Task Force 4
Refuelling Growth: Clean Energy and Green Transitions

LOW CARBON DEVELOPMENT PATHWAYS FOR COOLING: LEVERAGING KIGALI AMENDMENT ACROSS RESIDENTIAL APPLICATIONS

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Abstract

Heating and cooling demand for space conditioning and refrigeration accounts for around a fifth of global final energy consumption.[1] Climate change, urbanisation, and economic development have tripled electricity demand for cooling alone since the 1990s,[2] with the majority coming from the use of inefficient cooling equipment, which burdens electricity grids, especially during the peak hours. It is imperative to address the energy required to provide cooling. The Kigali Amendment to the Montreal Protocol addresses these needs by setting ambitious global targets to phase down refrigerants with high global warming potential, while improving energy efficiency. Integrating energy efficiency and the refrigerant transition will contribute to economic security, well-being, energy access and security, and sustainability among the G20 countries.

The Challenge

1

The past eight years have been the hottest ever recorded.[3] Rising temperatures, as well as increasing incomes, electrification, and urbanisation, are driving up the demand for refrigeration, air conditioning, and heat pump (RACHP) equipment, particularly in emerging economies with hot climates. Globally, energy consumption for RACHP is expected to increase as the number of people living in areas where at least some cooling is needed is projected to increase to over 95 percent of the global population by 2050.[4] Without intervention, these trends will saddle the world with billions of inefficient and climate-harming cooling equipment with an average lifetime of 10–15 years.[5]

At nearly 1.2°C of warming, the world is already experiencing a climate emergency—extreme events are occurring sooner and with greater severity than anticipated, and there is a 10 percent chance that the average temperature over the next five years could be above 1.5°C.[6] Warming is likely to exceed 1.5°C for at least one year between 2023 and 2027,[7] and could exceed 2.0°C as soon as the 2040s.[8] El Niño conditions could push 2023 to the warmest year on record, and 2024 to 1.4–1.5°C.[9] At current levels of warming, weather extremes are already becoming more severe,[10] activating self-amplifying feedback loops, with evidence that we are nearing or have already crossed multiple climate tipping points.[11] Even with a 1.5°C overshoot where the temperature limit is only temporarily breached, some impacts will be irreversible.[12]

Cooling equipment will be needed to protect from the crippling economic costs of increasing temperatures. In 2021 alone, heat exposure led to the loss of 470 billion potential labour hours globally.[13] The global potential loss of income from reduction in labour capacity due to extreme heat was US$669 billion in 2021, and the value of global heat-related mortality was estimated to be US$144 billion, equivalent to the average income of 12.4 million people.[14]

Access to cooling is a fundamental issue of equity and essential to support sustainable development, especially for the poorest and most climate-vulnerable countries.[15] However, developing countries have significantly lower access to cooling than advanced economies. Only 8 percent to 11 percent of households in India and 7 percent in Africa have air conditioners

(ACs), compared to 50 percent in advanced economies.[16] In India, rising temperatures and severe heat waves are responsible for thousands of deaths annually and will jeopardise up to 4.5 percent of India's GDP by 2030.[17] Cooling is a luxury available to only a few in India, where two-thirds of the population lives on less than US$2 a day, 75 percent of the workforce depends on heat-exposed labour, and the average cost of an AC unit is between US$260–500.[18]

While cooling is essential for adapting to a warming world, it is causing additional warming from emissions of high global warming potential (GWP) refrigerants and carbon dioxide (CO_2) and black carbon emissions from the fossil-fuelled electricity that powers inefficient cooling equipment.[19]

RACHP equipment is energy-intensive, especially if inefficient, and is a major driver of carbon-intensive, peak power demand,[20] which strains electricity grids, households, and national budgets.[21] Indirect emissions from generating electricity to operate RACHP systems account for over 80 percent of their global warming impact.[22] While the efficiency of RACHP equipment on the market has increased in response to minimum energy performance standards (MEPS) and equipment redesign catalysed by the Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol), best-in-class ACs are more than twice as efficient as the average equipment sold.[23] Additionally, nearly 90 percent of the projected global increase in space cooling electricity demand by 2050 occurs in emerging markets and developing countries, where MEPS are weaker than in advanced economies.[24]

Without policies to improve energy efficiency and reduce cooling demand, the projected growth in stationary AC and refrigeration could result in energy-related climate emissions of 230–430 $GtCO_2$ for 2020–2050,[25] representing over seven years of global energy-related CO_2 emissions at 2018 levels[26]—enough to deplete the remaining 1.5°C carbon budget.[27]

Global action in the cooling sector can carve out low-carbon development pathways that concurrently address climate impacts and energy security. By integrating refrigerant transitions and energy efficiency in the cooling sector, G20 governments reduce government expenditure on electricity production and fuel imports, enhance energy security in countries and territories

that rely on imports to meet domestic energy demand, and improve living standards while implementing the hydrofluorocarbon (HFC) phasedown mandated by the Kigali Amendment.

From 2000–2016, International Energy Agency member countries avoided approximately US$50 billion in additional spending on energy imports because of efficiency.[28] Energy efficiency can help reduce demand for electricity generation while supporting economic growth, equitable energy access, and addressing local health impacts of pollution including chronic/acute respiratory disease, allergies, and asthma, among others.[29]

The G20's Role

2

The Kigali Amendment provides the framework for effective and sustainable refrigerant solutions across all sectors. Optimising energy efficiency while implementing the Amendment is critical but not guaranteed under the Amendment and requires further ambitious support from major economies. The G20 includes the primary manufacturing countries[30] and the largest consumers of cooling equipment,[31] and therefore has a pivotal role in leading the way, accelerating implementation, and guaranteeing resources to maximise the benefits of the Kigali Amendment. G20 governments can carry momentum beyond the Kigali Amendment by building off complementary efforts such as the G20 Energy Efficiency Leading Programme, G7 Biarritz Pledge for Fast Action on Efficient Cooling, United for Energy Efficiency initiative, Super-Efficient Equipment and Appliance Deployment initiative, and upcoming Global Cooling Pledge, supported by the Cool Coalition and G20 Energy Transition Working Group. These efforts require decisive political backing in the form of concrete measures, as well as financing and institutional support to ensure fast and full implementation.

Collaboration can take many forms, such as through support to the Cool Coalition, which offers a platform for governments, the private sector, and civil society to promote the transition to efficient, clean cooling, or the Efficient Cooling Initiative of the Climate and Clean Air Coalition, a ministerial-level partnership with more than 100 partners, including 65 countries and international and regional financial institutions.

Recommendations to the G20

3

Accelerate implementation of the Kigali Amendment across member countries

The Montreal Protocol is considered the greatest environmental treaty of all time because it has achieved its objective of reversing the deterioration of the stratospheric ozone layer, which is on track to recover between 2040–2066,[32] effectively and equitably reduced ozone-depleting substances (ODSs) and could avoid 2.5°C of warming or more by 2100.[33]

In 2016, the parties to the Montreal Protocol agreed to the Kigali Amendment to phase down HFCs, which were developed to replace previous gases that depleted ozone and caused warming. While not an ODS, HFCs are potent greenhouse gases. Implementing the Kigali Amendment is expected to avoid about 90 percent of the 0.3–0.5°C of warming by 2100 that would have occurred absent control on HFCs.[34] Accelerating the phasedown could additionally reduce HFC emissions by 72 percent in 2050.[35]

The ODS phasedown under the Montreal Protocol has historically catalysed 30–60 percent significant energy efficiency gains in refrigeration and AC systems and contributed to reducing CO_2 emissions.[36] Maximising energy efficiency with the HFC phasedown could double the climate benefit of the phasedown alone[37] by avoiding cumulative emissions over 2030–2060 of 210–460 $GtCO_2e$ and allow other uses for the remaining 1.5°C carbon budget.[38]

G20 governments can call for universal ratification together with support for ambitious and regionally-harmonised efficiency standards and cooling action plans, and use procurement to support the market transition.

Strengthen G20 collaboration on ambitious and regionally-harmonised energy efficiency standards through national cooling action plans

National cooling action plans (NCAPs) enable policymakers to signal the market and create favourable conditions for a streamlined transformation that provides investment security to producers and end-users while preparing for anticipated future requirements. NCAPs can include up-front incentives and regulations to quickly drive the market alongside longer-term signals.

This can help lower barriers for the "first movers" offering higher-efficiency and low-GWP solutions.

Governments can use NCAPs to identify opportunities to incorporate efficient cooling into enhanced nationally determined contributions.[39] Cities, which have been leaders in implementing heat action plans,[40] have an important role in promoting efficient and climate-friendly cooling through urban heat mitigation plans, building codes and zoning, and urban planning for green spaces.

G20 governments can lead the way by developing and advancing implementation of NCAPs that integrate the HFC phasedown with energy efficiency and account for lifecycle refrigerant management by considering policies to reduce leakage of refrigerant from cooling equipment and ensure gas is recovered, recycled, or destroyed at the end of life.[41] As of 2022, China and India have published cooling plans, and Argentina, Brazil, Mexico, and South Africa are in the process of developing cooling plans.[42] For countries with detailed cooling plans, such as India, sharing experience and accelerating implementation with regional and global partners could leverage acquired experience beyond national borders. Japan and Australia have experience in lifecycle refrigerant management.

Regional cooperation and adoption of common standards and forward-looking efficiency tiers, such as the model regulation guidelines for energy-efficient and climate-friendly appliances developed by United for Energy Efficiency,[43] will enable manufacturers to capitalise on scale and drive down costs while increasing availability of efficient and low-GWP cooling equipment.[44]

MEPS can especially encourage manufacturers to improve the efficiency of their products or to innovate and develop more efficient technologies when applied in conjunction with supporting policies including labels, incentives, and procurement programs.

Harmonising testing and performance standards among regional trading partners allows countries, the private sector, and consumers to avoid the costs of test duplication and non-comparable performance information and requirements while removing administrative trade barriers for stakeholders.[45] Exporting and importing countries also must have laws and

policies prohibiting transboundary movement of environmentally harmful products. Accordingly, exporting countries share responsibility with importing countries, particularly where the importing country is a developing state that may not have sufficient capacity to stop imports of environmentally harmful products, to prevent harms inflicted as a result of the trade of inefficient new and used RACHP equipment using refrigerants scheduled for phase out or phase down under the Montreal Protocol.[46] The G20 should support and facilitate the adoption of harmonised regional testing and performance standards to increase access to higher-efficiency equipment alongside the HFC phasedown, ratchet up energy efficiency globally, and ensure equity.

Beyond MEPS, Japan's Top Runner programme shows how well-designed energy efficiency policies targeting the best available technology can catalyse innovation and improve energy efficiency while reducing costs for consumers. The Top Runner programme stimulated about an 80 percent room AC efficiency increase between 1997–2017. In addition, room AC prices dropped by about 68 percent in consumer price index terms.[47] The G20 could set similar energy efficiency targets alongside the HFC phasedown based on the current best available technology for 2030 or 2035 to catalyse innovation across the market for cooling equipment.[48]

Speed the market transition to energy-efficient RACHP equipment through buyers' clubs and public procurement

Public procurement and private 'Buyers Clubs' pool the country's or private members' collective buying power (bulk procurement) to aggregate demand to make purchases of large quantities of products at lower prices than would be available independently while simultaneously demanding newer, energy-efficient, and higher quality models.[49] Using this consumer power strategically is a key tool to address what otherwise could be higher initial costs of super-efficient ACs and other equipment and can help next-generation technologies penetrate the market faster.

India's bulk procurement programme improved room AC efficiency by 40 percent compared to average units at a comparable cost.[50] For countries that

do not have domestic manufacturers of cooling equipment, policies to slow or prevent the import of inefficient products may be utilised and may be eligible for support from climate funds.[51] Registration of exporters and importers, pre-shipment verification of conformity, and prohibitions and taxes on imports are examples of policies that can meet this objective.[52]

G20 leaders can ensure efficiency in the RACHP sector by using public and private sector procurement strategies to shift to the highest efficiency RACHP equipment at a lower cost. Donor countries should consider directing international financing institutions, such as the multilateral development banks, bilateral agencies, and private capital partners, to support financing mechanisms that drive innovation, production, and demand for ultra-efficient RACHPs at scale. Additionally, the G20 countries could work cooperatively to optimise trade policies that remove barriers and facilitate technology transfer for manufacturing components and units.

Attribution: Vibha Dhawan et al., "Low Carbon Development Pathways for Cooling: Leveraging Kigali Amendment Across Residential Applications," *T20 Policy Brief*, June 2023.

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