

# Cooling Initiative under the World Bank Group

Montreal Protocol Coordination  
World Bank

October 27, 2024



**WORLD BANK GROUP**

# Montreal Protocol (MP) Agenda in Cooling Initiatives

## Growth (of cooling)

- Climate heat (adaptation)
- Productivity
- Comfort/health/safety

## Private Sector

- Technology / innovation
- Business opportunities
- Jobs

## Development Finance

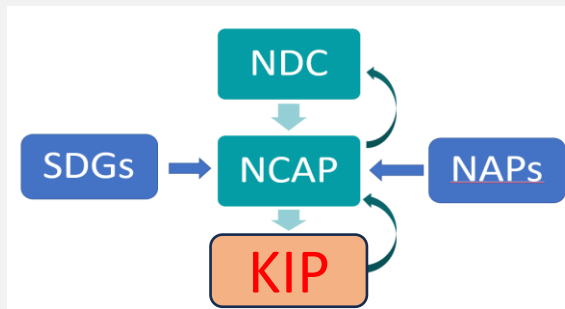
- Synergies
- Mainstreaming

## Climate / Ozone Policy

- Paris Agreement Goal
- **MP & Kigali Amendment\***
- **Greenhouse Gas (GHG) mitigation**

## Government Plans

- Economic & social policy



## Energy

- **Energy efficiency (EE), MEPS\*\***
- Renewable energy
- No/free/less energy

## Refrigerants

- **Non-ODS\* refrigerants**
- **Zero/low GHG refrigerants**
- Life cycle management
- No refrigerants

\*ODS: Ozone Depleting Substances

**Red box** = MP Agenda

**Green box** = Direct Linkages



\*The Montreal Protocol on Substances that Deplete the Ozone Layer was amended in Kigali in 2016 to include for the first time, non-ozone depleting substances (ODS) but potent GHGs – hydrofluorocarbons (HFCs) – a new group of controlled substances

\*\*Minimum energy performance standard

# Cooling Applications and Linkages

*UN Sustainable Development Goals and Linkages to MP and Cooling*



Refrigeration and Air Conditioning & Foam



AC



Refrigeration



Room AC



Building AC



Car/Mobile AC



Domestic



Commercial



Industrial



Transport



Cold Chain



Health

Buildings

Education

Agriculture & Fisheries

Transport



# 1998 - 2013: Chiller Replacement Projects

Efforts to harness ODS/EE/GHG synergies are not new. Multilateral Fund (MLF)\* provided subsidies for replacing 1<sup>st</sup> generation chlorofluorocarbon (CFC) -based chillers; whereas Global Environment Fund (GEF) provided support to ensure the new chillers were more efficient.



**Thailand: MLF + GEF**

**Mexico: MLF**

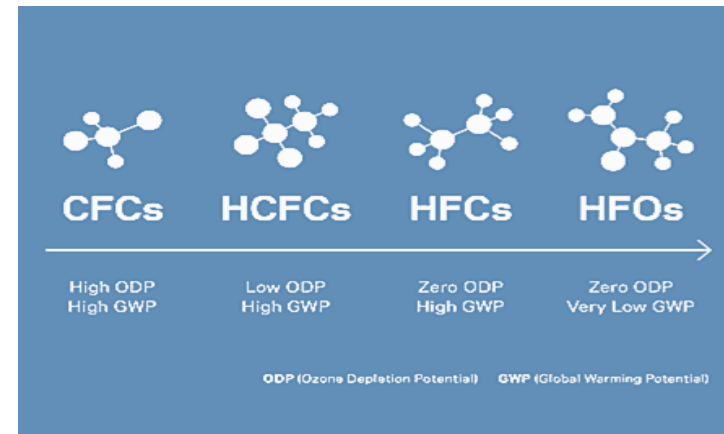
**Türkiye: MLF**

**Jordan: MLF**

**India: MLF + GEF**

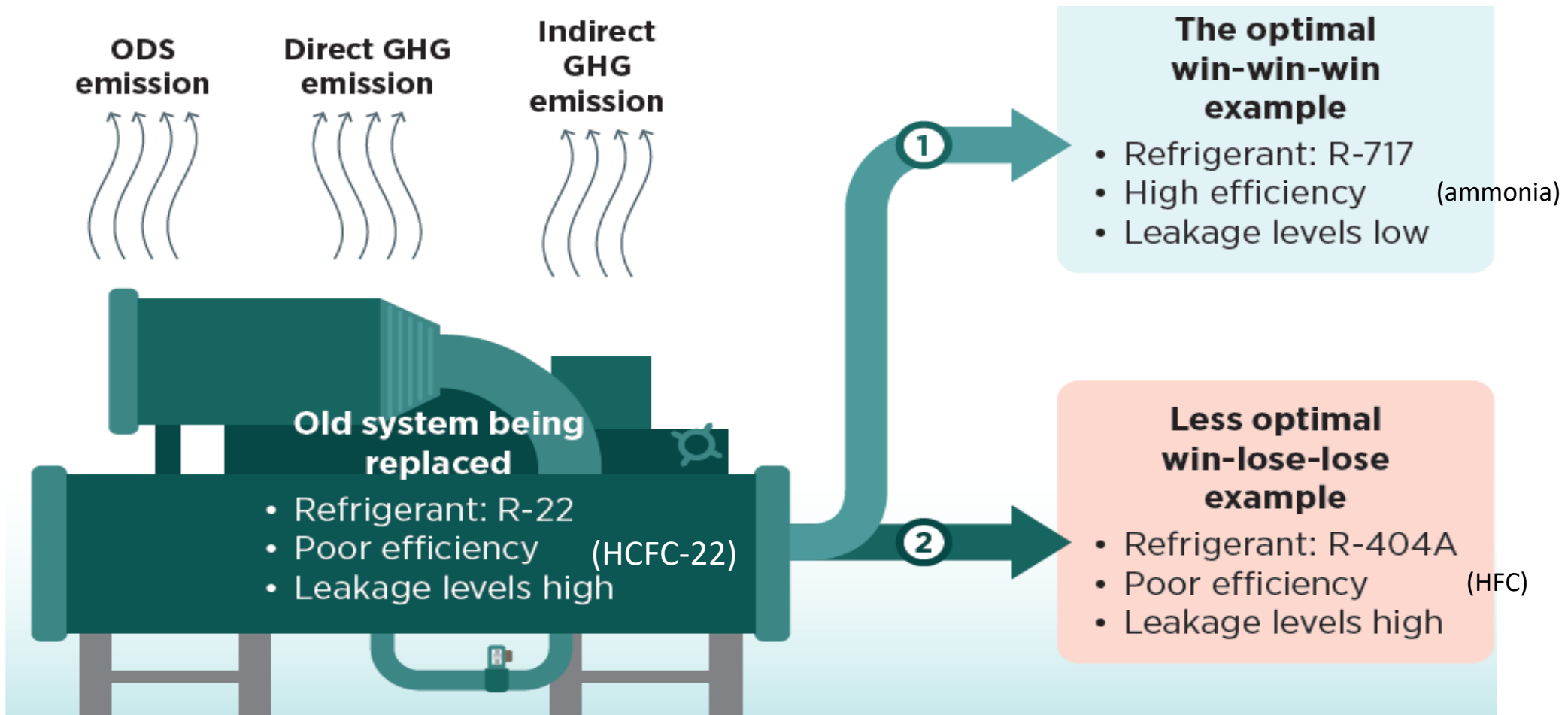
**Philippines: MLF + GEF**

## F-gas Generations



Since 1991, the World Bank (WB) has served as one of the four Implementing Agencies of the MLF with over US\$1.2 billion channeled through 2023 to more than 20 countries avoiding roughly 1.3 billion tons of CO<sub>2</sub> eq. emissions annually and phaseout of 68% of all ODS covered by the MLF at about 38% of the cost.

# 2018: The Triple Win



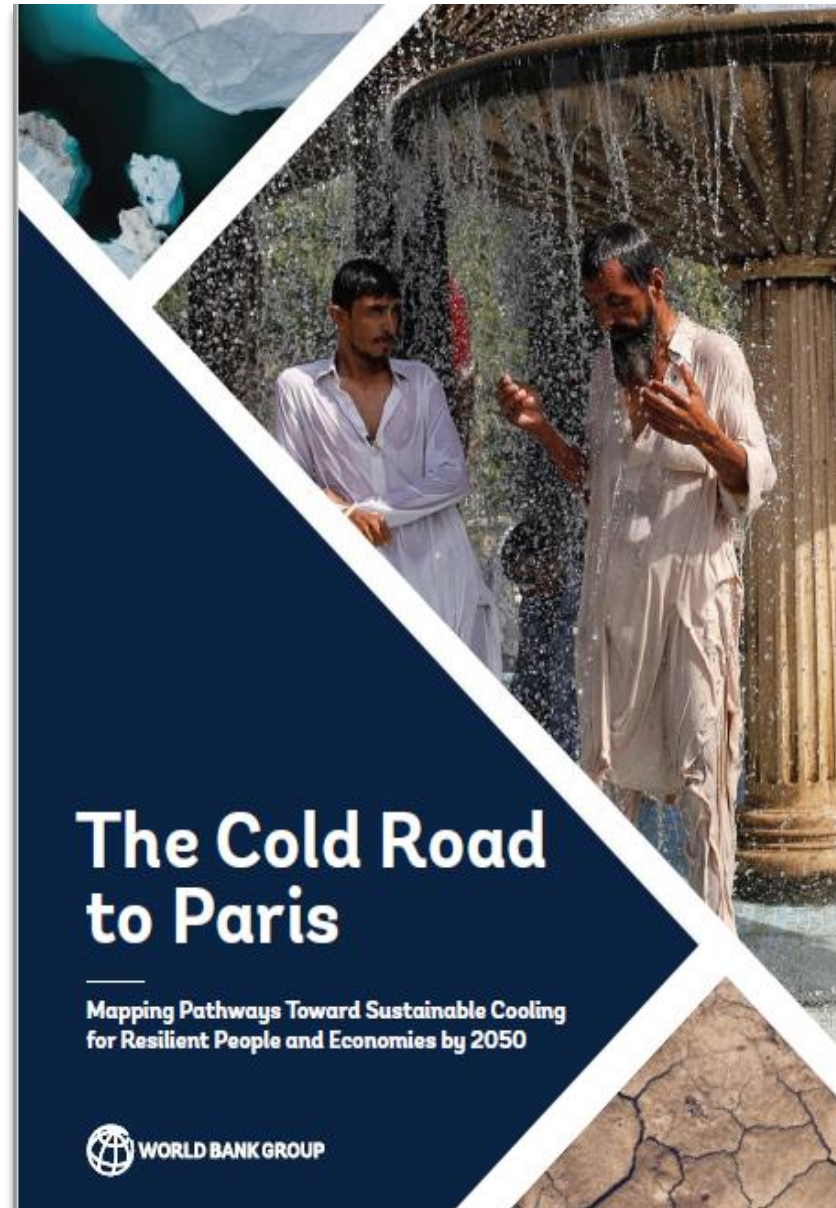
In the context of the Kigali Amendment that sealed the MP as a climate treaty by controlling HFCs, the WBG's cooling work to deliberately maximize synergies and environmental benefits begins to coalesce. (With bilateral and philanthropic assistance.)



# 2019 & 2021: Net-zero GHG emissions from cooling application

## BACKGROUND REPORTS

<b>CONTEXT</b>	Sustainable Cooling: The Context of a Roadmap. Background Working Paper. (Peters 2019a)
<b>BUILDINGS</b>	Primer for Space Cooling. (ESMAP 2020a) Compendium to the Primer for Space Cooling. (ESMAP 2020b)
<b>URBAN</b>	Primer for Cool Cities: Reducing Excessive Urban Heat – With a Focus on Passive Measures. (ESMAP 2020c)
<b>INDUSTRY</b>	Promoting the Adoption of Green Cooling Technologies and Practices: Insights from Industrial and Commercial End-Users. Background Paper. (IFC 2019)
<b>TRANSPORT</b>	Mobile Cooling: Assessment of Challenges and Options. (Ayres, Stankevich and Diehl 2020)
<b>COLD CHAIN</b>	Cold Chains in Developing Economies: A Techno-Socio-Economic Structural Development Challenge. Background Paper. (Peters 2019b)
<b>RURAL COOLING</b>	Rural Cooling: A Techno-Socio-Economic Structural Development Challenge. Background Paper. (Peters 2019c)
<b>SYSTEMS</b>	Integrated Cooling Systems: Harnessing Synergies and Co-Benefits Across Users, Technologies and Policies. Working Paper. (Heister and Peters 2020)
<b>SUMMARY</b>	Summary of Sustainable Cooling Background Papers. (World Bank 2020)



*Net-zero  
GHG emissions from  
cooling by 2050*



# 2020: Air-conditioning (AC) Manufacturing Readiness Program

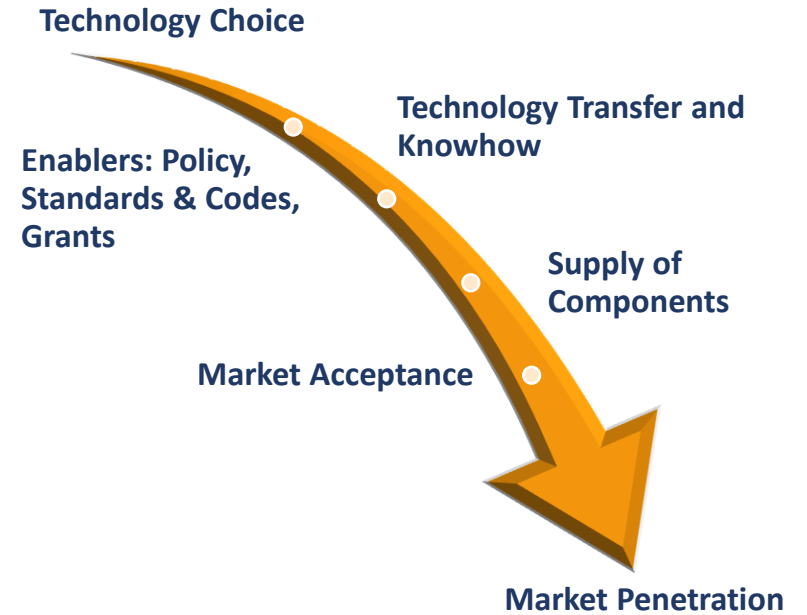
## Objective:

Equip local manufacturers with inverter technology to make and market more efficient AC using lower global warming refrigerant and accelerate market transformation in Thailand, Viet Nam.

- Policy review, data analysis, scenario development, recommendations
- Provision of open access tech. to make lower-GWP, HFC-32, inverter AC
- Field testing

## Reports and Tools:

- *Analytical Review and **Recommendations for Policy and Regulatory Frameworks** to Support AC Manufacturing Readiness and Sustainable Cooling in Thailand and Viet Nam.*
- ***Feasibility Analysis** of Adopting Highly Efficient RAC in Middle Income Economy Context.*
- ***Assessment of Barriers** to Wider Use of Energy Efficient, Lower GWP Room AC (in Thailand's and Viet Nam's small retail sector).*
- ***Instructional Videos** on thermodynamic basics, RefProp – open access design software, etc. for small, local manufacturers*
- ***User Manuals and Tools** for open access tech and other tools (design tools, simulation software, reliability testing program, AC readiness checklist, etc.)*



*MLF-funded Thailand AC conversion project to phaseout HCFCs in the sector and introduce a mildly flammable alternative is the precursor to this program.*



# 2020: Sustainable Cooling Innovation



## Accelerating **the adoption of innovation** where it is needed most

We are an award-winning program from IFC that matches innovators worldwide with leading companies in emerging markets to conduct cutting-edge pilot projects, build commercial relationships, de-risk investment, and scale solutions that tackle some of the world's most pressing challenges.

▶ [LEARN MORE](#)





# TE SCI: 3+ years of experience > 5 regional project

## Cooling Cities

### Mexico & Colombia

22 pilots / 18 co's / 14 tech

Climate-smart solutions in retail, pharma, agriculture, education, logistics, and space cooling



## Hospitality, India

12 pilots / 2 co's / 9 tech

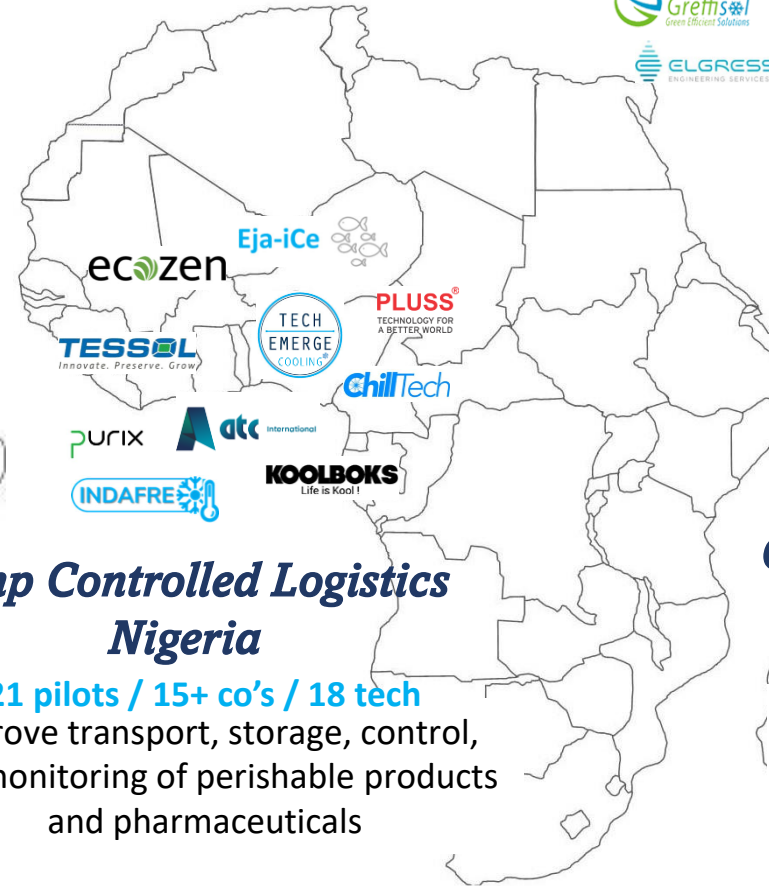
Climate smart cooling solutions for hotels



## Retail Cold Chains South Asia

8 pilots / 3 co's / 5 tech

Improve transport, storage, control, and monitoring of perishable products



## Temp Controlled Logistics Nigeria

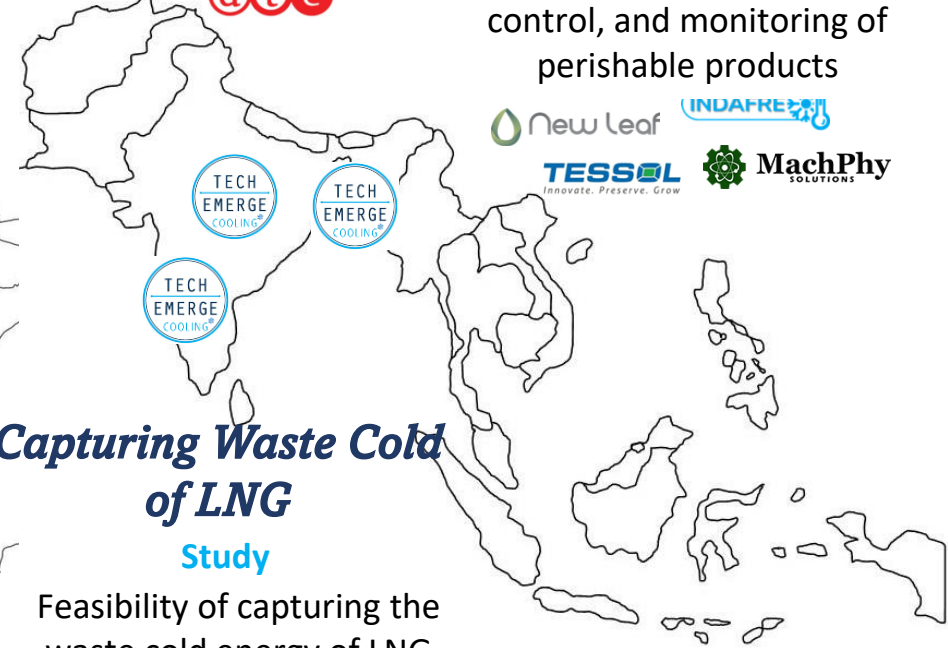
21 pilots / 15+ co's / 18 tech

Improve transport, storage, control, and monitoring of perishable products and pharmaceuticals

## Capturing Waste Cold of LNG

Study

Feasibility of capturing the waste cold energy of LNG receiving terminals



# 2021: IFC District Cooling



**US\$25 million of equity for a District Cooling Joint Venture with Tabreed** – a large district cooling utility based in UAE.

Plans to invest up to US\$ 400 million in Asia, with initial focus on India.

Expect to reduce 57,420 tonnes of GHG emissions annually.

**Water-cooled chillers:** 50% lower GHG p.a. compared to AC, 40% compared to air-cooled chillers.

*The platform is performing well in India and is now exploring opportunities in Southeast Asia.*



## 2021: Sustainable Cooling Facility



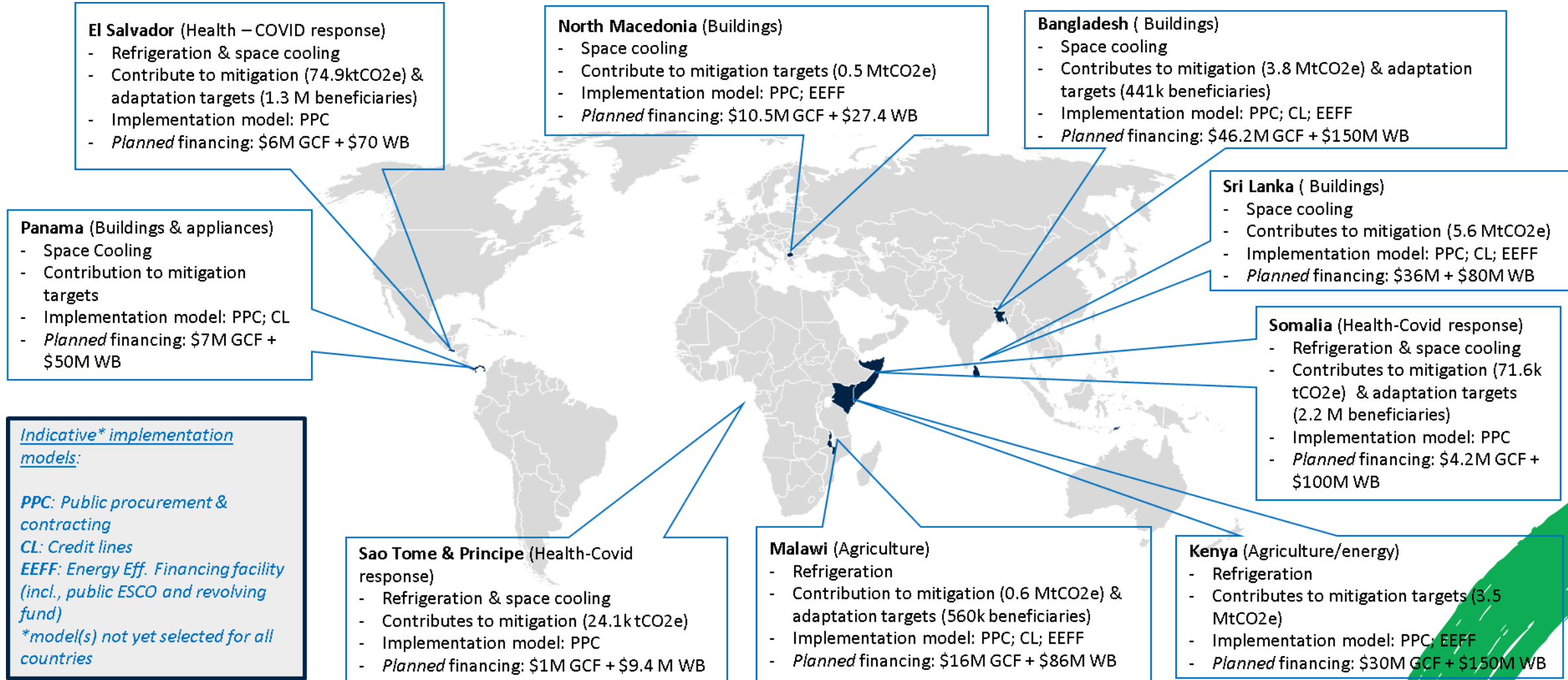
**World Bank Mobilizes USD\$157 million for Clean Cooling from Green Climate Fund**

To promote low-carbon and inclusive cooling solutions, the World Bank mobilized USD\$157 million from the Green Climate Fund (GCF).

The funding will go to nine countries for investments in climate-friendly cooling technologies, and the strengthening of enabling environments for clean cooling-related solutions.



# 2022: GCF Cooling Facility Portfolio



# 2022: Operationalizing HFC / Energy Efficiency Synergies

## India/South Asia: Fisheries Cold Chain

Revealed significant opportunities to implement EE and climate friendly cooling technology and practices in the fisheries sector.

## West Bengal, India: Temperature Controlled Logistics

Developed 2 pilot models with significant promise to shift temperature-sensitive goods from road to IW transport using integrated cold chain solutions

## El Salvador & Costa Rica: Energy Efficiency Standards

Identified economic and climate benefits through enhanced energy standards for appliances, recommending revisions to building and equipment codes

## Dominican Republic: Energy-Efficient Cooling Roadmap

Created a sustainable cooling roadmap, outlining financing and delivery mechanisms for the deployment of energy-efficient cooling equipment using low GWP refrigerants.

## Pakistan: Fisheries: Energy Efficiency Analysis

Supported the optimization of the fisheries sector efficiency through supply chain improvements, energy-efficient technologies, upgraded ice-making technology, and HFC-free solutions.

## Global: Financing with Cooling Bonds

Explored how sustainable cooling investments can be financed by issuing green bonds

## Objectives

Upstream support for cooling market transformation

Strategies and business models to operationalize national cooling plans

Knowledge products (guidance/toolkit/ others) on operationalizing MP-EE linkages



## 2022: Linked Investment Operations

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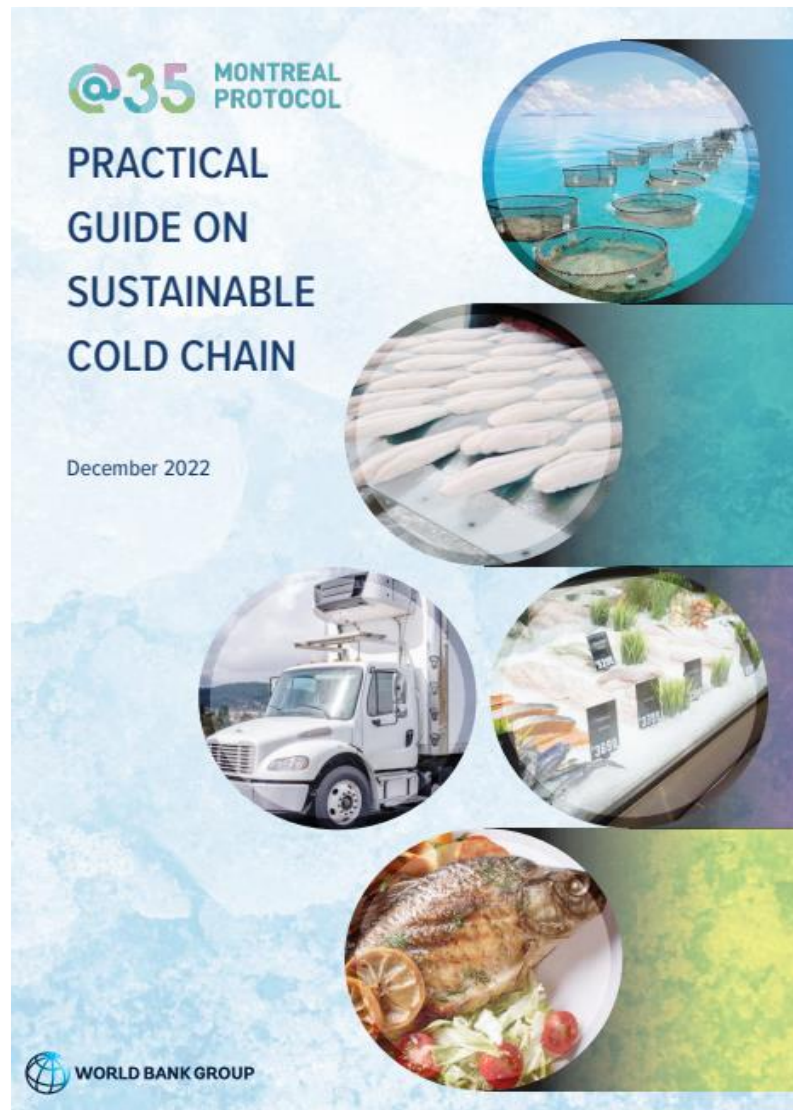
**India: India Fisheries Sector COVID-19 Recovery Project**

**India: West Bengal Inland Water Transport, Logistics and Spatial Development Project**

**Pakistan: Sindh Livestock and Aquaculture Sectors Transformation Project**



# 2022: Practical Guide on Sustainable Cold Chain



**Table 3.1 Industrial Refrigeration Equipment/Facilities**

Food Processing Refrigeration Equipment					
	Fishing Vessels: Freezing/Chilling Unit	Centralized Cooling Unit for Food Processing Facility	Air-blast Tunnel Freezer	Plate Freezer	Ultra-low Temperature Freezer
Equipment					
Application	Chilling and freezing of fish onboard	Fish processing	Freezing of marine products	Freezing of fish and meat	High-quality marine products: tuna, sashimi, sushi, etc. Vaccine storage
Operating temperature	-40°C to -10°C	-10°C to +2°C	-40°C to -30°C	-40°C to -30°C	-80°C to -60°C
Refrigerant	HCFC-22, R-404A, R-507A, HFC-134a	R-717, HCFC-22, R-404A, HFC-134a	R-717, HCFC-22, R-404A, HFC-134a	R-717, HCFC-22, R-404A	HFC-23, R-508A cascade with HCFC-22, HFC-134a or R-404A
Storage and Ice-making Equipment					
	Cold Store (bulk)	Cold Store (hub)	Walk-in Freezer/Cooler	Cold Room	Ice-making Plant
Equipment					
Application	Storage of frozen/chilled food products (multi-chamber)	Frozen/chilled/fresh food store at distribution point (multi-chamber)	Medium/small frozen/chilled food store in retail outlets	Small capacity chilled food storage	Onboard chilling of fishes using flake ice
Temperature	-30°C to +5°C	-30°C to +5°C	-30°C to +5°C	-10°C to +5°C	-10°C
Refrigerant	R-717	R-717, HCFC-22, R-404A	HCFC-22, R-404A, R-507A	HCFC-22, HFC-134a	R-717 (large units) HCFC-22, R-404A (small units)

<https://documents.worldbank.org/pt/publication/documents-reports/documentdetail/099744311232341555/idu08a9de87804f5f041d2082f007d19a71a61fb>



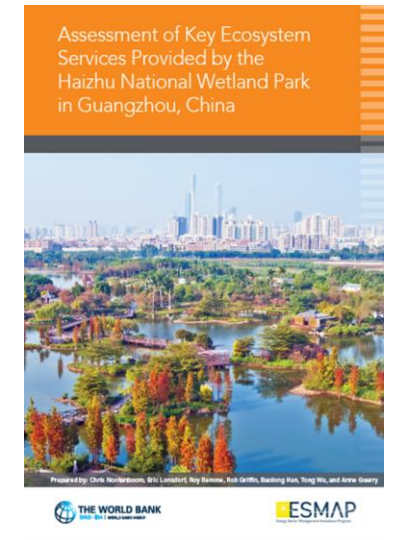
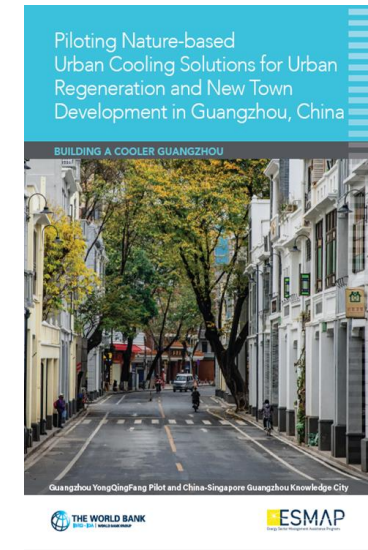
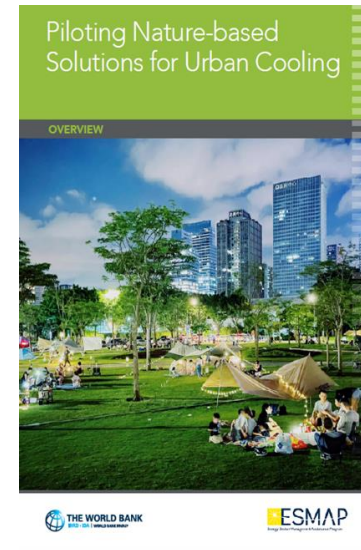
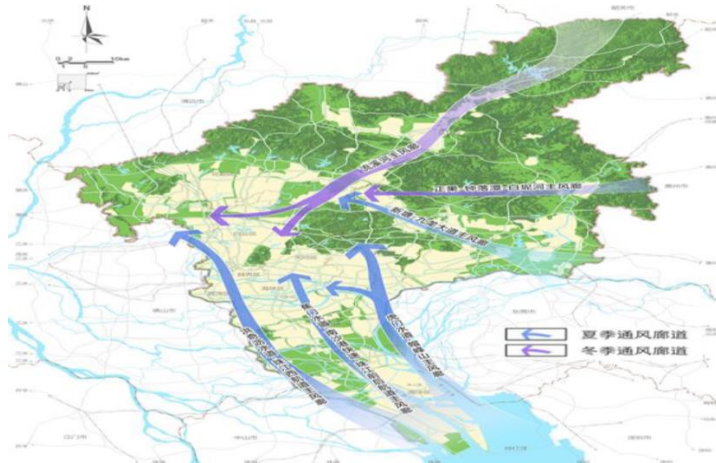
# 2022: Nature-Based Cooling Solutions in Guangzhou, China

## Map Urban Heat

- Urban Heat Island concentrates on old down areas with high population density

## Assess Wind flows

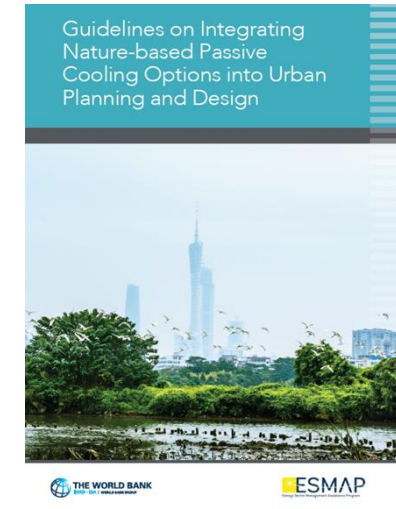
- Managing ventilation corridors to facilitate the formation of cooler air flow pathways.



## Enhance ecological planning

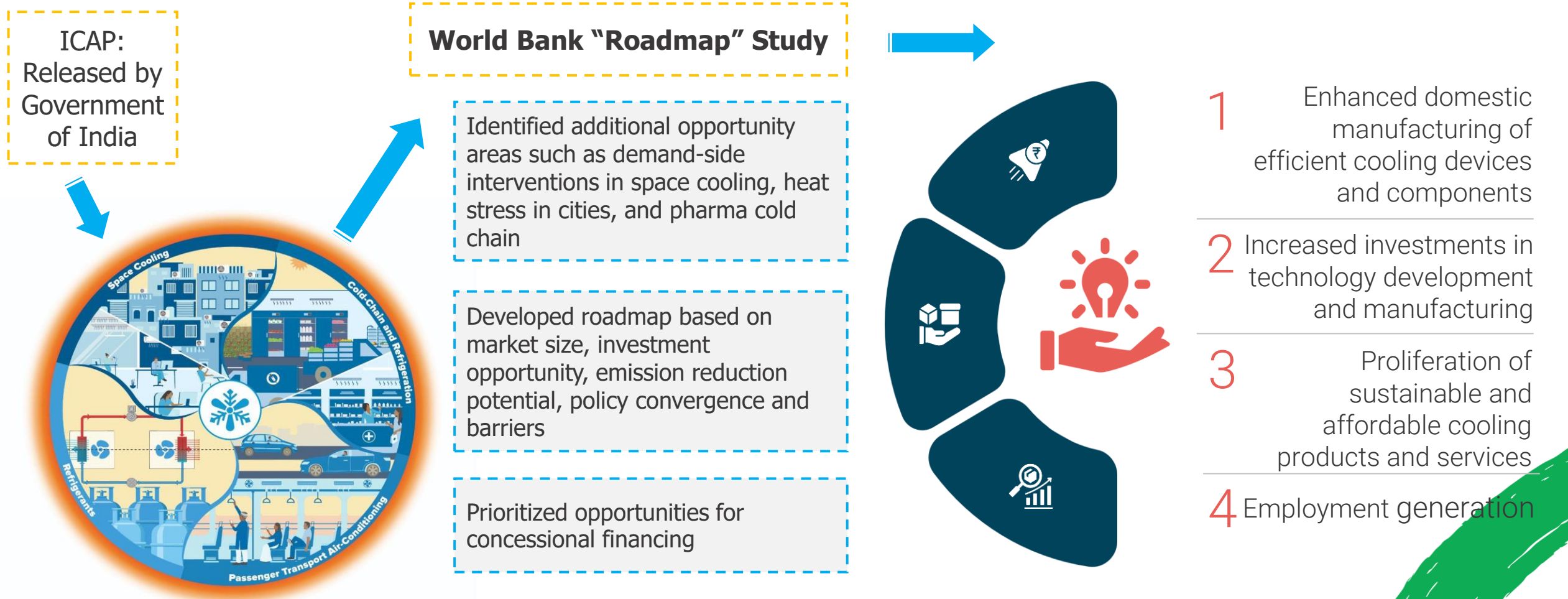
- Establishing a network of green/blue urban infrastructure to maximize cooling effects
- Using modeling tools to assess ecosystem services provided by natural assets

<https://www.esmap.org/>





# 2022: Investment Opportunities in India's Cooling Sectors



India has the potential to emerge as a manufacturing hub for cooling devices and components.



# 2024: Seawater Air Conditioning (SWAC)

uses the inexhaustible cold deep seawater available in the Caribbean to replace conventional, energy intensive cooling.

*World Bank is developing SWAC sites in Jamaica and the Dominican Republic*



SWAC systems **operate around the world**, including cooling Tahiti's largest hospital complex



SWAC can **save more than 80% of electricity** of conventional systems



Customers include **resorts, airports, office/municipal buildings and industrial zones**



In addition to cooling, ocean water is used for **aquaculture, agriculture and desalination**

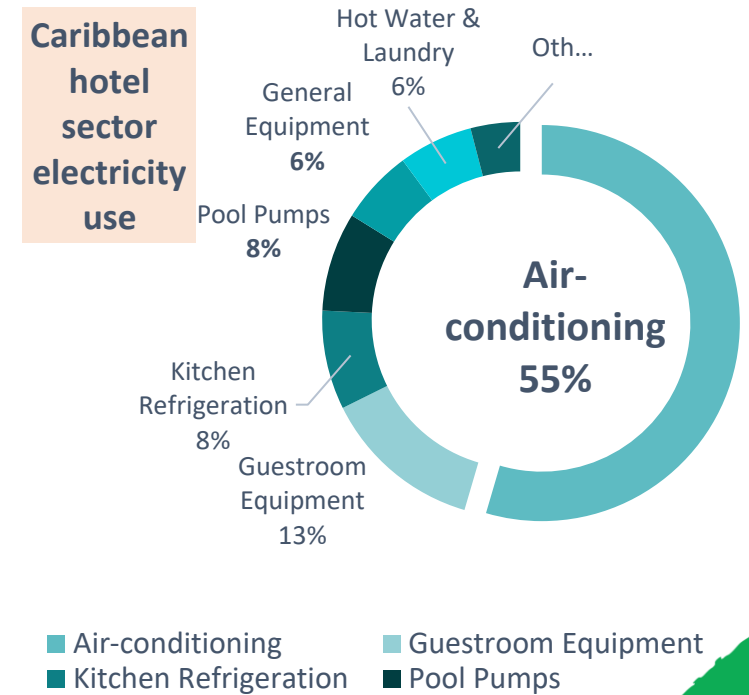


SWAC **substantially lowers CO2 emissions** to help meet climate targets



SWAC brings **investment, jobs, and reduced fossil fuel imports**

Caribbean hotel sector electricity use



# 2024: IFC's new Sustainable Cooling Strategy

## FIVE FOCUS SECTORS

DISTRICT COOLING



COOLING FOR BUILDINGS



CONSUMER & SME FINANCE



MANUFACTURING & INNOVATION



COLD CHAINS & LOGISTICS



## FIVE ENGAGEMENT PILLARS

THOUGHT LEADERSHIP,  
MARKET MAPPING



TRANSFORMATIVE COOLING SYSTEMS



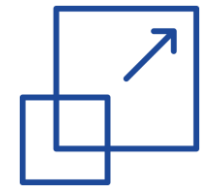
INVESTMENT READINESS

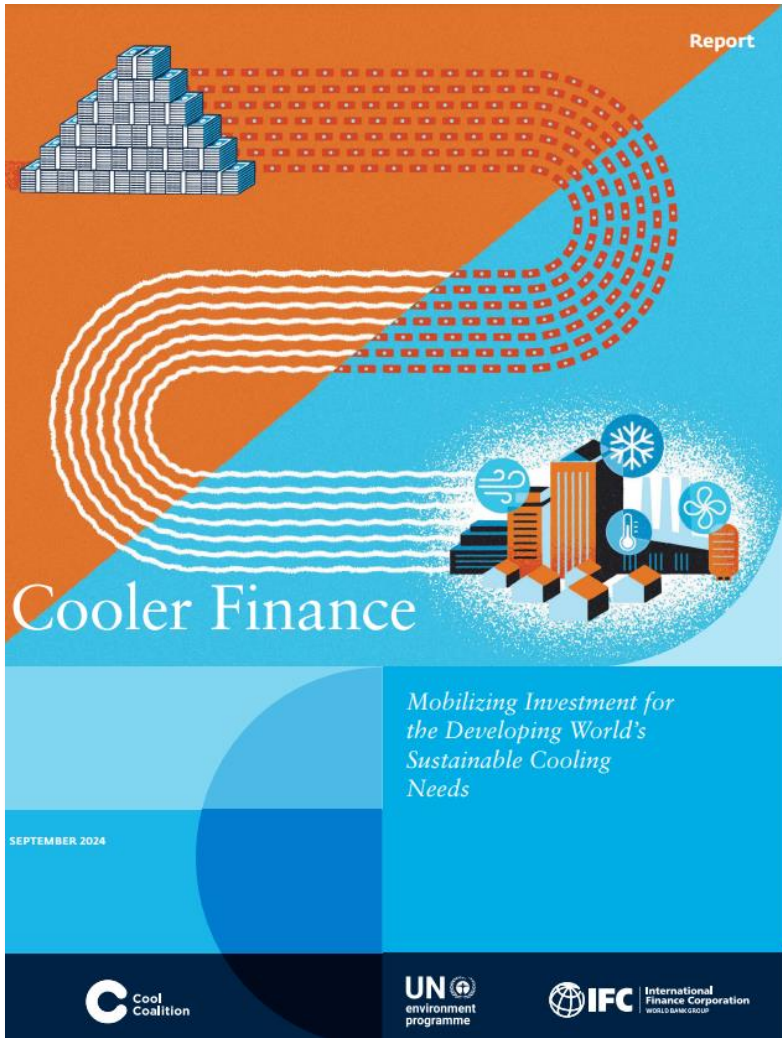


DE-RISK FINANCING



OPERATIONALIZE & SCALE UP

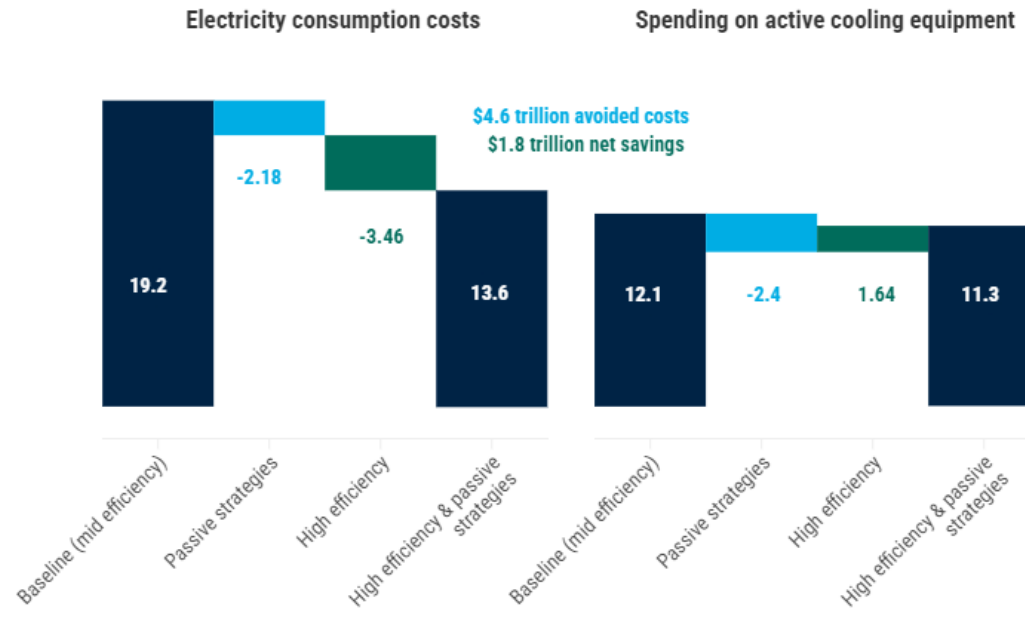




## Mobilizing Investment for the Developing World's Sustainable Cooling Needs

### Accelerating the Transition to Sustainable Cooling Will Help Developing Economy Consumers Spend \$6.4 Trillion Less by 2050

Changes in cumulative electricity consumption costs and spending on cooling equipment for consumers from accelerating adoption of sustainable cooling 2025 to 2050 (\$ Trillion)



# Moving Forward

## Government

- **Have a multi-stakeholder national cooling strategy**
  - Cooling as part of infrastructure, integrated with energy systems, defending against climate heat stress
- **Consider using MLF financed Kigali Implementation Plans (KIPs) to support “direct linkages” as possible:**
  - Consider socio-economic gains from cooling (jobs), energy efficiency, maximize impact
  - Use alternative energy sources and technologies (incl. nature-based solutions)
  - Access the MLF US\$100 million EE Operational Framework window for end-users of HFCs and inefficient equipment

## Development Partner

- Embed HFC phase-down in climate and development plans (CCDRs, CPFs)
- Support technical and business innovations
- Mainstream cooling in energy, urban, agriculture and transport projects
- Develop novel financing strategies for cooling

## Private Sector

- Invest in energy efficiency
- Develop “SMART” (data) and alternative (ODS/ GHG-free) cooling technologies
- Adapt business strategies to consumer needs
- Train more cooling technicians
- Stop “dumping” of outdated equipment

## Join the Global Cooling Community:

- The Cool Coalition – Cooling Pledge, NCAP working group, more <https://coolcoalition.org/>
- Climate and Clean Air Coalition – Cooling Hub (including grants) <https://www.ccacoalition.org/hubs/cooling-hub>



Thank you

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