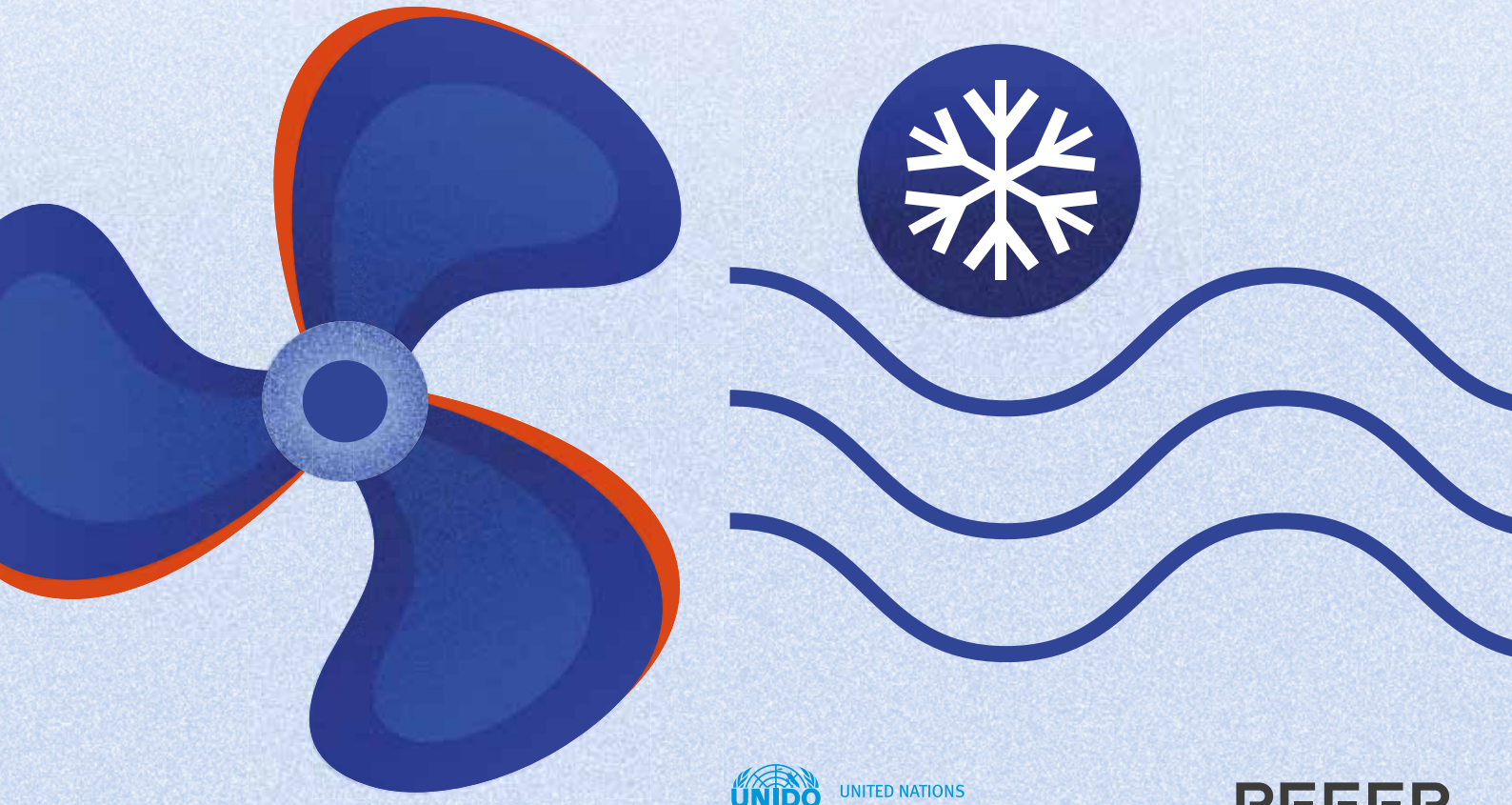
PFAN
Accelerating Investment for Climate and Clean Energy

KIGALI
COOLING EFFICIENCY PROGRAM

Investing in a Cooler Future for All

CATALYZING COOLING SOLUTIONS IN DEVELOPING COUNTRIES THROUGH THE PRIVATE FINANCING ADVISORY NETWORK



UNIDO
UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

REEEP

FOREWORD

After the COVID-19 crisis, nations have been urged to build back better and turn economic recovery into an opportunity for green and sustainable growth. We have a unique window to address climate change and avoid environmentally destructive economic activities. In this context, efficient and sustainable cooling solutions can be instrumental in lowering greenhouse gas emissions and pollution, whilst contributing to nations' efforts in building back better.

Cooling is estimated to account for around 7% of global greenhouse emissions, more than aviation and shipping emissions combined. The demand for cooling has been constantly growing, and rising temperatures across the world due to climate change is a major contributor. For instance, around 20% of all the electricity consumed in buildings is for space conditioning and the overall energy demand for cooling is anticipated to triple by 2050. Therefore, there is a pressing need for cooling technologies that are efficient, less harmful, and commercially viable.

To address this need, the Private Financing Advisory Network (PFAN) partnered with the Kigali Cooling Efficiency Program (K-CEP) in 2019 to promote energy-efficient cooling in developing countries. Since then, more than 20 projects have been supported with business coaching and investment facilitation services. Four of these projects have successfully raised financing over the last year. At the time of writing, the

remaining projects were either receiving coaching support or being already presented to selected investors. Supported projects are commercially viable and offer substantial greenhouse gas reductions via low-global warming potential refrigerants and improved energy efficiency. Projects ranging from climate-friendly shrimp cold chains to solar-powered freezers with pay-as-you-use technology and cooling control systems for buildings attest to the diverse application of cooling technologies, as well as their untapped potential in climate change mitigation efforts of developing countries.

PFAN has learned many lessons over the past two years. This knowledge can be used by aspiring entrepreneurs, investors, or anyone who wants to take forward sustainable cooling investments. It can also influence energy efficient polices that help to better adapt to climate change and promote sustainable development. This report has packaged these market trends, success stories, PFAN's engagement and business models, and investor expectations to disseminate the lessons to the wider cooling community.

This report starts by providing the reader with an overview of the cooling sector: the key features, challenges and increasing demand. Then it explains how PFAN and K-CEP have partnered to offer entrepreneurs operating in the cooling sector better access to PFAN's proven model of business development support and investment facilitation. This partnership has also contributed to addressing the issues facing the sector such as weak policies, lack of an engagement platform for investors and entrepreneurs, investor bias for localized solutions, and affordability for consumers. It also shares selected energy-efficient cooling solutions supported with the PFAN portfolio, and finally presents recommendations for policymakers; market insights PFAN has observed over the past two years as well as some of the partnership's key success stories.

As illuminated in this publication, there are still major challenges ahead in providing developing countries with access to sustainable and efficient cooling, but PFAN and K-CEP will continue to catalyse cooling solutions in developing countries to contribute to a cooler future.

Tareq Emtairah, Director, Department of Energy, UNIDO

Magdalena Kouneva, Director General, REEEP

Mirka Della Cava, Head of Policies, Standards and Programs, ClimateWorks Foundation

Acknowledgements

Investing in a Cooler Future for All is a collaborative effort of the United Nations Industrial Development Organization (UNIDO), the Renewable Energy and Energy Efficiency Partnership (REEEP) and the Kigali Cooling Efficiency Program (K-CEP).

The work was led by Umur Gökçe, Programme Manager at UNIDO under the guidance of Alois Mhlanga, Chief of Climate Technology and Innovation Division at UNIDO.

The principal author of the report was Mark Lister, PFAN's Global Clean Cooling Expert. The report benefitted from valuable inputs by Nagaraja Rao (PFAN Head of Investment Facilitation), Laurie Navarro (PFAN Philippines Country Coordinator), Olugbolahan Mark-George (PFAN Nigeria Country Coordinator), William Holden (PFAN Advisor), Amitava Sengupta (PFAN India Country Coordinator), Shaymal Barman (PFAN Bangladesh Country Coordinator), Colin Broulliard, Ella Avanessian and Teresa Oberascher (REEEP), Dimitris Karamitsos and Carla della Maggiora (Basel Agency for Sustainable Energy), and Judit Rodriguez Manotas and Duygu Aladağ Baldauf (UNIDO).

The report was reviewed and benefitted from comments by Patrick Nussbaumer (UNIDO) and Mirka Della Cava (Climateworks Foundation).

The team is grateful to the following companies for sharing their project details: ACI Agrolink (Bangladesh), Rahimafrooz (Bangladesh), Inficold (India), Koolboks (Nigeria), PT Sumber Mina Investama (Indonesia), ENdep (Tanzania), SokoFresh (Kenya), Inspira Farms (Kenya). The report also benefitted from insights by the following investors: Jim Maguire (SDCL), Mason Wallick (Clime Capital), Dennis Otieno (Acumen), Yves Komaclo (Oikocredit West Africa).

The report was prepared for publication by Baseline Arts Ltd. It was edited and proofread by Ella Avanessian (REEEP) and Ovinuchi Ejiohuo (UNIDO).

This report has been produced with the generous financial assistance of the Kigali Cooling Efficiency Program.

About PFAN

Established in 2006, The Private Financing and Advisory Network (PFAN) is a global network of finance and energy experts focused on scaling up investment into climate and clean energy solutions. As technology prices continue to fall, projects that deploy this technology for climate objectives become more profitable and the appetite of investors for such projects grows. Now is a time of enormous potential for the development of such projects around the world.

There are many entrepreneurs in all regions with great ideas for clean energy and broader climate mitigation and adaptation projects that are economically viable. However, especially in low and middle-income countries, the project developers and the investors tend to have difficulty finding each other:

- Entrepreneurs simply may lack the connections to find investment, or may be unsure of what investors look for in a business plan;
- Investors may find it difficult to assess investment opportunities in markets with which they are not familiar.

PFAN aims to bridge this gap by helping entrepreneurs build their businesses and present them in a language that investors will understand and become interested in. PFAN then helps investors to find and recognise the potential of these businesses. In other words, PFAN provides free business coaching and advice to low-carbon, climate resilient businesses in developing countries, with the aim of creating investment-ready projects, and then matches their projects to appropriate private financing through a process of investment facilitation.

Since its inception 15 years ago, PFAN has supported over 1,000 projects with over 173 of those reaching financial close by using its relatively modest public resources to leverage private finance of approximately USD 2 billion. This has seen addition of clean energy capacity of an estimated 2,046 GW and annual greenhouse gas emissions reductions of 4.3 million tonnes.

PFAN continues to scale up its activities and reach more entrepreneurs in more countries with a growing focus on supporting projects which provide climate change adaptation benefits. Applications are accepted year-round from 122 countries in Asia, Latin America and the Caribbean, Eastern Europe, Central Asia, sub-Saharan Africa, and the Pacific. PFAN is hosted by the United Nations Industrial Development Organization (UNIDO) and the Renewable Energy and Energy Efficiency Partnership (REEEP) with its secretariat in Vienna, Austria. To learn more about PFAN's network, history, and services, please visit its website at https://pfan.net/.

PFAN
Accelerating Investment for Climate and Clean Energy

Glossary

COP26 – the 2021 United Nations Climate Change Conference, also known as COP26, is the 26th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC).

Global warming potential – an index representing the relative effectiveness of different gases in absorbing outgoing infrared radiation, over a given time period, relative to CO_2, which has a GWP of 1.

PV system – photovoltaic system or solar power system.

Refrigeration – includes domestic and industrial refrigeration, extending to cold-chain logistics for the storage and transport of temperature sensitive goods like food and medicines.

Servitisation – transformation from selling of a product to providing services.

Space cooling – refers to the use of mechanical cooling such as air-conditioning and fans, as well as passive cooling that makes use of thermal resources.

Abbreviations

AC	Air conditioner
CaaS	Cooling as a service
CO_2	Carbon dioxide
EE	Energy efficiency
EIU	Economist Intelligence Unit
ESCO	Energy service company
GHG	Greenhouse gas
GWP	Global warming potential
HFC	Hydrofluorocarbons
HVAC	Heating, ventilation, and air conditioning
IEA	International Energy Agency
K-CEP	Kigali Cooling Efficiency Program
MAC	Mobile air conditioning
PPAs	Power purchase agreements
PV	Photovoltaic system
ROI	Return on investment
SME	Small and medium enterprise
UNEP	United Nations Environment Programme
USD	US dollars
VAT	Value added tax

Cooling is estimated to account for around 7% of global greenhouse gas emissions, more than aviation and shipping emissions combined.

CONTENTS

Executive summary

Access to sustainable and efficient cooling is increasingly recognised as a key development issue, not just for its influence on global greenhouse gas emissions, but because cooling underpins a range of issues such as food security, health services, productivity and livelihoods.

Rapidly increasing demand for cooling from industrial, commercial, healthcare, residential and transport sectors in developing countries is accelerating the need for sustainable, clean, and energy efficient cooling solutions. The current market dynamics point to the importance of cooling in pathways towards climate stabilisation: if the developing world adopts inefficient cooling technologies and uses outdated refrigerant gases at the rates of uptake expected this will seriously undermine efforts to restrict global temperature rise. .

The Kigali Cooling Efficiency Program (K-CEP) has given impetus to sustainable cooling and is focused on increasing cooling access while also improving efficiency and phaseout of harmful refrigerant gases from cooling technologies worldwide. K-CEP supported the Private Finance Advisory Network (PFAN) to explore successful applications of its model of business development support and investment facilitation to cooling entrepreneurs in developing countries. The program sought to increase exposure for cooling as an important development issue and to encourage cooling-related applications for support. The two-year program had substantial impact, including coaching and investment facilitation support for as many as 23 projects, and new private investments for four businesses totalling USD million.

Around 20% of all the electricity consumed in buildings is for space conditioning and the overall energy demand for cooling is anticipated to triple by 2050.

Along the way, PFAN learned many lessons and gained many insights into what is needed to catalyze investments into cooling technologies in developing countries. Some of these lessons include:

- Efforts of entrepreneurs can be reinforced by credible operating examples of how use of sustainable cooling can strengthen business performance, and support for demonstrations of cooling technologies in practice. PFAN assistance is typically focused on projects that are commercial-ready; however, upstream support for prototyping new technologies and skills development also remains important so that more projects can reach the point of securing investment on commercial terms.

- Government actions are playing a significant role in determining market conditions that drive consumer demand for cooling. There are many policies that can create an enabling environment for clean and sustainable cooling, some of which overlap with energy efficiency policies that support investment, appliance standards, and other broader energy savings measures.

- While momentum is building, there remains limited investor appetite especially for cooling solutions in developing countries, and a rudimentary understanding of 'cooling' as a stand-alone investment sector. To some extent, this is reinforced by insufficient market data on cooling that may help to further convince investors on the scale of the opportunities.

- The Cooling as a Service (CaaS) business model is gathering momentum as demand for sustainable cooling accelerates. The CaaS model uses a pay-per-use model applicable in multiple sectors across the world, and avoids the need for end users to raise upfront capital.

- In some instances, financial institutions are reluctant to finance cooling efficiency projects because of perceived high risk, small market potential and high transaction costs due to small transaction sizes. Banks prefer traditional corporate, asset-based loans and are less willing to provide project-based loans.

- It persists that many potential clients/project hosts in developing countries are simply not cognizant of the potential savings in pursuing energy efficiency in cooling. Additionally, in many developing countries, price is a determining factor in consumer purchase decisions and identification of suitable cooling technology which is affordable, economic and scalable, as well as financing to help overcome remaining cost differentials, is essential.

The insights and lessons from PFAN's experience are shared in this document in the interest of informing cooling developers and investors who may be interested in supporting the sector, and also to provide recommendations on further actions for PFAN and other agencies seeking to catalyse cooling investments in developing countries.

1. The cooling sector

1.1 Overview of the sector

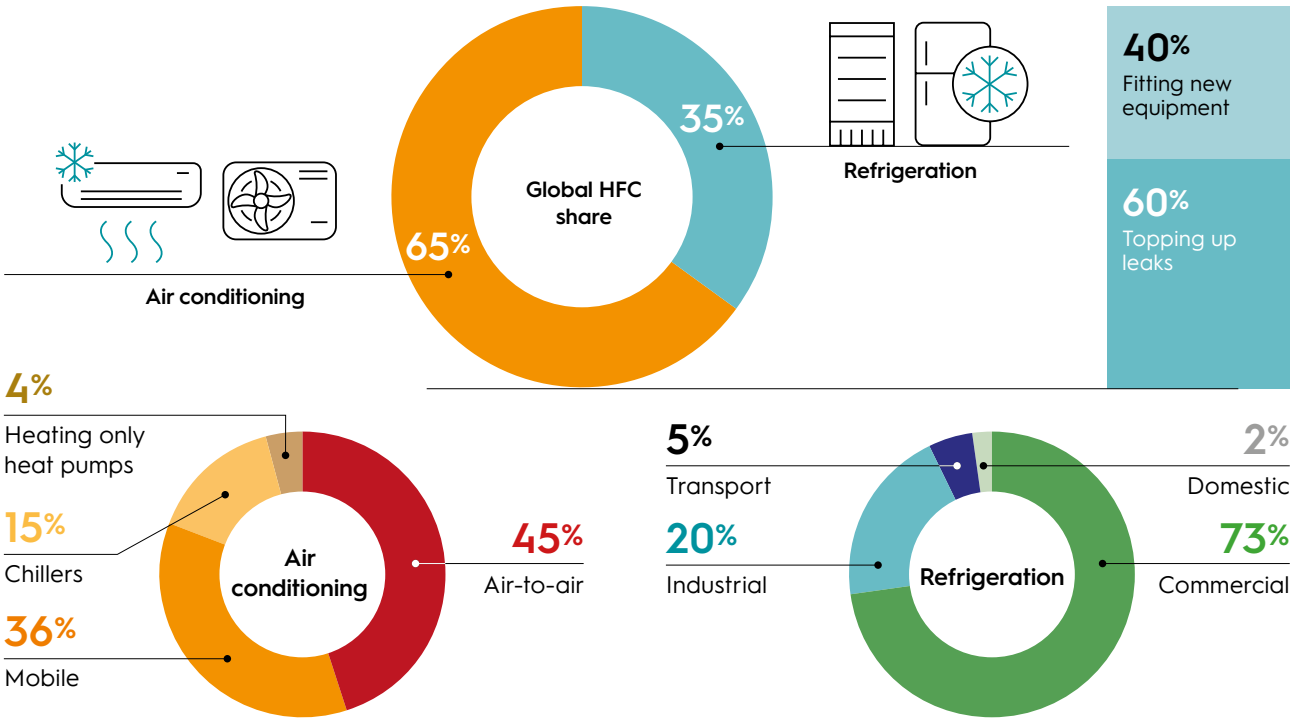
It is increasingly understood that access to **clean and efficient sources of cooling** is essential to ensuring health, underpinning economic livelihoods, and avoiding environmental impacts. Many people and businesses have direct experience in the centrality of cooling to these outcomes. However, cooling is not always immediately considered as a stand-alone sector when it comes to talking about climate change response (UNEP *et al*., 2020). Overall, requirements for cooling are typically thought of as a subset of both household and business requirements for electricity, either for industrial processes, cold storage and transport of perishable goods, or personal comfort. In recent times, however, cooling is increasingly understood as a stand-alone, cross cutting issue that goes beyond energy use and deserves specific attention. Viewed in this way, the centrality of cooling's impact cannot be denied: cooling accounts for around 7% of global greenhouse emissions, more than the emissions of aviation and shipping combined. Therefore, how global cooling needs are met matters to global decarbonization efforts, and more specifically, providing access to clean and efficient sources of cooling has become a recognised global development priority.

Cooling can be broken down into a few simple areas or sectors of focus, such as space cooling for human comfort and refrigeration of goods. **Space cooling** can refer to the use of mechanical cooling such as air-conditioning and fans, as well as passive cooling that makes use of thermal resources. **Refrigeration** includes domestic and industrial refrigeration, extending to cold-chain logistics for the storage and transport of temperature sensitive goods like food and medicines.

1.2 Sources of cooling

Importantly, mechanical sources of cooling are large users of energy and refrigerant gases that have huge implications for global climate change response. Air conditioners and fans alone account for nearly 20% of the total electricity used in buildings around the world today. Globally, energy related emissions from cooling are roughly equally split between space cooling, stationary refrigeration, and mobile cooling. At the same time, the so-called '**F-gases**' or hydrofluorocarbons (HFCs) commonly used for refrigerants in cooling are also powerful greenhouse gases that can be more potent than carbon dioxide in contributing to climate change. HFCs have been widely used alternatives to the ozone-depleting substances used in cooling applications that became subject to control under the Montreal Protocol (Montreal Protocol Fact sheet, 2018). However, these HFCs have created new issues for climate change. HFC use between different cooling applications is detailed in Figure 1 below.

FIGURE 1: **Global HFC use as share of total on GWP-weighted basis for stationary and mobile refrigeration, air conditioning, and heat pump sectors in 2012.**



Source: United Nations Environment Programme and International Energy Agency (2020). Cooling Emissions and Policy Synthesis Report; Benefits of cooling efficiency and the Kigali Amendment. UNEP, Nairobi and IEA, Paris. https://wedocs.unep.org/bitstream/handle/20.500.11822/33094/CoolRep.pdf?sequence=1&isAllowed=y

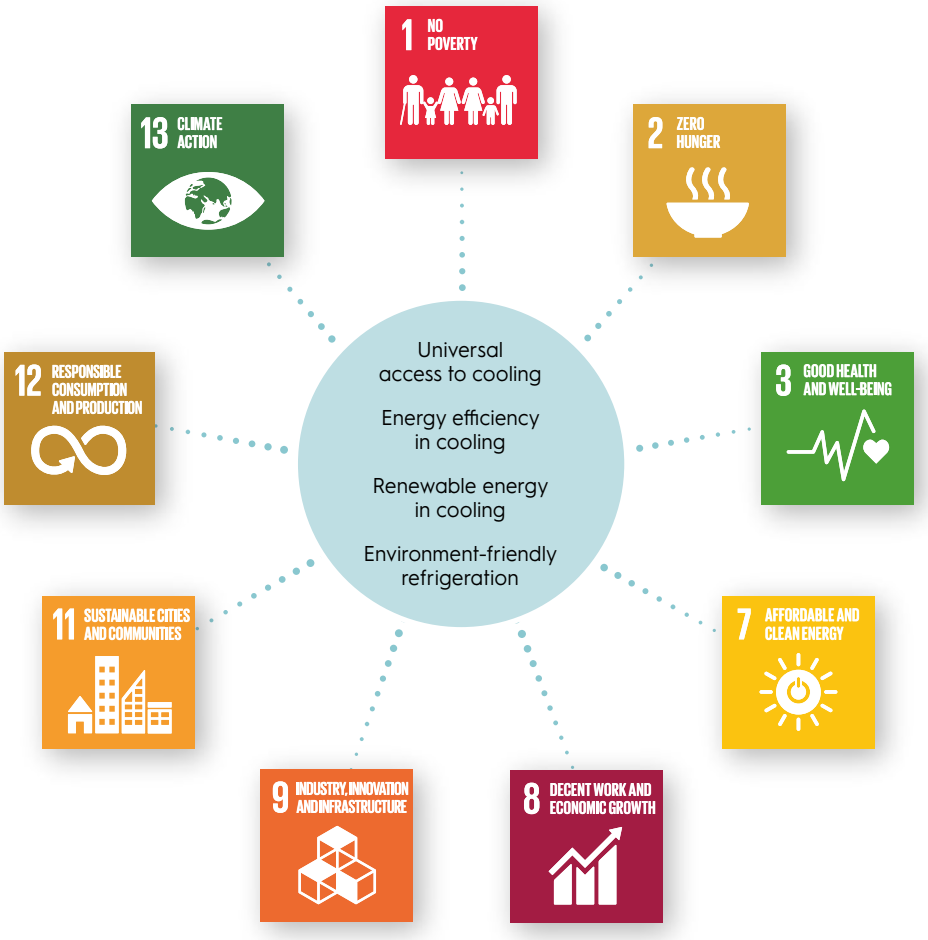
1.3 Contribution of the cooling sector to the SDGs

Beyond energy and environmental benefits, clean and efficient cooling contributes to a range of outcomes including storage and transport of food, increasing shelf life of medicines, overall health, and improved economic livelihoods. Clean and efficient cooling underpins a number of the **Sustainable Development Goals (SDGs)**; while the impact of cooling on energy and sustainable cities might be obvious, studies have demonstrated that cooling is a contributor linked to achievement of all 17 SDGs (Carbon Brief, 2020).

Figure 2 sets out more detail on how cooling makes a primary contribution to some of the SDGs, while other linkages and benefits of cooling are not immediately obvious. For example:

- No poverty (SDG 1): Increased extreme heat without cooling provisions is linked to lower productivity from land and income, exacerbating poverty especially in developing countries. Reduced cooling from decreased urban green spaces is also linked to increased income poverty.
- Quality education (SDG 4): Performance of students in schools reduces considerably where hot weather cannot be offset by the availability of cooling.
- Gender equality (SDG 5): Household food-related activities are often women's responsibilities, and the opportunities from cooling and refrigeration enable women to undertake small businesses and reduce time spent on daily food provision.

FIGURE 2: **Cooling's contributions to the SDGs**



Source: Adapted from National Cooling Action Plans (NCAPs) HCFC phase-out and HFC phase-down, climate action under the Paris Agreement and progress on the SDGs (UNEP OzonAction ECA Meeting, 12 May, 2021).
https://www.ozonactionmeetings.org/system/files/210512_national_cooling_action_plans_and_hcfc_hfc_strategies_marco_duran.pdf

1.4 Increased demand in the cooling sector and its associated impacts

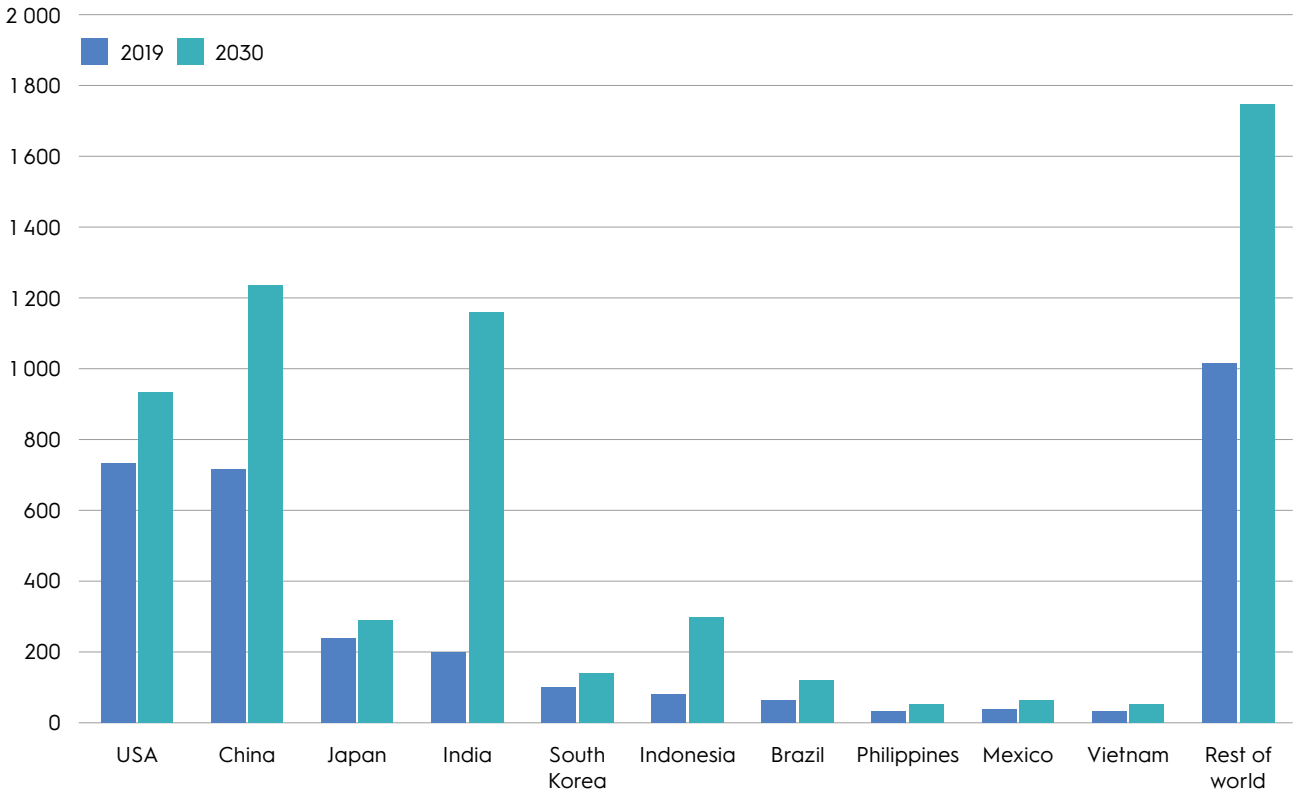
Unless cooling technology uses less harmful inputs and becomes significantly more efficient, rapidly rising demand for inputs and energy associated with cooling poses a huge environmental challenge. Unchecked growth in the cooling energy demand has enormous ramifications for global greenhouse gas emissions. There are substantial opportunities to improve cooling efficiency and access across all sectors.

AIR CONDITIONING

There is much focus on the increased demand for air-conditioners (ACs) driven by population growth, rising incomes, and higher ambient temperatures. Global demand for air conditioning is set to rapidly accelerate in the coming decades, with increases in both days of cooling demand and cooling penetration levels. These are set to **triple overall demand for cooling globally by 2050** (The Economist Intelligence Unit, 2020) as shown in Figure 3 below.

According to the latest available estimates from the International Energy Agency (IEA), nearly **two billion** air conditioners are in use worldwide; this is expected to increase to 5.5 billion by 2050 (IEA, 2020). The majority of this growth will be driven by China and India, accounting for almost 50% of the total. These numbers may dwarf those in other countries; however, trends elsewhere are similarly dramatic. The number of air conditioners in service is also expected to increase eleven-fold in Indonesia and six-fold in both Mexico and Brazil between 2020 and 2050. This is based on low current levels of penetration (Statista, 2020). This growth will significantly add to energy peak load infrastructure requirements and undermine efforts to curb emission reductions globally if it is met through installation of inefficient new AC equipment in these key markets.

FIGURE 3: **Electricity demand for space cooling by country/regions (2019 and 2030, TWh)**



Source: Adapted from Economist Intelligence Unit analysis based on multiple sources: Estimated based on IEA forecasts of growth in demand of AC units across countries. https://eiuperspectives.economist.com/sites/default/files/eiu154_-_power_of_cooling_-_dv6.pdf

REFRIGERATION AND COLD CHAIN

Having an uninterrupted cold chain is vital to reduce **food loss and waste**. Practical examples of this are fresh fish kept at 0°C can be kept for 10 days but only a few hours at 30°C; mangoes which can be stored for 2-3 weeks at 13°C but only 2 days at 43°C (SEforAll, 2018). In developing countries, fruit and vegetable wastage occurs overwhelmingly in the supply chain – rather than through consumer discards – and these are the countries where cold chain infrastructure is currently scant to non-existent. If the lowest levels of loss achieved in any region at each stage of the supply chain were replicated worldwide, global food loss could be reduced by 50%, an amount sufficient to feed an additional 1 billion people. Refrigerated storage and transport are potential key measures in achieving this goal.

MOBILE COOLING

Air conditioners in vehicles such as passenger cars, vans, buses and freight trucks – collectively known as mobile air conditioning (MAC) – consume almost 2 million barrels of oil equivalent per day and account for more than 1% of global energy-related CO_2 emissions. Energy consumption is responsible for around 70% of these emissions, while GHG emissions from refrigerant leakage account for 30%. The proportion of annual vehicle fuel consumption used by MAC varies by country ranging between 3% in colder climates and 20% in hotter climates, peaking at over 40% in warm climates and congested traffic. Without further policy intervention, for example fuel economy or component standards, MAC energy consumption may also triple by 2050 (IEA, 2019).

Doubling the energy efficiency of air conditioners could save up to USD 2.9 trillion by 2050 in reduced electricity generation

1.5 Global access to cooling

Although faced with precipitous growth in demand, **more than a billion people across 54 countries still have clear shortfalls in their access to cooling**. For example, of the 2.8 billion people living in the warmest parts of the world, only 8% currently have ACs, compared with over 90% of people in many developed countries. The poor rural and urban areas are at high risk due to their lack of access to electricity and below poverty-line incomes which prevent them from accessing sustainable cooling. Lack of access to controlled cold chains means that food spoils without proper refrigeration and vaccines are exposed to high temperatures. As temperatures and incomes rise, so does demand for cooling and higher levels of comfort, thus reinforcing these trends.

THE NEED FOR A SHIFT TOWARDS A CLEAN AND EFFICIENT FUTURE FOR COOLING

The IEA estimates that doubling the energy efficiency of air conditioning by 2050 would reduce the need for **1,300 Gigawatts** of additional electricity generation capacity to meet peak demand – the equivalent of all the coal-fired power generation capacity in China and India in 2018. Worldwide, doubling the energy efficiency

The poor rural and urban areas are at high risk due to their lack of access to electricity and below poverty-line incomes which prevent them from accessing sustainable cooling.

of air conditioners could save up to USD 2.9 trillion by 2050 in reduced electricity generation, transmission and distribution costs alone (IEA, 2018).

Combined with the phaseout of HFCs used as refrigerants, this could be significant. The Montreal Protocol adopted in 1987 is a global agreement to protect the stratospheric ozone layer by phasing out production and consumption of ozone-depleting substances. It has the distinction of being the first treaty to achieve universal ratification by all countries in the world. The 2016 Kigali Amendment to the Protocol added an agreement to phase down production and consumption of high-GWP HFCs by more than 80% over the next 30 years. The Kigali Amendment recognized that tackling the phaseout of harmful refrigerants at the same time as accelerating cooling efficiency can have a huge multiplier effect on emission reductions.

Spurred by this recognition, the **Kigali Cooling Efficiency Program**, or K-CEP, is a philanthropic initiative focused on improving people's lives and realizing the full climate benefits of implementing the Kigali Amendment. It is supported by 18 foundations and individuals who collectively pledged support to cooling energy efficiency enhancement alongside the Kigali Amendment. Since its inception in 2017, K-CEP has moved ahead with international efforts to shape the global agenda for clean and sustainable cooling. K-CEP has four areas of focus: 1. Strengthening for efficiency; 2. Policies, standards, and programs; 3. Finance; and 4. Access to cooling (K-CEP, 2021).

Further, in the leadup to COP26, international work is progressing towards a '**Net-Zero Cooling Pathway**' that includes a vision for net-zero cooling for all by 2050, through a focus on three impact areas:

- **Passive cooling:** Widespread adoption of measures that avoid or reduce the need for mechanical cooling including reducing cooling loads, smart and human centric design and urban planning.

- **Super-efficient equipment and appliances:** A 'race to the top' S-curve transformation where the norm is super-efficient cooling equipment and appliances are powered by zero carbon energy.

- **Ultra-low global warming potential (GWP) refrigerants and insulation foam gases:** Market domination of ultra-low (<5 GWP) refrigerants across all cooling sectors and applications (UNFCCC, 2020).

In this context, the need for innovation, entrepreneurship and private sector investment to help meet the cooling challenge has never been greater.

2. PFAN and its support for sustainable cooling projects

PFAN holds an important contribution to the necessary push for access to sustainable cooling, mainly through its support of entrepreneurs and project developers in developing countries with locally appropriate cooling solutions and technologies. With financial support from the Kigali Cooling Efficiency Program (K-CEP) commencing in late 2019, PFAN has actively sought out and encouraged cooling technology entrepreneurs to apply for assistance. Key elements of PFAN's activities in cooling are outlined below.

2.1 Overview of key achievements

To highlight the importance of the cooling sector in addressing climate change challenges, PFAN launched a special **Call for Proposals** in late 2019 for projects that deliver energy-efficient, climate-friendly, and affordable cooling solutions. PFAN solicited applications from businesses in developing countries that deliver substantial GHG reductions by not only moving to lower global warming potential (GWP) refrigerants and improving energy efficiency of air-conditioning and refrigeration, but also considering other passive cooling solutions appropriate to developing countries, such as building design, shading, and cool roofs. The selected projects received PFAN support through business coaching, financial advisory and/or tipping point technical assistance[1] depending on project needs and maturity, with the goal of attracting the required financing for the project.

Activity on cooling-related projects was accelerated through **continued outreach activities and engagement with other organizations** advocating for more sustainable cooling. Cooling-specific webinars were convened for the PFAN network in Africa and Asia, which were well attended and led to increasing interest from investors and developers alike. The K-CEP grantee network was also engaged in the work of PFAN to make referrals from other programs that support early-stage cooling businesses, and raise the profile of PFAN's work.

.

A specific **Cooling Investment Forum** was held in early 2021 and attracted registrations from more than 300 investors, project developers and cooling stakeholders, with the aim of matching some of the more advanced and investment-ready cooling projects that PFAN has supported with the groundswell of investment appetite

1. Tipping Point Technical Assistance refers to PFAN technical assistance, support and advice provided to selected projects to help them overcome late-stage development obstacles, update technical and financial studies, pass due diligence, achieve conditions precedent, address legal issues, and advance to financial closure

for sustainable cooling solutions. Momentum continues to build around this investor interest and the innovative provision of local cooling solutions that are needed in all of PFAN's operating regions.

As a result of these efforts, during the past two years PFAN has supported more than 20 cooling projects with a total investment ask of over USD 150m. A brief snapshot of the PFAN Cooling portfolio reveals the following activities and achievements:

35

Project applications evaluated

23

Projects assisted with business model development/ investment facilitation

10

Countries where project developers were located: Bangladesh, India, Indonesia, Kenya, Malaysia, Moldova, Nigeria, Philippines, Tanzania, Ukraine

USD 150m

Approximate total investment ask, across all assisted projects

USD 3m

Total investment mobilised and financial closures achieved (as of July 2021) spread across four PFAN supported companies, including:

- Debt funding of **USD 1,370,000** for PT Sumber Mina Investama in Indonesia;
- Equity funding of **USD 402,222** for Inficold in India;
- Grant funding of **USD 367,065** for ENdep in Tanzania;
- Grant funding of **USD 846,325** for Sokofresh in Kenya.

These four companies are showcased as **Case Studies** at the end of this publication.

Additionally, two further companies were supported with Tipping Point Technical Assistance: Basil Energetics (India) and ACI Agrolink (Bangladesh). It is expected that this 'last-mile' assistance will lead to stronger proof-of-concept for both companies that will help them secure financing in the near future.

Major technology clusters canvassed in proposals:

- **On-farm, solar PV-powered cold storage facilities, coupled with logistics platforms for end-to-end management of agricultural cold chains**
  A cluster emerged among the projects supported by PFAN related to agriculture and/or aquaculture due to the large unmet need for cooling to preserve perishable goods and ensure they make it to market with freshness and quality intact. Small, modular cold rooms that can be powered primarily by off-grid energy such as solar PV were a feature of many PFAN applications.

  In many such projects, cold storage technologies were supplemented by digital platforms that could allow farmers, wholesalers, and distributors to interact with refrigerated transport service to ensure goods were delivered to market in the right quantities. These supporting platforms often delivered via mobile phone technology, allow PFAN project developers to source produce directly from farmers, sort, package, and barcode them for traceability purposes, manage cold chains including transport between on-farm cold storage and distribution warehouses, receive orders from small scale traders and end consumers, deliver produce to retailers, market stalls and homes respectively, and collect payments.

- **Control and management technologies for cooling in buildings**
  There are large opportunities to improve and optimize cooling energy use in buildings, through improved utilization of passive cooling sources (such as improved airflow and shading), and also through better control of mechanical air conditioning use. A number of PFAN project developers put forward technologies for system optimization, both in control systems and in load matching with on-site generation. In most cases, this can save as much as 50% of building cooling energy use in warm-climate developing countries.

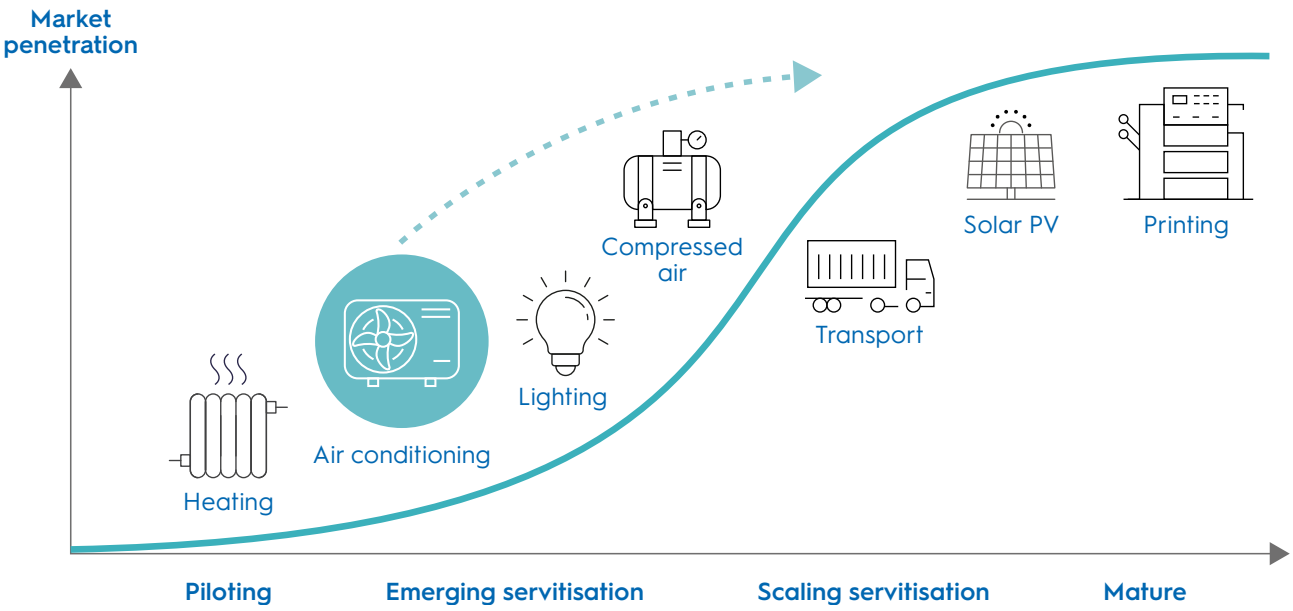
- **Off-grid refrigeration technologies**
  A good example of PFAN applications related to the provision of off-grid cooling and refrigeration is Koolboks in Nigeria, which has developed design for a reliable and alternative fridge/freezer than can run only on solar energy, due to superior insulation and a patented 'ice battery' technology which uses ice for storage. Intermittent power is used to create ice, where the resultant store of coldness can then power the unit for a long period. The unit can function as a refrigerator or as a freezer depending on the preference of the user and the available energy using an adjustable temperature range. The 'Koolhome' fridge/freezer also comes equipped with a room light and mobile phone charging points.

- **"Cooling as a Service" business models**
  Although the benefits of clean and energy efficient cooling technologies are clear, strong demand-side barriers prevent these from being widely deployed. These include higher upfront costs, a perception of greater performance risks and customers' investment priorities in the short term. **Servitisation** is an innovative business model which successfully overcomes these barriers; and within cooling, it is known as Cooling as a Service (CaaS).

With CaaS, the customer pays a fixed fee per unit of cooling service consumed, while the ownership of the system remains with the technology provider who also remains responsible for all operation costs. As such, the model strongly incentivises the equipment owner –the service provider – to implement energy efficient systems and to think long-term when designing and selecting the technology. Furthermore, the model promotes state-of-the-art maintenance from which the provider can minimise operating costs, in particular the energy use, which is the largest cost component over the life cycle of the equipment. Keeping ownership of the equipment also encourages service providers to continuously innovate and rethink the development of modular systems, which is key to a circular economy; therefore, not only benefiting the business and the people, but also the planet.

Servitisation is not new, and its adoption has been growing rapidly across many industries. The figure below illustrates some applications or services where the model has already been applied. Examples include the solar company SunEdison, who pioneered power purchase agreements (PPAs) for solar photovoltaics (PV), which enabled the rapid uptake of solar PV by allowing customers to purchase solar energy instead of investing in the panels themselves.

FIGURE 4: **Applications or services where the servitisation model has been applied**



Source: Basel Energy for Sustainable Energy. https://energy-base.org/news/what-is-servitisation-and-how-can-it-help-save-the-planet/

BOX 1: **BASEL ENERGY FOR SUSTAINABLE ENERGY: COOLING AS A SERVICE (CAAS) INITIATIVE**

PFAN network partner **Basel Energy for Sustainable Energy (BASE)** believes the cooling industry is on the brink of a revolution that will help achieve global climate targets and sustainable economic growth, as it enables customers to leap-frog to the best solutions available in their markets. The model can be applied to a wide spectrum of sectors from the manufacturing industry, real estate, hospitality and healthcare to the cold-chains necessary for food and health. For instance, in Nigeria, the implementation of CaaS in solar off-grid refrigeration for the agriculture sector is providing cooling services to local farmers, yielding a 50% reduction in food waste, increased revenues and saving 460 tonnes of CO_2 per year by removing the need for diesel generators and the bad refrigerants typically used in the region. In India, CaaS enabled a large real estate complex to access state-of-the art cooling services while reducing their energy consumption by more than 30% without upfront investments. In South Africa, the model recently enabled a client to retrofit and further expand its facilities, implementing state of the art ammonia refrigeration with an estimated 30% improvement in the plant Coefficient of Performance.

Today, BASE is aware of more than USD 60 million worth of assets operated with CaaS, and this number is increasing rapidly. KAER, a company based in Singapore, has its entire portfolio operating with CaaS – they provide their services to a diverse range of clients which enables them to minimise their operational risks and yield stable revenues across their portfolio in operation. Diversification with CaaS (providing the service for customers who have different consumption profiles) is key to ensure reliable revenue generation, while it also enables solution providers to provide CaaS with more flexible contractual terms.

For more information on Cooling as a Service, please visit: www.caas-initiative.org.

3. Going forward
Lessons learned and recommendations

PFAN's model of engagement and core business in early-stage project development in developing countries provides unique insights into the issues faced in particular markets. This on-the-ground insight extends to a pragmatic and specific understanding of the challenges faced in greater deployment of cooling technologies sectors. Some of these insights are shared below in the interest of informing both cooling developers and investors who may be interested in supporting the sector.

Information in this section is gleaned from the experience of both PFAN advisors and cooling project developers in multiple developing countries, who were interviewed for this publication about their experiences and perspectives.

3.1 PFAN's experience in the context of the COVID-19 pandemic

The COVID-19 pandemic's impact on the cooling sector has been mixed. On the one hand, market conditions for energy efficient cooling have been challenging. New projects especially require potential clients to invest into energy efficiency projects, whereas the priority of businesses –and particularly small and medium enterprises (SMEs) – is to cut discretionary spending just to stay afloat, and therefore not invest in energy efficiency technologies.

On the other hand, the recent COVID-19 pandemic has catalyzed some interest in the sector, given the cooling needs of vaccines that has seen more investor attention. However, actual investments are still slow and only happening gradually.

In attempting to recoup economic momentum in the wake of COVID-19, policymakers in many countries have launched policies and programmes to deliver jobs and stimulate additional spending that can be implemented quickly and easily. Recent studies highlight that spending on energy efficiency creates 77 jobs per USD 10m invested, compared with just 27 jobs for the same amount of spending on fossil fuels. The effect may be even greater for improving building efficiency, with 90-300 jobs created for every USD10m spent. Policymakers consider the economic benefits of including energy efficiency, also for cooling, in longer-term recovery packages.

3.2 Challenges for the cooling sector in developing countries

Principal challenges reported by project developers, advisors and investors include:

Technology development time to reach proof-of-concept. The work to develop an efficient, innovative, and market ready technical solution for cooling takes many iterations. It can take years of refinement and working with potential customers for adaptation of the technology to suit local needs, before potential solutions can progress to become proven under trial conditions and piloted prior to scaling up. Typical early-stage investors are looking for faster conversion, and project developers need patient capital support to allow time to experiment with physical systems and get a good 'market fit' for their products. The dearth of such capital for product development means that start-ups can do only minimal research and development work, severely hampering the development of investment-ready cooling projects.

To spur the market, efforts of entrepreneurs can be reinforced by credible operating examples of how use of sustainable cooling can strengthen business performance, and support for demonstrations of cooling technologies in practice. PFAN assistance is typically focused on projects that are commercial-ready, however, upstream support for prototyping new technologies and skills development also remains important, so that more projects can reach the point of securing investment on commercial terms.

Government policy. While the mood is strong for supportive policies on green recovery including energy efficiency as noted above, the ability of policymakers to respond effectively is low in many developing countries. Targeting of such policy towards cooling as a priority remains problematic in some cases. For example, in India, subsidies are currently available for diesel generators to shore up supply, rather than prioritizing energy efficient equipment. Additionally, cooling solutions such as air-conditioning systems are subject to same goods and services tax as a luxury goods, whether efficient or inefficient, making cold storage and cooling systems less affordable.

Developers reported that government actions are playing a significant role in determining market conditions that drive consumer demand. Examples include the re-introduction of VAT on solar products in Kenya, and changes in tax codes for renewable products in Nigeria. Although governments have made pronouncements to support renewables and in some cases, clean and sustainable cooling, there is often no clarity in execution and low availability of information regarding such plans. There are also negative side-effects in the lack of enforcement of policies: for example, non-compliant cooling technologies that may be banned for sale in the developed world are regularly dumped or off-loaded to African and Asian markets as cheap options, making competition and business cases for efficient equipment more difficult.

There are many policies that can create an enabling environment for clean and sustainable cooling, some of which overlap with energy efficiency policies that support investment, appliance standards, and other broader energy savings measures (refer section on 'Recommendations'). Some developers noted the importance of Government ratification of the Kigali Amendment to the Montreal Protocol, as a way to spur ambition and action on the move to cleaner cooling gases, and to drive market uptake and awareness. It is interesting to note some early evidence that such an enabling policy, focused on cooling, does indeed create a stronger framework for the progression of business ideas. For example, India has been a front-runner in adoption of policies and ambitions to include cooling in its Nationally Determined Contributions and other energy sector programs in a more centralized manner[2]. India was the country that originated the highest number of PFAN applications from its project developers during the period, which may be in part due to the emphasis placed by government on enabling policy for cooling. As noted above, support for business incubators and funding for early-stage technology research and development programs may also be beneficial to increase the level of entrepreneurial activity in the cooling ecosystem.

2. India's National Cooling Action Plan was launched in March 2019 and set out the country's cross-cutting ambition for reducing cooling energy use and transitioning to low-GWP refrigerants. The Plan covered space cooling in buildings, cold-chain and refrigeration, transport air-conditioning, the maintenance and servicing sector, refrigerant demand and indigenous production of alternative refrigerants.

Investor bias against small, localized solutions. PFAN project developers reported a perceived bias of investors and donor programmes towards supporting large multinational cooling companies instead of local SMEs. Generally, investors and financial institutions have baulked at finance for new cooling technology which is unproven or comparatively less known. As is commonly found with many energy efficiency investment facilitation efforts, project sizes are often too small to meet the preferred minimum investment size of investors. Given the above challenges, it is difficult to attract foreign investment while current lending terms and conditions of financing packages offered by local financing institutions are often not friendly enough to developing country SMEs or Energy Service Companies (ESCOs) working with them, who may be seeking financing for cooling projects.

Understanding the true market demand and scale of potential investment opportunities can also be challenging, especially when it comes to off-grid cooling. Cooling demand is under-served and therefore mostly suppressed in many off-grid areas, and therefore it is hard to predict how much the demand for cooling will actually increase if cooling access becomes available. A balance between willingness to pay and ability to pay needs to be thoroughly assessed, and a well-planned market survey is required to develop sustainable business models that are substantively robust to attract investment. Investors have not focused sufficiently on the sector to undertake this market research.

Lack of an engaged cooling investor community. While momentum is building, there remains limited investor appetite especially for cooling solutions in developing countries, and a rudimentary understanding of 'cooling' as a stand-alone investment sector. To some extent, this is reinforced by insufficient market data on cooling that may help to further convince investors on the scale of the opportunities.

It has also been observed that investor interest remains strong in ***financially*** sustainable business models, rather than ***environmentally*** sustainable energy technologies per se. This holds true even for investors that identify as impact investors or 'green'/ sustainability investors.

Even in well-developed and functioning economies, the difficulties of investment in energy efficiency projects are well documented. Due to small-scale projects, technology uncertainties and a heightened perception of project risk, energy efficiency project investors including ESCOs are often reluctant to proceed in the absence of fiscal and non-fiscal incentives to increase the financial viability of energy efficiency projects. An example of a promising investment incentive program is in the Philippines, where the Department of Energy is in the final stage of effecting a scheme to provide fiscal and non-fiscal incentives for energy efficiency projects that deliver specified minimum energy savings. Such incentives could also be provided in other formats, e.g. as favourable terms and conditions for equity and debt provision offered by developers themselves.

Meaningful connection between the investment and investor remains a major challenge. To understand the appetite of the investor and find the appropriate one is usually a difficult task. In most countries, the search cost for project developers to find an investor with interest in the right cooling technology, at the right stage of development, with the right business model remains high, leading to regular difficulties in attracting new investment.

Public Awareness. Public awareness of sustainability and energy performance in general, rather than cooling specifically, has grown in recent years, which in turn has supported interest from investors, customers and governments alike. Despite this gradual process, many potential clients/project hosts in developing countries are simply not cognizant of the potential savings in pursuing energy efficiency in cooling. Laws and regulations that mandate organizations to

identify energy efficiency opportunities are a trigger for establishments to look into their operations and determine opportunities for energy savings, however in developing countries, mandates for implementation of these identified opportunities are routinely not comprehensively enforced. There are many programmes that encourage consumers towards more greenhouse-friendly purchases in terms of cooling and other electrical equipment. However, many such campaigns are limited, not well resourced, or not deep or sustained enough to create transformative change in consumer behaviour.

Beyond consumer awareness, many entrepreneurs in developing countries find difficulties in convincing business customers to think in terms of 'lifetime value' rather than just immediate capital expenditure requirements. Clients often lack the financial sophistication to manage or assess different offers fully, and therefore may consider that the green premium is too high and/or under-value technologies that yield benefits that cannot be monetised.

Affordability. In many developing countries, price is the determining factor in consumer purchase decisions. Identification of suitable cooling technology which is affordable, economic and scalable is key. With more efficient or sustainable technologies, including cooling technologies, investment initially required may be higher, and accordingly it takes time for the additional benefits to recover this excess investment. However, low prevailing incomes mean limited cash for most potential customers to make such long-term decisions. Without mechanisms for the consumer to defray such additional initial expenses for 'green' solutions, the market for project developers becomes more difficult, which is a major impediment to product development and growth of the sustainable cooling market. Business models have emerged such as 'cooling as a service' which aim to overcome this first cost barrier.

3.3 Cooling opportunities for PFAN by sector

Despite the challenges in predicting future trends and investor preferences, PFAN project developers and their advisors saw many areas of opportunity for sustainable cooling in developing countries for which viable business models may be developed. There was no clear sense in the past couple of years of a sharp increase in appetite for cooling in practice in any of these areas, however increasing acknowledgement, engagement, and interest were reported across:

- Micro scale cooling solutions for farmers (applicable to Agri/Aqua/livestock etc.), such as solar milk chilling, solar based cold storage, etc. There are a range of archetypal projects in cooling for agriculture, including on-farm cold storages, IT-based logistics platforms, and upgrade of centralized cooling and warehousing facilities. Many of the on-farm solutions successfully deploy cooling as a service and pay-as-you-go models that remove the requirement for farmers to meet upfront capital costs of cooling equipment.
- Inexpensive systems that can attach to existing ACs to convert them into 'smart' ACs; this can reduce energy expenses for the customer, and be provided by the utility via on-bill financing.
- Efficient HVAC system for commercial buildings, especially monitoring and control systems
- Insulation technologies – e.g. in India and other countries, buildings were not built with air conditioning in mind, and there are many cheap and effective interventions to reduce huge air leakages that result in excess power consumption.

3.4 Recommendations

The operation of PFAN's activities in cooling has given rise to a number of noticeable portfolio trends and implications for future work. This will help to guide PFAN's future efforts, as well as informing others of areas that deserve prioritization.

- **Focus on specific, locally appropriate technologies.** PFAN is actively supporting new cooling business models and technologies in a range of countries that will benefit both the climate and local economies. A few specific niches have emerged in which PFAN can play a very active role. For example, there is a wide need for effective cold-chain business models and technologies, that will need to be met with local-scale interventions. Globally, it is estimated that approximately 15% of agricultural produce perishes before it can reach markets and consumers, rising to as much as one-third of all meat and fish. In terms of cooling projects that fit PFAN's model, therefore, key sectors within agriculture are important, particularly first-mile cold storage of highly perishable, high value crops for export. Additionally, highly perishable crops for local/regional consumption ought to continue as an important focus: there is enormous additional

need for business models that can secure rural produce value and effectively link to off takers in urban areas. These same cold chains and logistical models can also be deployed to bolster effective vaccine rollout, something that is critically important to developing countries in the current circumstances. PFAN can therefore actively target project developers in this subsector and continue to build its sector expertise, in terms of business models and potential financing sources. Additionally, PFAN can also bring awareness and promote the integration of sustainable cooling solutions into other projects that initially did not incorporate this technology.

It is also evident that more developers and property owners are seeking to develop better buildings which invariably is linked to comfort, energy efficiency, and ultimately ROI. 'Green' buildings may be more expensive at commissioning, but are cheaper to run, typically have longer term and higher value tenants. Energy performance of buildings for which cooling (and heating) is a key component are of increasing interest and there are many successful building energy management control technologies being developed that are amenable to PFAN support.

- **Continue engagement between cooling investors and project developers for knowledge exchange**. Given its cooling knowledge base, a widely expressed belief is that PFAN can continue to build awareness and momentum for sustainable cooling with more idea and experience sharing through investor sessions and capacity building workshops. Sharing successful business cases and showcasing new technology solutions were considered useful to address knowledge gaps, build awareness, confirm successful approaches, and encourage developer and investor connections within the cooling sector. The Cooling Investment Forum convened by PFAN was considered valuable and more periodic forums where cooling focused companies could present to potential investors were recommended. A more permanent platform could be considered for information dissemination and projects idea sharing, demonstration of projects, investor outreach, and news of investments made in contemporary cooling projects; this is something that may be developed in conjunction with other global cooling initiatives such as the Cool Coalition, or other investor knowledge management platforms.

- **Enable the PFAN Network to undertake advocacy for policy change**. Extending the above idea through its network, PFAN can also continue to provide awareness raising on the cooling imperative among its members that can enable effective advocacy to developing country governments. Advocacy for stronger government policy in cooling is considered a key factor to accelerated investment, particularly in relation to off-grid and rural area cooling projects, in increasing the uptake of sustainable cooling technologies and fostering private sector investment. Energy efficiency and conservation policies and regulations of governments need to be accompanied by a suite of practical support targeting various stakeholders like ESCOs, project hosts, and even financing sources for better appreciation of their roles in supporting national aspirations. Greater research and development is required to bring more effective

micro-scale cooling solutions to market in developing countries. Grant funding may play a vital role in such research and development, along with technical assistance for technology selection, piloting, and commercialization of the technology solutions.

Some recommended policy options (IEA, 2018) that can make cooling part of climate and sustainable development solutions include:

- International cooperation through universal ratification and implementation of the Kigali Amendment, and initiatives such as the Cool Coalition and the Biarritz Pledge for Fast Action on Efficient Cooling;

- National Cooling Action Plans that accelerate the transition to climate friendly cooling, and identify opportunities to incorporate efficient cooling into stronger Nationally Determined Contributions under the Paris Agreement;

- Development and implementation of Minimum Energy Performance Standards and energy efficiency labelling to improve equipment efficiency;

- Promotion of building codes and other considerations to reduce demand for refrigerant and mechanical cooling, including integration of district and community cooling into urban planning, improved building design, green roofs, and tree shading;

- Campaigns to stop environmentally harmful product dumping to transform markets and avoid the burden of obsolete and inefficient cooling technologies;

- Support for sustainable cold-chains to both reduce food loss – a major contributor to GHG emissions – and reduce emissions from cold chains.

- **Bundle and aggregate projects**. PFAN can look further into models for bundling cooling projects. For an ESCO to develop a bundle of projects to their investment-ready state, this requires project development capital which may not be within their financial capacity. Smaller cooling proponents and ESCOs cannot typically attract financing for projects and are an important subsector for PFAN support. One way to overcome some of the ESCO sector limitations is through a 'Super-ESCO' approach, whereby a larger company can assume the responsibility of achieving financial savings, and in which financiers can place more confidence. The 'Super-ESCO' can then sub-contract smaller ESCOs to undertake the installations and make smaller payments, thereby unlocking larger projects. An added advantage of this approach is that the larger organization can look towards aggregation of demand for industrial energy efficiency.

A prime example of this approach is India's Energy Efficiency Services Limited (EESL), which has deployed this approach with widespread impact in India. EESL's approach is predicated on bulk procurement of energy efficient equipment for technologies that are relatively low-cost, homogenous, and easily aggregated such as LED lamps, fans and some kinds of pumps and electric motors. The idea is to drive down market prices for efficient equipment through larger volume purchasing, which in turn helps to transform the market. EESL has been extremely successful with this approach in India and has also grown to become a full service provider, helping to design and install energy efficiency projects and operate as a service provider for many project types in India. Part of this success is predicated on EESL's status as a government entity with an ability to enforce repayments; it has proven difficult for the private sector to deploy models of demand aggregation, bulk procurement, and repayment from project revenues in other markets.

As noted, aggregation approaches are more amenable for low cost and homogenous technologies. This model may be able to be extended to bulk purchase of some types of cooling equipment. PFAN could assist project developers with efforts to create aggregation business models, learning from international lessons as above in an effort to facilitate both larger projects and increased access to financing. ESCO business models are becoming more familiar to financial institutions in developing markets, whereas previously they had little knowledge or grasp of such delivery models, and PFAN is well placed to act as a catalyst to this greater understanding.

- **Focus on private sector investors.** PFAN can also expand efforts to ensure there are more investors focused on cooling in their mix and maintain a database of investors interested in this space. On the one hand, PFAN is well-positioned to map investor preferences. By identifing those investors with a strong interest in cooling technologies, PFAN can more easily matchmake projects with relevant investors. On the other hand, PFAN can demonstrate that there are commercially successful business models and projects in the cooling sector, yielding good returns on investment. By doing so, PFAN can trigger an increased interest in cooling projects among investors.

Conclusion

There is a growing awareness of the importance of cooling and visibly enhanced interest in developing cooling projects among entrepreneurs. To drive these innovations from research to development, more investors need to buy into the growing trend. This will require funding, thus, PFAN will play a critical role in providing financial and business support to budding entrepreneurs while channeling the interest of investors towards those projects that ensure climate adaptation and a smooth transition towards clean energy.

Going forward, the lessons learned from the partnership with K-CEP will be instrumental for PFAN in scaling up its operations and increasing the impact of its services in support of the deployment of efficient and sustainable cooling solutions across the developing world.

Case Studies

This section provides an overview of five selected projects that have been supported by PFAN between 2019-2021. At the time of writing, these projects had either raised financing for their projects or were very close to reaching financial closure.

Left: ACI Agrolink shrimp processing plant, Satkhira, Bangladesh.

ACI Agrolink

With the export potential of the world shrimp market in Bangladesh amounting to USD 3 billion of the total annual USD 32 billion global trade, sustainability of the shrimp market in Bangladesh is heavily linked to the livelihood of millions. Low farm productivity, together with the lack of market integration and various compliance requirement are undermining the sustainability of this important sector for Bangladesh.

In the southern region of Bangladesh, farmers often cannot produce crops due to the high levels of salinity. Moreover, many of these farmers depend on Sundarbans for their livelihood, as making money from shrimp cultivation is simply no longer possble for them. Damage to the natural habitat and the mangrove forest occurs as a result.

ACI Agrolink Limited has contributed towards improving the livelihood of farmers and has established an export-oriented shrimp and fish processing business with a state-of-theart processing factory. With this venture, the PFAN-supported project will increase the farm productivity of shrimp and ensure good price with climate resilient sustainable shrimp production, as well

Left: State-of-the art efficient freezing and cold storage methods.

as allowing the people at the bottom of the pyramid to return to land to produce shrimp.

ACI Agrolink will provide training, raw material and other knowledge and input to the climate vulnerable farmers of the coastal community to transform their conventional culture to climate smart aquaculture and also by employing sustainable, efficient cold supply chain and quick-frozen technology they will provide farm-to-fork freshness quality products. The business model includes contract farming and managing a sustainable and efficient cold supply chain to bring the shrimp from farms to a low energy intensive processing unit with minimum handling and shortest possible time to keep the freshness and quality intact. From the processing plant the product is shipped out directly to international buyers.

Since starting with the PFAN journey in 2020, ACI Agrolink continues to receive PFAN support, with PFAN's Tipping Point Technical Assistance as the most recent support from PFAN. Nonetheless, the processing plant already in operation, with the total export volume in 2019-2020 amounted to a total of USD 8.5 m. Alongside the tremendous impact the project has made to the shrimp export sector, the project also greatly contributes to reduce GHG emissions by 4,353 ton of CO_2 per year and aims to empower women through training at least 50% of women shrimp farmers and 90% of women to be employed in the factory.

ACI Agrolink

Inficold

With India as the world's largest milk producer, milk constitutes almost 4% of India's GDP and requires cold chain to prevent spoilage. However, current chilling hardware operates at a slow rate, is inefficient, and requires diesel generators for power backup. Due to a lack of effective and efficient cold chain facilities, rural and semi-rural areas of India are facing a major problem. With dairy, fruit, vegetable, and horticultural farmers not being able to store or take fresh produce to the local collection centre or market to get a better price realisation, supplying fresh and better quality products is difficult and this causes significant wastage.

To mitigate the lack of chilling and cold storage facilities, Inficold, with its suite of products which can work with on-grid, off-grid, and solar, uses a patented process of thermal energy storage and round the clock chilling to keep milk, fruits horticulture and vegetables chilled at the right temperature. This product can enable farmers to sell fresher produce, get better price realization and significantly reduce wastage and spoiling of milk, fruits and vegetables. Moreover, Inficold provides sustainable energy solutions to rural, semi-rural and semi-urban Indian farmers and milk, fruit, vegetable and horticulture sellers. The same technology can also be used in cold chain logistics for last mile transport of medicines that need to be stored at cooler temperatures.

Inficold has developed cold chain products for milk cooling and fruits/vegetable modular solar cold storage that can make the dairy operations more efficient, improve milk quality as well as effectively solve the fruits and vegetable wastage problem in India. Its products are installed in over 15 Indian states and many of the leading dairies.

Through the PFAN journey, support in terms of when, how and what kind of investors should be approached was offered to Inficold. Moreover, Inficold participated in the PFAN Cooling Investment Forum where Inficold had the opportunity to pitch its business case to investors. PFAN has also assisted in preparing a feasible business plan, and acted as a sounding board for new product and business ideas. With support from PFAN and through development within the PFAN journey, Inficold has raised around USD 900 000, with the last USD 402,000 raised in January 2021 from Rajasthan Venture Capital Fund by way of convertible equity.

Right: Inficold solar cold storage for agricultural produce by Sanatanpali Farmer Producer Company in India.

Left: Avocado from farmers in Kivute, Embu County to be stored in Sokofresh cold storage.

SokoFresh

Kenya alone represents 5 million potential customers of the large market in sub-Saharan Africa for off-grid solar cold storage solutions, with smallholder farmers and cooperatives mainly in off-grid areas as the target population for this market. Nonetheless, cold storage in Kenya has a very low adoption rate, especially for a country which is heavily dependent on agriculture. Almost half of the horticulture produce in Kenya fails to make it to market, of which 56% of these failures is caused by post-harvest and storing issues. Although food production in Kenya is highly distributed, with approximately 5 million smallholder farmers responsible for 90% of Kenya's food production, these farmers do not have enough income to invest in professional equipment.

SokoFresh, with over 50 years of experience and expertise in agribusiness, energy access, IT, logistics, operations and sales, aims to mitigate such challenges for Kenyan farmers through offering affordable cold storage services to Kenyan farmers and agribusinesses and integrating it with market linkage services. In fact, SokoFresh is one of the only companies in the market to offer first-mile off-grid pay-as-you-go cold storage with market linkage. With SokoFresh, more than 800 farmers have been onboarded and 3 cold storage systems have been deployed. The cold storage solutions are brought as close to the point of production as possible, to make it accessible and affordable, since most smallholder farmers are poor. Agribusinesses, communities and smallholders are able to rent cold storage facilities from two different models: a flat monthly rental fee per cold storage (USD 8,800 total revenue per cold storage per year), and a rental fee per kg stored per day (USD 15,000 per cold storage per year).

SokoFresh is currently operational with 3 cold storage solutions deployed. The company has over 10 off taker relationships established, and 4 strategic partnerships signed. Current clients include wholesale market vendors, exporters, supermarket chains and social enterprises. SokoFresh operates in the regions of Murang'a County, Embu County, Kajiado County, Makueni County and Kitui County in the mango, avocado and French beans value chains.

PFAN supported project of SokoFresh is expected to link 100 cold storages, thereby helping 30,000 farmers, 50% of which are women, have access to cold storage solutions. SokoFresh not only aims to provide women farmers with access to cold storage solutions, but also increases women's incomes through improved accessibility and affordability of cold storage enhancing food preservation, access to markets and produce quality. SokoFresh had the opportunity to present its project at the PFAN Cooling Investment Forum, and has been successful in securing grant funding to further develop its business model, while discussions with investors regarding long-term commercial finance are ongoing at the time of writing.

SokoFresh

ENdep

Although Africa contains over 50% arable land, African crops yield five times less than the global average. Since food loss usually occurs at the early stages of the food value chain due to inadequate storage and cooling facilities and electricity supply, this presents a strong business opportunity to strengthen the food cold chain in the region.

ENdep Limited, a Tanzanian turnkey ESCO, provides customized end-to-end solutions aimed at mitigating energy costs and increasing efficiency. Cooling is offered as a service to smallholders, suppliers and aggregators to preserve food quality and reduce post-harvest loss at an affordable price. Moreover, ENdep offers affordable rental of solar cold rooms, particularly targeting women and youth fish traders.

Besides the positive impacts on businesses, ENdep also contributes to environmental and social impacts. Through the deployment of solar cold rooms, the company helps mitigate GHG, reduce carbon footprint, and create employment especially for women and youth fish traders. Women and youth are empowered through entrepreneurship, by facilitating rental of solar cold rooms at a very lower and competitive cost to allow them to have time to search for more lucrative markets. ENdep employs more than 60% of women, with 150 fish traders belonging to women and 240 fish traders to youth.

With the support of the PFAN journey since December 2020, ENdep limited was able to raise a grant from the Nordic Development Fund/Energy and Environment Partnership Fund (EEP), worth close to USD 400,000. Additional financing targets are also set for ENdep, with ongoing discussions at the time of writing with several individual investors that have expressed interest.

ENdep
renewable | efficient | clean

PT Sumber Mina Investama

With processed shrimp products having longer shelf life up of to one year, being more hygienic and free from dangerous diseases and pests, PT. Sumber Mina Investama, a fishery product processing company, focuses on shrimp commodities and operations with cold storage and Individual Quick Freezing (IQF) to maintain a cold chain system. The company operates shrimp processing plants in South Sulawesi and In East Java, and has formed a business partnership with exporter CV Kudatama Mas to help meet the high market demand for processed shrimp. The company currently has three client requests, all of which come from the United States, with the total of these requests reaching ca. USD 20 million.

The emergence of the processing shrimp plant will create new jobs for the local population through approximately 100 to 800 workers, and the company aims to exercise a strong gender focus by creating new jobs for women. PT. Sumber Mina Investama also commits to using renewable energy sources from on-grid, grid-tie solar power systems for better operational cost-efficiency, which in turn enables other related businesses to grow, reduce GHG emissions through adopting renewables as energy sources and increase market access to fishery products.

Since becoming part of the PFAN journey in February 2021 and receiving expert coaching from PFAN advisors, PT Sumber Mina Investama was successfully able to reach debt investment of USD 1,370,000.00 from PT. Jaring Aruna Dagang, a private company in Indonesia.

Left: A woman fish trader at Lake Victoria in Tanzania.

Right: PT. Sumber Mina Investama shrimp processing plant.

REFERENCES

Basel Energy for Sustainable Energy (2020). What is Servitisation and How Can It Help Save the Planet https://energy-base.org/news/what-is-servitisation-and-how-can-it-help-save-the-planet/

Carbon Brief (2020). Dr Radhika Khosla. Guest Post: Demand for Cooling Is Blind Spot for Climate and Sustainable Development. https://www.carbonbrief.org/guest-post-demand-for-cooling-is-blind-sport-for-climate-and-sustainable-development

IEA (2018). Air Conditioning Use Emerges as One of the Key Drivers of Global Electricity-Demand Growth. https://www.iea.org/news/air-conditioning-use-emerges-as-one-of-the-key-drivers-of-global-electricity-demand-growth

IEA (2018). The Future of Cooling; Opportunities for energy-efficient air conditioning https://www.iea.org/reports/the-future-of-cooling

IEA (2019). Cooling on the Move; The Future of Air Conditioning in Vehicles. https://www.iea.org/reports/cooling-on-the-move

IEA (2020). Climate-friendly Cooling Could Cut Years of Greenhouse Gas Emissions and Save Trillions of Dollars https://www.iea.org/news/climate-friendly-cooling-could-cut-years-of-greenhouse-gas-emissions-and-save-trillions-of-dollars

Kigali Cooling Efficiency Program (K-CEP) (2021), Scaling up clean cooling for all: the Kigali Cooling Efficiency Program impact report (2017-2021), https://www.cleancoolingcollaborative.org/wp-content/uploads/2021/08/K-CEP-Phase-I-Impact-Report.pdf

Montreal Protocol Fact sheet (2018) https://www.environment.gov.au/protection/ozone/publications/montreal-protocol-factsheet

National Cooling Action Plans (NCAPs) HCFC Phase-out and HFC Phase-down, Climate Action Under the Paris Agreement and Progress on the SDGs (UNEP OzonAction ECA Meeting, 12 May, 2021). https://www.ozonactionmeetings.org/system/files/210512_national_cooling_action_plans_and_hcfc_hfc_strategies_marco_duran.pdf

PFAN Charter (2019). http://pfan.net/wp-content/uploads/2021/01/PFAN-Charter-Annexes-2-4.pdf

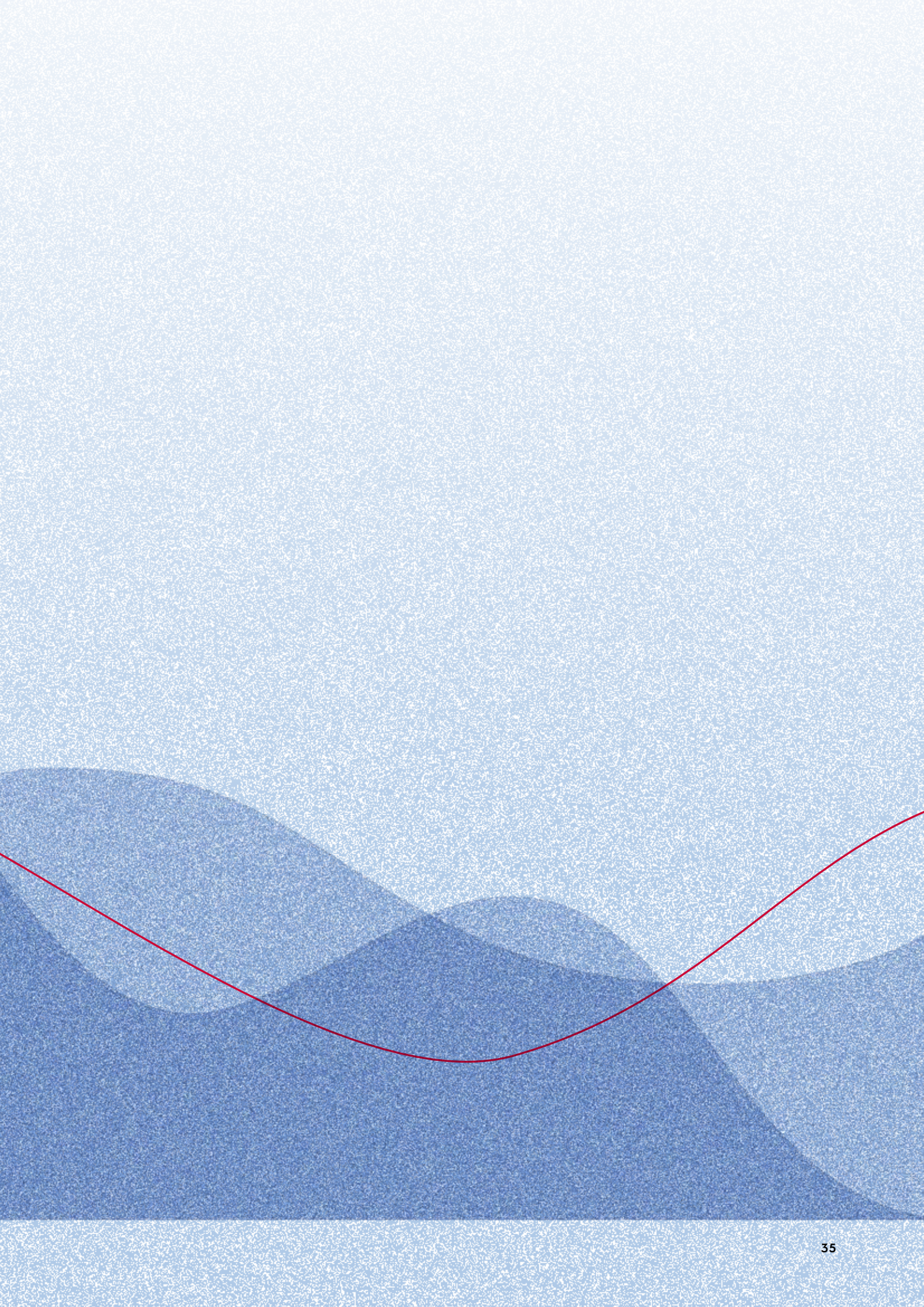
Statista (2020). China and India Drive Global Demand for Air Conditioning https://www.statista.com/chart/22703/air-conditioning-by-region-country/

Sustainable Energy for All (2018), Chilling Prospects: Providing Sustainable Cooling for All. https://www.seforall.org/system/files/gather-content/SEforALL_CoolingForAll-Report.pdf

The Economist Intelligence Unit, Perspectives Series (2020). The Power of Efficient Cooling. https://eiuperspectives.economist.com/sites/default/files/eiu154_-_power_of_cooling_-_dv6.pdf

United Nations Environment Programme and International Energy Agency (2020). Cooling Emissions and Policy Synthesis Report; Benefits of cooling efficiency and the Kigali Amendment. UNEP, Nairobi and IEA, Paris. https://wedocs.unep.org/bitstream/handle/20.500.11822/33094/CoolRep.pdf?sequence=1&isAllowed=y

United Nations Framework Convention on Climate Change (2020). The pathway to net-zero cooling. https://racetozero.unfccc.int/cooling-pathway/



REEEP

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Hosting arrangement

PFAN is hosted by the United Nations Industrial Development Organization (UNIDO) in collaboration with the Renewable Energy and Energy Efficiency Partnership (REEEP).

www.pfan.net
info@pfan.net