Cooling is essential to health, prosperity and the environment, underpinning the Sustainable Development Goals (SDGs).[i] Yet most cooling is energy intensive and highly polluting. Demand for cooling is booming,[ii] so there is an urgent need to cut cooling related pollution. Without action, cooling emissions could double to account for 15% of global greenhouse gas (GHG) emissions by 2030.[iii]

The Kigali Cooling Efficiency Program (K-CEP), launched in 2017, is a collaboration of 17 philanthropic foundations, international organisations, governments, NGOs, academics and businesses, aiming to address emissions from cooling. K-CEP supports the Kigali Amendment to the Montreal Protocol, which commits 197 countries to cut hydrofluorocarbons (HFCs) – super polluting GHGs used in refrigeration and air-conditioning – by more than 80 percent over the next 30 years. Approximately 71% of emissions from cooling come from energy use,[iv] so K-CEP focuses on the energy efficiency of cooling, to increase and accelerate the climate and development benefits of the Kigali Amendment. K-CEP envisions a world in which efficient, clean cooling is accessible to all.

K-CEP and our partners welcome the opportunity to contribute to the UNFCCC's Talanoa Dialogue. This process represents an important opportunity for truly inclusive engagement on one of the most formidable collective challenges facing humanity. Access to efficient, clean cooling can make an essential contribution to achieving the ambitions in the Paris Climate Change Agreement and the SDGs. K-CEP and its partners acknowledge the world's legitimate cooling aspirations and seek to engage constructively with governments, the private sector, and civil society on how to meet these aspirations sustainably.

1. *Where we are?*

Cooling demand is rapidly increasing and our current approach to cooling is highly polluting

Demand for cooling is booming, and will increase further as the world urbanizes, economies grow, and the planet heats up. While more cooling is needed, particularly in developing countries, most cooling is energy intensive and highly polluting. Cooling is responsible for 7% of total electricity consumption and related GHG and air pollutant emissions[v]. Cooling already causes substantial global GHG emissions of between 3.8[vi] and 4.1[vii] $GtCO_2e$ each year (>7% global emissions). These emissions are projected to double to 15% by 2030.[viii] We urgently need to cut pollution from existing cooling – in both the developed and developing world – and do so in a way that ensures future cooling needs are met sustainably.

Cooling is critical to emissions, crucial for development, and needs more global attention

Energy consumption from cooling is projected to exceed consumption from heating by 2060.[ix] Emissions from cooling are growing three times faster than total emissions.[x] Improving room air conditioner efficiency alone by 30% in 2030 could avoid cumulative emissions of up to 60 Gt CO_2e by 2050.[xi] Fast phasedown of HFCs under the Montreal Protocol would prevent 100 to 200 Gt CO_2e emissions by 2050 and avoid up to 0.5°C warming by 2100.[xii] Combining fast HFC reductions with cooling efficiency in the air conditioner and refrigeration sectors can be an engineering and policy 'win-win' that could together avoid one degree Celsius of warming by 2100.

Cooling is also critical to sustainable development. The 30 hottest cities in the world are in developing countries.[xiii] In India, where fewer than 6% of urban households have air conditioning, electricity demand for cooling already accounts for 40-60% of peak electricity demand in New Delhi.[xiv] In a warming, urbanising world, inefficient cooling energy demand will increase costs and stress on the power sector. Access to efficient, clean cooling is linked to achieving multiple SDGs including: No poverty (1), Zero hunger (2), Good health & well-being (3), Affordable & clean energy (7), Decent work (8), Industry (9), Sustainable communities (11), Responsible consumption & production (12), and Climate action (13).[xv] Despite the widespread need for efficient, clean cooling, less than 0.1% of Overseas Development Assistance is spent on cooling.[xvi] Market penetration of efficient, clean cooling is woefully low and even the best refrigeration and air conditioning (RAC) equipment is only operating at 50–60% of the theoretical maximum energy efficiency.[xvii]

2. Where do we want to go?

Energy efficient, clean cooling needs full recognition as a 'must do' opportunity to help solve the climate crisis and ensure a more prosperous future. It is essential that we mitigate both CO_2 and short-lived climate pollutants like HFCs. It is likely impossible to stay below 2°C warming without both.[xviii]

Technology, policy, and finance for efficient, clean cooling

Cooling technology can improve to approximately 70 – 80% of the theoretical efficiency limit without prohibitively affecting costs.[xix] An even bigger opportunity is improving the average efficiency to be closer to the best on the market. This would be approximately a 200 – 300% (i.e. 2-3 fold) improvement (the best air conditioning units are three times as efficient as the average).[xx] Cooling technology also needs better maintenance. It is estimated that 30GT CO_2e could be avoided by 2050 through better optimisation, monitoring and maintenance of cooling equipment.[xxi]

Policy and regulation can also drive the adoption of efficient RAC equipment. However, the majority of developing countries do not have minimum energy performance standards (MEPS) or labels. Where MEPS are in place, they are typically set at a lower standard than developed countries. In many cases, developing countries also do not have the enforcement capacity to ensure these MEPS and labels work – this may be an even bigger issue than the MEPS themselves although this is hard to quantify. Financial incentives are also important to support the introduction of low global warming potential (GWP) refrigerants simultaneously with high efficiency RAC equipment. This can help offset higher initial equipment costs through a variety of mechanisms and funding sources.

We need to transition to clean refrigerants

Refrigerant selection is important alongside improving energy efficiency. For typical RAC systems, indirect emissions (from energy consumption) account for 71% and direct emissions (from refrigerant leakage) account for 29% of total GHG emissions.[xxii] For maximum climate benefits, energy efficiency should be paired with selection of the lowest GWP refrigerant available and appropriate for the application.

We also need new business models and creative service and systems thinking about cooling

In addition to clean refrigerants and improved efficiency, we also need to manage our cooling needs and think beyond electrons. More efficient refrigerators and air conditioning (AC) units alone will not meet the targets. So we need to ask: 'What is the cooling service we require, and how can we provide it in the least damaging way?', rather than 'How much green electricity do I need to generate for an AC or fridge?'

We need to develop integrated solutions. This will require a stronger understanding of the links between energy networks and cooling along with effective deployment and business models. We need to increase deployment of renewable energy, clean cooling, and energy storage technologies. We also need to develop, demonstrate and transfer innovative solutions to the developing world to accelerate their deployment. Efficient, clean cooling will require new system-level approaches that reimagine the way we deliver cooling. This includes understanding the size and location of multiple thermal, waste

and wrong-time energy resources available and the novel energy vectors, thermal stores and efficient, clean cooling technologies suited to social, climate, and infrastructure contexts.

3. How we can get there?

The transition to efficient, clean cooling will require coordinated policies, new technologies, system-level thinking, new business models, and new sources and mechanisms of finance.

Efficient clean cooling needs joined up policy and finance

Efficient, clean cooling needs joined up policy, for example joint standards and labels for efficiency and refrigerants, or financing for efficient fridges as part of solar home systems. Better coordination between NDCs and HPMPs' (the plans submitted to the Montreal Protocol) should also be explored, as well as how to optimize the finance that comes from the Multi-lateral Fund of the Montreal Protocol with the various sources of climate and development finance for energy efficiency.

Efficient, clean cooling needs to be recognised as a key development issue

Cooling is often overlooked as an urgent development issue. Less than 0.1% of total Overseas Development Assistance is directed to cooling solutions. Yet more than 1 billion people lack access to energy and thus lack access to electric cooling as well. Approximately 500 million lives are at risk from heat stress, 2 million people die preventable deaths every year due to ineffective distribution of vaccines – in which a lack of cooling plays a major role, and 400 million tonnes of food is lost due to lack of refrigeration and effective cold chains.[xxiii] Too many countries are still locked into costly, high-carbon, energy-inefficient, socially regressive cooling pathways.

Systems thinking is critical

Current cooling technologies can become very efficient and clean but technologies must be designed for different needs, to take account of intermittent generation, and to handle flexible loads and operating conditions. Cooling and heating are likely to need to be more closely integrated and, where practical, untapped resources of waste cold, 'free' cold, waste heat, renewable heat, and 'wrong time' energy must be used to provide cooling.

By thinking about a 'cold energy system' in terms of thermal sources and sinks, and the technical opportunities for integration and efficiency improvement, additional benefits and novel business models will emerge along with reduced cost and impact of cooling energy. We see five key strategies:[xxiv]

1. *Reduce cold load/cooling work required* (e.g. better building design, vaccines that survive at higher temperatures);
2. *Reduce the energy required for cooling* (i.e. increase the efficiency of cooling technologies while using low GWP refrigerants);
3. *Reduce the climate impact of refrigerants* (i.e. reduce the GWP of refrigerant gases used while improving the efficiency of cooling equipment);
4. *System level thinking* (e.g. explore opportunities to harness waste thermal resources and explore system integration opportunities across buildings, transport and cold energy storage);
5. *Sustainable energy sources* (i.e. having minimised energy demand and climate impacts, convert remaining cooling loads to sustainable energy sources).

K-CEP is already taking action

With a $51 million capitalisation, K-CEP is seizing the opportunity created by the Kigali Amendment to bring together the Montreal Protocol, UNFCCC, and broader energy communities to make efficient, clean cooling a reality. K-CEP has a clear focus on delivering results up to 2020 and is supporting activity across four 'windows': 1. institutional strengthening (policy training, national planning, technical support for businesses, enforcement); 2. policy, standards and programs; 3. financial

mechanisms; and 4. access to cooling solutions. K-CEP support is being provided to 38 developing countries across Africa, the Middle East, Asia, Latin America, and the Caribbean.

We are keen to collaborate to unlock this opportunity

K-CEP is keen to engage and collaborate with efficient, clean cooling partners through the Talanoa Dialogue process, the UNFCCC process, and other initiatives to make efficient, clean cooling a reality. Efficient, clean cooling is fundamental to the agreed topics of energy in 2019 and human settlements in 2020.[xxv] K-CEP would like to suggest the following next steps as potential collaboration areas:

1. K-CEP offers to lead a series of regional Technical Expert Meetings on efficient, clean cooling starting in 2018 in order to prepare for the 2019 UNFCCC focus on clean energy, especially in the agri-food chain.
2. We propose that funding institutions operating under the UNFCCC explore opportunities to collaborate with K-CEP on efficient, clean cooling. The aim of these discussions would be to co-finance energy efficiency along with refrigerant transition related activities under the Kigali Amendment. In April 2018 K-CEP is launching a $10m finance window to provide grants to unlock finance for efficient, clean cooling in developing countries.
3. We would like to engage with the Climate Technology Center and Network (CTCN), as the operational arm of the UNFCCC Technology Mechanism, which has identified enhancing energy efficiency of appliances as a priority and is supporting cooling efficiency projects. K-CEP could explore collaborations with CTCN supported cooling efficiency projects.

We would welcome the opportunity for further discussion, including at the upcoming UNFCCC meeting in Bonn from 30 April to 10 May 2018, to discuss these and other tangible ways to engage with the Talanoa Dialogue process and help deliver a world in which efficient, clean cooling is accessible to all, and a major contributor to the Paris Agreement.

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