Accelerating Energy Efficiency in Buildings and District Energy Systems — UNEP Actions Across APEC Economies

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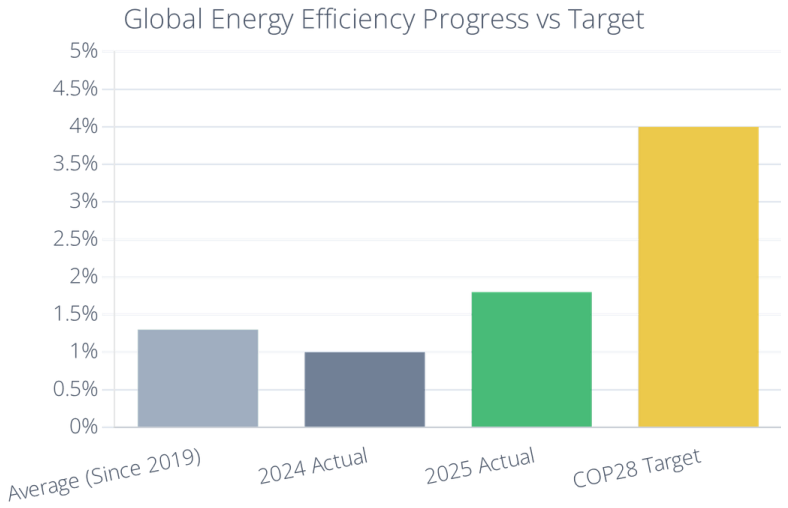
Global energy efficiency improved to 1.8% in 2025, still far below the 4% annual target

IEA Energy Efficiency 2025 Report: Global improvement rate reached 1.8% in 2025, up from 1.0% in 2024.

COP28 Commitment: Doubling the global rate of energy efficiency improvement to over 4% per year.

The Role of Buildings: Account for approximately 30% of global final energy consumption and 26% of global energy-related emissions.

Cooling Demand: The fastest-growing end use in buildings, projected to triple by 2050 under business-as-usual.



Average improvement since 2019

1.3% per year

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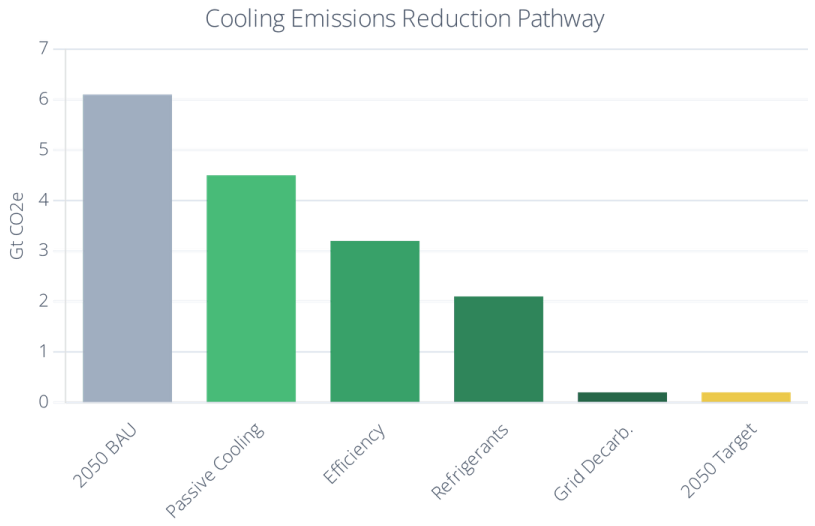
Sustainable Cooling Pathway can cut cooling emissions by up to 96% and save trillions



UNEP Global Cooling Watch 2025: Sustainable Cooling Pathway could reduce emissions by 64% (2.6 billion tons CO2e) below projected 2050 levels.

Passive-First Approach: Building design, urban planning, and nature-based solutions can achieve up to 96% reduction combined with grid decarbonization.

Economic Impact: Potential savings of trillions of dollars in avoided energy and infrastructure costs.

COP28 Global Cooling Pledge

67 countries committed to reduce cooling-sector emissions. APEC economies represent a large share of global cooling demand growth, making this directly relevant.

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Why this matters now for APEC economies

The meeting theme explicitly links bio-circular economy, clean energy, energy intensity reduction and AI-driven energy efficiency.

30%
Buildings share of global energy demand

945
TWh data-centre electricity demand by 2030

60%
Potential cut in projected 2050 cooling emissions

Three signals

- Electricity demand is accelerating because of cooling, electrification and data centres.
- Cooling has become a capacity, affordability and resilience issue, not only a comfort issue.
- APEC needs implementable projects, standards and delivery models that scale.

Combining incentive policies, business models, and cost-effective technologies to accelerate implementation

Incentive Policies

Define roles of municipalities and cities, and create enabling regulatory frameworks to drive energy efficiency.

Business Models

Deploy suitable models to enable the investment environment, such as Cooling-as-a-Service, ESCO, and concession models.

Technologies

Implement cost-effective technologies to integrate multiple sectors for higher systemic efficiency and performance.

Synergistic Impact: Combining all three pillars can accelerate the development of carbon-neutral communities and enable rapid scale-up after successful demonstration.

90+ Cities

across 35 countries since 2016

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Case Study 1: Sino-Danish collaboration is transforming China's district heating from coal to clean energy

- **Sino-Danish Cooperation Centre:** A strategic partnership between UNEP Copenhagen Climate Centre, the Danish Energy Agency, and the China Renewable Energy Engineering Institute (CREEI).
- **Clean Energy Transition:** Focuses on transitioning coal-fired district heating to clean and renewable sources, including geothermal, industrial waste heat recovery, large-scale heat pumps, and solar thermal.
- **Knowledge Management:** Developed a comprehensive Knowledge Management System with training modules available in both Chinese and English to build local capacity.
- **Jinan District Energy Project:** Supported the design and implementation of these projects, demonstrating high energy efficiency performance in real-world applications with innovative long-term financial mechanism of REIT.

90%

of the world's district heating capacity is operated by China

Strategic Impact

Directly supporting China's national climate goals: achieving **carbon peaking by 2030** and **carbon neutrality by 2060** through scalable clean heating solutions.

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Case Study 2: GEF-funded district energy in Chile can reduce particulate pollution by 99% and save 2,800 lives annually

Story 2 — Chile

Project Overview: GEF-financed USD 2 million project, "Accelerating investment in efficient and renewable district energy systems in Chile." Implemented by UNEP and executed by the Chilean Ministry of Energy.

Heat Roadmap Chile: District energy could cover 40% of the heating market by 2050, achieving a 13% reduction in primary energy consumption and a 20% reduction in CO2 emissions.

Implementation & Scale: A National District Energy Office has been established, targeting 10 new cities for development.

Regional Lighthouse: Chile is positioned as a leading example for district energy implementation among Latin American APEC economies.

~99%

Pollution Reduction

Reduction in local particulate pollution in areas where district energy is applied.

2,800

Lives Saved Annually

Significant improvement in public health due to reduced air pollution from wood-burning heating.

$2.5B

Public Health Savings

Potential economic benefits generated from improved air quality and health outcomes.

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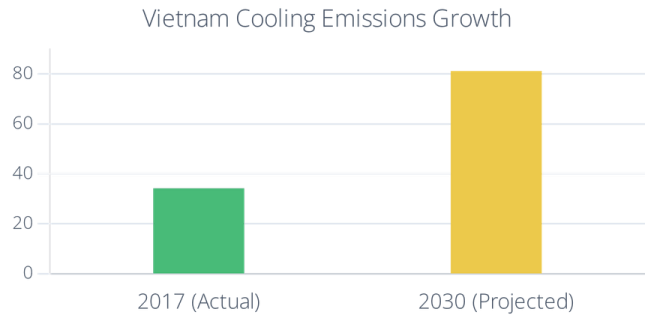
Case Study 3: UNEP is developing Urban Cooling Action Plans for Vietnamese cities to address surging cooling demand

Pilot Cities: Can Tho (Mekong Delta) and Tam Ky (central coast). Urban Cooling Action Plans (UCAP) are being developed through extensive stakeholder workshops.

Surging Demand: Vietnam's cooling emissions are projected to rise from 34 MtCO2e in 2017 to 81 MtCO2e by 2030 — a 138% increase.

National Commitments: Vietnam is committed to net-zero by 2050 and has a Global Cooling Pledge target of 68% reduction by 2050.



Can Tho New Urban Area & IT Park: 72-Hectare Pre-Feasibility Study

Exterior Landscaping

Creating wind corridors to promote natural ventilation, tree shading for pedestrian pathways, and extensive incorporation of green spaces.

Passive Solutions

Implementing features like green roofs, exterior shading devices, and energy-efficient windows (low-emissivity glass) to reduce heat gain.

Active Solutions

Utilizing high-efficiency cooling systems, advanced fans, and climate-friendly refrigerants to ensure optimal energy performance.

Case Study 4: UNEP-supported NAMAs in Thailand are cutting building emissions while advancing the BCG Economy model

UNEP supported Thailand to register two Nationally Appropriate Mitigation Actions (NAMAs) with the UNFCCC:

Greening Low- and Middle-Income Housing

304 kt CO_2e

Projected emission reduction per year. Supported by the GEF project "Accelerating construction of energy efficient green housing units in Thailand."

Greening Government Buildings

98.8 kt CO_2e

Potential annual emission reduction if extended to all 639 government buildings.

Alignment with BCG Economy Model

These initiatives directly support Thailand's Bio-Circular-Green (BCG) Economy model, the central theme of this EGEEC66 meeting, positioning Thailand as a model for green building in Southeast Asia.

National Determined Contribution (NDC):
Contributes to Thailand's target of 20% emission reductions from business-as-usual by 2030.

Energy Efficiency Plan:
Supports the national goal of achieving a 30% energy intensity reduction by 2036 compared to 2010 levels.

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Case study 5: Tech Emerge program delivered 60+ pilots across APEC economies with 15-80% energy savings

Tech Emerge Sustainable Cooling Innovation: A partnership between UNEP CCC, IFC, and the UK Government to accelerate the adoption of innovative cooling technologies.

Mexico & Colombia Pilots: Deployed 22 pilots across 18 companies using 14 different technologies in sectors including retail, pharma, agriculture, education, and logistics.

ASEAN Cool Initiative: Accelerating energy efficiency regulations for cooling across APEC Southeast Asian economies, including Malaysia, Indonesia, Thailand, Vietnam, and the Philippines.

Investment Platforms: Catalyzed significant market movement, including a $100 million district cooling investment platform in India.

60+
Pilots Conducted

15-80%
Energy/Cost Savings

2M+
Tons GHG Avoided

$35M+
Financing Raised

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AI can deliver 20-30% additional energy savings in buildings, aligned with APEC's AI Initiative 2026-2030

QUANTITATIVE IMPACT

14%

Average Energy Savings: Achieved by AI-based building energy management systems, while maintaining 91% occupant satisfaction.

20-30%

Waste Reduction: Potential energy waste reduction when AI is combined with Strategic Energy Management frameworks.

< 5%

Prediction Error (RMSE): High accuracy of AI-enabled energy baselines across diverse building types.

Key AI Applications in District Energy & Buildings

- ✓ Predictive HVAC Optimization
- ✓ Automated Fault Detection
- ✓ Smart Demand Response
- ✓ Digital Twins for District Systems

Strategic Alignment

APEC AI Initiative 2026-2030

Endorsed in November 2025, this initiative specifically encourages AI adoption in energy systems to enhance efficiency, security, and reliability across member economies.

EGEEC65 Momentum

Building on the previous meeting's theme of "AI-Driven Energy Innovation," establishing a clear trajectory for the region.

UNEP CCC Action

Hosted a regional capacity-building workshop on climate technology and AI innovation in December 2025 to support implementation.

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AI should amplify energy efficiency — not erode it

AI becomes valuable when it rests on metering, clear baselines, and governance discipline.

Where AI adds value

- Load forecasting and demand-response scheduling
- Plant and equipment optimization in district cooling and large buildings
- Fault detection, predictive maintenance, and continuous commissioning
- Automated M&V support where baselines and meters are already credible

Operational rule: digitize the meter, the plant, and the verification chain before digitizing the story.

Guardrails for credibility

- Do not let new AI loads cancel the savings story.
- Require interoperable data and clear ownership rules.
- Use AI where decisions can be verified through measured performance.
- Protect cyber resilience and privacy in connected building systems.

UNEP view
AI is useful when it strengthens the measurement and operational discipline of efficiency programs.

Five priority actions to accelerate energy efficiency across APEC member economies

1 Adopt integrated city-level energy mapping

Use spatial data and demand analysis to identify priority zones for district energy, following successful models from Amsterdam, Tokyo, and London.

2 Establish enabling policy frameworks

Implement connect-unless policies, stringent building energy codes, and mandatory energy plans for large urban developments.

3 Deploy innovative business models

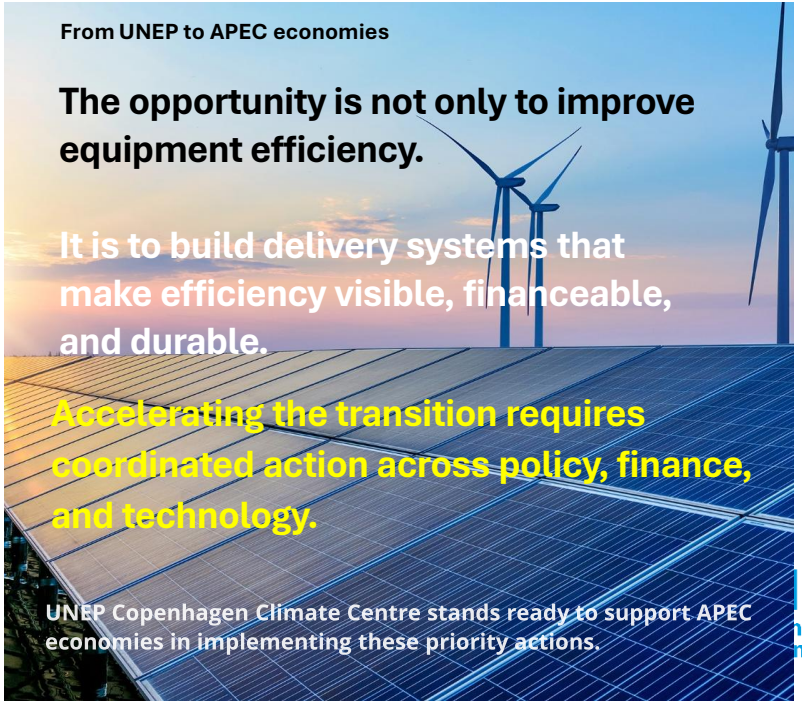
Utilize Cooling-as-a-Service (CaaS), ESCO models, and concession structures with 20-30 year agreements to overcome upfront cost barriers.

4 Leverage AI and digital tools

Integrate AI for building energy optimization, predictive maintenance, and the management of complex district energy systems.

5 Scale up through regional cooperation

Foster South-South learning via UNEP's Knowledge Management System, APEC knowledge sharing, and cross-economy pilot projects.



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UNEP Copenhagen Climate Centre provides open-access tools and knowledge for energy efficiency implementation

UNEP CCC Toolbox

Comprehensive assessment tools designed to evaluate energy efficiency potential across multiple sectors.

- Buildings
- District Energy
- Transformers
- Motor-pump
- Street Lighting
- Water Supply

Knowledge Management System

In-depth training modules covering the full project development cycle for district energy systems.

- Introduction
- Stakeholder Coordination
- Energy Mapping
- Strategy & Policy
- Business Models

Country-Specific Collections

Tailored resources and case studies from our global implementation experience.

- China (Clean Heating)
- Chile (District Energy)
- India (District Cooling)
- Vietnam (Urban Cooling)

Global Platform for Urban Climate Neutrality (GPUC): https://c2e2.unepccc.org/gpuc/countries-and-regions/

Advisory Services

Research-based advisory services to assist developing countries and emerging economies in delivering on the Paris Agreement and Sustainable Development Goals (SDGs).

Ready to support APEC member economies with technical assistance, policy design, and capacity building.

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Thank you very much!

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