

BUILDING A CLIMATE-FRIENDLY COOLING SECTOR THROUGH ENERGY EFFICIENCY IMPROVEMENT: A CASE STUDY OF NINGBO CITY

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Outline

1. **Background:** Cooling in China and Ningbo
2. **Project Introduction:** Building a Climate-friendly Cooling Sector
3. **Energy Efficiency Assessment Case Study:** Ningbo Jinguang Mall
4. **Conclusions**

Why targeting cooling?

- **HFCs:** High GWP, global annual emission growth rate of 10%-15% and could account for 20% of total GHG emissions in 2050
- **Fossil fuel powered electricity used for cooling** contributes additional 10% global carbon emissions
- **Cooling loads:** one of the largest power system peak loads with the lowest efficiency

China's potential for GHG reduction in cooling sector is far from being tapped.

- **Electricity use:** over 15% of national total use, almost 20% annual growth rate
- **Cooling loads:** 60% of summer peak load in large & medium-sized cities
- **Energy saving potential:** 30%-50% for major refrigeration/cooling systems

China's Green and High Energy Efficiency Cooling Action Plan

Green and High Energy Efficiency Cooling Action Plan was released jointly by 7 ministries of Chinese government in June 2019.

Key Targets:

- **By 2022**, cooling products including household AC's EE level up by over 30%; market share of green and high EE cooling products up by 20%; electricity save up to 100 billion kWh.
- **By 2030**, the cooling efficiency of large-scale public buildings up by 30%; average cooling efficiency up by over 25%; market share of green and high EE cooling products up by over 40%; electricity save up to 400 billion kWh.

Why Targeting the City of Ningbo?

Basic Info:

- ❑ Located in **Yangzi-Delta-River areas** of China
- ❑ Climate: **hot/humid** with significant cooling needs
- ❑ China's largest port & marine product center: **250,000 tons** of refrigeration handling capacity
- ❑ Energy mix: **97%** of fossil fuel
- ❑ **Electricity price:** among the highest in China

Cooling sector	% of total cooling electricity use
Industrial	50
Commercial	22
Public	13
Residential & others	15



Why Targeting the City of Ningbo? (continued)

Initial User Survey was conducted to identify energy efficiency potentials.

Key findings:

- ❑ Many cooling systems are over 15-20 years old, some even 25+ years.
- ❑ Efficiency level of old systems is one-third lower than the China's level 1 cooling efficiency standard.
- ❑ A significant number of cooling systems uses high GWP/ODP refrigerants (e.g., R22 and R404a).
- ❑ Over 80% of Ningbo's cooling system are owned by SMEs, lacking access to financing or face high borrowing cost



DEVELOPING A CLIMATE-FRIENDLY COOLING SECTOR THROUGH MARKET AND FINANCING INNOVATION

Overall goal: assist Ningbo in designing a city-scale climate-friendly, energy-efficient cooling initiative to capture multi-sectors opportunities in reducing GHG emissions and improving energy efficiency related to refrigeration and/or cooling

Key tasks:

- **Reviewing** cooling-related policies in China, **Identifying** policy gaps
- **Assessing** cooling-related technologies and applications
- **Designing** viable **business models** and innovative **financing mechanisms** that would allow Ningbo to carry out and finance a large-scale cooling initiative
- **Prototype design** on internet+ cooling application

Maximize Cooling Opportunities in Cities

Climate Friendly
Cooling Deployment

Internet+
cooling

Efficient
Cooling
Deployment

Comprehensive
resource
utilization

Climate
friendly
refrigerants

Promote
Renewables

Commercial

Public Sector

Residential

Freezer
(warehouse)

Refrigerator
(warehouse,
supermarket)

Cold-chain
transport

AC (hotels,
business
buildings)

Colleges

Hospitals

AC

Car

User Survey to Identify Potential in Ningbo

- To conduct three batches of user surveys with a plan of collecting info on 1,000 facilities to
 - have a landscape understanding about the city's cooling sector
 - to build project database for a city-wide *early replacement* program
- First round of survey received responses from 206 facilities of various types, ranging from manufacturing, food processing, cold storage, ice-making facilities, dairy factories, auto parts stores, super-market, shopping malls, restaurants, sport complex, hotels, conference centers, libraries, hospitals, amusement park, vocational college, universities, government facilities, transportation hub, and banks.



ENERGY EFFICIENCY ASSESSMENT CASE: JINGUANG MALL

Opened in 1998 in the busiest financial district, Jinguang Mall is one of the largest shopping mall in the city of Ningbo. The total construction area is 30,000 m², with Phase I (25,000 m²) and Phase II (5000 m²). Currently, there are 30 air-cooled heat pump units attached on the surface of the building. The estimated electricity use from heating & cooling is 1,984,770~2,778,678 kWh.

Energy Efficiency Assessment Case: Jinguang Mall

No.	Identified problems	EE action plan	Estimated cost saving	Estimated investment	Payback period
1	Inefficient air-cooled heat pump units	Invest in grade-1 efficiency frequency conversion centrifugal chillers (climate-friendly R134A), meeting the cooling demand of phase I & II at the same time	¥548,760	¥2,500,000	4.56
	Phase I & II has separate cooling systems				
2	High peak load	Invest in cold storage water tank to cut peak load	¥516,480	¥3,098,880	6.00
3	Inefficient AC fans	Partly replaced with high-efficiency DC frequency conversion EC fan	¥96,000	¥350,000	3.65
4	Chilled water pumps operate in fixed frequency	Switch to frequency conversion water pumps	¥14,400	¥45,600	3.17
5	Lack of group control	Invest in a set of BA controlling system	¥129,120	¥350,000	2.71

Conclusions

- Overall goal: assist Ningbo in designing a city-scale climate-friendly, energy-efficient cooling initiative to capture multi-sectors opportunities in reducing GHG emissions and improving energy efficiency related to refrigeration and/or cooling
- Specific goals include assessing cooling-related policies and technologies as well as designing viable business models and innovative financing mechanisms that would allow Ningbo to carry out and finance a large-scale cooling initiative
- The project will also explore extended opportunities beyond cooling energy efficiency retrofits, including renewable energy, comprehensive use of resources, cooling as a flexible grid resources, digitalization to transform cooling sector, and low- to zero-carbon transportation derived from cooling logistics
- Enabling green cooling to become a part of new economy (knowledge economy, internet+ economy, digital economy)
- **Build a scalable model transferable to other parts of China and beyond China**

QUESTIONS?

THANK YOU

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