Request for Extension of Annex 54

Heat Pump Systems with Low GWP Refrigerants

1. Background

ANNEX54 started in January 2019 to promote the application of low-GWP refrigerants for accelerating the phase-down of high-GWP HFCs. When the IEA-HPT executive committee approved ANNEX54 in 2018, one feedback was to provide an annual report while considering the development stage of this important topic, the application of low-GWP refrigerants. After operating ANNEX54 activities for the last two years, we realized that current ANNEX54 activities do not cover the entire scope of low-GWP refrigerant applications to achieve our original objectives. Then one of the current participating members suggested the extension in early 2021. After the email survey of the extension, seven participating member countries agreed while one hold up a decision.

2. Extension

This document provides a revised scope and activity plan for the extension period and the clarification of the operating agent fee.

2.1 Objectives and Scope

Our objectives remain the same as follows:

- Promoting the application of low-GWP refrigerants to accelerate phase-down of high-GWP HFCs
- Developing design guidelines of optimized components and systems for low-GWP refrigerants

These objectives shall be achieved by the following task-sharing activities:

- Task 1: Review of state-of-the-art technologies (Year E1, and E2)
- Task 2: Case studies and design guidelines for optimization of components and systems (Year E1 and E2)
- Task 3: Review of design optimization and advancement impacts on LCCP reduction (Year E1 and E2)
- Task 4: Outlook for 2030 (Year E2)
- Task 5: Report and information dissemination (Year E2)

As listed above, we are planning to expand low-GWP refrigerant lists for investigation and repeat the following tasks annually: Task 1: the review of available low-GWP refrigerants, their properties and applicable standards, safety and flammability of refrigerants, and safe use of flammable refrigerants; Task 2: optimization of heat pump components and system for low-GWP refrigerants; Task 3: analysis of the LCCP impact by the current design and optimized design with low-GWP refrigerants.

Two following tasks originally planned for Year 3 are postponed to Extended Year 2: Task 4: market opportunity study for heat pumps with low-GWP refrigerants and low-GWP refrigerants availability for 2030; Task 5: final report and information dissemination.

The following shows the details of five tasks and their milestones and deliverables.

Task 1: Review of state-of-the-art technologies
This task aims at reviewing latest information on low-GWP refrigerants being investigated, current components and system designs, current standards and policies, thermophysical
properties and heat transfer characteristics, safety and flammability of refrigerants, and safe use of flammable refrigerants of identified low-GWP refrigerants.

Each participant will be asked to propose one or more technical areas to contribute and submit country reports summarizing current development of low-GWP refrigerants and related project plans to OA/Task leader. OA/Task leader will compile country reports into Annex Task 1 summary report.

**Milestone/deliverable** – Task 1 report by December 2022 and June 2023.

**Task 2: Case studies and design guidelines for optimization of components and systems**

This task aims at conducting case studies and developing design guidelines for optimizing components and systems for identified low-GWP refrigerants from Task 1. Both modeling tools and experimental approach can be used for optimizing components and systems for identified low-GWP refrigerants in selected applications. Moreover, additional information for Task 1 will be collected, analyzed, reported and applied to Task 2.

Each participant will be asked to propose one or more target components and/or systems to investigate and submit country reports summarizing their optimization results of components and systems, and design guidelines to the OA/Task leader.

OA/Task leader will compile country reports into Annex Task 2 summary report.

**Milestone/deliverable** – Task 2 report by December 2022 and June 2023.

**Task 3: Review of design optimization and advancement impacts on LCCP reduction**

The LCCP impact of using optimized designs and various technical options as compared to the baseline system will be investigated such as advanced cycles, new components, and integrated options. Moreover, additional information for Task 1 will be collected and analyzed. Task 2 will be repeated for new important refrigerant candidates identified from additional Task 1. Results of revised Task 2 will be applied to Task 3.

A short report shall be submitted to the OA/Task leader for compilation into an Annex Task 3 report. OA/Task leader will compile country reports into Annex Task 3 summary report.

**Milestone/deliverable** – Task 3 report by December 2022 and June 2023.

**Task 4: Outlook for 2030**

This task aims at studying market opportunities of heat pumps with low-GWP refrigerants and low-GWP refrigerants availability in different levels for 2030 while considering possible bottlenecks on availability of low-GWP refrigerants. Furthermore, similar work will be conducted for projecting beyond 2030.

**Milestone/deliverable** – Task 4 report by September 2023.

**Task 5: Report and information dissemination**

This task aims at reporting works conducted and disseminating information developed in Annex.
Each participant will be asked to provide country report summarizing all tasks conducted with any update to the OA/Task leader for compilation into an Annex report. OA/Task leader will compile country reports into draft Annex report and submit to ExCo for their review and approval. After approval with any revision, Annex will publish final report.

**Milestone/deliverable** – draft final country reports summarizing all Annex activities by November 2023.

**Milestone/deliverable** – final Annex report submitted to ExCo for review/approval by December 2023.

### 2.2 Funding

(a) Working Meetings. The working meetings shall be hosted in turn by 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 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, workshop(s) participation, 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.

**Operating Agent Fee**

As described in the legal text of the ANNEX54, Operating Agent covers coordination and report preparation expenses and other Annex-related costs including travel costs and conference registration fees. Since the IEA-HPT executive committee requested ANNEX54 to provide an annual report, a part-time post-doctor researcher was hired to conduct researches on Task 1, Task 2 and Task 5, and to prepare annual reports. The operating agent fee will be limited to the proposed participation fee schedule shown in Table 1 without bearing any additional cost to the participating members. The following table shows the participation fee for the extension period, which is essentially same as fees charged in 2021.

<table>
<thead>
<tr>
<th>Number of Participants</th>
<th>Participant Fee (USD)</th>
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<tbody>
<tr>
<td></td>
<td>2022 (Ext. Y1)</td>
</tr>
<tr>
<td>2</td>
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</tr>
<tr>
<td>3</td>
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<tr>
<td>6</td>
<td>4,164</td>
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<tr>
<td>7 and greater</td>
<td>3,774</td>
</tr>
</tbody>
</table>

The table above shows the OA fees per participating country, based upon varying numbers of participating countries.