The Cooling Challenge: A call to action

GLOBAL COOLING PRIZE REGIONAL EVENTS
Mumbai: December 11, 2018
Chennai: December 13, 2018
Increasing demand for comfort cooling in developing markets represents one of the biggest end-use risks to our climate goals

### POPULATION GROWTH
Population is growing by over 80 million people/year, with 97% of growth in developing countries.

### URBANIZATION
99% of population growth is occurring in urban environments, worsening heat island effects.

### INCOME GROWTH
GDP growth for non-OECD countries will exceed 5% through 2025, making comfort economical for millions of new consumers.

### A WARMING PLANET
Global average temperatures expected to rise over 2.0°C by 2100, making summers longer and hotter.

**Non-OECD Cooling Demand will increase 5x by 2050**

The Projected Growth in Room Air Conditioners

- **3.7-times increase globally**
  - 1.2 billion units today to 4.5 billion units by 2050
- **5-times increase in emerging economies**
  - Account for nearly 70% of the projected growth
- **India - over 20% of the global growth**
  - 1.1 billion units in operation by 2050
For many people, comfort cooling is transitioning from a luxury, to a vital enabler of health and productivity.

Worldwide, by 2030, extreme heat could lead to a $2 trillion loss in labor productivity. India’s economy alone stands to lose $450 billion.

These RACs will account for over 20% of total building energy use (and over 8% of all energy use) by 2050.

Energy consumption associated with comfort cooling, 1990-2050

Source: IEA Report: The Future of Cooling, 2018

Equivalent to the electricity consumption of the U.S., Germany, and Japan... combined.
Air conditioning demand will place significant burdens on grids and consumers

New Delhi’s grid electricity demand profile, hourly

- Peak load impacts
- Capital investments in grid infrastructure
- Significant additional generation capacity
- High operational costs to consumers

While existing cooling efficiency efforts are critical, they are not sufficient.
Large GAP: addressing the operational performance of… but this opportunity remains largely unaddressed by a globally consolidated RAC industry

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<tr>
<th>Industry progress toward theoretical max efficiency</th>
<th>Consolidated industry</th>
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<tr>
<td>Lighting</td>
<td>• Fewer than 500 AC companies worldwide</td>
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<td>• 70% of global RAC production in China</td>
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<td>• Just two companies represent 50% of China’s production</td>
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<td>Solar PV</td>
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<td>A/C</td>
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**High barriers to entry**

“The threat from a new entrant is causing a negligible impact to the present players because of heavy R&D and technical requirements needed to enter into the AC market”

– 2015-2020 Global AC Market Forecast, BIS Research
How far can the conventional solution and strategies take us

Improved Scenario
Consideration interventions in four key areas:
• accelerated improvements in building energy codes and code compliance,
• accelerated improvements in MEPS of air-conditioning units,
• improved practices for refrigerant recovery at end of life,
• successfully meeting the HFC phase-down requirements under the Kigali Amendment.
The takeaways…

• Conventional solutions do not bring us anywhere close to neutralizing the climate impact of the exponential growth in RACs

• We cannot solve this magnitude of growth by adding renewables alone
  • 2017, our record year of solar growth with 94 GW of generation deployed globally - eclipsed by the incremental load of new RACs added to the grid, estimated at ~ 100 GW

• The world needs a radical change in comfort cooling technology
  • one that can effectively and assuredly offset the 5X increase in cooling energy demand in developing economies and put us on a path to cooling with less warming
What if ...

We have a radical room air conditioner solution: one that will have at least five times (5X) less climate impact
A prize has the potential to spur climate-friendly innovation and address the market failure in the cooling industry; here is our approach

• Understand the Status Quo
  ➢ Current technology, R&D efforts, emerging technologies

• Create a community of innovators
  ➢ Showcase opportunity for innovation with policymakers, incumbents, and investors

• Create an Ambitious Target
  ➢ Complement on-going efforts to “raise the floor” of available technology through policy

• Clearly Define Outcomes
  ➢ Feasible performance needed to achieve climate goals

• Don’t Define the Solution
  ➢ Solutions can come from anywhere; incentivize new solvers and approaches

• Help Create ‘Certainty of Demand’
  ➢ Advance market commitments; regulatory signals; scale to drive down costs
Our Prize criteria will ensure the product works for developing countries, in challenging conditions.

Weighting for final evaluation: Climate criteria: 71.5%, affordability criteria: 28.5%

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<th>Criteria</th>
<th>Details</th>
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<td><strong>CLIMATE</strong></td>
<td>One-fifth of the life-time climate impact (electricity and refrigerant) of the baseline RAC unit¹</td>
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<td><strong>AFFORDABILITY</strong></td>
<td>At assessed industrial scale, will cost less than 2x first cost of the baseline RAC unit</td>
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<td><strong>REFRIGERANTS IF USED</strong></td>
<td>GWP assessed as part of energy / climate impact, zero ODP, flammability constraint</td>
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<td><strong>EMISSIONS</strong></td>
<td>Zero onsite emissions from any captive power source.</td>
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<td><strong>POWER</strong></td>
<td>Demands less than 700W at full load</td>
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<td><strong>OPERATION</strong></td>
<td>Maintains at or below 27°C DBT and 60% RH for the duration of the test period</td>
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<td><strong>WATER</strong></td>
<td>Consumes less than 14 liters per day</td>
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<td><strong>SCALABILITY</strong></td>
<td>Usable in existing homes, no “designed in” solution; less than 2x volumetric size of the baseline RAC unit</td>
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¹ The baseline unit represents the most common RAC product sold in India and is in accordance with the BEE defined ISEER rating for a 3 star AC in 2018. It is equivalent to EER 3.5 of a 5 star AC in 2016-17.
The potential impact of a super-efficient, climate-friendly cooling solution would be profound ... 

... for people, the AC industry, the power sector, and the planet
Annual emissions in 2050: 5X is 7.5-times less
Cumulative emissions: 2016 to 2050

75+ GT
CO₂eq emissions avoided through 2050

0.5°C
Global warming mitigation by 2100
Electricity and grid impacts of the 5X Solution

The 5X solution in 2050:

- Uses about 20% less electricity used by RACs in 2016, despite a 3.7-times growth in RAC stock
- Avoids an additional 2,000 GW of power generation capacity
- Translates to global savings of about US$1.4 trillion (INR 10,14,720 Crores) on capital investment in power generation capacity alone
What the 5X solution means for India

- **Electricity savings** - By 2050 ~70% reduction in electricity consumption from RACs – equivalent to India’s total annual consumption today
- **Avoided capacity** - By 2050 ~400 GW of peak load reduction
- **Reduction in emission intensity** – 15% by 2030 (from 2005 levels) equivalent to ~40% of the NDC
- **Cost savings to consumers** – NPV savings of INR 60,000 over the life of the unit

Electricity consumption from RAC operation in RS and 5X Scenario in India
What the 5X solution means for India…contd.

• Supports Government of India’s global climate change commitments and national priorities

• Supports the Government of India’s focus to enable access to efficient and affordable thermal comfort for all

• Provides a tremendous opportunity to the manufacturers, innovators, and researchers in the air-conditioning industry across the globe and particularly in India to develop a cooling solution for a market with the enormous potential to scale

• Puts India at the epicenter of breakthrough innovation as a tool to catalyze large-scale market change and bring in a cooling revolution that will lead us to cooling for all without warming the planet
Universal adoption of a “5x” technology would help bring global climate goals within reach

- **75+ GT** CO₂eq emissions avoided through 2050
- **0.5°C** Global warming mitigation by 2100

**EQUIVALENT IMPACTS**

- Replace **415 GW of new coal-fired generation capacity** with renewable energy
- Make all 28 countries in the European Union **carbon neutral tomorrow**
- Take **50% of today’s global stock of passenger vehicles** off the road
- Achieve the impact envisioned in the **Kigali Amendment**

Scaling the 5X solution could be the most effective and assured step we can take to mitigate the climate impact of comfort cooling and put us on a path to cooling with less warming.