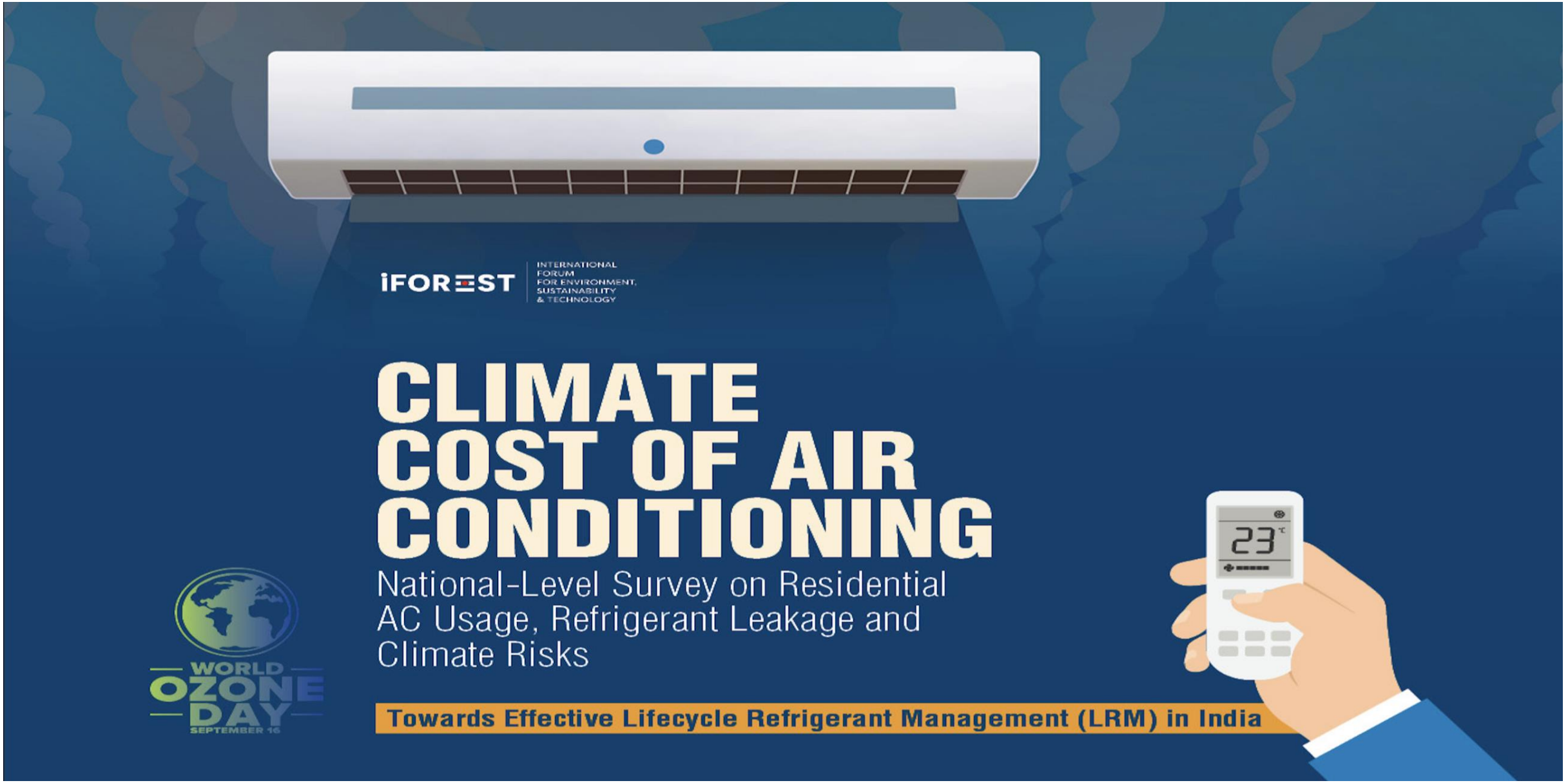

iFOREST
INTERNATIONAL FORUM FOR ENVIRONMENT, SUSTAINABILITY & TECHNOLOGY
CLIMATE COST OF AIR CONDITIONING
National-Level Survey on Residential AC Usage, Refrigerant Leakage and Climate Risks
WORLD OZONE DAY
SEPTEMBER 16
Towards Effective Lifecycle Refrigerant Management (LRM) in India
23

iFOREST's Survey: AC Usage, Refrigerant Leakage & Climate Risks

Survey: A Cross-sectional survey-based research– to inform the development of a lifecycle refrigerant management (LRM) roadmap in India to promote sustainable cooling and climate-friendly transition.

To Understand:

- AC ownership trend and socio-economic factors influencing it
- Priorities in purchasing decisions
- Usage pattern
- Experiences with servicing
- Refrigerant leakage and refilling- scale and cost burden
- Disposal practices
- Consumer awareness- Energy, Climate-friendly options

Respondents: Primary household decision-makers and AC users.

Survey Sample: <u>Stratified random sampling</u>

- Coverage across- High, Middle and Low-income groups
- Coverage across- hot climate zones- hot-dry, composite, warm-humid
- More than 3,100 households across 7 cities (Delhi, Mumbai, Kolkata, Chennai, Ahmedabad, Pune, Jaipur)
- 95% Confidence Level with a 5% Margin of Error for the overall national estimates.

Key Analysis Points

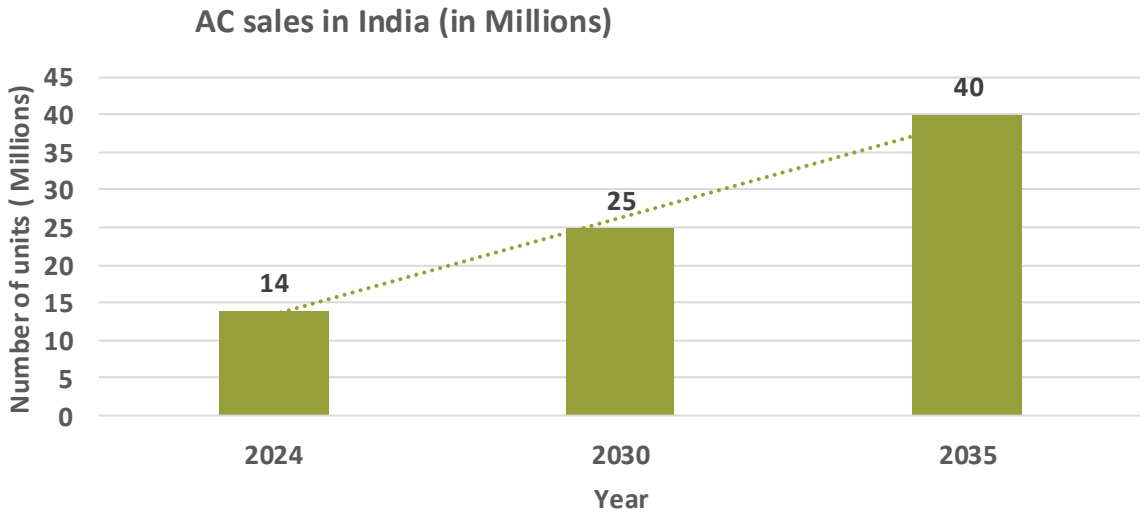
- AC Ownership
- Cooling Capacity (TR) Distribution
- AC Age Profile
- Daily Usage Hours
- Distribution of Energy Star Rating
- Household Buying Preferences
- End-of-Life Disposal
- Service Complaint Types
- Cost of Servicing
- Cost of Refrigerant Refilling
- Temperature Setting Preferences
- Consumer readiness for climate friendly refrigerant
- Technician Preference
- GHG Emissions Analysis

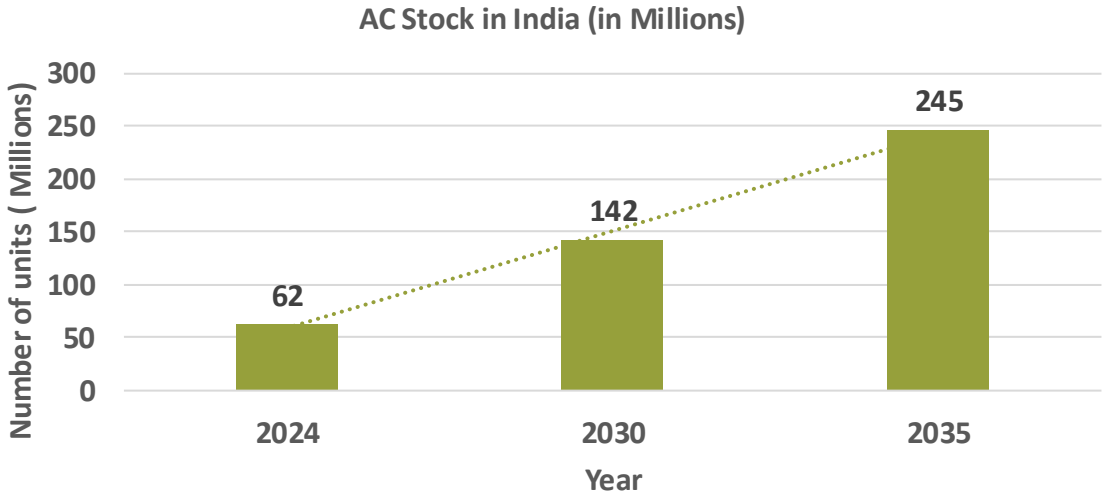
AC sales and Stock

- With **rapid increase in sales from 14 million ACs in 2024 to 40 million in 2035**, the India's AC stock is estimated to increase form 62 millions in 2024, this **at the moderate 10% CAGR is expected to reach three-fold at 245 million in 2035**.

- Notably, AC sales have grown 15–20% annually since 2020.

- This rapid growth in AC use will increase refrigerant demand, making it important to manage refrigerant use and emissions carefully.





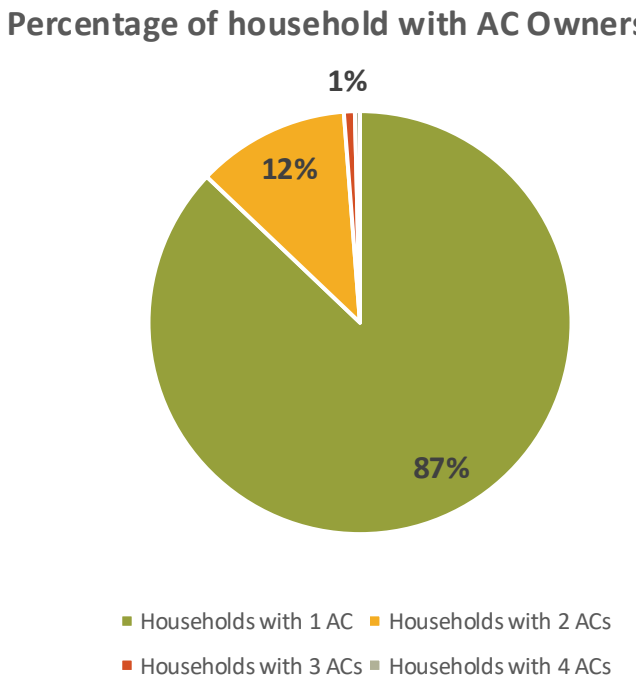
** For detailed country-specific references, please see the Annexure-B*

AC Ownership

- **87% AC owner households has one AC-** indicating building space cooling is a necessity, contesting the affordability.

- **13% of households own 2 ACs and more** City-wise, Chennai, Jaipur, Kolkata and Pune shows higher ownership of 2ACs per household, ranging 13-20%.

Table: Percentage of household with AC Ownership– City and National			
City	**Households with 1 AC**	**Households with 2 ACs**	**Households with 2+ ACs**
Ahmedabad	95	5	0
Chennai	77	20	3
Delhi	94	6	0
Jaipur	82	13	5
Kolkata	83	17	0
Mumbai	96	4	0
Pune	83	16	0
National	**87**	**12**	**1**



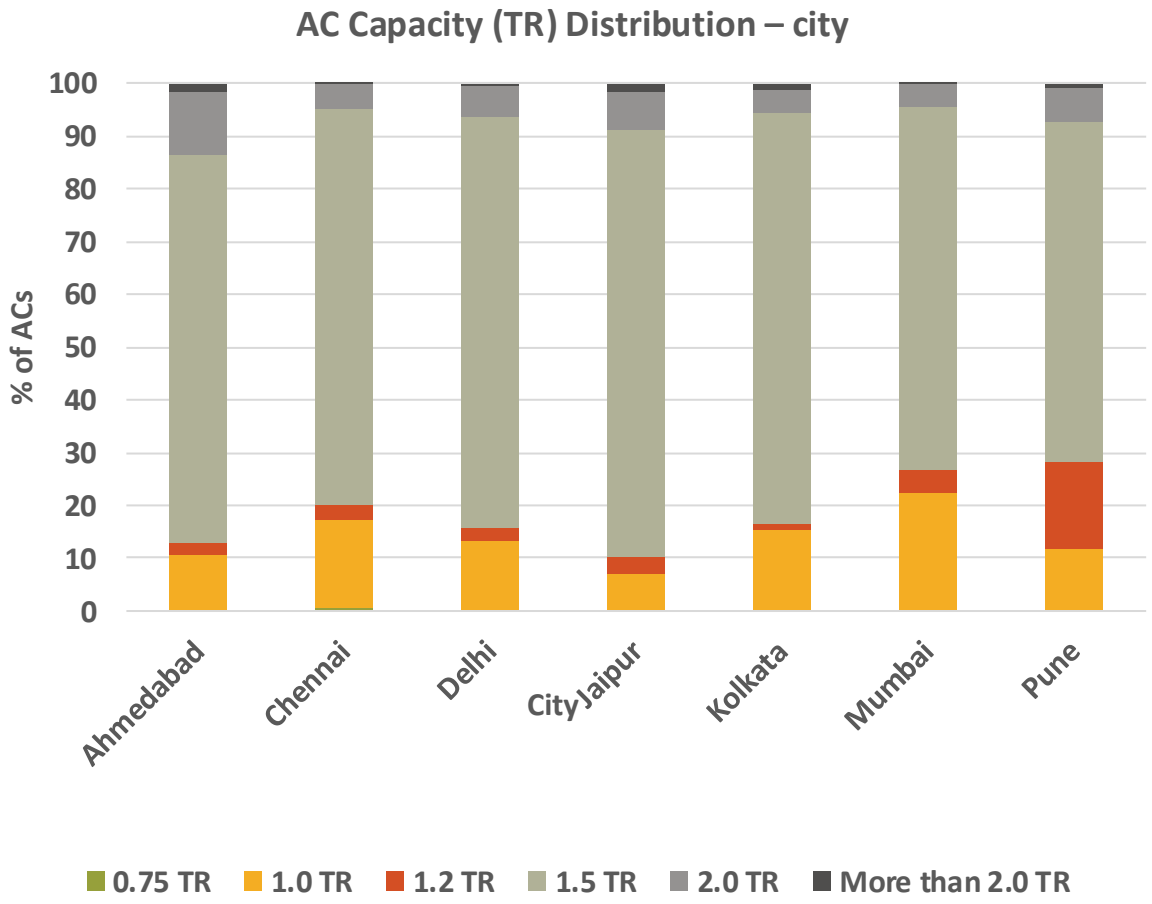
Age profile

- Around 80% of the ACs are <5 years old- indicates **the increased AC ownership for the last 5 years.**
- Over 40% of ACs are < 2 years old, indicating **a significant rise in new AC ownership in India,** with Jaipur, Kolkata, and Pune leading this trend.
- **One-fifth** of the total ACs in India are more than 5 years old.

AC Age profile (%) – City, National				
City	**less than 1 year**	**1- 2 years**	**3-5 years**	**More than 5 years**
Ahmedabad	13	26	35	26
Chennai	4	26	43	27
Delhi	10	30	38	22
Jaipur	8	40	33	19
Kolkata	10	40	31	20
Mumbai	9	29	40	23
Pune	4	41	44	12
National	**8**	**33**	**38**	**21**

Cooling Capacity (Tonnage) Distribution

- Lower capacity AC dominates the Indian households.
- **Over 90% Indian households owns 1 TR - 1.5TR capacity ACs to meet their cooling demand.**
- 1.5 tonne AC capacity is most common among the households- 74% of all household prefers it.
- Smaller capacity- 0.75TR is least preferred, nationally.



Buying preferences

- **Brand is the first preference for Indian AC buyers-** indicates that manufacturers have high potential to drive constructive policy implementation.
- **56% households choose brand as first preference, and 38% choose Price, as second.**
- **Energy saving is a significant factor, with 50% of consumers ranking it within their top two priorities**
- **After-sales service is not an important criterion at the time of purchase.**

AC Buying Preference – National (%)				
Preference	**Rank1**	**Rank2**	**Rank3**	**Rank4**
Brand	56	28	12	5
Price	15	38	31	16
Energy Saving	25	25	36	14
After-sales service	4	9	22	65

Distribution of Energy Star Ratings

- Nearly 98% household have 3-star to 5-star rated ACs- indicating **awareness and preference for energy efficient ACs is well-established in Indian households.**

- The **3-star category is dominant (average 60%)** across all cities, ranging from 53% in Kolkata to 68% in Delhi.

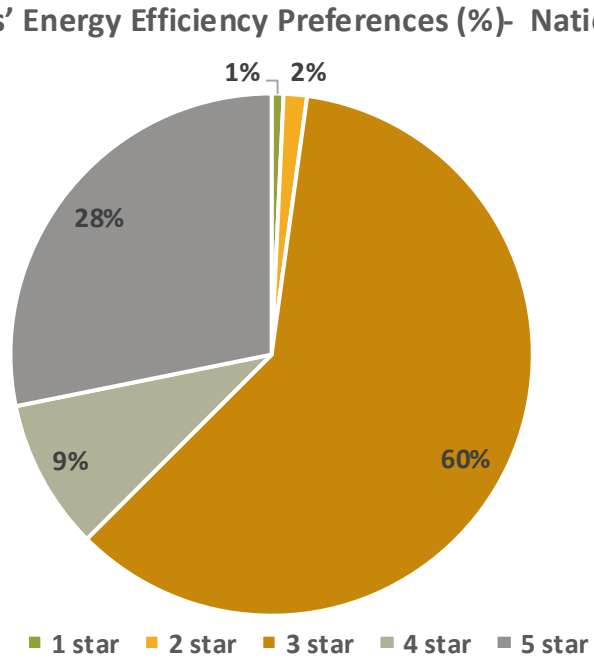
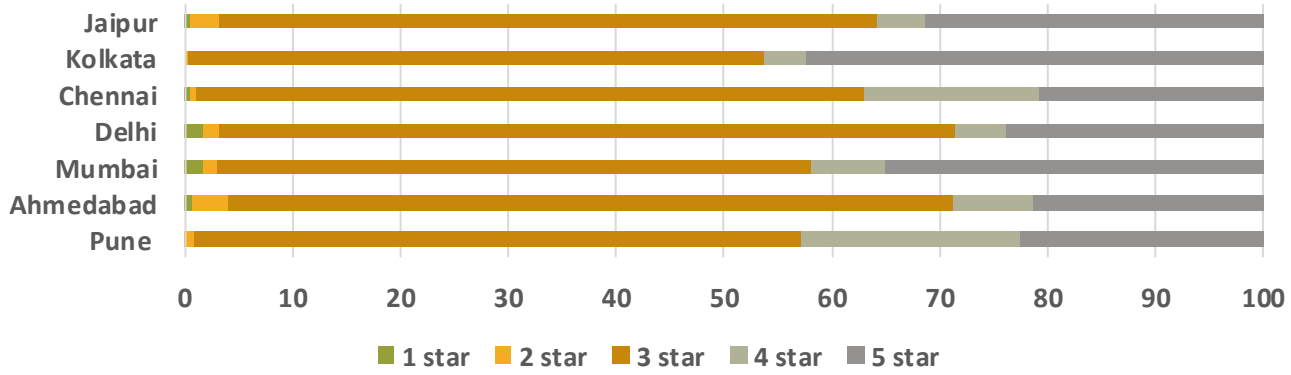


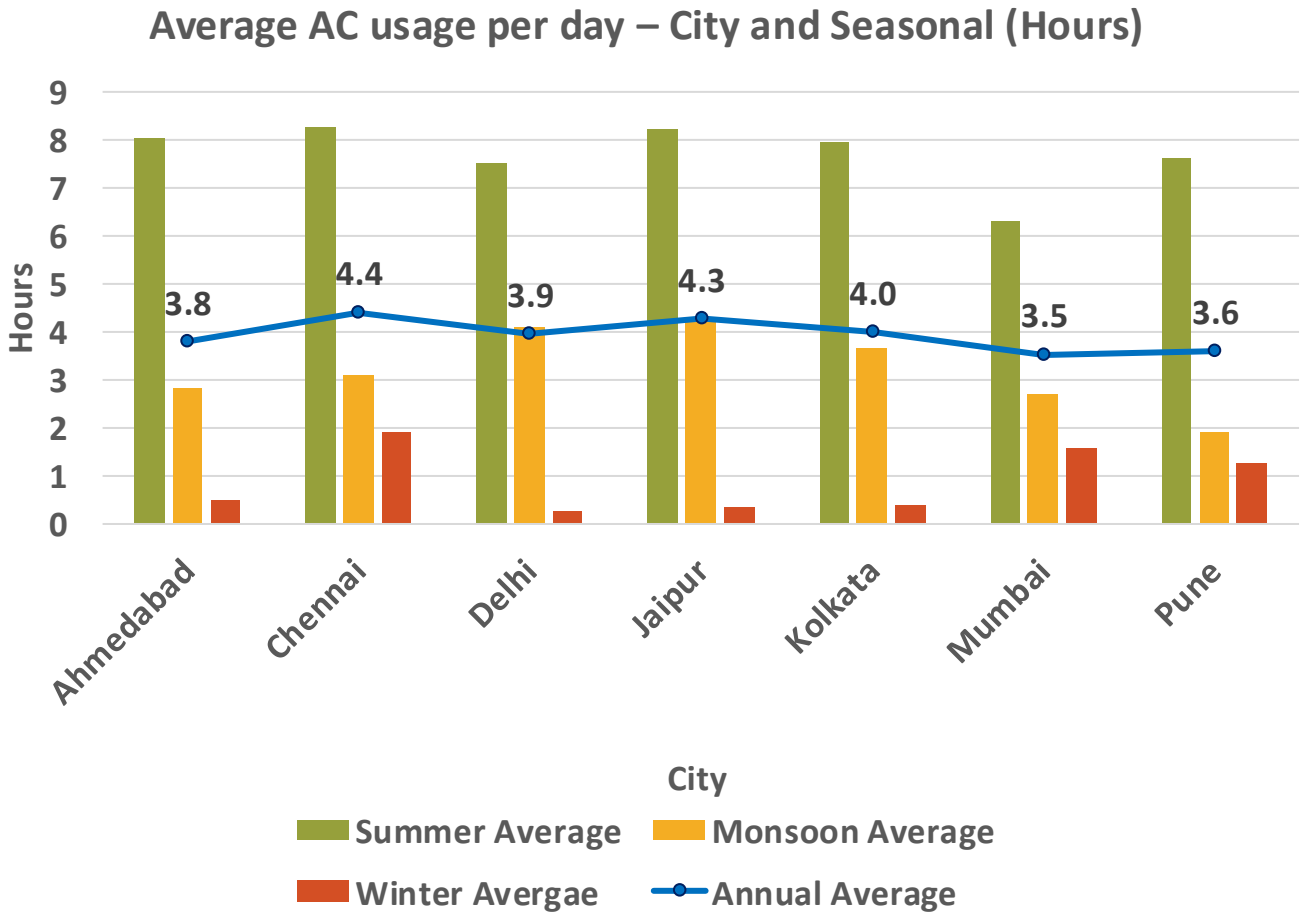
Figure 10: Acs Energy Efficiency Preferences (%) – City



Daily Usage Hours

- **Indian households use AC for 4.0 hours per day on an average in a year.** The annual average daily usage across most cities falls within a relatively narrow range of 3.5 - 4.4 hours.

- **AC usage in summer season is more than double (7.7 hours per day) of the monsoon season (3.2 hours per day)**. Summer is consistently the period of highest demand across all cities.



Temperature setting preferences

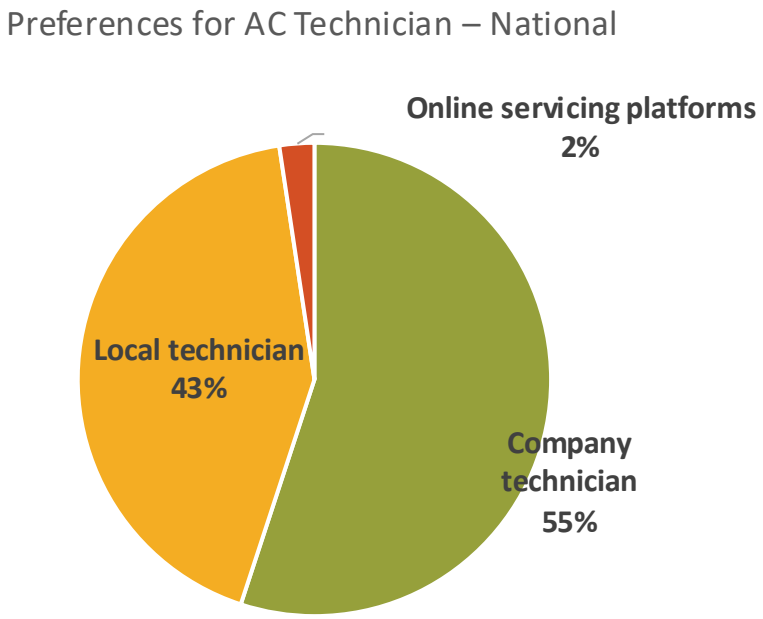
- **Indian households are keeping thermostats at optimum temperatures.** Contrary to popular belief, the most preferred temperature setting nationally is 23–25°C.
- About 67% of households set their AC above 23°C. This trend was observed consistently across cities.
- The most preferred temperature is 23–24°C.
- **One-third of households set temperatures below 22°C.** Households in Delhi, Mumbai, and Pune show a preference for lower temperature settings.

Household Temperature Setting Preferences (°C)				
Set Temp (Celsius)	**Less than 20°C**	**20-22°C**	**23-24°C**	**25 and above°C**
Ahmedabad	2	16	40	43
Chennai	10	29	49	11
Delhi	13	18	51	18
Jaipur	9	20	59	12
Kolkata	4	17	49	30
Mumbai	12	32	37	18
Pune	15	37	39	9
National	9	24	47	20

Technician Preferences

- Across the country, more than **40% of all consumers rely on local technicians, proving they are a huge and important part of the service sector**, that can not be ignored.

- Households in Jaipur, Delhi, Mumbai, Pune and Kolkata have higher preference for company technicians, which also reflected in national level choices.



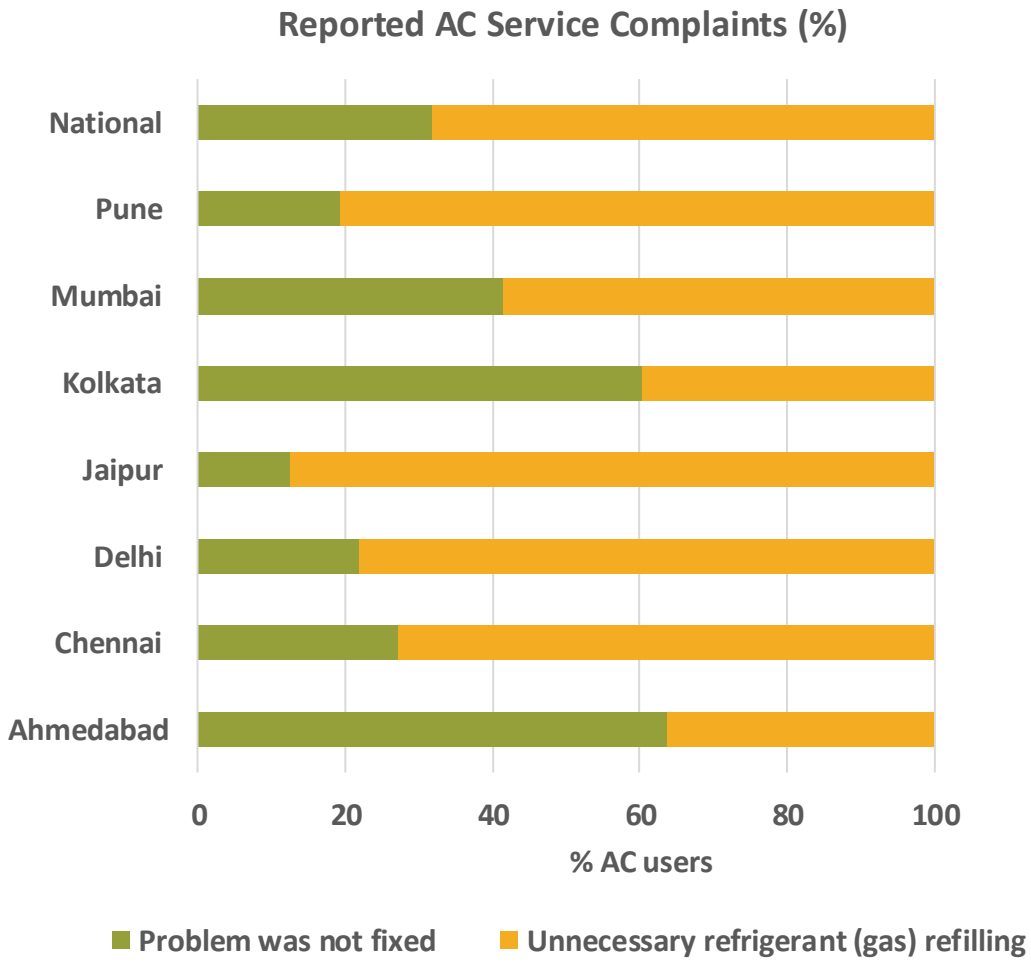
Service Complaint Types

- **Unnecessary refrigerant refilling is the dominant service complaint across Indian households**. 68% Indian households complain of unnecessary refrigerant refilling during servicing**,** indicating a quality service issues that not only costs to the consumer, but, significantly, to the climate.

- **The problem is particularly high in major cities — Jaipur (88%), Delhi (78%), Pune (81%), and Chennai (73%).**

- **One-third household complains that problem was not fixed** by technician.

- The need of improvement in the AC-Servicing sector is apparent.



Frequency of Refrigerant Refills

Age of ACs - Vs - Frequency of Refrigerant Refills– National		
AC category	**% of total ACs**	**Refill frequency**
ACs (less than 5 years old)*	33%	Annual
ACs (5 years and above)	80%	Annual
	20%	Once in a 2 years

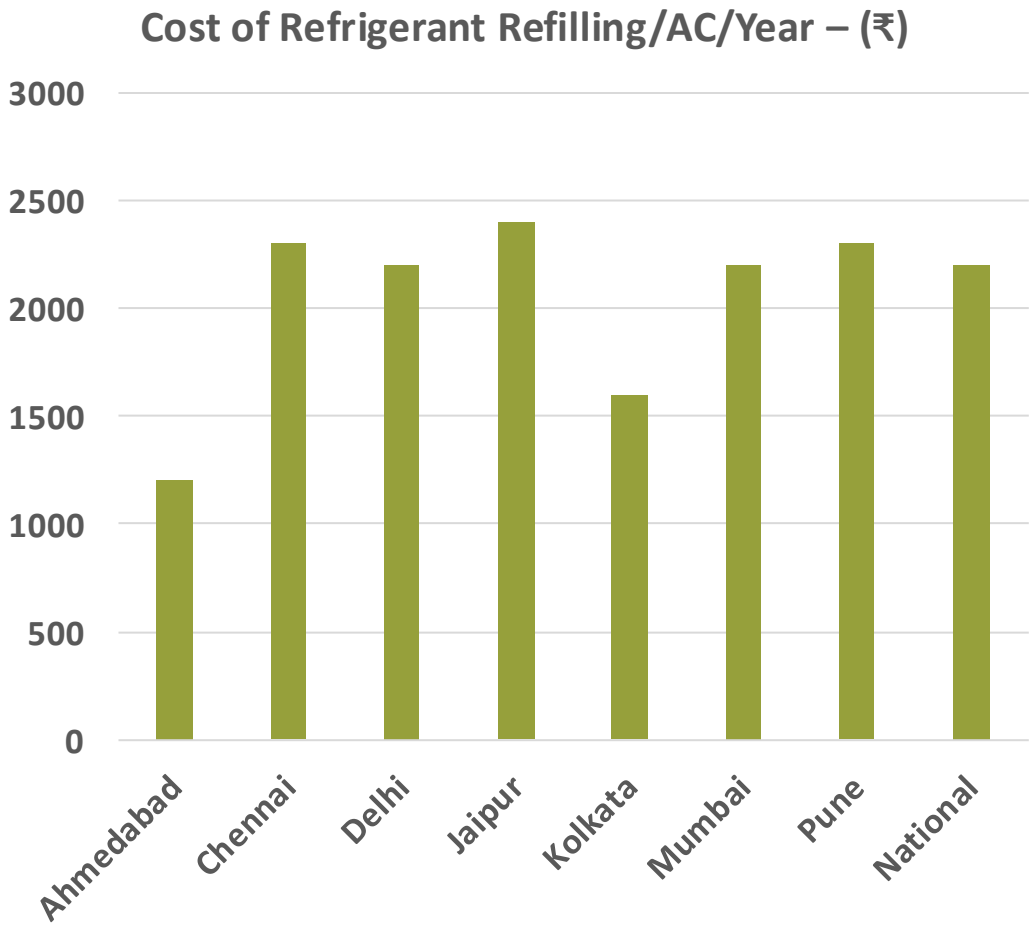
- **In India, refrigerant refilling is far higher than global practices.** Overall, **about 42–45% of all ACs in India are refilled every year**. Ideally, on average, ACs should require refilling once in 5 years.
- 80% of ACs >5-years old are refilled annually, while the remaining 20% are refilled once every 2 years or more. Among ACs less than 5 years old, one-third are refilled annually.
- Frequent refrigerant refills raise **critical questions about the quality of RACs and the services in the Indian market, in addition to user operation and maintenance practices.**

Cost of Refrigerant Refilling

- An Indian household on an average pays **₹2,200 per AC refrigerant refill every year. The cost rage ₹1,200 - ₹2,400 across cities.**

- It is important to note that, **refrigerant charging is rarely offered as a full warranty benefit**. Most brands either exclude it or allow under specific conditions. Many brands keep their first-year warranty terms vague- ultimately consumers have to pay.

India's ACs required 32 million kg (32,000 tonnes) of refrigerant refills in 2024. With an average refilling cost of ₹2,200 per AC, consumers spent about ₹7,000 crore ($0.8 billion) in 2024. In a Business-as-Usual scenario, annual refilling costs will quadruple to ₹27,540 crore ($3.1 billion) by 2035.

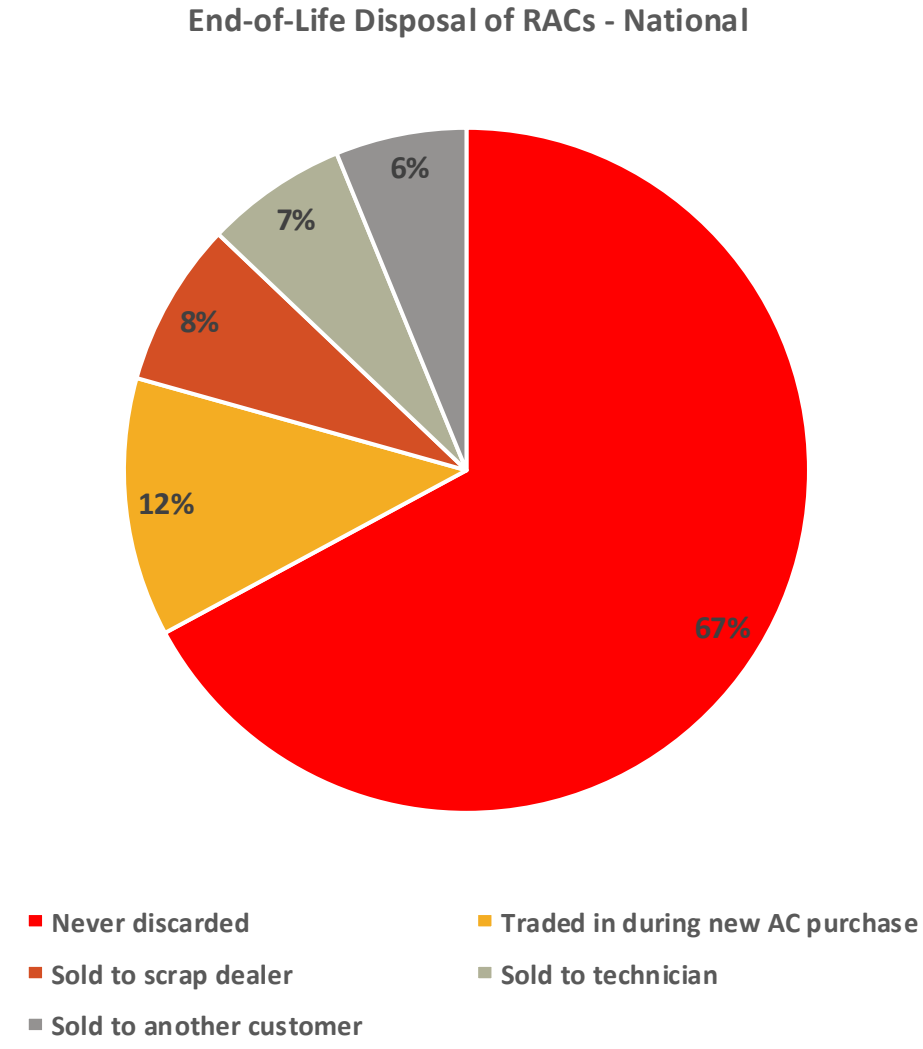


End-of-Life Disposal

- **67% of households have never discarded an** AC- indicates new ownership. This aligns with the previous finding that new AC ownership is growing rapidly.

- Among the discarded a ACs, **45% went to informal channels like scrap dealers and local technicians,** demonstrating that these pathways are already a dominant force in end-of-life management which is not covered under EPR currently.

- The existing reliance on informal collection networks- if strengthen- presents an important opportunity better refrigerant management in India.



GHG Emissions

- India's ACs required 32 million kg (32,000 tonnes) of refrigerant refills in 2024, which is expected to increase with AC stock to 125,000 tonnes by 2035.

- The equivalent GHG emissions from refrigerant release are estimated at 52 million tonnes of CO_2e in 2024, likely increasing to 84 million tonnes of CO_2e by 2035.
- A proper LRM in the place can save- **500-650 million tonnes GHG emission over the next 10 year (by 2035)- equals $25-33 billion in carbon credit** (at a moderate price of $50 / tonne CO2).

Overall GHG emissions from AC use (including electricity) will increase from 156 million tonnes in 2024 to 329 million tonnes per year in 2035 under a Business-as-Usual scenario. **By 2030, ACs will become the highest GHG-emitting appliance in the country.**

GHG emission (Million Tonnes CO_2e) for AC stock			
Category	**2024**	**2030**	**2035**
Emissions from refrigerant refilling (Million Tonnes CO_2e)	52	47	84
Emissions from Electricity Consumption (Million Tonnes CO_2e)	104	159	245
Total emission (Million Tonnes CO_2e)	156	206	329
Emission per AC (Tonnes CO_2e)	2.52	1.45	1.34

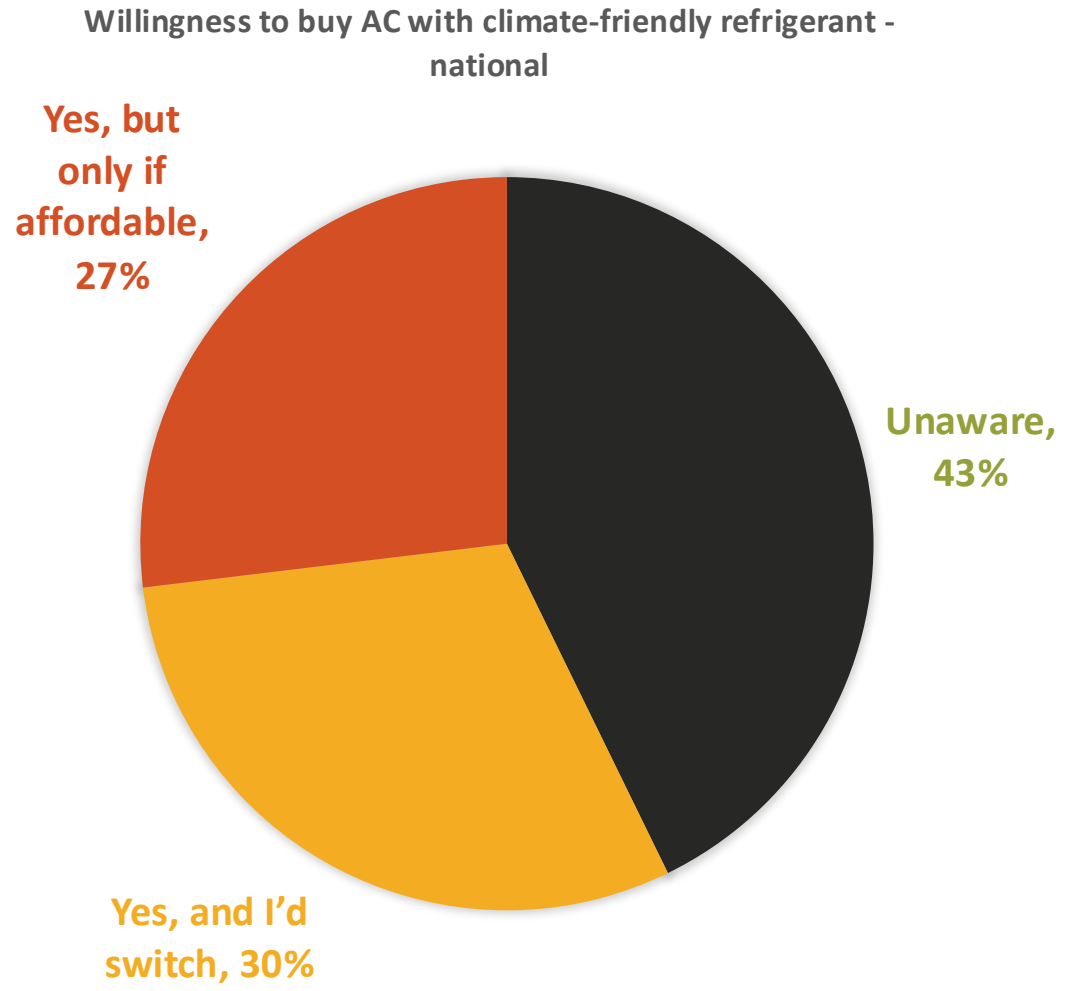
Consumer Readiness for Climate-Friendly Refrigerant

- **Indian household show good awareness on energy efficiency of ACs, but awareness on climate- friendly or natural refrigerant-based ACs is very low-** 43% of households are unaware of it.

- Kolkata (69%) and Chennai (64%) households are the most unaware ones.

- Overall, **one-third of total households shows willingness to shift to climate-friendly options** and another **one-third wishes if it is affordable**- highlighting that cost is a key consideration alongside awareness.

- Pune (51%), Delhi (42%) and Jaipur (36%) show the highest willingness to switch. Jaipur appeared the most price-conscious city- 44% households wished to choose climate-friendly option if it is affordable.



Regulations on Refrigerant Management

Fragmented policy and weak enforcement

- The India Cooling Action Plan (ICAP) targets a 25–30% reduction in refrigerant demand by 2037–38 **but lacks regulations and enforcement mechanisms to prevent refrigerant leakage and ensure environmentally sound disposal.**
- The E-Waste (Management) Rules, amended in 2023, include provisions for environmentally sound disposal of refrigerants from end-of-life ACs at CPCB-approved facilities. **However, there is no information on implementation.** Overall, India lacks adequate regulation and enforcement to manage climate-warming refrigerants.
- **India needs an "Extended Producer Responsibility (EPR) for refrigerants.** It India needs comprehensive rules and enforcement mechanisms for Lifecycle Refrigerant Management – from filling in equipment to servicing and end-of-life disposal. This should include an EPR obligation for AC manufacturers.

  A **real-time refrigerant management database**, **skilling of technicians**, **simplified administrative control** and **consumer awareness** will also be needed.

  India can also learn from the Global Best Practices- Norway, Japan, and China have strong laws, licensing, and data registries, while Australia has a robust governance structure and incentive mechanisms.

Summary of Findings

- **Rapidly expanding cooling demand:** India's RAC market is growing rapidly, fueled by urbanization, rising incomes, and intensifying heat stress. Around 80% of households have ACs less than 5 years old, and 40% of them are less than 2 years old.
- **ACs are now essential appliances:** Of the households owning AC, nearly 87% own just one AC, while 13% own more than two. Air-conditioning is no longer a privilege of the rich.
- **1.5 tonne AC dominates:** The survey finds that ACs of 1.0–1.5 TR are the most preferred.
- **Energy efficiency awareness is high:** Nearly 98% of households have 3-star to 5-star rated ACs– they account for over 90% of total ACs in Indian households
- **Households are keeping thermostats at optimum temperatures:** Contrary to popular belief, the most preferred temperature setting nationally is 23–25°C .
- **India's RAC stock will at least triple by 2035:** The AC stock (total number of ACs installed) in 2025 is estimated to be 76 million, which will grow to at least 245 million by 2035, even at a modest sales growth rate of 10%.
- **AC servicing is now synonymous with refrigerant refilling:** In India, refrigerant refilling is far higher than global practices. Effectively, about 40% of all ACs in India are refilled annually. Ideally, on average ACs should require refilling once in 5 years.

Summary of Findings

- **Refrigerant refilling has high costs for consumers and the climate:** India's ACs required 32 million kg (32,000 tonnes) of refrigerant refills in 2024. With an average refilling cost of ₹2,200/AC, consumers spent about ₹7,000 crore ($0.8 billion) in 2024. In a BaU, it will quadruple to ₹27,540 crore ($3.1 billion) by 2035.
- The equivalent GHG emissions from refrigerant release are estimated at 52 million tonnes of CO_2e in 2024. Emissions from refrigerant release are likely to increase to 84 million tonnes of CO_2e by 2035.
- **Mounting GHG burden of ACs:** Owing to high refrigerant leakage and increasing electricity use. Toal GHG emissions from ACs (refrigerant + electricity) in **2024 were 156 million tonnes CO_2e—equivalent to emissions from all passenger cars.** In fact, an AC in India, refilled every two years, releases the same amount of GHGs as a passenger car.
- Total GHG emissions from ACs will increase to 329 million tonnes CO_2e in 2035 under a BaU**. By 2030, ACs will be the highest GHG-emitting appliance in the country.**

India lacks adequate regulation and enforcement to manage climate-warming refrigerants. It **needs EPR for refrigerant** management, real-time refrigerant database and efficient administrative control. Refrigerant management **will save costs and the climate: It can avoid 500–650 million tonnes of GHG emissions** from refrigerant releases–equivalent to **$25–33 billion in carbon credits, over the next 10 years** (@ moderate $50/tonne CO_2). It will also **save consumers $10 billion in unnecessary refilling costs.**

Thank you