

Update - Innovation Community on Affordable Heating and Cooling of Buildings –

March 2023

This newsletter provides an overview of the projects we are considering taking forward plus also some other news items. Please feel free to engage with the project leads listed. One of the “hot” areas of innovation is extreme heat and we hope you will consider potentially getting involved in a project on this subject.

The objective of the Innovation Community (IC) is to build on Innovation Challenge 7 (IC7) and support innovation to help deliver affordable low-carbon heating and cooling everyone. The project ideas and news highlighted in the newsletter are just a small sample of what is going on. We hope you are already involved in some of the activities, but if not, please consider getting in touch with us to find out how you might be able to get involved.

Your IC Co-leads



Dr JBV Reddy



Piero De-Bonis



Graeme Maidment

Supported by



Rajasekar Elangovan



Manoj Kumar S

Best Wishes to Jon Saltmarsh

Some of you will be aware that Jon Saltmarsh – one of originators of the Innovation Community has changed jobs and joined the UK’s Energy Systems Catapult (ESC) as Chief Technology Officer. The ESC provides technical, commercial and policy expertise to drive innovation across the whole energy system. We thank Jon for all the efforts with the IC and wish him best in his new role.



Introduction

Dear Innovation Community members,
First of all, Happy 2023!

The activities of our Innovation Community kept a good pace during the second half of 2022 and a very important moment was the Global Clean Energy Action Forum on 22-23 September 2022, during which we co-organised two side events.

We are now focusing on new activities that are under development, such as the collaborative work on grid-integrated control of buildings and the role we can play in supporting the Urban Transitions Mission. A list of our priority areas is shown in the figure below.



- Comfort Climate Box – cooling & system integration
- Global heating prize
- Grid interactive control of buildings
- Heat pumps – fuelled by green hydrogen
- Heat sinks and sources
- Passive heating and cooling
- System integration – District heating & cooling
- Thermal comfort driven controls
- Industrial building solutions
- City cooling roadmap tool

A major milestone in 2023 will be COP28, which will take place from 30 November to 12 December 2023 in Dubai and during which sustainable cooling will have a prominent role.

MI7 Ministerial Meeting and Global Clean Energy Action Forum

The seventh Mission Innovation Ministerial meeting took place on 21-23 September 2022 in Pittsburgh (United States), back-to-back with the first Global Clean Energy Action Forum. A key announcement was concerned with public commitments to provide USD 94 billion for Clean Energy Technology Demonstrations.

As Innovation Community, we contributed to organizing two side events: ‘Innovation and policy measures to solve the global heating challenge’ and ‘From blindspot to hotspot: accelerating the transition to sustainable cooling for climate mitigation and adaptation’. The outcomes of the first event are available [here](#), while the recording of the second event is available [here](#).

COP27 and Planning for COP28

Graeme Maidment represented the Innovation Community at Sharm El-Sheikh in November. Unsurprisingly the focus on the decarbonisation of cooling has increased partly because of the summer of extreme heat but also because of the location in Egypt. As a result, there were many

events which involved innovation in sustainable cooling and mitigation of extreme heat.



The Moroccan Pavilion at COP27



The Buildings ABC Pavilion at COP27

This included discussion of the Buildings Breakthrough and mitigation of extreme heat at the Clean Heat Forum in the Global Alliance for Buildings and Construction Pavilion. It was exciting to be involved in the SEforAll launch of a nature based solution’s challenge Cities and buildings was a big focus and we supported the MI Urban Transitions Mission launch of 48 net zero cities and had pleasure in taking part in a workshop on smart cities at the Moroccan Pavilion.

Looking ahead to COP28, we had chance to meet with Dane McQueen UAE special envoy for COP28 as part of a Cool Coalition delegation who is keen on a potential central focus for cooling at in Dubai in November. More to follow later.



Extreme heat resilience alliance platform

The Adrienne Arsht- Rockefeller Foundation Resilience Center has together with the IC, the Cool Coalition, Global Covenant of Mayors and RMI, developed an [online platform](#) providing guidance on reducing the human and economic impacts of extreme heat at the regional or municipal level. The Heat Action Platform is a living, engagement-oriented tool for city officials, practitioners, and financial institutions to find guidance, both existing resources and tailor-made solutions, on reducing the human and economic impacts of extreme heat at the regional or municipal level.

The platform offers opportunities to engage with world-leading experts across a diversity of disciplines to plan, fund, implement, and measure heat resilience actions. The platform builds on our previous collaboration with Cool Coalition, RMI, Global Covenant of Mayors and Clean Cooling Collaborative to prepare a [handbook on sustainable cooling for cities](#) which was launched at COP26 in Glasgow.

The platform will be tested using case study cities and will provide a prospect to explore innovation opportunities. If you are interested in finding out more or getting involved, contact- Graeme.maidment@beis.gov.uk

Comfort climate box – emerging outcomes

The “Comfort and Climate Box” (CCB) was initially conceptualized during the first IC7 workshop, in Abu Dhabi, in November 2017. The CCB concept provides integrated heating, cooling and energy storage while working with a smart energy grid. It was conceived to receive multiple energy sources and use these to meet heating, cooling and power demands in the most optimal way (be that lowest carbon, lowest cost or lowest impact on the electricity grid). The CCB fits well with the IC’s objectives and the concept is being progressed in collaboration with the International Energy Agency (IEA), as part of the IEA’s Technology Collaboration Programme (TCP).

The technical challenge is the smart combination of different technologies in one system. Specialists from various fields of technology are required and need to cooperate to accelerate product development and market introduction. The goal is to develop nearly market-ready systems, including, as a minimum, a heat pump and a storage system.

13 Countries are involved in the CCB including 10 IC Member Countries. Cooperation between specialists from various technology areas are required, given the challenge of combining multiple technologies into one compact system. CCB solutions have been developed as part of the first phase of this project. A set of four CCB ‘archetypes’ have been developed that should help policy makers to design appropriate support mechanisms to achieve their policy goals within the local market context - ‘Budget CCB’ - ‘Flexible CCB’ - ‘Compact CCB’ - ‘Top quality CCB’.

The Annex was coordinated by The Netherlands and we are currently exploring a new project for CCB solutions with a focus on warm and humid climates.

If you would like to participate in the new CCB project please make contact:

Monica Axell - monica.axell@ri.se

Urban Transitions Mission

The [Urban Transitions Mission](#) (UTM) announced at COP27 the first [48 cities from 24 countries](#) which will progressively engage with the UTM from 2023. This first group of cities will receive support to test, pilot and scale up solutions and adopt system-wide approaches to strengthen their climate neutrality visions and accelerate implementation to reach net-zero.

Launched at COP26 under the framework of Mission Innovation (MI), the UTM is a joint effort by the [Global Covenant of Mayors](#), the European Commission, and Joint Programming Initiative Urban Europe.

The UTM brokers access to solutions, focusing on accelerating implementation of technological,



regulatory, and financial solutions. It offers an urban net-zero transition framework that builds on the knowledge and expertise of a Global Innovation Alliance of supporting partners and organizations together with the first-hand experience of cities.

Of the new UTM cities, all have conducted GHG inventories and Risk and Vulnerability Assessments, 19 have set targets more ambitious than their countries Nationally Determined Contributions (NDCs), and 27 have committed to net-zero and developed climate action plans to meet these targets.

Cities joining the UTM will prioritize projects focused on energy infrastructure, efficiency and low-emissions built environments to build critical pathways to reach net-zero. 23 cities will explore renewable energy source (RES) potential and 4 cities will pursue clean hydrogen and zero-emission solutions for shipping and industry. Additionally, 6 cities will prioritize solutions for sustainable cooling, whilst 16 more will investigate Nature-based Solutions and sustainable use of land as priority pathways.

More information on the Urban Transition Mission is available [here](#). Information on getting involved with the UTM can be found through Graeme.maidment@beis.gov.uk

Potential Priority Area in Grid Integrated Control of Buildings

Building HVAC loads can be shifted away from periods when there is a shortage of generation, or when the electricity network is overloaded. Digitalisation can make this load flexibility a dispatchable resource, that can be used to support the transition to a clean electricity system containing large amounts of variable renewable energy generation. The US DoE’s Grid-Interactive Efficient Buildings Roadmap (2021) found that grid integrated buildings could save the US power system USD 100-200 billion, through to 2040, and help reduce CO₂ emissions by 80 million tonnes/year.

Preparation has begun for a possible MI research priority area on this topic. The priority area aims

to develop scalable digitalisation solutions for flexible demand, from building HVAC loads, and help overcome barriers to the deployment of flexible demand.

A preliminary discussion was held in Gothenburg in October, as part of the IEA Annex 81 “Data Driven Smart Buildings” plenary meeting. Key barriers and opportunities were surveyed. This and other research findings have been synthesised into a discussion document with an initial draft structure for possible research collaboration.

Please contact Dr Stephen White (stephen.d.white@csiro.au) for more information and if you like to participate in future preparation discussions.

Cool Roofs

We have been working over the past few months to scope out this initiative that we first presented in concept at the November workshop, as we dug into the space we felt it important to expand beyond just real-world comparative testing of new

innovative nano polymer materials along with traditional reflective materials to how they would both interact with roof-mounted solar PV – both traditional and bifacial so as to have definitive answers as to the optimal use of roof space in hot climate zones.

RMI and IC worked together previously to great effect on the Global Cooling Prize and we would be delighted to see another collaboration between Mission Innovation and its members along with RMI and CEPT University.

We are currently exploring funding opportunities and supporting Iain Campbell from RMI who is leading the development of this project. If you would like to be kept involved in these discussions, please get in touch with him directly at icampbell@rmi.org



Nature for Cooling Cities Challenge

Cities are warming twice as fast as the global average, and it is imperative we scale up solutions to tackle dangerous urban heat. [The Nature for Cool Cities Challenge](#) seeks to catalyze this goal by supporting cities committed to developing and implementing nature-based solutions to deliver on heat resilience and cooling benefits. Challenge participants (municipalities, groups of municipalities, or regional governments) will pledge to increase or enhance the proportion of high-quality nature-based cooling solutions within their cities by 2030, with demonstrable progress by 2025. To achieve the pledge, Challenge participants set a quantitative target, a funding target, and at least three implementation actions.

[Register your interest here](#) and stay tuned for further details. To get involved contact Ben.Hartley@seforall.org

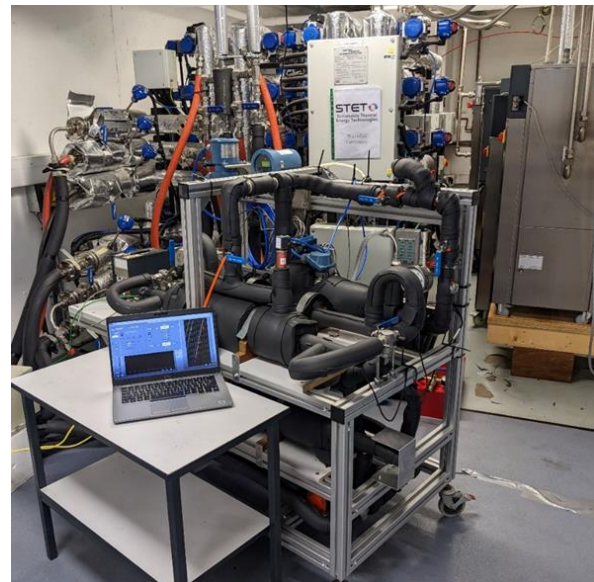
Sorption Heat Pump Systems

A Mission Innovation (MI) funded research project (UKRI Ref.: EP/V011316/1) is aiming both to investigate and develop low-cost heat-powered heat pump systems based on adsorption (sorption) technology and to network sorption research with MI partners in Canada, China, Germany, Italy and the Netherlands

With the funding made available through MI, and linked with the LoT-NET EPSRC Programme Grant, the design, manufacture and test of a proof-of-concept (PoC) laboratory kW-scale resorption heat pump, based on the reaction of ammonia refrigerant with halide salts (adsorbent), has been realised.

A resorption heat pump uses two, or more, solid-gas adsorbent heat exchangers, and the reactions are designed to maintain the ammonia refrigerant in a gaseous phase. The developed PoC system (see image), uses two different halide salts and operates on the principle of different thermochemical equilibrium temperatures at the

same pressure. The principal development challenge has been in the development of a compact reactor (solid-gas adsorbent heat exchanger) for the rapid adsorption (synthesis reaction) and desorption (decomposition reaction) of ammonia refrigerant to and from the salts; a secondary challenge has been in the design of the control logic to operate the PoC system with the ThermExS laboratory for the evaluation of thermal energy technologies. Initial resorption heat pump tests are aiming to achieve an internal COP (Coefficient of Performance = Heat Output / Heat Input) in the range of 1.3 to 1.4, which compared to a conventional gas boiler with an efficiency of 0.9, could lead to a 30-40 % reduction in gas usage at a domestic scale.



Resorption heat pump test rig (foreground) with the ThermExS thermal test facility in the Sustainable Thermal Energy Technologies (STET) research group laboratories at the University of Warwick (background).

The principles of resorption heat pumping have been known since the 1980s but we believe our PoC is the first to demonstrate a compact workable kW scale system that can be implemented in a domestic setting.

Applications include not only use as a transition technology to reduce gas consumption in natural gas boilers, but to utilise hydrogen or biogas fuels in future energy systems. Hydrogen will always be



a premium energy vector and the ability to use it for heating with a high COP will improve the overall viability and economics.

Hydrogen driven heat pumps

This project plans to develop heat pumps driven by hydrogen for heating and cooling purposes. By combining conventional sorption heat pumps with green hydrogen it's possible to deliver efficient, very low-carbon heating and cooling without using electricity and putting pressure on the electrical grid.

The project is still in development stage and more information can be found from Bob Critoph. R.e.critoph@warwick.ac.uk.

Thermal comfort driven controls

The IC is forging a partnership for research development and deployment in the area of thermal comfort driven controls. This effort is intended to support/complement the development and demonstration of smart controls with capabilities including comfort regulation, energy demand management, fault detection, diagnostics and prediction. The international survey on R&D priorities conducted by the IC highlighted wider interest for research and collaboration in this field. We are holding consultations. Please reach out to us if you have an ongoing/upcoming program in this area.

More information from Dr JBV Reddy - jbvreddy@nic.in

Virtual Platform: MI Heating Cooling Wiki

The IC has launched the MI heating and cooling wiki a [virtual platform](#) to map global innovation, research priorities/enablers/barriers and enable collaboration. Do register yourself here and share your updates in the wiki platform.

If you would like to know more, please contact IC7 Resource unit-jbvreddyic7@gmail.com

How to get involved with IC7?

We welcome involvement from our members in any of the IC priority areas, as well as news items, announcements, etc. for inclusion in future newsletters.

If you would like to get more involved and find out more about IC activities, please contact Graeme. Graeme.maidment@beis.gov.uk

IC Activities Website

<http://mission-innovation.net/platform/innovation-community>

