

# 中国制冷空调产业发展和 制冷剂替代进程

## China R&AC Industry Development and Refrigerant Substitution Progress

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# 主要内容 Contents

## 一、制冷空调产业发展现状

Development of R&AC Industry

## 二、制冷剂替代进程

Progress of Refrigerant Substitution

# 一、制冷空调产业发展现状

## Development of R&AC Industry

中国是当今全球最大的制冷空调设备制造国和消费市场，行业内多项产品产量位居世界第一。

Nowadays, China is the largest manufacturer of refrigeration and air conditioning equipment and has the biggest consuming market. The production volume of many types of industrial products rank first in the world.

根据CRAA统计，中国制冷空调行业2018年度实现工业总产值近7000亿元，同比增长超过6.5%；出口交货值达1200亿元，同比增长超过9%。

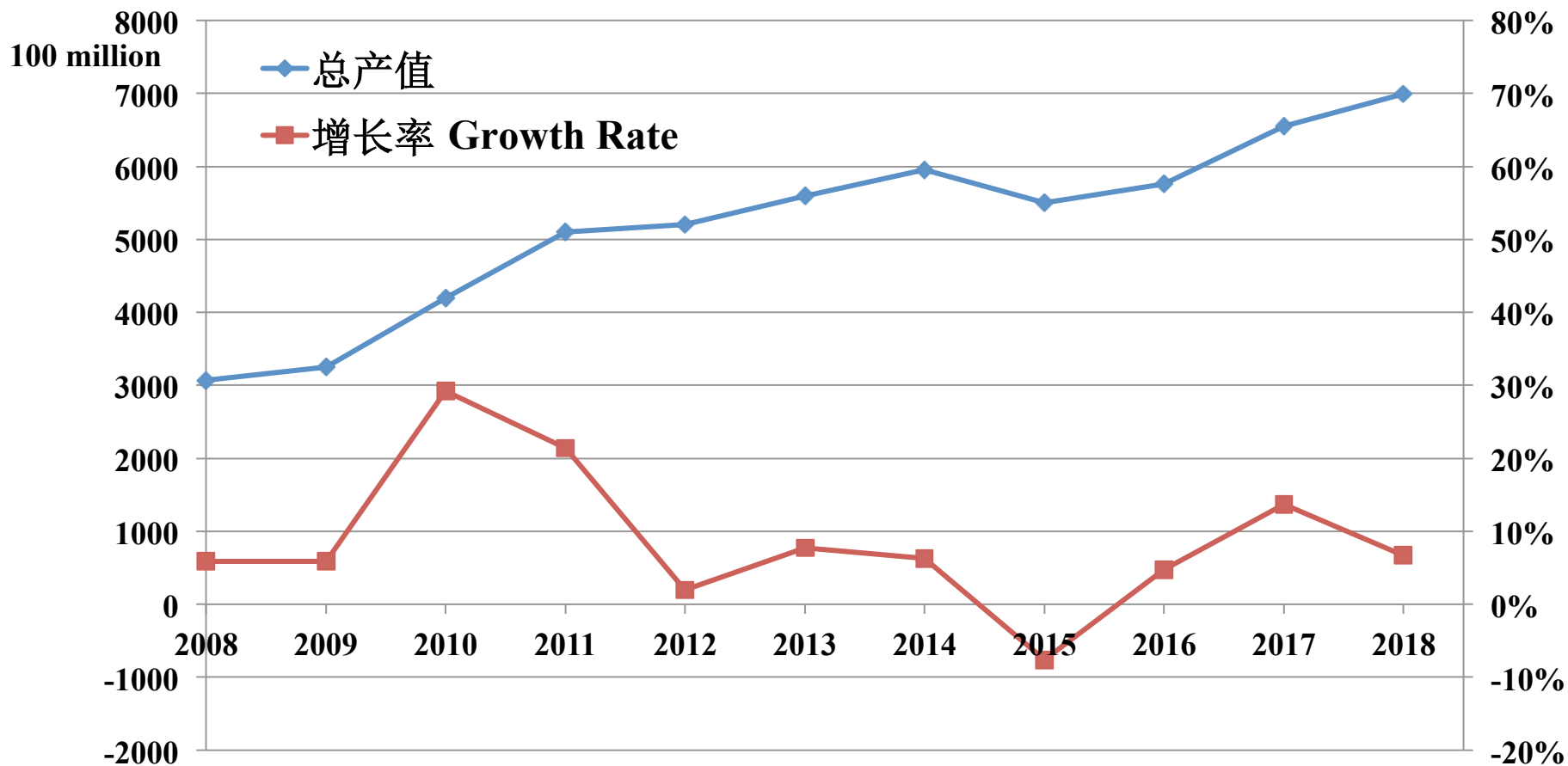
According to CRAA statistics, the total output value of China R&AC industry in 2018 was over RMB 700 billion, increased 6.5% from previous year, while the export delivery value was about RMB 120 billion, rose 9% .

# 2008—2018 行业工业总产值增长情况

Trend of 2008-2018 Total Output Value in China R&AC Industry

亿元

## Total Output Value



# 行业技术发展方向 Technology Trends

节能环保是当今人类社会文明发展的主流方向，多年来行业的发展也一直是围绕着节能环保的主题不断迈进。

Energy conservation and environmental protection are the main themes during the development of human society civilization. Over years, the industry development has been carried out surrounding the themes.

节能环保需求成为推动制冷空调行业技术进步的原动力，近年来行业中节能环保产品不断涌现、市场占有率在稳步提高。

The demand for energy conservation and environmental protection has become the driving force in terms of promoting the technical progress of refrigeration and air conditioning industry. In recent years, energy-saving and environmental protection products have continuously sprung up and their market share increased steadily.

在传统产业领域，新技术、新发明带来了新的市场机遇和经济增长点：

In traditional sectors, new technologies and new inventions brought new market opportunities and economic growth points

✓ 直流驱动及变容量调节技术 DC drive and variable capacity adjustment technology

✓ 热泵技术 Heat pump technology

✓ 蒸发冷却技术 Evaporative cooling technology

✓ 互联网、大数据、人工智能与传统制造业的融合发展 The integrative development of internet, big data, artificial intelligence, as well as traditional manufacturing industry

各种余热、废热和可再生能源利用产品的大量开发应用也为国家的节能减排事业做出了重要贡献。

development and application of plenty of products utilizing afterheat, waste heat and renewable energy products have also made great contributions to the national energy conservation and emission reduction.

对节能环保的关注推动了产业结构优化调整，以用户端节能效益为导向，对各类制冷空调产品能效水平的评价，正在由单一名义工况性能系数考核逐步转向对产品部分负荷综合性能系数的考核，评价指标体系的转变在实际应用中显示出巨大的节能潜力，也取得了显著的节能效益。

While concerning energy conservation and environmental protection, it improved the industrial structure optimization, which focusing on clients' energy-saving benefits. The energy efficiency evaluation for all types of refrigeration and air conditioning products has been gradually shifting from the single nominal working condition performance coefficient assessment to the part-load comprehensive performance coefficient assessment. It shows great energy saving potential in practical application, also has grant remarkable energy saving benefits.

# 市场最新动态

## Market Situation

- ❖ 国家为治理雾霾实施的“煤改电”等政策措施，推动行业内热泵类产品生产和技术水平快速发展。

Government policies coping with smog, such as “coal to electricity” have promoted the rapid development of heat pump production and technical level in the industry.

- ❖ 百姓居住条件改善以及对空气品质的重视和需求提升，推动小型家用多联机和空气净化产品市场的快速增长。

The improvement of people's living conditions, the concern and demand to air quality, has promoted the rapid growth of household VRF and air purification products markets.

- ❖ 人民生活水平提高带来对食品品质和安全要求的提升，推动冷冻冷藏设备和冷链物流领域生产和技术水平的较快增长。

The improvement of people's living standards brought requirements to the food quality and safety, which promoted the rapid growth of production and technology levels of refrigeration equipment and cold chain logistics.



# 2 制冷剂替代进程

## Progress of Refrigerant Substitution

### 2.1 《蒙特利尔议定书》 Montreal Protocol

为了保护大气臭氧层，国际社会于1985年缔结了《保护臭氧层维也纳公约》，在1987年进一步签署了《关于消耗臭氧层物质的蒙特利尔议定书》。

In order to protect the atmospheric ozonosphere , the international community concluded the *Vienna Convention for the Protection of the Ozone layer* in 1985 and further signed the *Montreal Protocol on Substances that Deplete the Ozone Layer* in 1987.

通过有组织的履约行动，2010年1月1日在全球范围内实现了CFCs及哈龙生产和消费的完全淘汰，《蒙特利尔议定书》成为全球国际公约实施典范。With organized implementation actions, the complete elimination of production and consumption of CFCs and halon worldwide was achieved by January 1, 2010. It made

**The Montreal protocol a model for the implementation of global international conventions.**

## 2.2 HCFCs加速淘汰

### Accelerating Elimination of HCFCs

随着CFCs淘汰的完成，在2007年9月举行的《蒙特利尔议定书》第19次缔约方大会上，国际社会又达成了加速淘汰HCFCs的决定。

With the completion of CFCs elimination, the international community reached a deal to accelerate HCFCs elimination at the 19th conference of the parties of the Montreal protocol in September 2007.

中国在2010基限年的HCFCs消费总量为29.8万吨，约占全球消费总量的40%；其中用作制冷剂（包括制冷维修领域）的消费量约为19.5万吨，占全国总消费量的2/3。

in 2010, China consumed 298,000 tons of HCFCs, which account for about 40% of total global consumption. The refrigerant consumption (including refrigeration maintenance sector) was about 195,000 tons, accounting for 2/3 of the total consumption in China.

## 2.3 中国的ODS淘汰行动 China's ODS Phase-out Action

我国于1991年正式加入了《蒙特利尔议定书》，在议定书的框架下，我国政府组织开展了全面的ODS淘汰和替代转换工作，于1993年发布了《中国消耗臭氧层物质逐步淘汰国家方案》。

China formally acceded to the Montreal protocol in 1991. Under the protocol framework, the Chinese government organized and carried out comprehensive ODS phase-out and substitute work, and released *China's national program for phasing out ozone-depleting substances* in 1993.

## CFCs淘汰进程 CFCs Phase-out Process

中国在2007年7月1日实现了CFCs及哈龙生产和消费的完全淘汰，提前两年半完成议定书规定的目标，体现了负责任大国的良好形象。

By July 1, 2007, China completely eliminated the production and consumption of CFCs and halon, and achieved the protocol target two and half years beforehand. It shows China is a responsible nation.

中国制冷空调行业共计淘汰CFCs约2.6万吨，为国家淘汰任务目标的完成做出了重要贡献。

By July 1, 2007, China refrigeration and air conditioning industry eliminated about 26,000 tons of CFCs in total, which made an great contribution to completion of national elimination target.

# HCFCs加速淘汰进程

## Accelerated HCFCs phase-out process

围绕HCFCs加速淘汰议案，国家生态环境部（原环境保护部）牵头组织各相关机构分别编制了国家整体战略和分行业的HCFCs淘汰管理计划（HPMP），全面启动了我国HCFCs淘汰转换工作。

According to the accelerated HCFCs phase-out plan, the Ministry of Ecology and Environment took the lead in organizing relevant organizations to draft the national strategy as well as the HCFCs phase-out management plan (HPMP) for related industry, initiated the HCFCs phase-out comprehensively.

在第一阶段（2011-2015）行业HCFCs淘汰管理计划的实施过程中，大量低GWP替代技术得到了广泛采用：

During the implementation of HPMP stage-I (2011-2015) , many low GWP substitute technologies were widely adopted.

✓工商制冷空调领域更多的采用了CO<sub>2</sub>、NH<sub>3</sub>、R32等环境友好的替代制冷剂，高GWP值的HFCs类制冷剂在第一阶段仅占不到30%的份额。

In ICR sector, environmental friendly alternatives were adopted, including CO<sub>2</sub>、NH<sub>3</sub>、R32 etc.. Among these, high GWP HFCs accounted for less than 30%.

✓家用空调领域采用R290和R410A作为替代技术选择。

R290 and R410A were adopted as alternatives for household sector .

制冷空调行业第一阶段行业计划的实施完成后，每年可取得温室气体直接减排2200万吨CO<sub>2</sub>当量的协同效益，同时行业对替代新产品能效提升的关注带来了更多的温室气体间接减排协同效益。

After the accomplishment of HPMP stage-I, the annual emission was reduced to 22 million tons of CO<sub>2</sub> equivalent. At the same time, improving product efficiency has directly reduced greenhouse gas emission.

第一阶段行业计划实施取得的环境效益远超国内外预期。

The environmental benefits achieved in the implementation of HPMP stage-I far exceeded expectations from both China and other countries.

制冷空调行业第二阶段HCFCs淘汰管理计划（2016-2020）在2016年12月初的《蒙特利尔议定书》执委会第77次会议上获得批准：

The HPMP stage-II for the refrigeration and air-conditioning industry (2016-2020) was approved at the 77th meeting of the Montreal Protocol Executive Committee in early December 2016.

工商领域第二阶段行业计划涉及的产品转换包括有单元机、冷冻冷藏设备、热泵热水机、冷水机组等，计划采用NH<sub>3</sub>、CO<sub>2</sub>、R32、HFOs、HC等作为替代制冷剂，第二阶段淘汰活动将覆盖更多的中小企业。

In the HPMP stage-II for ICR sector, NH<sub>3</sub>、CO<sub>2</sub>、R32、HFOs and HC are proposed as alternatives, involved products include unitary AC, refrigeration & condensing units, chillers etc.. More small and medium enterprises will be included.

家用领域第二阶段行业计划涉及的产品包括房间空调器、家用热泵热水器，计划采用R290和CO<sub>2</sub>作为替代制冷剂。

**In the HPMP stage-II for household sector will include room AC, residential heat pump water heater. R290 and CO<sub>2</sub> will be used as alternatives**



在第一阶段行业计划中，我们分别组织实施了R32在小型空调设备中以及CO<sub>2</sub>/NH<sub>3</sub>复叠技术在冷冻冷藏设备中替代R22的示范项目，取得了圆满成功。由烟台冰轮公司承担的CO<sub>2</sub>/NH<sub>3</sub>复叠技术示范项目在《蒙特利尔议定书》缔结30周年纪念活动中被授予“保护臭氧层示范项目奖”，CO<sub>2</sub>/NH<sub>3</sub>复叠技术产品还先后荣获“国家重点新产品”及“改革开放40周年机械工业杰出产品”称号。

In The HPMP stage-I , CRAA organized demonstration projects including utilizing R32 in small air conditioners and using CO<sub>2</sub>/NH<sub>3</sub> cascade technology replacing R22 in refrigeration equipment, which have completed successfully. The CO<sub>2</sub>/NH<sub>3</sub> cascade technology demonstration project undertaken by Yantai Moon was awarded "Exemplary Project Award" , and the product have also won the title of "national key new product" and "outstanding product of machinery industry in the 40th anniversary of reform and opening up".

据初步统计，行业计划支持的 CO<sub>2</sub>/NH<sub>3</sub>复叠技术替代R22产品的市场推广已超过2000套，替代和淘汰R22消费量超过0.5万吨；R32替代R22空调累计销售已超过4500万台，累计实现淘汰R22消费量超过5万吨；仅此二项相加累计实现温室气体直接减排超过7700万吨CO<sub>2</sub>当量。

According to the preliminary statistics, more than 2,000 sets of CO<sub>2</sub>/NH<sub>3</sub> cascade products have been put into the market, which reduced over 5000 tons of R22. Over 45 million R32 air conditioners were sold accumulatively, with over 50,000 tons of R22 reduced. Added up, the greenhouse gas emission have been accumulatively reduced by more than 77 million tons of CO<sub>2</sub> equivalent.

## 2.4 基加利修正案与HFCs削减 Kigali Amendment and HFCs phase-down

2016年10月召开的《蒙特利尔议定书》第28次缔约方会议经过艰苦的谈判，达成了《蒙特利尔议定书》关于HFCs削减的基加利修正案。这是《蒙特利尔议定书》履约进程中又一里程碑式的历史性事件。

The 28th Meeting of the Parties to the Montreal Protocol, held in October 2016, reached the Kigali Amendment to the Montreal Protocol on HFCs phase down, after an arduous negotiation. This is another milestone historic event in the Montreal Protocol implementation process.

国家类别	主要发展中国家 (中国等)	少部分发展中国家 (印度、沙特、巴基斯坦等)
基线	100%HFCs三年均值 (2020-2022) +65%HCFCs基线	100%HFCs三年均值 (2024-2026) +65%HCFCs基线
削减进度	2024: 冻结 2029: 10% 2035: 30% 2040: 50% 2045: 80%	2028: 冻结 2032: 10% 2037: 20% 2042: 30% 2047: 85%

修正案的达成意味着目前制冷空调行业普遍使用的R410A、R134a、R404A等常用的高GWP的HFCs制冷剂在有限的时期内将走向市场应用的完结。

The Kigali Amendment means that high-GWP HFCs such as R410A, R134a and R404A, which now commonly used in the refrigeration and air-conditioning industry, would be replaced within a limited time.

基加利修正案明确实施HFCs削减时要关注能效提升的协同效应。

The Kigali Amendment specifies that energy efficiency improvement should be concerned while phasing down HFCs.





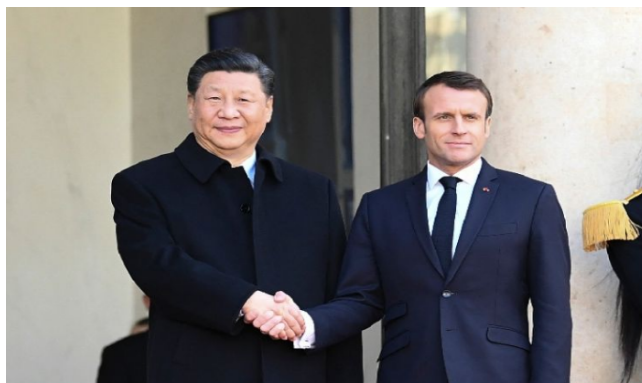






❖ **2019年3月26日中国和法国共同发布的联合声明也明确提出：  
The joint statement issued by China and France on March 26, 2019  
expressed clearly that both of them would:**

- ✓ **推动提高制冷行业能效标准。  
Improve energy efficiency standards in the refrigeration industry.**



基于基加利修正案的规定及全球未来发展趋势，我们在第二阶段行业计划实施方案中已确定不再资助采用高GWP值HFCs作为替代技术的生产转换项目，以此引导企业走更加绿色环保的可持续发展道路。

Based on the Kigali Amendment and the global industry development trend, China will no longer fund production conversion projects using high GWP HFCs as alternatives. That will lead to more green and sustainable development.

# 结束语 Conclusion

- 中国政府和行业各界为履行《蒙特利尔议定书》做了大量富有成效的工作，为国际履约目标的达成做出了巨大的贡献，体现了负责任大国应有的态度，也赢得了国际社会的广泛赞赏。

The Chinese government and the industry have done a lot of fruitful work for the Montreal Protocol implementation, and have made tremendous contributions to achieving the goals. It showed China's responsible attitude and won widespread appreciation from the international community.

- 我们希望在未来的工作中与国际同行进一步加强合作、共享信息，积极探寻更加绿色高效可持续的行业解决方案，为实现ODS完全淘汰和减缓全球变暖做出更多的努力和贡献！

We hope to strengthen cooperation and share information with global peers in the future, to explore, more green efficient and sustainable industry solutions, and to make more efforts and contributions in order to eliminating ODS and slowing down global warming!