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FUTURE OF COOLING | OXFORD MARTIN SCHOOL | UNIVERSITY OF OXFORD

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OXFORD FUTURE OF COOLING: COOLING FOR COP26 WEBINAR SERIES

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Cooling is necessary for the quality of life of billions of people, whether in hot climates or temperate regions experiencing more frequent heatwaves due to climate change.

By 2050, the energy needed for AC is projected to triple. This huge demand has the potential to drive up GHGs and exacerbate the very problem it is designed to alleviate. Countries can prepare for extreme heat by prioritising passive and energy efficient technology that use low global warming potential (GWP) refrigerants, shifting the trajectory of cooling growth towards sustainability.

As we move towards one of the most important rounds of the UNFCCC Climate Negotiations, the Oxford **Future of Cooling Programme** is hosting a series of online seminars leading up to COP26, linking to the programme's **framework on sustainable cooling**. The **third webinar in the series, Cooling Technology and Innovation**, engages in conversation with Iain Campbell, Senior Fellow at the Rocky Mountains Institute (RMI).

Breaking the ice: how does technology and innovation accelerate a sustainable cooling sector?

The session on cooling technology focussed on active cooling (AC) and some passive cooling technologies (building-specific measures) highlighting promising technologies and how to scale them.

How to meet current and future cooling needs?

The **trajectory to 2050** suggests AC adoption globally will rise significantly with emerging economies - India, Mexico, Indonesia, Nigeria, and Brazil – driving the trend. **One estimate** projects a 395% jump in global capacity needs for cooling - from 850GW in 2016 to 3,350 GW in 2050. This increase of 2,500 GW is equal to the total generating capacity of the US, Europe, and India combined today.

To meet this growing cooling demand sustainably, RMI proposes a hierarchy of measures. The first is to reduce the amount of cooling needed - passive cooling - with a focus on design of urban areas and buildings. Second is providing cooling in an efficient manner and, third, optimising cooling by operating only when needed or for a specific space; smart controls are integral to this.

Breakthroughs in mechanical cooling technology

On efficiency, RMI studies show that the Best Available Technology (BAT) in cooling is often 2x more efficient than the lowest cost products. Furthermore, the Global Warming Potential (GWP) of BAT refrigerants can be less than 10 while most current refrigerants have a GWP of over 1800 times that of CO2. More efficient technology is also good for consumers with the lifetime costs of less efficient AC's double that of BAT.

RMI's **Global Cooling Prize** identified innovations that can deliver cooling at a 5x lower climate impact. Teams from Daikin and Gree won the prize with technologies that improved upon existing 'vapour compression' technologies. Gree has pledged this technology will be ready for market by 2025. However, ensuring adoption of this technology, which is likely to have an upfront premium but lower lifecycle cost, is a challenging issue. Underlying market barriers include general awareness, transparency, upfront cost bias, and split incentives need to be addressed by policy solutions.

For example, communicating degree of performance is a barrier that must be overcome. Many labelling programmes do not sufficiently differentiate between super-efficient technology and other technologies. To drive transformation of the market, super-efficient technology should be used as the benchmark against which other products are compared, pulling the market to the ceiling.

What does the future of cooling technology look like?

- **Technological innovations:** Beyond vapour compression technologies, other active cooling solutions are in development however some may be more suited for niche applications. Solid state solutions – using electricity and semiconductors to produce cooling (thermoelectric cooling) – is one example which faces a challenge of reaching high efficiency levels. Another innovative system is in radiative cooling, using nano materials, which acts as a supercharged passive cooling solution. Passive solutions are also found in what materials best reflect heat and emit suitable wavelengths to aid cooling. This type of solution needs to be adopted in building codes but holds significant promise and can significantly reduce the cooling load in hot humid climates.
- **Time and place of use:** Beyond technology types, how they are used is critical to a more sustainable cooling sector. A simple example is in vending machines which traditionally cool drinks 24/7. Alternately, vending machines could use a solid-state cooling system to chill a drink in seconds, once a selection is made, offering economic gains, and avoiding a huge amount of cooling load.
- **Place-based solutions**: Some locations will have specific solutions due to their geography. For example, Toronto, Canada uses Lake Superior to provide cooling that can be distributed to buildings in the city. The benefit to large scale solutions such as this and other district cooling is that often investors are managing such a system for 20-30 years and are therefore motivated to put in the highest efficiency and lowest cost systems over a lifecycle.

The future of cooling must navigate the global lock-in of vapour compression, accounting for how thermal comfort can be integrated into existing structures and, where possible, implementing passive cooling solutions by design.

For questions on the policy recommendations above, please contact Renaldi Renaldi, Research Associate at Oxford University (**renaldi.renaldi@eng.ox.ac.uk**) or James Hawkins, Senior Researcher at E3G (**james.hawkins@e3g.org**).

Watch a recording of the webinar here.

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About E3G

E3G is an independent climate change think tank accelerating the transition to a climate-safe world. E3G builds cross-sectoral coalitions to achieve carefully defined outcomes, chosen for their capacity to leverage change. E3G works closely with like-minded partners in government, politics, business, civil society, science, the media, public interest foundations and elsewhere.

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