



# 10<sup>th</sup> Heat-Powered Cycles Conference

## 3-6 September 2023, Edinburgh, Scotland, UK

The University of Edinburgh, Appleton Tower

### Conference Programme

30 August 2023 Release



THE UNIVERSITY of EDINBURGH  
School of Engineering



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Larisa Gordeeva, Boreskov Institute of Catalysis (Russia)  
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## Keynotes

**Prof Stefano Brandani** – The University of Edinburgh

Editor in Chief of the journal Adsorption (Springer) and Professor of Chemical Engineering at The University of Edinburgh. He is a world-leading expert in the fundamentals of adsorption and adsorption processes, with a particular interest in the characterisation of kinetics of gases and vapours in nanoporous materials.



### **Keynote 1: Determining the Adsorption Properties of Novel Nanoporous Materials for the Evaluation of Process Performance for Applications in Energy Recovery and Storage**

The use of novel nanoporous adsorbent materials for applications in energy recovery and storage is a field that has grown rapidly in the last 10 years. Systems that use water are widespread, yet the measurement of equilibrium and even more kinetic properties is time-consuming and challenging. To predict correctly process performance it is important to obtain the intrinsic properties of the material, but in the case of water adsorption it is nearly impossible to achieve isothermal conditions in kinetic experiments and complex isotherm shapes are obtained. Therefore, the transport coefficients estimated will be affected by the accuracy of the isotherm used and the correct decoupling of heat effects. Here we outline the methodology used in our group, based on combining conventional experiments and the zero length column technique. An example for water adsorption on silica gel will be used to show how the zero length column technique can be used to obtain directly mass transport coefficients without the need to use an explicit isotherm model.

# Keynotes

## **Dr David Oliver** – Sunamp Ltd

Head of materials at Sunamp Ltd, world leader in thermal storage batteries. David is a recognised expert in phase change materials and in transferring applied thermal storage and thermal energy materials concepts from lab to society. He is co-author of seven patents and as Head of materials at Sunamp, he is responsible for materials development and quality control, intellectual property, enhancement of collaborations with academia and integration of new innovations into existing architectures.



## **Keynote 2: Decarbonising the world through compact thermal energy storage**

Heating and cooling processes are the major contributor to CO<sub>2</sub> emissions globally, and thermal storage has a major role to play in decarbonising how we deliver warmth and coolth. This talk explains the role of Sunamp thermal batteries in this transition.

Sunamp's compact thermal storage solutions utilise solid-to-liquid phase change materials as an energy dense storage medium. These heat batteries are combined with cleantech heating and cooling devices, such as heat pumps and sorption devices to result in increased electrification, and decarbonisation, of heating and cooling via renewable electricity usage. Key heat battery features are: compactness, low heat loss/gain, integrations with renewable heat/cold generators and operation over low differential temperatures. To date, over 25,000 Sunamp heat batteries have been installed.

## Keynotes

**Prof Annelies Vandersickel** – University of Stuttgart and Head of the Thermal Process Technology Department of the German Aerospace Center (DLR Institute of Engineering Thermodynamics)



**Keynote 4: Latent Heat storage for flexible sector coupling and efficient process steam generation**

This contribution gives an overview of our latest research on the development of compact, high power latent heat storages for steam processes. The current dual tube design of the heat exchanger embedded in the storage has been developed within the framework of the European Union's H2020 project CHESTER. It enables the storage's use in a wide range of applications ranging from waste heat recuperation, Power-to-Heat to Power-to-Heat-to-Power (also known as Carnot Battery). This presentation will focus on experimental results obtained from a 200kWh in house demonstrator and touch upon the technologies potential for flexible sector coupling and power to process heat applications.

## Joint Talk on Materials and Processes for Carbon Dioxide and Water

### **Prof Paul Wright** – University of St Andrews

Professor of Physical Chemistry at the University of St Andrews. His work contributes to the research of metal-organic frameworks and zeolites, as well as mesoporous materials. His research focuses on the development of new materials and fundamental research in the area of porous materials, as well as the application of known materials in industrially important areas.



### **Prof Susana Garcia** – Heriot-Watt University

Susana García is Professor of Chemical and Process Engineering and Deputy Head of the Institute of Mechanical, Process and Energy Engineering at Heriot-Watt University in Edinburgh, United Kingdom. Currently, she is a Visiting Professor at École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland. She is also the Associate Director in Carbon Capture and Storage at the Research Centre for Carbon Solutions (RCCS), an interdisciplinary world leading engineering centre, inspiring and delivering innovation for the wider deployment of technologies needed to meet necessary carbon targets.



Her current research focuses on advancing materials and separation processes for energy, industrial and environmental applications. She ambitions to change the paradigm on how novel processes based on advanced materials are developed through the integration of process engineering and basic science.

### **Dr Larisa Gordeeva** – Boreskov Institute of Catalysis

Larisa Gordeeva is a Leading Researcher at Boreskov Institute of Catalysis (BIC), Russia (the Group of Energy Accumulating Materials and Processes). She received her Ph.D. in Chemistry in 1998 and Dr. Sci. degree (Dr. Hab.) in Physical Chemistry in 2013 from BIC. Her research interests are in Material chemistry, rational design of adsorbents, Nanocomposites salt/matrix, Metal-Organic Frameworks, Adsorption, Adsorptive heat conversion and storage.



## Kenneth Denbigh Medal Lecture

Kenneth George Denbigh (30 May 1911 – 23 January 2004) was the 1st Professor of Chemical Technology at The University of Edinburgh in 1955. His books are still pillars for the clear understanding of Thermodynamics and irreversibility.

In honour of Kenneth Denbigh and to support his long-lasting legacy, the School of Engineering of The University of Edinburgh established the Kenneth Denbigh Medal.

Kenneth Denbigh interests were broader than purely technical and expository texts to wider social and metaphysical issues. In 1963, during his inaugural lecture at Edinburgh, he pointed out how depressing many of the last manifestations of the industrial revolution had been with their legacy of monotonous jobs and the environmental disasters that our manufacturing cities had become. His remedy was that of social sensitivity to factors less measurable than money.

In the spirit of Kenneth Denbigh, the Medal acknowledges the person who most distinguished in research on generation, conversion, management or utilization of low temperature heat after having faced the challenge of “finding a way” for low temperature heat under the inescapable second law constraints.

After a process that involved 37 colleagues from academia and industry and staff from the School of Engineering - The University of Edinburgh, panel is delighted to invite **Emeritus Prof Francis Meunier** from the Laboratoire de Chimie Moléculaire, Génie des Procédés Chimiques et Énergétiques, Conservatoire National des Arts et Métiers Paris, to receive the inaugural Kenneth Denbigh Medal.





## Lecture Title: Challenges for Heat-Powered Processes

The eruption of important planetary problems, concerning the climate as well as the global carbon and water cycles, forces humanity to revisit its interference with these elements and to address several challenges.

The current trend of decision-makers is to promote green electrical solutions, whether to decarbonize industry or intervene on the carbon and water cycles.

However, not only do heat powered processes present solutions to these problems, but they are absolutely necessary because they allow to exploit the huge reservoir of waste heat to put it at the service of energy and also of negative emissions as well as of water harvesting or desalination.

This new situation requires to revisit heat powered processes since heat sources are modified both by decarbonisation and by the need to valorize waste heat of diversified origin and at lower temperature.

This huge challenge calls for working methods opening up even more strongly collaborations between interdisciplinary academics, industry and end users.

Extracts from some of the nominations:

*“has impacted the research in adsorption science for decades. Also, he is among the first to pioneer the application of CO<sub>2</sub> capture with adsorption as a negative emission technology as early as 2008.”*

*“many seminal works throughout the 1980s and 1990s on the second law analysis of sorption refrigeration cycles, discovering the thermal efficiency limits of heat recovery and thermal wave cycles and developing new entropy analysis techniques that have become the cornerstone for those working in the field... He has inspired the next generation of researchers”*

*“published a set of investigations on equilibrium and non-equilibrium of heat-driven adsorption processes that are still pillars in the field. Creativity and rigour are the two most distinctive features of his production, always written in a way easy to understand and follow for both the junior and senior reader.”*

*“has been instrumental in advancing the field of energy efficiency and sustainability. Muenier is known for his leadership, integrity, and commitment to public service. He has served on various industry boards and committees, including the International Energy Agency. His contributions to the field of sustainable engineering and commitment to making the world a better place make him a highly deserving recipient of this prestigious award.”*

*“a pioneer in the field of thermally-driven sorption technologies. Some of his scientific papers, even if published many years ago, are still relevant today - especially those addressing the study of advanced sorption cycles and the related H&M transfer phenomena in porous media.”*

*“has made significant achievements in fundamental research on the thermodynamics of sorption technologies, system design, knowledge spreading and education, which are in excellent accord with the criteria of the Kenneth Denbigh Medal.”*

## Day 1: Sunday 3 September 2023

Time (BST)	Event
15.30 – 19.00	Appleton Tower – Foyer Area 10th Heat-Powered Cycles Conference Registration and Welcome Reception <b>Upload your presentation at the Registration Desk until 19.00</b> (Eloise Bevan)

## Day 2: Monday 4 September 2023

Morning

Time (BST)	Event	Chair
8.15 –	Foyer Area – 10 <sup>th</sup> Heat Powered Cycles Conference Registration <i>Secretarial Support remains open until 15.30 except during breaks</i> You will have one last chance to upload your presentation at the Registration Desk until 8.50 (Eloise Bevan)	--
8.50 – 9.10	Lecture Theatre 1 – Conference welcome	
9.10 – 10.00	Lecture Theatre 1 – Keynote 1: Prof Stefano Brandani (The University of Edinburgh) Determining the Adsorption Properties of Novel Nanoporous Materials for the Evaluation of Process Performance for Applications in Energy Recovery and Storage (40min) Q&A (10min) Room Lead: Isabella Quaranta;	Gerrit Fuedner, Fraunhofer ISE, Germany
10.00 – 10.30	Foyer Area – Coffee Break and Poster Exhibition	
	Morning Sessions	
10.30 – 12.30	Lecture Theatre 1 – Sorption Processes – D2A Room Lead: Isabella Quaranta; Room Support: Khaloud Al Balushi  <b>#119. Optimization of thermochemical heat storage system by controlling operating parameters and using double reactors.</b> Dongyu Meng*, Abdalqader Ahmad, Yulong Ding, Martin Freer  <b>#80. Modeling and optimization of a packed-bed adsorption thermal battery.</b> Ziya Zeng*, Bingchen Zhao, Duc Thuan Bui, Weidong Chen, Kian Jon Ernest Chua, Ruzhu Wang  <b>#21. Methanol/Activated Carbon Sorption Thermal Energy Storage.</b> Nir Tzabar, Yakov Garfinkel, Netanel Lempel*  <b>#71. Using Effective Heat and Mass Transfer Resistances and Characteristic Temperature Differences to Predict Performance of Adsorptive Heat Transformation Devices - a Simple and Robust Approach.</b> Andreas Velte-Schäfer, Eric Laurenz, Tobias Weilenmann Weisser, Gerrit Fuldner*  <b>#26. Carbon-Dioxide Sorption Compressors for Refrigeration and Air-Conditioning Systems.</b> Sugod Iraqi*, Nir Tzabar  <b>#59. Sustainable Sorption Heat Pumps for Residential Applications.</b> Amir Zivariravan*, Giulio Santori, Alessia Arteconi	Enzo Mangano, The University of Edinburgh, UK
10.30 – 12.30	Lecture Theatre 2 – Heat Storage Devices Room Lead: Eloise Bevan; Room Support: Janice To  <b>#54. Experimental testing of an adsorption thermal energy storage system.</b> Salvatore Vasta, Alejandro Jose Di Cicco, Tommaso Toppi, Mario Motta, Angelo Freni*  <b>#96. Molten-salt thermochemical thermal energy storage with a temperature booster.</b> Shigehiko Funayama*, Takashi Kato, Soichiro Tamano, Kyosuke Mochizuki, Tsukasa Sugiyama, Tsuyoshi Izaki, Hiroki Takasu, Yukitaka Kato  <b>#103. Particle Properties of CaO/Ca(OH)<sub>2</sub> Throughout Cyclisation in a Fluidized Bed for Thermochemical Energy Storage – Consequences for Fluidization.</b> Leander Morgenstern*, Sören Ohmstedt, Florian Kerscher, Hartmut Spliethoff  <b>#105. Heat and mass transfer analysis of an aqueous sodium hydroxide based thermal storage system.</b> Sai Yagnamurthy*, Steven Metcalf, Bob Critoph  <b>#110. Design and experimental evaluation of a thermochemical energy storage system for mid-term energy storage.</b> Valeria Palomba*, Vincenza Brancato, Yannan Zhang, Andrea Frazzica, Elmira Pirshayan, Gabriele Penello, Walter Mittelbach  <b>#33. Development of a latent heat thermal energy storage system for waste heat recovery on ships.</b> Pouriya Niknam, Lorenzo Ciappi*, Robin Fisher, Adriano Sciacovelli	David Oliver, Sunamp Ltd, UK
12.30 – 13.30	Foyer Area – Lunch and Poster Exhibition	

## Day 2: Monday 4 September 2023

Afternoon

Time (BST)	Event	Chair
13.30 – 14.20	Lecture Theatre 1 – Keynote 2: Dr David Oliver (Sunamp Ltd) Decarbonising the world through compact thermal energy storage (40 min) Q&A (last 10 minutes) Room Lead: Isabella Quaranta	Walter Mittelbach, Sorpton Technologies, Germany
	Afternoon Sessions 1	
14.30 – 15.50	Lecture Theatre 1 – Nanoporous Materials for Vapours Room Lead: Eloise Bevan; Room Support: Marwan Mohammed  <b>#47. Experimental evaluation of barium bromide-ammonia equilibrium lines.</b> Jake Locke*, George Atkinson, Stan Shire, Bob Critoph, Steven Metcalf  <b>#35. Salt in porous matrix composites for sorption heat transformers: How to maximize sorption capacity and dynamic performance while avoiding leakage.</b> Ilya Girnuk, Claire McCague, Majid Bahrami*  <b>#42. Development of SrBr<sub>2</sub>/MOF composites with enhanced water adsorption dynamics for low temperature thermochemical heat storage.</b> Luxi Yang*, Wenjing Wei, Giulio Santori, Xianfeng Fan  <b>#112. Microfibrous hygroscopic materials for water adsorption at high RH.</b> Lucio Bonaccorsi*, Stefano De Antonellis, Angelo Freni, Angela Malara, Antonio Fotia	Bob Critoph, University of Warwick, UK
14.30 – 15.50	Lecture Theatre 2 – Heat Transformation Room Lead: Khaloud Al Balushi; Room Support: Eloise Bevan  <b>#67. Ammonia-salt resorption heat pump development and analysis.</b> George Atkinson*, Steven Metcalf, Bob Critoph, Stan Shire  <b>#78. Experimental analysis of a hybrid thermochemical cycle for simultaneous cold &amp; work productions driven by low grade heat sources.</b> Hasan Ghazale*, Nathalie Mazet, Pierre Neveu, Maxime Perier-Muzet  <b>#131. Testing of an adsorption chiller prototype for data center cooling.</b> Alejandro Jose Di Cicco*, Walter Mittelbach, Tommaso Toppi, Angelo Freni, Marcello Aprile  <b>#114. Waste Heat Driven Adsorbent Coated Adsorption Cycle.</b> Muhammad Wakil Shahzad*, Kim Choon Ng, Muhammad Ahmad, Kum Ja, Doskhan Ybraiyimkul, Qian Chen	Steve Metcalf, University of Warwick, UK
15.50 – 16.20	Foyer Area – Coffee Break and Poster Exhibition	
	Afternoon Sessions 2	
16.20 – 18.20	Lecture Theatre 1 – Sorption Processes – D2B Room Lead: Anam Abbas; Room Support: Janice To  <b>#92. Thermal Energy Storage and Upgrade Using and Integrated Adsorption-Adsorption System.</b> Allannah M. Duffy*, Kristian T. Lockyear, Matthew T. Hughes, Srinivas Garimella  <b>#109. Materials screening, lab-scale testing and simulation for high-efficiency adsorption desalination.</b> Yannan Zhang, Vincenza Brancato, Davide Palamara, Luigi Calabrese, Valeria Palomba*, Walter Mittelbach, Andrea Frazzica  <b>#68. Adsorption Cryocooler.</b> Zacharie Tamainot-Telto*  <b>#75. Alternating operation of a façade-integrated adsorption chiller for continuous cooling of lightweight buildings.</b> Olaf Boeckmann*, Micha Schaefer  <b>#94. Analysis of two bed adsorption heat pump with a stratified storage to supply heating demands in a house for retrofitting of multi-family buildings.</b> Ferdinand Schmidt, Alireza Sadeghlu* (rec)  <b>#IP. Adsorption Chillers in Process Industry – a New Type of Adsorption Chiller for Waste-Heat Recovery from Industrial Processes.</b> Walter Mittelbach*	Muhammad Wakil Shahzad, Northumbria University, UK

<p>16.20 – 17.50</p>	<p>Lecture Theatre 2 – Heat, Artificial Intelligence and Grey Box approaches                  Room Lead: Khaloud Al Balushi; Room Support: Marwan Mohammed</p> <p><b>#70. A benchmark study of supervised learning methods for predicting the live steam production of thermal power plants.</b> Gleb Prokhorskii*, Elias Eder, Souman Rudra, Markus Preissinger</p> <p><b>#41. A machine learning based model for membrane-based absorbers in absorption heat pumps.</b> Mahyar Ashouri*, Naghme Kheyrikoochaksarayee, Callum Chhokar, Amir Shabani, Majid Bahrami</p> <p><b>#95. Retrofit strategy for greenhouse gas reduction in institutional buildings.</b> Milad Ebadi*, Majid Bahrami, Bernard Chan</p> <p><b>#44. Systematic Model Selection for Grey Box Modeling of HVAC Systems.</b> Valentin Seiler*, Gerhard Huber, Peter Kepplinger</p>	<p>Yukitaka Kato,                  Tokyo Institute of                  Technology,                  Japan</p>
<p>18.20 – 18.30</p>	<p>Lecture Theatre 1 – Day Closure and Notices</p>	

## Day 3: Tuesday 5 September 2023

Includes the Workshop on Direct Air Capture, Storage and Utilization (boxes in grey)

Morning

Time (BST)	Event	Chair
8.15 –	Foyer Area – 10th Heat Powered Cycles Conference and Workshop on Atmospheric Carbon Capture, Storage and Utilization Registration. <i>Secretarial Support remains open until 15.30 except during breaks.</i> You will have one last chance to upload your presentation at the Registration Desk until 8.50 (Eloise Bevan)	--
8.50 – 9.10	Open to HPC2023 and Workshop Delegates Lecture Theatre 1 – Kenneth Denbigh Medal award	
9.10 – 10.00	Open to HPC2023 and Workshop Delegates Lecture Theatre 1 – Kenneth Denbigh Medal Recipient Room Lead: Isabella Quaranta Emeritus Prof Francis Meunier (Conservatoire National des Arts et Métiers, Paris), Challenges for Heat-Powered Processes (40 min), followed by Q&A (10 min)	Daniel Friedrich, The University of Edinburgh, UK
10.00 – 10.30	Foyer Area – Coffee Break and Poster Exhibition	
	<b>Morning Sessions</b>	
10.30 – 12.30	Open to HPC2023 Delegates only Lecture Theatre 1 – Heat in Polygen. and Purific. – D3 Room Lead: Anam Abbas; Room Support: Khaloud Al Balushi <b>#102. A multi-scale optimization tool for the design of Organic Rankine Cycles for fluctuating heat source and sink.</b> Donghoi Kim*, Lasse Anderson, Rubén Montañés, Johan Espelund, Lars Nord, Luca Riboldi <b>#18. Steam Rankine Cycle Pilot Plant – Long-term operating experience and lessons learnt for future plants regarding reliability and economic efficiency.</b> Florian Raab*, Harald Klei, Frank Opferkuch <b>#45. Investigating the characteristics of a dynamic model of a once-through steam generator for waste heat recovery.</b> Magnus Windfeldt*, Rubén Montañés, Leif Erik Andersson <b>#43. A framework for physics based off-design and dynamic modelling and simulation of combined cycle power plants in weight and volume constraint environments.</b> Rubén Montañés*, Magnus Windfeldt, Leif Erik Andersson, Geir Skaugen <b>#122. Dynamic use of SOFC for flexible heat &amp; electricity supply in industrial processes.</b> Michel van der Pal*, Robert Smidt, Martien Koppes <b>#144. Nonequilibrium condensation of supercritical carbon dioxide (sCO<sub>2</sub>) in a centrifugal compressor for the Brayton cycle.</b> Hongbing Ding, Yuanyuan Dong, Yu Zhang, Yan Yang, Chuang Wen*	Roger Riehl, GamaTech Thermal Solutions, Brazil
10.30 – 10.50	Open to HPC2023 and Workshop Delegates Lecture Theatre 2 – Air Capture, Storage and Utilization Research Projects Spotlight presentations Room Lead: Isabella Quaranta; Room Support: Marwan Mohammed <b>#90. Unlocking the scalable potential for sorbent-based DAC technologies (USorb-DAC).</b> Jin-Yu Wang*, Johannes Schilling, Elias Moubarak, Eva Sanchez-Fernandez, Laura Herraiz, Charithea Charalambous, Fergus McIlwaine, John Young, Mijndert van der Spek, Shaohan Chen, Vincent Dufour-Décieux, Sauradeep Majumdar, Kevin Jablonka, Joren van Herck, André Bardow, Berend Smit, Susana Garcia 1. Research Centre for Carbon Solutions, Heriot-Watt University; 2. Energy and Process Systems Engineering (EPSE); 3. ETH Zürich; 4. Laboratory of Molecular Simulation (LSMO); 5. Institut des Sciences et Ingénierie Chimiques, École Polytechnique Fédérale de Lausanne (EPFL) 6. Solverlo Limited; 7. RMI <b>#117. SolDAC: Full Spectrum Solar-Powered Direct CO<sub>2</sub> Capture from Air and Conversion in Ethylene.</b> Núria Mañes, Vincenza Brancato, Stefano Brandani, Nina M. Carretero, Edgar Contreras*, Daniel Chemisana, Andrea Frazzica, Marisa Gracia, Isaac Herraiz, Harpreet Kaur, Eduard Loscos, Jaime Madrid, Santiago Maestro, Marwan Mohammed, Álex Moreno, Sebastian Murcia-Lopez, Luis Navarro-Tovar, Joan Núñez, Valeria Palomba, Isabella Cavalcante Quaranta, Alejandro Solans, Gisela Soley, Venkata Tandava, Oriol Teixidó, Mayra Tovar-Oliva, Ignacio Tudela-Montes, Paul Wright, Zhenye Xu, Giulio Santori 1. Comet Global Innovation S.L.; 2. Istituto di Tecnologie Avanzate per l'Energia "Nicola Giordano" – CNR ITAE; 3. The University Of Edinburgh; 4. Catalonia Institute for Energy Research (IREC); 5. LOMARTOV; 6. University of Lleida; 7. University of St Andrews; 8. European Innovation Marketplace	Mauro Luberti, The University of Manchester, UK

<p>10.50 – 12.30</p>	<p>Open to HPC2023 and Workshop Delegates  <b>Lecture Theatre 2 – Air Capture, Storage and Utilization 1</b>          Room Lead: Isabella Quaranta; Room Support: Marwan Mohammed</p> <p><b>#72. DACCS Roadmap to 2050: Achieving a safe, scalable, and low-cost implementation.</b> Silvan Aeschlimann*, Charithea Charalambous, Lukas Kueng, Mijndert van der Spek, Susana Garcia, Daniel Pike</p> <p><b>#19. Demand-Side Management for Direct Air Carbon Capture and Storage: An Enabler for Low-Cost Negative Emissions?</b> Patrik Postweiler, Mirko Engelpracht, Daniel Rezo*, Benedikt Nilges, Niklas von der Assen</p> <p><b>#22. Mapping the Global Carbon Capture Efficiency of DAC.</b> Daniel Rezo*, Patrik Postweiler, Mirko Engelpracht, Niklas von der Assen</p> <p><b>#135. Adsorption heat and mass conversion cycles for direct air capture.</b> Long Jiang*</p> <p><b>#52. Innovative Process Integrating Waste Heat Source Heat Pumps and Direct Air Capture Processes.</b> Bingyao Ge*, Man Zhang, Xuancan Zhu</p>	<p>Mauro Luberti,          The University of          Manchester,          UK</p>
<p>12.30 – 13.30</p>	<p>Foyer Area – Lunch and Poster Exhibition</p>	

## Day 3: Tuesday 5 September 2023

Includes the Workshop on Direct Air Capture, Storage and Utilization  
Afternoon

Time (BST)	Event	Chair
13.30 – 14.20	Open to HPC2023 and Workshop Delegates Lecture Theatre 1 – Joint Talk on Materials and Processes for CO <sub>2</sub> and Water Room Lead: Isabella Quaranta Prof Susana Garcia (Heriot-Watt University) Prof Paul Wright (University of St Andrews) Dr Larisa Gordeeva (Boreskov Institute of Catalysis) (15min presentations+ 15min talk + 15 min Q&A)	Giulio Santori, The University of Edinburgh, UK
	Afternoon Sessions 1	
14.30 – 15.50	Open to HPC2023 and Workshop Delegates Lecture Theatre 1 – Character. of Materials and Structures Room Lead: Eloise Bevan; Room Support: Anam Abbas  <b>#69. Preliminary testing and evaluation of two zeolites for integration of a sorption system into industrial tumble dryers</b> Henri Schmit*, Andreas Velte-Schäfer, Eberhard Lävemann, Andreas Krönauer, Simon Pöllinger, Tobias Schubert, Eric Laurenz, Gerrit Fuedner, Stefan Hiebler  <b>#66. Dynamics of water vapour sorption on composite LiCl/(silica gel): comparative study of loose adsorbent grains vs. coatings</b> Svetlana Strelova, Yuri Aristov, Larisa Gordeeva*  <b>#132. Exploring Energy Materials at the Atomic Scale with Solid State Nuclear Magnetic Resonance Spectroscopy.</b> Silvia Pizzanelli*, Francesca Nardelli, Angelo Freni  <b>#13. Evaluating the Performance of Adsorption Chillers with Water, Methanol, and Ethanol: IR-LTJ Experiments and Model-Based Scale-Up.</b> Matthias Henninger*, Daniel Tuchlinski, Mohamed Ismail, Jan Seiler, André Bardow	Pierre Neveu, PROMES- CNRS, France
14.30 – 15.50	Open to HPC2023 and Workshop Delegates Lecture Theatre 2 – Air Capture, Storage and Utilization 2 Room Lead: Janice To; Room Support: Khaloud Al Balushi  <b>#127. Fabrication of Gas-Diffusion Electrodes for CO<sub>2</sub> Conversion: Effect of Sputtering Parameters.</b> Venkata Tandava, Dioulde Sylla, Nina M. Carretero, Sebastian Murcia-Lopez*  <b>#79. Model analysis of rotary adsorber in steam-assisted temperature swing adsorption processes for efficient CO<sub>2</sub> capture from ambient air.</b> Junye Wu*, Kuihua Wang, Xuancan Zhu, Ruzhu Wang, Chi-Hwa Wang, Tianshu Ge  <b>#140. Realistic evaluation of prototypical solid sorbents for temperature swing adsorption CO<sub>2</sub> capture processes.</b> Paul Iacomì*  <b>#64. Life Cycle Assessment (LCA) of CO<sub>2</sub>-Adsorbing Metal Organic Framework “CALF-20”.</b> Edgar Contreras*, Isaac Herraiz, Enrique Moliner	Xuancan Zhu, Shanghai Jiao Tong University, China
15.50 – 16.20	Foyer Area – Coffee Break and Poster Exhibition	



Afternoon Sessions 2		
16.20 – 18.00	<p>Open to HPC2023 and Workshop Delegates Lecture Theatre 1 – Structuring Nanoporous Materials Room Lead: Khaloud Al Balushi; Room Support: Anam Abbas</p> <p><b>#37. Experimental Study on Thermal Contact Resistance in Sorbent Reactors.</b> Salman Hassanabadi*, Majid Bahrami</p> <p><b>#56. Assessment of coated monoliths for Direct Air Capture.</b> Isabella Cavalcante Quaranta*, Mauro Luberti, Stefano Brandani, Giulio Santori</p> <p><b>#113. 3D adsorbent lattice structure based on SAPO-34/S-PEEK composite material obtained by additive manufacturing for energy storage applications.</b> Luigi Calabrese*, Gabriele Marabello, Emanuela Mastronardo, Andrea Frazzica</p> <p><b>#136. Hollow Fibre Technology: The Key to the Designing Compact Systems to Facilitate Transport Decarbonisation.</b> Collette Larkin, Fermin Oliva, Francisco Rafael Garcia Garcia*</p> <p><b>#138. Assessment of electrospun nanofibrous mats for direct air capture of CO<sub>2</sub>.</b> Kseniya Papchenko, Louis Curtice, Elsa Lasseuquette, Maria-Chiara Ferrari, Maria Grazia De Angelis*</p>	<p>Lucio Bonaccorsi, Mediterranean University of Reggio Calabria, Italy</p>
16.20 – 17.20	<p>Open to HPC2023 and Workshop Delegates Lecture Theatre 2 – Water Harvesting &amp; Humidity Control Room Lead: Janice To; Room Support: Marwan Mohammed</p> <p><b>#99. Experimental and theoretical analysis of alginate-based hydrogel kinetics on sorption and desorption of atmospheric water vapor.</b> Matteo Calò*, Vincenzo Gentile</p> <p><b>#15. Thermal-driven water production using sorbent-coated adsorber.</b> Yaohui Feng*, Tianshu Ge</p> <p><b>#76. Stability of adsorbent coatings for open-cycle adsorption processes.</b> Angelo Freni*, Emanuela Mastronardo, Stefano De Antonellis, Emilia Bramanti, Luigi Calabrese</p>	<p>Majid Bahrami, Simon Fraser University, Canada</p>
18.00 – 18.10	Lecture Theatre 1 – Day 3 Closure and Notices	

## Day 3: Tuesday 5 September 2023

Evening

Time (BST)	Event
19.15 – 21.45	<p>Open to HPC2023 and Workshop Delegates Playfair Library, Old College, South Bridge, Edinburgh Gala Dinner and Prizes</p>

## Day 4: Wednesday 6 September 2023

Morning

Time (BST)	Event	Chair
8.30 –	Foyer Area – Secretarial Support <i>open until 12.00</i> You will have one last chance to upload your presentation at the Registration Desk until 8.50 (Eloise Bevan)	
8.50 – 9.00	Lecture Theatre 1 – Keynote 5 intro	
9.00 – 10.00	Lecture Theatre 1 – Keynote 5: Prof Annelies Vandersickel (University of Stuttgart and German Aerospace Center) Latent Heat storage for flexible sector coupling and efficient process steam generation (40 min) Q&A (10 min) Room Lead: Khaloud Al Balushi	Srinivas Garimella, GeorgiaTech, USA
10.00 – 10.30	Foyer Area – Coffee Break and Last Poster Exhibition	
	Morning Sessions	
10.30 – 12.30	Lecture Theatre 1 – Innovation in Heating and Cooling Room Lead: Eloise Bevan; Room Support: Janice To  <b>#12. Automotive hybrid compressor ejector heat recovery cooling system.</b> Luboslav Kollár*, Sairam Polasa, Adam Hrdý  <b>#77. An air-charged Stirling-cycle refrigerator with novel isothermalisers.</b> Jafar Daoud*, Daniel Friedrich  <b>#50. A Dual-Purpose Innovative Cooling Cycle for Future Sustainability.</b> Muhammad Ahmad*, Muhammad Wakil Shahzad  <b>#9. Integration of high-temperature heat pumps into geothermal energy systems.</b> Jaromir Jeřberger*, Florian Heberle, Dieter Brüggemann  <b>#84. High-temperature heat pumps and zeotropic refrigerant mixtures: A perfect match?</b> Philip Widmaier*, André Bardow, Dennis Roskosch.  <b>#86. In-situ Monitoring of an Air-to-Water Hybrid Heat Pumps for Residential Buildings.</b> Camila Davila*, Vincent Lemort	Tommaso Toppi, Polytechnic of Milan, Italy
10.30 – 12.30	Lecture Theatre 2 – Multiphase Heat Transfer Room Lead: Khaloud Al Balushi; Room Support: Anam Abbas  <b>#106. Experimental investigation on the thermal performance of low-temperature OM55/GNPs/SPAN80 nanocomposites.</b> Elisangela D'Oliveira*, Sol Carolina Costa Pereira, Ulugbek Azimov, Dominic Groulx, Tomas Costa  <b>#82. The effect of polytetrafluoroethylene (PTFE) thin films deposited on aluminium surfaces on Phase Change Material (PCM) solidification.</b> Ronald Muhumuza*, Pawel Dominik Nycz, Philip Eames  <b>#130. 3D simulation of a compact counter-flow dew-point indirect evaporative cooler.</b> Beichen Wang*, Mario Garcia, Thuan B. Duc, GuangGui Cheng, Wei Pang, JianNing Ding  <b>#107. Dropwise Condensation on Silicone Oil Grafted and Impregnated Surfaces.</b> Anam Abbas*, Gary Wells, Glen McHale, Khellil Sefiane, Dani Orejon Mantecon  <b>#97. Enhanced Solar Evaporation by Superhydrophilic Copper Foam Graphene Coated Inverted 3D Cone.</b> Fengyong Lv, Jie Miao, Jing Hu, Dani Orejon Mantecon*	Stan Shire, University of Warwick UK
12.30 – 13.20	Foyer Area – Lunch <b>Remove all posters by this time</b>	

## Day 4: Wednesday 6 September 2023

Afternoon

Time (BST)	Event	Chair
	Afternoon Sessions 1	
13.20 – 14.20	<p>Lecture Theatre 1 – Heat Transfer Enhancement Room Lead: Anam Abbas;</p> <p><b>#58. Thermosyphon geysering shows characteristic pressure pattern.</b> Matthias Buschmann*, Roger Riehl</p> <p><b>#137. An overview of performance and viability of nanofluids in thermal energy systems.</b> Roger Riehl*, S.M.S. Murshed</p> <p><b>#4. Oscillating heat pipe operated with a heterogeneous mixture of water and particles.</b> Matthias Buschmann*</p>	<p>Daniel Orejon Mantecon, The University of Edinburgh, UK</p>
13.20 – 14.20	<p>Lecture Theatre 2 – Thermodynamics and Dynamics of Sorption Room Lead: Janice To;</p> <p><b>#32. Dynamic Modelling of Adsorption Chillers Using Refrigerant Mixtures: Impacts of Equilibrium and Dynamics on Performance.</b> Marten Lache*, Mirko Engelpracht, Sarah Leidolf, Jan Seiler, André Bardow</p> <p><b>#85. Second law analysis of metal hydride based polygeneration cycle.</b> Anil Kumar Emadabathuni, Bandaru Chandrakala, Sarath Babu*</p> <p><b>#49. Entransy based heat transfer irreversibility analysis for cascaded absorption-compression heat pumps.</b> Jinfang You*, Xi Zhang, Ruzhu Wang, Zhenyuan Xu</p>	<p>Zacharie Tamainot-Telto, University of Warwick, UK</p>
	Afternoon Sessions 2	
14.30 – 16.10	<p>Lecture Theatre 1 – Heat in Polygen. and Purific. – D4 Room Lead: Anam Abbas; Room Support: Janice To</p> <p><b>#8. Isochoric Vapour Engine - Introduction, Discussion and Evaluation of a New Approach for Low Grade Waste Heat Recovery.</b> Philipp Streit*, Andreas P. Weiß, Dominik Stümpfl, Andreas Lesser, Florian Stadler</p> <p><b>#74. Experimental study of an isobaric expansion engine – Shaft power and electricity generation.</b> Alexander Kronberg*, Maxim Glushenkov, Joël Gül</p> <p><b>#133. Feedheat-based electricity storage system for nuclear plant</b> James Lazenby*, Eugene Shwageraus, Alexander White</p> <p><b>#91. Techno-economic evaluation and optimisation of a transcritical ejector CCHP system for district heating applications.</b> Florian Schittl*, Alexander Kühner, Stefan Buchner, Jürgen Krail, Richard Krottil</p> <p><b>#93. Green ammonia fuelled combined system integrating solid oxide fuel cell with cathode recycling and Kalina cycle.</b> Dibyendu Roy, Samiran Samanta, Sumit Roy*, Andrew Smallbone, Anthony Roskilly</p>	<p>Christopher Olkis, Mitsubishi Electric R&amp;D Centre, UK</p>
16.10 – 17.00	Foyer Area – Conference Closure with Refreshments	