

Climate Neutral Heating and Cooling: RD&D needs and perspectives for international collaboration

Webinar organized under the auspices of the
IEA Experts' Group on R&D Priority-setting and Evaluation (EGRD)

20th April 2023, 1:00-3:30 pm (CET)

Many governments worldwide have committed themselves to achieve net greenhouse gas neutrality in the next decades in order to limit global warming to well below 2, preferably to 1.5 degree Celsius, compared to pre-industrial levels. In order to reach these goals fossil fuels, which as of today still account for more than 80 percent of the global total energy consumption¹ will largely have to be replaced by renewable sources. Whereas the decarbonisation of the electricity sector is on a successful path in many countries reaching greenhouse gas neutrality in the heating and cooling sector is much harder. In Germany for example, more than half of final energy consumption is accounted for by heating and cooling, of which so far only a small part has been produced in a climate-neutral way. To decarbonize the heating and cooling sector ambitious initiatives have been launched in many countries in recent years. The recent geopolitical developments, with Russia's aggression against Ukraine and the consequent disruptive developments on the gas market, have furthermore shown the vulnerability of an energy system based on fossil fuels further strengthening governmental efforts to shift towards renewable energy sources in all sectors.

The transformation of the heating sector includes all relevant areas of use and infrastructures. Fossil energy sources must be replaced by renewable energies and the use of waste heat, heating and cooling requirements must be reduced through efficiency measures, and electricity and heating infrastructures must be coupled and used optimally. The heat supply must be converted to a new basis of renewable energy sources, electrification and alternative fuels.

Applied energy research contributes to achieving climate neutrality in the heating sector. Many technical solutions are already available today. However, these are not yet sufficient to reach the target. Research and innovation are necessary to develop further urgently needed technologies and to prepare novel technologies that are not yet established on the market for widespread use. In addition, the systemic integration of new technologies as well as their dissemination and standardisation are still pending. Socio-economic interactions and regional peculiarities must be taken into account.

¹ <https://ourworldindata.org/energy-mix>

This webinar will discuss RD&D needs in the area of climate neutral heating and cooling in order to serve as an input to governmental research policies and strategies.

Key questions to be answered at the webinar are:

- What RD&D is crucial to decarbonize the heating and cooling sector?
- Which obstacles hinder the large scale deployment and roll out of climate neutral heating and cooling technologies in various end-use sectors?
- Which problems arise on a system-level?
- How can acceptance problems of climate neutral heating and cooling technologies be overcome?
- Is it possible to shortcut the knowledge creation from basic science to application by means of new methods, technologies and mechanisms?
- How can governments support and accelerate RD&D in climate neutral heating and cooling?
- What are the best opportunities for the IEA TCPs to take forward these research questions?

Expected outcomes

The webinar will result in a summary report with the main discussion points and recommendations for further RD&D in climate neutral heating and cooling.

Registration: https://formulare.ptj.de/workshop_on_climate_neutral_heating_and_cooling

Experts' Group on R&D Priority-Setting and Evaluation (EGRD)

The EGRD examines analytical approaches to energy technologies, policies, and RD&D on targeted, timely topics. The results and recommendations support the CERT, feed into IEA analysis, and enable a broad perspective of energy technology issues. Recent topics analysed include “International Collaboration for ensuring Secure and Sustainable Critical Minerals in Clean Energy Technologies” (May 2022), “Hydrogen in the Energy System Decarbonization” (Nov 2021) and “Evaluating the impacts of energy innovation policies” (Oct 2021). Workshop summaries are available here: <https://userstcp.org/iea-egrd>.

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| Introduction: Opening and scene-setting remarks | |
| 13:00 - 13:15 | <p>Wolfgang Langen, Head of Division "Energy Research - Project Funding and Market Building; Key Technologies for the Energy Transition", Federal Ministry for Economic Affairs and Climate Protection</p> <p>Birte Holst Jørgensen, DTU, Chair of EGRD</p> |
| <p>Session I: Why do we have to accelerate RD&D for climate neutral heating and cooling? Moderator: Johannes Tambornino</p> <p>This session will describe why research in climate neutral heating and cooling needs to be accelerated and discuss the status quo. The following questions shall be addressed:</p> <ul style="list-style-type: none"> - Where do we need to arrive in heating and cooling in 2050? - Which technologies will be important in the next decades? - Which are the detailed targets for 2050 which need to be addressed by RD&D? | |
| 13:15 | Chiara Delmastro , Energy Analyst Buildings, Energy Technology Policy Division, IEA, <i>"Net Zero by 2050: opportunities for innovations in heating and cooling in buildings"</i> |
| 13:30 | Johan Carlsson , Scientific officer, leader of the Sustainable Heating and Cooling team, JRC Petten <i>"Strengthened EU policies in the heating and cooling domain, and key results from a new heat pump study"</i> |
| 13:45 | Christoph Reinhart , Alan and Terri Spoon Professor of Architecture and Climate, Department of Architecture, Director Building Technology Program, Massachusetts Institute of Technology, <i>"Socio-economic carbon reduction pathways for urban building stocks"</i> |
| <p>Session II: What RD&D is needed for climate neutral heating and cooling? Moderator: Anne-Kathrin Faust</p> <p>Decarbonising the heating and cooling sector requires substantial RD&D, especially with regards to the integration of different technologies into large-scale systems and their interplay with the electricity system.</p> <p>This session provides examples of current RD&D projects:</p> <ol style="list-style-type: none"> i) Large-scale use of heat pumps for residential heating systems ii) Replacing fossil based heating systems in industrial processes by heat pumps in industrial processes iii) Increasing efficiency in industrial processes by coupling heating infrastructures iv) Systems perspective: Stabilizing the power grid by system-supporting use heating supplies, heat storage v) Overcoming acceptance problems hindering the large scale roll out of climate neutral heating technologies (end users perspective) | |
| 14:00 | Andrej Jentsch , R&D project manager, AGFW, <i>"R&D needs for large heat pumps and district heating and cooling"</i> |

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| 14:15 | Steffen Nielsen , Associate Professor, Sustainable Energy Planning Research Group, Aalborg University, <i>“A European Perspective on Climate-neutral District Heating and Cooling”</i> |
| 14:30 | Takahide Tokuda , Manager of International Department & Technical Research Department, Heat Pump & Thermal Storage Technology Center of Japan, <i>“Introduction of Japanese district heating and cooling case studies using heat pumps”</i> |
| 14:45 | Martin Patel , Chair for Energy Efficiency, Interim director of the Institute for Environmental Sciences (ISE) at University of Geneva, <i>“SWEET DeCarbCH – Some insights on Decarbonisation of Cooling and Heating in Switzerland ”</i> |
| <p>Session III: How can governments accelerate RD&D for climate neutral heating and cooling? Moderator: Herbert Greisberger Discussion session</p> | |
| 15:00 | <p>Selected presenters from session I and session II will participate in a guided discussion centered around the following questions:</p> <ul style="list-style-type: none"> • Bridging the gap between basic and applied research. What is needed to speed up the knowledge transfer? • Related RD&D to ensure energy security and address environmental and social challenges • Managing the trade-offs between cooperation and competition • What is the role for international coordination/cooperation? <p>Questions from the audience will be addressed.</p> |
| 15:30 | Concluding remarks by Chair EGRD |

Presenters and Moderators

Wolfgang Langen is head of division “Energy Research - Project Funding and Market Building; Key Technologies for the Energy Transition” at the German Federal Ministry for Economic Affairs and Climate Action. He holds a PhD in Physics. As head of division he oversees funding for applied energy research for Germany on the federal level. Currently a key research field is climate neutral heating and cooling.

Birte Holst Jørgensen, Technical University of Denmark, is Chair of the IEA EGRD. She is an internationally acknowledged expert in energy science, technology and innovation policy. She has more than 20 years of experience in research based consultancy in the energy sector, which includes leading positions at DTU and Nordic Energy Research. She is chairing various national and international energy committees and groups, a.o. The Stakeholder Forum of Energinet - the Danish transmission system operator. She holds an M.Sc. in Business Economics from Copenhagen Business School and an Ph.D. in Political Science (University of Copenhagen) and an MSc in Business Economics (Copenhagen Business School).

Chiara Delmastro is energy analyst and modeler at the International Energy Agency, with main focus on the buildings sector. She is member of the Steering Committee of the Global Alliance for Buildings and Construction and member of the board for the Global District Energy and Climate Award, also acting as desk officer for the IEA District Heating and Cooling Technology Collaboration Programme. Previously research fellow in Politecnico di Torino with main focus on energy access in developing countries and decarbonisation of heat in buildings. Chiara holds a M.Sc in Energy and Nuclear Engineering and further specialized with a PhD in urban energy planning and energy modelling for policy-oriented scenarios analysis.

Johan Carlsson works at the European Commission's Joint Research Centre (JRC) in Petten, the Netherlands. He holds a PhD from the Royal Institute of Technology in Stockholm, Sweden and an MBA from the University of Amsterdam. Johan's work concerns energy efficiency and renewable energy in the heating and cooling sector. Examples of topics covered are the design and evaluation of energy policies, preparing definitions and guidelines (e.g. waste heat, renewable cooling, efficient district heating and cooling), and technology status reports.

Christoph Reinhart is a building scientist and architectural educator working in the field of sustainable building design and environmental modeling. At MIT, he is the Director of the Building Technology Program and head of the Sustainable Design Lab (SDL), an inter-disciplinary group with a grounding in architecture that develops design workflows, planning tools and metrics to evaluate the environmental performance of buildings and neighborhoods. He is also a managing member at Solemma, a technology company and Harvard University spinoff and served as strategic development advisor for MIT spinoff mapdwell until it joined Palmetto Clean Technology in 2021. Planning tools originating from SDL and Solemma are used in practice and education in over 90 countries.

Johannes Tambornino (moderator) is Vice Chair of IEA EGRD. He is the head of the Energy Strategies and Systems Analysis Unit at Project Management Jülich, where he is responsible for the R&D program on

energy systems analysis funded by the German Ministry of Economic Affairs and Energy. He is leading a group that covers a broad range of topics along the energy innovation chain and currently serves as the German representative in the IEA Experts' Group on R&D Priority Setting and Innovation. He holds a PhD in Mathematical Physics (University of Potsdam and Max Planck Institute for Gravitational Physics) and has more than ten years of experience in energy research policy covering a broad range of topics from applied research in energy to large infrastructure programmes in the hydrogen sector.

Andrej Jentsch is R&D project manager at AGFW, the energy efficiency association for heating, cooling and CHP in Germany and project coordinator of the living lab for large heat pumps. He holds a PhD in Energy and Process Engineering and currently serves as the programme manager of the international district heating research programme IEA DHC. Since 2007 he specialised in comparative technology assessment based on exergy, since 2010 also self-employed as owner of the energy systems consultancy Richtvert. His current work focuses on large heat pumps, resource exergy analysis, greenhouse gas assessment methodology and research management.

Steffen Nielsen is Associate Professor in the Sustainable Energy Planning Research Group at Aalborg University and has more than 10 years' research experience with strategic heating planning, using GIS mapping of energy demands and renewable energy resources and linking these to more detailed energy system analysis models. A key research focus has been on the heating sector within the context of transitioning to 100% renewable energy systems. This transition includes a focus on energy efficiency in buildings, low-temperature district heating and utilisation of excess and renewable heat in the heating sector. Most of the research has been part of different European research projects in collaboration with external partners from both industries, local/regional governments and other universities.

Takahide Tokuda is the Manager of the International Department & Technical Research Department at the Heat Pump & Thermal Storage Technology Center of Japan (HPTCJ) since 2022. HPTCJ develops the promotion and technological improvement of heat pumps and thermal storage systems and engages in international activities. In his business activities, Takahide participates at exhibitions as an exhibitor, hold seminars, and works with international organizations. He is participating in the IEA's Technology Collaboration Programs within the Energy Storage TCP. Takahide was an essential contributor at HPTCJ to establish the Asian Heat Pump Network back in 2011 together with 7 Asian countries which are Thailand, Korea, China, India, Vietnam, Indonesia and Japan.

Martin K. Patel is professor at University of Geneva, where he has been holding the Chair for Energy Efficiency since 2013. He is an engineer by training and worked at the Fraunhofer Institute for Systems and Innovation Research in Germany, in an energy consultancy and at Utrecht University in the Netherlands. His research deals with energy savings and emission reduction in the built environment and industry as well as with energy storage. His group performs environmental and economic assessments of technologies, processes, products and services as well as evaluations of policy programmes. He is involved in several national and international research projects

Anne-Kathrin Faust (moderator) works in the Economics division of the Swiss Federal Office of Energy. She is in charge of the Energy-Economy-Society research programme, which funds socio-economic research projects in the field of energy policy. She further is a specialist for the evaluation of the economic impact of energy and environmental policies and is responsible for the economic analysis in the Swiss energy perspectives. Anne-Kathrin studied economics and business administration at the University of Geneva and completed her PhD in environmental economics at the Ecole Polytechnique Fédérale de Lausanne (EPFL).

Herbert Greisberger (moderator) is Managing Director of the Lower Austrian Energy and Environment Agency (eNu), where his focus is on energy and innovation with a special focus on sustainable buildings and renewables. He is also part of the scientific management of the Austrian Green Energy Lab focusing on long-term developments and their consequences for society. He was formerly the Senior Scientist on R&D, innovation and energy technologies for the Austrian Energy Agency and the Austrian Society for Environment and Technology. Herbert holds a PhD (University of Stuttgart) and studied economics (Universities of Graz and Vienna) and is a lecturer at the Institute for Research and Education focusing on energy economy and energy management.