see STB)

- Template for **Best Practice examples**
  - Used for **collection of best practices** of thermosyphon and PV Hot water systems
  - Entails **technical and economical** parameters and description of project **boundary conditions** (2-4 pages)
  - Draft is currently under review from STA experts



SOLTRAIN+ Comparison Test Bed

- **Side-by-side comparison of solar hot water technologies**
  - Indirect thermosyphon system with a flat plate collector
  - Indirect thermosyphon system with evacuated heat pipe collector
  - PV-to-Heat (PV2Heat) system
- **Monitoring phase**: Dec. 2023 to Dec. 2024
- **Location**: Namibia University of Science and Technology
- **Data** of the comparison test bed together with insights from **SOLTRAIN project** (665 demo systems over 12 years) will be shared with the Task



SubTask A: Progress to date

1) No deliverables due yet, but tangible progress towards all 3.
2) Funding for Task (Federal Ministry of Austria) and for SOLTRAIN+ (Should give us a rich data set!)
3) Global Thermosyphon/PV hot water market has been divided into **8** market regions

Region	Regional Lead
China	Bojia Li
Sub-Sahara Africa	Samson Mhlanga
Asia excl. China	Jaideep Malaviya (India), Hitoshi Hara (Japan)
Europe	Pedro Dias
North America	Stephen Harrison
Latin America	Danielle Johann
MENA	Souad Abrougui, Khalid Salmi
Oceana	Ken Guthrie

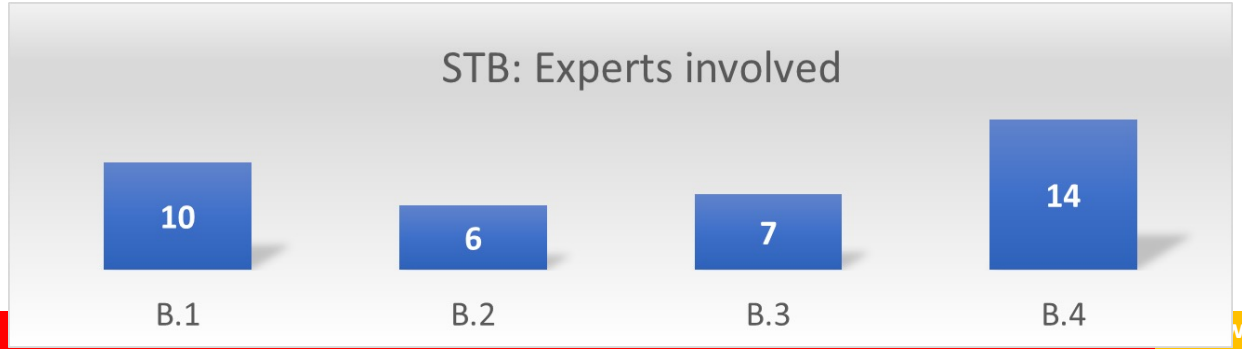
4) 2nd Task meeting had in-depth, technical discussion about success stories and market barriers in relevant regions (towards Deliverable A.1 & A.2)
5) Draft for "Questionnaires for Manufacturers of Thermosyphon Systems" & "Template for Best Practice examples" were developed

Subtask B: Thermosyphon hot water systems

Lead: Li Bojia, China

Aim: To promote thermosyphon hot water systems by investigating design and management technologies for convenience and performance. And survey the failure modes and effects, provide durability and reliability improving suggestions. The subtask will also investigate the Energy-saving & GHG reduction performance in different region.

No.	Deliverable	Month
B.1	Report of thermosyphon system potential	12
B.2	Survey of failure modes and effects and suggestions	18
B.3	Report on durability and reliability	18
B.4	Report on energy-saving & GHG reduction methods along with current and future trends	36



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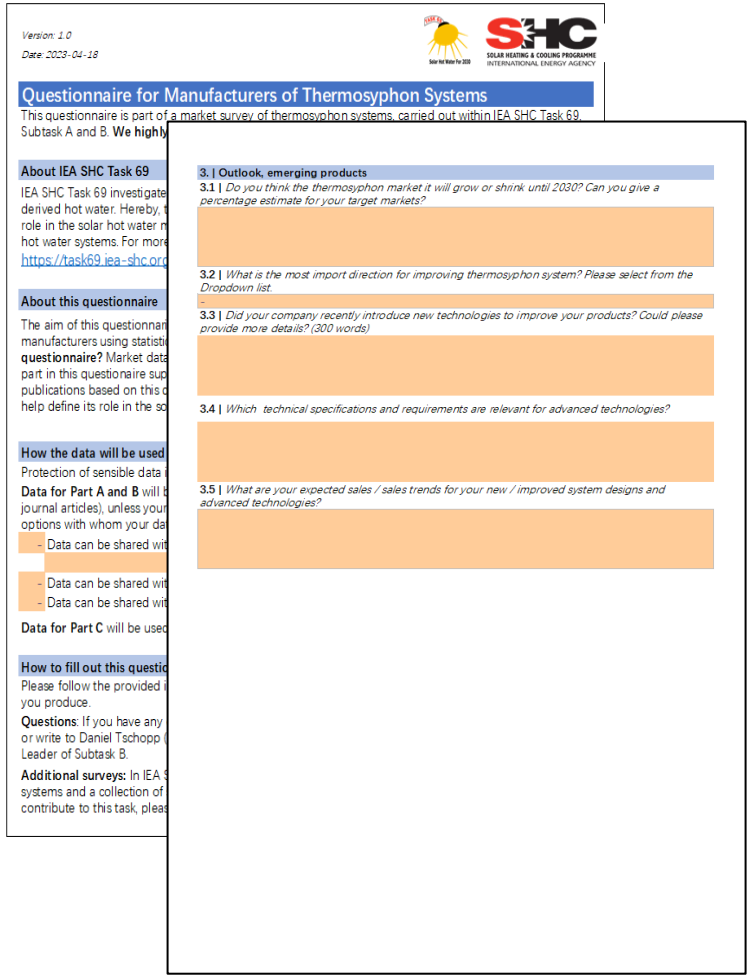
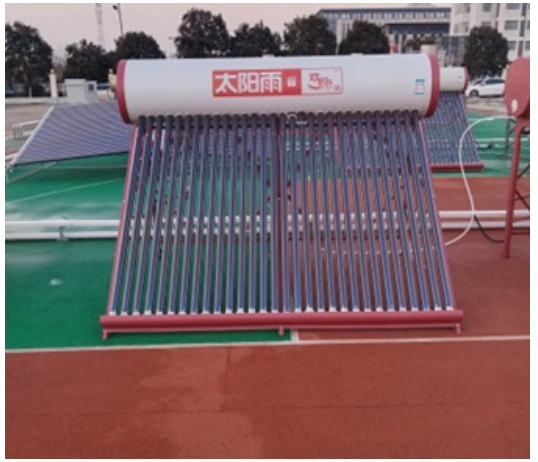
Questionnaire for Manufacturers of Thermosyphon Systems

- **A draft questionnaire** for manufacturers of *Thermosyphon System* have been developed concerning the new technologies and their benefits in different market.
- Questions on **Trend of thermosyphon**, **New models and their benefits** have been integrated in the questionnaire.
- Stats of **technical specifications and requirements** is also a concern of this questionnaire.
- The draft questionnaire was developed with STA, and already sent to STA & STB experts gathering their improve suggestions to finalize.
- **Next:** Survey will be done with help of regional experts and experts from STA & STB.


Version: 1.0
Date: 2023-04-18
Questionnaire for Manufacturers of Thermosyphon Systems
This questionnaire is part of a market survey of thermosyphon systems, carried out within IEA SHC Task 69, Subtask A and B. We highly
About IEA SHC Task 69
IEA SHC Task 69 investigate
derived hot water. Hereby,
role in the solar hot water
hot water systems. For more
https://task69.iea-shc.org
About this questionnaire
The aim of this questionnai
manufacturers using statisti
questionnaire? Market data
part in this questionaire sup
publications based on this
help define its role in the so
How the data will be used
Protection of sensible data
Data for Part A and B will
journal articles), unless your
options with whom your da
- Data can be shared wit
- Data can be shared wit
- Data can be shared wit
Data for Part C will be used
How to fill out this questio
Please follow the provided
you produce.
Questions: If you have any
or write to Daniel Tschopp
Leader of Subtask B.
Additional surveys: In IEA
systems and a collection of
contribute to this task, plea
3. | Outlook, emerging products
3.1 | Do you think the thermosyphon market it will grow or shrink until 2030? Can you give a percentage estimate for your target markets?
3.2 | What is the most import direction for improving thermosyphon system? Please select from the Dropdown list.
-
3.3 | Did your company recently introduce new technologies to improve your products? Could please provide more details? (300 words)
3.4 | Which technical specifications and requirements are relevant for advanced technologies?
3.5 | What are your expected sales / sales trends for your new / improved system designs and advanced technologies?

GHG reduction testing in China

- A GHG reduction test bed for thermosyphon systems has been set up in China.
- GHG reduction of different hot water systems are testing by CABR and Sunrain in China.
- Figures and results would be the inputs of STB.



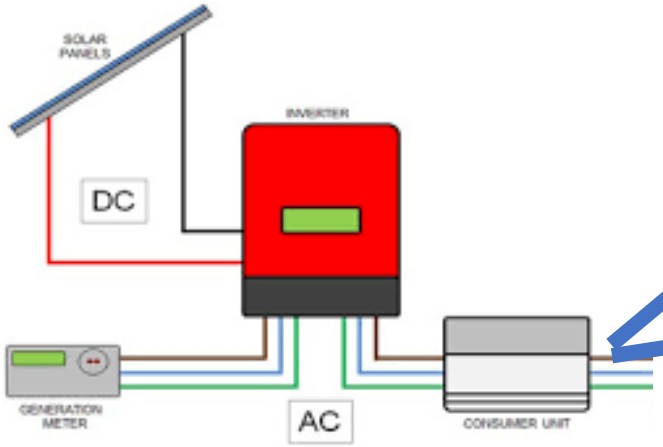
SubTask B: Progress to date

- None of the SubTask A deliverables are due by the time of the June ExCo Meeting, but deliverable B.1 is due soon. We would like to extend the deliverable B.1 from 12 months to 18 months, to gather more inputs and better prepared reports.
- Funding commenced for Subtask B (China National Key R&D Project, *"Key technologies and demonstration on zero carbon building in solar energy rich region"*
  - Duration: *Nov 2022 to Oct 2026*
  - RMB 1,421,300 (~200.000 €)
- 2nd Task meeting (in Spain), an excellent technical discussion was held relating to durability and reliability of materials for solar collectors and overall energy and GHG savings (deliverable B.3/B.4) on "Life cycle assessment of novel all-polymeric solar thermal collector systems for hot water".

Subtask C: Solar Photovoltaic Hot Water

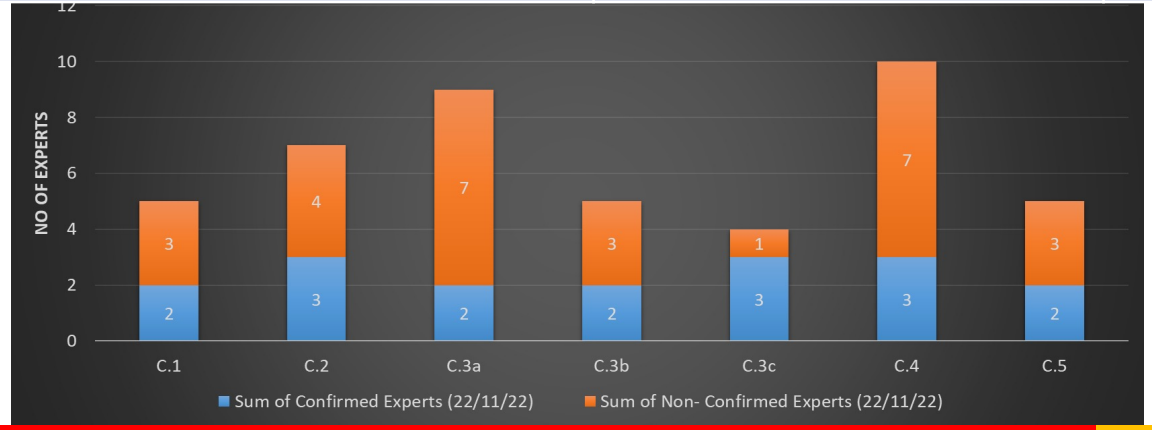
Joint Leads: George Bennett (UK- Temp) & Dean Clift (AU)

- **Aim:** Evaluate the environmental, social and economic implications of the increased deployment of PV water heating technologies
- **Why?:** Similar efficiency for COP =3 heat pump, reliable, affordable ($/L), offers new opportunities for grid/consumers, and we need all hands-on deck!



SubTask C: Deliverables and Timeline

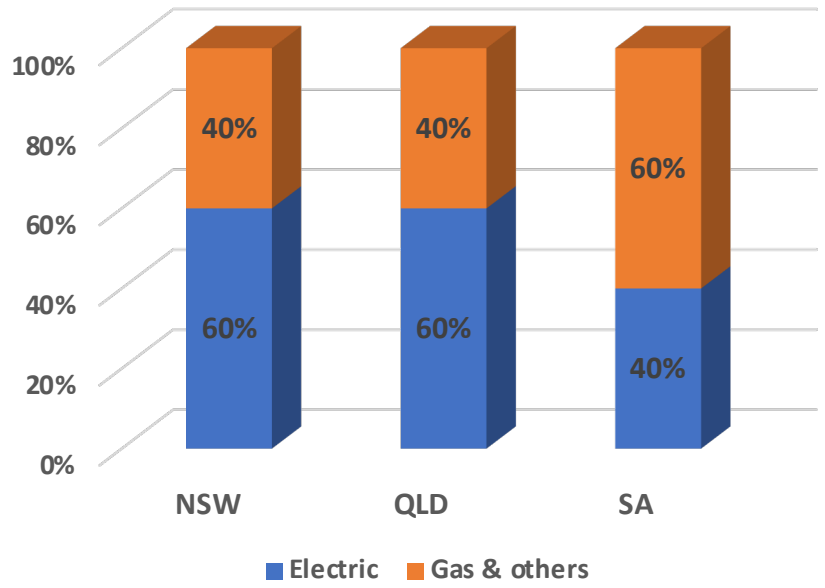
No.	1 July 2022 - Deliverables	1 July 2023 Proposed Deliverables	Month
C.1	Expert Network, Expert Questionnaire / Interviews and Case Studies	Unchanged	~~12~~ ->18
C.2	Systematic International Literature Review + Market Review	Unchanged	24
C.3a	Technology / Policy Brief	IEA SHC Technology Brief	24
C.3b	New ISO Solar Energy Vocabulary	Delete C.3b	~~36~~
C.3c	Reference Models + Solar Heat Worldwide Chapter	Academic Publications (2) on PV Hot Water System Modelling	24
C.4	Solar PV Hot Water Technology Harmonisation Strategy	Delete C.4	~~36~~
C.5	Implementation of Solar PV Hot Water Technology Harmonisation Strategy	IEA SHC Report on Solar PV Hot Water Technology Configuration/Operation Optimisation	36



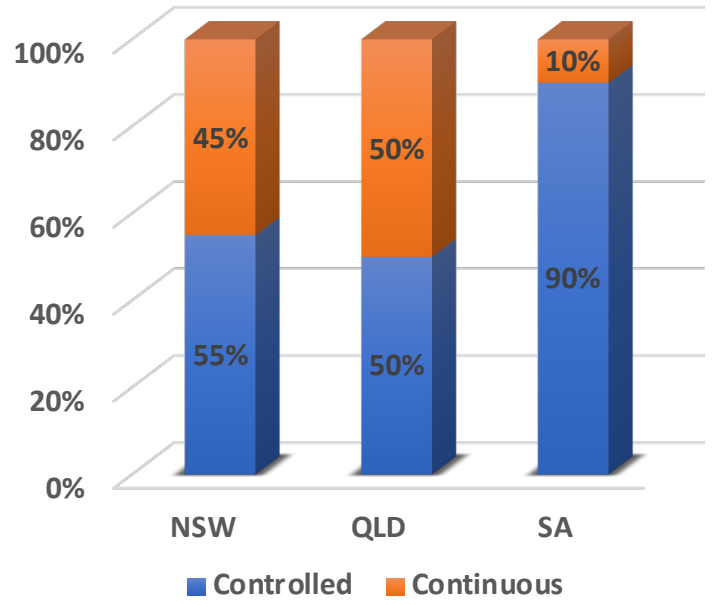
Australian Case Study (from Task Meeting #2)

- Around 1/3 of total residential energy use is attributed to water heating in Australia

- Around ~52% of water heaters are electric in Australia [E3 Equipment Energy Efficiency].



- Traditional controlled load systems (ripple control) are phasing out



SolarShift – Research activities

Phase 1: Desktop modelling

(Dec 2022 – Jul 2023)

Phase 2: Field trial – Albion Park, NSW

(Jul 2023 – Jul 2024)

Phase 3: Assessment of field trial and final project report

(Jul 2024 – Nov 2024)

- **Data-sets:**
  - 5 minutely net household import/export and DEWH consumption data from ~2,850 households in Albion Park trial
  - Power quality data including per phase voltage, current, reactive power and feeder info
  - 5 minutely gross household consumption, solar generation, DEWH consumption and other circuit level consumption data from ~1,500 households across Australia
  - Power quality data including per phase voltage, current and reactive power
  - Weather data

Other activities

- Regulatory assessment of DEWH control
  - Investigate current regulations and required alterations regarding the metrology and control of DEWH circuits across different DNSPs.
  - Enablement of self-consumption and/or netting off arrangements

- Input to important rule-making processes and standards:
  - **AEMC** flexible trading arrangements process
  - **EL-54**: Remote Demand Management of Electrical Products Standards Committee
  - **AS/NZS 4755.3.3**: Demand response capabilities and supporting technologies for electrical products: Operational instructions and connections for electric storage and electric-boosted storage water heaters
  - **AS/NZS 4234**: Heated water systems

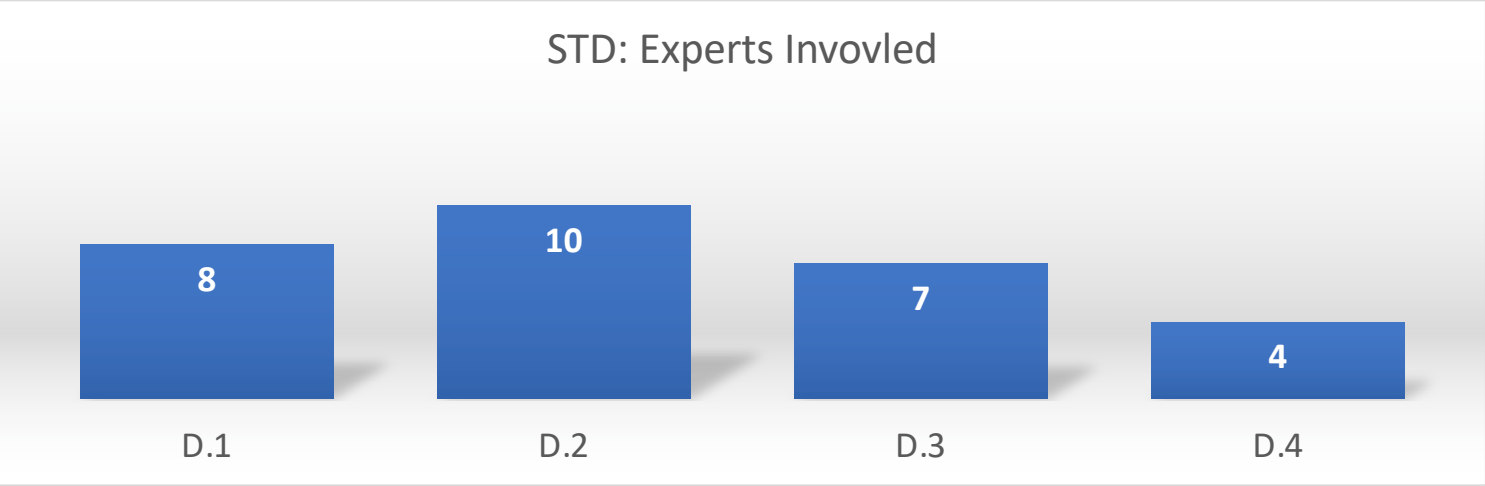
SubTask C: Progress to date

- None of the SubTask C deliverables are due, but C.1 was due in July 2023.
- C.1 Questionnaire has been developed
- Request modification to Deliverables due to a lack of Policy expertise & progress
- *Good technical progress:* **SolarShift** case study + technical analysis (i.e., Clift et al. “Assessment of advanced demand response value streams for water heaters in renewable-rich electricity markets” Energy, 267, 2023, https://doi.org/10.1016/j.energy.2022.126577

SubTask D: Training and Standards

Lead: Jianhua Fan (DK), Denmark

No.	Deliverable	Month
D.1	Report on needs for new Standards or Standards updates and the status of selected warranty and certification networks	18
D.2	Facilitate Training	15 & 30
D.3	Needs Assessment Report (Training for Solar Energy Practitioners)	24
D.4	Report on success stories	36



Standards Review

- **ISO** TC 180.

  Looking into possible updates for:

  - ISO 9459-4, Solar heating — Domestic water heating systems — Part 4: System performance characterization by means of component tests and computer simulation,
  - ISO 9459-5, Solar heating — Domestic water heating systems — Part 5: System performance characterization by means of whole-system tests and computer simulation
- Task Experts on **Australian** Standards Committee CS-28
- Task Experts on **China** Standards Committee SAC/TC 402:

  Looking at possible updates for **China** :

  - *GB/T 35606-2017:* Green product assessment- Solar water heating system
  - *GB/T 18708-2002:* Test methods for thermal performance of domestic solar water heating systems
  - *GB/T 19141-2011:* Specification of domestic solar water heating systems
  - *GB/T 25966-2010:* Specification of domestic solar water heating systems with electrical auxiliary heat source
  - *GB/T 25967-2010:* Test methods for thermal performance of domestic solar-plus-supplementary water heating systems

Updates on related work done in China - Standards

- The standard body in China is **the Standardization Administration of the P.R.C. (SAC).**
- **Technical Committee on Solar Energy Standardization of SAC (SAC/TC 402)** is the Chinese Mirror Committee of ISO/TC 180
- It‘s responsible for the standardization of **solar thermal products** such as：
  - Solar thermal collectors,
  - Collector components and materials
  - Domestic water heating systems
  - Solar cookers

Standards in China

- Technical Committee on Building Environment and Energy Efficiency Standardization of the Ministry of Housing and Urban-Rural Development of the P.R.C. (MOHURD) is responsible for the standardization on design and construction of building HVAC and other service systems.
- There're several standards related to solar thermal system applied in buildings such as solar water heating system, solar heating system, solar cooling system, etc.

Training Plans

- 1 onsite training seminar
- 1 online training webinar (solar academy)
- Time: M15 (by Q1 2024) and M30 (01.2025)

SubTask D: Progress to date

- None of the SubTask D deliverables are due by the time of the June ExCo Meeting.

1. Funding commenced for Subtask D leadership (Danish Energy Agency, EUDP project ‘Participation in the IEA Task 69 on Solar hot water for 2030’. A researcher has been hired = Edoardo Callegari

2. A news page on the project was published on DTU's homepage.

3. Progress on Standards Review: Review of standards started. Inputs from China on standard updates were collected.

4. Highlight from Task Meeting #2: Related updates from ISO standards committee are presented by Korbinian Kramer, Fraunhofer ISE

Issues for the ExCo

- STC leadership –New UK candidate has applied (policy background)
- Update STC Deliverables– Pending 6 Months review?

Plan B

No.	1 July 2022 - Deliverables	Month
C.1	Expert Network, Expert Questionnaire	~~12~~ ->18
C.2	Systematic International Literature Review + Market Review	24
C.3a	Technology / Policy Brief	24
C.3b	New ISO Solar Energy Vocabulary	36
C.3c	Reference Models + Solar Heat Worldwide Chapter	24
C.4	Solar PV Hot Water Technology Harmonisation Strategy	36
C.5	Implementation of Solar PV Hot Water Technology Harmonisation Strategy	36

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Plan C (in meeting paper)

No.	1 July 2022 - Deliverables	1 July 2023 Proposed Deliverables	Month
C.1	Expert Network, Expert Questionnaire	Unchanged	~~12~~ ->18
C.2	Systematic International Literature Review + Market Review	Unchanged	24
C.3a	Technology / Policy Brief	IEA SHC Technology Brief	24
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Thanks!

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