

Legal text for Annex 52

Long-term performance measurement of GSHP systems serving commercial, institutional and multi-family buildings

1. Background

Measured long-term performance data for ground source heat pump systems serving commercial, institutional and multi-family buildings are rarely reported in the literature. Energy use intensity figures are occasionally published, but as they necessarily lump the building loads and the system performance together, they are of limited usefulness in understanding real-world system performance.

Carefully instrumented long-term measurement and analyzed system performance data from recently installed GSHP systems of various sizes and types, or of GSHP systems that have been in operation for a longer period of time, are rare but highly valuable tools for researchers, practitioners and buildings owners. Such measurements help to show how the various system components and control strategies affect the overall performance, to identify best practices, design and installation issues that lead to poor performance and to give guidance on how unanticipated consequences of the design be partially or totally avoided.

The focus of the proposed annex is performance measurement of GSHP systems serving commercial, institutional and multi-family buildings. These buildings may, for example, have:

- Multiple heat pumps, which may be part of a central heating and cooling plant or be distributed throughout the building(s).
- Water-to-water (brine-to-brine), or water-to-air heat pumps.
- Depending on the above two items, a separate distribution system for heating and cooling may be needed, or the distribution system may only involve attaching ductwork to the distributed water-to-air heat pumps.
- Heating and cooling, with the cooling often being predominant for commercial and institutional buildings. Furthermore, heating and cooling may be provided simultaneously to different parts of the building, either by using both sides of the heat pump, or with some heat pumps providing heating and others cooling. In some cases, cooling or pre-heating may be provided directly by the boreholes without the aid of heat pumps (so-called free-cooling).
- In addition to the ground heat exchanger made up of multiple boreholes or doublets etc., complementary heat sinks or sources (e.g. cooling towers, fluid coolers, solar collectors) may be utilized, forming what is sometimes called a hybrid GSHP system.
- A range of pumping/piping system designs using variable speed central circulation pumps, distributed circulation pumps, primary/secondary pumping, and two-pipe or one-pipe configurations.
- Control systems that affect flow rates in part-load conditions, operation of the auxiliary heat sink or source, and other aspects of the system operation.
- Standby electrical losses from control boards in the heat pumps, circulation pump variable-speed drives, Legionella protection and other components.
- Heat pumps sometimes operating with only the fan running to assist in distribution of outdoor air.



These variations in the system configuration add several degrees of complexity to analyses of seasonal performance factors. E.g. when the heat pumps are providing both heating and cooling, how is the electrical energy used by the central circulation pump allocated? How should the free-cooling amount be quantified? How do heat pump standby losses affect seasonal performance factors?

The EU project SEPEMO (Nordman 2012) defined heating and cooling seasonal performance factors (SPF) for residential heat pump systems with a range of boundary conditions. The final report noted that heat pump system performance depends not only on the heat pump, but also on the climate and quality of installation. While the SEPEMO project guidelines serve as an excellent starting point for GSHP systems serving commercial, institutional and multi-family buildings, they do not address fully all of the features that may be found in these systems. The results from the proposed annex will make possible both improvements to GSHP system performance and direct comparisons with other heating/cooling systems installed in similar buildings.

One example of measured performance of an office-building GSHP system leading to system performance factors is described by Southard et al. (2014a, 2014b). This study involved a detailed analysis of two heat pump systems at the ASHRAE Headquarters building in Atlanta – an air-source variable-refrigerant flow heat pump system and a ground-source heat pump system. Features of the study not seen in the SEPEMO study are quantified uncertainty of the performance factors and the relationship between system COP and outdoor air temperature.

Another aspect of this work is that the long-term performance measurements will generate quality data that may be used for development and validation of models of components (e.g. heat pump with integrated tanks, different types of tanks, borehole heat exchangers) as well as GSHP systems. Developing and validating models based on measured data will facilitate further optimization of GSHP systems.

IEA HPT Annex 44 "Performance indicators for energy efficient supermarket buildings" is looking specifically at the supermarket sector and aims to create key performance indicators and materials for benchmarking of energy efficient supermarket buildings. The annex covers all types of heat pumps, not only GSHPs, and is narrowly focused on supermarket applications, where refrigeration is often a dominant part of the energy consumption. Therefore, though there is the potential for some overlap, Annex 44 is highly complementary to the Proposed Annex.

The closed Annex 39 "A common method for testing and rating residential HP and AC/Seasonal performance" was focused on residential buildings and all kinds of heat pumps, not only GSHPs. Hence the Proposed Annex is complementary, and the results from Annex 39 may be built on to further develop the methods for commercial and institutional buildings and specifically for GSHP applications.

The closed Annex 40 "Heat Pump Concepts for Nearly Zero-Energy Buildings", and its successor, Annex 49 "Design and integration of heat pumps for nZEB", both aim specifically at use of all kinds of heat pumps in nZEB buildings, whereas the proposed Annex includes any kind of commercial building served by a GSHP system. Annexes 40 and 49 include field evaluation of nZEB, so the Proposed Annex may slightly overlap the two annexes. In formalizing the measurement and analysis methodologies, the Proposed Annex will complement Annexes 40 and 49.

Annex 50 "Heat Pumps in Multi-Family Buildings for space heating and DHW" aims to increase the use of heat pumps in multi-family buildings and its scope therefore lays outside the scope of the proposed Annex, even though some applications within Annex



50 may include GSHP systems, and may benefit from results from the proposed Annex regarding GSHP systems specifically.

The work within IEA TCP ECES and IEA Geothermal TCP relate to the proposed Annex and it may be possible to arrange collaboration between the TCPs. ECES has over the years provided several important annexes in the field of underground thermal energy storage (with or without heat pumps) with emphasis on the ground source and the storage process, which may also be included in the proposed Annex. Geothermal TCP has so far mainly been focused on deep geothermal resources, but its scope also includes low temperature sources connected to heat pumps, and may therefore offer opportunities to include case studies from different geological conditions. Geothermal TCP has also an on-going project related to geothermal energy statistics, in which one part is finding methods for estimating the energy uses through various GSHP system configurations. The Proposed Annex and the work within Geothermal may benefit from collaboration between the two TCPs.

The proposed Annex relates to the overall strategy of IEA and HPT by providing multinational consensus on how to measure, analyse and evaluate longterm performance of GSHP systems, thus advancing the energy technology within this field by facilitating further improvement of components, systems and operational strategies of GSHP systems. This fills an important gap in research and practice and will demonstrate good practice worldwide. Space heating, cooling, and air-conditioning technology will benefit from this work – other space heating, cooling, and air-conditioning systems can also benefit from the same measurement, analysis, and evaluation methods and procedures being developed in this annex. The bibliography and case study report will provide good examples and success stories from well functioning GSHP systems.

2. Description of technical sector; definitions

The technical sector targeted in this annex is primarily the commercial and institutional building sector, typically where both heating and cooling are needed, but other sectors such as the large building residential sector and the industrial building sector may also benefit from the outcomes of the annex. Improved model validation, component development and improvements in control- and monitoring systems will provide improvement on large GSHP systems in general.

The cooling and free-cooling aspects are increasingly important as buildings become better insulated and efficient. Instrumentation, monitoring and evaluation of the heat pumps and both the source and distribution sides of the GSHP system are included. Some case studies may have more detailed measurements for one portion of the system.

3. Objectives and scope

The proposed annex aims to survey and create a library of quality long-term measurements of GSHP system performance for commercial, institutional and multi-family buildings. All types of ground sources (rock, soil, groundwater, surface water) are included in the scope. While previous work will be surveyed, the emphasis of the annex will be on recent and current measurements. The annex also aims to refine and extend current methodology to better characterize GSHP system performance serving commercial, institutional and multi-family buildings with the full range of features shown on the market, and to provide a set of benchmarks for comparisons of such GSHP systems around the world.

In order to better characterize performance of GSHP systems serving commercial and institutional buildings, the guidelines provided by the SEPOMO project will be refined, extended to cover as many features listed in the Background section as possible, and



formalized in a guidelines document. This will be done in concert with measurement projects in the participating countries. Additional analysis procedures that help diagnose poor performance and opportunities for system performance improvements will also be investigated. Multiple case studies featuring GSHP system performance measurements for systems around the world will be included and these case studies will serve as reference sets for future benchmarking.

4. Means

The Participants shall share the coordinated work necessary to carry out the work required for this Annex. The objectives shall be achieved by the following task-sharing activities; scheduling and milestones are presented in Section 8:

Task 1. Long-term measurement case studies – new and previous

- An annotated bibliography covering past GSHP system performance studies will be prepared. As part of this work, a summary of benchmarking results will be developed.
- A report covering case studies of GSHP performance monitoring projects will be prepared. It is expected that each participant will provide at least one case study and some participants will provide more than one. As the projects will be at various stages of completion at the beginning of the annex, it is expected that the more complete projects will provide useful lessons learned and suggested improvements for the newer projects.

Task 2. Guide for instrumentation and measurement of GSHP systems

- A consensus on necessary instrumentation and monitoring (parameters, frequency, instrument quality, etc.) will be reached by the participants.
- A report (guideline document) on instrumentation and measurement of GSHP system performance will be published.

Task 3. Guide for analysis and reporting of GSHP system performance data

- A consensus on key parameters and analysis procedures for GSHP system performance monitoring will be reached.
- A report (guideline document) on analysis and evaluation reporting of GSHP system long-term performance will be published.

5. Target audience and benefits

The proposed annex will benefit researchers, building owners, installers and manufacturers by providing high quality measured performance data that can be used for further research, validation of simulation models, and testing of control strategies.

It will provide useful guidelines for instrumentation and data logging, optimization strategies and quality control and give valuable feed-back on system components and instrumentation which may lead to further product development.

The collection of results from the measurement projects will also serve as a useful set of benchmarks for comparisons of other systems in the future.

Society will benefit from the proposed annex as optimized GSHP performance minimizes CO₂-emissions and increases the utilization of local and renewable energy resources.

IEA will benefit from improved and verified methods for collecting operational data and determining performance of GSHP systems. This will also facilitate collection of more accurate and uniform statistics, and thus help estimating how much energy we can



produce and how much CO₂ emissions we can reduce with GSHP systems with a lower uncertainty.

6. Deliverables

The compulsory deliverables of the Annex are:

- Final report of the Annex according to template
- A public Annex Website as a subsite to the HPC website
- Progress reports to ExCo meetings according to template, once a year oral (focusing on results, achievements and/or success stories) and twice a year management reports
- Short status report to the HPC two to four times annually for publication in the Newsletter/Magazine, focusing on results, achievements and/or success stories
- One article per year, topical or non-topical, to the HPC Newsletter/Magazine
- Report to the HPT Annual report
- Text and pictures to a 2-page popular scientific summary of Annex results to be freely disseminated

Further deliverables of the Annex are:

- *Technical deliverables*: Improved energy efficiency and system performance
- *Economic deliverables*: Cost effective instrumentation, and energy and cost savings from optimizing GSHP systems.
- *Environmental deliverables*: Optimized GSHP systems result in decreased CO₂-emissions.
- *Reports*: Subtask reports and case studies. Annotated bibliography. Guidelines for instrumentation and calculation of performance data for GSHP systems. Reports from annex workshops.
- *Articles in newsletters and magazines* such as GeoOutlook and possibly ASHRAE Journal, Rehva HVAC Journal, Swedish Center of Geoenergy newsletters, Svensk Geoenergi, KylaVärme etc.
- *Conference papers and journal papers* written by involved researchers.
- *Reference data* sets can be made available with journal papers (on the publisher's website) and/or on the annex web pages.

7. Funding

(a) Working Meetings. The working meetings shall be hosted in turn by the several Participants. The costs of organizing and hosting meetings shall be borne by the host Participant.

(b) Publications: The cost of publishing the Final Report and summary assessments described in paragraph 6 above shall be equally shared by all the Participants.

(c) Individual Financial Obligations. Each Participant shall bear all the costs incurring in carrying out the Task activities, including reporting and travel expenses. Additionally, each Participant shall make a direct financial contribution to the Operating Agent to cover co-ordination and report preparation expenses and other Annex-related (e.g. Workshop) costs.

The table below shows the fees per participating country, based upon varying numbers of participating countries. Each Participant's fee shall be paid in one annual instalment.



No of part.	Participants' fees			
	2018	2019	2020	2021
3	6 500 EUR	6 500 EUR	6 500 EUR	6 500 EUR
4	5 000 EUR	5 000 EUR	5 000 EUR	5 000 EUR
5	4 000 EUR	4 000 EUR	4 000 EUR	4 000 EUR
6	3 500 EUR	3 500 EUR	3 500 EUR	3 500 EUR
7	3 000 EUR	3 000 EUR	3 000 EUR	3 000 EUR
8	2 700 EUR	2 700 EUR	2 700 EUR	2 700 EUR
9	2 400 EUR	2 400 EUR	2 400 EUR	2 400 EUR
10	2 200 EUR	2 200 EUR	2 200 EUR	2 200 EUR

8. Time schedule

It is proposed that this Annex be conducted over a period of 48 months to begin January 1 2018. We expect to have projects at a range of different stages at the beginning of the Annex work, roughly categorized as follows:

- Stage III: Project instrumentation, data collection, and analysis are essentially complete. Some further analysis may be done, but the primary contribution of these projects will be to provide benchmarking data, lessons learned, and a case study chapter.
- Stage II: Project instrumentation is complete, data collection has begun, but analysis has not been completed and additional data collection may be needed.
- Stage I: Project instrumentation is underway, data collection has not begun.

The different project stages are reflected in the milestone schedule.

The project tasks and milestones are scheduled as follows:

Year	2018				2019				2020				2021			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Expert Meeting	1	2	3	4	5	6	7	8								
Start-up meeting and preparations																
Subtask 1 Long-term measurement case studies																
Subtask 2 Guide for instrumentation and measurement of GSHP systems																
Subtask 3 Guide for analysis and reporting of GSHP system performance data																
Final Report																



Year	2018				2019				2020				2021			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Expert Meeting	1	2	3	4	5	6	7	8								
1.1 Preliminary annotated bibliography.		X														
1.2 Completed annotated bibliography.																
1.3 Case study chapters for Stage III projects				X												
1.4 Case study chapters for Stage II projects							X									
1.5 Case study chapters for Stage I projects											X					
1.6 Complete case study report													X			
1.7 Updated annotated bibliography.													X			
2.1 Draft guide on instrumentation and monitoring of GSHP systems								X								
2.2 Final guide on instrumentation and monitoring of GSHP systems												X				
3.1 Draft guide for analysis and reporting of GSHP system performance data								X								
3.2 Final guide for analysis and reporting of GSHP system performance data												X				
Final Report																X

9. Specific obligations and responsibilities of the participants

- (a) Each Participant shall nominate a representative to participate in the work under this Annex.
- (b) Each Participant shall carry out a minimum of three total person months per year or equivalent of task-sharing work during the programme period *unless otherwise agreed by the Participants*.
- (c) Each Participant shall contribute to the working meetings and to a workshop on the results achieved through the activities conducted under this Annex, including the identification of speakers and participants.
- (d) Each Participant shall make a direct financial contribution to the Operating Agent to cover co-ordination and report preparation expenses and other Annex related (e.g. Workshop) costs.
- (e) Each Participant shall contribute by collecting and analysing published references for the annotated bibliography on GSHP system performance monitoring, and by providing a minimum of one case study with monitoring and measurement data to be analysed by the Participant during the Annex

10. Specific obligations and responsibilities of the Operating Agent

The Operating Agent shall:

- (a) Develop, in co-operation with the Participants, a detailed work programme, a framework for the Final Country Report and a budget for all the activities carried out under this Annex, including methodology and time schedule
- (b) Provide the Executive Committee with periodic reports describing the progress of the work being accomplished under the Annex, once a year oral (focusing on results, achievements and/or success stories) and twice a year a management report.



- (c) Deliver the results as described in Section 6
- (d) Provide to the Executive Committee, within six months after completion of all work under the Task, a Final Report for its approval and transmittal to the Agency
- (e) In co-ordination with the Participants, use its best efforts to avoid duplication with activities of other related programs and projects implemented by or under the auspices of the Agency or by other competent bodies
- (f) Provide the Participants with necessary guidelines for the work they carry out, assuring minimum duplication of effort
- (g) Co-ordinate the efforts of all Participants and ensure the flow of information within the Task
- (h) Co-ordinate the work to ensure the compulsory deliverables to the HPC Newsletter/Magazine and to the website
- (i) Provide general administration

The IEA Heat Pump Centre will assist in the establishment of the Annex. Thereafter, the Heat Pump Centre will follow the Annex to check that the routines are followed, that the status and progress reports are delivered in due time and the quality of them. They will also assist the OA in the publication of the final reports and compilation of the summary in the end of the Annex. Therefore, it is the responsibility of the OA to follow the instructions of Heat Pump Centre.

11. Information and Intellectual property

- (a) *Executive Committee's Powers.* The publication, distribution, handling, protection and ownership of information and intellectual property arising from this Annex shall be determined by the Executive Committee, acting by unanimity, in conformity with this Annex.
- (b) *Right to Publish.* The Participants shall have the right to publish information provided to or arising from their Task, except for proprietary information, as defined in paragraph (c) below.
- (c) *Proprietary Information.* For the purposes of this Annex, proprietary information shall mean information of a confidential nature such as trade secrets and know-how (for example, computer programmes, design procedures and techniques, chemical compositions of materials, or manufacturing methods, processes or treatments) which is appropriately marked provided that such information:
 - (1) Is not generally known or publicly available from other sources
 - (2) Has not previously been made available by its owner(s) to others without obligation concerning its confidentiality; and
 - (3) Is not already in the possession of the recipient Participant(s) without obligation concerning its confidentiality.

It shall be the responsibility of each Participant supplying proprietary information, and of the Operating Agent, to identify such information as proprietary and to ensure that it is appropriately marked.



The Participants and the Operating Agent shall take all necessary measures in accordance with this paragraph, the laws of their respective countries and international law to protect the proprietary information provided to or arising from this Task.

(d) *Production of Relevant Information by Governments.* The Operating Agent should encourage the governments of all Agency Participating Countries to make available or identify to the Operating Agent all published or otherwise freely available information known to them that is relevant to the Task.

(e) *Production of Relevant Information by Participants.* Each participant agrees to provide to the Operating Agent all previously existing information, and information developed independently of the Task, which can assist or is needed by the Operating Agent to carry out its functions in this Task, which is freely at the disposal of the Participants, and the transmission of which is not subject to any contractual and/or legal limitations, under the following conditions:

- (1) The Participant will make such information available, at its own costs, provided that such costs are not substantial
- (2) If substantial costs are necessary for the Participant to make such information available, the Operating Agent and all Participants will determine the charge of the costs for each participant, upon approval of the Executive Committee.

(f) *Use of Confidential Information.* If a Participant has access to confidential information which would be useful to the Operating Agent in carrying out the studies, assessments, analysis or evaluations described in this Annex, such information may be communicated to the Operating Agent but shall not become part of any report or other form of documentation issued as part of this Task, nor shall it be communicated to the other Participants, except as may be agreed between the Operating Agent and the Participant who supplies such information. This information has to be marked clearly as “confidential”.

(g) *Acquisition of Information for the Task.* Each Participant shall inform the Operating Agent of the existence of information that can be of value to the Task, but which is not freely available, and each Participant shall endeavour to make such information available to the Task under reasonable conditions, in which event the Executive Committee may, acting unanimity, decide to acquire each information.

(h) *Reports on Work Performed under the Task.* The Operating Agent shall prepare reports on all work performed under the Task and the result thereof, including studies, assessments, analysis, evaluations and other documentation, but excluding proprietary information, in accordance with paragraph 11(c) above.

(i) *Copyright.* The Operating Agent, or each Participant for its own results, may take appropriate measures necessary to protect copyrightable material generated under this Task. Copyright obtained shall be the property of the Operating Agent, for the benefit of the Participants provided, however, that Participants may reproduce and distribute such material, but shall not publish it with a view to profit, except as otherwise provided by the Executive Committee.

The Contracting Parties understand and agree that the name, acronym and emblem of the IEA has been notified to the World Intellectual Property Organisation (WIPO) Secretariat according to Article 6 of the Paris Convention for the Protection of Industrial Property, as



amended on 28 September 1979. The Contracting Parties further understand and agree that the OECD/IEA shall retain the copyright to all IEA deliverables, materials or publications published or to be published by the IEA or jointly by the IEA and a third party to this Annex. Should the Contracting Parties use any such deliverables, materials or publications they shall give full acknowledgement to the OECD/IEA as being the source of the material with a copyright notice in the following form: © OECD/IEA, (year of publication).

(j) Authors. Each Participant shall, without prejudice to any rights of authors under its national laws, take necessary steps to provide the co-operation from its authors required to carry out the provisions in this paragraph. Each Participant shall assume the responsibility to pay awards or compensation required to be paid to its employees according to the laws of its country.

12. Operating Agent

Sweden (The Swedish Center for Geoenergy), is designated as Operating Agent. The Swedish Center for Geoenergy is a body for knowledge on geoenergy technology and GSHP systems. The main task is to gather and disseminate information related to geoenergy and GSHP systems, and follow up on national and international research. The center works in close contact with contractors, industry and academia.

Contact information for the Operating Agent:

Name	Signhild Gehlin
Affiliation	The Swedish Center for Geoenergy
Postal address	P.O. Box 1127, SE-22104 Lund, SWEDEN
Telephone number	+46-(0)75-700 88 20
E-mail address	signhild@geoenergicentrum.se

13. Participants in this Annex

The Contracting Parties within TCP HPT which are Participants in this Task are the following:

(Anticipated participating countries are highlighted in green. Countries that have expressed interest but not confirmed participation are highlighted in blue.)

Organisation	Country
The Federal Ministry of Transport, Innovation and Technology <i>Bundesministerium für Verkehr, Innovation und Technologie (bmvit)</i>	Austria
	Belgium
Natural Resources Canada	Canada
Danish Technological Institute	Denmark
TEKES	Finland
Ademe	France
Forschungszentrum Jülich GmbH	Germany
Italian National Research Council	Italy
New Energy and Industrial Technology Development Organization	Japan
The Ministry of Trade Industry and Energy (MOTIE)	South Korea
NL Agency	Netherlands
ENOVA SF	Norway
The Swedish National Energy Administration	Sweden

The Swiss Federal Office of Energy	Switzerland
Department of Energy & Climate Change (DECC)	United Kingdom
Department of Energy	USA

14. Research organisations participating in this Annex

(Anticipated participating organisations are highlighted in green. Organisations that have expressed interest but not confirmed participation are highlighted in blue.) Membership in TCPs are indicated with H for HPT, E for ECES and G for Geothermal.

Organisation, Name, address and website	Contact person, phone and e-mail	Country	Annex NT leader (Y/N)
The Swedish Center for Geoenergy Box 1127 SE-22104 Lund SWEDEN www.geoenergicentrum.se	Signhild Gehlin +46-(0)75 700 88 20 signhild@geoenergicentrum.se	Sweden ^{HE}	
KTH	José Acuña	Sweden ^{HE}	
Chalmers/LTH	Saqib Javed	Sweden ^{HE}	
GroenHolland	Henk Witte	Netherlands ^{HE}	
Vlaamse Confederatie Bouw	Bertrand Waucquez	Belgium ^{HE}	
Boydens	Wim Boydens	Belgium ^{HE}	
KU Leuven	Lieve Helsen	Belgium ^{HE}	
OSU	Jeffrey D Spitler	USA ^{HEG}	
ORNL	Xiaobing Liu	USA ^{HEG}	
VIA University College	Henrik Bjørn	Denmark ^{HE}	
University of Leeds	Simon Rees and Fleur Loveridge	UK ^{HG}	
EIFER	Roman Zorn	Germany ^{HEG}	
Fraunhofer	Franziska Bockelmann	Germany ^{HEG}	
Polytechnique Montréal	Michel Bernier	Canada ^{HE}	
HEIG-VD	Daniel Pahud	Switzerland ^{HG}	
CMR	Kirsti Midttomme	Norway ^{HEG}	
NTNU	Randi Ramstad Kalskin	Norway ^{HEG}	
NTNU	Jorn Stene	Norway ^{HEG}	

Participation is open for 24 months after this legal text is approved.

15. Cooperation with other IEA TCPs

The Proposed Annex is well suited for collaboration between HPT, ECES and Geothermal. All three TCPs will benefit from the work and outcomes from the Proposed Annex.

The cooperation will be organized as follows:

- HPT is the leading TCP of the Proposed Annex, and the Annex will be run according to HPT regulations.
- Status and progress of the Proposed Annex will be regularly reported to the ExCos of HPT, ECES and Geothermal



(c) The Operating Agent of the Proposed Annex is connected to HPT. ECES and Geothermal will each nominate one “Sub-Agent” that is the person responsible for the coordination between the TCP and the Operating Agent, as well as reporting to the ECES and Geothermal ExCos.

(d) Countries that are members of HPT, ECES or Geothermal are welcome to participate in the Proposed Annex on the same conditions, as stated in this Legal Text. These conditions include payment of operating agent fees.

16. Geothermal and ECES partners co-operating with this Annex

(Anticipated participating organisations are highlighted in green. Organisations that have expressed interest but not confirmed participation are highlighted in blue.)

Organisation, Name, address and website	Contact person, phone and e-mail	Country	TCP
Geo-Future GmbH	Katharina Link	Switzerland	Geothermal
Korea Institute of Geoscience and Mineral Resources (KIGAM)	Yoonho Song	South Korea	Geothermal