

ANNEX 54

HEAT PUMP SYSTEMS WITH LOW GWP REFRIGERANTS

Final Annex Presentation
Webinar
2024-06-11

Yunho Hwang (Operating Agent)



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WEBINAR AGENDA

1. IEA HPT Introduction, Metkel Yebiyu
2. Introduction: Annex54 Summary for Heat Pumps with Low GWP Refrigerants, Yunho Hwang (Operating Agent)
3. France country report, Julien Ballou (CETIAT).
4. Germany country report, Thore Oltersdorf (Fraunhofer) and Christian Vering (RWTH AACHEN Univ.)
5. Italy country report, Sergio Bobbo (CNR), Marco Azzolin (Univ. of Padova) and Luca Molinaroli (Politecnico Milano).
6. Sweden country report, Björn Palm (KTH).
7. USA country report, Lei Gao (Univ. of Maryland).



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ANNEX 54 OUTCOME WEBINAR

- This webinar is organized by the IEA HPT's ANNEX54: Heat Pumps with Low GWP Refrigerants.
- The webinar goal is to disseminate our outcome of ANNEX54 activities and will provide an update on the following topics:
 - Assessment of refrigerant thermophysical properties and heat transfer performance (flow boiling and condensation), energy performance (heating capacity and COP), and environmental performance (LCCP) of heat pumps with low GWP refrigerants;
 - Optimization of heat pump components and systems using low-GWP refrigerants;
 - Research activities in residential heat pumps and water heaters with low GWP alternative refrigerants;
 - Low charge R290 heat pump development, market data, and safety topics



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WEBINAR NOTICES

- The webinar will be recorded and subsequently published on HPT's social media channels.
- Each presentation is about 18 minutes long.
- The attendees may ask questions through the chat function.
- The moderator will read them for the presenters to discuss.

Please click the link below to join the webinar:

<https://rise.zoom.us/j/69810655906?pwd=WjdXTGdXQndIUHExZ2E1WG5hS1ZNZz09>



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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
- 2023 member countries are France, Germany, Italy, Korea, Sweden, and US.



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ANNEX 54: TASKS FOR 2019 TO 2023

Task 1: Review of state-of-the-art technologies

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

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

Task 4: Outlook for 2030

Task 5: Report

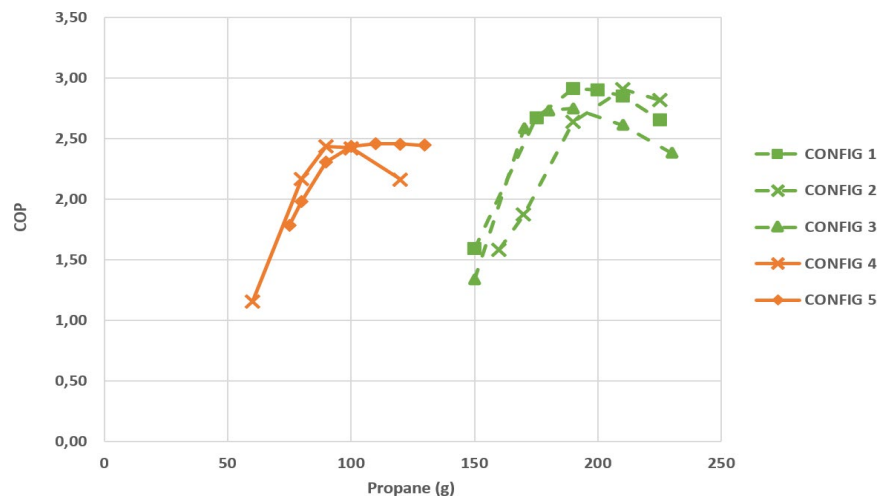


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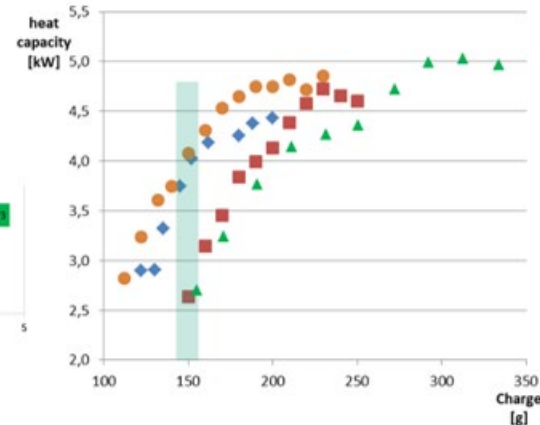
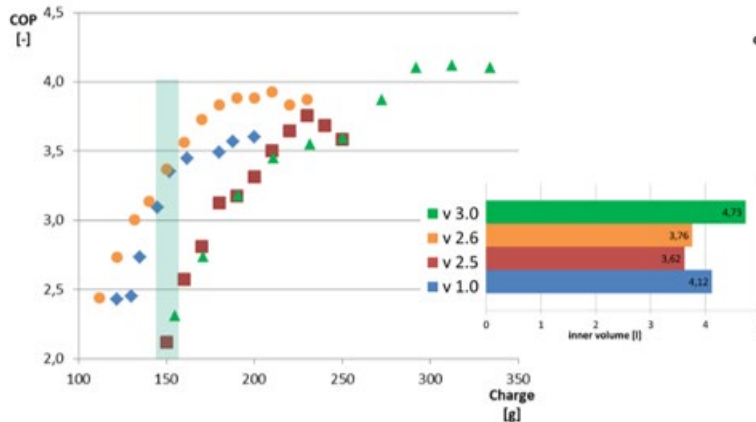
COUNTRY REPORT: FRANCE

- Developed a WWHP prototype with 150 g of propane
- Evaluated R-410A, R-407C, and R-134a alternative refrigerants in residential heat pumps) (GWP<700)
- Case studies and design guidelines for optimized components



COUNTRY REPORT: GERMANY

- Review of SOA technologies
- Case studies and design guidelines for optimized components and systems
- Developed the reduced heat pump module (LC150)



COUNTRY REPORT: ITALY

- Investigated boiling and condensation heat transfer and thermophysical properties of low GWP mixtures.
- Developed heat pumps working with low-GWP refrigerants.
 - R32 for small-medium capacity systems; R1234ze(E) and R513A for medium-large capacity systems;
 - R600a, R290 or R744 system.
- Developed a CO₂ solar-assisted heat pump.



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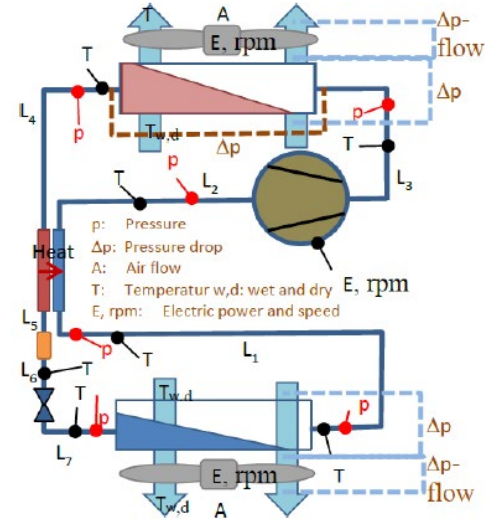


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COUNTRY REPORT: SWEDEN

- EcoPack: R290 HP with R600a subcooler.
- PROPack: AAHP with 150g of R290.
- EBOX: R290 GSHP for multi-family building.
- Design optimization and impacts on LCCP reduction
- Outlook for 2030
- Swedish HP market analysis.



ProPac system



COUNTRY REPORT: USA

- Optimization of refrigerant HX shape topology.
- Review of standards and policy for HP Systems.
- R516A for heat pump systems.
- R290 unitary AAHP systems
- Established a detailed database of low-GWP refrigerants for different HVAC&R applications
- Optimization of AAHP
- Saturation HP system analysis
- LCCP comparison for AC/HP systems



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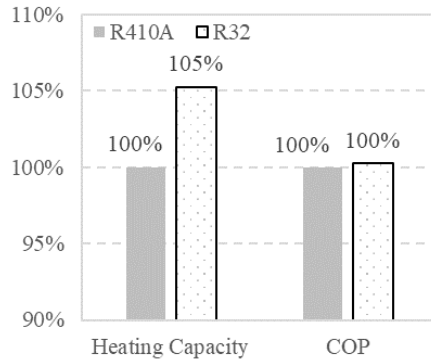


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COUNTRY REPORT: KOREA

- Commercialization of R32 ACs in window ACs for the US market and split ACs for the European market
- Literature review on the application of low-GWP refrigerants (HFOs) for high-temperature heat pump



Performance Test Results at Rated Conditions
(Wall-Mounted Type)

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COUNTRY REPORT: AUSTRIA

- Charge optimized R290 system saves 18% annual energy consumption compared to the R-410A baseline
- LCCP evaluation for an optimized R290 system compared to the R410A baseline and NG heating. (87% ↓)

| System | TEWI in 15 years [tons CO _{2e}] | Relative values |
|------------------------------|--|-----------------|
| R410A baseline | 58.5 | 46% |
| Charge-optimized R290 system | 16.6 | 13% |
| Natural gas heating system | 127.8 | 100% |



AUSTRIAN ENERGY AGENCY



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COUNTRY REPORT: JAPAN

- Review of regulations and SOA technologies
- Low-GWP residential and commercial system development (HFO1123, HCFO1224yd(Z))
- Risk assessment of A2L refrigerants
- LCCP evaluation for AAHPs using next-generation refrigerants



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SUMMARY

- We explored SOA technologies using low-GWP refrigerants.
- Presented many case studies for optimizing components and systems to reduce the refrigerant charge and improve their LCCP.
- Asian countries and the U.S. favor HFC and A2L HFO/HFC mixtures.
- Europe leans towards natural refrigerants like HCs and CO₂.
- Overall, the comprehensive reports from these countries emphasize a global push towards adopting lower-GWP refrigerants.
- The collaborative development of safety standards and system architectures for flammable refrigerants will advance sustainable HVAC technologies, significantly reducing greenhouse gas emissions.



SUGGESTIONS

- By the regulations, low-GWP refrigerants will be used in the coming years.
- To accelerate this transition, the safe use of flammable refrigerants (except for CO₂) must be supported.
- For this reason, safety aspects are the target of the newly started Annex 64.
- Some suggested research topics are:
 - Charge minimization designs for components (compressors and HXs)
 - Mitigation methods for leakage cases (refrigerant sensors, shut-off valves, and dampers)
 - New cooling/heating system architecture
 - Fault detection and diagnosis

| | |
|--|--|
| ANNEX 64 | START DATE: 1 April 2023 END DATE: 31 December 2025 |
| Safety Measures for Flammable Refrigerants | |





INSTITUT INTERNATIONAL DU FROID
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August 11 - 14, 2024

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**First Call for Papers and
Abstracts: Jan. 1, 2024**



Important Dates

- March 10, 2024 Paper Submission Deadline
- May 1, 2024 Early Registration Deadline
- Aug. 11, 2024 Welcome Reception
- Aug 13, 2024 Conference Dinner
- Aug. 14, 2024 Conference Closing
- Aug 14, 2024 Technical Tours



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