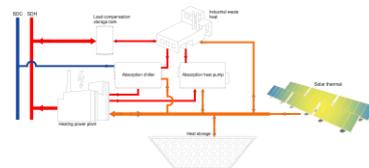


Task 55 – Towards the Integration of Large SHC Systems into DHC Networks

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Task Overview

IEA SHC Task 55 elaborates on technical and economic requirements for the commercial market introduction of solar district heating and cooling systems in a broad range of countries. The Task activities aim to improve technological and market know-how, as well as to develop tools for the network integration of solar thermal systems and the implementation of other renewable energy technologies for maximum energy coverage. A key element is the direct cooperation of SDH experts with associations, companies, and institutions from the DHC community to bridge the gap between the research fields and organizations.

The Task's work is divided into four subtasks:

- Subtask A: Network Analyses and Integration (Austria)
- Subtask B: Components Testing, System Monitoring, and Quality Assurance (China)
- Subtask C: Design of the Solar Thermal System and of Hybrid Technologies (Denmark)
- Subtask D: Promotion and dissemination of SDH/SDC and hybrid technologies in new markets Scope (Germany)

Subtask A: Network Analyses and Integration (Lead Country: Austria)

The main research questions of Subtask A are how to integrate significant shares of ST, what the impact on other generation units is, how to solve the integration technically, and what measures are suitable to maximize the share of solar thermal applications.

The expected outcomes are: collection of best practice examples and case studies; energetic, ecologic and economic assessments of the overall solar DHC system; possible transformation strategies of DHC networks towards high shares of ST; lessons learnt on challenges and benefits of ST integration; optimized control strategies and hydraulic options for the integration of SHC systems into DHC networks.

Subtask B: Components Testing, System Monitoring, and Quality Assurance (Lead Country: China)

The main research objectives of Subtask B are to elaborate on methods for in-situ collector tests, hybrid elements, and provide methods for simple thermal and energy performance proofs. Furthermore, it will provide data on automated monitoring and failure detection software for key components, and develop and describe control strategies for self-learning control systems.

Subtask C: Design of the Solar Thermal System and of Hybrid Technologies (Lead Country: Denmark)

Subtask C focuses on the simulation and design of solar thermal systems and components (storage, piping and others, e.g. heat pumps). The Subtask elaborates on characteristics of collector array units, large and seasonal storages, hydraulics, and heat pumps within system operations. Large scale collector fields will be simulated and compared to the measurements in Subtask B. If needed, the simulation tool will be corrected. Parameters of seasonal storages will be calculated and guidelines for the design and construction of different storage types updated. Hydraulics within systems are sensitive to a variety of parameters. These parameters will be optimized. Piping within large systems will be investigated as well and options for a modular conception and construction for very large systems.

Subtask D: Promotion and dissemination of SDH/SDC and hybrid technologies in new markets (Lead Country: Germany)

Subtask D elaborates economic aspects and the promotion of results from SHC Task 55. Large scale solar thermal systems require sophisticated financing models due to high initial investment costs. Different business models are already in place and facilitate the realization of large systems. The subtask will assist planners, architects, system designers and district heating providers in their efforts for the integration of DHC applications. Stakeholders face several economic challenges and risks and can benefit from the deliverables of this subtask.

Best practice examples will collect information on different system types already in operation. Moreover, the subtask will assist the other subtasks in the promotion and dissemination of their results.

Collaboration with Other IEA TCPs

The District Heating and Cooling including Combined Heat and Power Programme (IEA DHC) is officially collaborating with SHC Task 55 on a moderate level as defined by the IEA SHC.

Collaboration with Industry

18 companies are providing actively expertise to SHC Task 55. As most of them are not funded for the Task work their contribution is to highlight.

Several SDH installations have been built due to cooperations, which started during the Task meetings. As the SDH market is still a niche market, it's very important, that strategic business cooperations have been established amongst the Task Experts during the Task life time.

Task Duration

The Task started in September 2016 and will be completed in August 2020.

Participating Countries

Austria, Canada, China, Denmark, Finland*, France, Germany, Italy, Spain, Sweden, United Kingdom

*Through IEA DHC

Observer: The Netherlands

Work During 2019

Subtask A: Network Analyses and Integration

- Solar Energy into District Heating Networks was finalized and published on the Task 55 Homepage.
- Joined Workshop Summary of the Workshop 2018 in Graz (DHC Annex TS2 and SHC Task 55) was published on the SHC Task 55 and on the DHC Annex TS2 Homepage. A presentation of the joined workshop is available
- Final definition of the template for data collection and identification of the best practice examples (in synergy with Subtask D)
- Data collection from 9 of the identifies best practice examples (AIT, SOLITES, SOLID, Aalborg CSP, TU Chemnitz)
- The SWOT analysis was shared with the experts of IEA DHC|CHP TS2 and was further discussed in the Task 55 Workshop in Sweden, where it received some new inputs and all listed points were rated by all the participants, so that a ranking in order of importance is possible. The SWOT has been published on the Task 55 homepage
- Economic data (necessary input to evaluate or develop possible transformation strategies) of Danish solar district heating systems were collected (TNO/ECN)
- Forecast study "Evolution of the Austrian district heating and the role of solar thermal: scenarios for 2030" (AIT)
- First results from the H2020 project CHESTER about compressed heat storage for cross-sectoral integration of renewables (DLR)
- Simulation-based techno-economic evaluation of different large-scale heat storage sizes and configurations: tank, pit with trafficable/not-trafficable cover, with/without insulation, with/without groundwater flow barrier (UIBK)
- Development and validation of a numerical model in Dymola/Modelica for pit TES (AIT, UIBK)
- Results from Austrian project Urban-DH-extended: lessons learnt and guidelines for large-scale solar thermal and storage applications for DH
- Development of innovative business models for reducing return temperatures in DH networks (AIT)
- Progress on H2020 demonstration project TEMPO about temperature reduction in existing urban DH systems (AIT)
- Progress on simulation-based development of a fault detection and diagnostics algorithm for district heating systems (AIT)
- Implementation of a modular MILP-based Energy Management System for the operation of cross-sectoral energy systems in two real case studies + sensitivity analysis based on co-simulation for a new planned district (BE2020)

Subtask B: Components Testing, System Monitoring, and Quality Assurance

- Radiation model developed, which allows precise prediction of thermal output of collector arrays
- improved control of absorption heat pumping systems by means of model-based control approaches which explicitly consider the machine's dynamic operational behavior
- ISO 9806:2017 - collector test methods available
- First monitoring results TIBET installation
- Improved control of absorption heat pumping systems by means of model-based control approaches which explicitly consider the machine's dynamic operational behavior; mathematical modelling of a water/lithium bromide heat pumping system for control purposes

Subtask C: Design of the Solar Thermal System and of Hybrid Technologies

- First draft fact sheets from C.D1 "Simulation and design of collector array units within large systems":
 - C.D1.1: Long-term thermal performances of solar collector fields: Measured and calculated
 - C.D1.2: Solar radiation modelling on tilted surfaces based on global radiation
 - C.D1.3: Collector types for large collector fields: Thermal performance and control strategies
 - C.D1.4: CFD models of different collector types
- Draft fact sheets from C.D1 "Simulation and design of collector array units within large systems" have been revised by several experts
 - C.D1.1: Long-term thermal performances of solar collector fields: Measured and calculated
 - C.D1.2: Solar radiation modelling on tilted surfaces based on global radiation
 - C.D1.3: Collector types for large collector fields: Thermal performance and control strategies
 - C.D1.4: CFD models of different collector types
- Modelling of large-scale TES (thermal energy storages) results from project gigaTES are available as well as CFD based studies on the heat transfer in large TES

Subtask D: Promotion and dissemination of SDH/SDC and hybrid technologies in new markets

- D-D1 is completed
- D-D2 is completed: The investor brochure was published in November 2019 (<http://task55.iea-shc.org/publications>). Moreover, info charts were published and are available online (<http://task55.iea-shc.org/>)
- D-D3: For the best practice installations there are 15 out of 20 draft factsheets finished
- D-D4: Number of new Country reports (Austria, Canada, Denmark, France, Germany, and The Netherlands)
- D-D4: Drafts of factsheets of the country reports for Denmark, The Netherlands, France, and Austria are finished and in review.
- D-D5: For the handbook the responsible partner Sunrain did not provide any information.
D-D5: CEA Ines is developing a calculation tool for renewable heat production installations. A first version is finished in French and will be available in English in the end of 2019.
- Follow up Task: At the 6th Task meeting in April 2019 a brainstorming for collecting follow up Task topics has been done.
- Follow up Task: At the 7th Task meeting in October 2019 a second brainstorming for collecting follow up Task topics has been done. Next step → clustering of the topics and discuss the first structure at the last TASK meeting in 2020; Challenging is that in ECES and DHC similar topics are currently discussed.
- WIKI on solar district heating by Richard Hall /UK ExCo)
https://wiki.energytransitions.uk/wiki/Solar_Heat_Networks

Work Planned For 2020

Subtask A: Network Analyses and Integration

- A-D1: Collection of the missing data to finalize A-D1.2, work on A-D1.3
- A-D2: Collect and analyze more transformation strategies - From Partners and from literature
- A-D3: leader to be defined – possible contribution or even leadership from Gunnar Lennermo, as alternative, A-D3 will flow into Subtask C

Fact sheets in preparation:

- A-D1.2: Except for some systems, data is under collection
- A-D2.2: Final version of SWOT analysis
- A-D3: Fact sheets in preparation
- A-D4: Fact sheets in preparation

Subtask B: Components Testing, System Monitoring, and Quality Assurance

Heat pump controls

- Adjustments of model complexity (according to application)
- Development of a dynamic model for ammonia/water absorption heat pumping systems
- Development of model-based control strategies for both systems

Fact sheets in preparation:

- B-D1. Fact sheet preparation on In-situ collector array testing starts
- B-D2. Fact sheet based on the proposed new ISO Standard will a practical guide line how to use the standard for checking collector field performance. Will be elaborated towards the end of the ISO drafting period – so towards the end of this task.
- B-D3. Fact sheet preparation in connection with A-D4 starts

Subtask C: Design of the Solar Thermal System and of Hybrid Technologies

- C-D2. Update of Task 45 Fact Sheet (SOLITES)
- C-D2. Elaborate first initial draft Fact Sheet on “Survey on storage models?” OR “Innovations in design and operation of seasonal storages for urban energy systems?” (AIT)
- C-D2. Update Task 45 storage Fact Sheets (PlanEnergi, Canmet)
- C-D2. Final versionsofFact Sheets on CFD modelling of pit and tank storages (DTU, Chemnitz)
- C-D2. Report on Survey of storage models (AIT)
- C-D3. Final fact sheet on: “Thermal and hydraulic investigation of large-scale solar collector field” (Chemnitz).
- C-D3. Final fact sheet on: “Investigations of the influence of (partial) shading on flow distribution and thermal performance of solar collector fields (AEE-INTEC).
- C-D3. Updates of the Task 45 on hydraulics and piping Fact Sheets “45.A.2 Requirements & guidelines for collector loop installation” (AEE-INTEC, AT)
- C-D3. Elaborate a first draft fact sheet on “Modular Conception and construction” (SOLID)

Fact sheets in preparation:

- C-D2. Updated of Task 45 Fact Sheet “Seasonal thermal energy storage - Report on state of the art ...” (SOLITES)
- C-D2. Fact Sheet on “Survey on storage models?” OR “Innovations in design and operation of seasonal storages for urban energy systems?” (AIT)
- C-D2.1 Updated Task 45 storage Fact Sheets (PlanEnergi, Canmet)
- C-D2.3-5. Fact Sheet on CFD modelling of pit and tank storages (DTU, Chemnitz)
- C-D2. Fact Sheet on Survey of storage models (AIT)
- C-D3. Fact Sheet on: “Thermal and hydraulic investigation of large-scale solar collector field” (Chemnitz).
- C-D3.? Fact sheet on: “Investigations of the influence of (partial) shading on flow distribution and thermal performance of solar collector fields (AEE-INTEC).
- C-D3. Updates of the Task 45 Fact Sheets on hydraulics and piping Fact Sheets “45.A.2 Requirements & guidelines for collector loop installation” (AEE-INTEC, AT)
- C-D3. Fact Sheet on “Modular Conception and construction” (SOLID)

Subtask D: Promotion and dissemination of SDH/SDC and hybrid technologies in new markets

- D-D1 Factsheet on business Models of Solar Thermal and Hybrid Technologies will be reviewed by the experts and published in spring 2020D-D3: Best practice examples factsheet will be reviewed and finalized until the end of the task.
- D-D4: Fact sheet for country reports will be reviewed and finalized until the end of the task.
- D-D5: For the handbook the responsible partner Sunrain did not provide any information.
- D-D5: Publication of fact sheet about the pre-feasibility study tool EnRSIM.

Fact sheets in preparation:

D-D1: Factsheet almost completed and will be published in the end of 2019 or in the beginning of 2020

D-D2: Investor brochure is published

D-D3: Best practice examples factsheet in preparation, first drafts in review

D-D4: Fact sheet for country reports in preparation, first drafts in review

D-D5: Fact sheet about the existing handbook is in preparation

Dissemination Activities In 2019

Reports, Published Books

<i>Author / Editor</i>	<i>Title</i>	<i>Bibliographic Reference</i>
Sabine Putz	6 th Task 55 semi-annual Status Report	
Sabine Putz	7 th Task 55 semi-annual Status Report	
Sabine Putz	Task 55 Annual Report 2019	
Sabine Putz	Task 55 Highlights 2019 Report	
Richard Hall (ExCo UK)	Report Solar Academy Training in March 2019	
Bärbel Epp, Task 55	Task 55 Investor Brochure	

Journal Articles, Conference Papers, etc.

<i>Author(s)</i>	<i>Title</i>	<i>Publication / Conference</i>	<i>Bibliographic Reference</i>
Abdulrahman Dahash, Fabian Ochs, Michele Bianchi Janetti, Wolfgang Streicher	Advances in seasonal thermal energy storage for solar district heating applications: A critical review on large-scale hot-water tank and pit thermal energy storage systems	Applied Energy	Vol. 239, pp. 296-315, 2019
Abdulrahman Dahash, Fabian Ochs, Wolfgang Streicher	Large-Scale Thermal Energy Stores	Submitted to Energy and Buildings	Energy and Buildings Journal
Bärbel EPP	GBD 320 million for low carbon heat networks	Solarthermalworld.org	https://www.solarthermalworld.org/news/gbp-320-million-low-carbon-heat-networks
Bärbel EPP	Combining the strengths of the collector technologies	Solarthermalworld.org	https://www.solarthermalworld.org/news/combining-strengths-collector-technologies
Bärbel EPP	Sun meets 90% of district heating demand in Tibetan town	Solarthermalworld.org	https://www.solarthermalworld.org/news/sun-meets-90-district-heat-demand-tibetan-town
Bärbel EPP	Seasonal pit heat storage: Cost benchmark of 30€/m ³	Solarthermalworld.org	https://www.solarthermalworld.org/news/seasonal-pit-heat-storage-cost-benchmark-30-eurm3

Bärbel EPP	1 GW - Danish SDH market reaches new milestone	Solarthermalworld.org	https://www.solarthermalworld.org/news/danish-sdh-market-reaches-new-milestone
Richard Hall	SDH WIKI		https://wiki.energytransitions.uk/wiki/Solar_Heat_Networks
Bärbel Epp, IEA SHC Task 55	Solar Heat for Cities - the sustainable solution for district heating	Brochure, November 2019	http://task55.iea-shc.org/publications
Aurelien Bres	Fault detection in building installations	TEMPO workshop 'New digital solutions for lower temperatures', November 2019, Brescia, Italy	
Hamid Aghaie	The role of solar thermal in the Austrian district heating – Scenarios for 2030	Sustainable District Energy Conference, October 2019, Reykjavik, Iceland	
Paolo Leoni, Roman Geyer, Ralf-Roman Schmidt	Developing innovative business models for reducing return temperatures in district heating systems: approach and first results	5th International Conference on Smart Energy Systems, September 2019, Copenhagen, Denmark	
Aurelien Bres, Christian Johansson, Roman Geyer, Paolo Leoni, Johan Sjögren	Coupled Building and System Simulations for Detection and Diagnosis of High District Heating Return Temperatures	Building Simulation 2019: 16th Conference of IBPSA, September 2019, Rome, Italy	
Daniel Tschopp	Project MeQuSo	Connexio: „Symposium Solarthermie und innovative Wärmesysteme“, May 2019, Bad Staffelstein, Germany	

Conferences, Workshops, Seminars

Conference / Workshop / Seminar Name	Activity & Presenter	Date & Location	# of Attendees	If Task Hosted: Organized with, # participants
Solar Academy Webinar Task 55	Task Experts: Karin Rühling, TU Dresden; Sabine Putz, SOLID; Jan-Erik Nielsen, PlanEnergi; Lucio Mesquita, NRCAN; Jianhua Fan, DTU	21th of March 2019	267 attended; Registered: 586	Link
SDH/Task 55 Workshop UK	Task Experts Jan-Erik Nielsen and Christian Holter	8 th of March 2019	50 due to room limitation	LINK
IEA Solar Heating and Cooling Research Co-operation; Workshop in the Austrian Ministry; Presentation on TASK 55 results	OA Sabine Putz	5 th of June 2019, Vienna, Austria	Approx.. 100	-
District Heating of the Future Workshop	Joakim Byström, ABSOLICON; OA Sabine Putz	9 th of October 2019, Härnösand, Sweden	33 (including Swedish DH utilities)	LINK
SWC/SHC Conference 2019 – Task 55 keynote speech	Sabine Putz	5 th of November 2019, Santiago de Chile	Approx.. 200	
Renewable Heat for Heat networks Conference	Richard Hall (UK ExCo) and task experts: Grant Feasey, Christian Holter, Magdalena Kowalska, Renaldi Renaldi	4 th of December 2019, London, UK	120 due to room limitation	

Dissemination Activities Planned For 2020

- Task 55 Transfer Workshop (half day side event) at ISEC 2020 - 2nd International Sustainable Energy Conference, 14 – 16 October 2020
- 6 - 9 September 2020 “17th International Symposium for District Heating and Cooling” in Nottingham, UK, <http://dhc2020.uk/>

Task Meetings in 2019 and Planned for 2020

Meeting	Date	Location	# of Participants (# of Countries)
Experts Meeting	8 - 10 March 2019	Almeria, Spain	29 (11)
Experts Meeting	7 - 9 October 2019	Härnösand, Sweden	18 (11)
Workshop District Heating of the Future	9 October 2020	Härnösand, Sweden	33 (7)
Final Experts Meeting	26 – 28 May 2020	Stuttgart, Germany	

SHC Task 55 Participants

Country	Name	Institution / Company	Role
Austria	Christian Engel	Thermaflex Int Holding	National Expert
Austria	Christian Fink	AEE – Institute for Sustainable Technologies	National Expert
Austria	Christian Holter	SOLID	National Expert
Austria	Carles Ribas Tugores	AEE – Institute for Sustainable Technologies	National Expert
Austria	Daniel Tschopp	AEE – Institute for Sustainable Technologies	National Expert
Austria	Daniel Muschick	BIOENERGY 2020+ GmbH	National Expert
Austria	Fabian Ochs	University of Innsbruck	National Expert
Austria	Georg Engel	AEE INTEC	National Expert
Austria	Georg Sima	MGR GEORG SIMA E.U.	National Expert
Austria	Ingo Leusbrock	AEE INTEC	National Expert
Austria	Moritz Schubert	SOLID	National Expert
Austria	Markus Gölles	Bioenergy 2020+ GmbH	National Expert
Austria	Peter Luidolt	SOLID	National Expert
Austria	Philip Ohnewein	AEE INTEC	National Expert
Austria	Patrick Reiter	SOLID	National Expert
Austria	Paolo Leoni	AIT	National Expert
Austria	Ralf-Roman Schmidt	AIT/Austrian Institute of Technology	Subtask A Leader
Austria	Viktor Unterberger	Bioenergy 2020+ GmbH	National Expert
Austria	Werner Doll	SOLID	National Expert
Austrian	Christian Holter	SOLID	National Expert
Austrian	Sabine Putz	SOLID	OA
Canada	James Bererton	Naked Energy	National Expert
Canada	Ken Guthrie	SHC Chair	National Expert
Canada	Lucio Mesquita	CanmetENERGY	National Expert
China	Jianhua Fan	Technical University of Denmark	National Expert
China	Youjin Xu	Tongji university	National Expert

China	Aaron Feng Gao	Arcon-Sunmark Large-scale Solar Systems Integration Co., Ltd,	National Expert
China	Liu MU	Vicot Solar Technology Co., Ltd	National Expert
China	Qingtai Jiao	Jiangsu Sunrain Solar Energy Co., Ltd	Subtask B Leader
China	Kaichun Li	Jiangsu Sunrain Solar Energy Co., Ltd	National Expert
China	Shai Li	Jiangsu Sunrain Solar Energy Co., Ltd	National Expert
China	Zheng Wei	Yazaki Energy System Corporation	National Expert
Denmark	Lars Munkoe	Purix	National Expert
Denmark	Andreas Zourellis	Aalborg CSP	National Expert
Denmark	Bengt Perers	Technical University of Denmark	National Expert
Denmark	Christian Kok Nielsen	PlanEnergi	National Expert
Denmark	Jan Birk	Arcon Sunmark	National Expert
Denmark	Jakob Jensen	Heliac	National Expert
Denmark	Jes Donneborg	Aalborg CSP	National Expert
Denmark	Jan Erik Nilsen	PlanEnergi	Subtask C Leader
Denmark	Jianhua Fan	Technical University of Denmark	National Expert
Denmark	Junpeng Huang	Technical University of Denmark	National Expert
Denmark	Povl Frich	Danish Energy Agency	National Expert
Denmark	Simon Furbo	Technical University of Denmark	National Expert
Denmark	Zhiyong Tian	Technical University of Denmark	National Expert
Finland	Kaj Pischow	Savo-Solar Oy	National Expert
Finland	Morten Hofmeister	Savo-Solar Oy	National Expert
France	Alexis Gonnelle	New Heat Directeur technique / CTO	National Expert
France	Cedric Paulus	CEA/INES	National Expert
France	Nicolas Lamaison	CEA/INES	National Expert
France	Paul Kaaijk	Ademe	National Expert
France	Pierre Delmas	New Heat Directeur technique / CTO	National Expert
Germany	Axel Gottschalk	Bremerhaven University of Applied Sciences	National Expert
Germany	Magdalena Berberich	Solites	Subtask D Leader
Germany	Dominik Bestenlehner	ITW/TZS University of Stuttgart	National Expert
Germany	Detlev Seidler	SOLID	National Expert
Germany	Dan Bauer	DLR	National Expert
Germany	Dominik Bestenlehner	IGTE University of Stuttgart	National Expert
Germany	Bärbel Epp	Solrico	National Expert
Germany	Andrej Jentsch	Operating Agent DHC	National Expert
Germany	Karin Rühling	TU Dresden	National Expert
Germany	Korbinian Kramer	Fraunhofer ISE	National Expert
Germany	Roman Marx	ITW University of Stuttgart	National Expert
Germany	Nirendra Lal Shrestha	Technische Universität Chemnitz	National Expert
Germany	Norbert Rohde	KBB Kollektorbau GmbH	National Expert
Germany	Stefan Mehnert	ISE	National Expert
Germany	Sven Fahr	Fraunhofer ISE	National Expert
Germany	Thorsten Urbanek	TU Chemnitz	National Expert
Italy	Luca Degiorgis	Politecnico di Torino	National Expert
Italy	Marco Calderoni	Polimi	National Expert

Italy	Roberto Fedrizzi	Eurac Research	National Expert
Italy	Marco Scarpellino	TVP Solar	National Expert
Netherlands	Luuk Beurskens, L.W.M.	ECN-TNO	National Expert
Netherlands	Ruud Vandenbosch	Ecovat	National Expert
Poland	Armen Jaworski	Cim-Mes	National Expert
Spain	Ana Lazaro	University of Zaragoza	National Expert
Spain	Andoni Diazdemendibil	Tecnalia	National Expert
Spain	Carol Pascual	Tecnalia	National Expert
Spain	Javier Mazo	University of Zaragoza	National Expert
Spain	Miguel Lozano	University of Zaragoza	National Expert
Spain	Patricio Aguirre Múgica	Tecnalia	National Expert
Spain	Luis M. Serra	University of Zaragoza	National Expert
Sweden	Joakim Byström	Absolicon Solar Collector AB	National Expert
Sweden	Josefine Nilsson	Absolicon Solar Collector AB	National Expert
Sweden	Gunnar Lennermo	Energianalys AB	National expert
Sweden	Klaus Lorenz	Dalarna University	National Expert
Sweden	Peter Kjellgren	Absolicon Solar Collector AB	National Expert
Switzerland	Vittorio Palmieri	TVP Solar	National Expert
The Netherlands	Luuk Beurkens	ECN-TNO	National Expert
United Kingdom	Eamon Clarke	Kingspan Environmental Ltd.	National Expert
United Kingdom	Finbarr McCarthy	Kingspan Environmental Ltd.	National Expert
United Kingdom	Martin Crane	Carbon Alternatives Ltd	National Expert
United Kingdom	Richard Hall	Energy Transition	ExCo
United Kingdom	Gunnar Lennermo	Energianalys AB	National Expert
United Kingdom	Joshua King	AES Solar	National Expert