



GLOBAL COOLING PLEDGE ASSEMBLY

SINGAPORE 15 - 18 SEPTEMBER 2026

Extreme Heat & Sustainable Cooling: Evidence-based Decision Making

11:00-12:30

Expert Panel Discussion



Ministry of Sustainability
and the Environment
— SINGAPORE —



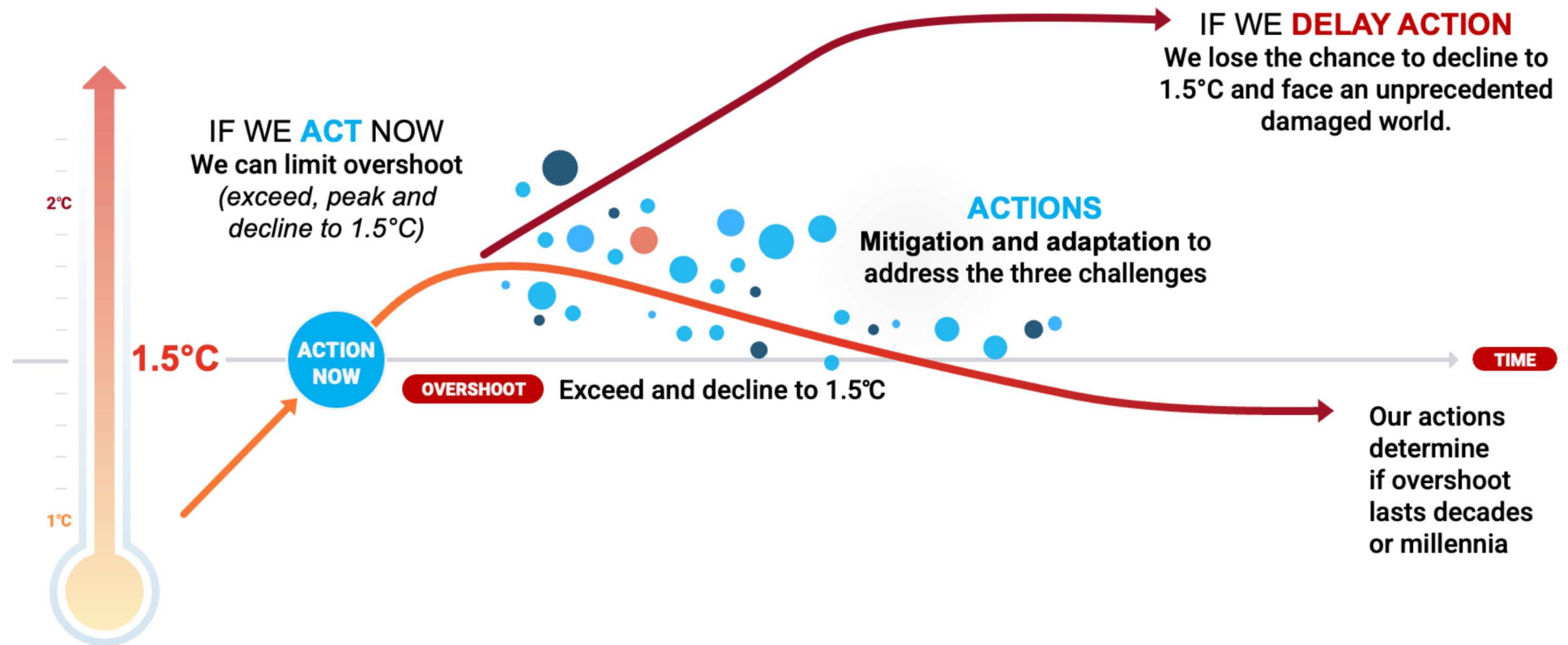
Moderator



Lily Riahi

Head of the Cooling, Buildings and
Energy Unit, Mitigation Branch, CCD;
Head of the Cool Coalition, UNEP

A Changing Sequence of Challenges



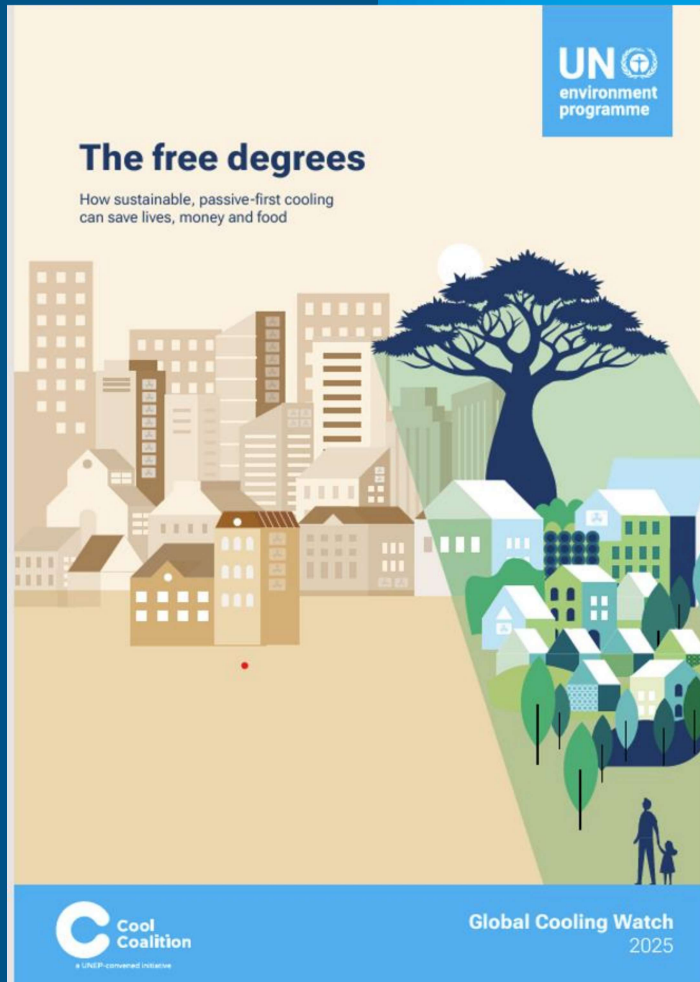
**“While exceeding
1.5°C is unavoidable,
how high we go and
for how long it lasts
is still in our hands.”**





Global Cooling Watch 2025

- Under BAU, cooling demand will **almost double emissions** over 2022 levels
- A Sustainable Cooling Pathway can **slash 97% of emissions by 2050**, increase access, with an economic upside in the trillions



A Resilience Heat Roadmap for a Warming World



SEVEN TARGETS
TO ACHIEVE
BY 2030

SEDAI FRAMEWORK
FOR DISASTER RISK REDUCTION 2015-2030

11 SUSTAINABLE CITIES
AND COMMUNITIES



**A Decision Making Architecture
For the New Heat Reality
that Brings Together Domestic and
International Agendas**

13 CLIMATE
ACTION



United Nations
Convention to Combat
Desertification



Kunming-Montreal
GLOBAL BIODIVERSITY FRAMEWORK



IMPLEMENTING
THE NEW
URBAN AGENDA

COP30
BRASIL
AMAZÔNIA
BELÉM 2025

UN
environment
programme

Cool
Coalition
a UNEP-convened initiative

Ministry of Sustainability
and the Environment
SINGAPORE

High-Level Panel Discussion:

Rapid-Fire Evidence Presentations & Moderated Scientific Conversation



Winston Chow

Co-Chair of the
Intergovernmental Panel on
Climate Change's (IPCC)
Working Group II



Jason Lee

Director,
Heat Resilience &
Performance Centre,
National University of
Singapore



Omar Abdelaziz

Associate Professor,
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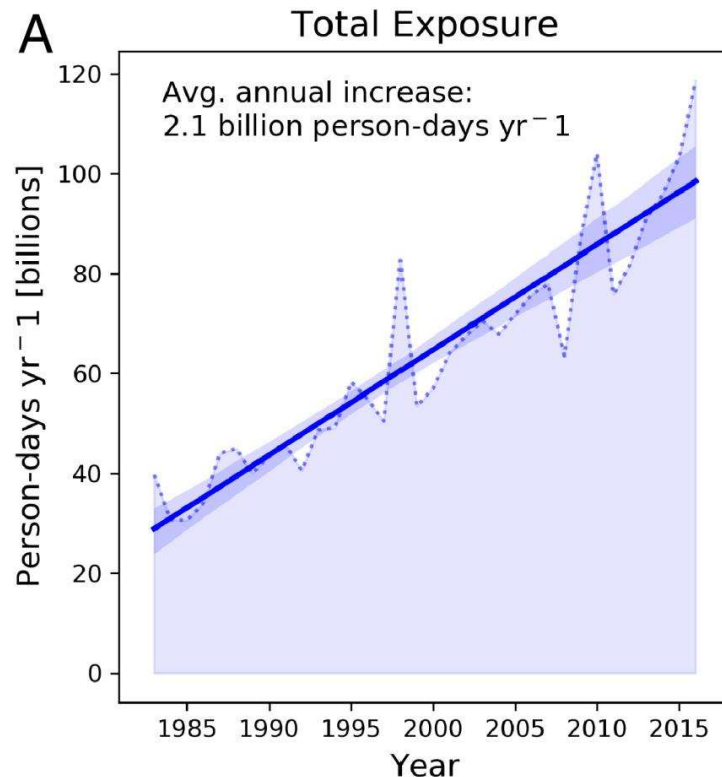
Eleni Myrivili

Global Chief Heat Officer,
UNEP

Extreme heat is expanding in scale and changing in character



The urban risk is already large, unequal, and increasingly chronic



Extreme urban heat exposure tripled from 40 to 119 billion person-days between 1983 - 2016

Additional warming raises tropical nights and cooling demand in nearly all cities

Urban form can amplify heat, especially at night. Within-city and urban–rural temperature differences can reach about 10°C under some conditions, and up to 7 °C in Singapore.

At 2°C warming, projected annual exposure beyond physiological tolerance reaches 224 hours in Dammam, 147 in Lahore and 39 in Delhi.

Heat depends on temperature, humidity, wind and solar radiation. In many tropical cities, heat is shifting from episodic emergency to everyday stress.



What do we still underestimate...?

Average outdoor temperature captures only part of the risk

- 1 Human exposure** Hot nights, humid heat, indoor temperatures and daily mobility can produce exposures that weather stations miss.
- 2 Unequal vulnerability** Poor housing, informal work, ageing, ill health, energy poverty and limited access to cooling results in larger heat risks.
- 3 System cascades** Heat can reduce power generation as cooling demand peaks, then disrupt water, health, transport, food, education and work.
- 4 Compound events** Heat combines with drought, air pollution, fire weather, water scarcity and heavy rainfall sequences. The joint risk can exceed each hazard assessed alone.
- 5 Adaptation limits** Plans often track whether measures exist, not whether they work during prolonged, repeated or unprecedented events.

Policy implication: govern heat as a systemic urban risk, using neighbourhood-scale data, health and labour protection, passive cooling, reliable low-carbon cooling, and stress tests across essential services.

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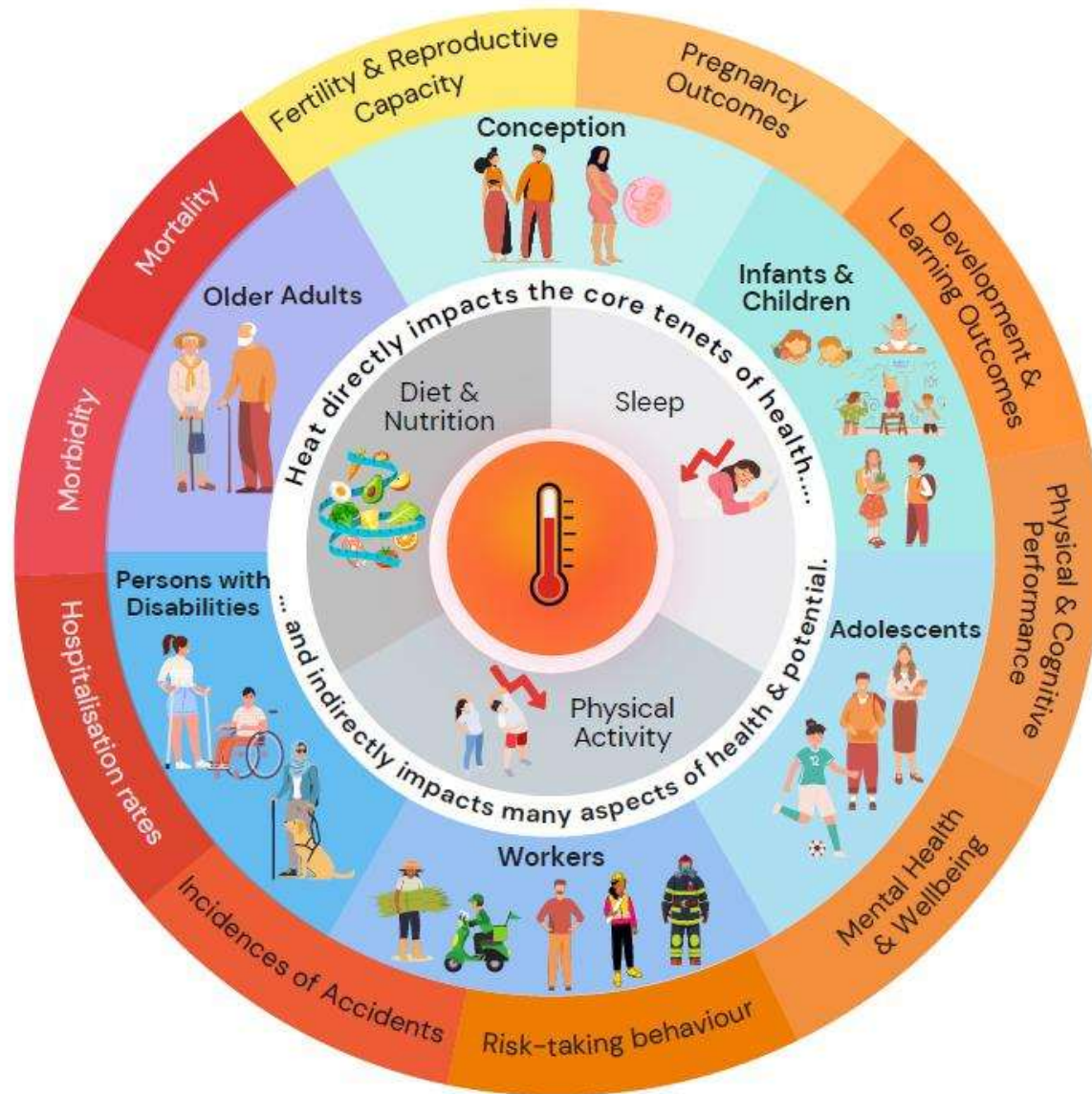
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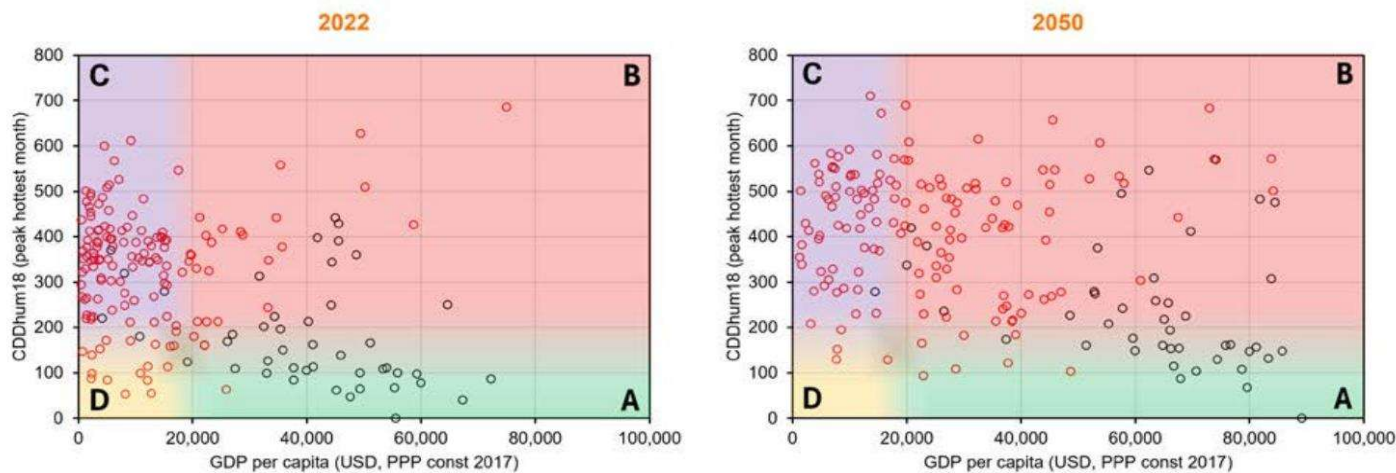
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Extreme heat + rising incomes are reshaping global cooling demand



By 2050, rising heat and incomes will bring billions of more people into the cooling market, yet ~3 billion people remain constrained by affordability and access.

Figure 4-3 Country GDP per capita versus peak monthly cooling degree days, 2022 and 2050



Note: Each dot represents an individual country. Article 5 Parties are in red, and non-Article 5 Parties are in black. The four coloured chart areas represent the Categories A to D described in this section. CDDhum18 is the cooling degree days (CDDs) corrected for humidity with a reference temperature of 18°C.

Source: Global Cooling Emissions Model

Cooling markets expand, access gaps persist

Income-cooling profile	2022	2050
A: High income, low cooling need	0.5	0.2
B: High income, high cooling need	2.7	6.5
C: Low income, high cooling need	4.5	2.9
D: Low income, low cooling need	0.3	0.0
Total (billions of people)	8.0	9.7

The shift into Category B accelerates active-cooling demand to 68 TW in 2050 = 3.1x the 2022 level;
The persistence of Category C (2.9 bn people) keeps cooling access and affordability at the centre of the policy challenge.

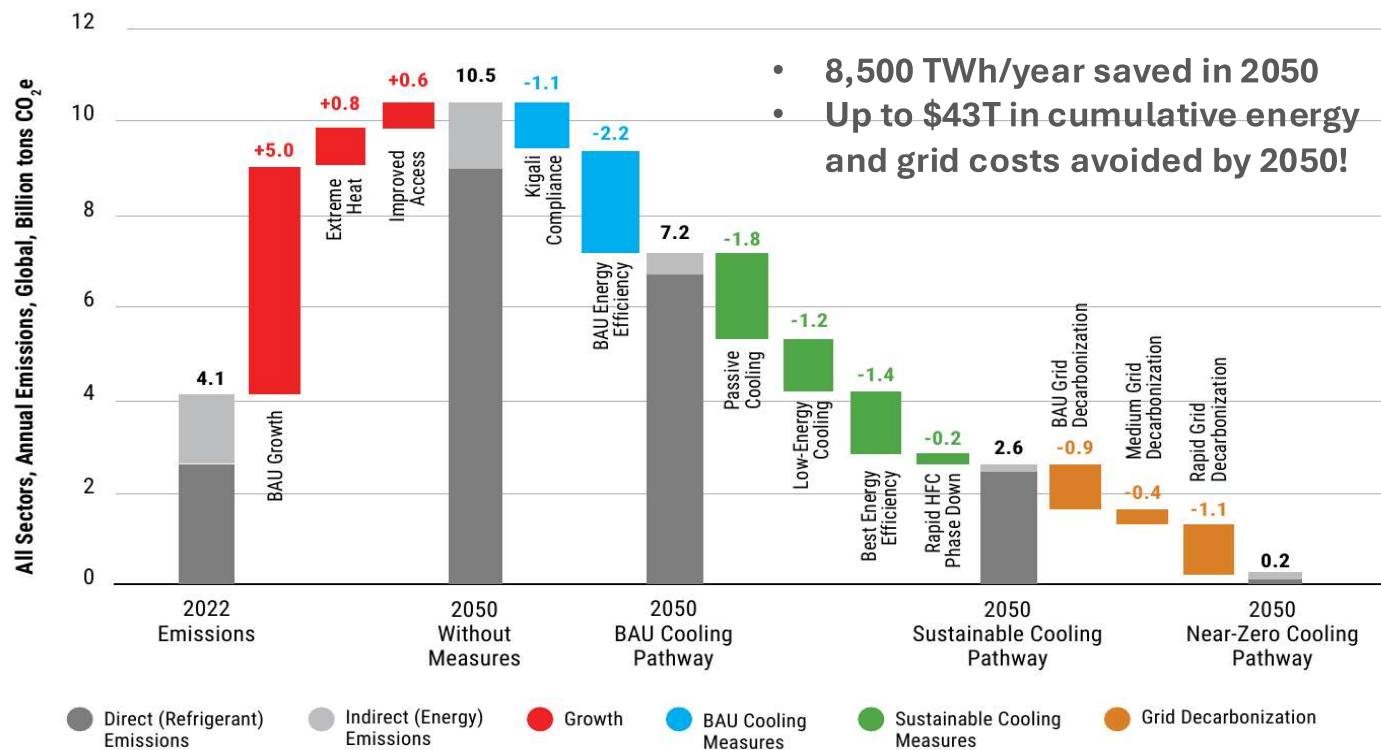
Source: UNEP (2025), Global Cooling Watch 2025: The Free Degrees.



The pathway is cumulative: reduce the load, then decarbonize the rest

The Sustainable Cooling Hierarchy follows a Reduce–Improve–Shift approach to meet growing cooling needs with reduced energy use and emissions.

Figure 4-8 Modelled pathway to near-zero GHG emissions from cooling in 2050



The cumulative pathway

Each step gets us closer to the end goal: the pathway works because the measures stack.

1 Growth pressure
4.1 → 10.5
+5.0 BAU growth
+0.8 extreme heat
+0.6 improved access

2 What BAU already delivers
10.5 → 7.2
-1.1 Kigali compliance
-2.2 BAU energy efficiency

3 Sustainable + clean power
7.2 → 2.6 → 0.2
-4.6 sustainable cooling measures
-2.4 grid decarbonization

Source: UNEP (2025), *Global Cooling Watch 2025: The Free Degrees*.

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Global Chief Heat Officer,
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The New Politics of Heat



- **More than half of humanity now lives in cities. Urbanization continues fastest in developing countries.**
- **The richest 1% own roughly 46% of global wealth, while the poorest half own less than 1%.**
- **Many of the world's fastest-growing cities are also among the world's most heat-vulnerable cities.**

Are we solving for cooling? or for thermal safety?



Access to Cooling

Who can afford:

- Better housing
- Back-up power
- Air conditioning
- Cooler neighborhoods
- Access to private refuge

Thermal Safety

Can everyone remain safe?

- At home
- At school
- Care facilities
- At work
- In public spaces

**Heat Resilience is a governance issue,
one that we have to decide collectively.**

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Reflections: Industry and Philanthropy Perspectives



Andrea Voigt

Vice-President,
Public & Industry Affairs, Sustainability,
Communications;
Interim Head of Corporate Public Affairs,
Danfoss



Noah Horowitz

Senior Director,
Clean Cooling Collaborative





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Synthesis: From Evidence to Action

Science is increasingly clear, the risks are growing, and many of the solutions already exist. What is the most important thing countries need in order to move from understanding heat risk to delivering action at scale?



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Heat Resilience Roadmap for a Warming World

What it adds • How countries use it • What UNEP's role should be

Eleni Myrivili

Global Chief Heat Officer,
UNEP, Cool Coalition



1. The proposition:

One guiding architecture for a problem that is currently fragmented



PROBLEM SETTING

Rising heat risk
and rising cooling demand
are accelerating together -

but are still addressed through
separate agendas.

THE SHIFT

From “How much
cooling do we need?”

to

“How do we deliver
thermal safety?”

THE VALUE

Connect the heat and cooling
agendas and actions across
sectors like health and wellbeing,
energy, water, buildings and
infrastructure .

Support domestic priorities and
help meet international obligations
- mitigation and adaptation
including Belem Indicators - which
include Heat Resilience.



2. Start with what we want to achieve - Two simple questions anchor the whole Roadmap

THERMAL SAFETY ACCESS (TSA)

Can people [communities?] remain safe
and participate in daily life
during extreme heat?

HEAT RESILIENCE CAPACITY (HRC)

Can critical systems –
health, energy, water, food, transport,
critical economy sectors,
and communications –
continue to function under heat stress?

Sustainable cooling is not a third outcome. It is the pathway to achieving both.

3. Building a flexible architecture:

Proposing and co-designing a collective architecture that leads from ambition to action.



A. GOVERNANCE

How do we coordinate and integrate planning and action?

How do we organise government leadership and connect it to national and international commitments?

B. STRATEGIC ACTION AREAS

Where is heat creating the greatest risks and what do we need to prioritise?

What's our Resilience Pathway: how do we organise and prioritise our risk, which sectors/systems need to respond?

C. SOLUTIONS

What actions will deliver those priorities?

Which combination of behavioural, nature-based, passive, active-cooling and policy/finance solutions is most appropriate?

D. OUTCOMES

Are people safer and are systems more resilient?

How do we measure Thermal Safety Access (TSA) and Heat Resilience Capacity (HRC)?

Governance enables > Strategic Action Areas organise > Solutions deliver > Outcomes measure & feed back into the system



A. Governance - proposed module for discussion

Political mandate

- Head of State/Government recognition the systemic heat challenge and as a “**disaster**”
- Mandate established through appropriate national mechanism

Institutional ownership

- Designate an institution or office with the mandate to coordinate development and implementation of the Roadmap
- Connect relevant ministries and existing national plans
- Establish multilevel governance mechanisms

Accountability & reporting

- Coordinate reporting on outcomes and progress
- Link heat resilience action to relevant national and international climate commitments

The Roadmap does not create a new bureaucracy; this governance module establishes the mandate, the coordination mechanism needed to connect existing responsibilities, and the authority to maximize impact.



B.1 Strategic Action Areas - proposed module for discussion

Step 1. Understand the Risk:

What are the country's greatest heat and cooling risks?

Step 2. Organise the Response in Five Strategic Action Areas:

Where do these risks affect people, systems and the economy and where should government action be organised?

Health & Human
Wellbeing

Cities / Buildings /
Public Space

Critical
Infrastructure

Economic &
Institutional
Resilience

Disaster Preparedness
Response & Recovery

Science/Data and Education/Capacity = cross-cutting areas.

Step 3. Deside Priorities

What should we do first and where should we focus?

Prioritise and sequence actions ➡ Define resilience pathway

Output: A clear set of national heat-resilience priorities

C. Solutions – proposed module for discussion



Resilience Pathway = WHAT needs to change ➔ **Solutions Taxonomy = the menu of HOW to achieve it.**

Solution families to choose from:

BEHAVIOURAL & SOCIAL

Heat-safe behaviour | community preparedness & capacity | EWS

NATURE-BASED

Trees | green/blue infrastructure | green corridors | green roofs

PASSIVE DESIGN & PLANNING

Shade | ventilation | cool roofs | building design | retrofits

ACTIVE COOLING

Efficient cooling | hybrid systems | district cooling where appropriate

POLICY, GOVERNANCE & FINANCE

Codes | standards | procurement | incentives | finance

Decision Rule:

Sustainable Cooling Hierarchy

Reduce exposure & demand >

Low-energy/hybrid >

Efficient active cooling >

Low-GWP + clean energy

The country selects and sequences the combination of solutions that best delivers its Resilience Pathway with a climate mitigation and economic lens .



D. Outcomes – proposed module for discussion

THERMAL SAFETY ACCESS (TSA)

Can people remain safe?

Possible indicators for population at:

- Home: what percentage of people remain safe at home?
- Workplace: what percentage of workers remain thermally safe?
- School and care facilities: are children and vulnerable people protected?
- Public realm: can people safely move through the city?
- Cooling refuge access: can people access emergency cooling?

HEAT RESILIENCE CAPACITY (HRC)

Can critical systems continue to function?

Possible indicators for critical systems:

- Critical infrastructure readiness and resilience
- Health-system heat readiness and resilience
- Critical Economic Sectors R&R
- Energy-system R&R
- Water system
- Transportation
- Communications and digital systems
- Supply and cold Chains, etc

Baseline > Track progress > Review > Adjust



7. Heat Resilience Roadmap for a Warming world – a proposition to take forward

As Heat is Rising COUNTRIES NEED:

- Common way to understand and handle heat + cooling risk
- A way to prioritised and sequenced action
- Connection to existing national plans and investments
- Regional peer-to-peer learning
- Meaningful resilience outcomes

What can we CO-DESIGN at the Singapore Assembly:

- Discuss outcomes: TSA & HRC indicators and national baselines
- Governance : how do we organise and implement
- Strategic Action Areas: how do we set national priorities
- Solutions Taxonomy: which solutions will get us there?
- Outcomes: measuring success and linking with existing efforts?

Global Cooling Pledge = ambition | Roadmap = modular decision architecture for implementation



“So what does this add?”

“It provides the missing implementation architecture that connects the actions different ministries are taking on health, adaptation, cooling, buildings, energy, infrastructure & development into a coherent, climate-resilient response to growing heat risk.”

“It provides a roadmap as well as a framework for the new climate reality, connecting the plans countries need with the ones they already have around the shared objective of heat resilience.”

Key Takeaways for the Assembly



Lily Riahi

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