



KNOWLEDGE BRIEF

China's Global Cool

The potential for more and better south-south cooperation on efficient, clean cooling from China

ENHANCING CHINA'S SOUTH-SOUTH COOPERATION ON EFFICIENT, CLEAN COOLING

A backgrounder and exploration of the potential for more
and improved South-South Cooperation between China
and developing countries

July 2018

ABOUT K-CEP

The Kigali Cooling Efficiency Program (K-CEP) is a philanthropic collaboration launched in 2017 to support the Kigali Amendment of the Montreal Protocol by focusing on the transition to energy efficient, climate-friendly, affordable cooling solutions for all. K-CEP's secretariat, the Efficiency Cooling Office, is located at the ClimateWorks Foundation.

For more details please visit www.k-cep.org, follow us at @Kigali_Cooling, or contact us at info@k-cep.org.

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EXECUTIVE SUMMARY

Are you interested in the interaction between international development and environment? Are you interested in China's global role in supporting developing countries and the Belt and Road Initiative?

If so, this knowledge brief is for you.

Refrigeration and air-conditioning (henceforth, cooling) is important to economic growth and development. Demand for cooling in developing countries is forecast to grow rapidly. At the same time, cooling appliances have damaged the environment in the past, and threaten to continue to do so. Technological change towards efficient, clean cooling is needed, and demand across the world needs to shift away from projected high use of damaging technologies, towards minimal use of efficient, clean cooling technologies.

The good news is that the efficient, clean cooling technologies are available, and that several global UN agreements have been made that confirm that the majority of governments around the world are willing to do all they can to enable the shift towards efficient, clean cooling as they develop further. In particular, 30 countries so far have ratified the "Kigali Amendment" of the Montreal Protocol, which focuses on stimulating efficient, clean cooling, meaning that all 197 countries that are Parties to the Montreal Protocol and agreed on the Amendment in October 2016, including China, will be bound by this international legal agreement from the beginning of 2019 onwards.

China is important to achieving efficient, clean cooling around the world for two reasons. First, because it is the world's largest manufacturer and user of cooling technology around the world, so how Chinese people act and how they adopt the efficient, clean technologies matters. Second, because China is the world's largest exporter of cooling technology around the world, with many overseas manufacturing bases, so how other countries' demand and apply standards for importing and manufacturing Chinese cooling technologies is very important.

In this report, we explain how Chinese private businesses and governmental organizations have been taking up the opportunity to support efficient, clean cooling in developing countries and therefore "green growth" and the achievement of at least half of the 17 UN Sustainable Development Goals so far. We also explain how they have a further opportunity to enhance this support, through new models of "South-South cooperation" as well as stronger alignment to the Belt and Road Initiative (BRI), first announced in October 2013.

We finish by sharing ideas for how other individuals, international organizations, and aid agencies beyond China, can also support this kind of work, and thereby support green growth and poverty reduction around the world.

1. INTRODUCTION – WHY READ THIS BRIEF?

This knowledge brief is written for anyone interested in how China can play a critical role in making refrigeration and air-conditioning more energy-efficient and environmentally friendly (henceforth, “efficient, clean cooling”) around the world through cooperation with other developing countries.

Given that achieving all of the 17 United Nations Sustainable Development Goals (SDGs) will to a greater or lesser extent depend on putting into place efficient, clean cooling solution (University of Birmingham 2017), this knowledge brief should be of interest to anyone working on development or environmental issues as well as businesses in China and beyond that are looking to have a more positive global footprint.

But why might such action by Chinese stakeholders matter?

For three reasons:

First, these appliances are important for development and poverty reduction.

Second, these appliances often damage the environment, although in future this does not have to be the case, due to technological innovation.

Third, as the world’s largest manufacturer and exporter of cooling appliances, actions by certain Chinese stakeholders at home and abroad have a major developmental and environmental impact on the rest of the world.

2. WHY IS EFFICIENT, CLEAN COOLING IMPORTANT?

2.1. Are cooling and development linked?

Cooling appliances are very important for development, in a wide range of ways.

A recent study based on cross-country data from 1960 onwards, showed that overall economic productivity “peaks” at an annual average temperature of 13 degrees Celsius, and declines strongly at higher temperatures, for both agricultural and non-agricultural activity, and in both rich and poor countries (Burke et al, 2015). While the causation is unclear, this and other studies suggest that lack of cooling can therefore be worse for countries the poorer their starting point. It also implies that with unchecked climate change, global economic growth could be stunted, simply because of higher temperatures in certain countries and regions.

For instance, cooling is essential to helping people be more productive, whether in factories, offices, or even in hospitals and classrooms. It’s hard for anyone to get work done in sweltering heat. For instance, a study in Denmark showed that using air-conditioning to reduce classroom temperatures to 20 degrees Celsius from 25 degrees Celsius resulted in significant improvements

in pupils' performance in arithmetic and language-based tests. Cooling is therefore crucial to economic growth and educational outcomes.

Cooling is also crucial to health and environmental outcomes. For instance, with regard to our food and medicine at home – without fridges it is hard to keep food or certain medicines safe for long, and therefore avoid waste.

And cooling is often needed for specific technologies we need and use every day – transport needs cooling to work (e.g. cars, etc), certain technologies in the healthcare field and other industries need cooling to work properly, and even small computers need some degree of cooling, which in turn uses energy such as electricity.

Cooling is therefore an important, even if often invisible, element of eliminating extreme poverty and boosting shared prosperity across the globe.

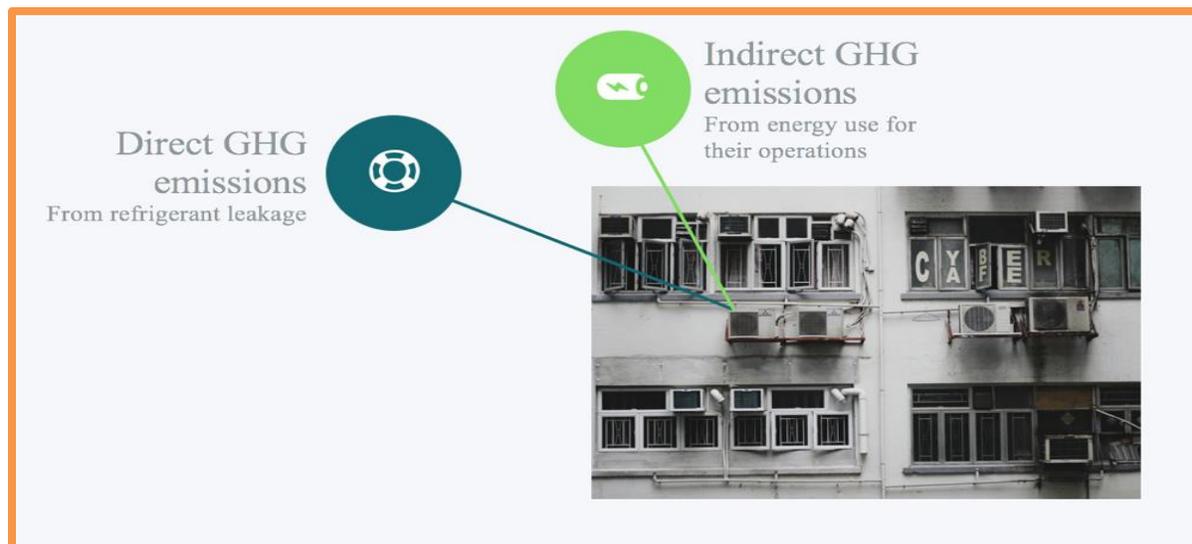
2.2. What's the problem with cooling?

Cooling appliances can damage the environment both through the refrigerants and energy they use.

During the life-cycle of cooling appliances, refrigerants – mostly Chlorofluorocarbons (CFCs), Hydrochlorofluorocarbons (HCFCs) and Hydrofluorocarbons (HFCs) – leak into the atmosphere, where they cause the destruction of the ozone layer and contribute to global warming.

Furthermore, when cooling appliances are used, they are powered by electricity or other forms of energy, which are derived from fossil-fuels (e.g. coal, gas) or renewable sources (solar, wind, etc). When the electricity/energy is derived from fossil-fuels, greenhouse gases are emitted. In supermarkets, hotels and cold stores, cooling can be responsible for more than half of the overall energy consumption. For some countries cooling can account for up to 24.5 per cent of the national electricity use (UNIDO 2017).

Figure 1: Direct and indirect Greenhouse Gas (GHG) emissions from cooling



The demand for cooling is rising particularly significantly in developing countries due to growing populations, rapid urbanization and the increasing living standards and frequency and intensity of extreme heatwaves.

However, as most developing countries still rely predominantly on fossil-fuel based energy, if demand rises without introducing energy-efficient cooling solutions or those that rely on renewable energy sources, energy-related GHG emissions will rise accordingly, and fast. The box below provides just one example of a country that is facing rising demand for cooling, while the incentives for searching for more efficient, clean options are changing.

A Country Facing Rising Demand for Cooling: Egypt

Egypt's population grew from 59 million in 1990 to 89 million in 2015 and is expected to reach 116 million by 2040. The current 20 Mt CO₂eq of direct and indirect emissions from cooling account for about 10% of Egypt's total GHG emissions and are set to double by 2040 with the growing demand for cooling appliances. The high emissions are driven by the rapid population growth coupled with rising temperature and humidity, large-scale urban development projects, a lack of awareness and most notably highly subsidized prices for electricity.

However, electricity subsidies are now being phased out until 2019, which offers a window of opportunity for energy-efficient appliances to enter the market. The cost of electricity already nearly tripled over the last years due to the reduction of government subsidies. Although there is still little to no energy-efficient cooling equipment options available on the Egyptian market, the increasing electricity costs are set to give a strong incentive for people to invest in less wasteful units that lead to significant cost-savings over their life cycle. The total emission reduction potential within the country's cooling sector by 2050 is estimated at 16 Mt CO₂eq, which is among the highest in Africa and the Middle East.

In most poor countries, however, the incentives to search for efficient, clean cooling options are currently low. Markets for efficient, clean products are limited as such products are significantly more expensive, while electricity prices are often subsidized to ensure cheap access for growing populations.

Additionally, due to a lack of public awareness about the alternatives to HCFC-based cooling systems, consumers and sales staff often do not always understand the benefits of non-HCFC models and prioritize the HCFC systems which cost substantially less. For instance, in Egypt, the price of an HCFC gas known as R22 is approx. US\$ 4-6/kilo, versus a very expensive US\$ 60-70LE/kilo for new non-HCFC refrigerants. There is thus little incentive for manufacturers to offer the latter as standard, unless forced to by regulations or consumers.

Furthermore, while there are some companies in developing countries that offer, for example, solar air conditioning solutions, a lack of public awareness about the benefits of these and other non-HCFC models makes it hard to compete on the market.

But there are examples where the market is more complex. Take Sudan, for example, where, similarly to other countries, an eco-friendly solar deep freezer costs 7000 SDG (US\$385 equivalent) – double the price of an electrically powered freezer costs 3500 SDG (US\$194). However, due to frequent power cuts, especially in summertime, a market for significantly more

power efficient “compressed carton models” has developed – which, for example, cost around 6500-8800 SDG (US\$360-487), versus around 21000 SDG (US\$1163) for split unit air conditioners. Markets for solar AC are similarly developing in the country. The picture below shows an advert by a local Sudanese company offering solar-based AC solutions.



Picture 1: Sor Dan in Sudan offers solar cooling solutions

Other countries are looking at even more technologically advanced, large scale solutions.

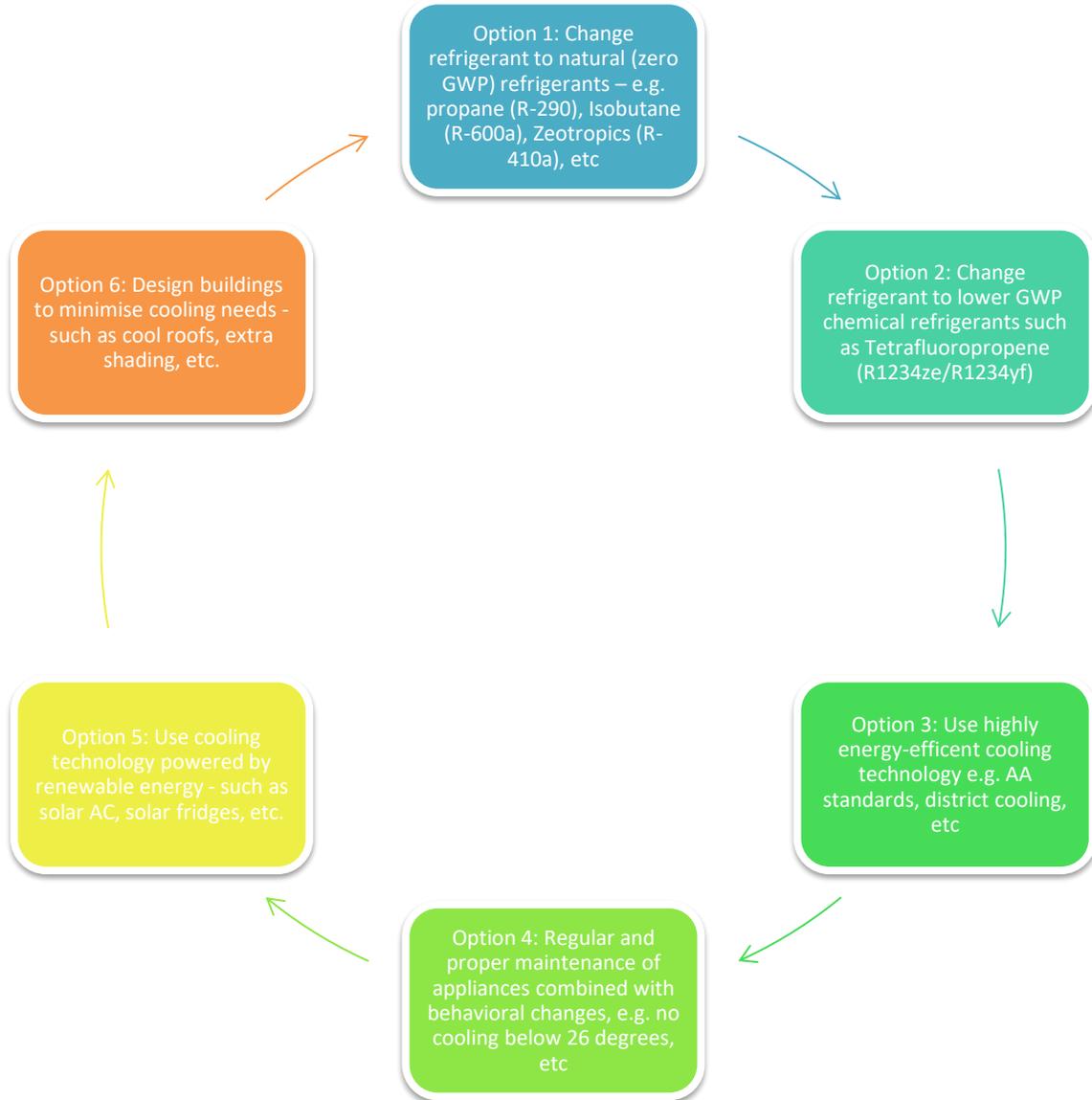
For instance, In the Maldives, the Japanese company Hitachi is exploring the possibility of deep sea water cooling systems, as the country meets the key criteria of having a high demand for cold energy while also having access to deep oceans from which cold water can be raised from >1,000m below the surface where the water temperature is 5°C. This could allow for the development of highly efficient cooling systems which yield an 80% reduction in greenhouse gases.

Therefore, it is not enough to simply assume developing countries face the same challenges. Each country is different, based on different climatic conditions, different energy profiles and costs, different environments for private sector innovation and development, and much more. Annex 1 provides more detailed case studies for five countries in varying situations, to illustrate exactly this point.

2.3. What does efficient, clean cooling look like?

There are many, and increasing means for individuals, companies and organizations to achieve efficient, clean cooling. The diagram below provides a very simple illustration of the various options and technologies currently available, most of which can and should ideally be pursued simultaneously.

Figure 2: A Simple Guide to Six Options for Achieving Efficient, Clean Cooling



But are these efficient, clean cooling solutions important, especially to development and poverty reduction?

2.4. Can efficient, clean cooling help meet the UN Sustainable Development Goals?

Achieving efficient, clean cooling – and therefore any international support for efficient, clean cooling – is directly linked to the achievement of both the UN Sustainable Development Goals (SDGs) and the Paris Agreement on climate change.

Our assessment is therefore that international support for efficient, clean cooling could contribute to the achievement of at least 9 of the 17 SDGs. The table below sets out our assessment of these mechanisms, with what we assess to be the greatest, most direct potential impact first:

Figure 3: How can international support for efficient, clean cooling contribute to the SDGs?

SDG Goal	How does efficient, clean cooling potentially contribute?
<p>7 AFFORDABLE AND CLEAN ENERGY</p> 	<ul style="list-style-type: none"> • Can help ensure universal access to affordable, reliable and modern energy services • Will help in doubling the global rate of improvement in energy efficiency • Can directly contribute to increasing the share of renewable energy in the global energy mix • Standards development and other capacity building on efficient, clean cooling can enhance international cooperation to facilitate access to clean energy research and technology
<p>8 DECENT WORK AND ECONOMIC GROWTH</p> 	<ul style="list-style-type: none"> • Directly contributes to enhancing economic productivity, including use in schools, hospitals, manufacturing, etc • Manufacture of efficient, clean cooling can support efforts for diversification, technological upgrading and innovation, including through a focus on high-value added sectors • Directly improves global resource efficiency in consumption and production and helps to decouple economic growth from environmental degradation • Can be used as a means to promote sustainable tourism (e.g. hotels, etc)
<p>11 SUSTAINABLE CITIES AND COMMUNITIES</p> 	<ul style="list-style-type: none"> • Can be used in the building of adequate, safe and affordable housing and basic services and upgraded slums, the provision of safe, affordable, accessible and sustainable transport systems and when safeguarding the world's cultural and natural heritage • Can be used when dealing with natural disasters, especially when protecting the poor and people in vulnerable situations • Can help to cut the adverse per capita environmental impact of cities, including by being used when paying special attention to air quality and municipal and other waste management • Can be used as part of national and regional development planning • Can be used by cities and human settlements aiming for/implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters • <i>Should be</i> used when supporting least developed countries, including through financial and technical assistance, to build sustainable and resilient buildings utilizing local materials

<p>12 RESPONSIBLE CONSUMPTION AND PRODUCTION</p> 	<ul style="list-style-type: none"> • Can contribute to sustainable management and efficient use of natural resources (esp. GHG emissions, energy, etc) • <i>Should be</i> encouraged as part of/through public procurement practices that are sustainable, in accordance with national policies and priorities • Standards development and other capacity building on efficient, clean cooling can strengthen countries' scientific and technological capacity to move towards more sustainable patterns of consumption and production
<p>9 INDUSTRY, INNOVATION AND INFRASTRUCTURE</p> 	<ul style="list-style-type: none"> • New manufacture of efficient, clean cooling can promote inclusive and sustainable industrialization, including in least developed countries • Use (in factories, etc) of efficient clean cooling can help to upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes
<p>13 CLIMATE ACTION</p> 	<ul style="list-style-type: none"> • Can strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries • Can be used when promoting effective climate change-related planning and management in least developed countries and small island developing States, including with women, youth and local and marginalized communities
<p>4 QUALITY EDUCATION</p> 	<ul style="list-style-type: none"> • Can be used when building/running education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all • By increasing productivity in schools and homes, efficient, clean cooling can contribute to ensuring that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy
<p>3 GOOD HEALTH AND WELL-BEING</p> 	<ul style="list-style-type: none"> • Can be used when building/running medical facilities to reduce premature mortality from non-communicable diseases • Can be used when building/running medical facilities to achieve universal health coverage, including access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all
<p>17 PARTNERSHIPS FOR THE GOALS</p> 	<ul style="list-style-type: none"> • Support for efficient, clean cooling is part of promoting the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favorable terms • Standards development and other capacity building for efficient, clean cooling is part of implementing effective and targeted capacity-building in developing countries to support national plans to implement all the sustainable development goals, including through North-South, South-South and triangular cooperation • Support for efficient, clean cooling can encourage and promote effective public, public-private and civil society partnerships

2.5. How are global agreements on cooling progressing?

When UN Member States realized the link between the use of CFCs and HCFCs as refrigerants and the rapid depletion of the ozone layer, they made an agreement to stop producing and using these ozone-depleting substances (ODS). This agreement, the Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol), became the first environmental agreement that every nation in the UN agreed on. Today it is celebrated as the most successful intergovernmental environmental agreement as it has reached its objective of ensuring that the ozone layer stays intact.

CFCs and HCFCs were replaced by HFCs in developed countries and HCFCs are still in the process of being replaced in developing countries. However, while HFCs do not harm the ozone layer, they are very potent greenhouse gases (GHGs) with a global warming potential (GWP) that is up to thousands of times higher than that of carbon dioxide. It has been estimated that phasing down HFCs could avoid up to 0.5 °C increase in global temperature by the end of the century.¹

More recently, in 2015, the global commitment agreed to urgently act on climate change with the adoption of the Paris Agreement under the United Nations Framework Convention on Climate Change. As a result, in 2016 197 countries agreed to amend the Montreal Protocol to phase down HFCs by replacing them with refrigerants with a low GWP. This agreement was reached in Rwanda and is known as the Kigali Amendment. Furthermore, at a 2017 Meeting of the Parties to the Montreal Protocol, countries agreed to identify ways to improve energy efficiency while meeting the Kigali Amendment.²

By the end of March 2018, 30 countries from all corners of the world, at all levels of development, had ratified the Kigali Amendment³, as shown in Figure 4.

Figure 4: The First 30 Countries that ratified the Kigali Amendment

¹ http://www.igsd.org/documents/HFCPrimerJune2014_010.pdf.

² UNEP/OzL.Pro.29/CRP.13.

³ https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-2-f&chapter=27&clang=_en.

30 INITIAL RATIFIERS OF THE KIGALI AMENDMENT



The ratification by these 30 countries is sufficient for the Amendment to enter into force on the earliest possible date, the 1st January 2019. This in turn means that all 197 countries that agreed to the Kigali Amendment in 2016, including China, will be legally bound by it from January 2019 onwards.

In addition, many governments are already thinking and planning how they will replace HFCs. Under the Kigali Amendment, China, all African countries and most Asian countries committed to freeze the use of HFCs by 2024 followed by a phase-down until 2045.⁴

2.6. Is South–South Cooperation relevant to efficient, clean cooling?

The United Nations Office for South–South Cooperation defines South-South cooperation as a “broad framework of collaboration among countries of the South in the political, economic, social, cultural, environmental and technical domains. Involving two or more developing countries, it can take place on a bilateral, regional, intraregional or interregional basis. Developing countries share knowledge, skills, expertise and resources to meet their development goals through concerted efforts”⁵.

Given that the support provided by developed countries to developing countries to implement the Kigali Amendment and to achieve the SDGs is insufficient, South-South cooperation offers an important complementary avenue for countries from the Global South to achieve their objectives. So far, the central role that efficient, clean cooling plays for development has often been overlooked in South-South cooperation. As explained above, efficient, clean cooling is key for the

⁴ <https://treaties.un.org/doc/Publication/CN/2016/CN.872.2016-Eng.pdf>.

⁵ <https://www.unsouthsouth.org/about/about-sstc>.

achievement of the SDGs and a lack of action in this area will undermine progress on the SDGs made through work in other areas.

However, with developing countries being the major producers and consumers of cooling appliances and some of them, such as China, leading in policy and technology innovations for ensuring an enabling environment and technological solutions for efficient, clean cooling, there is a huge potential for South-South cooperation in this area.

3. CHINA'S INFLUENCE ON EFFICIENT, CLEAN COOLING WORLDWIDE

3.1. Why is China important for cooling globally?

China is the world's largest manufacturer, exporter and user of cooling appliances. The largest markets for Chinese products overseas are developing countries, as shown in Figure 5. China is therefore a key player in the successful implementation of the Kigali Amendment, especially for developing countries.

Figure 5: Top 10 AC and Refrigerator importers from China in 2016

Top 10 AC importers from China in 2016		Top 10 Refrigerator importers from China in 2016	
Ranking	Country	Ranking	Country
1	India	1	India
2	Brazil	2	Indonesia
3	South Korea	3	South Korea
4	Thailand	4	Saudi Arabia
5	South Africa	5	Algeria
6	Afghanistan	6	Thailand
7	Vietnam	7	Malaysia
8	Egypt	8	Philippines
9	Iran (Islamic Republic of)	9	Mexico
10	Iraq	10	Iraq

Indeed, for most developing countries China is the main exporter of cooling appliances. In the majority of the cases studied, most notably Afghanistan, Myanmar, and Sudan, China was in the top three exporters of RAC products. Due to the market demands for affordability of RAC products in these countries, it was not perceived by those in the industry that importing firms had much incentive to push non-HCFC units heavily, and in some cases were unaware of the banning of HCFC imports. However, China was active in several countries, including Afghanistan, the Maldives, and Myanmar, in offering training to technicians in areas such as environmentally friendly alternatives and good practices involving flammable units. Some important Chinese manufacturers of RAC products include Galanz, Haier, TCL, Midea, Gree, Chig, and recently Skyworth.

Due to increasing production costs in China and the growing cooling appliance markets in many developing countries, Chinese producers have started to establish production facilities abroad in line with China's "Belt and Road Initiative"⁶. China's growing attention to overseas markets can bring benefits to developing countries in terms of job creation and reduced prices of locally produced cooling appliances compared to imports.

China is also among the largest spenders on research and development in this area and therefore holds a huge potential for contributing to the creation of new solutions that meet Kigali Amendment requirements while satisfying developing countries' market needs. Some of China's largest

⁶ http://english.gov.cn/archive/publications/2015/03/30/content_281475080249035.htm.

cooling appliances producers are already pioneering energy-efficient products that are above domestic standards and exploring opportunities for phasing down HFCs. A global study on China's South-South cooperation on climate change conducted by UNDP China in 2015 found that energy efficiency ranked fourth, after adaptation, agriculture and disaster risk reduction, in terms of developing countries' priority areas for future cooperation with China on climate action (Weigel 2016).

3.2. What does China's international cooperation look like?

China's international cooperation strategy is currently guided by its Belt and Road Initiative, which was announced in October 2013, initially aimed to increase interconnectivity between countries in Asia, Europe and Africa through infrastructure, economic, political and cultural cooperation. It has since been opened up to all countries that express an interest, and therefore now also includes countries in Latin America and the Caribbean as well as the Pacific region. Furthermore, China has established regional "plurilateral" fora together with partner countries to regularly meet and jointly decide on the priorities for international cooperation for the following years. Most prominently, these fora include the Forum on China-Africa Cooperation⁷ - created in 2000, the Shanghai Cooperation Organization, created in 2001, the China-Arab States Cooperation Forum created in 2004⁸, the China-CELAC (Community of Latin American and Caribbean States) Forum⁹ - created in 2016, and others such as the Boao Forum for Asia¹⁰ and the Forum Macao¹¹.

Beyond the overarching strategy, there are some other details available about China's international cooperation. Most recently, in 2014, the Chinese government published a white paper on its foreign aid¹² which suggested it spent an average of US\$4.8bn per year in developing countries from 2012-2014, more than 52% of which¹³ in countries that are classified by the UN as "least developed"¹⁴. The white paper set out examples of different types of grant-based cooperation that China offers to other countries – for example new buildings, training schemes, scholarships, donations of medicines, equipment, and much more. The white paper also included broad details about loan-based cooperation that China offers – in particular to complete large infrastructure projects such as roads, railways, bridges, airports and more.

However, the white paper did not include any information broken down by country.

Furthermore, since publishing the white paper, the Chinese government has made further significant pledges for supporting other developing countries to achieve the SDGs and implement their national contributions to the Paris Agreement. In 2015, the government pledged USD 2 billion for a new South-South Cooperation Aid Fund (SSAF), which has the overall objective of supporting developing countries to achieve the SDGs. The fund has been operational since 2016 and grant applications need to demonstrate clearly how the proposed project supports the achievement of specific SDGs and SDG indicators, ideally within 1 year.

⁷ <http://www.focac.org/eng>.

⁸ http://www.xinhuanet.com/english/2016-05/12/c_135354230.htm

⁹ <http://www.chinacelacforum.org/eng>.

¹⁰ <http://english.boaoforum.org>.

¹¹ <http://www.forumchinapl.org.mo/about-us/mission-and-objectives>.

¹² http://english.gov.cn/archive/white_paper/2014/08/23/content_281474982986592.htm.

¹³ <http://www.cn.undp.org/content/china/en/home/library/south-south-cooperation/fast-facts-on-china-s-south-south-and-global-cooperation-.html>.

¹⁴ <https://www.un.org/development/desa/dpad/least-developed-country-category/lDCs-at-a-glance.html>.

In 2015, the Chinese government also pledged CNY 20 billion (USD 3.1 billion) for the establishment of the South-South Cooperation Climate Fund (SSCCF) to further expand its support for other developing countries in this area. Energy-efficiency was one of the four focus areas of China's previous, smaller climate change South-South cooperation as shown in Figure 6 below.¹⁵ Much of this cooperation took place either as training in China, or as "on-demand" donations. With regard to the latter, different types of equipment and appliances are offered by NDRC to partner countries through regularly changing lists distributed by the Economic and Commercial Counsellor's Office at China's embassies. Requests by partner countries for equipment and appliances that is not included on the current list are considered for inclusion in the next version of the list. Partner countries are given the forms to submit an application and successful applicants then enter into an official agreement with NDRC, which is signed by both sides and contains specifics on type and scope of the equipment and the training for its use and installation (Weigel 2016).

Figure 6: Focus of China's Climate Change South-South Cooperation



The expanded SSCCF has not yet become operational., and it is unclear whether these procedures and the focus areas will remain the same going forwards. There have been suggestions that the types of cooperation offered should expand beyond training and donation, especially in order to disburse larger amounts more effectively (e.g. Weigel 2016).

Finally, China is experimenting with new models of cooperation through the SSAF. Recently based on the success of a few pilots, over 100 international organizations were invited to submit proposals for "Trilateral Cooperation projects" using finance from the SSAF, including UNDP, UNICEF, and UNEP. The proposals must be developed in partnership with domestic Chinese aid delivery organizations (for example NCSC and CICETE, see below). Trilateral cooperation can be understood as collaboration in which an entity from a traditional donor country or multilateral organization facilitates South-South cooperation through the provision of funding, training,

¹⁵ Based on a presentation held by NDRC in 2013 (Weigel 2016).

management and technological systems as well as other forms of support.¹⁶ This form of cooperation complements and brings together the traditional North-South and South-South cooperation models and as such holds a great potential for synergies and the scaling up of South-South cooperation. Typically, there are three main types of trilateral cooperation: 1. The “OECD country or international organization fully funds all project activities, while the “Southern provider” offers expertise and know-how; 2. The “Southern provider” fully funds all project activities, while the other provider offers expertise and know-how; 3. All partners makes complementary technical and financial contributions. In the case of the SSAF, projects may fit into all three categories. There is also a plan for Chinese non-governmental organizations to be able to access the SSAF in future¹⁷.

3.3. Who are the key official institutions working on cooling?

Within China there are two key Ministry-level institutions working on environmentally-friendly and energy efficient cooling: The newly created Ministry of Ecological Environment, which is overall in charge of the implementation of the Kigali Amendment as well as China’s domestic climate change implementation and international cooperation on environment and climate change; and the State Administration for Market Regulation¹⁸, which is now responsible for setting and enforcing a wide range of industry standards, including on the use of refrigerants and the energy efficiency of cooling appliances. When it comes to South-South cooperation on SDGs (and some environment/climate change related projects), China’s newly created China International Development Cooperation Agency will also be important.

3.3.1. Ministry of Ecological Environment

In March 2018, it was announced that a new Ministry of Environment and Energy (MEE) would be formed in China, merging the previous Ministry of Environmental Protection (MEP) with the Department for Climate Change and Department for International Cooperation from the National Development and Reform Commission (NDRC), one of China’s most powerful government ministries. NDRC was also leading coordination of China’s Belt and Road Initiative (BRI), which has now been enshrined in the constitution of the Communist Party of China as basis for China’s international cooperation, which includes South-South cooperation.¹⁹ With these recent changes, NDRC now has fewer responsibilities.

Multilateral environmental agreements, including the Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol with its Kigali Amendment, was one of the MEPs core mandates, and will therefore be a core mandate of the new MEE. MEE will also thereby oversee China’s South-South Cooperation Fund on Climate Change, announced in 2015²⁰.

¹⁶ <https://www.unsouthsouth.org/about/about-sstc>.

¹⁷ Interview with MOFCOM, 2017.

¹⁸ Previously the General Administration of Quality Supervision, Inspection and Quarantine, see further for an explanation, and the previous website: <http://english.aqsiq.gov.cn/AboutAQSIQ/Mission>.

¹⁹ http://news.xinhuanet.com/english/download/Constitution_of_the_Communist_Party_of_China.pdf.

²⁰ Confirmed in a speech made by Chinese climate change officials at the launch of a joint EU project in May 2018.

Despite these new shifts at the Ministry level, implementation agencies are likely to remain the same for at least several years. In particular, implementation of environmental agreements is likely to continue to be carried out by MEE's Foreign Economic Cooperation Office (FECO). FECO plays a key role in the implementation of the Kigali Amendment domestically and has a broad expertise in project development and implementation regarding the replacement of refrigerants in various industries.²¹ MEP also had an International Cooperation Center, which implemented South-South cooperation mainly through projects financed by the China Trust Fund. The Fund was jointly established by MEP and UN Environment in 2013 and has so far focused on ecosystem management, environmental governance, chemicals and waste as well as resource efficiency. MEP has been contributing USD 2 million annually to the Fund since its establishment (Phase 1: 2013-2015²² and Phase II: 2016-2018²³) and this can be expected to continue under MEE.

The China Household Electrical Appliances Association (CHEAA) will likely be one of MEE's key supporters on the domestic cooling sector in particular. CHEAA has been providing policy advice and technical support on the replacement of refrigerants for many years, including on negotiations under the Montreal Protocol. As such, CHEAA actively contributed to the development of the Kigali Amendment. CHEAA receives project funding from the Multilateral Fund through MEP.

In the area of energy efficiency standards, MEE, through a department dedicated to Resource Conservation and Environmental Protection, will take forward NDRC's former responsibility to work closely with the State Administration for Market Regulation (SAMR) at the policy level and with the China National Institute of Standardization (CNIS)²⁴ at the working level. CNIS is, inter alia, responsible for compulsory energy-efficiency standards²⁵ and labeling. CNIS also has a strong influence on the cooling appliances manufacturing sector as it sets specific production standards based on the work of specialized technical committees under its management.

Last but not least, the National Center for Climate Change Strategy and International Cooperation (NCSC), which was previously affiliated to NDRC, will also likely continue to play a key role, now reporting to MEE instead. NCSC handles most of the government's climate change project-related responsibilities at the working level, including the implementation of South-South cooperation projects.

3.3.2. State Administration for Market Regulation

Another major change that took place in March 2018 was the creation of the State Administration for Market Regulation (SAMR), which replaced the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) and its subordinate, the Standardization Administration of

²¹ <http://www.ozone.org.cn/xmxx/hqlf/pu>.

²² <http://wedocs.unep.org/bitstream/handle/20.500.11822/22315/China%20Trust%20Fund%20Brochure%20Phase%20I%20Eng.pdf?sequence=1&isAllowed=y>.

²³ <http://wedocs.unep.org/bitstream/handle/20.500.11822/22316/Chinese%20Trust%20Fund%20Brochure%20Phase%20II%20Eng.pdf?sequence=1&isAllowed=y>.

²⁴ <http://en.cnis.gov.cn/bzygk/kyly>.

²⁵ Under the guidance of NDRC, AQSIQ and other Ministries, CNIS is responsible for the development of compulsory energy efficiency standards that are imposed for example on the manufacturing of household appliances. Currently there are six standards related to AC appliances and commercial freezers. Commercial cold storage standards are under development. In addition, there are recommended AC energy efficiency developed by other institutions, such as the China Academy of Building Research.

China (SAC). The SAMR is now a key institution when it comes to standardization work, including cooling standards, in China.

For instance, SAC previously represented China within the International Organization for Standardization, the International Electrotechnical Commission and other international and regional standardization organizations. It also approves and organizes the implementation of international cooperation and the exchange of projects on standardization.²⁶ SAC sets general production standards in the cooling sector with the support of the Refrigeration and Air Conditioning Appliances Standardization Technical Committee, which is led by the China Household Electrical Appliances Research Institute (CHEARI).

CHEARI is also in charge of safety and performance standards of household ACs, the verification of refrigerants replacement and research and development in these areas. CHEARI has been considering involvement in South-South cooperation and would be able to, inter alia, support the establishment of a verification center in another developing country.

3.3.3. China International Development Cooperation Agency

In March 2018, it was announced that a new China International Development Cooperation Agency (CIDCA) would be formed to take charge of China's South-South cooperation and most of the spending of China's foreign aid. The head of CIDCA has since been announced as Mr Wang Xiaotao. He is a former NDRC Vice-Minister, which means that the linkage between China's foreign aid and the Belt and Road Initiative will be emphasized more strongly in future. However, although officially reporting directly to the State Council, the agency is not as powerful as a Ministry. The agency brings together officials from the Department for Foreign Aid (DFA) in the Ministry of Commerce (MOFCOM) as well as officials from the Ministry of Foreign Affairs (MOFA), such as from the Department of International Economic Affairs. Efforts may be made to expand the resources available to them (e.g. more staff, coordination responsibilities, etc), although this has not been confirmed as yet. MOFCOM's DFA previously administered China's South-South Cooperation Aid Fund (SSAF), as referred to earlier in Section 3.2, to which President Xi pledged USD 2 billion in 2015.

The China International Center for Economic and Technological Exchange (CICETE) has to date played a key role in the implementation of South-South cooperation projects under MOFCOM, and is likely to continue to do so for CIDCA. Another important implementation partner under MOFCOM has been the China Association for NGO Cooperation²⁷, which cooperates with CICETE and has undertaken a successful domestic public awareness campaign to get major end-users to agree on cooling office space not below 26 degrees Celsius during summer²⁸.

3.4. What are key Chinese cooling producers doing abroad?

²⁶<http://www.sac.gov.cn/sacen>.

²⁷ <http://www.cango.org/en>.

²⁸ <http://www.cango.org/en/showNews.aspx?id=493>.

China's largest cooling appliances producers are Gree²⁹, Midea³⁰, Haier³¹, Hisense-Kelon³², CHIGO³³ and AUCMA³⁴. As illustrated in Figure 7, most of these companies have a number of established production bases in other developing countries. The decision to produce overseas is driven by a range of factors, including internal reasons and forecast demand in the country, but also reasons such as whether the country itself allows foreign firms to set up independently or requires joint ventures, the countries' own manufacturing capacity and overall business environment. For instance, where countries have restrictions on foreign ownership, like China itself does in some sectors, Chinese companies often have exclusive distribution agreements with local companies. But this means they need to seek out such partnerships actively. Myanmar is an example of a country with restrictions and no local production, while Egypt allows foreign ownership, and also has significant local manufacturing capacity – at least 8 large local brands.

Case Study: Profitable Chinese operations in Egypt through local partnership

In 2010, Chinese Midea operated its first overseas joint venture with Carrier Corporation, based in Cairo under a company called Miraco. Miraco was founded in 1976 as a joint stock company. It initially had a 5,400 m² factory in Abu Rawash in Giza, West of Cairo, with a production capacity of 2,000 boxes per year and 250 employees. In 1992, Miraco signed a joint venture agreement with Carrier Corporation, and became the largest heating, ventilation and air conditioning company in Africa. Today there are two factories, all with the latest manufacturing technology, and a total working space of over 90,000 m², a yearly production of 400,000 boxes and 1,400 employees. By acquiring a 32.5% stake from the Egyptian listed company Miraco, Midea became the second largest shareholder of Miraco, next to Carrier. The joint venture company had sales revenue reaching US\$ 201 million in 2011.

Chinese RAC companies' overseas production mainly focuses on cooling household appliances – this appears to be where they are most competitive and where the most demand is. In some countries, such as Egypt, who have strong industrial capacity and a manufacturing base that serves the North African and Middle Eastern region, Chinese companies can also provide appliances for use in industry – up to 33%. But in many developing countries industrial demand is very nascent.

Under all these conditions, and across the world, the overseas market revenue for Chinese RAC companies is significant – it ranges from as little as 15% to close to 50% of total revenue for some of these firms. The overseas revenues include revenues from products sold under the companies' own brands, products sold as an original equipment manufacturer markets under another brand, and products produced and sold overseas.

Figure 7: Overview of China's top cooling appliances manufacturers' overseas footprints³⁵

²⁹ <http://global.gree.com>.

³⁰ <http://www.midea.com/global>.

³¹ <http://www.haier.net/en>.

³² <http://www.hisense.com>.

³³ <http://www.chigogroup.com>.

³⁴ <http://www.aucmaoverseas.com>.

³⁵ Only developing countries that are part of the group of countries with the highest ambition on phasing down HFCs under the Kigali Amendment (Group 1 countries) are considered here.

Company	Production in developing countries	Overseas markets revenue in % of total revenue of 2016
AUCMA	Nigeria and Vietnam	-
CHIGO	n/a	49
GREE	Brazil, Egypt	15
Haier	Algeria, Bangladesh, Jordan, Nigeria, Thailand, Tunisia and Venezuela	45
Hisense-Kelon	Algeria, Egypt, Mexico and South Africa	40
Midea	Argentina, Brazil, Egypt, Thailand and Vietnam	44

As regards the domestic introduction of low GWP refrigerants under the Kigali Amendment, Chinese cooling appliances producers are generally still awaiting a final MEP/MEE decision and timeframe of China's ratification of the Kigali Amendment. Hence, investments in research and development are currently more focusing on design aspects for achieving improvements in energy efficiency. However, given that MEP is already promoting propane as the new low GWP refrigerant for ACs, some companies have started to convert a part of their production lines accordingly. However, due to safety concerns over the flammability of propane, these new ACs are not yet sold domestically.

Internationally, Chinese cooling appliances producers, unless specialized in efficient, clean appliances, in principle aim to follow the guidelines of whichever jurisdiction they are operating in. Therefore, those countries that have production standards or import quotas, and clear enforcement of these bans/quotas or standards, are countries in which the most efficient and clean appliances from Chinese cooling manufacturers are likely to be found. The opposite also applies, which creates the possibility that some Chinese appliances in countries with poor enforcement of import quotas/bans or countries without standards may be less clean and inefficient than China's own.

Unfortunately, this is a real possibility in many countries, although we did not find any specific evidence of it during our in-country research. While a growing number of developing countries are putting in place import quotas, bans and Minimum Energy Performance Standards (MEPS), including for cooling appliances, most countries experience difficulties with enforcement of import quotes and bans and are still lacking standards. Where they do have standards, for instance in Egypt, those domestic standards are nevertheless below that of many other countries – such as the US and likely China too, so this presents challenges to meeting their SDGs through the private sector.

China has vast experience within the cooling sector as regards the development and implementation of domestic policies and standards as well as with the transition to more environmentally-friendly refrigerants from which many other developing countries could benefit. On the other hand, there are still some differences between how China and other producing countries measure their standards. Harmonization of these will be in the interests of countries (and companies) that in particular want to export to the rest of the world.

Furthermore, some of the top Chinese companies have developed innovative solutions for efficient, clean cooling, such as solar-powered cooling systems, which other developing countries could benefit from. For instance, Hainergy, a subsidiary of Haier, provides fully solar-powered

fridges and air-conditioners for developing countries. There are also many smaller and less well known other Chinese cooling companies experienced in implementing projects abroad, some of which are pioneering new technologies. For example, the Broad Group has taken its district cooling solutions to Singapore and elsewhere and solar air conditioners to India³⁶.

3.5. Has China's private sector contributed to south-south cooperation before?

The contribution of China's RAC private sector to south-south cooperation has to date mainly been determined by Chinese aid tender processes, as there appear to be no major examples of their Corporate Social Responsibility (CSR) efforts overseas.

For instance, in the context of its SSSCF, previously administered by NDRC (as above), China has donated thousands of energy-efficient ACs over the past years to Barbados, Benin, Burundi, Cameroon, Egypt, Ghana, Grenada, Madagascar, Nigeria, Samoa, Tonga and Uganda.³⁷ The procurement process for these is not public, but it is limited to Chinese companies only, as China's aid is usually "tied"³⁸.

MOFCOM has also donated cooling appliances in the past, although the countries that have received them are not published. MOFCOM states that it usually procures specific services and goods required for its South-South cooperation projects through public tender processes³⁹. Currently a list on the MOFCOM website shows 195 Chinese companies that have successfully passed the qualification process, which is a requirement for submitting tender bids. However, this list of companies does not include a cooling appliances producer or distributor. Qualified companies are allowed to sub-contract other companies for project implementation. Therefore, it remains unclear which of China's top companies have been involved in equipment donation projects in the past.

However, there are some examples of Chinese companies being directly involved in carrying out South-South cooperation projects in other countries. For example, in 2010 the MEE (previously MEP) organized a training in the Maldives in partnership with UNDP and the Germany development agency, delivered by Midea and Gree, on the installation and maintenance of room ACs.⁴⁰

There is similarly limited information available about the private sector involvement in other types of cooperation. For instance, the Chinese government has also been conducting cooling sector training within China for partners from developing countries in the context of the Belt and Road Initiative. In 2017 SAC organized the first "Belt and Road Appliance Standard Training", which included a training workshop by Hisense.⁴¹ Similar types of training are organized in Guangzhou (China)⁴² which Afghan and Maldivian government officials and private sector companies have

³⁶ <http://en.broad.com>.

³⁷ Weigel, 2016

³⁸ For an explanation see: <http://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/untied-aid.htm>

³⁹ Although some of these cannot be found on their website.

⁴⁰ <http://digi.163.com/17/0302/09/CEGV7536001680NS.html>.

⁴¹ <http://ref.chinaiol.com/r/0615/09183016.html>.

⁴² At the Guangzhou Industry and Trade Technical College

taken part in. However, it is not clear which Chinese stakeholders/companies sponsor such training.

Case Study: Cooperation potential in Afghanistan

In Afghanistan, where China is the 3rd largest exporter of refrigeration units and second largest of air-conditioning units, there is growing demand for RAC imports across both the commercial and household markets. Government officials and corporate leaders in the RAC industry are optimistic in their perception of growing China-Afghanistan relations, and greatly interest in increasing the availability of technician training programs from China. Growing China-Afghanistan relations offers Chinese firms a good opportunity to promote their products, including non-HCFC lines, while increasing the capacity of Afghan technicians to maintain their systems and the marketability of additional exports, especially if domestic production can be initiated, to contribute added value to Afghanistan's economy.

Finally, there are some examples of Chinese companies who are actively starting to engage in CSR efforts in poorer countries, however we have not found any examples in relation to the RAC sector directly. This is a gap that will hopefully be filled soon.

4. ENHANCING CHINA'S SOUTH-SOUTH COOPERATION ON COOLING

So far, we have explained how some Chinese governmental organizations and private businesses have been taking up the opportunity to support efficient, clean cooling in developing countries and therefore “green growth” and the achievement of at least half of the 17 UN Sustainable Development Goals.

However, we believe they and others have a huge opportunity to enhance this support, including through new, enhanced models set out below. In particular, based on desk research and interviews, we believe that it will be helpful for Chinese organizations to simultaneously implement types of cooperation that have previously been implemented separately.

For instance, cooperation that is related to policies, regulations and standards is only useful if these “sticks” can actually be enforced, and there is demand for them. Enforcement means that “rule-of-law” such as the legal system, the police and border needs to be active, have enough resources and be generally working smoothly or towards enforcement in order to ensure their realization. Ensuring demand means enhancing consumer awareness about cost-saving aspects of efficient, clean appliances or providing other “carrots” or incentives for the purchase of such appliances.

Similarly, the cooling market, just like any market, ultimately depends on the private sector, which makes it necessary to also consider economic factors when transitioning to efficient and clean cooling solutions. By linking SSC more to existing projects being delivered and manufactured by Chinese companies abroad or to the incentives to purchase efficient, clean appliances, these synergies can be taken advantage of.

The sections below propose three enhanced project types that Chinese stakeholders and their local partners could take forward, ideally in partnership.

4.1. Policies, Regulations, Standards and Enforcement

International cooperation on standardization is an important part of the Belt and Road Initiative (BRI) as highlighted in the list of deliverables of the 1st Belt and Road Forum on International Cooperation held in Beijing, China in 2017.⁴³ China intends to promote its own standards in BRI countries, in particular in those cases where local standards are still not in place, which are numerous.

Currently, AQSIQ and SAC, which are leading this work are looking for suitable areas for South-South cooperation on standard setting based on China's experience. The air-conditioning (AC) sector could lend itself for this purpose given China's vast experiences with the development, incentivizing and enforcement of AC standards and the fact that many developing countries are still lacking standards, have outdated standards or experience difficulties with enforcement of standards in this area. In addition, Chinese AC appliances producers are to a large extent

⁴³ http://www.chinadaily.com.cn/china/2017-05/16/content_29359377.htm.

depending on overseas markets and would potentially be interested in contributing to a project in this area.

The success of such a project would largely depend on the creation of incentives to ensure the uptake of the new AC energy efficiency standards in the local market, including, for example, through consumer awareness and marketing support (see further below). Research suggests that more stringent energy efficiency standards for household appliances result in consumers getting better quality appliances without paying more (Brucal and Roberts 2017). However, this may largely differ from country to country depending on local circumstances and ways and means by which such standards are introduced.

Given that much cooperation on standards/training tends to be focused on government officials, to make the results of such training practical, new standards could be applied to one or more new government procurement projects for cooling equipment as a pilot for further extension.

Finally, as noted above, the creation of new standards needs to go hand in hand with the building or enhancement of capacity to ensure the enforcement of these standards, which requires collaboration with and training of customs officials and/or police, which may or may not be possible in some countries, and may be ineffective in countries with high levels of small-scale bribery.

4.2. Technology and design-focused cooperation

China has become a technology leader in the cooling sector. As the world's largest manufacturer, exporter and user of cooling appliances, China is also among the largest spenders on research and development in this area and therefore holds a huge potential for contributing to the creation of new solutions that meet Kigali Amendment requirements while satisfying developing countries' needs. China's largest cooling appliances producers are not only pioneering energy-efficient products that are above domestic standards and exploring opportunities for phasing down HFCs, but also developing innovative products, such as solar-powered cooling systems. Haier is a technology leader in the area of solar AC inverter systems and solar refrigerator and freezer system solutions. These innovative off-grid solutions have the potential to significantly increase access to environmentally friendly and energy-efficient cooling in developing countries, in particular in those countries where a large part of the population and industries still do not have regular access to a power grid. Another upcoming technology in China that could lend itself for a South-South cooperation project is district cooling. This form of cooling allows for large energy efficiency gains in densely populated or high-use areas, and can be targeted towards public buildings, for example hospitals or schools. Some Chinese companies, such as Broad Air, have already gained a track-record of successful overseas district cooling projects. Another area for consideration is in relation to industrial use, and again there are particular companies such as Broad Air that manufacture and sell large cooling units. This could be particularly interesting to explore in the context of new large special economic zones being built by Chinese contractors and operators in BRI countries.

Finally, an alternative approach would be to explore designs and technology of buildings and their material, to either avoid or reduce the need for air cooling. This would likely be a more complex project, but would certainly be possible and most likely even more sustainable in the long-term.

Such types of projects (including for building design/materials) could be done as one-off donations or pilots from the Chinese government to partner countries (as has taken place in the past). However, such donation projects – especially for household use – often have limited results as

the technology is not well understood or maintained by users. In many cases, replacement parts or chemicals are not available in the country.

Alternatively, and more likely more successfully, the projects could be initiated on a commercial basis through a public private partnership (PPP) between the partner country and a Chinese private sector entity, perhaps supported by and international organisation such as UNEP, or K-CEP and/or the Chinese government with some form of donation or seed funding.

A PPP project could further take various forms. For example, turn-key projects, where the Chinese partner completes an installation and hands it over to the partner country. However, many governments around the world now prefer to encourage so-called “Build-Operate-Transfer” (BOT) models, where a foreign company does not only install the technology, but it also operates it for a certain period – in many cases while training domestic partners - before handing it over to those partner companies or government.

Such a PPP project – turn-key or BOT or otherwise – could arguably be applied to any type of cooling technology, from appliances for household use to appliances for industrial use. However, to make commercial sense, the key is to find an application that is at scale – i.e. meeting the demand of thousands of households or several factories.

4.3. Consumer-focused cooperation

The consumers of cooling appliances are as an important source of influencers as governments. Consumers cannot make the right choices without information, and as a default will use cost as basis for decision-making. For those consumers with the least money (who we are concerned with), a raft of studies show that they usually prefer the lowest cost equipment, even if costlier in the long-term (e.g. see Mullainathan & Shafir, 2013).



Picture 2: A consumer in Myanmar explores foreign brands of air conditioners

Thus, a consumer-focused project could take several forms.

First, since marketers are in business precisely to persuade customers to veer towards products they may not automatically choose, an innovative South-South cooperation project could be built around exactly this power and influence. This kind of project would likely require initial surveys of consumers, could involve some product testing, followed by a tailored marketing/branding campaign for sales of a key appliances. It would ideally focus around small-scale appliances bought in shops or online.

Second, addressing the financial constraints of money-conscious consumers through partnership with micro-finance institutions or arrangements through an escrow could be another direction for such cooperation. The payback period for many AC technologies, especially in countries where there is a perceived necessity for constant cooling, will likely be somewhere between 2-5 years. The project could be focused around helping customers to use their savings to purchase the most energy-efficient and environmentally friendly appliances. This can be coupled with latest technology developments (e.g. mobile/online payments). There are numerous examples of such development projects in other areas – e.g. M-Kopa provides a payback system through SMS for off-grid solar in Kenya⁴⁴.

These two types of consumer-focused cooperation projects could also be combined together, and could complement projects oriented towards standard creation and technology. They would require at least the engagement of one or two Chinese companies interested in expanding the take-up of their highest standard appliances abroad, and the engagement of local marketing or micro-finance/escrow experts and institutions.

⁴⁴ <http://www.m-kopa.com>.

5. CONCLUSION - THE WAY FORWARD

5.1. The efficient, clean opportunity

In this report, we have explained how Chinese private businesses and governmental organizations have been taking up the opportunity to support efficient, clean cooling in developing countries and therefore “green growth” and the achievement of at least half of the 17 SDGs so far.

However, we believe they and others have a further opportunity to enhance this support, through new models of South-South cooperation, which may have the co-benefit of ensuring stronger alignment to China’s Belt and Road Initiative (BRI).

In particular, in order to be more effective and deliver more transformational and sustainable results, we believe that China can and should explore delivering new types of “programmatic” south-south cooperation, beyond training and donation, including in partnership with the Chinese private sector. We also believe Chinese companies operating abroad themselves should initiate new CSR programmes, which could be designed based on the three specific ideas set out in Part 4. As noted earlier, Annex 1 provides background information for five countries that are ripe for and interested in going beyond traditional approaches.

But how to get started? And how can others outside China – from developing country governments and private sector companies, to international organizations and aid agencies, also support this kind of work, and thereby support green growth around the world?

5.2. China can support the countries that are most in need

There are all sorts of metrics and methodologies that Chinese stakeholders use to prioritize their engagement abroad. Most are currently not made available to the public, and often the results are not public either. However, we believe it is useful to be open and transparent about prioritization, and that prioritization should be tailored to the specific problem that poorer countries are trying to tackle.

We therefore used a particular methodology to identify five most relevant countries for future South-South cooperation in this area, by looking at both China’s priorities for South-South cooperation in the context of its Belt and Road Initiative as well as priorities, needs and ambitions of potential partner countries with a preference towards poor developing countries. We considered the following metrics in the selection:

- Ratification of the Kigali Amendment
- National contribution to the Paris Agreement with a reference to energy-efficiency of appliances
- Human Development Index (HDI) value below 8⁴⁵
- Memorandum of Understanding (MoU) with China on the Belt and Road Initiative
- MoU with ACSIQ on standardization in the context of the Belt and Road Initiative

⁴⁵ Countries with an HDI value above 8 are considered to have a very high human development.

- Country ranking by cooling appliances import from China
- Emission reduction potential within cooling sector

In line with this analysis, we found that the following countries ranked top, or are ideal for further and enhanced collaboration with Chinese stakeholders.



The cooling sectors and more specific ideas for collaboration in these five top ranking countries are explored in Annex 1.

5.3. Involving others could be helpful in trying new approaches

Finally, a promising way to start off enhancing China's South-South cooperation in the area of efficient and clean cooling could be some form of trilateral cooperation. There are number of non-Chinese, international partners with an interest, financial resources and technical expertise, such as UNEP, the Kigali Cooling Efficiency Program⁴⁶, and others. Indeed, such a model was used in 2010 for a project in the Maldives.

Furthermore, there are a number of other government agencies that have been spearheading cooperation with developing countries on efficient, clean cooling solutions for a number of years through dedicated programmes, for example the German Green Cooling Initiative⁴⁷. Their insights could provide valuable contributions to making South-South cooperation in this area more efficient and effective and in devising innovative models for advancing efficient, clean cooling solutions in low-income countries. The openness of Chinese organizations to new approaches, for example through the SSAF is promising in this regard.

We hope developing countries and the key institutions in this sector will together explore these opportunities as soon as possible. We hope this knowledge brief will contribute to stimulating such collaboration, for the benefit of poor people all over the world, for years to come.

⁴⁶ <https://www.k-cep.org>.

⁴⁷ <http://www.green-cooling-initiative.org>.

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ANNEX: THE AIR COOLING LANDSCAPE IN POTENTIAL PARTNER COUNTRIES

This section proposes five potential countries that China could partner with for advancing environmentally-friendly and energy-efficient cooling and provides an overview of the cooling sector in these countries.

Afghanistan

Afghanistan ranked high in the country analysis given that it is a Belt and Road country⁴⁸ and among the largest importers of ACs from China. In addition, Afghanistan has formulated a need for support to improve energy efficiency of household appliances, including through standards, as part of its NDC.⁴⁹ Furthermore, Afghanistan is among the lowest ranking Belt and Road countries in terms of HDI (0,479) and has a relatively high emission reduction potential within the cooling sector with 4.24 Mt by 2050.

Afghanistan has close economic ties with China, which is its third-largest trading partner. As regards the Belt and Road Initiative, Afghanistan is of strategic importance due to its geographic location⁵⁰. China and Pakistan are considering how to include Afghanistan in their newly formed USD 57 billion economic corridor⁵¹, which is one of the six economic corridors under the Belt and Road Initiative.

Afghanistan Cooling sector overview
<p>Policies, regulations and standards</p> <ul style="list-style-type: none"> • ODS regulation issued in 2006
<p>Institutions</p> <ul style="list-style-type: none"> • National Environmental Protection Agency⁵²/National Ozone Unit⁵³: <ul style="list-style-type: none"> ○ Responsible for development and implementation of cooling policies, regulations and standards, including on energy-efficiency of cooling equipment and banning of HCFC-based appliances ○ Conducts awareness-raises campaigns targeted at companies and consumers • Ministry of Commerce and Industry⁵⁴ • Customs Department⁵⁵ • Afghanistan National Standards Authority⁵⁶ • Afghanistan Chamber of Commerce and Industries⁵⁷
<p>Industry</p>

⁴⁸ The MoU on the Belt and Road Initiative between Afghanistan and NDRC was signed in 2016 and in 2015 China had pledged to provide USD 327 million in aid by 2017, which is about five times the amount per year provided from 2001 to 2013 (Carnegie India 2017).

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http://www4.unfccc.int/ndcregistry/PublishedDocuments/Afghanistan%20First/INDC_AFG_20150927_FIN_AL.pdf.

⁵⁰ <https://thediplomat.com/2017/04/linking-afghanistan-to-chinas-belt-and-road>.

⁵¹ <https://www.rt.com/business/414253-china-pakistan-afghanistan-economy-corridor>.

⁵² <http://nepa.gov.af/fa>.

⁵³ <http://www.ozone.gov.af>.

⁵⁴ <http://moci.gov.af/en>.

⁵⁵ <http://customs.mof.gov.af/en>.

⁵⁶ <http://ansa.gov.af>.

⁵⁷ <http://acci.gov.af>.

<ul style="list-style-type: none"> • Seven companies⁵⁸ assemble cooling appliances: refrigeration appliances for commercial, industrial and transportation use. The only household refrigerator production line is currently not in use as it is based on CFC-12/R-12, which are prohibited • Cooling service sector is very small with only a few qualified cooling technicians. No certification scheme in place
<p>Market</p> <ul style="list-style-type: none"> • Cooling appliances are mainly imported from China. The market is dominated by eight cooling importers/dealers, including Chigo from China. • There is an increasing demand for various types of cooling appliances mostly driven by urbanization and population growth. However, frequent power outages and the lack of access to the national grid by 70% of the population remain a main obstacle.
<p>Commitment</p> <ul style="list-style-type: none"> • Committed to working on legislation to: better control the cooling sector; set import quota for HCFC-based products; train technicians on the use of alternative refrigerants and technologies; ensure better reporting and awareness-raising • Preparing to ratify the Kigali Amendment • Interested in further expanding cooperation with China in the cooling sector, building on previous training in China on AC installation

Egypt

Egypt was identified as a potential partner country based on, inter alia, its status as a Belt and Road country⁵⁹ and given that it is among the largest importers of cooling appliances from China. Egypt has cooling standards in place and is home to overseas production of the Chinese cooling appliances producers Gree and Midea. In terms of emission reduction potential within the cooling sector, Egypt ranks among the highest with 16Mt by 2050 within developing countries that are also Belt and Road countries.

As regards the Belt and Road Initiative, Egypt is of strategic importance to the Maritime Silk Road given the linkage between Europe, Africa and Asia through the Suez Canal. Chinese state-owned companies have recently made significant pledges of USD 35 billion in financing to support the development of the New Suez Canal Development Area as an important hub along the Maritime Silk Road as well as the development of Egypt's new administrative capital city.

Egypt's rapid phase-out of energy subsidies, which were keeping electricity prices artificially low, is paving the way for a large adoption of energy-efficient equipment and appliances for the residential, commercial, governmental and industrial sectors.

Egypt Cooling sector overview
<p>Policies, regulations and standards</p> <ul style="list-style-type: none"> • Minimum energy performance standards and labelling for ACs, freezers and refrigerators are in place since 2003⁶⁰ • Upgrade of cooling energy efficiency requirements every three years and annual updates of AC code, latest update includes provisions on district cooling, which will be applied in the new capital city and in El Alamein
<p>Institutions</p>

⁵⁸ Herat Sarma, Jahan Sarmaish, Afghan Sarma, Damfus Sarma, Jame Sarma, Pamir Sarma and Mumtaz Sarma. All of these companies assemble only one to ten refrigeration appliances per day.

⁵⁹ Egypt is also among the few non-regional founding members of the Asian Infrastructure Investment Bank, which is linked to the Belt and Road Initiative.

⁶⁰ A recent study finds that Egypt has significant room for improving these standards (Shah 2017).

- Egyptian Organization for Standardization/Ministry of Trade and Industry:
 - Main authority on regulations and standards
 - Introduced taxes and quality standards for imported AC-related products in 2012 to protect local market
- National Ozone Unit/Ministry of Environment:
 - In charge of phase-out of ozone depleting substances, managed to completely phase-out CFCs in 2010, starting work on phase-out of HCFC in AC sector, facing challenges as refrigerant replacements depend on end-use, currently testing various alternatives
 - Established the Egyptian Program for Promoting Low-GWP Refrigerant Alternatives (EGYPRA) to prepare manufacturers for the future phase outs, currently cooling sector mostly depends on R22, which has no influence on the ozone layer but a high GWP.⁶¹
 - UNIDO lead agency in support of National Ozone Unit, including pilot project with cooling manufactures on low GWP refrigerants
 - UN Environment focusses its support mainly on training technicians regarding the handling new refrigerants and alternative substances.
- Housing and Building Research Center/Ministry of Housing:
 - Responsible for developing all codes and methods of operation related to the installation and maintenance of buildings in energy efficiency, air-conditioning, insulation and sanitation sectors.
 - Hosts Arab HVAC Code Committee, which revised the Egyptian code to serve as a common basis for Arab States. The revised version was adopted by the League of Arab States in 2016. It is the first Arab code harmonized with ISO and ASHRAE standards and includes one chapter on refrigerants. The Kigali Amendment will be integrated into the code in 2018 as part of a joint project with UN Environment
 - Leading testing lab in Middle East for flammability of refrigerants. Currently expanding testing lab in cooperation with Chinese partners to measure AC unit refrigerant leakages

Industry

Egypt's four largest cooling manufacturers:

- Tiba Engineering Group:
 - Leading manufacturer and supplier of AC systems in Egypt and the Middle East since its establishment in 1993, five factories
 - Sole agent for Gree in Egypt
 - Among the first in Egypt to receive ISO 9001:2000 and ISO 14001 certification and first in Africa to attain EUROVENT Performance certification
- Miraco:
 - Founded in 1976, entered into joint venture with Carrier in 1992 to become largest heating, ventilation and AC company in Africa, two modern factories with a total of 1,400 employees
 - In 2010, Midea opened its first overseas joint venture with Carrier, based in Cairo under Miraco. By acquiring a 32.5% stake from Miraco, Midea became the second largest shareholder of Miraco after Carrier. The joint venture's revenue reached USD 201 million in 2011
- El Araby Group:
 - Established in 1974, main foreign commercial partners are Toshiba and Sharp, 12 factories
 - Large sales and service network with 2,840 sales centers and 185 after-sales service centers across the country
- Unionaire:
 - Established in 1995, has a 35% share of the Egyptian cooling market, producing an average of 250,000 units for the local market per year, also exports to other African countries and the Middle East
 - Four assembly lines exclusively dedicated to indoors and outdoors air-conditioning equipment, employing 1,500 workers
 - Works with Highly and Sanhua from China
 - Follows international environmental standards and regulations in terms of R407C and R410A use
- Currently there are about 750.000-1.500.000 cooling units manufactured per year.
- Egyptian cooling manufacturers use two refrigerants for most applications: R22 and R410A. R22 is slated to be phased-out sooner than R410A. There are already quotas placed on imports of R22, to encourage the industry to shift to low-GWP alternatives, but the price difference between R22 (USD 4-6/kilo) and new refrigerants (USD 60-70/per kilo) remains stark.

⁶¹ Challenges foreseen by the National Ozone Unit regarding the switch from HCFCs to HFCs are: limited funding from multilateral sources compared to the switch from CFC to HCFC in the 1990s; uncertainties on which low-GWP refrigerants to choose; required changes in education and training curricula, production processes and codes. Both hydrocarbon and HFOs are foreseen to play an important role.

<ul style="list-style-type: none"> • Virtually no energy-efficient cooling appliances on the market, because until recently, no financial incentive existed to encourage people to invest in less wasteful and more expensive units. Currently, the minimum standard of energy efficiency ratio for cooling units is 10 (amount of cooling produced compared to the energy used-but countries), which is low compare to the US standard of 18.
<p>Market</p> <ul style="list-style-type: none"> • Consumers are very price sensitive and tend to go for the cheapest offer without consideration of product lifecycle costs, although the cost of electricity almost tripled over the last years due to the reduction of government subsidies, which will be completely abolished by 2019. Some banks are providing consumer loans for AC purchases.⁶² • Demand for cooling appliances is expected to grow significantly driven by Egypt's strong population growth, changes in lifestyles, rising temperature and humidity, and large-scale urban development projects, most notably its new administrative capital, which will span an area of 700 square kilometers and include housing for five million people as well as industrial zones. Other large-scale projects include the New Suez Canal Development Area as well as the expansion of Cairo's urban boundaries. Cairo's population is expected to grow from 25 million to 40 million until 2050.
<p>Commitment</p> <ul style="list-style-type: none"> • High increases in energy prices over the past seven years have put energy efficiency prominently on the agenda of policy-makers and consumers. Egypt established an Energy Efficiency Unit at the Ministry of Electricity and Renewable Energy and adopted the National Energy Efficiency Action Plan. • Committed to start work on the Kigali Amendment immediately after ratification in the course of 2018. Ratification already approved by Ministry of Environment, but needs further approval by other government entities and parliament.

Myanmar

Myanmar was identified as a potential partner country, inter alia, given that it is a Belt and Road country and that it ranks relatively high among importers of cooling appliances from China in terms of volume. Furthermore, Myanmar is among the lowest ranking Belt and Road countries in terms of HDI (0,556).

Myanmar has close economic and diplomatic relations with China and has been receiving Chinese aid for a range of projects. In December 2017, Chinese President Xi Jinping met Myanmar State Counsellor Aung San Suu Kyi in Beijing and both sides agreed to build the China-Myanmar Economic Corridor.

Myanmar Cooling Sector Overview
<p>Policies, regulations and standards</p> <ul style="list-style-type: none"> • No polices, regulations and standards regarding energy-efficiency of domestic, commercial or industrial use of cooling appliances in place, but National Policy Roadmap for Harmonization of Energy Performance Standard for Air Conditioners recently developed⁶³ • Ozone Order 2014 on phase-out of ODS as well as HCFC Phase-Out Management Plan (HPMP)⁶⁴
<p>Institutions</p> <ul style="list-style-type: none"> • Environmental Conservation Department/Ministry of Environmental Conservation and Forestry

⁶² The German development bank KfW has launched a pilot project on energy efficiency through which in intends to generate consumer interest in investing in energy-efficient equipment. If successful, KfW will provide consumer loans through local banks for this purpose.

⁶³ <http://www.aseanshine.org/download/get/812b4ba287f5ee0bc9d43bbf5bbe87fb>.

⁶⁴ <http://www.ecd.gov.mm/?q=organization-task/republic-union-myanmar-hpmp>.

<ul style="list-style-type: none"> ○ Coordinates with national and international agencies to formulate, plan, and implement ODS phase out measures, including the preparation and implementation of the national legislations to control and manage the ODS imports, exports and consumption ○ Implements and coordinates HCFC phase-out activities under the HPMP, including national awareness-raising campaigns, annual monitoring and reporting of achievements ● Ministry of Commerce <ul style="list-style-type: none"> ○ Issues import and export licenses of goods ○ Its Department of Border Trade plays vital role in controlling the import and export of goods in collaboration with the Customs Department ● Customs Department/Ministry of Finance and Revenue <ul style="list-style-type: none"> ○ Controls import and export of ODSs at ports of entry ● Ministry of Science and Technology <ul style="list-style-type: none"> ○ Provides training and certification of technicians ● Ministry of Livestock and Fisheries <ul style="list-style-type: none"> ○ Plays significant role in phasing-out HCFC-based equipment in fishing vessel and cold storage ● Ministry of Hotels and Tourism <ul style="list-style-type: none"> ○ Guides hotels on the phase-out of HCFC-based equipment ● Ministry of Industry <ul style="list-style-type: none"> ○ Prevents establishment of new industrial units using HCFCs ○ Provides training for trainers of cooling technicians
<p>Industry</p> <ul style="list-style-type: none"> ● No domestic cooling manufacturers or assemblers in Myanmar. In 2016 about 50% of all cooling imports came from China. Cooling importers require a license from the Ministry of Commerce and an approval of MONREC. Foreign brands are prohibited from conducting direct trade in Myanmar, so to sell their products in Myanmar, they must work with local distributors. Hisense, Chigo, Midea and Haier are among the six most common cooling brands in Myanmar with established local distributors.
<p>Market</p> <ul style="list-style-type: none"> ● The exact size of the cooling sector in Myanmar remains unknown. Foreign brands, importer and distributing companies are demanding the government to conduct research or release data on findings in the cooling sector to help business owners have a better understanding of the cooling sector in Myanmar. ● The Japan Refrigeration and Air Conditioning Industry Association found in 2016 that demand for ACs had almost tripled in Myanmar since 2011 from 70.000 to 206.000 units with most of the units being room ACs⁶⁵. ● Most room ACs use R22, which is currently being phased out. A quota system is in place since 2013 and a decision was taken in 2017 to ban the import of HCFC-based room ACs with cooling capacity less than 2.5 HP (equivalent to about 1.8 TR) starting in the course of 2018 and to ban the import of all types of HCFC-based cooling equipment from 2021. Currently R22-based ACs are about USD 80-100 cheaper than similar R410a-based models, which are more environmentally friendly given that R410a does not deplete the ozone layer and is more energy-efficient than R22. R410a does however have a high GWP. Myanmar is working to introduce HFC-32 as another alternative. ● There are no solar-powered cooling appliances on the market.
<p>Commitment</p> <ul style="list-style-type: none"> ● Committed to advance work in this area, but currently still focusing on ensuring that necessary institutional arrangements are in place. Once done, the ratification of the Kigali Amendment will be pursued ● Full engagement in South-South Cooperation will also only be possible once institutions are in place in the near future.

Sudan

Sudan was identified as a potential partner country, inter alia, given its status as a Belt and Road country and its need for support to improve energy efficiency of household appliances, including through the establishment of a labeling system, to achieve its NDC mitigation targets.⁶⁶ In addition,

⁶⁵ https://www.jraia.or.jp/english/World_AC_Demand.pdf.

⁶⁶ <http://www4.unfccc.int/ndcregistry/PublishedDocuments/Sudan%20First/28Oct15-Sudan%20INDC.pdf>.

Sudan is among the lowest ranking Belt and Road countries in terms of HDI (0,490), while having a relatively high emission reduction potential within the cooling sector with 11,3Mt by 2050.

China is Sudan’s biggest trade partner and investor. About 50% of Sudan’s cooling-related imports come from China. The two countries have a long history of diplomatic relations and South-South cooperation dating back to 1959, when Sudan was the first country in Sub-Saharan Africa to recognize the People’s Republic of China. South-South cooperation between the two countries has not yet included a project in the cooling sector.

Sudan Cooling Sector Overview
<p>Policies, regulations and standards</p> <ul style="list-style-type: none"> • Laws, regulations and standards related to the cooling sector are currently not being enforced due to a lack of institutional capacity
<p>Institutions</p> <ul style="list-style-type: none"> • Ministry of Environment/Forestry and Physical Development • Higher Council for Environment and Natural Resources • Ministry of Industry/Environment Bureau • Ministry of Water Resources and Ministry of Electricity and Dams • Chamber of Commerce • Chamber of Importers • Central Bank of Sudan • Standards and Metrology Organization • Sudanese Customs
<p>Industry</p> <ul style="list-style-type: none"> • Most cooling appliances are imported as there are only a few cooling manufactures within the country. Midea is among the largest cooling companies and Gree is one of the largest AC companies in the country
<p>Market</p> <ul style="list-style-type: none"> • Cooling appliance imports totaled USD 87.5 million in 2015 • Consumers are very price-sensitive, but also consider performance and warranty. Samsung’s 10 years warranty contributes to the brand’s success on the local market despite its higher product prices • Cooling importers/distributors sell the largest share of their products to consumers. Some also participate in public tenders for large construction projects. Gree is known to be particularly successful in winning public tenders through which it services government facilities. • Rising cost of electricity and frequent power-outages are the biggest challenge for the cooling sector as consumers hold back on their spending despite the high ambient temperatures • Solar powered ACs are rarely used in Sudan. Green Apple Ltd appears to be the only company distributing such appliances within the country

The Maldives

The identification of the Maldives as a potential partner country is, inter alia, based on its status as a Belt and Road country⁶⁷ and the fact that it is the only developing country that is also a Belt and Road country, which has already ratified the Kigali Amendment.

For the Maldives China has become a key partner from which it has been receiving large investments in infrastructure projects since President Xi Jinping’s State Visit to Male in 2014. In December 2017, Maldives signed its first ever bilateral free trade agreement with China alongside a set of eleven other bilateral agreements.⁶⁸

⁶⁷ http://news.xinhuanet.com/english/2017-12/07/c_136809164.htm.

⁶⁸ <https://www.maldivesembassy.in/government-of-maldives-and-china-signs-twelve-key-agreements>.

The Maldives has experience regarding South-South cooperation with China in the cooling sector through the donation of ACs in 2011 and training carried out by MEP and CHEAA on the installation and maintenance of ACs in 2017.

Maldives Cooling Sector Overview	
Policies, regulations and standards	<ul style="list-style-type: none"> ● In 2002, the Maldives set up a refrigerant licensing system, which covers all ODSs, including HCFC and HCFC blends. ● In 2010, in line with the HCFC Phase-out Management Plan and phase-out schedule, a regulation was introduced on HCFC-based equipment and appliances, allocating quotas for importers ● In 2016 the Ozone Layer Protection Act became effective under which the import of HCFC-based cooling equipment and appliances has been banned since 31 May 2016. The Act also requires the registration of any HCFCs/HCFC-blends used in the country ● The Ministry of Environment and Energy is developing standards and a labelling programme for electronics, which will include the cooling sector
Institutions	<ul style="list-style-type: none"> ● Ministry of Environment and Energy (MEE): key institution for cooling sector regulation, including import and consumption of appliances, equipment and refrigerants ● MEE/National Ozone Unit: coordinates and facilitates policies and projects on ODS/HFC phase-out/down ● Maldives Customs Service: enforces import and export regulations ● Ministry of Trade and Economic Development: in charge of import licenses for products ● Ministry of Defense and National Security: in charge of import licenses for chemicals
Industry	<ul style="list-style-type: none"> ● There is no production or assembly of cooling appliances. All cooling appliances are imported by about 250 importers with about 10 importers accounting for about 75% of total imports
Market	<ul style="list-style-type: none"> ● Domestic cooling appliances are the major types of equipment used in the cooling sector in the Maldives, accounting for 92% of the total cooling imports (32% refrigeration/60% ACs). It is estimated that there was a total of about 150,000 refrigeration units and 190,000 AC units in the country by end 2016. Cooling imports grew at an average of 18% per year from 2010 to 2015. About 10%-14% of cooling imports come from China ● Government procurement sets the price as the most important factor, but also considers energy efficiency and GWP of refrigerant in some cases