

Country Report Germany

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Final meeting of IEA HPT Annex 54 on low-GWP refrigerants

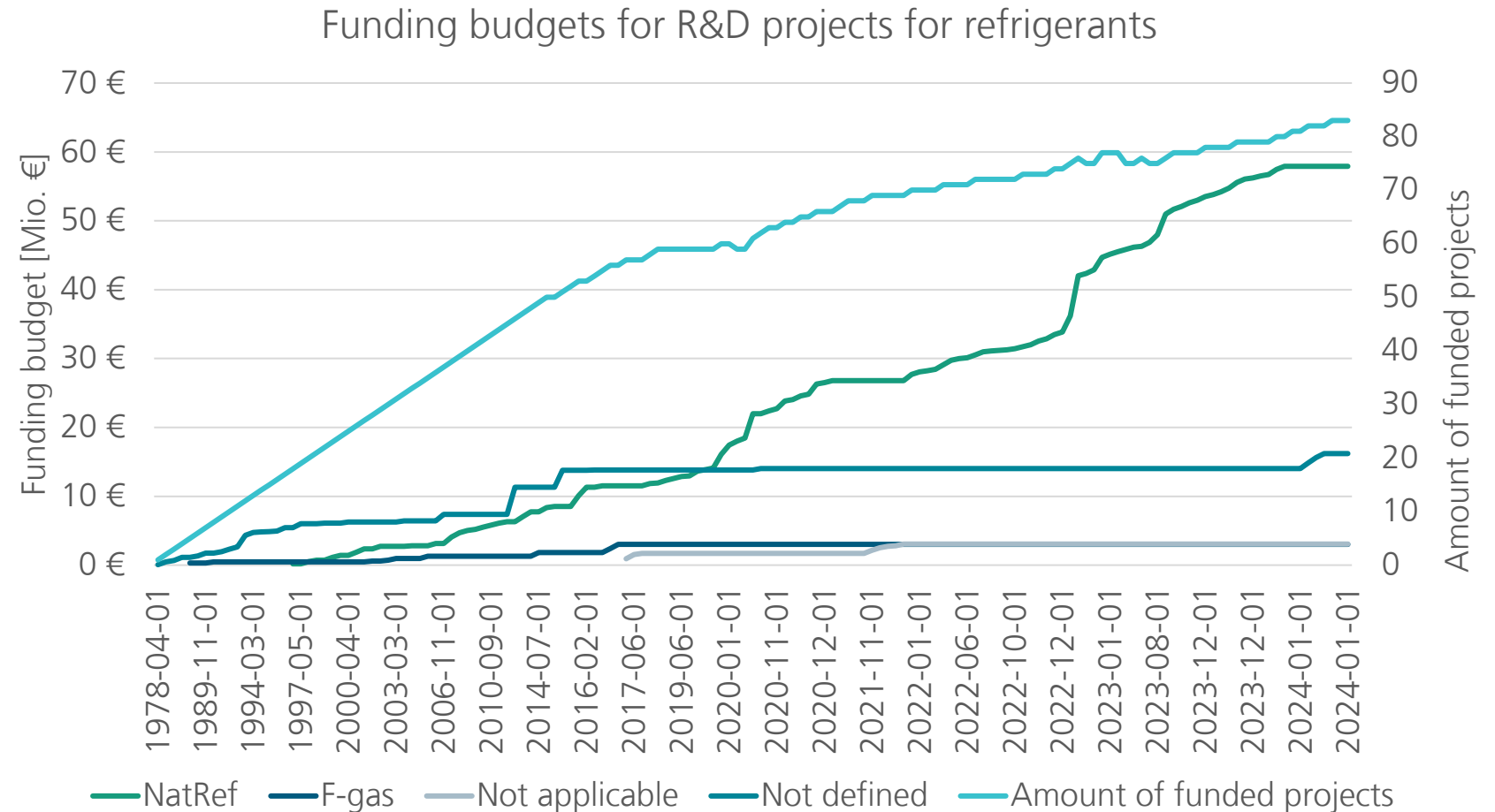
Online meeting, 11.06.2024

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Funded projects and Technological developments

- Changes of funding budgets of BMWK projects related to VCC developments
- Not defined: neither within the project database (enArgus) nor in final reports any available information to clarify the used refrigerant
- Not applicable: refrigeration/heat pump research but without refrigerants, e.g. caloric approaches



Sources: enArgus Database

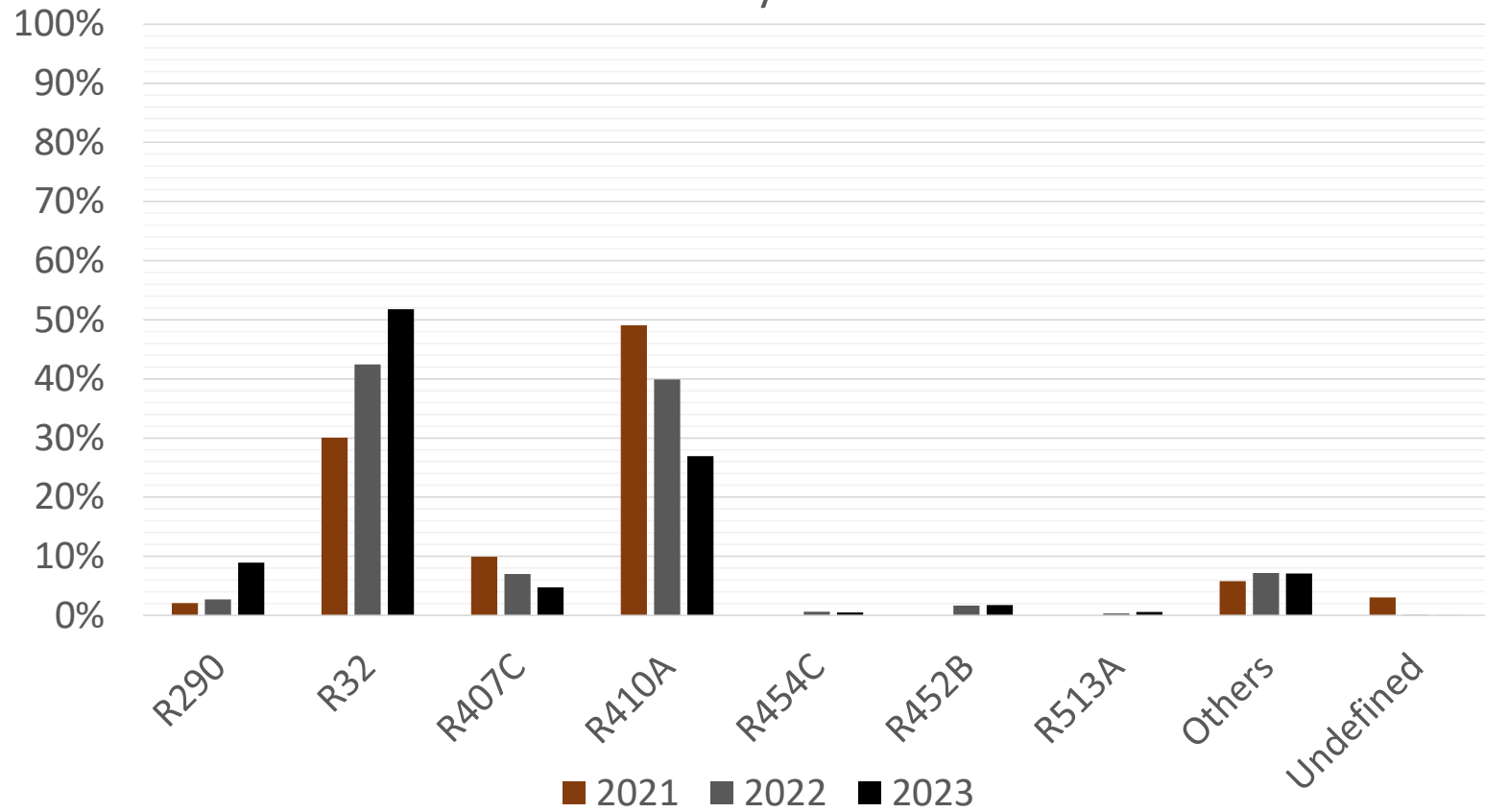
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Supply side of the residential heat pump market

- Lots of product databases could be used, each will show a different share for the evolution of charged refrigerants
- HP Keymark selected since it is ideally used for national funding schemes
- Excerpt of HP Keymark database from 2021, 2022 and 2023
 - 915 to >2000 subtypes
 - 4000 to >7000 models
- Not distinguished per type (DHW, ATW, ATA, GSHP, GWHP)

Refrigerant	GWP100 (4th/6th IPCC AR)	Refrigerant	GWP100 (4th/6th IPCC AR)
R290 (propane)	0.02	R454C	148
R410A	2088	R452B	698
R32	675	R513A	631
R407C	1774		

Share of refrigerants as charged in HP models (all types) listed in HP Keymark database



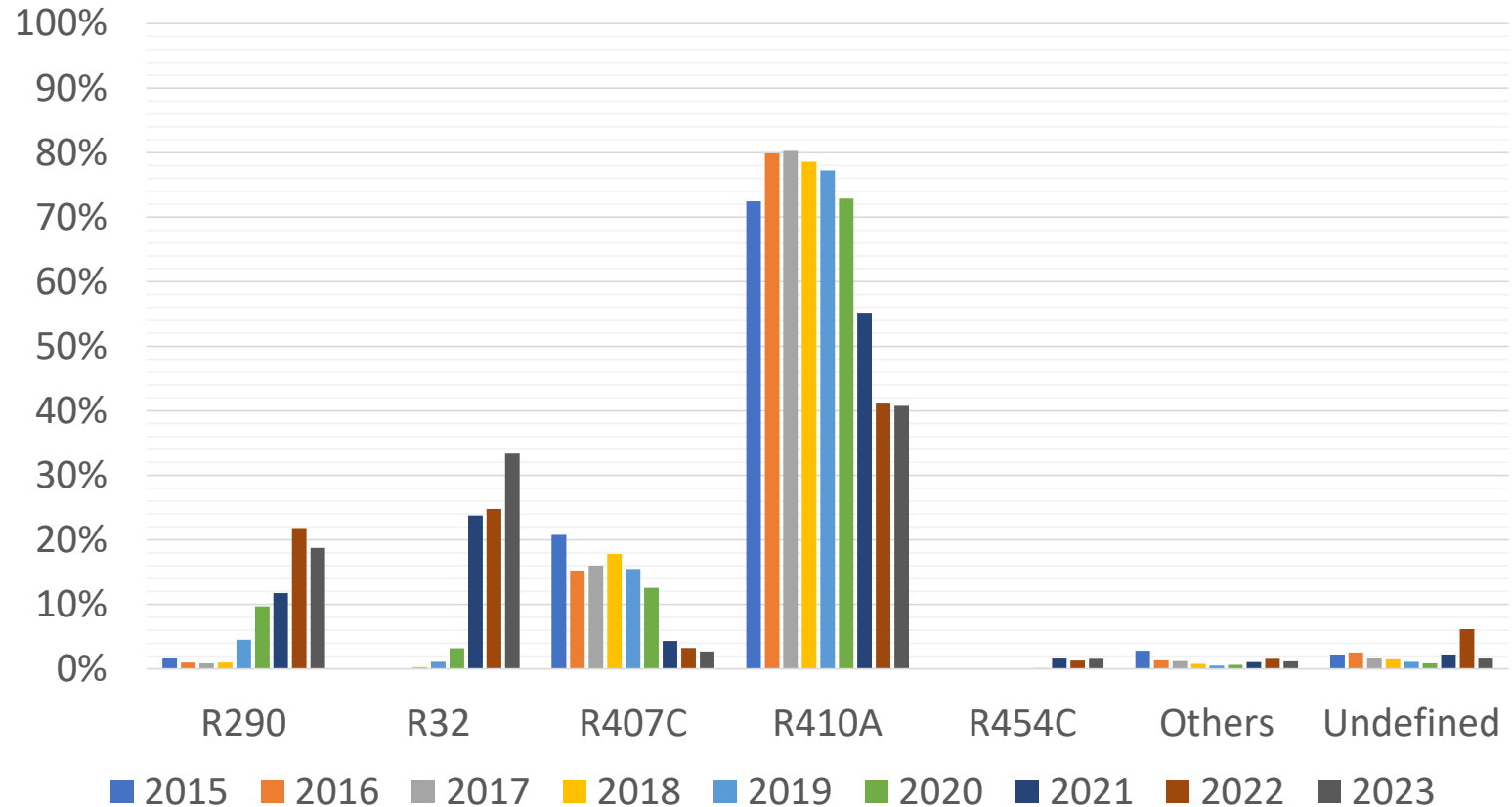
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Demand side of the residential heat pump market

- Only data for German market available
- These are data as „wanted“ by house owners, this is a thorough analysis of the funding applications from the BAFA but not annually sold units statistics!
- Important: Highrunners play a significant role to get the real picture
- Share of R410A was used to evaluate production capacity in case of F-gas regulation – fluctuations (supply issues, market structure) would happen but the capacities for substitution would already be available

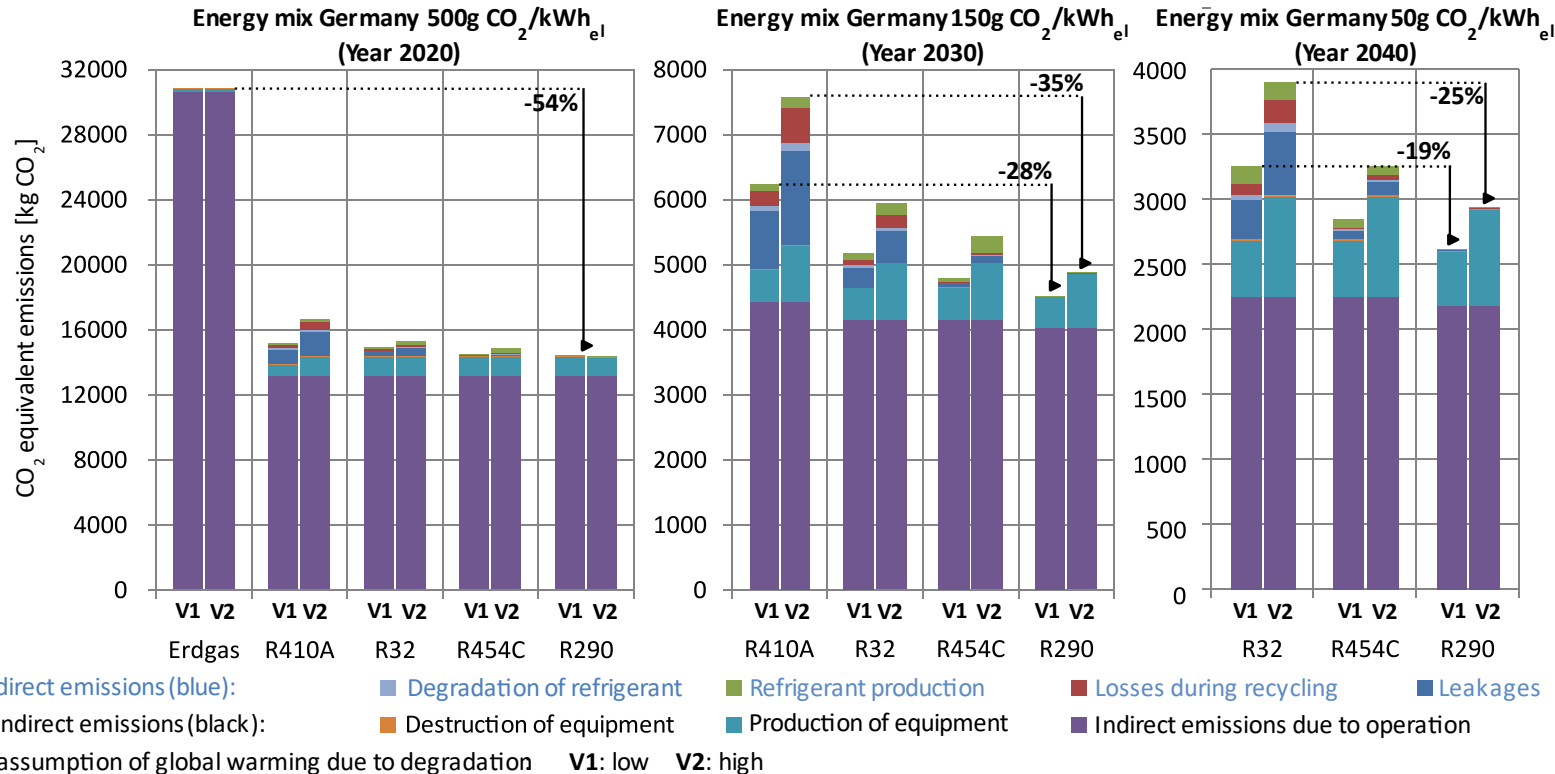
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Share of refrigerants in "funding applications" of German BEG from 2015-2023



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LCCP analysis



- Most crucial is transition to a Renewable heating and thus to heat pumps for an energy mix with high shares in fossile fueled power plants
- Since fossile-fueled energy mixes change rapidly the subtle differences of low-GWP come into play
- Uncertainty in global warming potentials and further effects of dedradation products almost disqualify any LCCP with absolute values (see differences in LCCP for versions of V1/V2)
- Based on this R290 is the best option for heat pumps

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LC150 - Project overview



BDR THERMEA GROUP

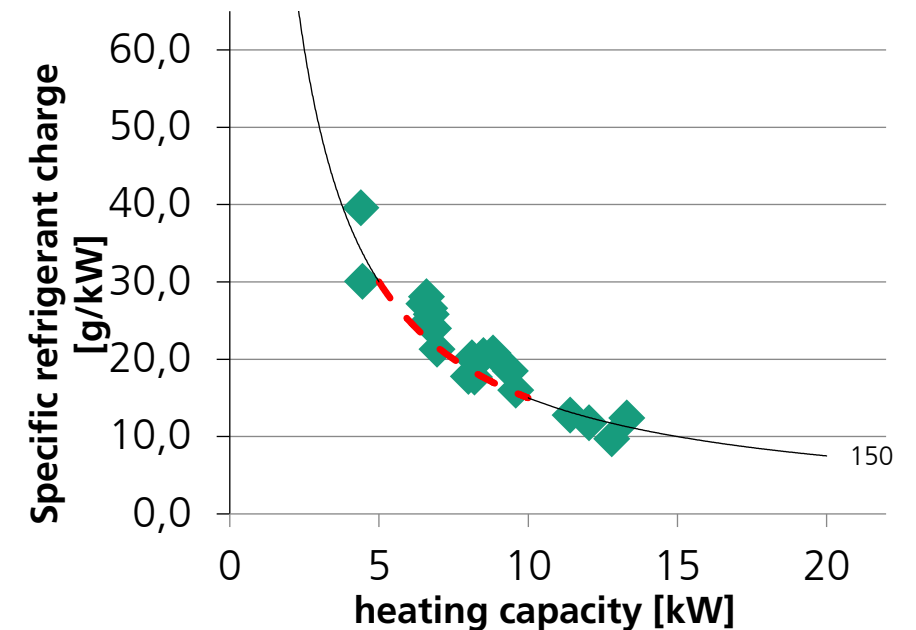


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Viessmann

Steering Committee, definition of requirements, receipt of results and access to IPs

- Cross evaluation for 24 experimentally tested prototypes
 - a large data base of measurement values and simulation data from refrigerant circuits and their components
 - Each prototype tested at 20 operation points with 8..20 charges → ~8000 successful steady measurements
- Graph shows
 - Minimal optimal charge @B0W35SH10F100%
 - Specific charge over max heating capacity
 - Red marked = target area



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Conclusion

- **Diverse Research for Heat Pumps and Refrigerants:** The situation for Germany shows a significant increase on research for natural refrigerants starting at about 2012
- **Efficiency and Safety:** Emphasis of the research in Germany is placed on improving efficiency and addressing safety concerns related to the flammability of low-GWP refrigerants, including charge reduction and safety analysis after leaks.
- **Broad Application Range:** Research also explored tumble dryers, thermal management systems for electric vehicles, and hybrid and absorption heat pumps alongside vapor compression systems.
- **Field Test Insights:** Continuous field tests since 2006 have evaluated heat pump efficiency, smart-mode operation with renewable energy, and CO2 avoidance potential, reflecting changing energy production emissions.

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Conclusion

- **(Funded) Market Analysis:** Thorough market analysis of funding applications of the transition to low-GWP refrigerants for residential heat pumps.
 - R290 HPs: Analysis shows that R290 HPs often achieve the highest performance, with significant market presence starting from 2019 and comprising 20% of the market by 2023.
 - Rise of R32 HPs: they began increasing their market share from 2020, now exceeding R290 systems, primarily through imports.
 - Decline of R410A Systems: despite these HPs still holding about 40% of the market in 2023, their share is decreasing, indicating a shift towards low-GWP refrigerants.
 - An analysis by Fraunhofer ISE about the production capacities of more than 30 European-based manufacturing facilities for heat pumps indicates no bottlenecks as often discussed due to F-gas regulation

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Outlook

- R&D projects – as analyzed – aiming usually for prototype level demonstrators but with close link to high TRLs (8 or higher), the large amount of still ongoing projects and the high share of projects aiming for non-halogenated refrigerant promises technologies for several device classes but with a clear focus on heat pumps in several sectors within the next 2-10 years
- Charge reduction and safety technologies in conjunction with each other will lead to safer heat pumps for single- and multi-family houses when ongoing R&D projects are finished (e.g. LC R290)
- Establishing safety performance testing* will lead to more knowledge, more reliable as well as more standardized testing to deal with flammable refrigerants satisfying the safety demand of the heat pump market (e.g. LC R290)
- Market data will be further analyzed to improve benchmark datasets as well as to allow more thorough market analysis

*Term defined by D. Colbourne, personal communication, 2024

Thank you for your attention!

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