



2019

CHILLING PROSPECTS: TRACKING SUSTAINABLE COOLING FOR ALL

EXECUTIVE SUMMARY



#CoolingforAll

KIGALI
COOLING EFFICIENCY PROGRAM

FOREWORD



**H.E. DR.
VINCENT BIRUTA**

Minister of Environment
Government of Rwanda

The Kigali Amendment to the Montreal Protocol represents a once in a generation opportunity to deliver on the HFC phase down, contribute to the 1.5°C pathway of the Paris Agreement, and improve the lives of millions by realizing the Sustainable Development Goals. Its entry into force in early 2019 is a testament to the environmental, climate, and social benefits it can deliver, but also to concerted political will to replicate the success of the world's most effective environmental treaty - the Montreal Protocol.

That aspiration can only be achieved through a coordinated effort to provide access to sustainable and affordable Cooling for All. With just over ten years to deliver the Sustainable Development Goals and avoid the most catastrophic impacts of climate change, this is not an abstract concept. Cooling for All is an issue of equity that demands our focus right now.

With record levels of heat capturing global attention, it is far too simple to consider the problem, and its solutions, solely in terms of air-conditioning. Cooling for All is not only urgent, it is also complex. For the most vulnerable populations, it requires access to quality, reliable electricity that can power life-saving equipment, cities that are built to protect people from extreme heat, and cold chains that bring farmers out of poverty and keep vaccines and medical products safe for use. Developing solutions to these issues requires a holistic approach and a complete understanding of the need across agricultural, medical, and energy sectors.

Released in 2018, *Chilling Prospects: Providing Sustainable Cooling for All* was a global wake-up call and a call to action. This report takes stock of the progress we have made and celebrates the acceleration in solutions to sustainable access to cooling. It

includes the development of National Cooling Plans in Rwanda, India, and China, as well as city-led action to protect the vulnerable from heat extremes. In the last year, innovative prizes to address air-conditioner efficiency, cooling by nature, and the transformative power of cool roofs have been launched and garnered significant interest.

While there has been marked global action on sustainable access to cooling, there is still significant work to do in scaling solutions and delivering them to those who need them most. There are still at least one billion people at high risk of lack of cooling access, and more than two billion who are ready to acquire a cooling device. While opportunities exist to accelerate action on finance for access to sustainable cooling, coordinating our efforts with these communities is necessary to achieve transformative impacts.

With the urgency and complexity of the challenge in mind, we must ask: What are the gaps that prevent holistic and accelerated action to provide affordable, efficient, and sustainable cooling for all?

This question grounded the research for this report, paired with the question of how: How will we generate solutions that meet the global cooling demand within the scope of the 1.5°C scenario set out by the Paris Agreement?

Through the analysis of the demographic and geographic trends of highest risk and vulnerability, this report advances a needs-based methodological tool that will help countries and communities to understand the full scope of cooling needs. Across human safety and comfort, agricultural productivity and nutrition, and medical services, cooling needs – and the solutions to address them – are diverse. This report provides governments with a blueprint to understand those needs through data and brings

together policy, finance and technology solutions that can deliver cooling for all.

I know that by bringing together the right data, the most innovative businesses, smart finance, and the best policies, we can deliver on the promise of the Kigali Amendment, the Paris Agreement and the Sustainable Development Goals. Here in Rwanda, we are happy to share what we have learned so far in service of this important mission and to learn from others across the globe.

We hope you will join us.



H.E. DR. VINCENT BIRUTA
Minister of Environment
Government of Rwanda

CHILLING PROSPECTS: TRACKING SUSTAINABLE COOLING FOR ALL

2019

VULNERABLE GROUPS



Rural Poor:
365 million

Likely to be subsistence farmers without access to an intact cold chain; may lack access to electricity and properly stored vaccines.



Urban Poor:
680 million

May have some access to electricity, but live in housing of poor quality; may have a refrigerator, but food often spoils due to intermittent power.



Lower-Middle Income:
2.2 billion

May purchase an affordable but likely inefficient air conditioner or refrigerator that raises energy consumption and GHG emissions.

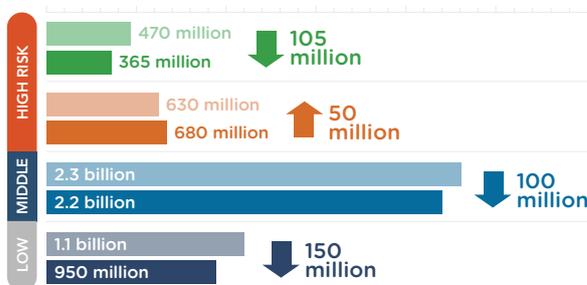


Middle Income:
950 million

May be able to afford a more efficient air conditioner or minimize its use; may move to energy efficient housing and working environments.

POPULATIONS AT RISK

■ 2018 ■ 2019



Findings and Trends

- Significant increase in rural energy access that would enable cooling, notably in India.
- Continued urbanization and fast-growing cities in Africa and Asia.
- Purchase of cooling devices associated with income growth and associated with lower prices for entry-level units.
- Increased purchasing power and growth of an established middle class.

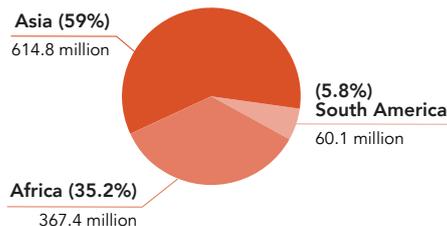
1.05 billion remain at highest risk, compared to 1.1 billion in 2018.

While energy access lowers risk exposure, it does not necessarily imply enhanced access to cooling, given the need for Tier 2 energy access to operate simple fans.

Changes in volume do not necessarily imply a transition from one population at risk to another.

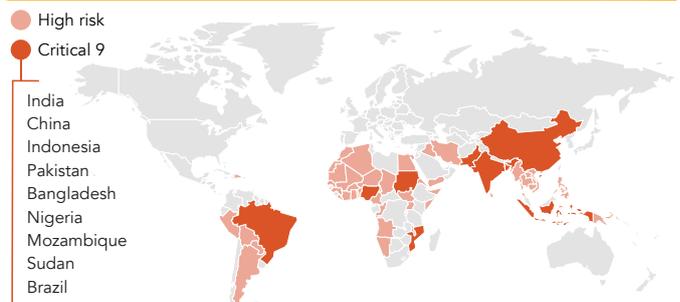
FINDINGS BY REGION

Regional share of population at high risk (Rural and Urban Poor)



12 countries, Angola, Benin, Burkina Faso, Djibuti, Guinea-Bissau, Liberia, Malawi, Mali, Mozambique, Nigeria, South Sudan and Togo, all located in Africa, have **over 60% of their populations at high risk** (Rural and Urban Poor).

COUNTRIES WITH POPULATIONS AT HIGH RISK



Critical 9 are the countries with largest number of people at high risk. Of these:

China and India have **already developed National Cooling Plans**

Brazil, Nigeria and Bangladesh are **currently developing National Cooling Plans**



UNDERSTANDING COOLING NEEDS BETTER

Understanding how to meet cooling needs and Sustainable Development Goals (SDGs) together is possible when using the new Cooling for All Needs Assessment. This assessment allows measurement of cooling needs across human comfort and safety, food security and agriculture as well as health services.

Scan the QR code to learn more.



EXECUTIVE SUMMARY

The world is getting hotter and drier. Climate impacts are being universally felt, most tangibly in the volatility and frequency of extreme weather events, and every year the situation becomes more dire. In 2019, the International Panel on Climate Change (IPCC) reported that at 1.5°C of warming, 2.3 billion people could be both exposed and vulnerable to heatwave events, a threshold that could be reached as early as 2030.¹ It also reported that food loss and waste account for 8-10 percent of annual GHG emissions and that food security, particularly the production of nutritious fruits and vegetables, is vulnerable to climate change. The World Health Organization (WHO) reported that global vaccination rates remain at a stubborn 86 percent, and that 19.4 million infants were not reached with routine immunizations, including the temperature sensitive DPT vaccine.

Unsurprisingly then, in 2018 and 2019 the issue of cooling and how we deliver it affordably and sustainably has emerged as a focus of governments, health care companies, food manufacturers, real estate firms, air-conditioning and refrigeration equipment manufacturers, refrigerant producers, as well as development institutions. Rather than viewing access to cooling as a luxury, they recognize that in a warming world, access to sustainable cooling is a necessity. Cooling is an issue of equity that underpins the ability of millions to realize the Sustainable Development Goals (SDGs). Safe living and working conditions, safe and nutritious food, and effective vaccines and medical care depend on access to cooling, and as need for cooling grows, we must deliver it in a manner consistent with the Paris Agreement on Climate Change and the Kigali Amendment to the Montreal Protocol. It has to be sustainable.

¹ Allen M., et al. (2018) SUMMARY FOR POLICYMAKERS, in IPCC (2018) GLOBAL WARMING OF 1.5°C, 6 ("Human activities are estimated to have caused approximately 1.0 °C of global warming above pre-industrial levels, with a likely range of 0.8 °C to 1.2 °C. Global warming is likely to reach 1.5 °C between 2030 and 2052 if it continues to increase at the current rate. (high confidence)").

This report is a follow-up to *Chilling Prospects: Providing Sustainable Cooling for All*, the first report to define and quantify the magnitude of the global cooling access challenge, including an assessment of 52 countries facing the biggest risks, measured by extreme heat, food losses, and damaged or destroyed vaccines and medicines. This report serves as a status update. It profiles fast action in access to cooling, provides an update on global access to cooling gaps, and provides policy makers, the private sector and development financiers with tools and guidance on how to accelerate progress on areas of priority.

FAST ACTION TO ACCESS ON COOLING

Since the release of *Chilling Prospects*, there have been important moments of progress in countries identified as highest at risk. In 2019, two major economies published national cooling plans: the India Cooling Action Plan (ICAP) and the Green Efficient Cooling Action Plan in China. Of the nine priority countries identified in 2018, Brazil, Bangladesh, and Nigeria are also currently working to develop national cooling plans. Additionally, Rwanda and Trinidad and Tobago have demonstrated critical national leadership on cooling policy. Indian cities have acted to protect their populations from extreme heat with the National Disaster Management Authority building capacity in local governments to develop life-saving heat action plans.

Simple solutions to enhance access to cooling have also been championed with prizes like the Million Cool Roofs Challenge and the Ashden Cooling by Nature Award, recognizing the critical role of innovation in urban greenery for cooling cities. Through its Global Cooling Prize, the Rocky Mountain Institute and partners have successfully engaged industry in the goal of designing a five times more efficient air conditioner at no more than two times the cost. Through public-private partnerships (PPPs), industry has shown itself as a crucial partner in testing solu-

Chilling Prospects: Providing Sustainable Cooling for All used the terms Rural Poor, Slum Dwellers, Carbon Captives, and Middle Income to segment the market. In this report, Slum Dwellers are termed Urban Poor and Carbon Captives are termed Lower-middle Income.

Rural Poor - Approximately 365 million

The rural poor lack access to electricity and are likely to live in extreme poverty. Many of them are likely to engage in subsistence farming and lack access to an intact cold chain enabling them to sell their products further afield at a higher price. Medical cold chains may also not be intact, putting lives at risk from spoiled vaccines.

Urban Poor - Approximately 680 million people

The urban poor may have some access to electricity, but housing quality is very poor and income may not be sufficient to purchase or run a fan. They may own or have access to a refrigerator, but intermittent electricity supplies may mean that food often spoils and that there is a high risk of food poisoning.

Lower-middle income - Approximately 2.2 billion people

The lower-middle income represent an increasingly affluent lower-middle class that is on the brink of purchasing the most affordable air conditioner or refrigerator on the market. Limited purchasing choices available to this group favor cooling devices that are likely inefficient and could cause a dramatic increase in energy consumption and associated GHG emissions.

Middle Income - Approximately 950 million people

The middle income are people who have owned an air conditioner and may be able to afford a more efficient one. They might make conscious choices not to own an AC unit or minimize its use. They may represent the established middle class where affordability may also allow them to move to better designed, more efficient housing and working environments.

tions and preparing them for scale in priority markets, and remains actively engaged in the critical task of gathering data on agricultural cold chains to overcome barriers to investment in growing markets.

Policy makers in both developed and developing countries have now started to focus their attention on the critical role of access to cooling in addressing poverty and achieving the SDGs. With the launch of SEforALL's Cooling for All Secretariat along with leadership from national governments and new civil society initiatives, there is a growing awareness of the role of access to sustainable cooling in lifting people from the base of the pyramid and providing them with life changing opportunities to protect themselves, improve their health and increase their productivity.

TRENDS IN COOLING ACCESS

This report provides an update on trends in cooling access. While challenges in measuring the spectrum of enhanced access to sustainable cooling persist and point to a need to refine the model, the segmentation of risk groups, or potential markets, in terms of the rural poor, the urban poor, and the lower-middle income, and tracking them annually, is crucial to building awareness and understanding the magnitude of the challenge and the actions that need to be taken.

The analysis shows that across the 52 high-impact countries 1.05 billion people among the rural and urban poor people remain at high risk from a lack of access to cooling. A further 2.2 billion lower-middle income people pose a different kind of risk: they will soon be able to purchase the most affordable air conditioner or refrigerator, but price sensitivity and limited purchasing options mean they favor devices that are likely to be inefficient, threatening energy systems and resulting in increased GHG emissions.

Compared to 2018, the analysis shows as seen in Table 1 a decrease of approximately 55 million people who are at highest risk of a lack of access to cooling, from 1.1 billion. The number of urban poor at highest risk has grown by approximately 50 million from 630 to 680 million, while the rural population has decreased

by approximately 105 million from 470 million to 365 million. The lower-middle income population has seen a reduction from 2.3 billion in 2018 to 2.2 billion in 2019. Across the 52 high- impact countries, at least 3.2 billion people face cooling access challenges in 2019.

Driving the change for rural people living in poverty is a significant increase in rural energy access, notably in India, Bangladesh and Indonesia, as well as continued urbanization trends in Africa and Asia. While energy access lowers risk exposure, it does not necessarily imply enhanced access to cooling, given the need for Tier 2² energy access to operate simple fans and the fact that poor people in rural areas face risks on multiple fronts. Significant concentrations of rural people at highest risk remain in Sub-Saharan Africa, particularly in Mozambique, Nigeria and Uganda.

In cities, the growth in the number of urban dwellers at highest risk between 2018 and 2019 is consistent with population growth and urbanization rates in the developing world, which have, in some instances, quadrupled during the last 50 years.

The decline in the lower-middle income population between 2018 and 2019 is indicative of a growing global middle class and lower prices for entry-level AC and refrigeration units. In Indonesia for example, which has seen a significant reduction in its lower-middle income population, the World Bank estimates that about 20 percent of the population are middle class and a further 45 percent of Indonesians are considered no longer vulnerable to poverty. Household consumption in Indonesia rose by 5.1 percent in 2018.

A geographic comparison shows that in Africa, the growth rates of those at highest risk from a lack of cooling access—rural poor and urban poor—have increased beyond population growth rates. Of the high-impact African countries identified, 12 have over 60 percent of their populations at highest risk. In Asia, there was a slight decrease in populations at highest

² ESMAP (2015). *Beyond connections – Energy Access Redefined* presents Tier 2 of the Multi-tier framework as a lower access to household electricity services, enough to power general lighting, television and fan.

TABLE ES 1: CHANGES IN VULNERABILITY BETWEEN 2018 AND 2019

POPULATIONS AT RISK	HIGH RISK		MIDDLE RISK	LOW RISK
	RURAL POOR	URBAN POOR	LOWER-MIDDLE INCOME	MIDDLE INCOME
RISK INDICATORS	<ul style="list-style-type: none"> Lack of access to energy Proportion of rural population living in poverty 	<ul style="list-style-type: none"> Lack of access to energy Proportion of population living in urban slums 	<ul style="list-style-type: none"> Proportion of population living on less than USD 10.01 / day outside of rural or urban poverty 	<ul style="list-style-type: none"> Proportion of population living between USD 10.01 and 20.01 / day
2018 ACCESS GAP	470 million	630 million	2.3 billion	1.1 billion
2019 ACCESS GAP	365 million	680 million	2.2 billion	950 million
CHANGE	-105 million	+50 million	-100 million	-150 million
FINDINGS AND TRENDS	<ul style="list-style-type: none"> Significant increase in rural energy access, notably in India Continued urbanization trends in Africa and Asia 	<ul style="list-style-type: none"> Continued urbanization and fast-growing cities in Africa and Asia 	<ul style="list-style-type: none"> Purchase of cooling devices associated with income growth, notably in Indonesia Lower prices for entry-level AC and refrigeration units 	<ul style="list-style-type: none"> Increased purchasing power and growth of an established middle class
NOTE	<ul style="list-style-type: none"> 1.05 billion remain at highest risk, compared to 1.1 billion in 2018. While energy access lowers risk exposure, it does not necessarily imply enhanced access to cooling, given the need for Tier 2 energy access to operate simple fans. Changes in volume do not necessarily imply a transition from one population at risk to another. 			

risk from 2018 to 2019, although 615 million people are still identified to be within the two high-risk groups.

MOVING FORWARD: NEEDS-BASED ASSESSMENT AND FINANCE

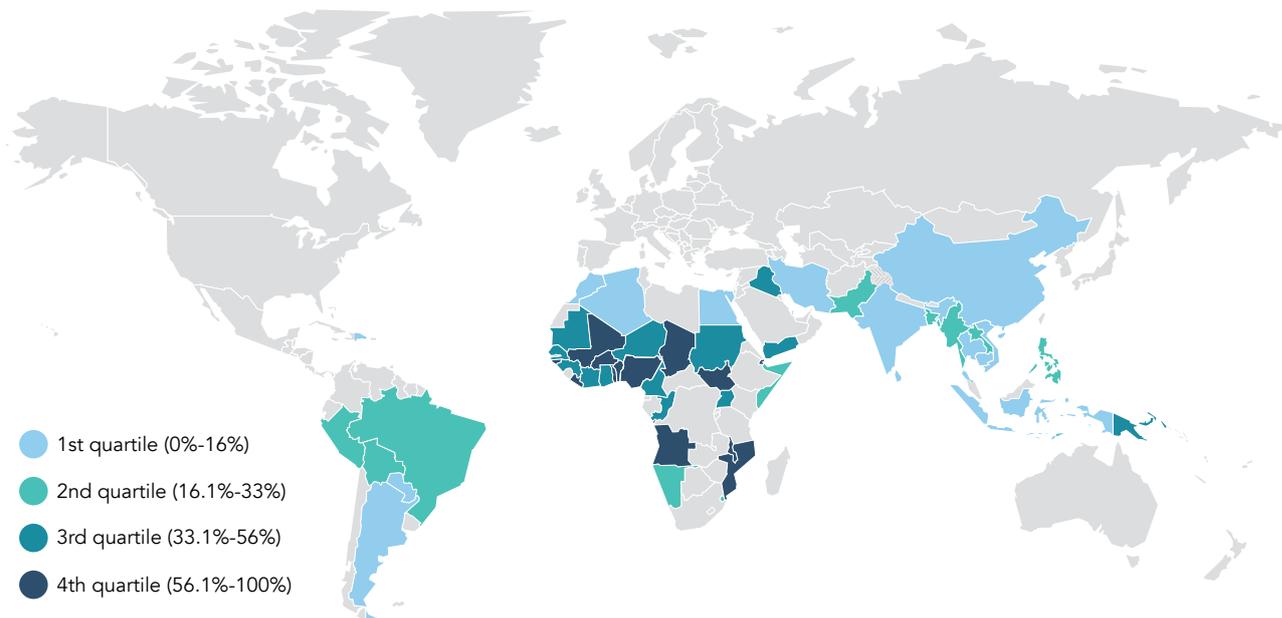
Delivering sustainable cooling for all requires a holistic approach that moves beyond equipment-based projections and addresses the full scope of cooling demand across thermal comfort, agricultural production, nutrition, and the provision of effective health services. An underestimation of the scale of the cooling demand could ultimately have far-reaching social, economic and environmental consequences. In response to this, the Cooling for All Secretariat at SEforALL and Heriot Watt University have partnered to create the Cooling for All Needs Assessment, a tool for governments, development institutions, and NGOs to measure the full spectrum of cooling needs and aggregate policy, technology, and finance measures to address them.

The needs assessment is a living document and is based on the principle that, in order for a country, city or community to ensure that the cooling needs of their population are met, they must first understand what those needs are. Through assessment across human comfort and safety needs, health service needs, food and nutrition security and agricultural needs, demand can be understood systemically and measured fully. A roadmap to delivering access to sustainable cooling for all can then be developed. These needs anchor a framework of analysis to measure present and future community, regional, and national access to cooling requirements. Each has a series of guiding questions that inform next steps for demand measurement.

Human comfort and safety: for living, learning, working, and mobility

- To what extent does the population have access to the space and mobility cooling that is

FIGURE ES 1: SHARE OF POPULATION AT HIGHEST RISK (RURAL AND URBAN POOR COMBINED)



Note: Each quartile includes one fourth of the countries. The percent represents the range of the share of population at high risk for each quartile.

Notes on all maps contained in this report: 1. The dotted line represents approximately the Line of Control in Jammu and Kashmir by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. 2. All maps were produced by SEforALL. They are based on the UN Map of the World, which can be found here: <http://www.un.org/Depts/Cartographic/map/profile/world.pdf>. The boundaries, colors, denominations and any other information shown on these maps do not imply, on the part of SEforALL, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.

adequate to maintain safety and productivity at home, in places of education and in the work environment and while moving between each?

- Are health infrastructure buildings equipped with the cooling they need to deliver adequate and reliable health services?

Food and nutrition security and agriculture: for nutrition, rural incomes, and connectivity

- To what extent does the population have access to the food they need to maintain a healthy (and socially acceptable) diet?
- Is income from agriculture and fisheries sufficient to keep workers out of absolute and relative poverty?

Using these guiding questions, the methodology then provides specific indicators for each guiding question. The indicators offer a starting point to establish a baseline for access to cooling, understand the implications of cooling demand, make outcome-based investments that target vulnerable groups, and track progress.

Health services: for safe medical clinics and the secure transport and storage of vaccines and medicines

- Are national vaccine programs reaching their target population?
- Is there sufficient unbroken cold chain to ensure the provision of medicines and healthcare products?

The diversity and complexity of cooling needs are a central part of the challenge in developing finance tools that reduce vulnerability. Utilized in a national cooling plan or equivalent set of measures, a needs-based approach can inform finance by identifying what is achievable with private investment and blended finance and what is only achievable through public support. It can create a foundation for financing strategies that

complement investment plans (where investment plans will indicate *what the investment needs are*, financing strategies will indicate *what type of financing is needed*).

Access to sustainable cooling finance is expanding, but it must grow quickly and substantially enough to meet the increased need for cooling services. There are signs that cooling is gaining importance with bilateral donors and the development finance community, as well as within the Montreal Protocol, and many international funds like the Green Climate Fund and the Global Environment Facility are bolstering their dedication to various cooling initiatives. The World Bank Group has announced a program within the Energy Sector Management Assistance Program (ESMAP) to develop necessary market infrastructure, financing mechanisms, policies, and regulations that support sustainable cooling, including cold chain.

These emerging opportunities signal the need not only for coordination, but for a clear road map based on cooling needs and with equity as a value. This is in stark contrast to equipment-based projections which do not take into account the base of the pyramid population. They also make clear the need to track access to cooling finance flows, which is currently difficult due to the issue's nascency. Indicative access to cooling finance can be understood through proxies such as access to electricity and climate finance to specific sectors, but a more granular approach would be beneficial as finance expands.

RECOMMENDATIONS

This report offers a set of recommendations for specific actors to urgently accelerate progress on access to sustainable cooling. It also identifies cross-cutting issues to be addressed that are relevant to multiple stakeholders regardless of their sector. A first step for all actors is to understand the enormity of the challenge and that we have only begun to make progress on delivering sustainable cooling for all.

For Government Policymakers

National and sub-national governments must catalyze accelerated action on sustainable access to cooling by creating comprehensive cooling plans that protect the vulnerable. Understanding gaps in cooling demand with the use of the Cooling for All Needs Assessment is a key first step in determining how to address these gaps. Through this assessment tool, available through the Cooling for All Secretariat at Sustainable Energy for All, policymakers can define targets, and aggregate policy, technology and finance options to address critical cooling needs. Opportunities for partnerships with the private sector must be pursued as a means of achieving market development.

For Donors, Development Practitioners and Financiers

A focus on society's most vulnerable, those at the base of the pyramid, must be a priority for development programs and finance to deliver sustainable cooling for all. Interventions must go beyond servicing the space cooling of buildings and address human security and safety, health services, agricultural productivity and food and nutrition security. The application of a cross-sectoral, multi-stakeholder approach is a crucial first step for donors and the development community to maximize finance and impact for access to sustainable cooling at the base of the pyramid. The private sector has also demonstrated its capability to be part of such efforts, and PPPs must be utilized to ensure the demonstration of technology and that new business models can reach scale. In considering finance and assistance, donors and the development community should use the needs assessment to identify desired outcomes and establish what can be achieved with private and blended finance, and what can only be achieved with public finance.

For Industry and Business

Industry should understand the size of the cooling market when counting in the unmet needs of those at the base of the pyramid and, together with government, work to ensure that high-efficiency devices are accessible and affordable. Technological innovation is crucial for creating efficient cooling products,

and must be paired with an effort to lower prices and up-front costs and speed deployment of proven approaches in design and engineering. The expansion of cooling as a service and pay-as-you-go models, as well as collaboration with inclusive financial institutions, can help to ensure that everyone can gain access to sustainable cooling. Additionally, industry and business have to step up to deliver skills development and maintenance training.

For Cities and Local Authorities

Cities and local authorities should also use the needs assessment to identify priority actions to protect vulnerable populations. The design or expansion of heat action plans and passive cooling through green spaces and cool roofs are important immediate steps. In addressing longer-term issues, collaboration across urban design and energy planning will be essential to mitigate cooling demand and reduce the urban heat island effect.

To Raise Awareness and Generate Knowledge Across Sectors

There are too many unknowns to deliver sustainable access to cooling for all and this report recommends key next steps to fill those gaps. We desperately need better data on the sufficiency of agricultural cold chains in high-impact countries, a gap the private sector is well-placed to fill. With a growing recognition of the nexus issues between health and energy, improved collaboration between the two sectors must be a priority for both communities and the private sector must be engaged. The recently established global Health and Energy Platform of Action led by the WHO could serve as a basis for new partnerships. Finally, the lack of gender-based analysis is another key weakness that prevents public and private programs from responding to the specific cooling needs of women and girls versus those of men and boys, a knowledge gap that Sustainable Energy for All is looking to fill.

To Build Capacity and Develop Skills

Efforts by K-CEP, GIZ, OzonAction and development organizations assisting with national cooling plans (NCPs) have laid a strong foundation which can be

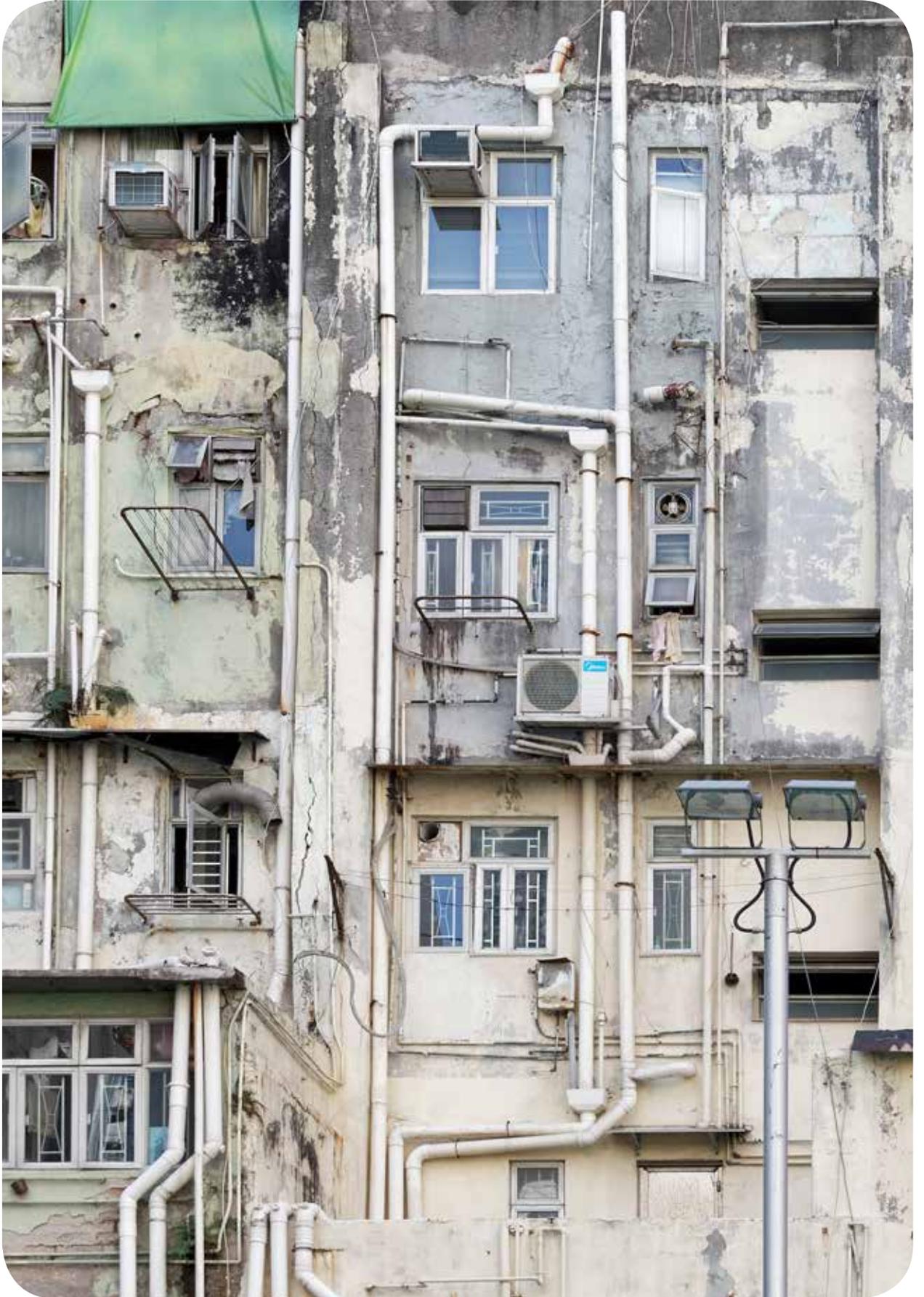
expanded on to build the global capacity necessary to deliver cooling for all. Training capacity and centers for promoting focused work on access to cooling in vulnerable countries, either at the country or regional level, should be established as a means to scale up current efforts. One model worthy of consideration is that of the Global Network of Regional Sustainable Energy Centres, led by the United Nations Industrial Development Organization (UNIDO), that provide a network and resources for regional practitioners.

To Benchmark Progress and Track Finance

While there are clear and acknowledged gaps in the data that preclude a complete understanding of risk across the spectrum of access to cooling, globally available data will continue to support tracking of cooling access gaps for those at the highest risk. As greater emphasis is placed on cooling by development finance institutions and bi- and multilateral donors, there will be a clear need to track financial flows directed towards access to cooling for vulnerable populations. Understanding the amount, geography, type of finance and the rate of distribution and absorption is critical to prioritizing new investments.

As populations grow, heatwaves intensify, and the global middle class expands, the role of cooling in the productivity of developed economies and the safety of people has never been easier to appreciate. The developed world now understands how cooling made the transition from a luxury in the mid-19th century to a necessity today.

It is the responsibility of governments, industry, civil society, and the development community to internalize the lesson that delivering access to sustainable cooling to vulnerable populations is an issue of equity and to apply it with urgency. With solutions at hand, growing interest, and ambitious commitments, ensuring we deliver results for those at the base of the pyramid requires a clear road map based on cooling needs, one which moves beyond equipment-based projections, and that places equity at the heart of our efforts.



ACKNOWLEDGEMENTS

The report was written by a team from Sustainable Energy for All that includes: Ben Hartley, Clotilde Rossi di Schio, Alice Uwamaliya, Emelia Williams, Alan Miller and Brian Dean. The SEforALL team was led by Glenn Pearce-Oroz.

SEforALL would like to thank the following people and organizations, without whose input the report would not have been possible:

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Achim Steiner, Administrator, UNDP; Dan Hamza-Goodacre, Executive Director, Kigali Cooling Efficiency Program; Iain Campbell, Managing Director, Rocky Mountain Institute; Jürgen Fischer, President, Danfoss Cooling, and Member of Group Executive Team; Kate Hampton, CEO, Children's Investment Fund Foundation; Kurt Shickman, Executive Director, Global Cool Cities Alliance; Maria Neira, Director, Public Health and the Environment Department, WHO; May Mei, Executive Director, GoalBlue Low Carbon & Promotion Center; Tina Birmpili, Executive Secretary, Ozone Secretariat; Nithya Ramathan, CEO and Co-Founder, Nexleaf Analytics.

SPECIAL ACKNOWLEDGEMENT FOR THEIR CONTRIBUTIONS: Helen Picot, Jessica Brown, Mark Radka, Brian Holuj, Marcel Alers, Peter Warren, Brian Motherway, Jonas Loholm Hamann, Katharina Arndt, Meg Seki, Johannes Heister, Ian Crosby, Jenny Cory Smith, Yasemin Erboy Ruff, Juliet Kabera, Anderson Alves, Denise Andres, Thomas Motmans.

ADDITIONAL ACKNOWLEDGEMENT: EPEE: Andrea Voigt; GFCCC: Juergen Goeller; ARAP: Kevin Fay.

SEforALL team members contributing to the report: Olivia Coldrey, Stephen Kent, Andrea Stojanov, Annette Aharonian, Tamojit Chatterjee, Juan Cerda, Jenny Nasser, Vilmar Luiz, Caroline McGregor, Hannah Girardeau, Jem Porcaro, and Luc Severi.

SEforALL acknowledges with gratitude the financial and technical assistance provided by the Kigali Cooling Efficiency Program that made this report possible. We also acknowledge the funding provided by the Children's Investment Fund Foundation, the Austrian Development Agency, the Charles Stewart Mott Foundation, the IKEA Foundation, the Ministry of Foreign Affairs of Denmark, the Ministry of Foreign Affairs of Iceland, and the Ministry of Foreign Affairs of Sweden for their support in delivering the SEforALL work program.

Finally, the team would like to thank Rachel Kyte, former CEO of Sustainable Energy for All, for her guidance in the development of the report and for championing Cooling for All as an urgent development and climate change issue.

Thank you! The Cooling for All team.

This report was prepared by Sustainable Energy for All staff in consultation with Senior Advisors Alan Miller and Professor Toby Peters. Its content is based on desk research and data analysis conducted by the SEforALL team as well as interviews and information gathering calls with stakeholder organizations.

Professor Toby Peters and Heriot Watt University contributed significantly to the development of the Cooling for All Needs Assessment. SEforALL also undertook consultation with organizations providing technical assistance in the development of national cooling plans, including UNDP, UN Environment, and the World Bank to survey need and demand.

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