



OEWG48

Bangkok
13-17 July 2026



SPACE COOL

Reducing Energy Demand and HFC Dependence Through Next-Generation Technologies

14 July 2026
18:00 – 20:00 (UTC+7)



Opening Remarks



Mr Amr Seleem

Country Engagement and Climate Policy Lead
UNEP Cool Coalition

Keynote



Mr Rio Jon Piter Silitonga

Senior Officer

Energy Efficiency and Conservation (EE&C) Department

ASEAN Centre for Energy



ASEAN Centre for Energy
One Community for Sustainable Energy

The Demand Side of the Refrigerant Transition

How passive cooling and low-energy technologies cut HFC dependence at source

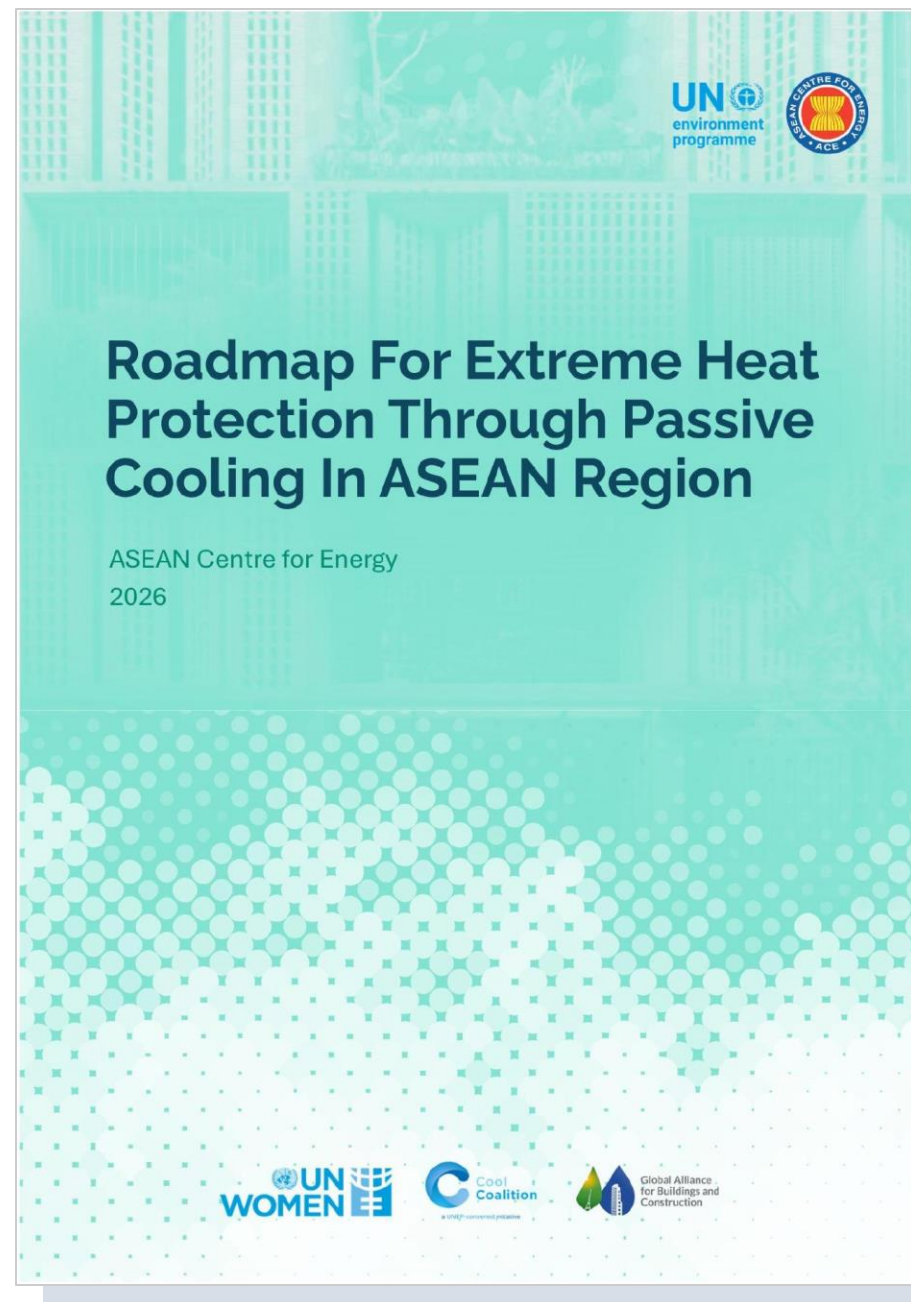
Rio Jon Piter Silitonga

Senior Officer, Energy Efficiency and Conservation Department, ASEAN Centre for Energy

OEWG48 Side Event | UN Conference Centre, Bangkok | 14 July 2026

Launched: The ASEAN Passive Cooling Roadmap

Roadmap for Extreme Heat Protection through Passive Cooling in the ASEAN Region — ACE & UNEP, 2026



LAUNCHED

7 April 2026 · Manila, Philippines

Launched by ACE and UNEP with the Department of Energy of the Philippines, ASEAN Chair 2026

10

ASEAN Member
States covered

168

survey respondents
across the region

2026–2040

phased implementation
pathway

What is inside

- Extreme heat and cooling-demand assessment across ASEAN's climate zones
- Technology, cost and payback assessment of six passive cooling categories
- Policy, finance, capacity and gender-responsive recommendations
- Phased implementation pathway with differentiated targets for each Member State



Download the full Roadmap

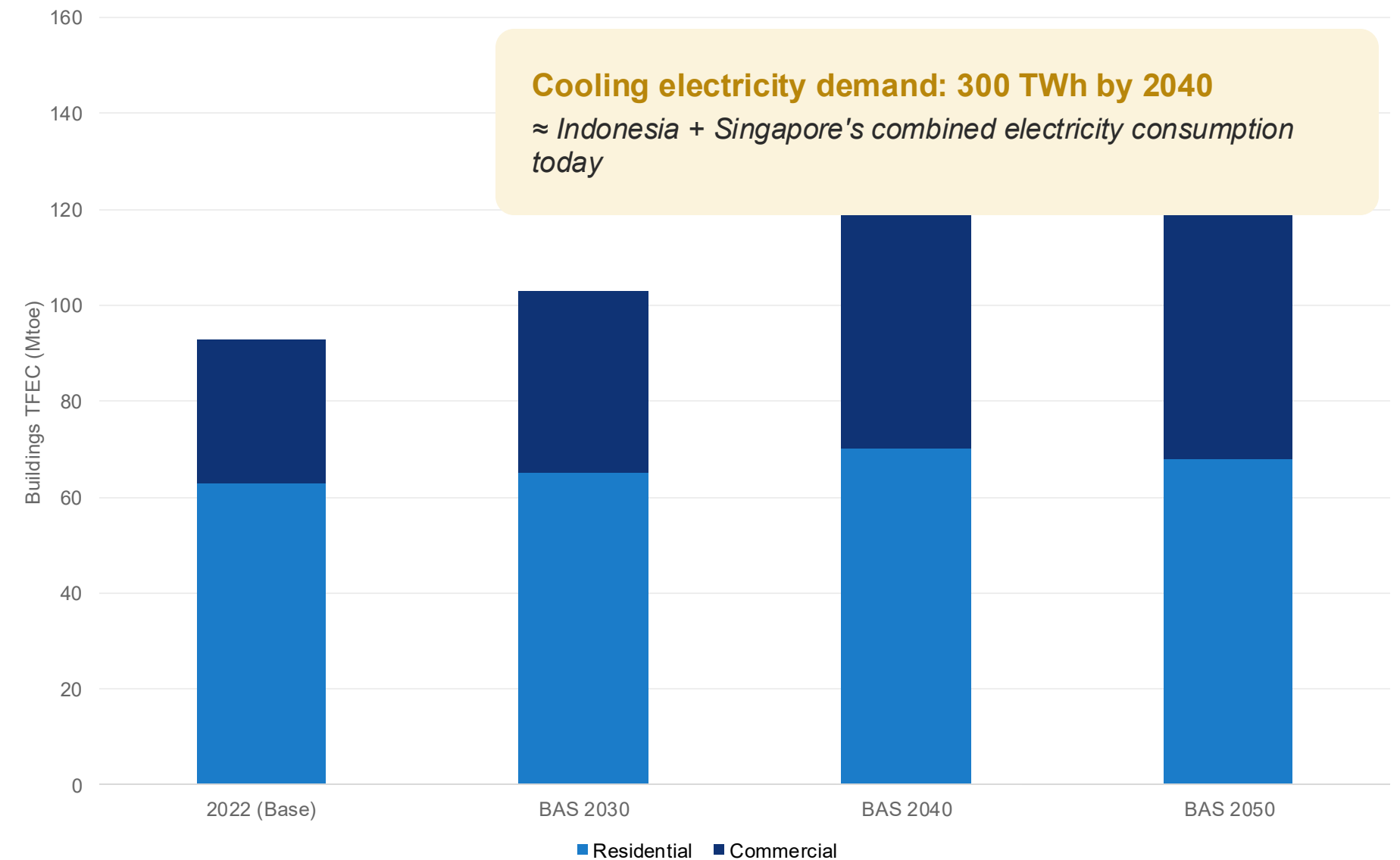
aseanenergy.org/publications

Roadmap for Extreme Heat Protection through Passive Cooling in the ASEAN Region — ACE & UNEP (Cool Coalition and EmPower), launched Manila, 7 April 2026 with the Philippine Department of Energy

ASEAN's Cooling Demand Trajectory

Buildings Demand Sector — Business-as-Usual Scenario

- **Buildings (residential + commercial) account for 23% of ASEAN's total final energy consumption, and space cooling is the fastest-growing end use within it.**
- Under BAS, buildings-sector TFEC grows from 93 Mtoe (2022) to ~144 Mtoe by 2050 — a 55% increase, with the commercial sector growing fastest.
- Air conditioners alone take ~15% of residential energy today; fans a further 9%.
- Space-cooling electricity demand is projected to reach 300 TWh by 2040.
- Every terawatt-hour on this curve is met by vapour-compression equipment — so the demand curve and the HFC curve are the same curve.

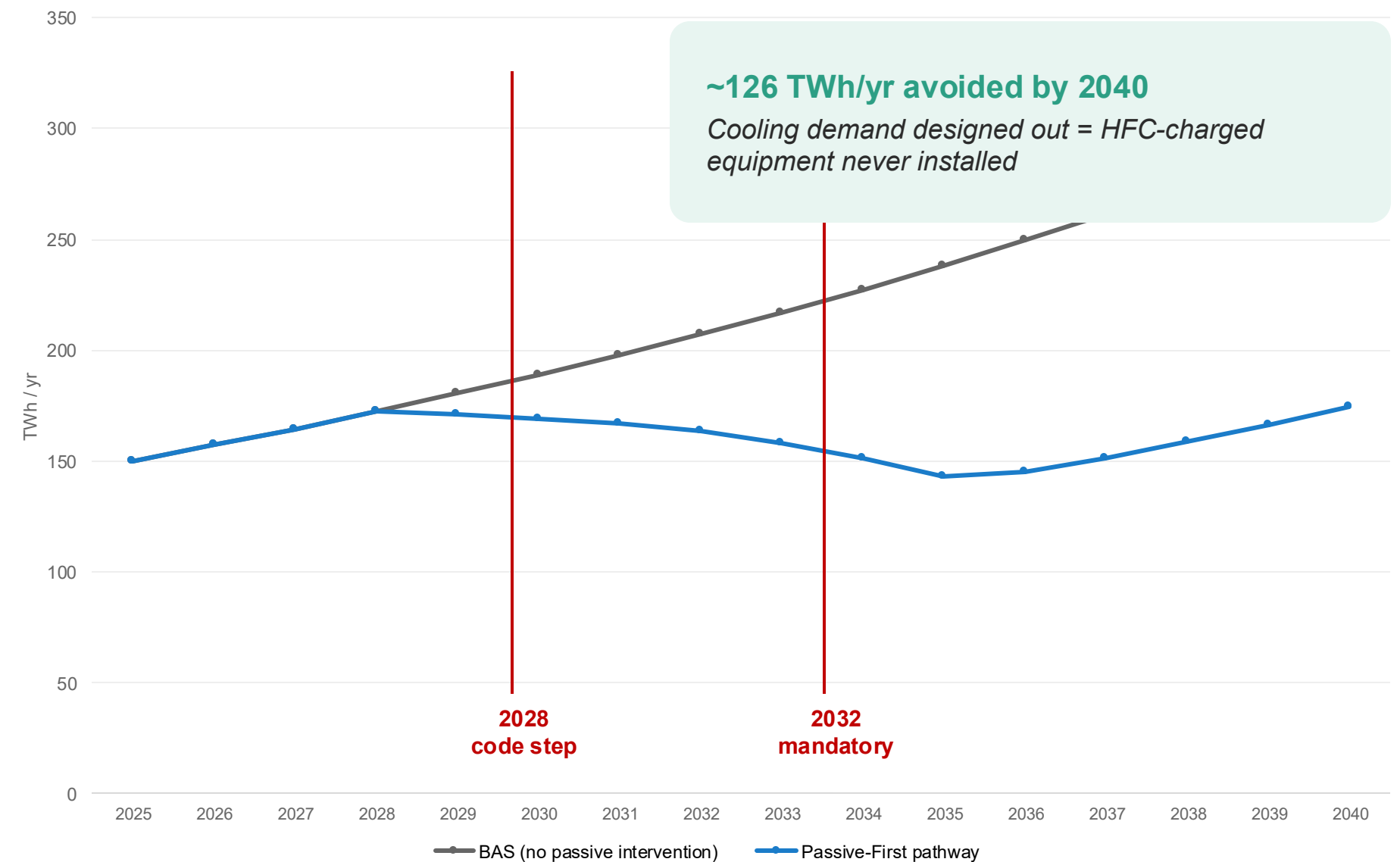


93 Mtoe → 144 Mtoe: buildings-sector energy demand, 2022–2050 (BAS)

The Avoidance Curve: Business-as-Usual vs Passive-First

Space Cooling Electricity Demand, ASEAN — Illustrative Pathway to 2040

- Applying the Roadmap's 41.95% integrated passive-cooling reduction to the BAS trajectory yields a **Passive-First** pathway that bends the cooling demand curve before mechanical cooling is ever specified.
- BAS reaches 300 TWh by 2040. Passive-First reaches ~174 TWh — an avoided demand of ~126 TWh/yr.
- Savings are back-loaded: they accrue only as codes take effect (2028) and become mandatory (2032), then compound with each construction cycle.
- Because avoided cooling demand is equipment never installed, the same 126 TWh represents HFC charge that never enters the regional stock.
- Passive measures reach full effect one building-stock turnover after the final code step — which is why the first step year matters more than its stringency.

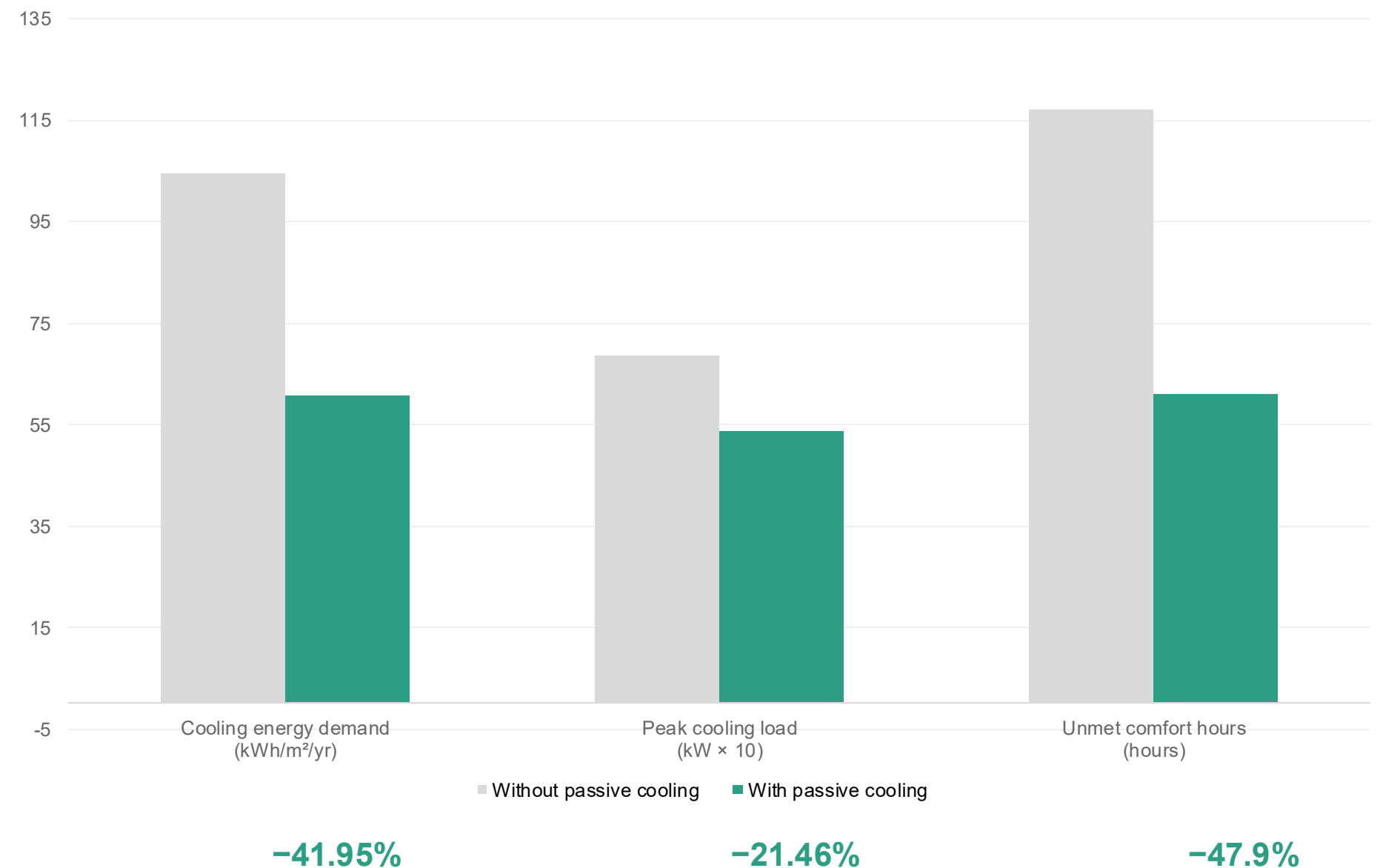


Illustrative pathway. BAS interpolated at constant growth to the Roadmap's published 2040 value (300 TWh), 2025 baseline assumed 150 TWh; Passive-First applies the Roadmap's 41.95% integrated reduction (Table 13), phased from the 2028 code step. Source: ACE & UNEP 2026

Simulation Evidence: What an Integrated Package Delivers

ACE DesignBuilder Modelling — Tropical Urban Reference Building, 48 m²

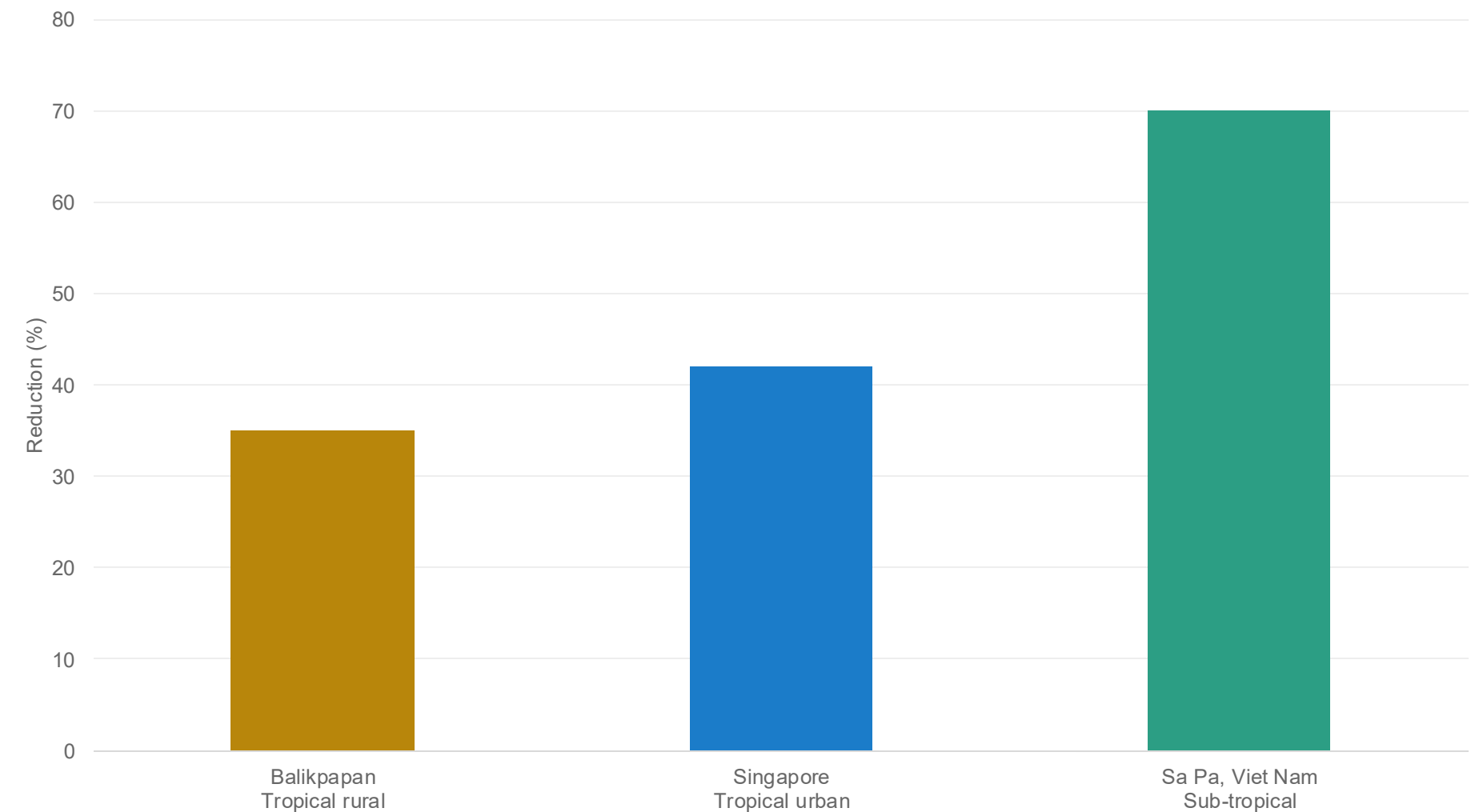
- **An integrated package — envelope optimisation, natural ventilation, cool surfaces and shading — cuts cooling energy demand by 41.95%, from 104.44 to 60.63 kWh/m²/yr.**
- Peak cooling load falls 21.46% (6.85 kW → 5.38 kW), which is what determines the size — and therefore the refrigerant charge — of the equipment installed.
- Unmet comfort hours nearly halve, from 117 to 61 hours: less energy and better comfort, not a trade-off between them.
- No single measure achieves this. The 41.95% is a package effect and substantially exceeds any individual technology's performance.
- A smaller peak load also means a smaller unit: the demand-side intervention shrinks both the kWh and the kilograms of HFC.



Does It Hold in High-Ambient Conditions?

Cooling Energy Demand Reduction by ASEAN Climate Zone

- **Passive cooling performs across every climate type modelled in ASEAN — the question is not whether it works in the tropics, but by how much.**
- Tropical rural (Balikpapan): 35% reduction — the conservative floor, in the hottest and most humid conditions.
- Tropical urban (Singapore): ~42% reduction, with the urban heat island effect included.
- Sub-tropical (Sa Pa, Viet Nam): up to 70% reduction, where diurnal swing allows night ventilation and thermal mass to work.
- Across all locations, thermal discomfort falls and dependence on mechanical systems declines — so 35% is the number to plan against, not 70%.

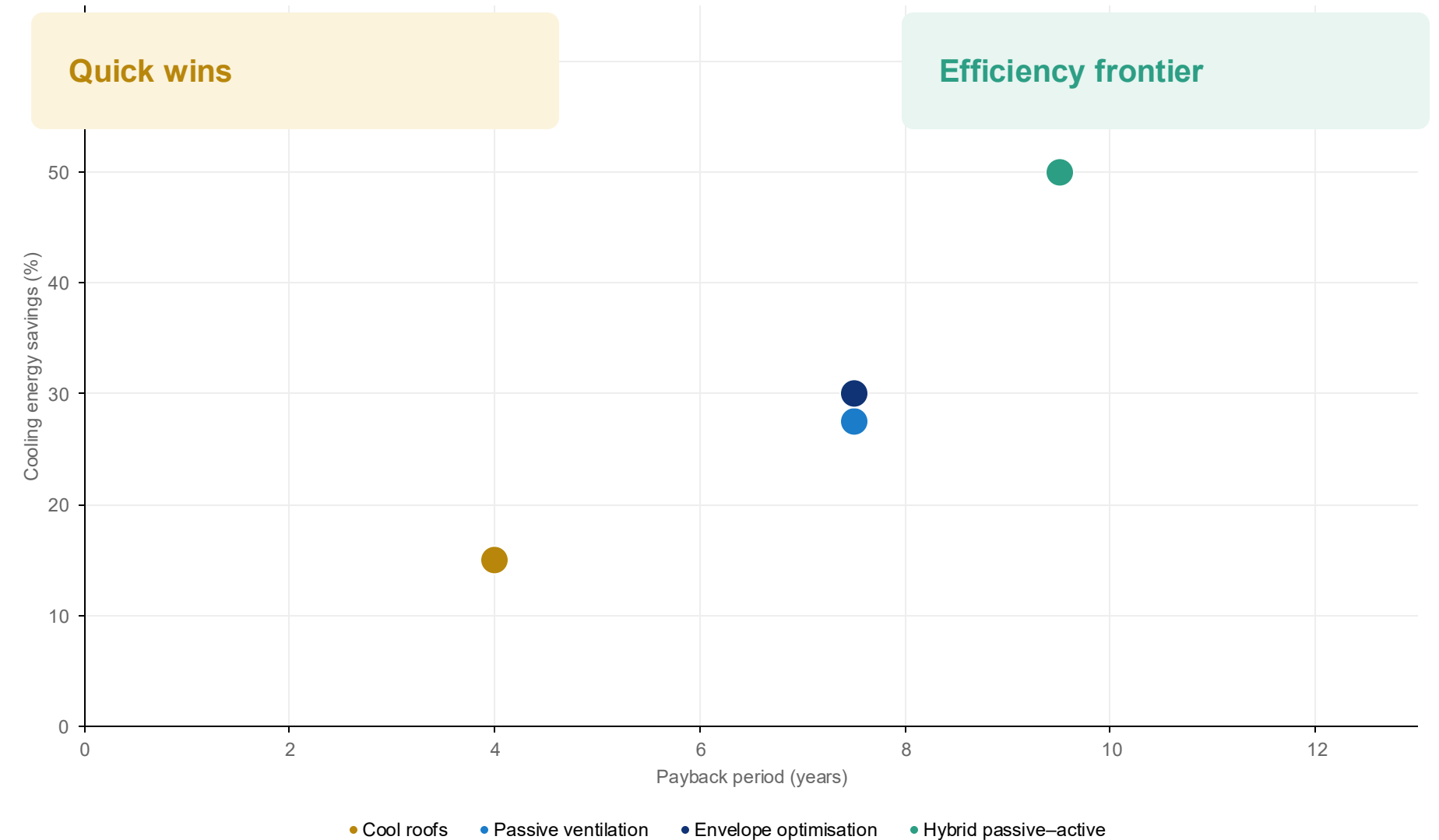


Plan against the floor, not the ceiling: 35% is achievable in ASEAN's most demanding hot-humid conditions.

Least-Cost Sequencing of Passive Measures

Cooling Energy Savings vs Payback Period — ASEAN Hot-Humid Conditions

- **Ranking measures by savings against payback gives policymakers an implementation sequence rather than a shopping list.**
- Cool roofs are the low-hanging fruit: 10–20% savings at 3–5 years payback, and the most scalable retrofit for low-income housing.
- Envelope optimisation delivers 20–40% at 5–10 years — the core requirement for any building code.
- Passive ventilation gives 20–35% at 6–9 years, and is near-costless in new construction.
- Hybrid passive–active sits at the frontier: 40–60% savings at 7–12 years, and is the most validated configuration for ASEAN's climate.
- Where residual load remains, high-efficiency equipment (CSPF $\geq$ 6.09) finishes what passive design starts.

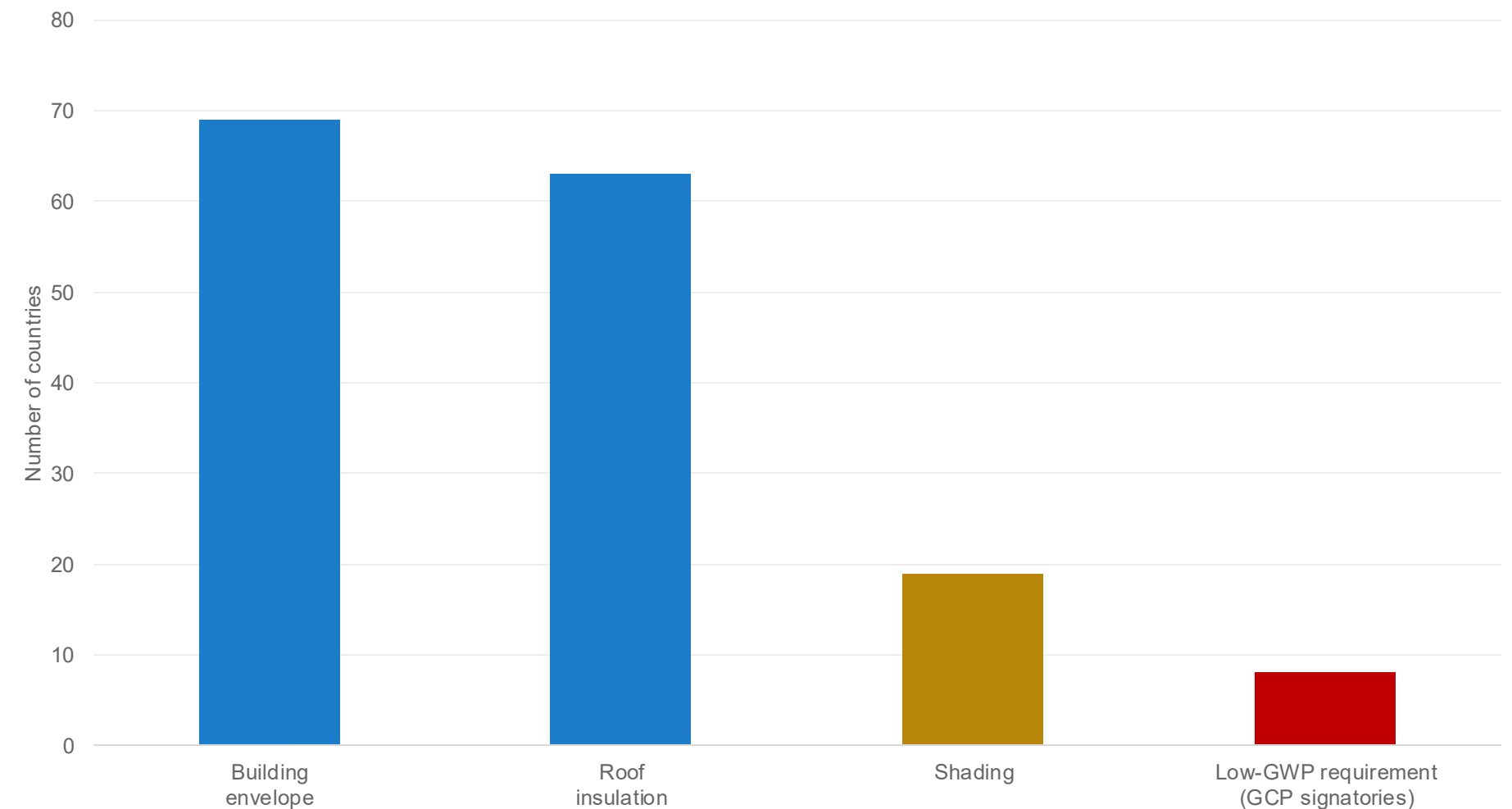


Source: Roadmap Tables 11, 19 and 38 (midpoints of published ranges plotted). ASEAN Roadmap, ACE & UNEP 2026

The Binding Constraint Is Policy, Not Technology

Mandatory Requirements in National Building Codes — Global Status

- **The technology is proven and commercially available. What is missing is the mandate that converts it into installed capacity.**
- 69 countries mandate building-envelope improvements and 63 require roof insulation — but only 19 mandate shading.
- Of the 167 countries with at least one minimum energy performance standard for cooling equipment, only a quarter integrate limits on refrigerant GWP.
- Among Global Cooling Pledge signatories: 30 have codes supporting passive cooling, 16 encourage high-efficiency equipment — and only 8 include low-GWP refrigerant requirements.
- That 8 is the evidence that we are still running two parallel processes. Kigali Implementation Plans and National Cooling Action Plans should be one strategy.



Building codes are the decisive lever — mandatory passive requirements, not voluntary guidance, are what convert available technology into installed capacity at scale.

Source: UNEP Global Cooling Watch 2025; Global Cooling Pledge signatory review, 2026

APAEC 2026–2030: The Regional Mandate Behind the Roadmap

How ASEAN's energy cooperation plan delivers the Kigali Amendment from both sides



- **APAEC 2026–2030 is ASEAN's binding energy instrument — it turns the Roadmap's recommendations into obligations across ten Member States.**
- EE&C is one of seven programme areas, carrying the headline target: 40% energy intensity reduction by 2030 against 2005.
- Two of its five Outcome-Based Strategies touch cooling — and together they cover both halves of the Kigali problem.
- OBS 1 drives harmonised ASEAN MEPS: ~510 kWh/unit stock-average AC savings, 36% below BAS. The supply side.
- OBS 2 removes the cooling load before a unit is ever specified. The demand side.
- Both run through the EE&C Sub-Sector Network — Kigali plans plug into machinery that already exists.

Download
APAEC 2026–2030



APAEC 2026–2030 · EE&C Programme Area · 40% energy intensity reduction by 2030 (2005 baseline)

OBS 1 · SUPPLY SIDE

Efficient appliances and equipment

APAEC Outcome-Based Strategy 1

Harmonised ASEAN MEPS

CSPF ≥ 6.09 · ~510 kWh/unit saved

Fewer, better units
Smaller charge, low-GWP ready

OBS 2 · DEMAND SIDE

Zero Energy Buildings through passive design

APAEC Outcome-Based Strategy 2

Passive requirements in building codes

Envelope · ventilation · shading

Load designed out
Equipment never installed

→ **One delivery framework: Kigali Implementation Plans + National Cooling Action Plans**

Supply side and demand side, coordinated through the existing ASEAN EE&C Sub-Sector Network

Sources: ASEAN Plan of Action for Energy Cooperation (APAEC) 2026–2030, EE&C Programme Area; ACE harmonised MEPS least-cost optimisation (30th EE&C-SSN, 2026); ASEAN Passive Cooling Roadmap, ACE & UNEP 2026

Regional Readiness: Where Support Is Needed

ASEAN Member State Maturity Across Four Enabling Conditions

A single pathway cannot succeed across this spectrum. Singapore consolidates, Thailand and Malaysia regulate, and the CLM group must first build baseline capacity — which is why the Roadmap differentiates by tier rather than prescribing one sequence for all ten.

	Building codes	Technical capacity	Green finance	Market adoption
Brunei	Developing	Emerging	Developing	Emerging
Cambodia	Initial	Initial	Initial	Initial
Indonesia	Emerging	Developing	Emerging	Emerging
Lao PDR	Initial	Initial	Initial	Initial
Malaysia	Developing	Developing	Developing	Developing
Myanmar	Initial	Initial	Initial	Initial
Philippines	Emerging	Emerging	Emerging	Emerging
Singapore	Advanced	Advanced	Advanced	Advanced
Thailand	Developing	Developing	Developing	Developing
Viet Nam	Developing	Developing	Emerging	Developing

Gaps the Roadmap is designed to close

Policy gap

Most national building codes still do not mandate passive cooling

Technical gap

Insufficient TMY climate data; shortage of certified professionals

Financial gap

Limited green finance products; high perceived investment risk

Market & coordination gap

Fragmented supply chains, few demonstration projects, inconsistent standards across AMS

Source: Roadmap Table 37, Regional Status Overview. ASEAN Roadmap for Extreme Heat Protection through Passive Cooling, ACE & UNEP 2026

Passive First: One Agenda, One Implementation Framework

ASEAN Roadmap for Extreme Heat Protection through Passive Cooling, 2026–2040

PASSIVE FIRST

Eliminate cooling demand at source through design, orientation and envelope. Size mechanical cooling only for the residual load — cutting kilowatt-hours, capital cost and refrigerant charge together.

2026–2028

Foundation

Baseline assessment, TMY climate data, professional training, demonstration projects in every AMS

2028–2032

Regulation

Passive requirements phased into national building codes — large commercial and public buildings first

2032–2040

Transformation

Harmonised regional standards, green finance at scale, passive-first as default practice

Ten years after Kigali, the question is no longer only how fast to phase down HFCs — but how to build a cooling system that needs fewer of them.

ACE invites national ozone units, Montreal Protocol institutions and partners to work with us as the Roadmap moves into implementation.

Source: ASEAN Roadmap for Extreme Heat Protection through Passive Cooling, ACE & UNEP 2026; aligned with APAEC 2026–2030 and the Global Cooling Pledge

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Panel discussion: From innovation to deployment

Moderator



**Mr Rio Jon Piter
Silitonga**

Senior Officer
Energy Efficiency and Conservation
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Panellists



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**Mr Elie
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National Ozone Unit
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**Mr Masahiro
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CEO
SPACECOOL

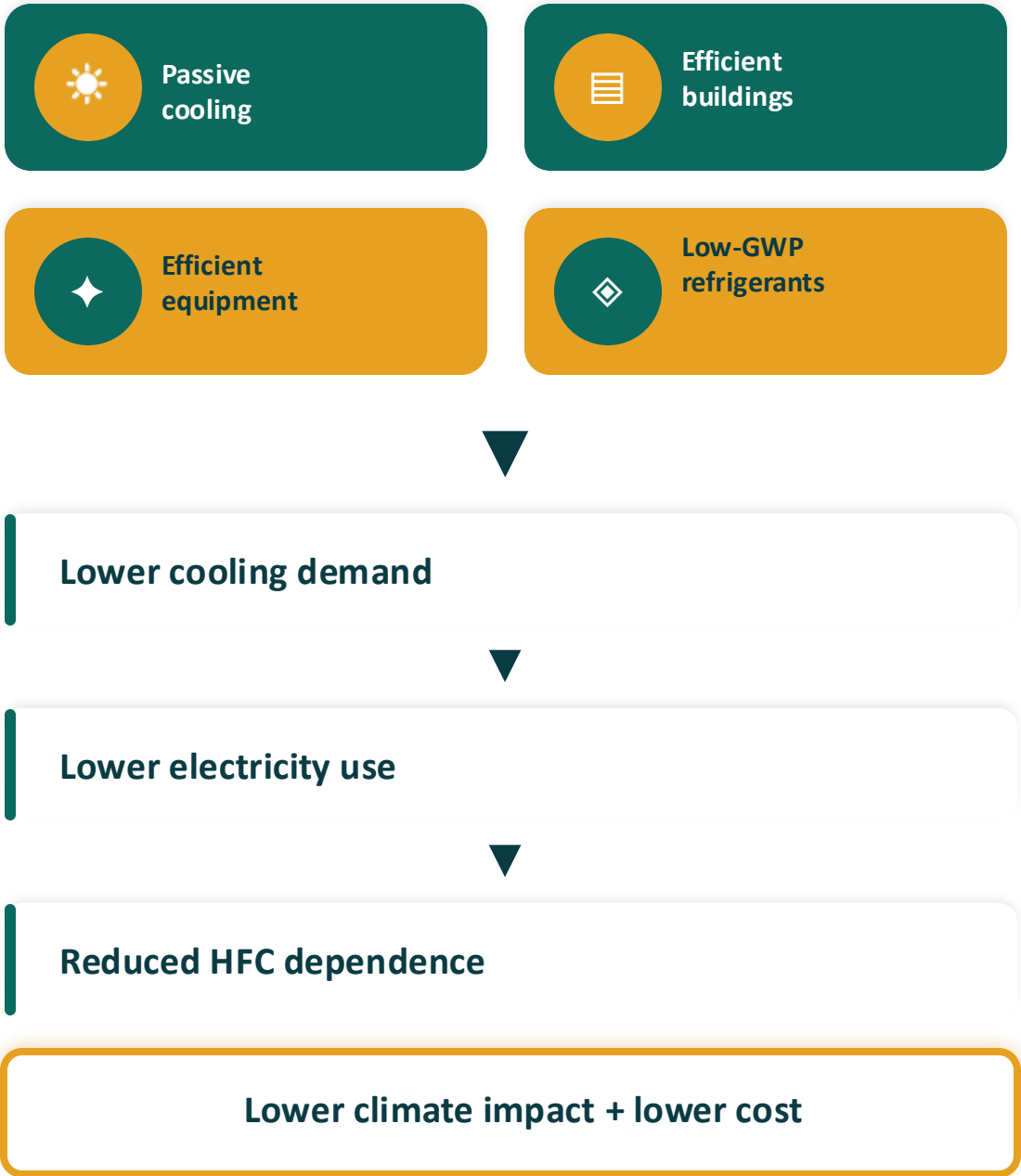


**Ms Alexandra
Mutungi**

Gender and Climate
Change Expert
UNEP Regional Office for
Asia Pacific

Why Viet Nam integrates efficiency and the refrigerant transition

"The fastest route to Kigali compliance is to reduce the cooling we need in the first place."



≈ 7% / yr

COOLING ELECTRICITY LOAD

Growth of Viet Nam's cooling electricity load — the fastest-rising demand segment.

65%

SUSTAINABLE COOLING PATHWAY

Share of cooling-sector emissions reductions delivered by passive & low-energy cooling — UNEP Global Cooling Watch.

34 → 80.7

M tCO₂e / yr · 2017 → 2030

Projected rise in Viet Nam's cooling emissions without integrated action.

Viet Nam treats passive cooling, energy efficiency and low-GWP refrigerants as ONE integrated cooling strategy — not three parallel agendas.

Reinforcing conditions that let technology scale

CENTRAL LESSON

Policy, not pilots,
is what scales.

PROOF POINT — QCVN 09 IN PRACTICE

up to 25%

Cooling-energy savings in code-compliant commercial buildings in Viet Nam (envelope, shading, ventilation performance under QCVN 09:2017/BXD).
Source: Ministry of Construction / IFC EDGE / World Bank building-sector assessments.

ONE COUNTRY · ONE PLAN · ONE GOVERNANCE TRACK

KIP

Kigali
Implementation Plan

NCAP

National Cooling
Action Plan

ONE NATIONAL COOLING STRATEGY

Aligned governance · shared metrics · shared finance

1

National policy &
Kigali architecture

Decree 06/2022 · Decree 119/2025 · Decision 496/QĐ-TTg (National Cooling Action Plan, Jun 2024) · Global Cooling Pledge, COP28

3

Building codes &
passive design

QCVN 09 revision — mandatory shading, envelope and ventilation performance.

5

Capacity building
& safety

National certification for A2L/A3 refrigerants · QCVN 76:2023 recovery standard.

2

Energy-efficiency
regulation

MEPS + mandatory energy labels — ratcheting AC performance to regional best practice.

4

Technology
transition

R32 · R290 · NH₃ · CO₂ · HFO — GWP caps on new equipment from 2029.

6

Finance at scale

Multilateral Fund · World Bank refrigerant inventory · green credit · emerging carbon market.

7

Market transformation

Extended Producer Responsibility (EPR) pilots for recovery, recycling and reclamation.

SCALING
SUSTAINABLE
COOLING

HPMP delivered on schedule · Kigali Implementation Plan under preparation with MLF · 2024 refrigerant bank: 49,200 tonnes ≈ 85 M tCO₂e · ≈ 240 M tCO₂e avoided since 1994.

What has worked, what still blocks scale, and the way forward

LESSONS FROM VIET NAM



- ▶ **Integrated policy** beats parallel agendas
- ▶ **Servicing** decides lifecycle emissions — not just new equipment
- ▶ **Building codes** are the highest-leverage entry point
- ▶ **International finance + national law** must move together

REMAINING CHALLENGES



- ▶ **Passive cooling** still underused in practice
- ▶ **Building standards** need stronger enforcement
- ▶ **Weak incentives** for next-generation technologies
- ▶ **Servicing gap** — potential HFC quota shortfall

≈ **2.2M**
tCO₂e BY 2032

Modelled servicing gap — potential HFC quota shortfall if action is delayed.

RECOMMENDATIONS



- 1 **MERGE** National Cooling Action Plans with Kigali Implementation Plans
- 2 **MANDATE** passive cooling in building codes
- 3 **PRIORITISE** demand reduction before equipment replacement
- 4 **SCALE** finance for next-generation cooling technologies
- 5 **DESIGN-IN** equitable access — passive cooling for heat-vulnerable and low-income households by default

“ The fastest path to Kigali compliance is not only replacing refrigerants — it is reducing the need for cooling in the first place. ”

Q&A

Moderator



Mr Amr Seleem

Country Engagement and Climate
Policy Lead
UNEP Cool Coalition

Panellists



**Dr Jihad
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Environment of Jordan



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Closing Remarks



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Cooling Policy Specialist

UNEP Cool Coalition



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THE KIGALI
AMENDMENT
2016–2026