

Efficient, Clean Cooling: A Major Near-Term Opportunity for China

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KIGALI
COOLING EFFICIENCY PROGRAM



This brief outlines the benefits that efficient, clean cooling can deliver in China, and how ambitious Minimum Energy Performance Standards (MEPS) for cooling technology will be instrumental to realising these benefits and fulfilling China's key national and international strategies.

1. INTRODUCTION

Cooling is central to health, prosperity, and the environment. Efficient, clean cooling underpins many Sustainable Development Goals and represents an opportunity to avoid substantial greenhouse gas (GHG) emissions. However, most cooling is currently energy-intensive and highly polluting – particularly because of the impact it has on upstream electricity. Existing pollution needs to be cut urgently and booming demand for future cooling met sustainably.

China is the largest manufacturer, consumer and exporter of cooling technologies, yet the Chinese market still has room to grow. Meeting cooling demand while taking robust action to improve the energy efficiency of cooling equipment and moving to low global warming potential (GWP) refrigerants can be at the core of the implementation of China's key strategies. This includes Nationally Determined Contributions (NDCs) to the Paris Agreement, the Three-year Plan on Defending the Blue

Sky, Construction of an Ecological Civilisation (which includes principles of a circular economy), Made in China 2025, and the Green Belt and Road Initiative. However, China must take further action on the opportunity presented by efficient, clean cooling, including:

- Ensuring brand competitiveness and innovation;
- Unlocking cost savings for businesses and consumers;
- Strengthening the energy system and tackling air pollution;
- Improving food security, health and productivity; and
- Reinforcing China's global environmental leadership.

This brief describes these benefits, and highlights how China can unlock them through ambitious MEPS, enhanced strategies and plans, and action on cooling initiatives, finance and exports.

2. BENEFITS FOR CHINA

Brand competitiveness and innovation

China is the largest exporter and consumer of air conditioners (ACs) and refrigerators globally with a 33% share of global AC exports, worth US\$13.9 billion per annum, and a 22% share of global refrigerator and freezer exports, amounting to US\$9 billion p.a.ⁱ China's domestic market is 41.6% of global room AC sales.ⁱⁱ

Cooling is a big and rapidly growing economic opportunity for China. The International Energy Agency (IEA) states that since 1990, annual sales of ACs have more than tripled with about 1.6 billion units currently in use.ⁱⁱⁱ Growth continues to be driven by rising incomes, electrification, urbanisation, and a warming world.^{iv} AC

sales in many emerging high population economies with a low stock of ACs such as Brazil, India, and Indonesia are growing at 10-15% per annum.^v

Under the Paris Climate Agreement and Kigali Amendment to the Montreal Protocol there is recognition of the need to transition to cleaner and more efficient technologies. Scaling-up production of high-efficiency cooling products and capturing economies of scale for domestic and export markets will enable Chinese manufacturers to remain competitive at the expanding high-end of the market. This will help China compete to grow its global market share in energy-efficient and low-GWP AC production, consistent with Made in China

2025 and Green Belt and Road Initiative objectives. As President Xi Jinping said in October 2018 during a visit to Gree Electric, China’s largest manufacturer of ACs: “Manufacturing is a key to the real economy, and the core strength of manufacturing is innovation... We must seek innovation by relying on ourselves, and I hope all enterprises will work in this direction.”^{vi}

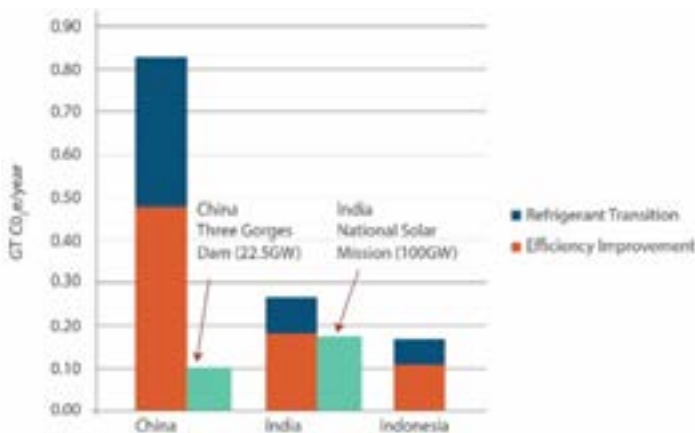
Cost savings for businesses and consumers

Efficient, clean cooling delivers significant energy cost savings for businesses and consumers over the life cycle of the equipment. For example, the IEA has calculated that efficient cooling can almost halve electricity costs per capita for space cooling in China in 2050 from around US\$60 to US\$30 per person.^{vii} Lower costs in turn make more efficient cooling devices more affordable to a broader segment of the population.

Stronger energy system and cleaner air

Efficient, clean cooling can also strengthen the energy system in China. Energy used for space cooling has surged in China from 6.6TWh in 1990 to 450TWh in 2016.^{viii} Implementing energy efficiency and low GWP refrigerant policies in parallel for room AC would offer peak load reductions of up to 310 GW by 2030 in China and save GHG emissions equivalent to more than eight Three Gorges Dams (Figure 1).^{ix}

Figure 1 – Estimated Annual Emissions Abatement Potential of AC Stock in 2030 over AC lifetime (Source: LBNL, 2015)

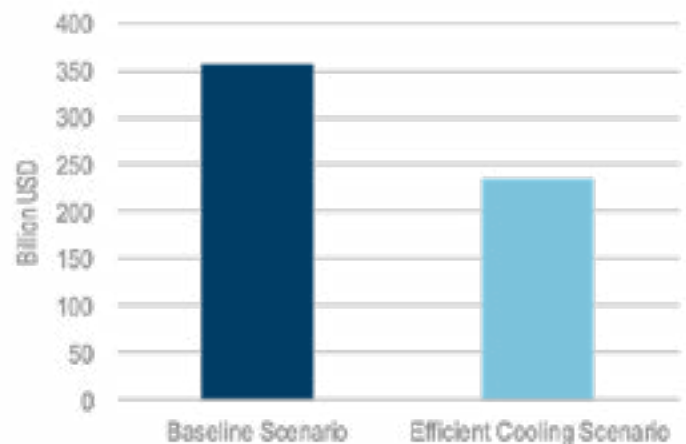


Furthermore, energy efficient ACs could deliver more than 8,000 TWh of electricity savings in China to 2050

and save US\$120 billion in cumulative power generation investments (see Figure 2 below).^x

Cooling in China places large demands on the energy system. In cities like Beijing, cooling can account for over 50% of daily peak demand on summer days.^{xi} More than 60% of China’s electricity is generated from coal, so energy used for cooling is a significant contributor to ambient (outdoor) air pollution. More than a million people die each year due to particulate emissions from power plants, cars and other sources.^{xii} Efficient, clean cooling can help save lives by reducing this pollution.

Figure 2 – Cumulative investments in power generation for space cooling to 2050 in China (Source: IEA, 2018)



More food, better health, improved productivity

Efficient, clean cooling can help to reduce food waste and boost incomes for farmers. The Global Food Cold Chain Council found that due to an inadequate cold chain, China wasted around 25% of fruit and vegetables, 10% of meats, 11% of fish and seafood, and 28% of chicken and eggs.^{xiii}

Approximately 1.1 billion people globally face access to cooling risks through exposure to extremes of heat or a lack of cooling for food or vaccines.^{xiv} China is one of nine countries identified with the largest risks related to access to cooling, notably its agriculture base and low-income urban dwellers.^{xv} Work hour losses are expected to be more than 2% in East Asia overall by 2050, which over 30 years can mean GDP growth per capita that is less than half as much as if adequate cooling were available.^{xvi}

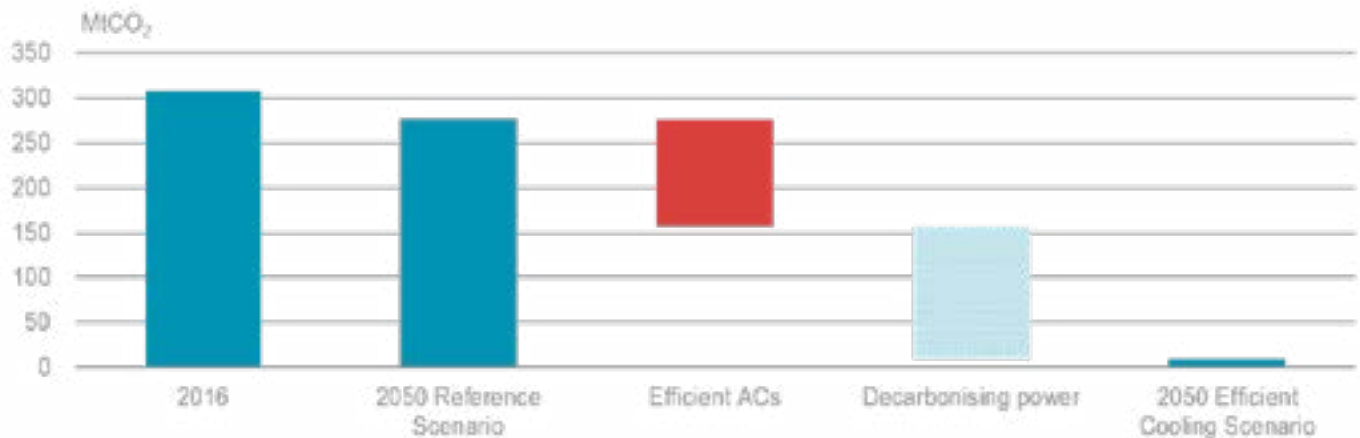
Climate change leadership

China aims to “take a driving seat in international cooperation to respond to climate change.”^{xvii}

Transitioning the AC industry in China to produce super-efficient and low GWP products would provide cumulative GHG emissions reductions of 16.9. Gt CO₂e from 2020 to 2030 – one third of the global potential.^{xviii}

More efficient ACs in China are projected to cut CO₂ emissions from space cooling by more than 40% by 2050 and help enable the transition to clean decarbonised power (see Figure 3).^{xix} This would drastically reduce cooling related GHG emissions and help China accelerate resource conservation contributing to China’s national policy for constructing an Ecological Civilisation, and its aim to meet NDC climate targets.

Figure 3 – Contribution of more efficient space cooling on CO₂ emissions in China (MtCO₂) (Source: IEA 2018)



3. HOW AMBITIOUS MEPS WILL UNLOCK MULTIPLE BENEFITS FOR CHINA

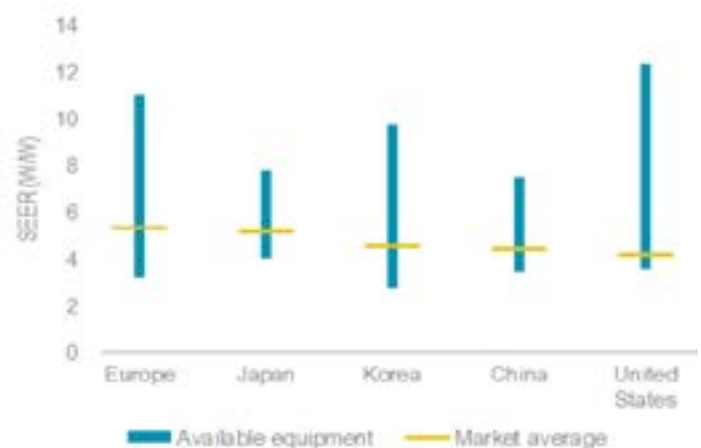
Ambitious MEPS are critical to the deployment of efficient cooling technology and can deliver significant benefits for China. MEPS raise the floor in terms of the minimum quality and efficiency of products that can be sold in the market, stimulating manufacturers to produce more high quality and environmentally friendly equipment.

the refrigerant transition which is equivalent to avoiding 265–619 500MW power plants.^{xxii}

Efficiency benefits

The average efficiency of air conditioners sold today is at the low end of what is typically available on store shelves and online – and one third of the best available technology (Figure 4).^{xx}

Figure 4 – Energy performance of ACs already available in markets today. Metric is not comparable across countries (Source: IEA, 2018)



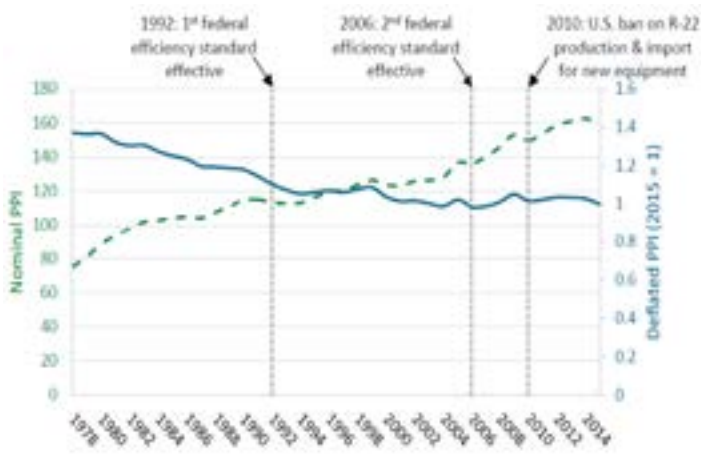
Environmental and climate benefits

Increasing MEPS by 30% over the current fixed-speed room AC minimum, in parallel with low GWP refrigerants in room ACs, could deliver cumulative savings of up to 98 billion tonnes of CO₂ by 2050.^{xxi} Increasing efficiency of a fixed-speed AC by 30%, alone, could reduce peak load by 118–277GW in 2030 and increase to 132–310GW alongside

Improving savings and affordability

Retail prices for ACs and refrigerators have continued to decrease across multiple markets even as energy efficiency standards have increased. Figure 5 shows unitary AC equipment in the US steadily becoming more efficient and more cost effective since the 1970s. The inflation adjusted equipment price has shown a steady decline in prices following the introduction of various efficiency standards over the last 40 years.^{xxiii} Similar trends have been seen in Japan, Korea and India.^{xxiv}

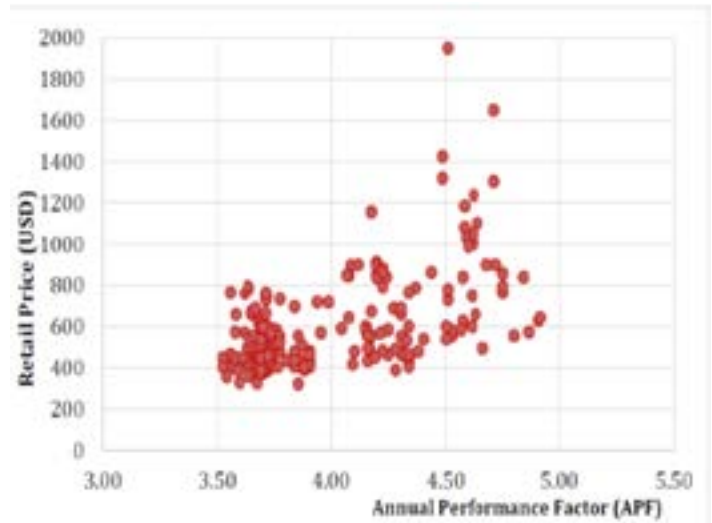
Figure 5 – Inflation adjusted prices for unitary AC equipment in the US over time (Source: US DOE, 2016)



Even at a single point in time, high efficiency does not mean high cost. Price varies approximately four fold from around US\$500 to US\$2,000 for small unitary variable speed ACs in China (see Figure 6). However, there is wide price variation at a single efficiency level so there are lower cost, high efficiency units. This effect holds for multiple cooling capacities, multiple efficiency levels and across both fixed speed and variable speed ACs.^{xxv xxvi}

Furthermore, lifetime costs of more efficient ACs are lower, saving businesses and consumers money. Initial payback periods of more efficient ACs can be as little as 3 years. Payback periods could be eliminated or even made into upfront cost savings as scale is achieved.

Figure 6 – Retail price (US\$) versus efficiency (APF) of 3.5kW mini-split ACs on the Chinese market (Source: LBNL's IDEA database and the Chinese National Institute of Standardization database)



Market potential and opportunities

Demand for efficient cooling is growing and higher MEPS are progressing in key export markets for China. For example, the Kigali Cooling Efficiency Program (K-CEP) is working with more than 30 countries and supporting the development of MEPS in 10 key export markets for China. China last revised its fixed speed room ACs in 2010 and variable speed in 2013.^{xxvii} Other countries and competitors are acting. For example, the Japanese AC manufacturing firm, Daikin, reported record sales and profits in the first quarter to June 2018 with sales and profits up by 12% overall with strong growth in lower GWP AC equipment.^{xxviii} Increasing MEPS and exporting efficient cooling equipment will help China maintain its manufacturing and economic competitiveness, and meet its objectives for Made in China 2025.

China must also apply higher MEPS to its exports. Selling inefficient ACs to other countries undermines China's contribution to combating climate change, as well as the climate change and development efforts of countries importing from China.

4. CHINA'S NATIONAL STRATEGY AND THE ROLE OF K-CEP

Fulfilling key national goals

China has made some progress in improving cooling efficiency. Efficient clean cooling is incorporated into China's national strategies, and there are recent relevant policy statements from the State Council, various Ministries, and the National Development and Reform Commission.^{xxx} As President Xi Jinping has stated: "We shall advocate for green, low carbon, circular and sustainable manufacturing and lifestyles... China will continue to take climate change response actions, and fulfil our own responsibilities one hundred percent".^{xxx} China's Paris Agreement commitment requires its CO₂ emissions to peak by 2030 and China has committed to freeze and phasedown high-GWP refrigerants from 2024.

K-CEP support

The challenge of delivering efficient, clean cooling is a vast one, and China has an outsized impact on meeting this challenge. K-CEP is the largest ever program of philanthropic support to improve efficiency standards for any appliance. In China K-CEP is working with Energy Foundation China and a range of partners to support a countrywide program from 2018-2020 that aims to maximise GHG emission reductions in residential and commercial AC. There are three main parts:

5. RECOMMENDATIONS

1. Set ambitious MEPS

The stringency of MEPS for room ACs should be increased by at least 30% and MEPS for commercial ACs should be updated as soon as possible with an ambitious improvement. We recommend that MEPS for VRF ACs are increased significantly since the average market efficiency has improved between 29% and 65% since 2012 and above 90% of products in market have met the grade I level. Further research is needed to determine the exact amount of revision. If MEPS for room ACs in China were increased by at least 30%, it would save over 6.6 GtCO₂e by 2030. Furthermore, if VRF MEPS were increased by at least 30%, 1.4 Gt CO₂e would be saved by 2030.

1. POLICIES AND STRATEGY

Developing a national cooling efficiency strategy and roadmap through technical and economic analysis on cooling demand, HFCs alternatives and efficiency improvement pathways. Policy recommendations will be provided for potential inclusion in the 14th Five Year Plan.

2. MEPS

Providing technical assistance focusing on standards-makers in China to improve existing MEPS for Variable Refrigerant Flow (VRF) ACs in the commercial sector and to aid the transition of residential and commercial ACs to efficient, clean cooling across the market.

3. MARKET TRANSFORMATION

Increasing the market share of high efficiency ACs through developing procurement policies and sub-national implementation programs in Chinese cities that are expected to peak emissions earlier. The estimated cumulative reduction potential in China for transitioning all residential and commercial air conditioning to higher efficiency is 16.9 GtCO₂e (2020-2030) and 52.1 GtCO₂e (2020-2050).^{xxxi} There is a large spillover effect outside China as China exports similar volumes of residential ACs as it sells domestically.

2. Develop a national cooling plan and strategies

China should develop a national cooling plan and integrate it into China's 14th Five Year Plan and 2050 energy and GHG emission long-term-strategy program. China should include improving cooling efficiency as a priority area under its Nationally Determined Contribution to the UN Framework Convention on Climate Change.

3. Establish an efficient, clean cooling initiative

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to catalyse action at scale. This could build on and learn from China's successful green lighting initiative.

4. Encourage efficient, clean cooling abroad

China should encourage other countries to adopt ambitious MEPS or appropriate mutual recognition of standards. We recommend this include developing countries through One Belt One Road and the South-South Cooperation Platform.

5. Mainstream efficient cooling into the finance system

China should prioritize financing of efficient, clean cooling in its economic system to provide incentives to support this transition, for example by requiring publicly-supported housing development credit lines to include thermal comfort measures e.g. passive design, shading, and cool roofs (both upgrades and new developments).

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ABOUT K-CEP

K-CEP is a philanthropic collaboration launched in 2017 to support the Kigali Amendment to the Montreal Protocol and transitioning to efficient, clean cooling solutions for all.

CONTACT US

We welcome feedback. For more details and a full list of sources, please visit www.k-cep.org, follow us at @Kigali Cooling, or contact us at info@k-cep.org and humin.hu@climateworks.org