http://www.hpc2020.org



The 13th International Energy Agency Heat Pump Conference

Mission for the Green World

Ramada Plaza Hotel Jeju, Korea April 26 - 29, 2021



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WELCOME MESSAGE

Welcome,

The IEA Technology Collaboration Programme on Heat Pumping Technologies (HPT TCP) operates under the International Energy Agency, as a non-profit organization where member-country participants cooperate in projects in the field of heat pumps and related heat pumping technologies such as air conditioning and refrigeration. Under the management of an Executive Committee representing the member countries, the program carries out a strategy to accelerate heat pump use in all applications where they can reduce energy consumption for the benefit of the environment.

This event is the world's premier event where industry and research experts go to discuss the latest advancements in the field of heat pumps. Focused primarily on technical applications, the event provides a side opportunity for dialogue and the establishment of business and research partnerships.

The Heat Pump Conference is also a key event for policymakers, executives and representatives from industry, utilities and the public sector, R&D managers and technology supporters, energy managers, planners, consultants, etc. This is the place to be for all those who wish to learn about the market trends and the future applications of heat pumps.

The 13th IEA Heat Pump Conference will take place on April 26-29, 2021, a year later than originally scheduled. Due to the corona virus outbreak, the conference is held as online-offline hybrid. The offline conference is held at Ramada Plaza Hotel Jeju in Korea, and the online conference is held along with offline for those who cannot attend the conference physically.

This conference is the perfect forum to learn from and communicate with industry and research experts from all over the world. In spite of the COVID-19, more than 200 high quality papers are ready to be presented. As Chairman of the National Organizing Committee (NOC), it is my pleasure to extend an invitation to showcase your technologies and products as a sponsor.

The Jeju conference will be the 13th in a series of triennial conferences. Previous conferences were held in, Graz, Austria (1984), Orlando, Florida, USA (1987), Tokyo, Japan (1990), Maastricht, the Netherlands (1993), Toronto, Canada (1996), Berlin, Germany (1999), Beijing, China (2002), Las Vegas, USA (2005), Zurich, Switzerland (2008), Tokyo, Japan (2011), Montreal, Canada (2014) and Rotterdam, Netherland (2017).

Although the conference has changed several times, we appreciate your patience, understanding and strong support of the HPC 2020. We hope you stay safe and healthy, and we are looking forward to seeing you at the conference!



Chair National Organizing Committee of HPC 2020

Min Soo Kim

♦ IEA HPT TCP



Technology Collaboration Programme on Heat Pumping Technologies by International Energy Agency

Every three years the IEA Technology Collaboration Programme on Heat Pumping Technologies, (IEA HPT TCP) stages the IEA Heat Pump Conference. We are members of IEA International Energy Agency (IEA) and the programme was founded in 1978. We have been active in more than 40 years, which is a strength since a lot of knowledge and experiences has been generated during the years.

Only a country's government can participate in a TCP (Technology Collaboration Programme), not separate organisations. This means that all people living in a member country are participants of the programme. We have 16 members in HPT TCP. The current member countries are Austria, Belgium, Canada, Denmark, Finland, France, Italy, Germany, Japan, the Netherlands, Norway, South Korea, Sweden, Switzerland, United Kingdom and the United States.

The HPT TCP is a non-profit organization working in the field of heat pumping technologies, i.e. all technologies where heat is pumped from a lower temperature level to a higher one, such as heat pumps, air conditioning and refrigeration. Under the management of an Executive Committee representing the member countries, the programme carries out a strategy to accelerate the use of heat pumping technologies in all applications where they can reduce energy consumption and increase the use of renewal energy sources for the benefit of the environment.

Chair for HPT TCP is Mr. Stephan Renz (Switzerland).

DISCLAIMER

The HPT TCP is part of a network of autonomous collaborative partnerships focused on a wide range of energy technologies known as Technology Collaboration Programmes or TCPs. The TCPs are organized under the auspices of the International Energy Agency (IEA), but the TCPs are functionally and legally autonomous. Views, findings and publications of the HPT TCP do not necessarily represent the views or policies of the IEA Secretariat or its individual member countries.

INTRODUCTION

About the Conference

Energy and the environment – two topics that are always of great concern to human beings. Heating and cooling play a great role in our daily life, we use a tremendous amount of fossil fuels for heating and cooling. When changing temperature levels using substantial energy input, a heat pump is always recommended as promising technologies against climate change.

With this in mind, the 13th IEA Heat Pump Conference will be held in Jeju Island from Monday, April 26st through Thursday, April 29th in 2021. With the theme 'Heat Pumps – Mission for the Green World', we aim to address global climate change and discuss necessary actions.

Considering the varied applications of heat pump systems in the residential, building and industrial fields, this major conference with hundreds of participants will definitely broaden the horizons of our heat pump community. The theme, "Heat Pumps – Mission for the Green World", will make all the researchers proud that we really are creating a Green World together through research and development for a better future.

Conference Goal

Heat pumps, as a reliable and confirmed technology, is the key equipment for energy savings and greenhouse gas reductions with its wide range of application to various energy sources. The upcoming conference will serve as a forum to discuss the latest technologies in heat pumps, and exchange valuable knowledge in market, policy, and standards information on related technologies.

Conference Structure

- Keynote and Plenary lectures by renowned researchers
- Oral and poster presentations on innovative heat pump technology, applications and markets
- Workshops on collaborative projects, connected to annexes in the HPT TCP
- Global Student Video Competition

Previous Conferences

The upcoming conference will be 13th of the series of conferences held by Technology Collaboration Programme on Heat Pumping Technologies by International Energy Agency, (IEA HPT TCP). Preceding conferences were held in Austria (1984), USA (1987, 2005), Japan (1990, 2011), The Netherlands (1993, 2017), Canada (1996, 2014), Germany (1999), China (2002), and Switzerland (2008). After successful histories in Japan and China, it is the fourth Heat Pump Conference to be held in Asia, and the first to be held in the Republic of Korea.

ORGANIZATION

The conference is organized by the International Organizing Committee (IOC) and the National Organizing Committee (NOC) on behalf of the Executive Committee of the IEA HPT TCP.

International Organizing Committee (IOC)

Chair

- Per Jonasson: Swedish Refrigeration & Heat Pump Association, Sweden

Vice-chair

- Sophie Hosatte: CanmetENERGY, Canada
- Hideaki Maeyama: HPTCJ (Heat Pump and Thermal Storage Technology Centre of Japan)

National Organizing Committee (NOC)

Chair

- Min Soo Kim: Seoul National University, South Korea

Vice-chair

- Yong Tae Kang: Korea University, South Korea

Members

- Jae Dong Chung: Sejong University, South Korea
- Young Soo Chang: Kookmin University, South Korea
- Taesung Kim: Sungkyunkwan University, South Korea
- Seong Hyuk Lee: Chung-Ang University, South Korea
- Jun Young Choi: Korea Testing Laboratory, South Korea
- Ji Hwan Jeong: Pusan National University, South Korea
- Jeongsik Seo: Korean Refrigeration and Air Conditioning Assessment Center, South Korea
- Dong Kyu Kim: Chung-Ang University, South Korea
- Youn Cheol Park: Jeju National University, South Korea

Secretary General

- Minsung Kim: Chung-Ang University, South Korea

Conference Secretariat

Enlight PCO

114, Yeoksam-ro, Gangnam-gu, Seoul 06252, South Korea E-mail : secretariat@hpc2020.org / Tel : + 82-(0)2-6964-8320 / Fax : + 82-(0)2-553-7527 HEAT PUMPS - MISSION FOR THE GREEN WORLD

SPONSORS

The Organizing Committee greatly Appreciates the Generous Support of Our Sponsors!

For more information on our sponsors,

please visit the conference website or click on the logo below to connect to the sponsor website.

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Image: Street by Image: Street by

The 13th IEA Heat Pump Conference

Mission for the Green World

HYBRID CONFERENCE MODEL OF THE 13TH IEA HEAT PUMP CONFERENCE

- How It Works
- Hybrid Operations Overview
- Detailed Formats for All Presentations
- General Information
 - Time Zone
 - Participants Precautions
 - Hybrid Conference Platform
 - Full Papers
 - Opening Ceremony
 - Closing Ceremony
 - Certificate of Participation
 - Session Chair Guideline

HOW IT WORKS

For the online participants, online conference platform will be provided. The conference program will be a generous online platform, which will give attendees the possibility to take part of the presentations over an extended amount of time. Register now and you will have the opportunity to take part of all the highlights of the 13th IEA Heat Pump Conference between the 18th of April until the 1st of May – on-demand when it suites you.

The Conference will be organized to offer as much value as possible to "offline" (physical) as well as online attendees. The presentations will be pre-recorded, broadcasted online and shown at the conference venue in accordance with the conference program. However, in order to make it possible for the conference attendees to select and take part in as many presentations as possible, it is recommended to watch the pre-recorded presentations on-demand before the conference start. The whole online conference plan in accordance with the scheme is shown in below.

When it comes to questions & answers, there will be two separate schemes for the attendees as well as for the authors. It will be possible for the conference attendees to pose their questions online during the whole preconference as well during the conference period. The author is responsible for answering the questions until 1st of May at the latest. During the offline program slot for the presentation, the authors will be encouraged to attend online via Zoom, or physically at the venue, to be able to answer questions from the audience live.



HYBRID OPERATIONS OVERVIEW

The HPC 2020 Hybrid Model

Onsite-online hybrid model ensures effective interaction between online participants (participants that are not at the venue) and onsite participants (participants that can attend the venue).

Onsite & Online Operations

Each room in the conference venue will be equipped with a screen and a microphone, so that participants can join a zoom meeting together and connect with other participants. Whether onsite or online, attendees can freely change room, depending on what presentations are of the most interest. All sessions will be broadcast (live-streamed) to the website on HPC 2020.



Onsite & Online Communication

Onsite and Online participants will be able to engage with each other via the Zoom chat interface, leaving questions and comments during pre-conference period on the HPC 2020 website, which the session moderator can navigate through.

Also, The presenters are responsible for answering the questions at the website until 1st of May at the latest.

Room Overview and Roles Involved

Each presentation session will involve the following support roles: Session Chair– moderates the panel; Admin support – hosts the zoom meeting; Technical support – prevents onsite technical issues. (Admin staff and Session Chair do not have to be onsite.)



DETAILED FORMATS FOR ALL PRESENTATIONS

	Catagory	Operation				
	Category	Offline	Online			
Plenary	Presentation Video	Pre-recorded presentation must be submitted via	a website in advance.			
	Q&A	Speakers will participate in real time online or communicate with the participants via chat window of virtual conference platform.				
	Participation	Considering being broadcast on ZOOM, arrive at session room 15 minutes prior to session.				
Keynote	Presentation Video	Pre-recorded presentation must be submitted via website by Mar. 5, 2021.				
/Oral	Q&A	Speakers must participate in real time in th session room.	e Speakers must decide whether to participate in live Q&A while submitting their video on website. (Please consider the time difference.)			
		All speakers even if who participated in live Q& website until 1st of May at the latest.	A is responsible for answering the questions at the			
	Participation	Considering being broadcast on ZOOM, arrive at	session room 15 minutes prior to session.			
Poster	Presentation Video	Pre-recorded presentation must be submitted via website by Mar. 5, 2021.				
	Poster File	Submit the poster file via website in advance for online availability by Mar. 5, 2021.				
	Poster Size	A0 (Width 84cm $ imes$ Height 118cm)				
	Posting	Presenters should put up the poster on your ow at the designated place.	The secretariat will print it out and attach it to the assigned spot.			
	Q&A	All speakers are responsible for answering the qu	uestions at the website until 1st of May at the latest.			
	Participation	Under the social distance policy, direct face-to face presentation of posters will be omitted.	-			
Participants		All participants are able to watch presentation website during Pre-conference (April 18, 2021) to	videos or leave questions and comments on the Post-conference (May 1, 2021.) period.			
		Participate in the session room. - If access to the session hall is difficult due to restricted number of people, participate through ZOOM.	Participate in real time through ZOOM.			

Time allocation

- Plenary Lectures : 25min. (20 min. speech + 5 min. Q&A)
- Keynote lectures : 20 min. (15 min. speech + 5 min. Q&A)
- Oral presentations : 15 min. (12 min. speech + 3 min. Q&A)
- Poster presentations : 5 min. (5 min. speech)

♦ GENERAL INFORMATION

Time Zone

The live stream schedule is based on Korea Standard Time (KST / UTC +9).

Program at a Glance also included Eastern Daylight Time (EDT / UTC-4) and Central European Summer Time (CEST / UTC+2) for international participants.

Participants Precautions

Offline Participants

- All participants are required to have their temperature checked.
- Entry is restricted in case of fever (37.5 °C or higher) and respiratory symptoms (cough, sore throat, etc.).
- Keep a 1-meter distance from each other in the session room. (Photo will be taken in order to keep the room setting.)
- Masks must be worn in all spaces.
- Wash hands often and use hand sanitizer provided.
- Due to social distance policy, it could be difficult to enter the session room if the session room is crowded.

Online Participants

- We recommend you check the network before the session.
- If your security system settings prevent you from accessing through PC, watch it on your mobile device.
- Viewing will be restricted when two or more people enter with the same ID.
- Only one device (PC or mobile) can enter.
- Avoid simultaneous access.
- Use of Chrome/ Safari/ Edge/ Firefox browser is recommended.
- Using Internet Explorer may restrict viewing or access.

Hybrid Conference Platform

- https://www.hpc2020.org
- ID/PW are the same as the HPC 2020 Website.
- It is highly recommended you use only Chrome, Safari, or Firefox to access the platform.
- The platform will be open from April 19, 2021 to May 1, 2021.

Full Papers

• After logging into the Hybrid Conference Platform, you can view the full papers of HPC 2020 by clicking the 'Proceedings' button at the top of the main page or clicking the 'Paper' button next to each presentation video.

♦ GENERAL INFORMATION

Opening Ceremony

Date/Venue	Tuesday, April 27, 2021, 09:00~09:20 (KST/UTC+9) Room A (Tamna Hall, 8F)		
Host	ost Taesung Kim (Sungkyunkwan University, South Korea)		
 Welcome Address Opening Remarks 	Stephan Renz (IEA HPT TCP Chair, Switzerland) Min Soo Kim (President of Society of Air-conditioning and Refrigerating Engineers of Korea, NOC Chair)		
Congratulatory Re	marks Won Hee-ryong (Governor of Jeju Province, South Korea)		

Closing Ceremony

Date/Venue	Thursday, April 29, 2021, 16:00~17:00 (KST) Room A(Tamna Hall, 8F)
Host	Minsung Kim (Chung-Ang University, South Korea)

Opening Speech	Per Jonasson (IOC Chair)
Award Ceremony	Per Jonasson (IOC Chair)
- Ritter von Rittinger Award	
- Global Student Video Competition	
 Conference Report & Closing Speech 	Minsung Kim (Secretary General)
 The 14th IEA Heat Pump Conference (HPC 2023) 	Brian A. Fricke (Chair of U.S. National Organizing Committee)
Closing Remarks	Minsung Kim (Secretary General)

Session Chair

Guideline

% Important Notice

- $\cdot\,$ We recommend the session chairs to check the **network condition** before the session.
- · Use a high-speed network for a stable connection to the meeting.
- · Use a **headset** to minimize any noise issues.
- · Please try to find a **quiet environment** and maintain the environment during a session.
- · Please note that photo taking and video recording are strictly prohibited.
- · Please visit the zoom help center to get more information : https://support.zoom.us/hc/en-us
- For detailed instructions as follows, please refer to our website.
 Initial Setup / Before Session / During Session / During Q&A/ After Session

• List of Session Chairs and Schedule

* Time: The live stream schedule is based on Korea Standard Time (KST / UTC +9)

No.	Chair	Affiliation	Country	Date	Time*	Room
1	Akio Miyara	Saga University	JP	Tue., April 27	S 01 : 13:00~14:20	Room C
2	Bamdad Bahar	Xergy	US	Thur., April 29	S 10 : 10:40~12:00	Room B
3	Benjamin Zühlsdorf	Danish Technological Institute	DK	Wed., April 28	S 08 : 16:10~17:30	Room C
4	Bin Hu	Shanghai Jiao Tong University	CN	Tue., April 27	S 01 : 13:00~14:20	Room A
5	Brian Fricke	Oak Ridge National Laboratory	US	Thur., April 29	S 10 : 10:40~12:00	Room A
6	Carsten Wemhöner	HSR University of Applied Sciences Rapperswil	CH	Wed., April 28	S 06: 13:00~14:20	Room B
7	Christoph Reichl	AIT Austrian Institute of Technology	AT	Tue., April 27	S 02 : 14:40~16:00	Room B
8	Didier Coulumb	IIR Director	FR	Tue., April 27	S 03 : 16:10~17:45	Room A
9	Eckhard Groll	Purdue University	US	Thur., April 29	S 09:09:00~10:20	Room C
10	Ed Vineyard	U.S. Department of Energy	US	Thur., April 29	S 09:09:00~10:20	Room B
11	Emina Pasic	IEA HPT ExCo Delegate Sweden	SE	Wed., April 28	S 08 : 16:10~17:30	Room B
12	Guoyuan Ma	Beijing University of Technology	CN	Thur., April 29	S 10:10:40~12:00	Room C
13	Hideaki Maeyama	Heat pump & Thermal Storage Technology Center of Japan	JP	Wed., April 28	S 05 : 10:40~12:00	Room A
14	Jeffrey Spitler	Oklahoma State University	US	Wed., April 28	S 04 : 09:00~10:20	Room B
15	Ji Hwan Jeong	Pusan National Univ.	KR	Thur., April 29	S 11: 13:00~14:20	Room B
16	Jun Young Choi	Korea Testing Laboratory	KR	Thur., April 29	S 11 : 13:00~14:20	Room A
17	Jussi Hirvonen	Finnish Heat Pump Association SULPU ry	FI	Tue., April 27	S 02:14:40~16:00	Room A
18	Marion Bakker	NL Delegate	NL	Thur., April 29	S 12 : 14:40~16:00	Room A
19	Masafumi Katsuta	Waseda University	JP	Wed., April 28	S 06:13:00~14:20	Room C
20	Maurizio Pieve	ENEA	IT	Tue., April 27	S 03 : 16:10~17:45	Room C
21	Michele Mondot	CETIAT	FR	Tue., April 27	S 02 : 14:40~16:00	Room C
22	Mitsuhiro Fukuta	Shizuoka University	JP	Tue., April 27	S 01:13:00~14:20	Room B
23	Peter Schossig	Fraunhofer ISE	DE	Wed., April 28	S 07 : 14:40~16:00	Room A
24	Rainer Jacobs	IZW e.V., Information Centre on Heat Pumps and Refrigeration	DE	Wed., April 28	S 07 : 14:40~16:00	Room C
25	Reinhard Radermacher	University of Maryland	US	Wed., April 28	S 04 : 09:00~10:20	Room C
26	Rolf-Iver Hagemoen	EHPA	NO	Thur., April 29	S 12:14:40~16:00	Room C
27	Sheng Wang	Gree Electric Appliances, Inc. of Zhuhai	CN	Wed., April 28	S 06 : 13:00~14:20	Room A
28	Signhild Gehlin	Swedish Geoenergi Center	SE	Wed., April 28	S 08 : 16:10~17:30	Room A
29	Sophie Hosatte	Natural Resources Canada - CanmetENERGY	CA	Thur., April 29	S 09:00~10:20	Room A
30	Stephan Renz/ Carina Alles	Beratung Renz Consulting/Swiss Federal Office of Energy	СН	Thur., April 29	S 12 : 14:40~16:00	Room B
31	Svend Pedersen	Danish Technological Institute	DK	Wed., April 28	S 07 : 14:40~16:00	Room B
32	Tetsushiro Iwatsubo	New Energy and Industorial Technology Development Organaization	JP	Wed., April 28	S 05 : 10:40~12:00	Room B
33	Thomas Fleckl	AIT Austrian Institute of Technology	AT	Tue., April 27	S 03:16:10~17:45	Room B
34	Van D. Baxter	Oak Ridge National Laboratory	US	Wed., April 28	S 05: 10:40~12:00	Room C
35	Veronika Wilks	AIT Austrian Institute of Technology GmbH	AT	Thur., April 29	S 11: 13:00~14:20	Room C
36	Yunho Hwang	University of Maryland	US	Wed., April 28	S 04:09:00~10:20	Room A

The 13th IEA Heat Pump Conference

Mission for the Green World

CONFERENCE INFORMATION

- Registration
- For Offline Participants
 - Conference Venue
 - Floor Plan
 - Wireless Internet
 - Lunch / Banquet / Coffee Break
- Peter Ritter von Rittinger International
 Heat Pump Award
- Global Student Video Competition

REGISTRATION

* Offline registration is not accepted for the safety of participants in accordance with the COVID-19 quarantine policy.

* Participants who have registered in advance should come to the 8th floor, Ramada Plaza Jeju Hotel to receive a name tag, Certificate of participation, program book, and a small gift from HPC 2020 NOC.

Registration Fee

- Considering the current COVID-19 pandemic situation, HPC 2020 will be held as a hybrid event; a combination of "live" face to face event and a "virtual" online component.
- HPC 2020 has decided to reduce registration fees to make the virtual conference widely accessible.

Category		Early Bird (~Jan. 31, 2021)	Regular (~Mar. 15, 2021)	Late (~Mar. 31, 2021)	Last Time (~April 29, 2021)
Offline	Regular	\$700	\$800	\$900 \$800	N/A
	Student	\$350	\$400	\$450 \$400	N/A
Online	Regular	\$350	\$400	\$600 \$400	\$600 \$400
	Student	\$175	\$200	\$300 \$200	\$300 \$200

* If you would like to change from offline to online participation, please contact secretariat at secretariat@hpc2020.org no later than April 1, 2021.

Offline Conference Registration

Domestic attendees are recommended to registration for the offline conference. Full registration includes access to all sessions, lunches, banquet, and break refreshments.

Online Conference Registration

International attendees who are not able to come to the conference will give their presentation by the video clip. The registrants can access all the sessions through the online portal.

Requirement of Paper Presentation

- In principle, at least one of the authors must register by January 30, 2021 in order for their papers to be included in the program of HPC 2020
- For authors presenting multiple papers, one registration is valid for rest presentations.

Cancellation and Refund Policy

Before applying for cancellation, please refer to the following policy

Date of Cancellation	Amount to be Refunded
Cancellation before February 28, 2021	Refundable but 75%
Cancellation between March 1 and March 30, 2021	Refundable but 50%
Cancellation after April 1, 2021	Non-refundable

• Note that for administrative reasons, refund will be made after the conference.

- All bank service charges will be deducted from the refunded amount.
- Any phone application will not be accepted, a request letter by email(secretariat@hpc2020.org) is required.

FOR OFFLINE PARTICIPANTS

Conference Venue

About Jeju



1,848.85km2. Jeju is the largest island in South Korea.

Jeju Island is the largest volcanic island in Korea and it has a mild oceanic climate throughout the year with the smallest annual temperature range in South Korea. Officially called Jeju Special Self-Governing Province, this best tourist destination boasts mild weather, as well as scenic beauties of beaches, waterfalls, cliffs and caves. The island is 73km wide and 31km long with a total area of

Mt. Halla rises in the center of Jeju to 1950m above sea level. The rest of the island slopes down from its summit and is covered with dark gray volcanic rocks and volcanic ash soil. Seongsan Ilchulbong Peak with breathtaking views is also one of the most scenic areas, and Manjanggul Cave, the world's longest lava tube has been registered as a UNESCO World Natural Heritage. Meanwhile, Jeju has recently won the Global Geopark certificate, and also has been selected as the New 7 Wonders of Nature.

Ramada Plaza Hotel Jeju



Located near the beautiful ocean at the center of Jeju city

The conference venue is 5 star hotel with 400 guest rooms and suites and a convention room with a meeting capacity of 1200 people. This country's first costal hotel built right on the ocean is located just five minutes away from Jeju International Airport and Jeju Port.

CONFERENCE INFORMATION

Transportation

The Hotel is located in 3.8 km away from Jeju International Airport. You can reach the hotel in ten minutes by taxi. No shuttle is provided. See the map below:



Ramada Plaza Jeju Hotel

- Address: 66 Topdong Ro, Jeju, 63165, Korea

- Tel: +82-64-729-8100

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FLOOR PLAN

8th Floor, Ramada Plaza Hotel Jeju



Lobby	Body Temperature MeasurementRegistration/Conference KitPoster Session	Tamna Hall	 Opening Ceremony Plenary Sessions Oral Presentation Closing Ceremony	
Halla Hall	Oral Presentation	Ora Hall	ll • Organizing Committee	
Ara Hall	Oral Presentation		(until noon on April 29,2021)	

Wireless Internet

Wireless internet is available for the participants at the conference venue. ID/PW will be informed on-site.

Lunch / Banquet / Coffee Break

Depending on the COVID-19 situation, Lunches, Banquet, and Coffee Breaks will be provided by applying the local Social Distancing Policy in Jeju at the time of the conference. The NOC is committed to the convenience of offline participants, and the secretariat will inform the details before the conference. We hope for your kind understanding on this matter.



RITTER VON RITTINGER AWARD

Peter Ritter von Rittinger International Heat Pump Award

Trittingerhe Peter Ritter von Rittinger International Heat Pump Award is the highest international award in the air conditioning, heat pump and refrigeration field and was introduced at the Las Vegas Conference (8th IEA HP Conference). This award highlights outstanding contributions to the advancement of international collaboration in research, policy development and applications for energy-efficient heat pumping technologies. It is awarded every three years in conjunction with the International Heat Pump Conference.

The Rittinger award is named for Peter Ritter von Rittinger who is credited with the design and installation of the first energy-conserving heat pump system at a salt works in Upper Austria in 1855.

The winners of the Ritter von Rittinger Award 2020 will be announced at the online homepage and closing ceremony.

2017	Prof. Eckhard A Groll, Prof. Alberto Cavallini, ORNL Building Equipment Team,		
2014	Prof. Per Lundqvist Mr. Frédy Burkhalter, Mr. Daniel Ellis, Dr. Andrew Pearson, Dr. Koichi Watanabe, Dr. Michel Bernier.		
2011	Prof. Per-Erling Frivik, Prof. Hermann Halozan, Mr. John D. Ryan.		
2008	Prof. Eric Granryd, Prof. Predrag S. Hrnjak, Mr Gerald C. Groff.		1
2005	Dr Bernard Spinner, Dr Katsuhiko Narita, Mr Nance C. Lovvorn, Research Team GEMINI, Mr. Wayne R. Reedy.	A Part	

Previous Awardees

WORKSHOP - ONLINE ONLY

Monday, April 26, 2021

1. Workshop A1 (20:00~22:00 KST/13:00~15:00 CEST/07:00~09:00 EDT)

Title	Annex 42 (HPs in smart grids) and Annex 45 (Hybrid HPs)	
Organizer	Peter Wagener (Business Development Holland, wagener@bdho.nl) Maarten Hommelberg (Business Development Holland, hommelberg@bdho.nl)	
Theme	 What role can hybrid HPs play in the energy transition and how can they contribute to smart grid success? Introduction into hybrid HPs The hybrid HP success story in the Netherlands First results from a hybrid HP monitoring campaign Hybrid HPs in a smart grid: great results from the Freedom Project (Wales, UK) 	
Speakers	Peter Wagener (BDH, Netherlands) Oliver Lancaster (Wales & West Utilities, Wales, UK)	

2. Workshop A2 (22:00~24:00 KST/15:00~17:00 CEST/09:00~11:00 EDT)

Title	Heat Pumps for Low GWP Refrigerants (Annex 54)
Organizer	Yunho Hwang (University of Maryland, USA)
Theme	Annex 54 aims at promoting the low GWP refrigerant application to accelerate phase down of high GWP HFCs via 1) a comprehensive review of recent R&D progress on component optimization using low-GWP refrigerants, 2) in-depth case studies of component optimization, which can provide design guidelines and real-world experiences.
Program	 "Introduction of IEA HPT's Annex 54 for Heat Pumps for Low-GWP refrigerants" by Yunho Hwang (University of Maryland, USA) "Experimental evaluation of R410A, R407C and R134a alternative refrigerants in residential heat pumps" by Pierre Pardo (CETIAT, France) "Modular and scalable heat pump models for the design process of heat pump systems" by Christian Vering (RWTH Aachen University, Germany) "Commercialization of R32 in a Window Type Air Conditioner for US Market and Split Air Conditioners for European Market" by Younghwan Ko (LGE Korea) "Comparitive analysis of propane heat pumps - a try to harmonize technical boundary conditions in world-wide projects" by Thore Oltersdorf, Peter Schossig, Lena Schnabel (ISE Fraunhofer, Germany) "Lower GWP Refrigerants for Heap Pump Application" by Samuel Yana Motta (Honeywell, USA)

3. Workshop B2 (22:00~24:00 KST/15:00~17:00 CEST/09:00~11:00 EDT)

Title	Annex 55 (combined with ECES Annex 34) on Heat Pumps and Storage
Organizer	Peter Wagener (Business Development Holland, wagener@bdho.nl) Maarten Hommelberg (Business Development Holland, hommelberg@bdho.nl)
Theme	 Heat pumps and energy storage in smart grids - how can we achieve better results by better integration of HP and storage components? Introduction to the goal and contents of the annex. Present status and latest annex results Recommendations for policy action
Speakers	Peter Wagener (BDH, Netherlands) Caroline Haglund-Stignor (RISE, Sweden) Liu Xiaobing (Oakridge National Laboratories, USA)

4. Workshop C1 (20:00~22:00 KST/13:00~15:00 CEST/07:00~09:00 EDT)

Title	Heat Pumps in Multi-Family Buildings for space heating and DHW (Annex 50)		
Organizer	Marek Miara (Fraunhofer ISE, Germany)		
Program	Time CEST	Speaker	Торіс
	13:00-13:20	Odile Cauret EDF – Research & Development	Presentation of the Multi-Family Buildings status in participating countries (results from the Task 1)
	13:20-13:40	Marek Miara Fraunhofer ISE	Presentation of the "solution matrix" as the main outcome of the Annex 50. From general categorization of solutions to the case studies.
	13:40-14:10	Charles Geelen Infinitus Energy Solutions Group, Andreas Zottl AIT Austrian Institute of Technology GmbH	Presentation of the "solution matrix" as the main outcome of the Annex 50. From general categorization of solutions to the case studies.
	14:10-14:30	Nicole Calame CSD INGÉNIEURS SA	Presentation of the case studies, different types of building and dedicated solutions
	14:30-14:50	Marco Simonetti Politecnico di Torino	New simulation approach – as simple as possible, as precise as required

5. Workshop C2 (22:00~24:00 KST/15:00~17:00 CEST/09:00~11:00 EDT)

Title	Design and integration of heat pumps for nZEB (Annex 49)	
Organizer	Prof. Carsten Wemhöner (Professor for Building system technologies Institute partner IET –Institute of Energy Technology, OST – Eastern Switzerland Univ. of Appl. Sciences)	
Theme	The workshop presents result of IEA HPT Annex 49 on heat pump application in nearly Zero energy buildings nZEB. Starting from the state of the art of nZEB results of heat pump monitoring in nZEB and simulation- based studies on design and control of heat pumps are presented. The workshop is concluded with developed multifunctional HP prototypes and lessons learned.	
Program	 nZEB definition and ambition level 15:00 - 15:10 Introduction and overview of IEA HPT Annex 49 (C. Wemhoener) 15:10 - 15:20 Swedish nZEB implementation and comparison of heating systems (O. Gustafsson) 15:20 - 15:35 Methodology to compare nZEB ambition level in different countries (F. Ochs) 	
	Case studies and optimisation of heat pumps in nZEB by monitoring/simulation15:35 - 15:50Group of eight buildings with low temperature heating grid (C. Betzold)15:50 - 16:05Vögelebichl Innsbruck – Monitoring and simulation of two multi-family houses with heat pump, PV and collectors (F. Ochs)16:05 - 16:20Monitoring of Energy plus buildings with different use (F. Bockelmann)	
	Prototype technologies and heat pump integration options	
	16:20 - 16:35Façade integrated PV-coupled heat pump system for space cooling (A. Heinz)16:35 - 16:50Integrated heat pump (IHP) prototypes for NZEB (V. Baxter)	
	Conclusions 16:50 – 17:00 Lessons learned (C. Wemhoener)	

6. Workshop D1 (20:00~22:00 KST/13:00~15:00 CEST/07:00~09:00 EDT)

Title	Comfort and Climate Box Solutions for warm and humid climates
Organizer	Heat Pump Centre, Oakridge National Laboratory (ORNL) and BDH (in the Netherlands)
Theme	The demand for comfort cooling is growing rapidly in many parts of the world, especially in emerging countries, and stated policies will not be able to curb electricity use for cooling, which is set to grow threefold by 2070 relative to 2019, according to IEA. There are great possibilities to increase the energy efficiency and the share of renewable electricity used for comfort cooling, by combining heat pumping technologies with energy storages and integrated control. The purpose of the workshop is to develop a proposal for a new international collaboration project (i.e. Annex) aiming at speed up deployment of such solutions, so called "Comfort and Climate Boxes" for warm and humid climates – solutions that are efficient, affordable, applicable and scalable.
Program	 Introduction to the theme and challenges - presentations General introduction - Monica Axell and Caroline Haglund Stignor, Heat Pump Centre "Low Carbon and Energy Efficient Cooling in Warm and Humid Areas" - Chiara Delmastro, IEA "Consumer awareness and use of energy efficient cooling applications in India" - Shika Bhasin, CEEW, India "Low Carbon and Energy Efficient Cooling in Warm and Humid Areas" - Wang Sheng, GREE, China "Challenges and opportunities to realize "Comfort and Climate Box solutions" in United States and Beyond" - Kashif Nawaz, ORNL, US Workshop session Presentation of draft Objectives and Scope of a future annex, Kashif Nawaz, ORNL, US Definition about tasks, means and deliverables from a future annex – group discussion Summary and next steps

CONFERENCE INFORMATION

7. Workshop D2 (22:00~24:00 KST/15:00~17:00 CEST/09:00~11:00 EDT)

Title	Large demonstration project for flexibility by heat pumps (Annex 57)
Organizer	Senior Consultant Svend Pedersen (Danish Technological Institute, Denmark)
Theme	Annex 57 aim is to focus on the implementation of heat pumps in district heating and cooling systems. The main focus areas are 1) the creation of possible flexibility in the thermal network and electrical grids. 2) the possibilities of increasing larger share of renewable energy and excess heat as well as to reduce the CO2 emissions in the heating systems by using heat pumps.
Program	 "Introduction of IEA HPT's Annex 57 Flexibility by implementation of heat pump in multi-vector energy systems and thermal networks" by Svend Pedersen Danish Technological Institute "Hybrid Energy Networks in a international and national perspective" by Peter Sorknäs Aalborg University "Experiences from creation of flexibility with heat pumps in district heating grids" by Wibke Messenburg Danish technical University "Potentials of flexible heat pump operation on a district scale" by DrIng. Young Jae Yu Discussion

♦ GLOBAL STUDENT VIDEO COMPETITION

We would like to invite all students who will join our conference to participate in the HPC 2020 Global Student Video Competition. This competition provides an excellent opportunity to create a video that will be awarded at the conference. It aims to exchange creative ideas and relevant knowledge on the topics such as heat pump application, environmental issues, energy, or what students do in the laboratory. The winners, as listed below, will be announced online on the HPC 2020 conference website.

Awards

- Gold Medal (Overall championships) : \$300 Award and Certificate
- Silver Medal : \$200 Award and Certificate
- Bronze Medal : \$100 Award and Certificate

Important Dates

- March 15, 2021 Open submission for participants
- March 31, 2021 Closed Submission for participants
- April 15, 2021 Video Submission deadline (secretariat@hpc2020.org)
- April 18, 2021 Displayed on the conference homepage
- April 28, 2021 Announcement of the winners online at the conference website and closing ceremony.

Recommended Categories

- Heat pump applications
- Environmental issues
- Energy
- Research activity in the laboratory
- Etc.

Submission

The competition is open for the students who have finished registration for the HPC 2020.

Students who wish to participate in this competition, please submit the form below through the link below by March 31, 2021.

- Format : Presentation files will be accepted in MP4
- Presentation Time : Less than 3 minutes
- Video Submission : secretariat@hpc2020.org by April 15, 2021.

The 13th IEA Heat Pump Conference

Mission for the Green World

PROGRAM INFORMATION

- Conference Topics
- Program at a Glance
- Session Timetable
 - Oral Session Tuesday, April 27, 2021

Wednesday, April 28, 2021

Thursday, April 29, 2021

- Poster Session April 27-29, 2021
- Plenary Lectures
- Keynote Lectures
- Technical Program
CONFERENCE TOPICS

Within the conference program, participants will encounter numerous cutting-edge presentations on the following issues:

- Recent Advances on Heat Pumping Technologies
- Environment-friendly Technology
- Systems and Components
- Field Demonstration and Multi-disciplined Applications
- Research and Development
- Policy, Standards, and Market
- International Activities

PROGRAM AT A GLANCE

* For detailed information about the workshop program on Monday, April 26, 2021, please refer to the page 29.

Date/Time N		Mon. April 26	Tuesday, April 27			We	Wednesday, April 28			Thursday, April 2	9	
Ses	sion Ro	om										
KST (UTC+9)	EDT (UTC-4)	CEST (UTC+2)	Online Workshop	Room A	Room B	Room C	Room A	Room B	Room C	Room A	Room B	Room C
08:30 ~ 09:00								Registration				
09:00	<mark>(Day -1)</mark> 20:00	02:00			Opening Ceremony 09:00~09:20 (KST)	I	Sessi	ion 4 : 09:00~10:20	(KST)	Se	ssion 9 : 09:00~10:20 (KST)
~ 10:00	~21:00	~ 03:00			Plenary Lecture 1 (Policy and market) 09:20~10:35 (KST)	L	Low GWP Refrigerants (3)	Ground Source and Storage	Sorption Heat Pumps (1)	Variable Refrigerant Flo Heat Pumps ar Air-conditioner	v Heat d Exchangers (2) s	Food Storage and Display
10:00 ~ 11:00	(Day -1) 21:00 ~22:00	03:00 ~ 04:00		Coffee	Break and Poster S	Session			Coffee Break and 10:20~10	d Poster Session 1:40 (KST)	ı	
					10:35~10:45 (KST)		Sessi	ion 5 : 10:40~12:00	(KST)	Se	sion 10 : 10:40~12:00	(KST)
11:00 ~ 12:00	<mark>(Day -1)</mark> 22:00 ~23:00	04:00 ~ 05:00			Plenary Lecture 2 (Technology) 10.45~12:00 (KST)	2	Low GWP Refrigerants (4)	Market and Policy for Heat Pumps (2)	Electrochemical Related	Sorption Heat Pumps (3)	Dehumidifcation Technology	Heat Pump Performance
12:00 ~ 13:00	(Day -1) 23:00 ~24:00	05:00 ~ 06:00					Lunch and P	oster Session 12:0	10~13:00 (KST)			
13:00 ~ 14:00	00:00 ~ 01:00	06:00 ~ 07:00		Ses	sion 1 : 13:00~14:20 (KST)	Sessi	ion 6 : 13:00~14:20	(KST)	Se	sion 11 : 13:00~14:20	(KST)
				Low GWP Refrigerants (1) - Natural	Air Conditioning and Cooling	Heat Pump Applications	Heat Transfer	Residential Heat Pumps	Heat Exchangers (1)	Industrial Hea Pumps (2)	Heat Pumps in HVAC systems	Advanced Controls and Modelling
14:00 ~ 15:00	01:00 ~ 02:00	07:00 ~ 08:00					Coffee Break an	d Poster Session	14:20~14:40 (KST)			
				Ses	sion 2 : 14:40~16:00 (KST)	Sessi	ion 7 : 14:40~16:00	(KST)	Se	ssion 12 : 14:40~15:45	(KST)
15:00 ~ 16:00	02:00 ~ 03:00	08:00 ~09:00		Market and Policy for Heat Pumps (1)	Acoustics Signatures of Heat Pumps	Space and Hot Water Heat Pumps	Sorption Heat Pumps (2)	Heat Pumps in Smart Grids and District Heating and Cooling Systems (1)	Industrial Heat Pumps (1)	Heat Pumps combined with Thermal Energ Strorage and Recovery	¹ Nearly Zero ^y Energy Buildings	Smart Applications of Heat Pumps
						Break 16:00	~16:10 (KST)				Break 15:45~16:00 (KS	T)
~ 17:00	~ 04:00	~ 10:00		Sess	sion 3 : 16:10~17:30 (KST)	Sessi	ion 8 : 16:10~17:30	(KST)		Closing Ceremony 16:00~17:00 (KST)	
17:00 ~18:00	04:00 ~ 05:00	10:00 ~ 11:00		Low GWP Refrigerants (2)	Heat Pump Analysis - components and cycles	New Heat Pump Technologies	Ground Source Heat Pumps	Heat Pumps in Smart Grids and District Heating and Cooling Systems (2)	High Temperature Heat Pumps			
18:00 ~ 20:00	05:00 ~ 07:00	11:00 ~ 13:00								Session	Presentation	
20:00 ~ 22:00	07:00 ~ 09:00	13:00 ~ 15:00	Workshop A1/C1/D1								EDT (for American)	
			,,								EDT/KST (for America	an and Asian)
22:00 ~ 24:00	09:00 ~ 11:00	15:00 ~ 17:00	Workshop A2/B2/C2/D2								KSI/CEST (for Asian CEST (for Europian)	and Europian)

SESSION TIMETABLE - ORAL SESSION

Date/Time		9	Tuesday, April 27, 2021							
Se	ssion Roo	om								
KST (UTC+9)	EDT (UTC-4)	CEST (UTC+2)	Room A	Room B	Room C					
08:30 ~ 09:00			Registration							
				Opening Ceremony 09:00~09:20 (KST)						
09:00 ~ 10:00	(Apr. 26, Mon)	02:00	Welcome Address (Stephan F	Renz / IEA HPT TCP Chair) / Opening Remark (Min Soo Kim / N	IOC Chair, President of SAREK / South Korea)					
	20:00	~ 03:00	Plenary Lecture 1 (Policy and Market) 09:20~10:35 (KST)							
	~ 21:00		Plenary Lecture 1-1	Heat Pumping Technologies in Clean Energy Transitions (Mechtild Worsdorfer / Director for Sustainability, Technology and C	Dutlooks / IEA)					
			Plenary Lecture 1-2	The European Legal Framework is Well Set for a Massive F (Martin Forsen / President of EHPA (European Heat Pump Associati	Roll-out of Heat Pumps - but More Efforts are Needed!					
10:00	(Apr. 26, Mon)	03:00	Plenary Lecture 1-3 Korean Policy for Green World and Heat Pumping Technologies (Min Soo Kim / NOC Chair, President of SAREK / South Korea)							
~ 11.00	~ 22:00	~ 04.00		Coffee Break and Poster Session 10:35~10:45 (KS	ST)					
				Plenary Lecture 2 (Technology) 10:45~12:00 (KS	Τ)					
	(Apr 26		Plenary Lecture 2-1	Heat Pump System Technology Trend (Saikee Oh/ Executive Vice President, Center Director of LG Electron	ics / South Korea)					
11:00 ~ 12:00	Mon) 22:00	04:00 ~ 05:00	Plenary Lecture 2-2	Ensuring a Safe Refrigerant Transition (Xudong Wang/ Vice President of AHRI/US)						
	~ 23:00		Plenary Lecture 2-3	Clean and Safe Air by HVAC systems – Laws and Advanced (Nohoni Kagawa / Professor of National Defense Academy / Janan	Technologies in Japan					
	(Apr. 26,			(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,						
12:00 ~ 13:00	Mon 23:00 ~ 24:00	05:00 ~ 06:00		Lunch and Poster Session 12:00~13:00 (KST)						
				Session 1:13:00~14:20 (KST)						
			Low GWP Refrigerants (1) - Natural	Air Conditioning and Cooling	Heat Pump Applications					
	00:00 ~ 01:00	06:00 ~ 07:00	Keynote (125) Bin Hu	Keynote (356) LBN Poddy	Keynote					
13.00 ~ 14:00			Shanghai Jiao Tong University	Department of Science and Technology, Government of India	Korea Institute of Energy Research					
			(297) Takaoki Suzuki Wasoda University	(113) Jae Yeon Kim Huundai Motors / Sungkaunkwan University	(180) Tommy Walfridson					
			(136) Sergio Maria Capanelli	(035) Myung Sup Yoon	(343) Takenobu Kaida					
			Carel Industries Spa	Korea Testing Laboratory	Central Reseach Institute of Electric Power Industry					
	01:00		(170) Valentin Salgado Fuentes Technical University of Denmark	(245) Inguk Hwang Hanonsystems	(117) Yu-Jia He Tongji University					
14:00		07:00 ~ 08:00	(172) Manuel Verdnik Graz University of Technology	(262) Dae Bok Keon Hanon System	(134) Ivan Malenkovic Fraunhofer Institute for Solar Thermal Systems (ISE)					
~ 15:00	~ 02:00			Coffee Break and Poster Session 14:20~14:40 (KS	ST)					
				Session 2:14:40~16:00 (KST)						
			Market and Policy for Heat Pumps (1)	Acoustic Signatures of Heat Pumps	Space and Hot Water Heat Pumps					
			(267) Thomas Nowak	(192) Gerwin Drexler-Schmid	(079) Emilio Navarro-Peris					
			European Heat Pump Association aisbl	Austrian Institute of Technology	Universidad Politecnica de Valencia					
			(150) Cate Lyon Delta Energy & Environment	(068) Christian Vering RWTH Aachen University	(059) Cordin Arpagaus NTB University of Applied Sciences and Technology Buchs					
15:00 ~ 16:00	02:00 ~ 03:00	08:00 ~ 09:00	(238) Martin Forsen	(160) Thomas Fleckl	(255) Omar Montero Dominguez					
			(164) Jussi Hirvonen	AIT Austrian Institute of Technology (088) Thomas Eleckl	(273) Elliot Romano					
			Finnish Heat Pump Association SULPU ry	AIT Austrian Institute of Technology	University of Geneva					
			(352) Therese Guttmann Austrian Institute of Technology	(184) Ola Gustafsson RISE Research Institutes of Sweden	(270) Carolina Fraga Services Industriels de Geneve					
				Break 16:00~16:10 (KST)						
				Session 3 : 16:10~17:30 (KST)						
16:00	03.00	00.00	Low GWP Refrigerants (2)	Heat Pump Analysis - components and cycles	New Heat Pump Technologies					
~ 17:00	~ 04:00	~ 10:00	Keynote	Keynote	Keynote					
			(357) Didier Coulomb International Institute of Refrigeration	(067) Constantin Zenz Austrian Institute of Technology	(100) Andreas Langauer ecop Technologies GmbH					
			(247) Laure Meljac NIBF	(108) Emilio Navarro-Peris Universidad Politecnica de Valencia	(272) Dominic Zajonc Lucerne University of Applied Sciences and Arts					
			(141) Kenneth Hoffmann	(050) Hai Trieu Phan	(229) Melanie Cop					
17:00	04:00	10:00	GEA Retrigeration	French Atomic Energy and Alternative Energy Commission CEA	(163) Ryosuke Superitor					
~ 17:30	~ 04:30	~ 10:30	Arkema inc.	Graz University of Technology	Mitsubishi Heavy Industries Thermal Systems, Ltd.					
			(214) Manmood Thabaddor Underwriters Laboratories LLC	(179) Laura Maier RWTH Aachen University	الالالالالالالالالالالالالالالالالالال					

SESSION TIMETABLE - ORAL SESSION

Session Room Room A Room A KST EDT CEST Room A Room B 09:30 - Registration Registration 09:30 - Session 4: 09:00-10:20 (KST) 09:00 U 02:00 Cound Source and Storage 09:00 U 02:00 Cound Source and Storage 09:00 U 02:00 Cound Source and Storage - Keynote Keynote Keynote - Cound Cound Source and Storage Cound Source and Storage Cound Source and Storage - 00:00 10:00 Oak Ridge National Lab Oak Ridge National Laboratory - 00:00 Cound Source and Storage Cound Cound Source and Storage - 00:00 Cound Source and Storage Cound Cound Source and Storage - 00:00 Cound Source and Storage Cound Cound Source and Storage - 00:00 Cound Source and Storage Cound Cound Source and Storage - 00:00 Cound Source and Storage Cound Cound Source and Storage	Room C Sorption Heat Pumps (1) Keynote (203) Bandad Bahar Xergy Inc. (206) Kyle Gluesenkamp Oak Ridge National Laboratory Oak Ridge National Laboratory (201) Zhiyao Yang Purdue University Electrochemical Related Keynote (201) Bandad Bahar Xergy Inc. (209) Viral K. Patel Oak Ridge National Laboratory (204) Bandad Bahar Xergy Inc. (209) Viral K. Patel Oak Ridge National Laboratory (204) Ridge National Laboratory (204) Bandad Bahar Xergy Inc. (209) Viral K. Patel Oak Ridge National Laboratory (204) Bandad Bahar Xergy Inc. (209) Viral K. Patel Oak Ridge National Laboratory (204) Bandad Bahar Xergy Inc. (209) Viral K. Patel Oak Ridge National Laboratory (204) Bandad Bahar Kergy Inc. (209) Viral K. Patel Oak Ridge National Laboratory (204) Bandad Bahar Kergy Inc. (201) Bandad Bahar Kergy Inc. (201) Bandad Bahar Kergy Inc. (201) Contemposity (201) Contemposit
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22:00 22:00 23:00 2	(124) Gabyong Kim Korea University (014) Bamdad bahar Xergy Inc.
(336) Jong-Taek Un (010) Melissa Lapsa Chonnam National University Oak Ridge National Laboratory	(350) Joohee Song Chung-Ang University
(Apr: 27,: (Apr: 27,: 12:00 Tue) 05:00 ~ 13:00 ~ 06:00 - 06:00 ~ 24:00 Lunch and Poster Session 12:00~13:00 (KST)	
Session 6: 13:00~14:20 (KST)	
Heat Transfer Residential Heat Pumps	Heat Exchangers (1)
Keynote Keynote Keynote 13:00 00:00 06:00 (022) Ji Hwan Jeong (168) Carsten Wemhoener ~ 14:00 ~ 01:00 ~ 07:00 Pusan National University HSR University of Applied Sciences Rapperswil (345) Riku Fukuju (275) Marek Miara (275) Marek Miara	(244) Masafumi Katsuta Waseda University (335) Zhanpeng Liu
The University of Electro-Communications Fraunhofer ISE (279) Sho Fukuda (047) Minsu Park Kurchu Sameu Luisverthy (165) Electronice	Tongji University (140) Jin Woo Yoo Koroa Institute of Machinery and Materials
(294) Chan Ho Jeong (093) Yujin Hwang Chung-Ang University Hanyang university (312) Youngsuk Nam (127) Xingyu Liang Kyung Hee University Toppil	(334) Tiantian Wang Tongji University (316) Andreas Karageorgis FlvalHalcor Company
14:00 02:00 08:00 Coffee Break and Poster Session 14:20~14:40 (KST)	
Session 7:14:40~16:00 (KST)	
Sorption Heat Pumps (2) Heat Pumps in Smart Grids and District Heating and Cooling Systems (1)	Industrial Heat Pumps (1)
Keynote Keynote Keynote Keynote 15:00 02:00 (308) Carlos Infante Ferreira 15:00 02:00 08:00 Consiglio Nazionale delle Ricerche 16:00 03:00 09:00 Fraunhofer Institute for Adam Thereina Systems (ISE) Delft University of Technology 16:00 03:00 09:00 Fraunhofer Institute for Solar Thermal Systems (ISE) Delft University of Technology (131) And Malenkovic (309) Carlos Infante Ferreira (309) Carlos Infante Ferreira * 16:00 03:00 09:00 Fraunhofer Institute for Solar Thermal Systems (ISE) Delft University of Technology (341) Hail Trice Phan (253) Nicky Cowan French Atomic Energy and Alternative Energy Commission CEA	(004) Tor-Martin Tveit (004) Tor-Martin Tveit Olvondo Technology AS (103) Miguel Ramirez Stefanou Tecnalia (156) Andrew Marina TNO (216) Cordin Arpagaus NTB University of Apolied Sciences and Technology Buchs
(191) Oliver Ziegler (151) Cate Lyon Technische Universität Dresden Delta Energy & Environment Break 16:00~16:10 (KST)	(306) Carlos Infante Ferreira Delft University of Technology
Session 8 : 16:10-17:30 (KST) 16:00 03:00 09:00 Ground Source Heat Pumps Heat Pumps in Smart Grids and District Heating and Cooling Systems (2) ~17:00 ~04:00 10:00 Keynote Keynote	High Temperature Heat Pumps Keynote
(045) Signhild Gehlin (072) Thibault Péan Swedish Geoenergi Center IREC (098) Michael Lauermann (329) Torben Funder-Kristensen ATT Austrian Institute of Technology GmbH Danfoss A/S	(104) Miguel Ramirez Stefanou Tecnalia (062) Cordin Arpagaus NTB University of Applied Sciences and Technology Buchs
17:00 04:00 10:00 (243) Franziska Bockelmann (043) Stephan Göbel 17:00 04:00 10:00 (351) Kamil Kwatkowski (131) Marius Lindahl ~ 18:00 ~ 05:00 ~ 11:00 Euros Energy RISE Research Institutes of Sweden (301) Wim Boydens boydens engineering boydens boydens	(075) Veronika Wilk AIT Austrian Institute of Technology GmbH (340) Johannes Oehler German Aerospace Center (DLR) (097) Sabrina Dusek Austrian Institute of Technology GmbH

SESSION TIMETABLE - ORAL SESSION

	Date/Time	2	Thursday, April 29, 2021						
S	ession Roo	m							
KST (UTC+9)	EDT (UTC-4)	CEST (UTC+2)	Room A	Room B	Room C				
08:30 ~ 09:00			Registration						
				Session 9:09:00~10:20 (KST)					
			Variable Refrigerant Flow Heat Pumps and Air-conditioners	Heat Exchangers (2)	Food Storage and Display				
09:00 ~ 10:00	(Apr. 29, Wed) 20:00	02:00 ~ 03:00	Keynote (210) Fatih Meral Purdue University	Keynote (109) Zhenning Li University of Maryland	Keynote (122) Koji Yamashita JRAJA				
	~ 21:00		(112) Aziz Mbaye Polytechnique Montréal	(332) Haotian Liu Purdue University	(250) Koichi Kitamura Waseda University				
			(196) Hanlong Wan University of Maryland	(344) Haruki Mitarai The University of Electro-Communications	(286) Chenghao Wei The University of Tokyo				
			(082) Riley Barta Purdue University	(314) Shehryar Ishaque Kyungpook National University	(025) Bamdad Bahar Xergy Inc.				
10:00	(Apr. 29, Wed)	03:00	(283) Ammi Amarnath Electric Power Research Institute	(110) Jiazhen Ling University of Maryland	(027) Bamdad Bahar Xergy Inc.				
~ 11:00	21:00 ~ 22:00	~ 04:00		Coffee Break and Poster Session 10:20~10:40 (KST)					
				Session 10: 10:40~12:00 (KST)					
			Sorption Heat Pumps (3)	Dehumidifcation Technology	Heat Pump Performance				
	(Apr. 29, Wed) 22:00 ~ 23:00	04:00 ~ 05:00	Keynote (086) Jae Dong Chung Sejong University	(003) Minsung Kim Chung-Ang University	(130) Katsumi Hashimoto Central Research Institute of Electric Power Industry				
			(049) Ding Lu	(026) Bamdad Bahar	(346) Parveen Dhillon				
11:00			(095) Jae-hee Lee	(090) Hyejin Cho	(123) Gulsun Demirezen				
~ 12.00			Hanyang University	Hanyang University	Ryerson University				
			(118) Gawon Lee Korea University	Hanyang University	Purdue University				
			(094) Soo-Jin Lee Hanyang University	(054) Bamdad bahar Xergy Inc.	(101) Jia-Hao Cheng Tongji University				
12:00 ~ 13:00	(Apr. 29, Wed) 23:00 ~ 24:00	05:00 ~ 06:00	Lunch and Poster Session 12:00~13:00 (KST)						
		0 06:00 00 ~ 07:00		Session 11: 13:00~14:20 (KST)					
	00:00 ~ 01:00		Industrial Heat Pumps (2)	Heat Pumps in HVAC systems	Advanced Controls and Modelling				
12:00			Keynote (322) Jongsoo Jeong	Keynote (092) Hye-Won Dong	Keynote (096) Yong Hwan Fom				
~ 14:00			Waseda University	Hanyang University	Seoul National University				
			(232) Soo Kwang Yang Pusan National University	(071) Lei Wang Beijing University of Technology	(339) Myung Sup Yoon Korea Testing Laboratory				
			(342) Mehdi Rasti Pusan National University	(175) Mara Magni UIBK	(236) Myung Sup Yoon Korea Testing Laboratory				
			(241) Dominik Seliger TU Wien	(145) Tzu Wei Yeh Kokushikan University	(032) Xiangfei Liang Gree Electric Appliances, Inc. of Zhuhai				
14:00	01:00		(271) Raphael Agner Lucerne University of Applied Sciences and Arts	(224) Korbinian Kramer Fraunhofer ISE	(074) Philipp Mehrfeld RWTH Aachen University				
~ 15:00	~ 02:00	~ 08:00		Coffee Break and Poster Session 14:20~14:40 (KST)					
				Session 12: 14:40~15:45 (KST)					
			Heat Pumps combined with Thermal Energy Strorage and Recovery	Nearly Zero Energy Buildings	Smart Applications of Heat Pumps				
			Keynote (178) Klemens Marx	Keynote (167) Carsten Wemhoener	Keynote (268) Thomas Nowak				
			AIT Austrian Institute of Technology	HSR University of Applied Sciences Rapperswil	European Heat Pump Association aisbl				
15:00	02:00	08:00	(307) Carlos Infante Ferreira Delft University of Technology	(066) Fabian Ochs University of Innsbruck	(203) Lena Schnabel Heating and Cooling Technologies				
~ 16.00	~ 03.00	~ 09.00	(008) Franziska Bockelmann	(042) Christina Betzold	(183) Ola Gustafsson				
			(254) Simon Callegari University of Geneva	(165) Carsten Wemberg Georg Simon Onm HSR University of Applied Sciences Rapperswil	(310) Aziz Mbaye He-Tech Suisse				
10:00	00.00	00:00		Break 15:45~16:00 (KST)					
16:00 ~ 17:00	03:00 ~ 04:00	09:00 ~ 10:00		Closing Ceremony 16:00~17:00 (KST)					
				Closing continuity 10:00 11:00 (1/31)					

SESSION TIMETABLE - POSTER SESSION

April 27-29, 2021

No.	Paper No.	Name	Affiliation
Track 1	Residential	and Building applications	
1	013	Shuxue Xu	Beijing University of Technology
2	069	Christian Vering	RWTH Aachen University
3	258	Jong Min Choi	Hanbat National University
4	260	Yechan Yun	Kookmin University
5	291	Chenxi Ni	Hefei University of Technology
6	311	Jonathan Ore	Purdue University
7	162	Carsten Wemhoener	HSR University of Applied Sciences Rapperswil
8	269	Miwako Fujita	Chubu Electric Power, Co., Inc.
9	331	Nobuhiro Takahashi	Japan Facility Solutions, Inc
10	031	Xiangfei Liang	Gree Electric Appliances, Inc. of Zhuhai
Track 2	Smart Ener	gy Systems and Renewables	
11	039	Euy-Joon Lee	Korea Institute of Energy Research
12	315	Junhyun Cho	Korea Institute of Energy Research
13	348	Rho Kyo Heon	Chung-Ang University
14	285	Lingyan Yang	China Academy of Building Research
15	070	Jussi Alpua	Oilon Oy
Track 3	3: Air-Conditio	oning & Industry	
16	147	Hiroshi Nakayama	Chubu Electric Power co.,Inc.
17	148	Hiroyuki Miyazaki	Chubu Electric Power Co.,Inc
18	321	Youngju Joo	SAMSUNG ELECTRONICS
19	353	Sun-Ik Na	Seoul National University
20	354	Gu Hwang Kang	Seoul National University
21	227	Chulwoo Roh	Korea Institute of Energy Research
22	248	Xlaohui Yu	Hebei University of Technology
23	288	Yunchan Shin	Chosun University
24	347	Xiaoning Chen	Emerson Research and Solutions Center
Track 4	l: Working Flu	uids and Advances	
25	355	Jinwook Lee	Chung-Ang University
26	349	Minsoo Kim	Chung-Ang University

Plenary Session 1-1: Policy and market

- Date/Time : Tuesday, April 27, 2021, 09:20~09:45 (KST/UTC+9)
- Venue: Room A (Tamna Hall, 8F)
- Session Chair : Taesung Kim (Sungkyunkwan University, South Korea)



Heat Pumping Technologies in Clean Energy Transitions

Mechthild Wörsdörfer IEA Director of Sustainability, Technology and Outlooks, France

Abstract

Heating and cooling in buildings account for almost 15% of total global energy-related CO2 emissions, or 5 gigatons per year. While nearly 60% of global buildings heat provision relies on direct fossil fuel combustion, heat pumps could already supply more than 90% of heat demand with a lower carbon footprint than any fossil alternative. The deployment of heat pumps in new, well-insulated buildings in many places such as the United States or Europe shows that the heat pump market is taking off. Yet, deployment is uneven across market segments. To meet the Paris Agreement, the IEA defined a 3-pillar action plan. First, achieving greater deployment rates across all applications (including in retrofits, district energy systems and industrial processes) would tap into early emissions reduction opportunities. Second, the integration of heat pumps with power systems is essential to ensure their scalability and operability with high shares of variable renewables in the electricity generation mix. Last, enhancing heat pumps is key so that they could become multi-service providers that can operate in a variety of climate contexts (such as hot and humid, cold or multi-seasonal climates) while taking advantage of next generation designs (such as refrigerant-free, evaporative or solid-state applications).

Biography

Heating Mechthild Wörsdörfer (@MWorsdorfer) joined the IEA on 1 October 2018 as Director of Sustainability, Technology and Outlooks (STO). Ms Wörsdörfer plans and co-ordinates the IEA's work on energy sustainability, encompassing clean energy technologies and climate change policy. Previously, Mechthild held several senior management positions in the European Commission, where she coordinated the work on the 2030 Energy and Climate Framework, the Clean Energy Package and the 2050 Energy Roadmap. She had been involved with the IEA for a number of years as IEA Governing Board Representative for the EU, and served in the Cabinet of Commissioners, in charge of industry, competitiveness, trade and digital economy.

Plenary Session 1-2: Policy and market

- Date/Time : Tuesday, April 27, 2021, 09:45~10:10 (KST/UTC+9)
- Venue: Room A (Tamna Hall, 8F)
- Session Chair : Taesung Kim (Sungkyunkwan University, South Korea)



The European Legal Framework is Well Set for a Massive Roll-out of Heat Pumps - but More Efforts are Needed!

Martin Forsén

President of European Heat Pump Association, Sweden

Abstract

The present European Commission has, since they entered office in 2019, significantly raised the ambition in policies related to energy and climate actions. The European green deal including a European renovation wave of buildings, circular economy action plan and a strategy for energy system integration are all essential parts of the plan to make Europe the first climate neutral continent by 2050. The aim of the renovation wave is to double the current rate of renovation. Renovations shall be implemented adhering to the energy efficiency first principle as well as the need to decarbonize while increasing the use of renewable energy sources. Electrification of the heating sector will play a central role and in particular by a wide introduction of heat pumps. The energy system integration strategy is expecting an increase of the share of electricity-based heating to double by 2030 and to reach 50-70% by 2050. The tremendous push for decarbonization and electrification will have considerable impact on the revision of existing regulations. This presentation will give an overview of the overarching targets, policies and ongoing revisions of existing regulations as well as the possibilities and challenges faced by the heat pump industry.

Biography

Martin received his Master of Science in mechanical engineering at the Royal Institute of Technology in Stockholm 1997. After a short time at the electric utility company Vattenfall he got back to the university as a researcher, where he stayed until he was hired as President of the Swedish Heat Pump Association 2003. After ten years at the association, Mr Forsén was recruited as Manager International Affairs for NIBE in 2013. Mr Forsén has for the last decade been an active member of the European Heat Pump Association. He has been a member of the board for several years and serves as President for the Association.

Plenary Session 1-3: Policy and market

- Date/Time : Tuesday, April 27, 2021, 10:10 ~10:35 (KST/UTC+9)
- Venue: Room A (Tamna Hall, 8F)
- Session Chair : Taesung Kim (Sungkyunkwan University, South Korea)



Korean Policy for Green World and Heat Pumping Technologies

Min Soo Kim

President of Society of Air-conditioning and Refrigerating Engineers of Korea, NOC Chair, South Korea

Abstract

Responses to climate change have permeated everyday life in the 21st century, as countries are increasingly faced the threat of global warming and natural disasters. Even in the wake of the COVID-19 pandemic, attitudes towards climate change have been mostly unanimous as international cooperation remains tight.

Governments are increasingly implementing green policies in an effort to reduce emissions and to stimulate economic recovery. Recently, U.S. released a climate change plan worth USD1.7 trillion to completely phase out nonrenewable energy and achieve net-zero emissions by 2050. Meanwhile, China pledged to achieve carbon neutrality before 2060, hitting peak emissions before 2030. In Europe, the European Commission announced the European Green Deal as a community-wide policy in December 2019 to make Europe the world's first climate-neutral bloc by 2050.

South Korea also released the New Deal policy in 2020 amid the COVID-19 pandemic situation, outlining targets in renewable energy and ICT infrastructure through the Green New Deal and Digital New Deal. Through the Green New Deal, the Korean government will invest KRW73.4 trillion for transition to a low-carbon, green economy by making additional advancements in mobility, energy, and other supporting climate-friendly technology.

In 2019, renewable energy accounted for 15,791 MW of electricity in Korea, about 13% of total power generation. Out of this, solar energy accounted for 67% of the renewable energy. To accelerate the green transition, the Korean government announced a 3020 renewable energy plan by which it will generate 20% of energy from renewable sources by 2030. In addition, the Korean Hydrogen Roadmap will be used to build a hydrogen economy for the public and private sector by 2040.

To achieve net zero emissions, heating and cooling energy, which accounts for about half of total energy consumption, must be reduced. For this, a heat pump is essential; however, there are many obstacles to adequately supply heat pumps in Korea such as high gas permeability, low energy prices, and sedentary culture. As shown in the examples of geothermal and hydrothermal heat pumps, designation of renewable energy sources can promote the growth of the heat pump industry in Korea. The designation of renewable energy sources for heat pump covering all heat sources will be of paramount help in achieving the net-zero emissions.

Biography

Min Soo KIM received the B.S. (1985), M.S. (1987), and Ph.D. (1991) degrees in mechanical engineering at Seoul National University. He is a Professor of the Department of Mechanical Engineering at Seoul National University since 1994. He serves as chair of the Department of Mechanical Engineering including refrigeration and air conditioning. He spent three years from 1992 to 1994 at the National Institute of Standards and Technology (NIST) in U.S. as a guest researcher. He has more than 240 journal papers and more than 440 conference papers together with about 40 patents in the field of thermal engineering and refrigeration. He is a member of ASME, ASHRAE, IIR, KSME, and SAREK.

In 2010, he served as Policy Advisor to Minister of the Ministry of Education, Science and Technology, and during 2011-2013, he was a member of Presidential Advisory Council on Education, Science & Technology. He was delegate of Korea to the International Institute of Refrigeration (IIR), and he served as vice president of the Management Committee of IIR and serves now as president of the General Council of IIR.

He got the Outstanding Academic Award from the Society of Air-conditioning and Refrigerating Engineers of Korea (SAREK) in 2006, Asian Academic Award from SAREK/CAR/JSRAE (2012), Outstanding Academic Award from Korean Society of Mechanical Engineers (KSME) (2013), Best Industry-University Cooperation Award from the College of Engineering at SNU (2015), and Minister Award from the Ministry of Land, Infrastructure, and Transport (2016). He was designated as 70 Excellent PhDs of College of Engineering at Seoul National University (2016) and he received Presidential Citation by the Ministry of Public Administration and Security (2017).

Plenary Session 2-1: Technology

- Date/Time : Tuesday, April 27, 2021, 10:45 ~11:10 (KST/UTC+9)
- Venue: Room A (Tamna Hall, 8F)
- Session Chair : Taesung Kim (Sungkyunkwan University, South Korea)



Heat Pump System Technology Trend

Saikee Oh Executive Vice President / Center Director of LG Electronics, South Korea

Abstract

The role of heat pump in reducing greenhouse gases. Some fundamental bottlenecks of traditional air-source heat pumps. The cutting-edge heat pump technology to overcome these problems.

Biography

Education

Department of Mechanical Engineering

- Bachelor : Seoul National University (~Fab. 1989)
- Master: KAIST (~Fab. 1991)
- Ph.D.: KAIST (~Fab. 1997)

Professional Activities

LG Electronics

- H&A R&D Center Director (2020~)
- Air Solution R&D Lab. Director (2018 ~ 2019)
- System Air Conditioning Research / Engineering Division Leader (2014 ~ 2017)
- Air Conditioning & Energy Solution Lab. Director (2013)
- Entering LG Electronics (Mar. 1994)

Research Interests

Department of Mechanical Engineering

- Inverter Heat Pump (Air to Air, Air to Water)
- Indoor Air Quality
- Energy Saving HVAC Control

Plenary Session 2-2: Technology

- Date/Time : Tuesday, April 27, 2021, 11:10~11:35 (KST/UTC+9)
- Venue: Room A (Tamna Hall, 8F)
- Session Chair : Taesung Kim (Sungkyunkwan University, South Korea)



Ensuring a Safe Refrigerant Transition

Xudong Wang

Vice President of Air-Conditioning, Heating, and Refrigeration Institute, United States

Abstract

The global industry is transitioning to environmentally friendly low global warming potential (GWP) refrigerants. To date, most of promising low GWP refrigerants are flammable. Implementation of these refrigerants in the field requires necessary steps to ensure safety. The presentation will summarize the US industry activities on transitioning to low GWP refrigerants. The content will cover the current status on relevant code and standard development, research and remaining efforts needed in the transition to low-GWP refrigerants in the future.

Biography

Dr. Xudong Wang is the vice president of research at AHRI. He closely works with AHRI Members to develop research programs addressing common issues and challenges that the HVACR industry faces. He has initiated and managed multiple research programs related to assess low GWP refrigerants' performance, compatibility and safety. He holds a Ph.D. in Mechanical Engineering from the University of Maryland at College Park. Dr. Wang is a member of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers ASHRAE.



Plenary Session 2-3: Technology

- Date/Time : Tuesday, April 27, 2021, 11:35 ~12:00 (KST/UTC+9)
- Venue: Room A (Tamna Hall, 8F)
- Session Chair : Taesung Kim (Sungkyunkwan University, South Korea)



Clean and Safe Air by HVAC systems – Laws and Advanced Technologies in Japan

Noboru Kagawa

Professor of National Defense Academy, Japan

Abstract

Experience of health problems and pandemics changes the design of HVAC systems frequently. Accumulated knowledge can improve the HVAC technologies. Related laws and new technologies in Japan will be overviewed.

Biography

Prof. Noboru Kagawa is a Technical adviser and the former president of the Japan Society of Refrigerating and Air Conditioning Engineers, JSRAE, a member of the Executive committee and the Management committee of IIR, and the Leadership councillor of ASHRAE AASA. He works as a professor in Department of Mechanical Systems Engineering of National Defense Academy of Japan. His major fields of study are thermophysical properties of refrigerants, Stirling engine and refrigerator, and refrigerants management. He is also the chair of the 2nd IIR Conference of HFOs and Low GWP Blends, HFO2021 will be held at Osaka in June 2021.

♦ KEYNOTE LECTURES

Tuesday, April 27

• The Influence of Different Water-injection Methods on Water Vapor High Temperature Heat Pump

- Bin Hu (Shanghai Jiao Tong University, China)

• Next Stop: the Mass Market! Heat Pumps on the Verge of Large Scale Deployment in Europe

- Thomas Nowak (European Heat Pump Association AISBL, Belgium)

• The low-GWP refrigerant challenge

- Didier Coulomb (International Institute of Refrigeration, France)

• Air-Conditioning and Cooling

- J.B.V. Reddy (Government of India, India)

· Augmented Reality Acoustics of Air Heat Pumps - APP Development and Methods

- Gerwin H.S. Drexler-Schmid (AIT - Austrian Institute of Technology, Austria)

• Numerical Analysis of the Vortex Tube Characteristics Used Within a High Temperature Heat Pump

- Constantin Zenz (Austrian Institute of Technology, Austria)

 Development and Implementation of Industrial High Temperature Heat Pumps for Waste Scrubbing Process

- Gilbong Lee (Korea Institute of Energy Research, South Korea)

• Design of a Grey Water Heat Recovery System in Order to Satisfy the Domestic Hot Water Demand of a Block of Dwellings

- Emilio Navarro-Peris (Universidad Politecnica de Valencia, Spain)

Test Results of a Rotation Heat Pump and Further Developments

- Andreas Längauer (ecop Technologies GmbH, CEO, Austria)

Wednesday, April 28

Residential Split Heat Pump Using Low GWP Refrigerants

- Bo Shen (Oak Ridge National Lab, United States)

Disproportionation Risk Study for HFO-1123 Compositions as Low-GWP Refrigerants

- Hidekazu Okamoto (AGC Inc., Japan)

Numerical Simulation of Two-phase Flow Distribution in a Vertically Installed Refrigerant Distributor

- Ji Hwan Jeong (Pusan National University, South Korea)

Trends and Recent R&D Activities on Fuel Driven Sorption Heat Pumps

- Peter Schossig (Fraunhofer Institute Solar Energy Systems ISE, Germany)

Shifting Building Electric Demands	
- Xiaobing Liu (Oak Ridge National Laboratory, United S	States,
NEDO R&D Project for Innovative Thermal Management	
- Tetsusiro Iwatsubo (New Energy and Industrial Technology Development Organization (NEDO,	Japan,
ullet Evaluation of Solar Heat Source and Sink in Multi-functional Heat Pump Operation	
- Carsten Wemhoener (HSR University of Applied Sciences Rapperswil, Switze	erland,
Seasonal Thermal Energy Storage for Large Scale District Heating	
- Carlos Infante Ferreira (Delft University of Technology, Nether	lands,
 Impact of the Weather Forecast on a Predictive Controller Performance : Experimental Studies with a Residential Heat Pump for Space Cooling 	
- Thibault Péan (IREC, UPC, .	Spain,
Membrane-Based Air Dehumidification Using Organic Ionic Liquid Desiccant	
- Bamdad Bahar (Xergy Inc., United S	States,
An Overview of Hydrogen Compressors for Heat Pump Systems	
- Bamdad Bahar (Xergy Inc., United S	States,
 Study on the Frosting Phenomena between Concavity and Convexity Plate under Forced Convectio The Prediction of Frost Layer Growth using the Observation from the Frost and Defrost Multi-cycle Experiment 	n -
- Masafumi Katsuta (Waseda University, J	Japan,
ullet Environmentally Friendly Steam Generation Using VHTHPs at a Pharmaceutical Research Facility	
- Tor-Martin Tveit (Olvondo Technology AS, No	orway,

· Experimental Analysis of a High Temperature Heat Pump Using Stored Heat from a Solar Thermal System.

- Miguel Ramirez Stefanou (Tecnalia, Spain)

Thursday, April 29

· Impact of Variable Speed Components on the Seasonal Performance of a Residential Air-Source Heat Pump

- Fatih Meral (Purdue University, Ray W. Herrick Laboratories, United States)

· Effect of Evaporator and Condenser in the Analysis of Adsorption Chiller

- Jae Dong Chung (Sejong University, South Korea)

· Categorization of Industrial Heat Pump for Integrated Simulation Technology

- Jongsoo Jeong (Waseda University, Japan)

Half-term Results from IEA HPT Annex 52 - Long-term Performance Monitoring of Large GSHP Systems

- Signhild Gehlin (Swedish Geoenergi Center, Sweden)

A Novel Geothermal Heat Pump System Integrated with Underground Thermal Storage for

• Dynamic Performance Tests of a Heat Pump Cycle Integrated Latent Heat Thermal Energy Storage for Optimized DHW Generation

- Klemens Marx (AIT Austrian Institute of Technology, Austria)

 Refrigerant Circuitry Optimization of Heat Exchangers for Charge Reduction and Robust Performance in Reversible Heat Pump Application

- Zhenning Li (University of Maryland, United States)

 Comparison on Vacuum Membrane Dehumidification Systems with Moisture Selective Dense Membrane

- Minsung Kim (Chung-Ang University, South Korea)

• Working Fluid Selection of Organic Rankine Cycle for a Liquid Desiccant System

- Hye-Won Dong (Hanyang University, South Korea)

• Cost Optimized Design of Ground Probe Fields with Solar Regeneration

- Carsten Wemhoener (HSR University of Applied Sciences Rapperswil, Switzerland)

• Risk Assessment of Built-in Refrigerated Display Cabinet Using A3 Refrigerant

- Koji Yamashita (the Japan Refrigeration and Air Conditioning Industry Association, Japan)

• Energy Performance Estimation and Verification of an Industrial Waste Heat Recovery Heat Pump

- Katsumi Hashimoto (Central Research Institute of Electric Power Industry)

· Deep learning-based Refrigerant Charge Fault Detection Method of Air-source Heat Pump System

- Yong Hwan Eom (Seoul National University, South Korea)

• From Smarties, Ice-cream and Flowers

- Thomas Nowak (European Heat Pump Association AISBL, Belgium)

ORAL SESSION

TUESDAY, APRIL 27, 2021

* THE LIVE STREAM SCHEDULE IS BASED ON KOREA STANDARD TIME (KST / UTC +9).

Room A (Tamna Hall)

Tuesday, April 27 | Room A (Tamna Hall, 8F)

09:00-09:20	Opening	; Ceremony					
		Host: Taesung Kim (Sungkyunkwan University, South Korea)					
	- Welcome Address (Stephan Renz / IEA HPT TCP Chair, Switzerland) - Opening Remark (Min Soo Kim / NOC Chair, President of Society of Air-conditioning and Refrigerating Engineers of Ko South Korea) - Congratulatory Remarks (Hee-ryong Won / Governor of Jeju Province, South Korea)						
09:20-10:35	Plenary	Lecture I - Policy and Market Session Chair: Taesung Kim (Sungkyunkwan University, South Korea)					
09:20-09:45	Plenary Lecture 1-1	Heat Pumping Technologies in Clean Energy Transitions Mechtild Worsdorfer, Director for Sustainability, Technology & Outlooks, IEA, France					
09:45-10:10	Plenary Lecture 1-2	The European Legal Framework is Well Set for a Massive Roll-out of Heat Pumps - but More Efforts are Needed! Martin Forsen, President of European Heat Pump Association, Sweden					
10:10-10:35	Plenary Lecture 1-3	Korean Policy for Green World and Heat Pumping Technologies Min Soo Kim, NOC Chair of HPC 2020, President of Society of Air-conditioning and Refrigerating Engineers of Korea, South Korea					
10:35-10:45		Coffee Break and Poster Session					

Tuesday, April 27 | ROOM A (Tamna Hall, 8F)

10:45-12:00	Plenary	Lecture II - Technology Session Chair: Taesung Kim (Sungkyunkwan University, South Korea)
10:45-11:10	Plenary Lecture 2-1	Heat Pump System Technology Trend Saikee Oh, Executive Vice President / Center Director of LG Electronics, South Korea
11:10-11:35	Plenary Lecture 2-2	Ensuring a Safe Refrigerant Transition Xudong Wang, Vice President of Air-Conditioning, Heating, and Refrigeration Institute, US
11:35-12:00	Plenary Lecture 2-3	HVAC Systems against COVID-19 Noboru Kagawa, Professor of National Defense Academy, Japan
12:00-13:00		Lunch and Poster Session

Tuesday, April 27 | Room A (Tamna Hall, 8F)

Session 1A: Low GWP Refrigerants (1) - Natural						
			Session Chair : Bin Hu (Shanghai Jiao Tong University, China)			
13:00-13:20	Keynote [[135]	The Influence of Different Water-injection Methods on Water Vapor High Temperature Heat Pump Di Wu (Shanghai Jiao Tong University), Bin Hu (Shanghai Jiao Tong University) † , R.Z Wang (Shanghai Jiao Tong University)			
13:20-13:35	[[297]	Annual Performance Assessment of Heat Pump Water Heaters Applying Various Refrigerants Takaoki Suzuki (Waseda University), Zheng Ge (Waseda University), Muhamad Yulianto (Waseda University), Yoichi Miyaoka (Waseda University), Seiichi Yamaguchi (Waseda University), Kiyoshi Saito (Waseda University) †			
13:35-13:50	[[136]	Benefits and Reliability of Air to Water Heat Pump in Residential Applications, using R290 Refrigerant and Alternative Design Solution to Guarantee High Safety Level with Standard Components Sergio Maria Capanelli (Carel Industries Spa) †, Biagio Lamanna (Carel Industries Spa)			
13:50-14:05	[[170]	Medium Capacity Low Charge Ammonia Chiller and Heat Pump Valentin Salgado Fuentes (Technical University of Denmark) †, Wiebke Brix Markussen (Technical University of Denmark), Erasmus Damgaard Rothuizen (Technical University of Denmark), Jóhannes Kristófersson (Danish Technological Institute), Claus Madsen (Danish Technological Institute), Brian Elmegaard (Technical University of Denmark)			
14:05-14:20	[[172]	High-temperature Vapor Compression Heat Pump using Butane (R600) - Development of a Prototype and First Measurements Manuel Verdnik (Graz University of Technology) † , René Rieberer (Graz University of Technology)			
14:20-14:40			Coffee Break and Poster Session			

Tuesday, April 27, 2021 | Room A (Tamna Hall, 8F)

Session 2A	Session 2A: Market and Policy for Heat Pumps (1) Session Chair : Jussi Hirvonen (Finnish Heat Pump Association SULPU ry, Finland)							
14:40~15:00	Keynote [26	Next Stop: The Mass Market! Heat Pumps on the Verge of Large Scale Deployment in Europe Thomas Nowak (European Heat Pump Association AISBL) †						
15:00~15:15	[15	Disruption to Heat Business Models: From Shifting Boxes to Selling Comfort Cate Lyon (Delta Energy & Environment)) +, Lindsay Sugden (Delta Energy & Environment) +, Roxanne Pieterse (Delta Energy & Environment)						
15:15~15:30	[23	The Role of Heat Pumps in the Decarbonisation of the Heating Sector in Europe Martin Forsen (NIBE Energy Systems), Laure Meljac (NIBE Energy Systems) †						
15:30~15:45	[16-	Today's One Million Heat Pumps are Already in Essential Role in Smart Energy Transition Towards Carbon Neutral Finland Jussi Hirvonen (Finnish Heat Pump Association SULPU ry) †						
15:45~16:00	[35	Diffusion Barriers and Strategies for Heat Pump Systems with Integrated Storage and Photovoltaic in Austrian 1-2 Family Dwellings: an Explorative Investigation for the IEA HPT Annex 55/ECES Annex 34 Therese Guttmann (Austrian Institute of Technology) +, Thomas Schoberer (Forschung Burgenland GmbH), Caroline Haglund Stignor (Research Institutes of Sweden), Johann Emhofer (Austrian Institute of Technology)						
16:00~16:10		Break						

Tuesday, April 27, 2021 | Room A (Tamna Hall, 8F)

Session 3A	Low GWP Refrig	e rants (2) Session Chair: Didier Coulumb (IIR Director, France)
16:10~16:30	Keynote [357]	The low-GWP Refrigerant Challenge Didier Coulomb (International Institute of Refrigeration)
16:30~16:45	[247]	Increasing Flammable Refrigerant Charge Size without Compromising Safety Laure Meljac (NIBE) † , Martin Forsen (NIBE), Daniel Colbourne (c/o HEAT GmbH)
16:45~17:00	[141]	Is HFO the Last Range of Synthetical Refrigerant? Kenneth Hoffmann (GEA Refrigeration) † , Jan Gerritsen (GEA Refrigeration), Armin Hafner (NTNU)
17:00~17:15	[198]	Very Low GWP Refrigerant for Heat Pump Sarah Kim (Arkema inc) † , Laurent Abbas (Arkema France), Leping Zhang (Danfoss China), Drew Turner (Danfoss LLC)
17:15~17:30	[214]	Improving Risk Assessment of Refrigerant Leakage Hazards: Going beyond Physical Testing Mahmood Thabaddor (Underwriters Laboratories LLC) † , Sangamesh Hosur (UL India Pvt Ltd.) †

Room B (Halla Hall)

Tuesday, April 27 | Room A (Tamna Hall, 8F)

09:00-09:20	Opening Ceremony	Host: Taesung Kim (Sungkyunkwan University, South Korea)
09:20-10:35	Plenary Lecture I - Policy and Market	Session Chair: Taesung Kim (Sungkyunkwan University, South Korea)
10:35-10:45	Coffee B	reak and Poster Session
10:45-12:00	Plenary Lecture II - Technology	Session Chair: Taesung Kim (Sungkyunkwan University, South Korea)
12:00-13:00	Lunch	n and Poster Session

Tuesday, April 27 | Room B (Halla Hall, 8F)

Session 1B: Air Conditioning and Cooling				
Session Chair- Mitsuhiro Fukuta (Shizuoka University, Japan)				
13:00~13:20	Keynote	[356]	Air-Conditioning and Cooling J.B.V. Reddy (Department of Science and Technology, Government of India)	
13:20~13:35		[113]	Application of Improved Cooling & Heating System to Long-Range Electric Vehicles for Higher Power Efficiency Jae Yeon Kim (Hyundai Motors), Taesung Kim (Sungkyunkwan University) † , Yeon Ho Kim (Hyundai Motors), Jea Wan Kim (Hyundai Motors)	
13:35~13:50		[035]	Study on the Smart Operation Approach of an Air Conditioner when Occupants Go Out Myung Sup Yoon (Korea Testing Laboratory) † , Won Sik Yoon (Korea Testing Laboratory)	
13:50~14:05		[245]	The Study of Secondary Loop System with Efficient and Flammable Refrigerants in MAC Inguk Hwang (Hanonsystems) † , Haejun Lee (Hanonsystems), Gumbae Choi (Hanonsystems), Jaeyeon Kim (Hyundai Motor Group), Manju Oh (Hyundai Motor Group)	
14:05~14:20		[262]	A Development of AHP, the Integrated Climate System Module for EV Dae Bok Keon (Hanon System), Jae Chun Ryu (Hanon System), Ki Young Shin (Hyundai Motor Company), Sung Je Lee (Hanon System), Dong Woo Hwang (Hanon System) †	
14:20-14:40			Coffee Break and Poster Session	

Tuesday, April 27, 2021 | Room B (Halla Hall, 8F)

Session 2B: Acoustic Signatures of Heat Pumps Session Chair: Christoph Reichl (AIT Austrian Institute of Technology, Austria)				
14:40~15:00	Keynote	[192]	Augmented Reality Acoustics of Air Heat Pumps - APP Development and Methods Gerwin H.S. Drexler-Schmid (AIT - Austrian Institute of Technology) †, Christian H. Kasess (Austrian Academy of Sciences), Brigitte Blank-Landeshammer (AIT - Austrian Institute of Technology), Christian Köfinger (AIT - Austrian Institute of Technology), Johann Emhofer (AIT - Austrian Institute of Technology), Holger Waubke (Austrian Academy of Sciences), Christoph Reichl (AIT - Austrian Institute of Technology) †	

15:00~15:15	[068]	Simultaneous Energy Efficiency and Acoustic Evaluation of Heat Pump Systems Using Dynamic Simulation Models Christian Vering (RWTH Aachen University) †, François Bessac (CETIAT) †, Roberto Fumagalli (Polimi), Henrik Hellgren (RI.SE), Thore Oltersdorf (Fraunhofer ISE), Svend Pedersen (DTI), Christoph Reichl (AIT)
15:15~15:30	[160]	Acoustic Characterisation of an Air-To-Water Heat Pump for Different Operating Conditions: Inter- laboratory Results Thomas Fleckl (AIT), François Bessac (CETIAT) †, Roberto Fumagalli (Polimi), Henrik Hellgren (RI.SE), Thore Oltersdorf (Fraunhofer ISE), Svend Pedersen (DTI), Christoph Reichl (AIT)
15:30~15:45	[088]	Frosting and Defrosting Behavior of Evaporators Thomas Fleckl (Center for Energy, AIT Austrian Institute of Technology), Christoph Reichl (Center for Energy, AIT Austrian Institute of Technology) †, Mirza Popovac (Center for Energy, AIT Austrian Institute of Technology), Felix Hochwallner (Center for Energy, AIT Austrian Institute of Technology), Peter Wimberger (Institute of Applied Physics, Vienna University of Technology), Felix Linhardt (Department of Geography, Kiel University), Johann Emhofer (Center for Energy, AIT Austrian Institute of Technology)
15:45~16:00	[184]	Heat Pump Noise - Seasonal Averaging and Operation Dependence Ola Gustafsson (RISE Research Institutes of Sweden) † , Henrik Hellgren (RISE Research Institutes of Sweden), Caroline Haglund Stignor (RISE Research Institutes of Sweden)
16:00~16:10		Break

Tuesday, April 27, 2021 | Room B (Halla Hall, 8F)

Session 3B: Heat Pump Analysis - Components and Cycles Session Chair: Thomas Fleckl (AIT Austrian Institute of Technology, Austria) 16:10~16:30 [067] Numerical Analysis of the Vortex Tube Characteristics used within a High Temperature Heat Pump Keynote Michael Lauermann (Austrian Institute of Technology), Constantin Zenz (Austrian Institute of Technology) +, Mirza Popovac (Austrian Institute of Technology) [108] Analysis of the Refrigerant Maldistribution of Propane Evaporating in Brazed Plate Heat Exchangers as a 16:30~16:45 Function of Operating Conditions Emilio Navarro-Peris (Universitat Politecnica de Valencia) +, Lucas Alvarez (Universitat Politecnica de Valencia), Paloma Albaladejo (Universitat Politecnica de Valencia), Lena Schnabel (Fraunhofer Institute for Solar Energy Systems ISE), Jose Miguel Corberan (Universitat Politecnica de Valencia) [050] Performance Analysis of a Combined Cooling and Power Cycle 16:45~17:00 Philipp Wagner (Graz University of Technology) †, Rene Rieberer (Graz University of Technology) 17:00~17:15 [193] Analysis of a Directly Gas-fired Absorption Heat Pump with an Improved Condensing Boiler Technology Philipp Wagner (Graz University of Technology) †, Rene Rieberer (Graz University of Technology) 17:15~17:30 [179] Simulation-based Eco-economic Assessment of Heat Pump Systems for Refurbishing All-electric Nonresidential Buildings with Complex Energy Demand Structures Laura Maier (RWTH Aachen University) †, Xuchao Ying (RWTH Aachen University), Konstantin Finkbeiner (RWTH Aachen University), Sarah Henn (RWTH Aachen University), Jan Richarz (RWTH Aachen University), Markus Nürenberg (RWTH Aachen University), Tanja Osterhage (RWTH Aachen University), Dirk Müller (RWTH Aachen University)

Room C (Ara Hall)

Tuesday, April 27 | Room A (Tamna Hall, 8F)

09:00-09:20	Opening Ceremony	Host: Taesung Kim (Sungkyunkwan University, South Korea)
09:20-10:35	Plenary Lecture I - Policy and Market	Session Chair: Taesung Kim (Sungkyunkwan University, South Korea)
10:35-10:45	Coffee Br	reak and Poster Session
10:45-12:00	Plenary Lecture II - Technology	Session Chair: Taesung Kim (Sungkyunkwan University, South Korea)
12:00-13:00	Lunch	and Poster Session

Tuesday, April 27 | Room C (Ara Hall, 8F)

Session 1C	Session 1C: Heat Pump Applications Session Chair: Akio Miyara (Saga University, Japan)			
13:00~13:20	Keynote [240]	Development and Implementation of Industrial High Temperature Heat Pumps for Waste Scrubbing Process Gilbong Lee (Korea Institute of Energy Research), Beomjoon Lee (Korea Institute of Energy Research), Junhyun Cho (Korea Institute of Energy Research), Ho-Sang Ra (Korea Institute of Energy Research), Young-Jin Baik (Korea Institute of Energy Research), Eun Seok Wang (Korea Institute of Energy Research), Hyung-Ki Shin (Korea Institute of Energy Research), Young-Soo Lee (Korea Institute of Energy Research) † , Chulwoo Roh (Korea Institute of Energy Research)		
13:20~13:35	[180]	Long-term Evaluation of an Office Building with Large-scale Heat Pump and aquifer System in Southern Sweden Tommy Walfridson (Energy and Circular economy, RISE Research Institutes of Sweden) †, Martin Larsson (Energy and Circular economy, RISE Research Institutes of Sweden), Jessica Benson (Energy and Circular economy, RISE Research Institutes of Sweden), Oskar Räftegård (Energy and Circular economy, RISE Research Institutes of Sweden), Ola Gustafsson (Energy and Circular economy, RISE Research Institutes of Sweden), Caroline Haglund Stignor (Energy and Circular economy, RISE Research Institutes of Sweden), Lovisa Axelsson (Energy and Circular economy, RISE Research Institutes of Sweden), Lovisa Axelsson (Energy and Circular economy, RISE Research Institutes of Sweden), and Circular economy, RISE Research Institutes of Sweden)		
13:35~13:50	[343]	Thermodynamic Analysis of Refrigerant Selection for High Temperature Heat Pump Cycles Takenobu Kaida (Central Research Institute of Electric Power Industry (CRIEPI)) †		
13:50~14:05	[117]	Approaching Optimal High Pressure by Charge Management in Transcritical CO2 Heat Pump Water Heater Yu-Jia He (Tongji University), Xing-Yu Liang (Tongji University), Jia-Hao Cheng (Tongji University), Liang- Liang Shao (Tongji University) † , Chun-Lu (Tongji University)		
14:05~14:20	[134]	Results of an Interlaboratory Comparison on Four Different Heat Pumps: Standards on the Test Stand Ivan Malenkovic (Fraunhofer Institute for Solar Thermal Systems (ISE)) +, Urs Gumbel (Fraunhofer Institute for Solar Thermal Systems (ISE)), Christoph Thoma (Fraunhofer Institute for Solar Thermal Systems (ISE)		
14:20-14:40		Coffee Break and Poster Session		

Tuesday, April 27, 2021 | Room C (Ara Hall, 8F)

Session 2C: Space and Hot Water Heat Pumps					
	Session Chair: Michele Mondot (CETIAT, France)				
14:40~15:00	Keynote [079]	Design of a Grey Water Heat Recovery System in Order to Satisfy the Domestic Hot Water Demand of a Block of Dwellings Emilio Navarro-Peris (Universidad Politecnica de Valencia) †, Estefania Hervas-Blasco (Universitat Politecnica de Valencia), Jose Miguel Corberan (Universitat Politecnica de Valencia), Ximo Masip (Universitat Politecnica de Valencia)			
15:00~15:15	[059]	Field Performance of Domestic Heat Pumps for Heating and Hot Water in Switzerland Cordin Arpagaus (NTB University of Applied Sciences and Technology Buchs), Ralph Kuster (NTB University of Applied Sciences and Technology Buchs) †, Manuel Prinzing (NTB University of Applied Sciences and Technology Buchs), Matthias Berthold (NTB University of Applied Sciences and Technology Buchs), Mick Eschmann (NTB University of Applied Sciences and Technology Buchs), Stefan Bertsch (NTB University of Applied Sciences and Technology Buchs)			
15:15~15:30	[255]	Air-to-water Heat Pumps as a Substitution of Oil-boiler in a Non-retrofitted Multi-family Building of the 70's. In-situ Monitoring, Actual Energy Balance and Performance Omar Montero Dominguez (University of Geneva), Carolina De Sousa Fraga (University of Geneva), Pierre Hollmuller (University of Geneva), Simon Callegari (University of Geneva) †			
15:30~15:45	[273]	CO2 Emission Savings of Heat-pumps in the Residential Sector. Case Study for Multifamily Buildings in Geneva Elliot Romano (University of Geneva) † , Carolina Fraga (University of Geneva), Pierre Hollmuller (University of Geneva)			
15:45~16:00	[270]	Which Performance Indicators Should We Provide to Policy Makers to Switch from Gas Boilers to Air to Water Heat Pumps? Carolina Fraga (Services Industriels de Geneve) †, Alisa Freyre (Services Industriels de Geneve), Pierre Hollmuller (Université de Genève), Rodrigo De Pablo (Services Industriels de Geneve), Matthias Rüetschi (Services Industriels de Geneve)			
16:00~16:10		Break			

Tuesday, April 27, 2021 | Room C (Ara Hall, 8F)

Session 3C: New Heat Pump Technologies					
	Session Chair: Maurizio Pieve (ENEA. Italy)				
16:10~16:30	Keynote [100]	Test Results of a Rotation Heat Pump and Further Developments Bernhard Adler (ecop Technologies GmbH), Andreas Längauer (ecop Technologies GmbH) †, Christian Rakusch, (ecop Technologies GmbH)			
16:30~16:45	[272]	High Efficiency Low Temperature Lift Heat Pump with Novel Oil-free, Gas-bearing Turbo Compressor Dominic Zajonc (Lucerne University of Applied Sciences and Arts) †, Stefan Flück (Lucerne University of Applied Sciences and Arts), Edward J. Lucas (Lucerne University of Applied Sciences and Arts), Andreas Lehr (Teqtoniq GmbH), Beat Wellig (Lucerne University of Applied Sciences and Arts)			
16:45~17:00	[229]	Experimental Investigation of a Rolling Piston Compressor Operated with a Hydrocarbon Refrigerant Mixture Melanie Cop (Technische Universität Dresden) †, Ramona Nosbers (Technische Universität Dresden), Christiane Thomas (Technische Universität Dresden), Ullrich Hesse (Technische Universität Dresden)			

TECHNICAL PROGRAM		
17:00~17:15	[163]	Research and Development for 200°C Compressed Water Heat Pump using Exhaust Heat with Low GWP Refrigerant for Industrial Use Ryosuke Suemitsu (Mitsubushi Heavy Industries Thermal Systems, Ltd) †, Masanobu Sakai (Mitsubushi Heavy Industries Thermal Systems, Ltd), Yoshie Togano (Mitsubushi Heavy Industries Thermal Systems, Ltd), Naoki Kobayashi (Mitsubishi Heavy Industries, Ltd), Hiroyuki Yuki (Mitsubushi Heavy Industries Thermal Systems, Ltd), Yasushi Hasegawa (Mitsubushi Heavy Industries Thermal Systems, Ltd), Kazuki Wajima (Mitsubushi Heavy Industries Thermal Systems, Ltd), Kenji Ueda (MHI Bingshan Refrigeration (Dalian) Co., Ltd.)
17:15~17:30	[239]	Lubrication Management of a Reversible Compressor-expander-unit in a Combined HP-ORC-plant Daniel Steger (Institute of Process Machinery and Systems Engineering, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)) †, Markus Zwiefler (Institute of Process Machinery and Systems Engineering, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)), Eberhard Schlücker (Institute of Process Machinery and Systems Engineering, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU))

ORAL SESSION

WEDNESDAY, APRIL 28, 2021

* THE LIVE STREAM SCHEDULE IS BASED ON KOREA STANDARD TIME (KST / UTC +9).

Room A (Tamna Hall)

Wednesday, April 28, 2021 | Room A (Tamna Hall, 8F)

Session 4A: Low GWP Refrigerants (3)			
		Session Chair: Yunho Hwang (University of Maryland, United States)	
09:00~09:20	Keynote [2	Residential Split Heat Pump Using Low GWP Refrigerants Bo Shen (Oak Ridge National Lab) † , Moonis Ally (Oak Ridge National Lab)	
09:20~09:35	[0]	A3 Refrigerant R290 Leak and Ignition Testing for a Packaged Terminal Air-conditioner (PTAC) Xudong Wang (Air-Conditioning, Heating and Refrigeration Institute) †, George Hunter (UL LLC)	
09:35~09:50	[0.	Solid State (Metal Hydride) Refrigerant Based Air Conditioner and Freezer Systems Bamdad Bahar (Xergy Inc.) †, William TomHon (Xergy Inc.), Matt Golben (Xergy Inc.), Jacob Zerby (Xergy Inc.), Mark Golben (Xergy Inc.)	
09:50~10:05	[2	Alternate Refrigerants for Heat Pump Water Heater Applications Kashif Nawaz (Oak Ridge National Laboratory) †, Bo Shen (Oak Ridge National Laboratory), Van Baxter (Oak Ridge National Laboratory), Omar Abdelaziz (Oak Ridge National Laboratory)	
10:05~10:20	[1	Performance Evaluation of Light Commercial Air Conditioning and Heat Pump System Using Low GWP Refrigerants Joshua Hughes (The Chemours Company) †, Minsoo Kim (Air Solution Laboratory, LG Electronics)	
10:20~10:40		Coffee Break and Poster Session	

Wednesday, April 28, 2021 | Room A (Tamna Hall, 8F)

Session 5A: Low GWP Refrigerants (4) Session Chair: Hideaki Maeyama (Heat pump & Thermal Storage Technology Center of Japan, Japan)				
10:40~11:00	Keynote	[213]	Disproportionation Risk Study for HFO-1123 Compositions as Low-GWP Refrigerants Hidekazu Okamoto (AGC Inc.) † , Hiroki Hayamizu (AGC Inc.), Tetsuo Otsuka (AGC Inc.), Katsuya Ueno (AGC Inc.)	
11:00~11:15		[139]	Modeling of Megawatt R1233zd (E) High Temperature Heat Pump System Bin Hu (Shanghai Jiao Tong University) †, R.Z. Wang (Shanghai Jiao Tong University), Hua Liu (Gree Electric Appliances), Zhiping Zhang (GREE Electric Appliances), Hongbo Li (Gree Electric Appliances)	
11:15~11:30		[128]	Study on Layer Short Mechanism and Discharge Pattern in Refrigerant Compressor for Refrigerants with Disproportionation Reaction Like HFO-1123 Hideyuki Fujimoto (Shizuoka University), Mitsuhiro Fukuta (Shizuoka University) † , Masaaki Motozawa (Shizuoka University)	

TECHNICAL	TECHNICAL PROGRAM				
11:30~11:45	[138]	Clarification of the Disproportionation Reaction of HFO-1123 and Evaluation of the Reaction Inhibitor Zhihua Zhang (The University of Tokyo) †, Makoto Ito (The University of Tokyo), Chaobin Dang (The University of Tokyo), Eiji Hihara (The University of Tokyo)			
11:45~12:00	[336]	Experimental Investigation of Heat Transfer Coefficient of R1234yf During Condensation Inside Multiport Mini-channel Tube Jong-Taek Oh (Chonnam National University) † , Quang Vu Pham (Electric Power University)			
12:00-13:00		Lunch and Poster Session			

Wednesday, April 28, 2021 | Room A (Tamna Hall, 8F)

Session 6A	Session 6A: Heat Transfer Session Chair: Sheng Wang (Gree Electric Appliances, Inc. of Zhuhai, China)				
13:00~13:20	Keynote [02	Numerical Simulation of Two-phase Flow Distribution in a Vertically Installed Refrigerant Distributor Jihwan Jeong (Pusan National University) †, Siyoung Choi (Pusan National University), Hyoin Lee (Pusan National University)			
13:20~13:35	[34	Experimental Investigation of Local Nucleate Boiling Heat Transfer and Mixing Ratio on Copper Surface about Mixture R 32 / R 1234ze (E) Riku Fukuju (The University of Electro-Communications), Koji Enoki (The University of Electro- Communications) †, Kiyoshi Saito (Waseda University)			
13:35~13:50	[27	Effects of Tube Shape on Boiling Heat Transfer of Low-pressure Refrigerant R1233zd (E) Outside Horizontal Tubes Sho Fukuda (Kyushu Sangyo University) †, Yuki Shimizu (Mitsubishi Heavy Industries Thermal Systems, Ltd.), Naoya Miyoshi (Mitsubishi Heavy Industries Thermal Systems, Ltd.), Yasushi Hasegawa (Mitsubishi Heavy Industries Thermal Systems, Ltd.)			
13:50~14:05	[29	High-resolution Surface Plasmon Resonance Imaging of an Evaporating Droplet on the Surface Chan Ho Jeong (Chung-Ang University), Hyung Joo Lee (Chung-Ang University), Seong Hyuk Lee (Chung-Ang University) †			
14:05~14:20	[31	Lubricant-impregnated Surfaces (LIS) Incorporated with the Oil Supply System for Enhanced Durability and Condensation Heat Transfer Performance Youngsuk Nam (Kyung Hee University) † , Donghyun Seo (Kyung Hee University), Jaehwan Shim (Kyung Hee University), Choongyeop Lee (Kyung Hee University) †			
14:20-14:40		Coffee Break and Poster Session			

Wednesday, April 28, 2021 | Room A (Tamna Hall, 8F)

Session 7A	Sorption Heat P	umps (2) Session Chair: Peter Schossig (Fraunhofer ISE, Germany)
14:40~15:00	Keynote [176]	Trends and Recent R&D Activities on Fuel Driven Sorption Heat Pumps Peter Schossig (Fraunhofer Institute Solar Energy Systems ISE), Gerrit Fueldner (Fraunhofer Institute Solar Energy Systems ISE) †, Angeles Rivero Pacho (University of Warwick), Steven Metcalf (University of Warwick), Kyle Gluesenkamp (ORNL), Zhiyao Yang (ORNL), Andrea Frazzica (CNR-ITAE), Marcello Aprile (Politecnico di Milano), Tommaso Toppi (Politecnico di Milano), Mario Motta (Politecnico di Milano), Robert E. Critoph (University of Warwick), Edo Wiemken (Fraunhofer Institute Solar Energy Systems ISE)
15:00~15:15	[181]	Design of a Gas-driven Hybrid Adsorption Heat Pump Coupled to Geothermal Heat Exchangers for Retrofitting Applications Andrea Frazzica (Consiglio Nazionale delle Ricerche) †, Valeria Palomba (Consiglio Nazionale delle Ricerche), Antonino Bonanno (Consiglio Nazionale delle Ricerche), Davide La Rosa (Consiglio Nazionale delle Ricerche), Stefan Löwe (Fahrenheit GmbH), Ralph Herrmann (Fahrenheit GmbH)
15:15~15:30	[133]	Assessment of Standardized Test and Performance Evaluation Methods for Fuel Driven Sorption Heat Pumps Ivan Malenkovic (Fraunhofer Institute for Solar Thermal Systems (ISE)) †, Patrizia Norina Melograno (Politecnico di Milano) †, Peter Schossig (Fraunhofer Institute for Solar Thermal Systems (ISE))
15:30~15:45	[341]	Dynamic Simulations of an Absorption Refrigeration System for Automobile Application Hai Trieu Phan (French Atomic Energy and Alternative Energy Commission CEA) †, Mathilde Wirtz (French Atomic Energy and Alternative Energy Commission CEA), Julien Hergott (Faurecia Clean Mobility), François Boudehenn (French Atomic Energy and Alternative Energy Commission CEA)
15:45~16:00	[191]	CHP-Waste Heat Utilization with Small-scaled Absorption-Resorption Chillers for Supermarket Refrigeration Oliver Ziegler (Technische Universität Dresden) †, Ullrich Hesse (Technische Universität Dresden), Christiane Thomas (Technische Universität Dresden)
16:00~16:10		Break

Wednesday, April 28, 2021 | Room A (Tamna Hall, 8F)

Session 8A	Ground So	urce H	eat Pumps Session Chair: Signhild Gehlin (Swedish Geoenergi Center, Sweden)
16:10~16:30	Keynote	[045]	Half-term Results from IEA HPT Annex 52 - Long-term Performance Monitoring of Large GSHP Systems Signhild Gehlin (Swedish Geoenergi Center) † , Jeffrey Spitler (Oklahoma State University)
16:30~16:45		[098]	Ground Source Heat Pump Systems for Energy Efficient Building Retrofitting Michael Lauermann (AIT Austrian Institute of Technology GmbH) † , Johann Emhofer (AIT Austrian Institute of Technology GmbH), Karl sen. Ochsner (Ochsner Wärmepumpen GmbH)
16:45~17:00		[243]	It works! - Long-term Performance Measurement of Ground Source Heat Pump Systems Franziska Bockelmann (Steinbeis-Innovationszentrum (SIZ) Energie+) † , Christian Kley (TU Braunschweig)
17:00~17:15		[351]	Initial Stage of Thermal Response Tests Combined with Transient Numerical Model – a Foundation of Short-term Ground Storage of Cold for Effective Cooling of Office Buildings Kamil Kwiatkowski (Euros Energy), Jakub Garbacik (Euros Energy) † , Tomasz Walczak (Euros Energy)

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Room B (Halla Hall)

Wednesday, April 28, 2021 | Room B (Halla Hall, 8F)

Session 4B	Ground Source a	and Storage Session Chair: Jeffrey Spitler (Oklahoma State University, United States)
09:00~09:20	Keynote [056]	A Novel Geothermal Heat Pump System Integrated with Underground Thermal Storage for Shifting Building Electric Demands Xiaobing Liu (Oak Ridge National Laboratory) †, Liang Shi (Purdue University), Ming Qu (Purdue University)
09:20~09:35	[044]	Three Years' Performance Monitoring of a Mixed-use Ground Source Heat Pump System in Stockholm Jeffrey Spitler (Oklahoma State University) † , Signhild Gehlin (Swedish Geonergy Center)
09:35~09:50	[326]	Feasibility of Using Ground Source Heat Pumps in Heating and Cooling of Residential Buildings Seama Koohi-Fayegh (OntarioTech University) †
09:50~10:05	[282]	Performance Analysis of Ground Source Heat Pump System with Vertical Borehole Heat Exchangers Affected by Rapid Groundwater Flow Hobyung Chae (Hokkaido University) † , Katsunori Nagano (Hokkaido University), Yoshitaka Sakata (Hokkaido University), Takao Katsura (Hokkaido University), Takeshi Kondo (Nikken Sekkei Research Institute)
10:05~10:20	[325]	Development of LNG Vaporization Systems Applying Hybrid Ground Source Heat Pumps Combined Ground Heat Exchangers with Air-water Heat Exchangers Takao Katsura (Hokkaido University) † , Yutaka Shoji (Hokkaido University), Hitoshi Akai (Hokkaido University), Katsunori Nagano (Hokkaido University), Jun Shishido (Tohoku Electric Power Co., Inc.), Mitsuhiro Ishikawa (Hokkaido Electric Power Co., Inc.), Yuichi Yashima (Tohoku Electric Power Co., Inc.), Koji Tanifuji (Zeneral Heatpump Industry Co., Ltd.)
10:20~10:40		Coffee Break and Poster Session

Wednesday, April 28, 2021 | Room B (Halla Hall, 8F)

Session 5B: Market and Policy for Heat Pumps (2) Session Chair: Tetsushiro Iwatsubo (New Energy and Industorial Technology Development Organaization, Japan)				
10:40~11:00	Keynote [048]	NEDO R&D Project for Innovative Thermal Management Tetsusiro Iwatsubo (New Energy and Industrial Technology Development Organization (NEDO)) † , Yuka Ogasawara (New Energy and Industrial Technology Development Organization (NEDO)), Toshihiko Ota (New Energy and Industrial Technology Development Organization (NEDO)), Masanori Kobayashi (New Energy and Industrial Technology Development Organization (NEDO))		
11:00~11:15	[036]	Numerical Investigation on PCM-to-refrigerant Heat Exchangers for Thermal Energy Storage Yunho Hwang (University of Maryland) †, Yiyuan Qiao (University of Maryland), Tao Cao (University of Maryland), Jiazhen Ling (University of Maryland), Vikrant Aute (University of Maryland)		
11:15~11:30	[222]	Roadblocks to Heat Pump Use in Residential Buildings with Model Predictive Control for Demand Response and Ancillary Markets and Potential Solutions Ramanunni Parakkal Menon (Concordia University) †, Jessen Page (HES-SO Valais/Wallis), Frederic Amblard (HES-SO Valais/EPFL)		

11:30~11:45	[252]	A Techno-Economic Assessment of Air-Source Heat Pumping Technologies in the Canadian Residential Sector Justin Tamasauskas (CanmetENERGY/Natural Resources Canada) †, Stephanie Breton (CanmetENERGY/Natural Resources Canada), Martin Kegel (CanmetENERGY/Natural Resources Canada)
11:45~12:00	[010]	US Heat Pump Market Overview–2020 Melissa Lapsa (Oak Ridge National Laboratory) † , Jaewan Joe (Oak Ridge National Laboratory), Mini Malhotra (Oak Ridge National Laboratory), Van Baxter (Oak Ridge National Laboratory)
12:00-13:00		Lunch and Poster Session

Wednesday, April 28, 2021 | Room B (Halla Hall, 8F)

Session 6B: Residential Heat Pumps Session Chair: Carsten Wemhöner (HSR University of Applied Sciences Rapperswil, Switzerland)				
13:00~13:20	Keynote [168]	Evaluation of Solar Heat Source and Sink in Multi-functional Heat Pump Operation Carsten Wemhoener (HSR University of Applied Sciences Rapperswil) †, Lukas Rominger (HSR University of Applied Sciences Rapperswil), Simon Büsser (HSR University of Applied Sciences Rapperswil), Roman Schwarz (HSR University of Applied Sciences Rapperswil)		
13:20~13:35	[275]	Heat Pumps in Existing Residential Buildings Marek Miara (Fraunhofer ISE) † , Danny Günther (Fraunhofer ISE), Robert Langner (Fraunhofer ISE)		
13:35~13:50	[047]	Effectiveness-based Air Flow Rate Optimization for a Residential Heat Pump in Seasonal Performance Conditions Minsu Park (LG Electronics), Min Soo Kim (Seoul National University) †		
13:50~14:05	[093]	Energy Saving Potential of an Air Source Heat Pump Heating System Compared with a Radiant Floor Heating System with Ventilation in an Apartment Building Yu-Jin Hwang (Hanyang University), Yong-Kwon Kang (Hanyang University), Beom-Jun Kim (Hanyang University), Jae-Weon Jeong (Hanyang University) †		
14:05~14:20	[127]	A Residential Heat Pump System for Cooling, Heating, Dehumidification and Outdoor Air Supply Xingyu Liang (Tongji University), Chen Yang (Tongji University), Jing Zhang (Tongji University), Xiang Cao (Tongji University), Liangliang Shao (Tongji University), Chunlu Zhang (Tongji University), Chun Yang (Emerson Commercial & Residential Solutions), Xiaoning Chen (Emerson Commercial & Residential Solutions), Hongfei Shu (Emerson Commercial & Residential Solutions) †		
14:20-14:40		Coffee Break and Poster Session		

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Wednesday, April 28, 2021 | Room B (Halla Hall, 8F)

Session 7B: Heat Pumps in Smart Grids and District Heating and Cooling Systems (1) Session Chair: Svend Pedersen (Danish Technological Institute, Denmark)				
14:40~15:00	Keynote [308]	Seasonal Thermal Energy Storage for Large Scale District Heating Carlos Infante Ferreira (Delft University of Technology) † , Just Remmelts (Delft University of Technology), Sander Tensen (Eneco Industrial & Heat)		
15:00~15:15	[281]	Investigation of Model Predictive Control for Fifth Generation District Heating and Cooling (5GDHC) Substations Simone Buffa (Eurac Research, Free University of Bolzano) † , Anton Soppelsa (Eurac Research), Mauro Pipiciello (Eurac Research), Gregor P. Henze (University of Colorado Boulder), Roberto Fedrizzi (Eurac Research)		
15:15~15:30	[309]	Low Temperature District Heating based on Low Temperature Geothermal Heat (30oC) Carlos Infante Ferreira (Delft University of Technology) † , Sebastiaan Knepper (Delft University of Technology), Ivo Pothof (Delft University of Technology), Laure Itard (Delft University of Technology)		
15:30~15:45	[253]	Replicable Water Source Heat Pumps for a Zero Carbon Future Nicky Jason Cowan (Star Renwable Energy) †		
15:45~16:00	[151]	Electrification of Heat and Decarbonisation of the Electricity System: Sector Coupling is Creating Opportunities for Heat Pumps Cate Lyon (Delta Energy & Environment) † , Lindsay Sugden (Delta Energy & Environment) †		
16:00~16:10		Break		

Wednesday, April 28, 2021 | Room B (Halla Hall, 8F)

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Session 8B: Heat Pumps in Smart Grids and District Heating and Cooling Systems (2) Session Chair: Emina Pasic (IEA HPT ExCo Delegate Sweden, Sweden)				
16:10~16:30	Keynote	[072]	Impact of the Weather Forecast on a Predictive Controller Performance: Experimental Studies with a Residential Heat Pump for Space Cooling Thibault Péan (IREC, UPC) †, Ivan Bellanco (IREC), Jaume Salom (IREC)	
16:30~16:45		[329]	Large Heat Pumps for Decarbonized District Heating Torben Funder-Kristensen (Danfoss A/S) † , Drew Turner (Danfoss A/S), Leping Zhang (Danfoss A/S)	
16:45~17:00		[043]	Application of the DevOps Methodology on Heat Pump Controllers Stephan Göbel (RWTH Aachen University), Markus Nürenberg (RWTH Aachen University) † , Philipp Mehrfeld (RWTH Aachen University), Dirk Müller (RWTH Aachen University)	
17:00~17:15		[131]	Possibilities and Constraints of Grid Flexible Control of Todays and Tomorrows Heat Pumps Markus Lindahl (RISE Research Institutes of Sweden), Tommy Walfridson (RISE Research Institutes of Sweden) † , Jessica Benson (RISE Research Institutes of Sweden) † , Oskar Räftegård (RISE Research Institutes of Sweden), Ola Gustafsson (RISE Research Institutes of Sweden), Caroline Haglund Stignor (RISE Research Institutes of Sweden)	
17:15~17:30		[301]	Control Strategy Assessment of a Small GSHP Sourced DH System with End User DHW Booster Heat Pumps Wim Boydens (Ghent University) †, Sigrid Feyaerts (KU Leuven), Annelies Vandermeulen (KU Leuven/ VITO/EnergyVille), Lieve Helsen (KU Leuven/EnergyVille) †	

Room C (Ara Hall)

Wednesday, April 28, 2021 | Room C (Ara Hall, 8F)

Session 4C	Sorption Heat P	umps (1) Session Chair' Reinhard Radermacher (University of Maryland, United States)
09:00~09:20	Keynote [023]	Membrane-Based Air Dehumidification Using Organic Ionic Liquid Desiccant Bamdad Bahar (Xergy Inc.) † , Harish Opradishta (Xergy Inc.), Mark Stutman (Xergy Inc.), Xiaobing Liu (Oakridge National Laboratory), Jason Woods (National Renewable Energy Laboratory)
09:20~09:35	[206]	Semi-open Absorption Water Heater: Experimental Results Kyle R. Gluesenkamp (Oak Ridge National Laboratory) † , Navin Kumar (Oak Ridge National Laboratory), Ahmad Abu-Heiba (Oak Ridge National Laboratory), Viral K. Patel (Oak Ridge National Laboratory), Zhiyao Yang (Purdue University), Saeed Moghaddam (University of Florida), Rohit Bhagwat (University of Florida), Sidharth Sanadhya (University of Florida), Michael Schmid (University of Florida), Richard Rode (University of Florida), Basil Anabtawi (University of Florida)
09:35~09:50	[016]	Water Transmission Mechanisms in Advanced Ionic Membranes for HVAC Applications Bamdad Bahar (Xergy Inc.) † , David McAndrews (Xergy Inc.), Taoli Gu (Xergy Inc.), Abhishek Bandlore (Xergy Inc.)
09:50~10:05	[201]	Dynamic Modelling and Design Optimization of a Heat-Pipe-Integrated Chemisorption Adsorber Zhiyao Yang (Purdue University), Ming Qu (Purdue University), Kyle Gluesenkamp (Oak Ridge National Lab) †
10:05~10:40		Coffee Break and Poster Session

Wednesday, April 28, 2021 | Room C (Ara Hall, 8F)

Session 5C: Electrochemical Related				
			Session Chair: Van D. Baxter (Oak Ridge National Laboratory, United States)	
10:40~11:00	Keynote	[021]	An Overview of Hydrogen Compressors for Heat Pump Systems Bamdad Bahar (Xergy Inc.) †, Samuel Dorman (Xergy Inc.), Jacob Zergy (Xergy Inc.), Mark Golben (Xergy Inc.), William Tomhon (Xergy Inc.)	
11:00~11:15		[209]	Thermoelectric Heat Pump Performance Characterization Viral K. Patel (Oak Ridge National Laboratory) † , Kyle R. Gluesenkamp (Oak Ridge National Laboratory), Philip Boudreaux (Oak Ridge National Laboratory)	
11:15~11:30		[124]	Study on a Combined Absorption Heat Pump System Driven by Low Temperature Heat Source Gabyong Kim (Korea University), Han Sol Jung (Korea University), Yong Tae Kang (Korea University) †	
11:30~11:45		[014]	Electrochemical Compression of Ammonia/Hydrogen Blends for Heat Pump Applications Bamdad Bahar (Xergy Inc.) †, Ashish Chouhan (University of Delaware), Ajay Prasad (University of Delaware), Premanand Sivakumar (University of Delaware), Utsav Aryal (University of Delaware)	
11:45~12:00		[350]	Experimental Study of PEMFC Conditioning Methods Joohee Song (Chung-Ang University), Minsoo Kim (Chung-Ang University), Dongkyu Kim (Chung-Ang University) †	
12:00-13:00			Lunch and Poster Session	

Sossion 6C: Host Exchangers (1)

Wednesday, April 28, 2021 | Room C (Ara Hall, 8F)

56551011 00	· Heat Exchangers	Session Chair: Masafumi Katsuta (Waseda University, Japan)
13:00~13:20	Keynote [244]	Study on the Frosting Phenomena between Concavity and Convexity Plate under Forced Convection — The Prediction of Frost Layer Growth using the Observation from the Frost and Defrost Multi-cycle Experiment Masafumi Katsuta (Waseda University) †, Shota Ikutaya (Graduate School of Waseda University), Junya Yamagishi (Graduate School of Waseda University), Rio Asakawa (Graduate School of Waseda University), Yuki Terakado (Graduate School of Waseda University), Sangchul Bae (Waseda University)
13:20~13:35	[335]	Investigation on System Performance of Air Source Heat Pump Water Heater with Phase Change Material Zhanpeng Liu (Tongji University), Naiping Gao (Tongji University) †, Tiantian Wang (Tongji University), Hengyi Zhao (International Copper Association), Yifeng Gao (International Copper Association)
13:35~13:50	[140]	A Study on the Determination Method of Defrosting Start Time by Calculation of Frost Volume Jin Woo Yoo (Korea Institute of Machinery and Materials), Yoong Chung (Seoul National University), Dong Ho Kim (Korea Institute of Machinery and Materials), Seok Ho Yoon (Korea Institute of Machinery and Materials), Chan Ho Song (Korea Institute of Machinery and Materials), Kong Hoon Lee (Korea Institute of Machinery and Materials), Ook Joong Kim (Korea Institute of Machinery and Materials), Min Soo Kim (Seoul National University) †
13:50~14:05	[334]	Experimental Investigation of Condenser with Small Diameter Copper Tube in Air Source Heat Pump Water Heater Tiantian Wang (Tongji University), Naiping Gao (Tongji University) †, Zhanpeng Liu (Tongji University), Tingwei Fan (Gomon New Energy Ltd. of Jiangsu Province), Hengyi Zhao (International Copper Association), Yifeng Gao (International Copper Association)
14:05~14:20	[316]	Condensation Heat Transfer and Pressured Drop Characteristics of R-513A as An Alternative Refrigerant of R-134a Andreas Karageorgis (ElvalHalcor Company), George Hinopoulos (ElvalHalcor Company), Man-Hoe Kim (Kyungpook National University) †
14:20-14:40		Coffee Break and Poster Session

Wednesday, April 28, 2021 | Room C (Ara Hall, 8F)

Session 7C: Industrial Heat Pumps (1) Session Chair: Rainer Jacobs (IZW e.V., Information Centre on Heat Pumps and Refrigeration, Germany)				
14:40~15:00	Keynote [0	04]	Environmentally Friendly Steam Generation Using VHTHPs at a Pharmaceutical Research Facility Tor-Martin Tveit (Olvondo Technology AS) †, Martin N. Johansson (AstraZeneca), Ron Zevenhoven (Åbo Akademi University)	
15:00~15:15	[1	03]	Development and Lab-scale Performance Evaluation of a High Temperature Heat Pump for integration into a Power-to-Heat-to-Power System Miguel Ramirez (Tecnalia) † , Felipe Trebilcock Kelly (Tecnalia), Xabier Peña (Tecnalia), Asier Martinez- Urrutia (Tecnalia), Abdelrahman Hassan (Universitat Politècnica de València)	
15:15~15:30	[1	56]	Design and Experimental Results of a Two-Stage Steam Producing Industrial Heat Pump Andrew Marina (TNO) † , Simon Smeding (TNO), Anton Wemmers (TNO), Simon Spoelstra (TNO), Peter Kremers (IBK B.V.)	
15:30~15:45	[2	16]	Experimental Comparison of R1224yd (Z) and R1233zd (E) in a High Temperature Heat Pump Cordin Arpagaus (NTB University of Applied Sciences and Technology Buchs) † , Stefan Bertsch (NTB University of Applied Sciences and Technology Buchs)	
15:45~16:00	[3	06]	Heat Pump Assisted Drying of Flower Bulbs Carlos Infante Ferreira (Delft University of Technology) † , Sjors Wagenaar (Delft University of Technology)	
16:00~16:10			Break	

Wednesday, April 28, 2021 | Room C (Ara Hall, 8F)

Session 8C: High Temperature Heat Pumps Session Chair: Benjamin Zühlsdorf (Danish Technological Institute, Denmark)			
16:10~16:30	Keynote [1	4] Experimental Analysis of a High Temperature Heat Pump Using Stored Heat from a Solar Thermal System Miguel Ramirez Stefanou (Tecnalia) †, Neil J. Hewitt (Ulster University), Asier Martinez-Urrutia (Tecnalia), Nikhilkumar Shah (Ulster University)	
16:30~16:45	[0	2] Theoretical Investigation of High-temperature Heat Pump Cycles for Steam Generation Cordin Arpagaus (NTB University of Applied Sciences and Technology Buchs), Frédéric Bless (NTB University of Applied Sciences and Technology Buchs) †, Stefan Bertsch (NTB University of Applied Sciences and Technology Buchs)	
16:45~17:00	[0	5] High Temperature Heat Pumps for Drying – First Results of Operation in Industrial Environment Veronika Wilk (AIT Austrian Institute of Technology GmbH) † , Franz Helminger (AIT Austrian Institute of Technology GmbH), Michael Lauermann (AIT Austrian Institute of Technology GmbH), Bernd Windholz (AIT Austrian Institute of Technology GmbH), Andreas Sporr (AIT Austrian Institute of Technology GmbH)	
17:00~17:15	[3	Part Load Capability of a High Temperature Heat Pump with Reversed Brayton Cycle Johannes Oehler (German Aerospace Center (DLR)) †, Jens Gollasch (German Aerospace Center (DLR)), A. Phong Tran (German Aerospace Center (DLR)), Eberhard Nicke (German Aerospace Center (DLR))	
17:15~17:30	[0	7] Analysis of a Steam Generating High Temperature Heat Pump for Industrial Waste Heat Recovery Sabrina Dusek (Austrian Institute of Technology GmbH) †, Michael Lauermann (Austrian Institute of Technology GmbH), Franz Helminger (Austrian Institute of Technology GmbH), Veronika Wilk (Austrian Institute of Technology GmbH)	

ORAL SESSION

THURSDAY, APRIL 29, 2021

* THE LIVE STREAM SCHEDULE IS BASED ON KOREA STANDARD TIME (KST / UTC +9).

Room A (Tamna Hall)

Thursday, April 29, 2021 | Room A (Tamna Hall, 8F)

Session 9A: Variable Refrigerant Flow Heat Pumps and Air-conditioners Session Chair: Sophie Hosatte (Natural Resources Canada – CanmetENERGY, Canada)			
09:00~09:20	Keynote [210]	Impact of Variable Speed Components on the Seasonal Performance of a Residential Air-Source Heat Pump Fatih Meral (Purdue University, Ray W. Herrick Laboratories) †, Oliver Obst (Purdue University, Ray W. Herrick Laboratories), Eckhard Groll (Purdue University, Ray W. Herrick Laboratories), Nicholas P. Salts (Purdue University, Ray W. Herrick Laboratories)	
09:20~09:35	[112]	A Parameter-estimation Model for Variable Refrigerant Flow Heat Pump Systems Aziz Mbaye (Polytechnique Montréal) † , Massimo Cimmino (Polytechnique Montréal)	
09:35~09:50	[196]	Investigation of VRF System under Cooling Mode through Field Testing and Machine Learning-based Modeling Hanlong Wan (University of Maryland), Tao Cao (University of Maryland), Yunho Hwang (University of Maryland) † , Heunghee Bae (LG Electronics), Saikee Oh (LG Electronics)	
09:50~10:05	[082]	Experimental and Mechanistic Numerical Analysis of a Variable Speed Residential Heat Pump Unit with an Expansion Work-Recovery Device Riley B. Barta (Purdue University, Ray W. Herrick Labs) †, Ammar M. Bahman (Purdue University, Kuwait University), Lennart Stania (Purdue University, Ray W. Herrick Labs), Davide Ziviani (Purdue University, Ray W. Herrick Labs), Eckhard A. Groll (Purdue University, Ray W. Herrick Labs)	
10:05~10:20	[283]	Next-Generation Residential Space Conditioning System in the United States Ammi Amarnath (Electric Power Research Institute) †, Sara Beaini (Electric Power Research Institute), Aaron Tam (Electric Power Research Institute), Jerine Ahmed (Southern California Edison Company)	
10:20~10:40		Coffee Break and Poster Session	

Thursday, April 29, 2021 | Room A (Tamna Hall, 8F)

Session 10A: Sorption Heat Pumps (3)			
			Session Chair- Bhan Fricke (Oak Riuge National Laboratory, Onited States)
10:40~11:00	Keynote	[086]	Effect of Evaporator and Condenser in the Analysis of Adsorption Chiller Woo Su Lee (Sejong University), Jae Dong Chung (Sejong University) †, Moon Yong Park (Sejong University), Xuan Quang Duong (Sejong University), Ngoc Vi Cao (Sejong University)
11:00~11:15		[049]	Experimental Study on an Absorption Heat Pump Prototype Applied for Rural Residential Heating Ding Lu (Technical Institute of Physics and Chemistry, Chinese Academy of Sciences), Maoqiong Gong (Technical Institute of Physics and Chemistry, Chinese Academy of Sciences) †, Yin Bai (Technical Institute of Physics and Chemistry, Chinese Academy of Sciences), Yanxing Zhao (Technical Institute of Physics and Chemistry, Chinese Academy of Sciences), Xueqiang Dong (Technical Institute of Physics and Chemistry, Chinese Academy of Sciences)
11:15~11:30		[095]	Energy Performance Comparison of Two Different Types of Heat Pump-driven Liquid Desiccant-assisted Air-Conditioning Systems for an Apartment Building Jae-Hee Lee (Hanyang University), Hansol Lim (Hanyang University), Hye-Won Dong (Hanyang University), Jae-Weon Jeong (Hanyang University) †
11:30~11:45		[118]	Experimental Investigation on the Influence of Bubble Pump on the DAR Performance Hyung Won Choi (Korea University), Gawon Lee (Korea University), Jang Seok Lee (LG Electronics Inc.), Byung Ha Kang (Kookmin University), Yong Tae Kang (Korea University) †
11:45~12:00		[094]	Energy Benefits of Ventilation, Dehumidification, and Water Heating System Based on Liquid Desiccant Cycle Soo-Jin Lee (Hanyang University), Hansol Lim (Hanyang University), Yong-Kwon Kang (Hanyang University), Jae-Weon Jeong (Hanyang University) †
12:00-13:00			Lunch and Poster Session

Thursday, April 29, 2021 | Room A (Tamna Hall, 8F)

Session 11A: Industrial Heat Pumps (2)			
			Session Chair: Jun Young Choi (Korea Testing Laboratory, Korea)
13:00~13:20	Keynote	[322]	Categorization of Industrial Heat Pump for Integrated Simulation Technology Jongsoo Jeong (Waseda University), Akihiro Ichikawa (Waseda University), Yoichi Miyaoka (Waseda University) † , Takaoki Suzuki (Waseda University), Seiichi Yamaguchi (Waseda University), Kiyoshi Saito (Waseda University)
13:20~13:35		[232]	Experimental Setup and Test of a Desalination System Using a Heat Pump Soo Kwang Yang (Pusan National University), Hae Eun Song (Pusan National University), Young Chull Ahn (Pusan National University) †
13:35~13:50		[342]	Experimental Investigation of Parameters Affecting Drying Time and Power Consumption of a Heat Pump Tumble Dryer Mehdi Rasti (Pusan National University), Su-Il Park (LG Electronics), Geun-Hyung Lee (LG Electronics), Ji Hwan Jeong (Pusan National University) †
13:50~14:05		[241]	Method for a Quick Economic Assessment of Vapor Compression Heat Pumps Dominik Seliger (TU Wien) † , Daniel Lange (TU Wien), Veronika Wilk (AIT), Jürgen Fluch (AEE INTEC), Karl Ponweiser (TU Wien)

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TECHNICAL PROGRAM			
14:05~14:20	[271]	Heat Pump and Thermal Energy Storage Integration in Non-continuous Processes – An Application to the Food Industry Raphael Agner (Lucerne University of Applied Sciences and Arts), Edward J. Lucas (Lucerne University of Applied Sciences and Arts) †, Lorenz P. Rast (Lucerne University of Applied Sciences and Arts), Jan A. Stampfli (Lucerne University of Applied Sciences and Arts), Beat Wellig (Lucerne University of Applied Sciences and Arts)	
14:20-14:40		Coffee Break and Poster Session	

Thursday, April 29, 2021 | Room A (Tamna Hall, 8F)

Session 12A: Heat Pumps combined with Thermal Energy Storage and Recovery Session Chair: Marion Bakker (NL Delegate, Netherlands) 14:40~15:00 Keynote [178] Dynamic Performance Tests of a Heat Pump Cycle Integrated Latent Heat Thermal Energy Storage for Optimized DHW Generation Klemens Marx (AIT Austrian Institute of Technology) +, Johann Emhofer (AIT Austrian Institute of Technology), Tilman Barz (AIT Austrian Institute of Technology), Johannes Krämer (AIT Austrian Institute of Technology), Philipp Mascherbauer (AIT Austrian Institute of Technology), Luisa F. Cabeza (Universitat de Lleida), Gabriel Zsembinszki (Universitat de Lleida), Andreas Strehlow (AKG Verwaltungsgesellschaft mbH), Birgo Nitsch (AKG Verwaltungsgesellschaft mbH), Michael Wiesflecker (OCHSNER Wärmepumpen GmbH), Raimund Zitzenbacher (OCHSNER Wärmepumpen GmbH) 15:00~15:15 [307] Heating System based on Heat Recovery from Sewage Carlos Infante Ferreira (Delft University of Technology) +, Maneesh Avadhani (Delft University of Technology), Roland van Rooyen (Gemeente Rotterdam) 15:15~15:30 [800] Range of Application of Heat Pumps - Implementation of Heat Pumps with Different Heat Sources Franziska Bockelmann (Steinbeis-Innovationszentrum (SIZ) energie+) +, Markus Peter (Steinbeis-Innovationszentrum (SIZ) energie+), Mathias Schlosser (Steinbeis-Innovationszentrum (SIZ) energie+) [254] 15:30~15:45 In-situ Analysis of a Centralized Wastewater Heat Pump for a Complex of High Energy Standard Buildings Simon Callegari (University of Geneva) †, Fleury De Oliveira Filho (University of Geneva), Pierre Hollmuller (University of Geneva), Carolina De Sousa Fraga (University of Geneva) 15:45~16:00 Break

Thursday, April 29, 2021 | Room A (Tamna Hall, 8F)

16:00~17:00 Closing Ceremony

PROGRAM INFORMATION

Host: Minsung Kim (Chung-Ang University, South Korea)

- Opening Speech (Per Jonasson, IOC Chair, Sweden)
- Award Ceremony (Per Jonasson, IOC Chair, Sweden)
- Ritter von Rittinger Award
- Global Student Video Competition
- Conference Report & Closing Speech (Minsung Kim, Secretary General, Korea)
- The 14th IEA Heat Pump Conference (HPC 2023) (Brian A. Fricke, Chair of U.S. National Organizing Committee, U.S.)
- Closing Remarks(Minsung Kim, Secretary General, Korea)

Room B (Halla Hall)

Thursday, April 29, 2021 | Room B (Halla Hall, 8F)

Session 9B: Heat Exchangers (2)		
		Session Chair: Ed Vineyard (U.S. Department of Energy, United States)
09:00~09:20	Keynote [109]	Refrigerant Circuitry Optimization of Heat Exchangers for Charge Reduction and Robust Performance in Reversible Heat Pump Application Vikrant Aute (University of Maryland) †, Zhenning Li (University of Maryland), Jiazhen Ling (University of Maryland)
09:20~09:35	[332]	Proof-of-Concept Testing of Adhesive Joints for HVAC&R Applications Haotian Liu (Purdue University) † , Patrick J. Geoghegan (Oak Ridge National Laboratory), Justin A. Weibel (Purdue University), Davide Ziviani (Purdue University), Eckhard A. Groll (Purdue University)
09:35~09:50	[344]	Effect of Shape Change in the Flow Dirction of Mini-channel on the Flow Patterns Haruki Mitarai (The University of Electro-Communications), Tetsuya Kobayashi (The University of Electro-Communications), Koji Enoki (The University of Electro-Communications) † , Kousaku Nishida (MAYEKAWA MFG. Co. Ltd), Ikurou Akada (MAYEKAWA MFG. Co. Ltd)
09:50~10:05	[314]	Refrigerant Circuitry Optimization of an Outdoor Unit Heat Exchanger based on Partial Load Operating Conditions Shehryar Ishaque (Kyungpook National University), Man-Hoe Kim (Kyungpook National University) †
10:05~10:20	[110]	A Dynamic Model for Microchannel Heat Exchanger under Frost Conditions Jiazhen Ling (University of Maryland) † , Lingzhe Wang (University of Maryland), Rohit Dhumane (Modine Manufacturing Company), Vikrant Aute (University of Maryland)
10:20~10:40		Coffee Break and Poster Session

Thursday, April 29, 2021 | Room B (Halla Hall, 8F)

Session 10B: Dehumidification Technology Session Chair: Bamdad Bahar (Xergy Inc., United States) 10:40~11:00 Comparison on Vacuum Membrane Dehumidification Systems with Moisture Selective Dense [003] Keynote Membrane Hyunjeong Lim (Hyundai Motor Co.), Jinwook Lee(Chung-Ang University), Donik Ku (Chung-Ang University), Sangmi Choi (LG Electronics Inc.), Soyeon Kim (Chung-Ang University), Minkyu Jung (Chung-Ang University), Jihun Lim (Chung-Ang University), Minsung Kim (Chung-Ang University) + 11:00~11:15 [026] Active Humidity Control for Refrigeration Applications Bamdad Bahar (Xergy Inc.) +, Jacob Zerby (Xergy Inc.) [090] 11:15~11:30 Theoretical Analysis of Mass Transfer in a Vacuum Membrane Dehumidification System Hye-Jin Cho (Hanyang University), Seong-Yong Cheon (Hanyang University), Su Liu (Hanyang University), Jae-Weon Jeong (Hanyang University) † 11:30~11:45 [091] Empirical Analysis of Dehumidification Performance of a Hollow-Fiber-Membrane Dehumidifier Seong-Yong Cheon (Hanyang University), Jae-Weon Jeong (Hanyang University) †, Hye-Jin Cho (Hanyang University), Jinyoung Ko (Hanyang University) [054] Membrane based Pervaporation for Heating and Cooling 11:45~12:00 Bamdad Bahar (Xergy Inc.) +, Harish Opradishta (Xergy Inc.), Mark Stutman (Xergy Inc.), William Tomhon (Xergy Inc.) 12:00-13:00 Lunch and Poster Session
Thursday, April 29, 2021 | Room B (Halla Hall, 8F)

Session 11	B: Heat Pumps	in HVAC Systems Session Chair: Ji Hwan Jeong (Pusan National University, South Korea)
13:00~13:20	Keynote [09	Working Fluid Selection of Organic Rankine Cycle for a Liquid Desiccant System Hye-Won Dong (Hanyang University), Beom-Jun Kim (Hanyang University), Li-Hua Lin (Hanyang University), Jae-Weon Jeong (Hanyang University) †
13:20~13:35	[07	Experimental Investigations of Two Types of the Dual-loop Heat Pump Systems for Ventilation Heat Recovery Lei Wang (Beijing University of Technology), Guoyuan Ma (Beijing University of Technology) †, Anna Ma (Beijing University of Technology), Xiaoya Jia (Beijing University of Technology), Yu Liu (Beijing University of Technology), Feng Zhou (Beijing University of Technology)
13:35~13:50	[17	Analysis of the Impact of Different HVAC Configurations and Control Strategies on Primary Energy and Cost Savings for an Office Building Mara Magni (Universität Innsbruck) †, Fabian Ochs (Universität Innsbruck)
13:50~14:05	[14	Fundamental Study on a Green Roof Building Air-conditioning System – Experimental Analysis of Summer Mode using a Reduction Model Apparatus Tzu Wei Yeh (Kokushikan University) †, Toshio Otaka (Kokushikan University) †
14:05~14:20	[22	I Single Source "Solar Thermal" Heat Pump for Residential Heat Supply: Performance with an Array of Unglazed PVT Collectors Korbinian Kramer (Fraunhofer ISE), Christian Schmidt (Fraunhofer ISE), Arim Schäfer (Fraunhofer ISE) †
14:20-14:40		Coffee Break and Poster Session

Thursday, April 29, 2021 | Room B (Halla Hall, 8F)

Session 12	B: Nearly Zero	Energy Buildings Session Chair: Stephan Renz (Beratung Renz Consulting, Switzerland)
14:40~15:00	Keynote [16	Cost Optimized Design of Ground Probe Fields with Solar Regeneration Carsten Wemhoener (HSR University of Applied Sciences Rapperswil), Simon Buesser (HSR University of Applied Sciences Rapperswil), Lukas Rominger (HSR University of Applied Sciences Rapperswil)
15:00~15:15	[06	5] Control Optimization of a Double Stage Heat Pump with Desuperheater in Multi-family NZEBs Fabian Ochs (University of Innsbruck) †, Nicola Franzoi (University of Innsbruck), William Monteleone (University of Innsbruck), Georgios Dermentzis (University of Innsbruck)
15:15~15:30	[04	2] Control Strategies for Modulating Heat Pumps in a Plus Energy Building Christina Betzold (Technische Hochschule Nuernberg Georg Simon Ohm) †, Susanna Bordin (Technische Hochschule Nuernberg Georg Simon Ohm), Arno Dentel (Technische Hochschule Nuernberg Georg Simon Ohm), Gunnar Harhausen (Technische Hochschule Nuernberg Georg Simon Ohm)
15:30~15:45	[16	Energy Flexibility of Capacity-controlled Air-source Heat Pumps using Rule-based Control in Residential nZEB Carsten Wemhoener (HSR University of Applied Sciences Rapperswil) †, Lukas Rominger (HSR University of Applied Sciences Rapperswil), John Clauß (Norwegian University of Science and Technology, SINTEF Community), Laurent Georges (Norwegian University of Science and Technology)
15:45~16:00		Break

Thursday, April 29, 2021 | Room A (Tamna Hall, 8F)

16:00~17:00 Closing Ceremony

Host: Minsung Kim (Chung-Ang University, South Korea))

Room C (Ara Hall)

Session 9C: Food Storage and Display

Session Chair: Eckhard Groll (Purdue University, United States)

Thursday, April 29, 2021 | Room C (Ara Hall, 8F)

09:00~09:20	Keynote [122]	Risk Assessment of Built-in Refrigerated Display Cabinet Using A3 Refrigerant Koji Yamashita (the Japan Refrigeration and Air Conditioning Industry Association) †, Yoshihisa Sakamoto (the Japan Refrigeration and Air Conditioning Industry Association), Toshimasa Kato (the Japan Refrigeration and Air Conditioning Industry Association), Shigeki Ishihara (the Japan Refrigeration and Air Conditioning Industry Association), Shigeki Ishihara (the Japan Refrigeration and Air Conditioning Industry Association), Akira Kobayashi (the Japan Refrigeration and Air Conditioning Industry Association), Hidekazu Kainuma (the Japan Refrigeration and Air Conditioning Industry Association), Takaharu Hasegawa (the Japan Refrigeration and Air Conditioning Industry Association), Katsuyuki Osawa (the Japan Refrigeration and Air Conditioning Industry Association), Hiroshi Nagai (the Japan Refrigeration and Air Conditioning Industry Association), Keiko Hosaka (the Japan Refrigeration and Air Conditioning Industry Association)
09:20~09:35	[250]	Performance Evaluation by Simulation of Refrigerated Display Cabinets Using HFO Refrigerant Koichi Kitamura (Waseda University), Yoichi Miyaoka (Waseda University) †, Takaoki Suzuki (Waseda University), Kosuke Bizen (Waseda University), Seiichi Yamaguchi (Waseda University), Kiyoshi Saito (Waseda University), Tadao Watanabe (Fuji Electric), Takahiro Iwasaki (Fuji Electric), Koji Takiguchi (Fuji Electric)
09:35~09:50	[286]	Evaluation of Interaction between Load of Refrigerated Display Cases and Air Conditioners in a Grocery Store Using CFD Chenghao Wei (Yokohama National University) †, Miwako Fujita (Chubu Electric Power, Co., Inc.), Daisuke Narumi (Yokohama National University)
09:50~10:05	[025]	Electrochemical Inerting (Oxygen Control) for Food Preservation Bamdad Bahar (Xergy Inc.) † , Jacob Zerby (Xergy Inc.)
10:05~10:20	[027]	Pervaporation Membrane for Refrigerator Vegetable Tray Applications Bamdad Bahar (Xergy Inc.) † , Jacob Zerby (Xergy Inc.), Anderson Bortoletto (Sub-zero Group Inc.)
10:20~10:40		Coffee Break and Poster Session

Thursday, April 29, 2021 | Room C (Ara Hall, 8F)

Session 10C: Heat Pump Performance Session Chair: Guoyuan Ma (Beijing University of Technology, China) 10:40~11:00 Keynote [130] Energy Performance Estimation and Verification of an Industrial Waste Heat Recovery Heat Pump Toshihiko Okuno (Science Inc.), Takashi Kuwabara (Science Inc.), Jun Shishido (Tohoku Electric Power Co., Inc.), Katsumi Hashimoto (Central Research Institute of Electric Power Industry) †, Akira Koyama (Science Inc.) 11:00~11:15 [346] Load-based Testing Methodology for Evaluating Advanced Heat Pump Control Design Parveen Dhillon (Ray W. Herrick Laboratories, Purdue University) +, W. Travis Horton (Ray W. Herrick Laboratories, Purdue University), James E. Braun (Ray W. Herrick Laboratories, Purdue University) Economical and Environmental Data Analysis of Hybrid HVAC System of Air Source Heat Pump and 11:15~11:30 [123] Natural Gas Furnace for Cold Climate – Canada Gulsun Demirezen (Ryerson University) †, Khalid Ullah (Ryerson University), Amirali Rokn (Ryerson University), Alan S. Fung (Ryerson University) [102] Dynamic Modeling and Charge Minimization Study of a Packaged Propane Heat Pump with External 11:30~11:45 Flow Reversal for Cold Climates Tyler Shelly (Purdue University), Davide Ziviani (Purdue University) †, Riley Barta (Purdue University), Eckhard Groll (Purdue University) [101] An Air-water Dual-source Heat Pump System for Shrimp Ponds 11:45~12:00 Jia-Hao Cheng (Tongji University), Peng Gao (Tongji University), Xiang Cao (Tongji University), Peng Shao (Tongji University), Liang-Liang Shao (Tongji University), Chun-Lu Zhang (Tongji University) † 12:00-13:00 Lunch and Poster Session

Thursday, April 29, 2021 | Room C (Ara Hall, 8F)

Session 110	Session 11C: Advanced Controls and Modelling Session Chair: Veronika Wilks (AIT Austrian Institute of Technology GmbH, Austria)				
13:00~13:20	Keynote [096]	Deep Learning-based Refrigerant Charge Fault Detection Method of Air-source Heat Pump System Yong Hwan Eom (Seoul National University), Sung Bin Hong (Seoul National University), Jin Woo Yoo (KIMM), Min Soo Kim (Seoul National University) †			
13:20~13:35	[339]	Energy Saving Pre-cooling Pattern Search of an Inverter Air Conditioner Using a Deep Reinforcement Learning Algorithm Myung Sup Yoon (Korea Testing Laboratory) † , Won Sik Yoon (Korea Testing Laboratory)			
13:35~13:50	[236]	Application of a Deep Reinforcement Learning Algorithm in Household Inverter Air-conditioner Temperature Control Myung Sup Yoon (Korea Testing Laboratory) †, Won Sik Yoon (Korea Testing Laboratory), Jong-Seok Lee (Yonsei University)			
13:50~14:05	[032]	Optimization of Phase Change Thermal Energy Storage Unit based on a New Thermal Resistance Model Lingkun Liu (Gree Electric Appliances, Inc. of Zhuhai), Xiangfei Liang (Gree Electric Appliances, Inc. of Zhuhai) †			
14:05~14:20	[074]	Model Calibration of an Air Source Heat Pump System for Transient Simulations in Modelica Philipp Mehrfeld (RWTH Aachen University, E.ON Energy Research Center, Institute for Energy Efficient Buildings and Indoor Climate) †, Markus Nürenberg (RWTH Aachen University, E.ON Energy Research Center, Institute for Energy Efficient Buildings and Indoor Climate), Dirk Müller (RWTH Aachen University, E.ON Energy Research Center, Institute for Energy Efficient Buildings and Indoor Climate)			
14:20-14:40		Coffee Break and Poster Session			

Thursday, April 29, 2021 | Room C (Ara Hall, 8F)

		Session Chair: Rolf-Iver Hagemoen,(EHPA, Norway)
14:40~15:00	Keynote [268]	From Smarties, Ice-cream and Flowers Thomas Nowak (European Heat Pump Association AISBL) † , Eirini Litina (European Heat Pump Association)
15:00~15:15	[203]	Evaluation of a Lab Scale Low Charge Heat Pump Circuit Using Propane Lena Schnabel (Heating and Cooling Technologies), Clemens Dankwerth (Heating and Cooling Technologies) †, Timo Methler (Heating and Cooling Technologies), Simon Braungardt (Heating and Cooling Technologies), Thore Oltersdorf (Heating and Cooling Technologies), Christian Sonner (Heating and Cooling Technologies), Marek Miara (Heating and Cooling Technologies), Peter Schossig (Heating and Cooling Technologies)
15:15~15:30	[183]	Heat Pumps for nZEB in a Nordic Climate – Comparison of Field Data with Predicted Performance and LCC Analysis of Different Heat Pump Heating and Ventilation Systems Caroline Haglund Stignor (RISE Research Institutes of Sweden), Ola Gustafsson (RISE Research Institutes of Sweden), Markus Lindahl (RISE Research Institutes of Sweden), Svein Ruud (RISE Research Institutes of Sweden) †
15:30~15:45	[310]	Performance Analysis of a Vapor Extraction Heat Pump System for District Heating/Cooling Applications Aziz Mbaye (He-Tech Suisse), Malick Kane (University of Applied Sciences and Engineering, HES//SO Fribourg) †
15:45~16:00		Break

Thursday, April 29, 2021 | Room A (Tamna Hall, 8F)

16:00~17:00 Closing Ceremony

Session 12C: Smart Applications of Heat Pumps

Host: Minsung Kim (Chung-Ang University, South Korea)

POSTER SESSION

APRIL 27-29, 2021

Lobby (8F)

Track 1: Residential and Building applications

- 1 [013] Experimental Research on Air-source Heat Pump Using Heat Pipes as Heat Radiator Shuxue Xu(Beijing University of Technology) +, Guoyuan Ma(Beijing University of Technology),Yueyue Shao(Beijing University of Technology)
- 2 [069] Design of Heat Pump Systems Considering Operation Dynamics Christian Vering (RWTH Aachen University) † , Christoph Höges (RWTH Aachen University), Markus Nürenberg (RWTH Aachen University), Dirk Müller (RWTH Aachen University)
- 3 [258] Performance Characteristics of Cascade Multi-Functional Heat Pump in Cooling-Hot Water Mode with Variation in Secondary Fluid Temperature Conditions Selorm Kwaku Anka (Hanbat National University), Jong Min Choi (Hanbat National University) †, Samuel Boahen (Cape Coast

Technical University), Kwesi Mensah (Hanbat National University), Won Hee Kang (Korea University), Min Kyeong Park (Korea University), Kwang Ho Lee (Korea University)

- 4 [260] Development of a Dynamic Model of a Heat Pump System and Fault Detection Yechan Yun (Kookmin University), Dongwon Han (Korea University), Young Soo Chang (Kookmin University) †
- 5 [291] Energy Efficiency Research of an Air-source Heat Pump for Floor Heating System in Winter Test Chenxi Ni (Hefei University of Technology) †, Haihong Huang (Hefei University of Technology) †, Lei Yang (Hefei University of Technology), Tiejun Wang (Hefei University of Technology)
- 6 [311] Study on Aging of Heat Pump based on Long-term Assessment Nobuhiro Takahashi (Japan Facility Solutions, Inc),
- 7 [162] Heat Pump Integration for nZEB Results of IEA HPT Annex 49 Carsten Wemhoener (HSR University of Applied Sciences Rapperswil) †, Fabian Ochs (University of Innsbruck), Christina Betzold (TH Nürnberg), Arno Dentel (TH Nürnberg Georg Simon Ohm)
- 8 [269] Research on Energy Saving Calculation Combining Load of Air Conditioner and Load of Refrigerated Display Case in a Grocery Store Miwako Fujita (Chubu Electric Power, Co., Inc./Yokohama National University) †, Daisuke Narumi (Yokohama National University)
- 9 [331] Performance Characteristics of Cascade Multi-Functional Heat Pump in Cooling-Hot Water Mode with Variation in Secondary Fluid Temperature Conditions Nobuhiro Takahashi (Japan Facility Solutions, Inc), Masashi Momota (Tokyo Denki Univ.) †, Masashiko Kumagai (Japan Facility Solutions, Inc) †, Tadahiko Ibamoto (Tokyo Denki Univ.), Takashi Inoue (Tokyo University of Science)
- 10 [031] Experimental Investigation on One-time Heating R32 Two-stage Air Source Heat Pump Water Heater Bo Zheng (Gree Electric Appliances, Inc. of Zhuhai), Xiangfei Liang (Gree Electric Appliances, Inc. of Zhuhai) †, Rong Zhuang (Gree Electric Appliances, Inc. of Zhuhai)

Track 2: Smart Energy Systems and Renewables

- 11 [039] PVT Geo Coupled Air to Water Heat Pump System Twin Test Cell Experimental Study Euy-Joon Lee (Korea Institute of Energy Research) †, Kwang-Seob Lee (University of Science and Technology), Eun-Chul Kang (Korea Institute of Energy Research), Yu-Jin Kim (University of Science and Technology), Evgueniy Entchev (CanmetENERGY), Libing Yang (CanmetENERGY)
- 12 [315] Status on the Electric-thermal Energy Storage Technology and Application of a Supercritical Carbon Dioxide Power Cycle Junhyun Cho (Korea Institute of Energy Research) †, Chulwoo Roh (Korea Institute of Energy Research), Hyungki Shin (Korea Institute of Energy Research), Gilbong Lee (Korea Institute of Energy Research), Bongsu Choi (Korea Institute of Energy Research), Jongjae Cho (Korea Institute of Energy Research), Beomjoon Lee (Korea Institute of Energy Research), Ho-Sang Ra (Korea Institute of Energy Research), Young-Jin Baik (Korea Institute of Energy Research) †
- 13 [348] Electrochemical Reaction and Fluid Flow Analysis in PEMWE Kyu Heon Rho (Chung-Ang University), Dong Kyu Kim (Chung-Ang University) †
- 14 [285] Research and Analysis on Influence Factors of Accuracy of Geotechnical Thermal Response Test Lingyan Yang (China Academy of Building Research) †, Jintang Li (China Academy of Building Research), Fu Yijun (China Academy of Building Research), Ma Ning (Shandong Yimeike Energy Conservation Service Co., Ltd), Wei Wei (Shandong Yimeike Energy Conservation Service Co., Ltd), Bian Mengmeng (China Academy of Building Research)
- 15 [070] Combined Heating and Cooling in District Solutions Jussi Alpua (Industrial heat pumps and Chillers) +, Martti Kukkola (Industrial Heat Pumps and Chillers)

Track 3: Air-Conditioning & Industry

16 [147] Effect of Evaporating Temperature Rising Operation for Multi-Split type Air-Conditioner on Energy Conservation and Thermal Comfort Hiroshi Nakayama (Chubu Electric Power co.,Inc.) +, Yuji Naka (Chubu Electric Power co., Inc.), Masaaki Miura (Chubu Electric

Power co., Inc.), Hideki Tanaka (Nagoya University)

 17
 [148]
 Study on Short Circuit of Airflow in Outdoor Unit of Air Conditioner

Hiroyuki Miyazaki (Chubu Electric Power Co., Inc) †, Tsubasa Ito (Mie University), Hiroshi Nakayama (Chubu Electric Power Co., Inc), Masafumi Hirota (Mie University)

- 18 [321] An Experimental Study on Thermal Comfort Improvement For Residential Air Conditioner Applying a Wind-Free Technology Youngju Joo (Samsung Electronics), Jun Hwang (Samsung Electronics) †, Hyeongjoon Seo (Samsung Electronics), Byongguk Lim (Samsung Electronics)
- 19 [353] Performance Simulation of CO2 Transcritical Cooling System with Mechanical Subcooling Cycle Using Low GWP Refrigerants Sun-Ik Na (Seoul National University), Gu Hwang Kang (Seoul National University), Min Soo Kim (Seoul National University) †
- 20 [354] A Study on the Performance of Heat Pump by Mixing Ratio of Isobutane/Propane Mixed Refrigerants Gu Hwang Kang (Seoul National University), Sun Ik Na (Seoul National University), Min Soo Kim (Seoul National University) †

21 [227] A Study on the Heat Pump System for Removing White Plume of Cooling Tower and Recovering Water Vapor Chulwoo Roh (Korea Institute of Energy Research) +, Gilbong Lee (Korea Institute of Energy Research), Beom Joon Lee (Korea Institute of Energy Research), Eun Seok Wang (Korea Institute of Energy Research), Young Jin Baik (Korea Institute of Energy Research), Hyungki Shin (Korea Institute of Energy Research), Jong Jae Cho (Korea Institute of Energy Research), Jun Hyun Cho (Korea Institute of Energy Research), Bong Soo Choi (Korea Institute of Energy Research)

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22 [248] Analysis of the Mixture Refrigerant R600/R245fa Using in High Temperature Heat Pump
Xlaohui Yu (Hebei University of Technology) +, Chang Xu (Hebei University of Technology)
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PRO	GRAM IN	NFORMATION
TEC	CHNICA	AL PROGRAM
23	[288]	Analytical Study on for Performance of R134a, R404A, and R744 Refrigeration Truck System Honghyun Cho (Chosun University) † , Yunchan Shin (Chosun University), Yeonghun Kim (Chosun University), Minjun Kim (Chosun University)
24	[347]	Novel Cascade Solution of Ultra-temperature Industrial Heat Pump System with Multiple Functions Xiaoning Chen (Emerson Research and Solutions Center) †, Niansheng Han (Emerson Research and Solutions Center)
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