Workshop 21:
Environmental and Performance Aspects of Low GWP Refrigerants

IEA HPT ANNEX 54 Activities

August 25, 2024-05-15

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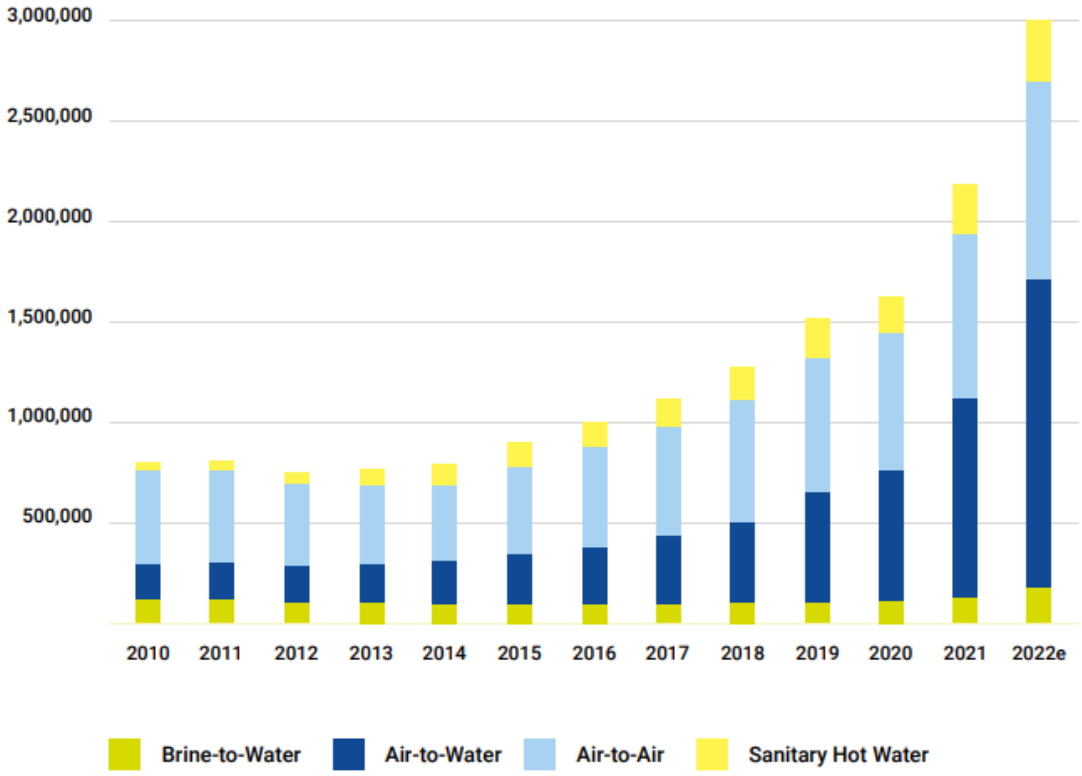
Background: Heat Pumps with Low GWPs (EU)

- In April 2022, the EU Commission proposed a strengthened fluorinated GHGs (F-gases) regulation over the current 2014 F-gas Regulation.
- Since then, many discussions and negotiations have been going on between 98% phase-down of HFCs by 2050 (EU Commissions) and total phase-out (EU Parliament).
- The EU Parliament aims to introduce strict bans on F-Gases in several types of AC-HP systems from 2026 and 2028 onwards.

Background: High Demands for Heat Pumps (EU)

Figure 17: Heat Pump sales in 21 European markets per type of technology



Source: EHPA (2023)

Background: High Demands for Heat Pumps (US)

- The Inflation Reduction Act (IRA) of 2022 (US) targets reducing carbon emissions by roughly 40 percent by 2030.
- Nearly $9 billion was allocated for the home efficiency rebate programs. This could support up to 1.6 million households nationwide in upgrading homes and apartments to lower energy bills, including by installing up to 500,000 heat pumps and conducting deep building retrofits through insulation and electrical wiring.
- In sum, these programs will make these cost-saving upgrades more accessible for low- and moderate-income families toward deploying at least 12 million heat pumps by 2030.

Background: Heat Pumps with Low GWPs (US)

The US DOE challenges the industry to develop a cold climate commercial rooftop heat pump capable of operation to -26.1°C using a refrigerant with a GWP ≤ 150, with a stretch goal 5.

Commercial Low GWP Cold Climate Rooftop Heat Pump	
Requirements	Target
COP @ 8.3°C / Max % capacity degradation from normal (8.3°C)	≥ 4 / 0%
COP @ -15°C / Max % capacity degradation from normal (8.3°C)	≥ 2.75 / 5%
COP @ -26.1°C / Max % capacity degradation from normal (8.3°C)	≥ 2.5 / 15%
Air discharge temperature @ -26.1°C	> 32.2°C
Simple payback period	≤ 5 years
GWP	≤ 150

IEA HPT Annex 54: Objectives

- Promoting the application of low-GWP refrigerants to accelerate the phase-down of high-GWP HFCs
- Developing design guidelines for optimized components and systems for low-GWP refrigerants
- 2022 member countries are Austria, France, Germany, Italy, Japan, Korea, Sweden, and US. (In 2023, six member countries.)

IEA HPT Annex 54: Tasks

- **Task 1: Review of state-of-the-art technologies (Year 1: 2019-2021)** (Latest low-GWP refrigerants; current components and system designs; Review of current standards and policies; thermophysical property and heat transfer characteristics; safety and flammability of refrigerants and safe use of flammable refrigerants)

- **Task 2: Case studies and design guidelines for optimization of components and systems (Year 2-4: 2020-2022)**

- **Task 3: Review of design optimization and advancement impacts on LCCP reduction (Year 3-5: 2021-2023)**
- **Task 4: Outlook for 2030 (Year 5: 2022-2023)**
- **Task 5: Report and information dissemination (Year 5: 2023)**

Annex54 Activities Overview

- Focused on: Task 2) case studies and design guidelines for optimizing components and systems, Task 3) Review of design optimization and advancement impacts on LCCP reduction, Task 4) 2030 outlook.

Task	AU	FR	DE	IT	JA	KO	SW	US
1. Lit. Review			☺					☺
2. Case study		☺	☺	☺	☺	☺	☺	☺
3. Design opt.	☺		☺	☺	☺		☺	☺
4. 2030 outlook	☺							v
5. Report				v				v

2002 Activity Highlights

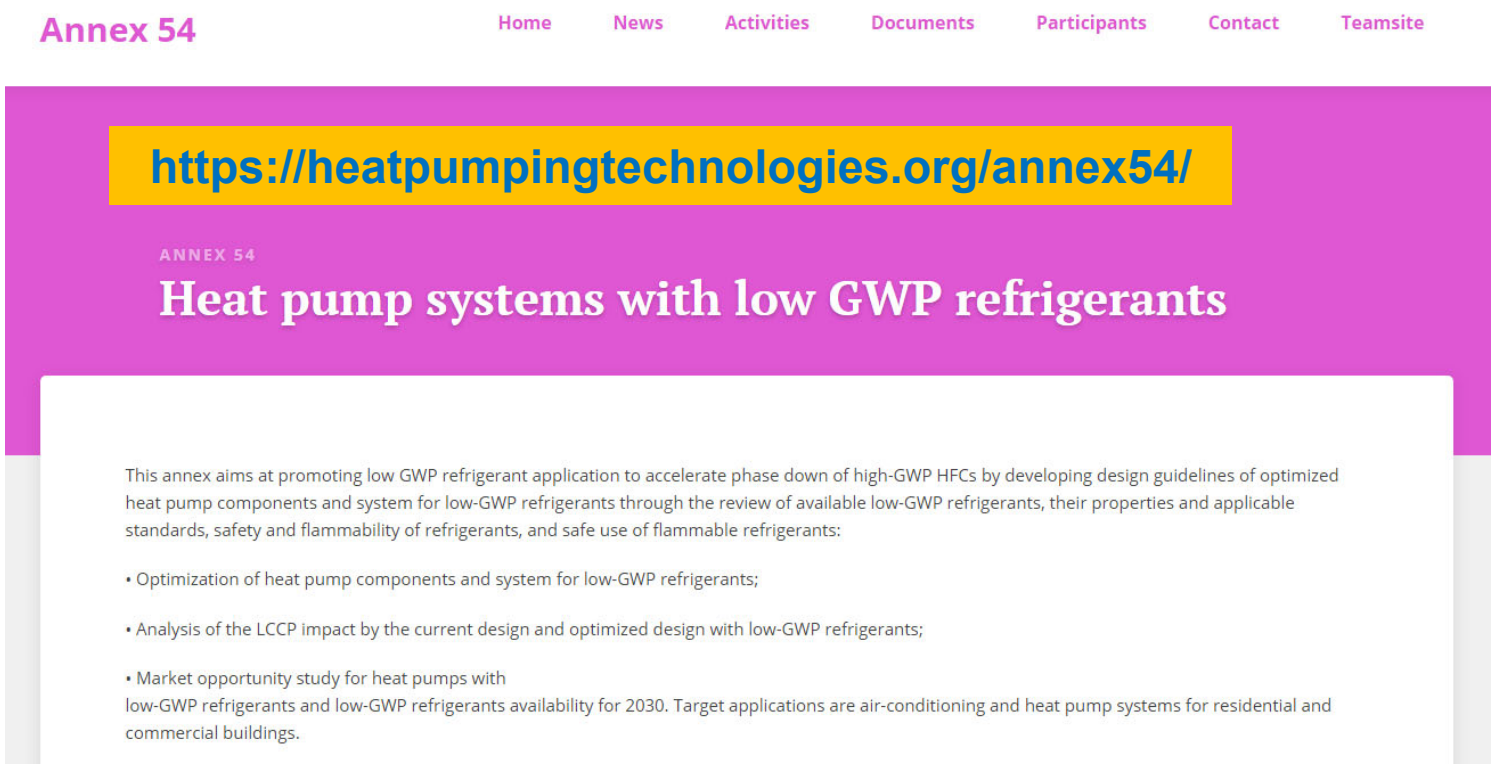
- AU: identified low GWP refrigerants and provided an overview of the Austrian heat pump market and examples of low GWP refrigerants in applications.
- DE: summarized the heat pump market survey; integrated fluid screening and evaluated SCOP of HCs, HFOs, and mixtures.
- IT: reported a solar-assisted heat pump water heaters using CO_2; compared R410A alternatives for residential HPs: R32, R454B and R454C.
- SE: provided the Swedish HP market for residential and commercial units, shared case studies and design guidelines for a geothermal R290 HP for multifamily buildings (EBOX), a CO_2 HP system for commercial buildings, and an R290 HP and chiller for the process cooling and heating.
- US: reported an ignition testing results, R290 HPWH, and the next-generation HX design framework and provided condenser optimization.

Summary

- In 2022, we achieved considerable progress in three areas: 1) Task 2: case studies and design guidelines for optimizing heat pump systems using low GWP refrigerants. 2) Task 3: a review of design optimization and advancement impacts on life cycle climate performance (LCCP) reduction. 3) Task 4: 2030 Market projection.
- Many HP designs were optimized for low GWP refrigerants.
- The work can be a valuable reference for researchers, engineers, and policymakers across the HVAC industry.

IEA HPT ANNEX 54 Website

All presentation materials, meeting agenda, minute and attendee list are available from ANNEX54 website.



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