India’s Cooling Challenge

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India: A very hot place

Some of the cities with the highest cooling demand are in India: Chennai, Mumbai, Hyderabad, Ahmedabad, New Delhi, Bangalore etc.

Figure: India has the highest cooling degree day per person per square kilometre (Source: The future of cooling, IEA, 2018)
Cooling needs of India

Figure: Only 5% of the households had ACs in 2016. (Source: The future of cooling, IEA, 2018)

- India (2016): 14M (Residential), 13M (Commercial), 91 GWh, 8% of demand, 11% of peak
- China (2016): 432M (Residential), 138M (Commercial), 450 GWh, 9% of demand, 16% of peak
- India (2050): ~1000M, 1350 GWh, 28% of demand, 45% of peak or about 250-300 GW (IEA projections)
When is the national demand peak?

Figure: Despite low AC penetration rates, the national peak demand is often around midnight as a result of residential AC demand. (Data from the National Load Dispatch Centre)
Delhi: The future of the Indian electricity demand curve.

Figure: The Delhi load curve on hottest June day ever: June 10th, 2019. (Data from the Delhi Load Dispatch Centre)

Solar can meet the commercial peak, not the residential peak.
Research agenda I: The energy system perspective

The energy systems boundary:

- Role of daily cycling storage in meeting residential AC demand if deep decarbonization is to be met (A few TWh every day).
- What kind of storage is required (thermal or battery?), and should it be distributed or district/grid level.
- What kind of ACs (conventional single or split units, solar adsorption, district cooling)
- Role of efficiency, building envelopes, building materials etc.
Research agenda II: The lived space perspective

The lived space or urban metabolism boundary:

- Indian cities are losing green cover at an alarming rate leading to urban heat island effects of 2-3 degree Centigrade.
- High share of impermeable surfaces, loss of surface water bodies, and groundwater extraction is leading to both flooding and water insecurity.
- What would be the role of increased tree cover, restoration of water bodies, groundwater recharge, re-orienting urban planning etc.
- How would we analyze the problem from an urban metabolism perspective?