

Global Cooling Prize

To provide cooling for all, without warming the planet

Rajan Rawal, CEPT University

International; Workshop on Energy Efficient Cooling
12-13 Dec 2019, New Delhi

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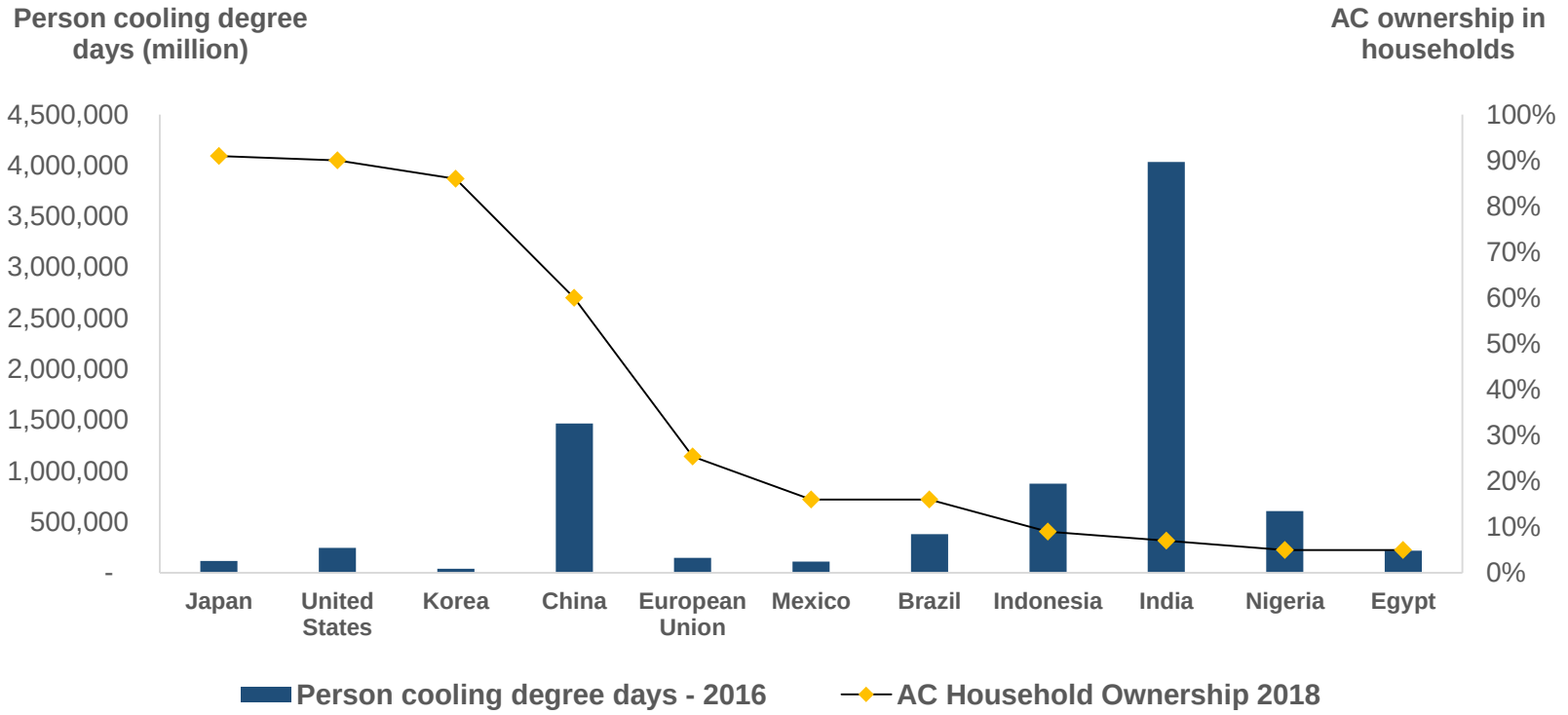
The Cooling Dilemma…..

Increasingly seen as a social need but at an environmental cost we cannot afford



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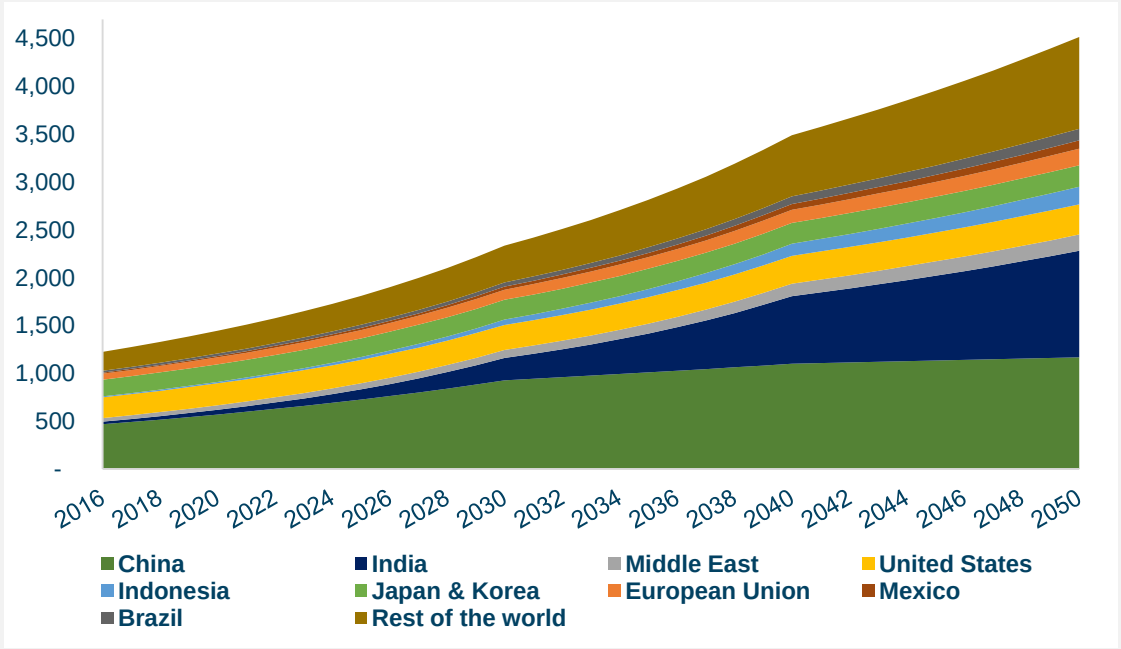
Cooling in the rear view mirror has not captured much attention .. looking to the road ahead cooling needs to be on everyone's agenda



Source: IEA Report: The Future of Cooling: Opportunities for Energy-efficient Air Conditioning (2018); United Nations, Department of Economic and Social Affairs, Population Division (2017); https://www.degreedays.net/

Entry level cooling is provided by the ubiquitous residential / room air conditioner (RAC) the number in operation could grow nearly fourfold by 2050

Expected global stock of room air conditioners, 2016-2050
RAC units, millions



PRESENT

Approx. 1.2 billion RAC units in the world; sales growing at 10-15% per year in developing economies.

2050

Approx. 4.5 billion RAC units in operation worldwide. Demand driven by non-OECD countries.

2100

50-fold increase in worldwide RAC energy demand from year 2000.

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Source: International Energy Agency (IEA) (2018), The Future of Cooling. LBNL Report: Benefits of Leapfrogging to Superefficiency and Low Global Warming Potential Refrigerants in Room Air Conditioning (2015), IPCC, “Fifth Assessment Report”, 2014

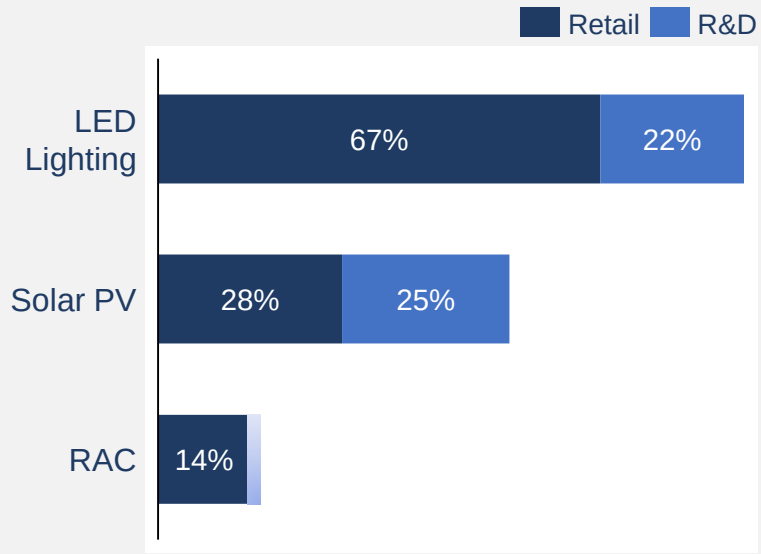
While existing cooling emissions & efficiency efforts are critical, they are not sufficient



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The efficiency opportunity remains largely unaddressed by the RAC industry due to lack of market and policy signals

Industry progress toward theoretical max efficiency



Consolidated industry

- RAC segment is subject to a massive market failure - the focus on lowest upfront cost...and industry responds to market signals
- Fewer than 500 AC companies worldwide

Market Analysis

- Mass market innovation has largely focused on first cost and meeting near term market requirements - not transformational efficiency
- Emerging & innovative technologies are unable to achieve scale

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Source: Greentech Media, “Sunpower Again Holds Record for World’s Most Efficient Rooftop Solar Panel”, 2017; PHYS, “White LEDs with Super-High Luminous Efficacy Could Satisfy All General Lighting Needs”, 2010; Fujitsu, 2017; CLASP, “AC Challenge Program for India”, 2017; LBNL, “Addressing Air Conditioner Energy Efficiency Lost in Translation to Strengthen Policy”, 2018

Do we allow inertia to define us or do we do what humankind has done through the ages and look for innovation to move us forward

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A prize has the potential to spur climate-friendly innovation and address the market failure in the cooling industry



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The Prize Criteria ensure that the next generation room air conditioners will deliver effective cooling at a dramatically lower environmental cost

Primary criteria used to determine final award

Supplementary criteria used to shortlist finalists

CLIMATE
One-fifth of the life-time climate impact (electricity and refrigerant) of the baseline AC unit



AFFORDABILITY
At manufacturing scale of 100,000 units, costs no more than twice the cost of the baseline AC unit to consumers



POWER
Consumes less than 700W from the grid at rated cooling capacity or during test period



EMISSIONS
Zero onsite emissions from any captive power or heat source



SCALABILITY
Usable in existing homes, no “designed in” solution; less than 2x volumetric size of the baseline unit



OPERATION
Designed to have 1.5 TR cooling capacity at standard outdoor conditions and Maintains below 27ºC DBT and 60% RH indoors for the duration of test period



WATER (if any is used)
Consumes an yearly average of 14 liters/day with daily maximum limit of 28 liters



REFRIGERANTS (if any is used)
Zero ODP, lower toxicity, and compliance with safety standards



MATERIALS
Minimal usage of high embodied carbon or rare earth materials



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A high profile competition with a $3M purse supported by a global coalition to spur innovation and catalyze future demand

















































































Our Journey and where we are

Outreach and Media

Over **62,000 users** on the prize website from **187 countries**. The Prize was featured in over **868 global publications** in news outlets in over **95 countries** and recorded over **457 million impressions**. The Prize has over **13,600 followers** on social media

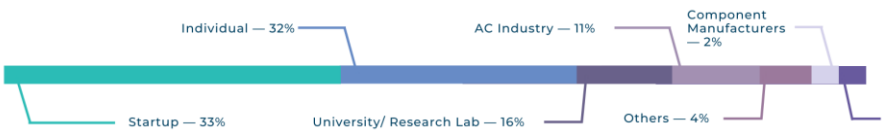
Global Application Submissions

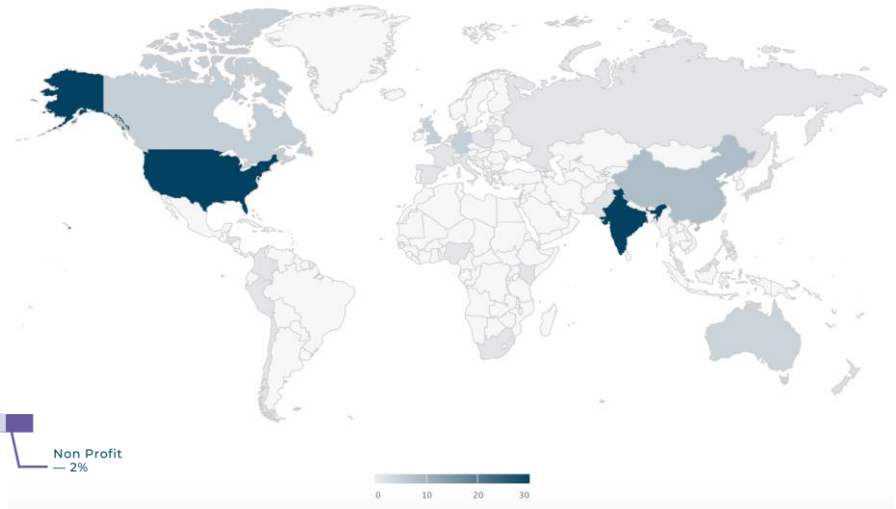
2,100+
TEAMS REGISTERED for the competition

445
completed the **INTENT TO APPLY FORM**

13
completed the **INITIALED TECHNICAL APPLICATION**

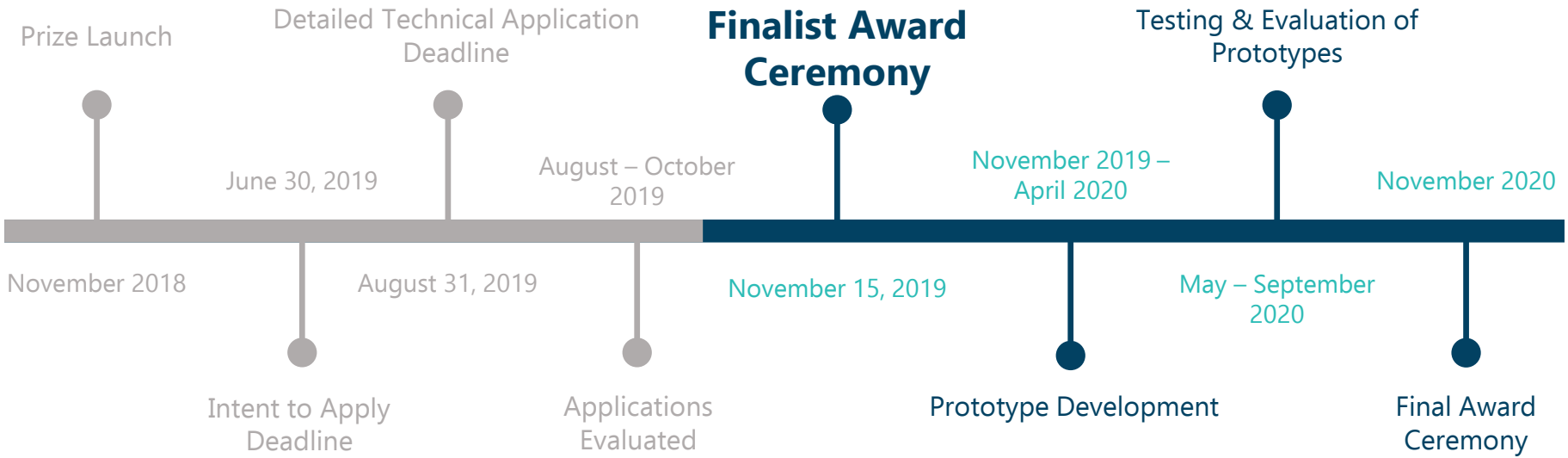
from **31**
COUNTRIES around the world





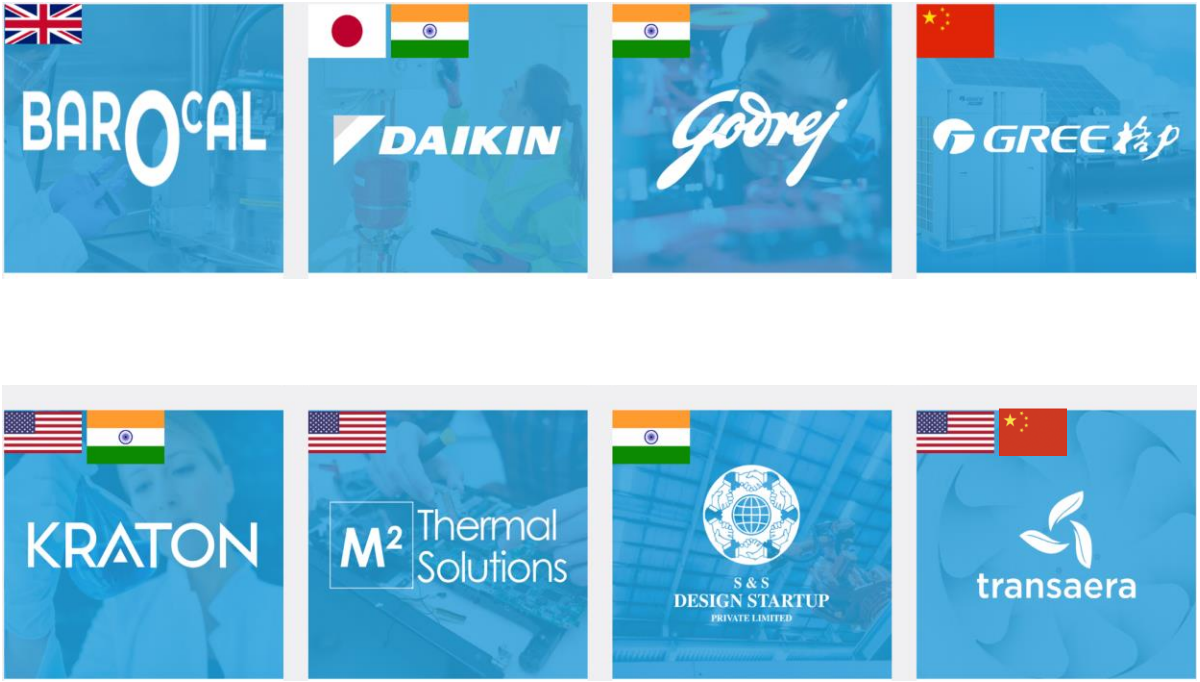
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Prize Timeline and Key Milestones



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8 Finalist teams were selected by the Technical Review Committee following a thorough consensus-based evaluation process



Key highlight is the diversity offered by the selected finalists

- Diversity of technology
- Diversity of geography
- Diversity of entity profile

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Selected 8 breakthrough cooling solutions combine multiple innovations to meet the prize criteria

- **Climate friendly refrigerants or alternatives**
  - R152a (GWP <150)
  - R290 (GWP <3)
  - HFO 1234ze (GWP <1)
  - Solid refrigerant: 2-Bromoadamantane (GWP 0)
  - Water
- **Independent sensible and latent cooling**
  - Desiccant materials to handle latent loads
  - Novel Membrane materials to handle latent loads
  - Multiple evaporator approach to independently manage sensible and latent cooling
- **Recover and reuse condensate to reduce water consumption**
  - Direct evaporative cooling at condensing unit
  - Direct or Indirect evaporative cooling unit to handle sensible load
- **Smart controls that optimizes hybrid operation mode based on sensed condition**
  - Optimize multiple evaporator or condenser operation
  - Auto-switching between ventilation, evaporative cooling, vapor compression
- **Integrated solar PV panel on condenser unit**
  - Reduce the grid electricity consumption
  - Reduce the peak demand on the grid
  - Facilitate rainwater capture for re-use in evaporative cooling

Finalists are required to ship two prototypes to India by April 15, 2020 for testing





Finalists eligible to receive an award of **US $200,000 each**



Finalists undertake prototype development and production between **November 2019 and April 2020**



Finalists ship two working prototypes to India by **April 15, 2020** for testing.

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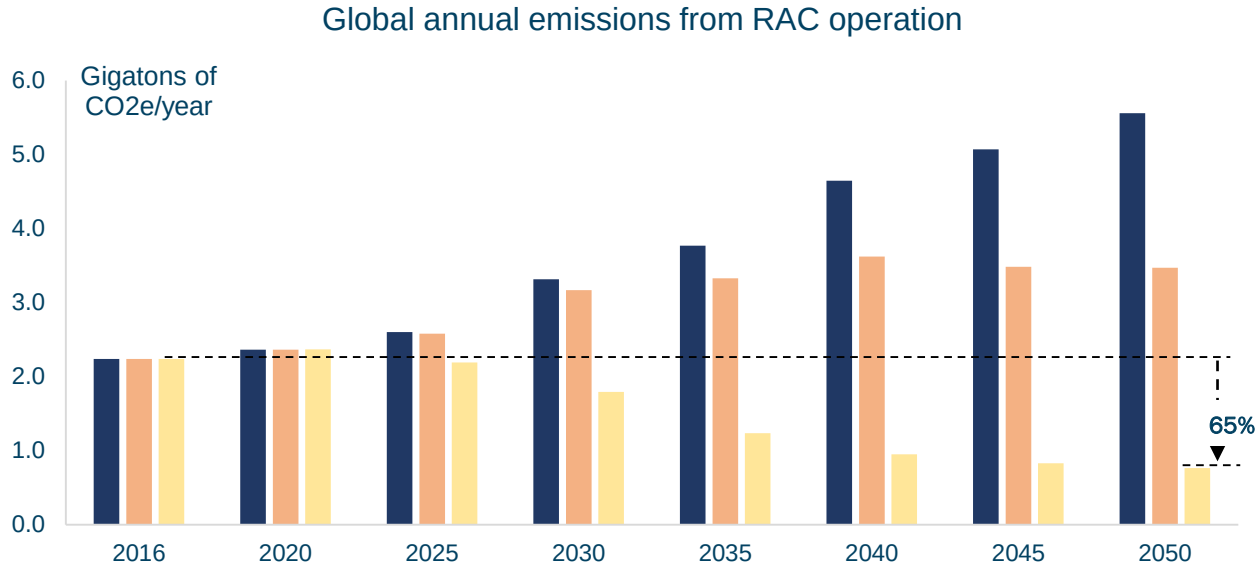
The potential impact of a super-efficient, climate-friendly cooling solution would be profound... in India and across the world

... for people, the AC industry, the power sector, and the planet



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Globally scaling of the 5X solution will reduce RAC associated global annual emissions in year 2050 to a level that is manageable



RS - Reference Scenario, or the business-as-usual RAC growth scenario, where the current adopted or committed policies and government commitments will move forward as per established timelines.

RS-K - Same as the Reference Scenario but adding in the successful implementation of the Kigali phasedown plan.

5X Scenario - Assumes the adoption of technology solution that will have at least five-times (5X) less climate impact than today's standard RAC units

Key assumptions:

- RMI analysis assumes an adoption curve for the 5X solution as follows: market adoption starts in 2022 with a 5% share; by year 2030 it gains an 80% share of the annual sales, and by year 2040 it achieves an almost 100% share of the annual sales.
- We assume that building envelope improvements (thermal insulation driven by building codes) have the potential to achieve a 7.5% reduction in cooling demand in 2050 in developed countries. For developing countries, we assume that a 15% reduction in cooling demand can be achieved in 2050 as a significant portion of the building stock is still to be built

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Thank You

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