ENERGY FOUNDATION
能源基金会

SCOPING STUDY ON MITIGATION POTENTIAL OF REFRIGERATION AND AIR CONDITIONING PRODUCTS IN CHINA

2020

01 Background

China is the world's largest producer, consumer, and exporter of refrigeration and air-conditioning products. In 2019, China's output value for refrigeration and air-conditioning products reached 800 billion RMB, and the export value was 200 billion RMB. Electricity consumption for cooling accounts for more than 15% of the total electricity consumption, and it is growing with an average annual rate of about 20%. In June 2019, China Green Cooling Action Plan (GCAP) was co-issued by the National Development and Reform Commission and six other ministries. The plan introduced energy goals that call for an energy efficiency increase of refrigeration and air conditioning products by more than 25% by 2030 and an increase in the market share of green and efficient refrigeration and air-conditioning products by more than 40%. The Ministry of Ecology and Environment also plans to incorporate alternative refrigerant and energy conservation tasks that are aligned with the climate goal into the 14th Five-Year Plan outline.

To meet the ambitious energy-conservation goals outlined in the GCAP, it is essential to identify and prioritize critical sectors and products that can bring the greatest mitigation potentials. There are a wide variety of refrigeration and air-conditioning products in China, among which the market penetration, the cooling capacity, and the operating conditions—factors that affect products' energy consumption—are very different. Besides, the energy savings potential and the cost of energy efficiency improvement of these products differ significantly due to different energy efficiency levels and technical variations among products. Thus, the mitigation potential analysis needs to be conducted with consideration of these factors.

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02 Analysis of Mitigation Potential of Refrigeration and Air Conditioning Products

This mitigation potential analysis was done under three scenarios: the business-as-usual scenario, the moderate scenario, and the GCAP scenario[1]. The study touches on five major sectors under the refrigeration and air conditioning industry and 29 types of key products, whose energy consumption makes up an overriding percentage of the overall energy consumption by cooling products. The five major sectors are household appliance, industrial and commercial refrigeration, industrial and commercial AC, data center, and transportation AC[2]. Using data from 2019, this research predicts the electricity saving by these products for the following ten years (2021-2030) base on factors including product sales, operation conditions, energy-saving technology potential.

[1] The business-as-usual scenario is calculated based on the current energy consumption and policies in the refrigeration and air conditioning industry. The GCAP scenario is calculated according to the rigorous energy efficiency improvement goals and tasks proposed in the plan. The moderate scenario is somewhere in between; it is calculated based on a mild energy efficiency improvement of the major cooling products.

[2] Only Electronic Vehicle AC was covered in this particular study under the transportation AC.

Electricity consumption

Under the business-as-usual scenario, the total electricity consumption of the 29 products in 2019 is about 1,347.2 billion kWh, representing 18.6% of the total electricity consumption. Total emissions from these products are about 765 million tons (Mt) CO_2 equivalent. Looking from the sector side, the household appliance sector accounts for the largest proportion of electricity consumption. With a total of 602.5 billion kWh, it adds up to 44.7% of the total electricity consumption out of the 29 products. This is followed by the industrial and commercial refrigeration sector, which consumes 459 billion kWh. That is 34.1% of the total electricity consumption. From the product side, the three most power-consuming products are room air conditioners, self-contained refrigerated display cabinets, and refrigerators (freezers). Figure 1 and 2 show the proportion of electricity consumption by five major sectors and by 29 types of products from 2019.

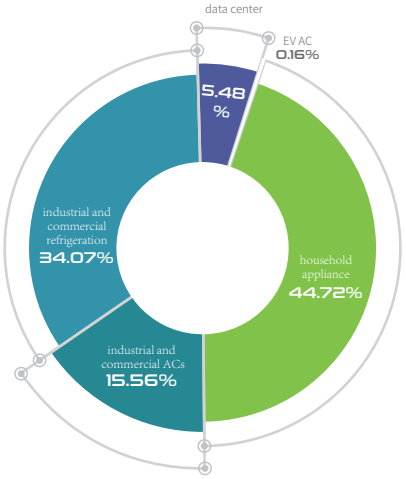

Figure 1. Electricity consumption by sectors in 2019

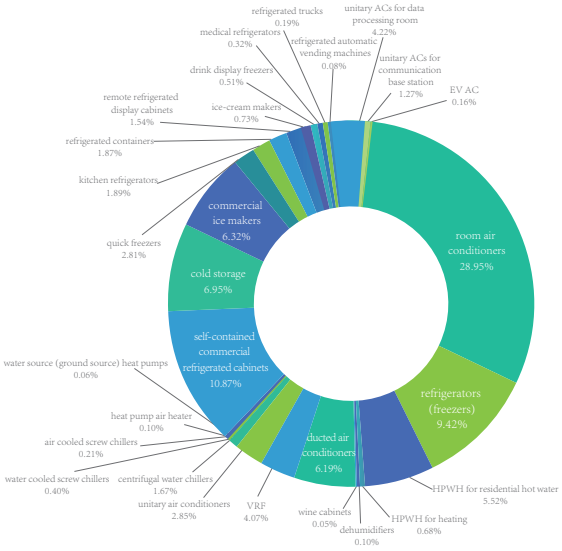

Figure 2. Electricity consumption by product types in 2019

Projected electricity savings and emission reductions

The projected cumulative electricity savings and emission reduction will be 1,376.1 billion kWh and 682 billion tons CO_2 equivalent, respectively, under the moderate scenario in the next ten years. However, more significant savings and reduction potential could be achieved with an ambitious yet tangible plan. Under GCAP, the projected electricity saving will be 2,261.8 billion kWh, and the emission reduction will be 1.123 billion tons CO_2 equivalent, almost doubles the numbers under the moderate scenario.

Figure 3 shows the electricity savings by each of the five major sectors. Under the GCAP scenario, the home appliance sector has the largest electricity-saving potential, with electricity saving counts of 34.8% of the total electricity saving from all five major sectors. It is due to the high market penetration of home appliances. The second place is industrial and commercial refrigeration, accounts for 33.5% of the total electricity savings. It is due to the large number of products that are covered by this sector. The next on the list is the industrial and commercial AC sector. These three sectors account for nearly 93% of the total electricity savings in the refrigeration and air conditioning industry.

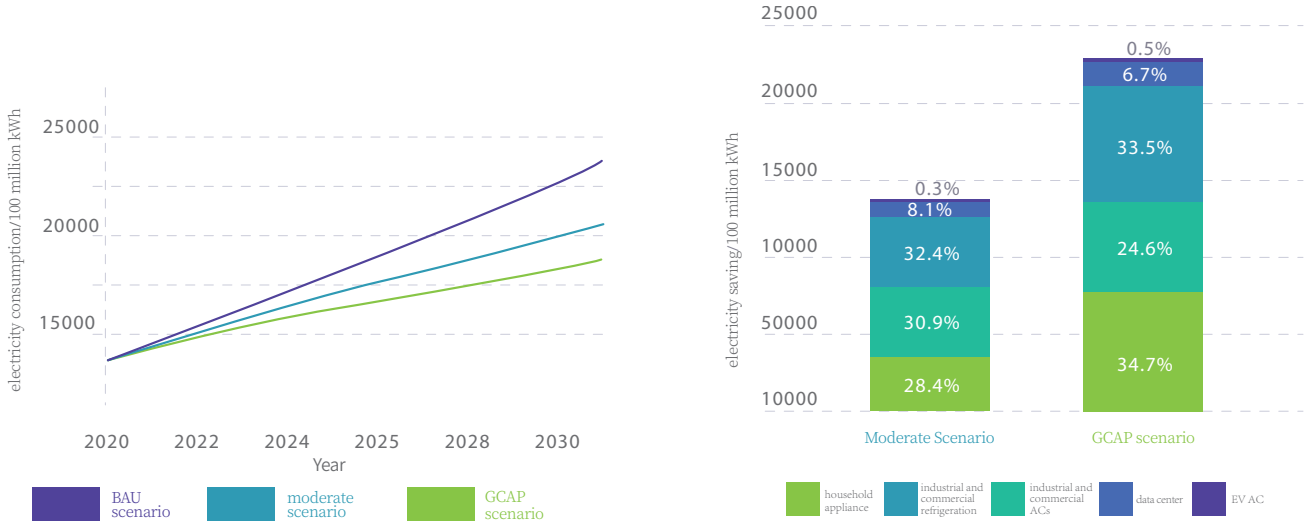

Figure 3. Estimated electricity savings by five major sectors under different scenario

The projected electricity savings of the 29 products and savings by proportion are shown in Figure 4 and Figure 5. Under the CGAP scenario, three products that possess the highest electricity saving potentials are room air conditioners, variable refrigerant flow (VRF), and self-contained refrigerated display cabinets, each account for 21.9%, 12.3%, and 10.5% of the total electricity saving of all 29 products, respectively. Room air conditioners have huge potential due to their extensive sales volume and wide use. VRF' s tremendous potential results from MEPS improvement, responding to the GCAP' s 40% improvement goal. For self-contained display freezer, it is its long service hours and the prospect increase in demand that contribute greatly to the its electricity savings potential.

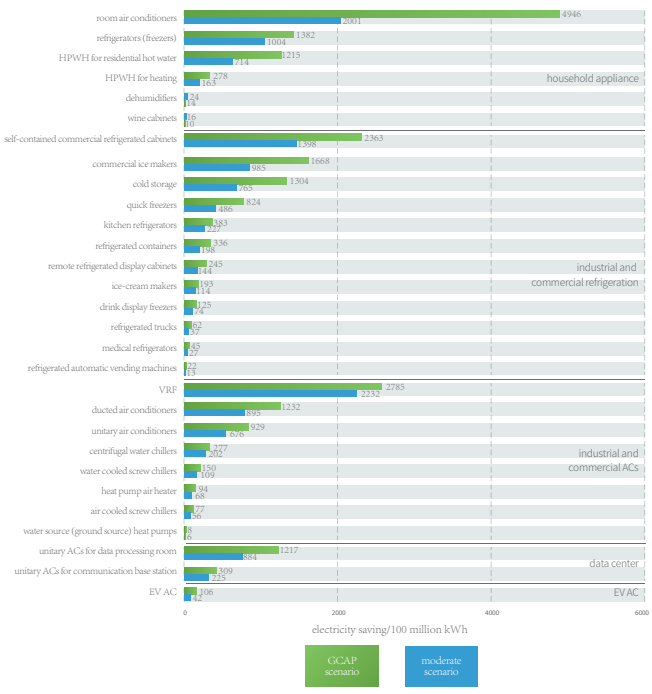

Figure 4. Projected electricity savings by 29 refrigeration & air-conditioning products

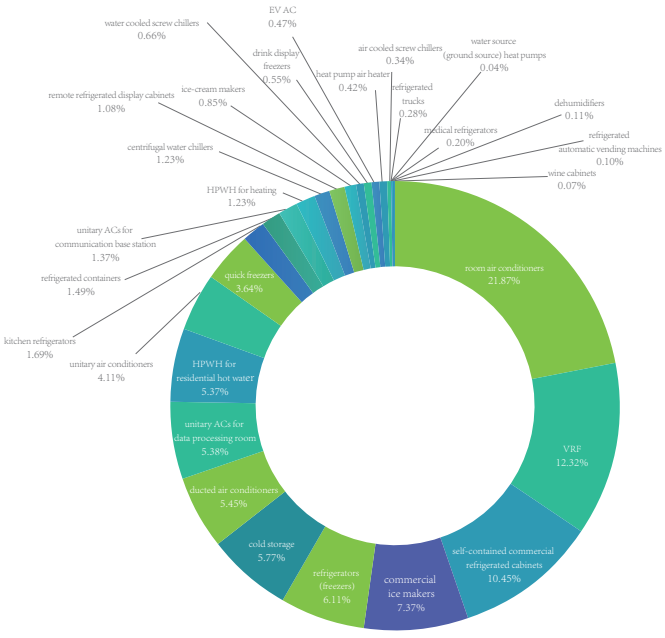

Figure 5. Projected electricity savings by proportion by 29 refrigeration & air-conditioning products under GCAP scenario

03 Policy Priorities and Recommendations

MEPS development and revision

Establishing Minimum Energy Performance Standards (MEPS) is the most direct and effective way to promote energy conservation regarding energy-consuming equipment and products. Upgrading refrigeration and air-conditioning products' MEPS can synergize a transition that boosts the use of low global warming potential (low-GWP) refrigerants in replacing high-GWP HFCs refrigerants. Recommendations on MEPS development and revision are formulated with the consideration of policy goals and requirements put forward in the energy-saving and environmental protection field, products' mitigation potential, and the status quo of MEPS development of each major product.

The priority for the next three to five years should be given to the development and revision of MEPS for products with considerable energy-saving potential and whose MEPS are obsolete or missing, including:

A VRF, chillers

B self-contained refrigerated display cabinets, refrigerated display cabinets with remote condensing units, cold storage

C electrically driven motor vehicle air-conditioning units, refrigerated containers

D unitary air-conditioners for computer and data processing room, unitary air-conditioners for communication base station

E heat pump water heaters for residential hot water, heat pump water heaters for heating)

F household refrigerators (freezers), kitchen refrigerators and beverage freezers, etc.

Energy label

Looking at China' s MEPS development status quo, we realized that energy labels could be further used to guide consumers in choosing energy-efficient products. Energy labels can provide users and consumers with the necessary information to make right purchasing decisions, which ultimately increases the market share of green and efficient products. Energy labels can also help provide energy-saving guides and improve the supervision of online and off-line sales systems. We recommend that focus be given to the following areas:

A

Product for Inclusion

Focus on the inclusion of products aimed at consumers, namely house appliances, into the scope of energy labeling in the next three to five years. These include ducted air conditioners, VRF, vending machines, heat pump heat for domestic hot water dispensers, heat pump water heaters for heating, kitchen refrigerators, beverage freezers, dehumidifiers, etc.

B

Information on Label

Expand the content and information delivered by energy labels to include energy efficiency "Top Runner" information, energy bill calculator, refrigerant information, quality and performance information, regulatory information.

C

On-line Sales

Improve the use and the supervision of energy labels in online commodity trading markets and online sales systems. Standardize the energy label requirements for online and offline sales. Sellers (including online commodity traders) and third-party trading platforms to establish and execute an inspection, acceptance, and monitoring system.

Incentives

The Government's Energy-Saving Products Procurement Program and the Enterprise Income Tax Preferential Catalogue of Energy-saving and Water-saving Equipment spearhead the green procurement by big corporations. Therefore, an on-time improvement and upgrade of the Program and the Catalogue can stimulate the market transformation in producing high-efficiency products. Upon the assessment of mitigation potential and demonstration impact, the analysis suggests to expand the Program and the Catalogue to further cover the following products: unitary air-conditioners for computer and data processing room, unitary air conditioners for communication base station, hospital freezers, refrigerated trucks, electrically driven motor vehicle air-conditioning units, refrigerated display cabinets, commercial ice makers.

Subsidies and incentives should be used in places where conditions allow to encourage residents to purchase green and efficient cooling products and upgrade or replace inefficient products. In sales, encouraging retail companies and e-commerce platforms to set up designated areas for green and efficient products and establishing a green consumption credit system are ways to promote green and low-carbon consumption. Meanwhile, the low-carbon consumption concept of cooling products should be enhanced by low-carbon advocacy through various forms of publicity to bring public awareness.

The Scoping Study was initiated and funded by Energy Foundation.

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