Consumer Behaviour and Climate Action

Insights from a Randomised Control Trial Experiment in India's Residential Cooling Sector

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An enumerator administering questions on AC servicing practices to a household at Meerut, Uttar Pradesh, as part of the randomised control trial.

Abstract

Air conditioning is expected to become the largest consumer of residential energy in India by mid-century. Good consumer practices related to servicing air conditioners (ACs) are critical for maintaining high operational efficiency and reducing leakages of high global-warming-potential (GWP) refrigerant gases. However, little information is available about Indian consumers' knowledge and operational practices regarding ACs.

The Government's *India Cooling Action Plan* (ICAP) recommends a massive consumer awareness programme to inform and change AC user behaviour, as part of its larger aim to provide access to sustainable cooling to the masses while minimising its environmental effects. Within this context, we undertake a survey and a randomised control trial experiment with Indian consumers to understand their AC servicing behaviour, examine alternative interventions, and glean insights for India's energy and climate policies.

We find that AC users' knowledge of the importance of preventive servicing is much lower than required, and few people know about the effect of good servicing practices on the environment or on energy savings. More than three-fourths of the respondents highlighted servicing cost as a critical factor in their choice of servicing technician, and few are willing to pay more than what they currently do. In fact, the choice of a technician is based on trust rather than on an evaluation of technical skills.

Furthermore, just over one-tenth of consumers are willing to spend more time on monitoring the technician than they currently do. The interventions in this study were successful in enhancing the general awareness of the importance of servicing practices, but not in enhancing technical knowledge related to specific practices.

Our analysis shows that consumers who are aware about its economic benefits are more likely to undertake preventive servicing. Thus, we suggest that the Government of India emphasise economic benefits in its awareness campaign, along with efforts to nudge consumers towards a higher willingness to pay. Our findings highlight the presence of information asymmetry in the Indian residential cooling market, which needs to be addressed through a robust certification system to achieve the desired behaviour change to mitigate climate change.

1. Introduction

The Government of India (GoI) recently released the *India Cooling Action Plan* (ICAP; GoI 2019). This strategic policy aims to achieve thermal comfort for all Indians and provide cooling solutions across sectors, while enhancing energy efficiency, mitigating climate change, generating livelihood opportunities, and changing consumer behaviour. To achieve the last target, the ICAP recommends a massive customer awareness programme focusing on the effects of proper maintenance of air conditioners (ACs) on their energy efficiency and refrigerant leakage. Changing consumer behaviour is an important element of the ICAP.

As the ICAP highlights, behaviour change is critical for the achievement of the global climate change mitigation goals. Many behavioural scientists and economists have studied the inculcation of pro-environmental behaviours in the form of household energy efficiency or conservation practices (Abrahamse et al. 2005; Frederiks et al. 2016; Steg 2008; Ščasný and Urban 2009; Moore and Boldero 2017; Banerjee and Banerjee 2015; Gandhe and Pandey 2017). A key argument for investing in behavioural interventions is their low implementation cost relative to investing in high-end technology to achieve a similar effect (Allcott and Mullainathan 2010). Allcott and Mullainathan (2010) argue that behavioural interventions can be much less cost-intensive to implement, especially for greenhouse gas abatement, than alternatives such as investing in Research and Development (R&D) for carbon-neutral technology or replacing fossil fuels in electricity generation.

However, policies for inducing behaviour change face many challenges. For instance, in a qualitative assessment of factors influencing households' adoption of energy-efficient behaviours, "lack of reward and motivation" was identified as a major impediment (Sony and Mekoth 2018). The respondents indicated that their lack of motivation to undertake energy conservation activities as it did not result in substantial savings in electricity bills. Lack of information was identified as another challenge, and information related to energy conservation was perceived to be too technical (Sony and Mekoth 2018). Irrespective of the challenges, government communication was an important influencing factor (Sony and Mekoth 2018). Motivational factors and context are therefore critical for inducing pro-environmental behaviour (Steg and Vlek 2009; Moore and Boldero 2017)

Motivating consumers to adopt climate-friendly practices regarding residential ACs is an important intervention for achieving climate goals. Space cooling is expected to emerge as the largest source of energy consumption in Indian households by 2050 (Chaturvedi et al. 2014). Accordingly, it has been identified as a policy priority in the ICAP as well as in other policies—not just for the prospective energy efficiency gains, but also because of the potential reduction in greenhouse gas emissions resulting from leakage of high global-warming-potential (GWP) refrigerants during AC use. In the absence of the Kigali Amendment to the Montreal Protocol, direct hydroflourocarbon (HFC) emissions from residential space cooling would have contributed 36 per cent of the total global warming impact of this sector in 2050, irrespective of the economic growth scenarios. Adopting sustainable lifestyle practices, including higher AC energy efficiency and lower refrigerant leakages, could reduce the global warming impact of this sector in India by 46 per cent during the period 2010–2050 (Chaturvedi and Sharma 2016).

Good servicing practices[1] (GSPs) are critical for optimising the energy efficiency potential of ACs and minimising GWP refrigerant leakages (Sridhar and Chaturvedi 2017). The ICAP recommends devising and implementing an awareness campaign to influence Indian consumers' servicing practices. However, little information is available about their GSP knowledge and whether an awareness campaign could affect their behaviour. Within this context, we undertake a randomised control trial (RCT) experiment to understand Indian consumers' AC servicing behaviour, examine alternative behavioural interventions, and glean insights for India's energy and climate policy.

The RCT is a quantitative experimental technique for gathering relevant evidence. In a methodological review on RCTs, White, Sabarwal and Hoop (2014), defined this methodology as *'a way of doing impact evaluation in which the population receiving the programme or policy intervention is chosen at random from the eligible population, and a control group is also chosen at random from the same eligible population. It (RCT) tests the extent to which specific, planned impacts are being achieved.'* The current RCT study of Indian consumers' AC servicing practices is the first of its kind.

Using a survey of consumer behaviour and an RCT experiment, we seek to answer the following questions: (i) What is the understanding and behaviour of Indian AC users in terms of environmental and economic implications of AC servicing, average cost and willingness to pay for servicing, time spent in servicing, and choice of servicing technicians? (ii) Of the two key messages—environmental benefit versus economic benefit—which is more effective in influencing consumer awareness levels and servicing practices? (iii) What should be the key elements of the GoI's awareness campaign to facilitate climate-friendly action? In the following sections, we present the details of the survey and experimental methodology, results, key insights, discussions, and conclusion.

2. Methodology: the experimental framework

The study was conceptualised as an RCT experiment to discern the effect of the intervention (information on AC servicing practices) on households' awareness and practices. RCTs are useful for measuring the causal effect of interventions or, in other words, determining the existence of a cause-and-effect relationship between an intervention and its intended outcome (Frederiks et al. 2016). It is especially useful to examine the effectiveness of a policy or measure change in human behaviour in response to interventions. The meticulous sampling procedure followed in RCTs ensures that external factors are fully controlled for; thus, any effect can be attributed solely to the intervention. Sufficient sample size and randomisation also ensures that the treatment and control groups have similar representation, which helps assess the change brought about by the interventions in the various treatments.

Our RCT experiment follows the 'test, learn, and adapt' framework proposed by Haynes et al. (2012). This framework outlines nine key steps. We elaborate on the original suggestion for each step, as well as on how it was incorporated into our study.

(i) Identification of policy interventions to be compared, that is, old vs. new policies or variations of one policy: The policy intervention considered in our experiment is awareness of the importance of GSPs and regular servicing. We separate this intervention for two treatment groups: one that receives information on the environmental benefits of following GSPs, and another that receives information on the economic benefits. Essentially, this intends to test the potential effect of an awareness campaign based on environmental messaging versus one focused on individual economic benefit. The treatment groups are tested against a control group that received no GSP-related messages.

(ii) Determination of the intended outcome of the intervention and how it will be measured: We measured two outcomes. The first was related to the awareness of the importance of GSPs, and the second to the change in behaviour as a result of increased awareness—that is, an increase in the actual numbers of AC services.

(iii) Decision on the randomisation unit (individual or clustered): The data collection and analysis unit was households. Given that urban areas dominate residential AC use in India, sample households were randomly chosen from cities, as explained later. For each household, we collected responses only from the member who makes decisions related to the purchase and maintenance of ACs. If there was more than one AC in the household, we collected basic information on all ACs, but the focus of the

1 Refer to https://www.ceew.in/sites/all/themes/ceew/images/CEEW-10-step-guide-to-maintain-room-ACs-16Aug19.pdf for a list of good servicing practices for maintaining room ACs.

survey questions was on ACs that were at least two years old and were the most frequently used.

(iv) Sample size determination in terms of the number units (people, institutions, or areas) to ensure robust results: This RCT considered the need for both randomisation and geographic diversity in its sampling procedure. A list of cities with a population of 1 million (10 lakh) or above were compiled based on Census 2011 data[2]. The city size is also a measure of economic activity. For example, the biggest cities in India are the metros, which are also the most populous and have a significant number of high-income people who own ACs. Choosing cities with a population of 1 million (10 lakh) or above ensures the availability of enough households that own an AC and are willing to be a part of our experiment. In smaller cities with lower AC penetration rates, sampling for our study would be very resource-intensive. The eligible cities were further classified based on their geographic zones: North, South, East and West. One city was picked randomly from each zone: Meerut, Madurai, Dhanbad, and Vadodara, respectively. Randomisation was employed at every sampling level, from city to households. Enumerators contacted local municipalities for a list of wards and housing localities, from which six wards in each city, and three localities in each ward were randomly selected.

Six households were chosen in each housing locality using the 'right hand rule'—every fifth household on the right was selected. Only those that had owned at least one AC unit for two years or more were considered for the survey. If the chosen household did not meet the selection criteria or was unavailable or disinterested in participating, the next household was chosen, subject to its agreement and fulfilment of the selection criteria. In this way, 432 households were recruited (108 in each city) for the survey.

(v) Use of randomisation for the assignment of policy interventions to the units and creation of treatment(s) and control groups: A total of 108 households in each city were randomly assigned to one control and two treatment groups (TG1 and TG2), as our study intended to test the effect of two alternative messages: environmental versus economic benefits.

(vi) Administration of the intervention to the treatment and control groups: The intervention was administered at the household level between June and November 2019. During the baseline survey (undertaken in the first two weeks of May 2019), participating households were informed that they would receive messages, and were told the mobile phone number from which these messages would be sent. Consent for participation in the survey and for receiving interventions was taken from all respondents at the start of interviews. The intervention messages were sent to the households via SMS in the most common regional language and in English text. This was Hindi for Dhanbad and Meerut, Gujarati for Vadodara, and Tamil for Madurai. Regarding the information conveyed in the intervention, households assigned to the control group received a 'thank you' message for their participation once every month and a half. Meanwhile, fortnightly messages containing information about the importance of servicing and GSPs were sent to the two treatment groups. Whereas the information on servicing remained the same between the treatment groups, the main distinction was in the specific theme for motivating households. Messages for TG1 focused on the positive effect of a specific GSP on the environment, and messages for TG2 focused on the potential economic benefit of the same GSP in the form of reduced electricity bills[3]. Pamphlets containing information on the importance of regular servicing and their effect on the environment and economic savings were mailed to the respective treatment groups at the midpoint of the intervention period, in the first week of September 2019. In September, a dedicated website link[4] containing information on specific servicing practices and how they must be conducted during servicing was also shared with households. These were simply a list of GSPs and did not contain information on environmental or economic benefits. The respondents were contacted by telephone in the middle of the intervention period to ascertain that they were receiving and reading the messages.

(vii) Result measurement and determination of the effect of the intervention: The effect of the interventions on the two treatment groups, in reference to the control group, was measured through an end-line survey administered in the first two weeks of December 2019, after the end of the AC usage

2 The list in the form of a sampling frame can be accessed at www.ceew.in. .
3 The specific dates and messages sent as interventions during the six-month period can be accessed at www.ceew.in
4 https://www.ceew.in/sites/all/themes/ceew/images/CEEW-10-step-guide-to-maintain-room-ACs-16Aug19.pdf

season. Information on basic demographic parameters, GSP awareness levels, and servicing practices was collected along with other relevant information. The end-line survey focused on fewer variables to measure the effects and check for the robustness of the data. The effect of the interventions was determined with the help of regression equations formulated for this purpose, incorporating information from both the baseline and end-line surveys. The detailed regression equations and results are presented in section 3.

The two final steps of the prescribed RCT framework are: (viii) Adapt policy interventions reflecting the results of the RCT experiment, and (ix) Return to Step 1 and repeat the process to finetune the understanding of the intervention that could work the most successfully. These steps essentially imply informing policies on the basis of the RCT experiment results. According to Ames and Wilson (2016), RCTs should complement existing policymaking processes rather than replacing them. As highlighted in section 1, this study was undertaken to inform recommendations for the ICAP regarding the awareness campaign for ensuring that consumers follow GSPs. The insight gained from our experiment can be used for this purpose. We intend to follow the last two steps once our results have been reviewed and published.

The baseline survey was conducted in May 2019. Based on this survey, questions attempting to measure the effect of the RCT on consumer awareness and practices related to GSPs were repeated in the end-line survey in December 2019, after six months of intervention.

Many RCTs are undertaken in tightly controlled settings, where participant dropout rates might be very low. Our study was undertaken across cities to ensure representativeness and generalisability of the statistical results given that it seeks to inform a national action plan. Of the 432 households participating in the baseline, 338 were interviewed in the end-line, indicating an attrition rate of 22 per cent. We excluded households that indicated that they had not read the intervention messages. Of the 338 households in the end-line survey, only 199 respondents mentioned that they had received and read our intervention. We undertook other checks specific to the input data for our regression equations, as explained in section 3, to ensure the robustness of our results. The baseline results are presented for all the respondents. The experiment's results are presented after excluding the dropouts, people who did not read the intervention messages, and those whose responses did not clear the robustness check for specific questions[5]. Annexure 1 presents a comparison of the baseline sample data and subset data used for our models (after excluding dropouts and non-robust responses) on demographic and AC characteristics. The comparison shows that in the baseline sample and both the subsets are similar in terms of various characteristics.

We present the general results of our baseline survey for all 432 respondents, and the results for the regression models based on reduced sample sizes (see section 3) after checking for robustness.


Image: Alina Sen/CEEW

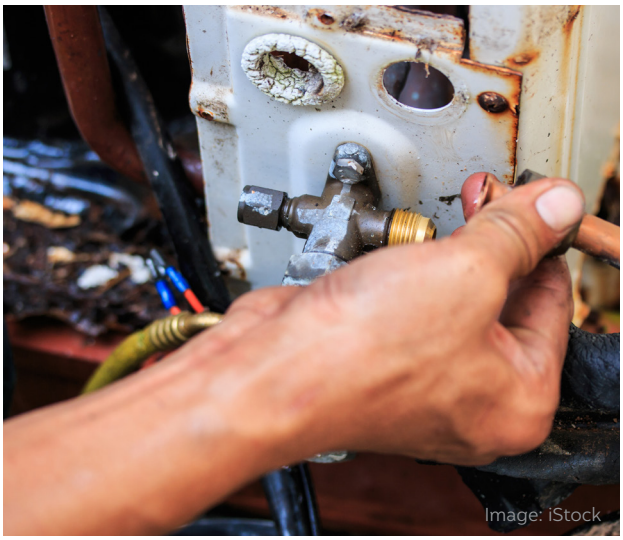


Image: iStock

5 The baseline and end-line questionnaires can be accessed at www.ceew.in.

3. Results

This section presents the results of the survey and behavioural experiment on AC consumer knowledge and behaviour change in terms of servicing practices.

3.1 Consumer knowledge and AC servicing practices

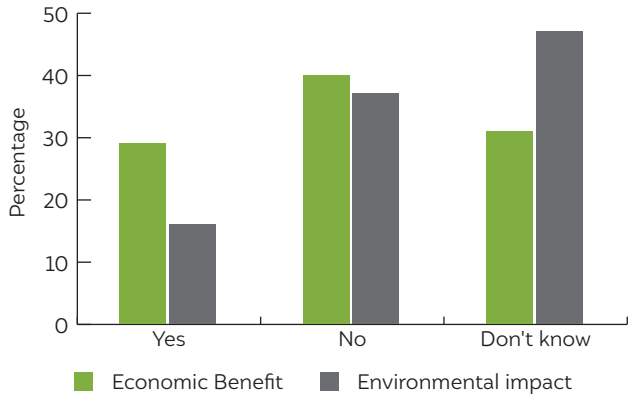
To describe the results related to consumer knowledge and practices, we share insights from the full set of respondents (432) from whom data was collected as a part of the baseline survey.

3.1.1 Consumer knowledge of the environmental and economic benefits of servicing

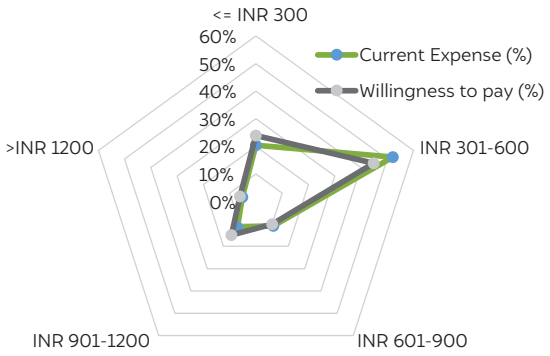
The larger motivation of our study is to influence consumer behaviour through communication programmes that motivate them to undertake better servicing practices. Environmental and economic benefits are the two key motivations identified and used in our intervention strategy. The former could be construed as comparatively altruistic in nature, whereas the latter could be construed as comparatively self-centered. Our question on the potential impact of AC servicing on energy efficiency implicitly implies

Figure 1 Consumer knowledge and AC servicing practices (N=432)

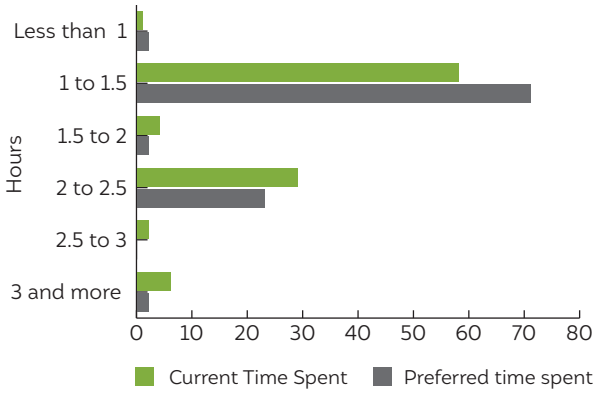
a) Awareness of impact of AC servicing



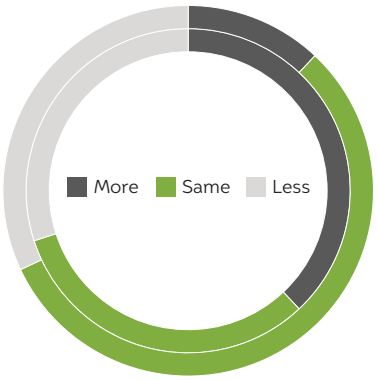
b) Current expense and 'willingness to pay'



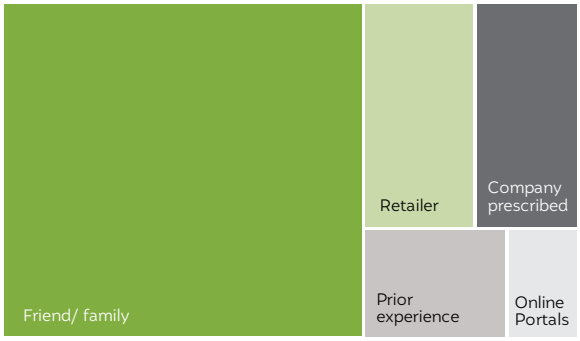
c) Time spent in AC servicing



d) Willingness to spend money (inner circle) and time (outer circle)



e) Information source for selecting technicians



f) Drivers influencing choice of servicing technician (%)

	Very important	Important	Not important
Price per service	76	20	4
Knowledge	93	1	6
Approachability	48	43	9
Qualification	35	49	16
Recommendation	41	39	20
Prior experience	43	44	13
Company	39	45	16

economic benefit as energy savings directly translates to economic benefit. This is supported by the result that of the respondents who report a positive impact of AC servicing on energy efficiency, 81 per cent also report a substantial or large contribution of ACs in their monthly electricity bill.

We first attempt to understand, based on the baseline survey, if consumers are aware of these two benefits. We find that most of the respondents either have no idea of any connection, or think that good AC servicing practices have no effect on either environmental or economic aspects (Figure 1a). However, more people (29 per cent) think that GSPs lead to energy savings with implied economic benefits than those who think that GSPs affect the environment positively (16 per cent).

3.1.2 Current expenses and 'willingness to pay' for servicing

AC servicing is a technical job, and what consumers pay or are willing to pay affects good service delivery. Regarding current average servicing costs, a large proportion of consumers (52 per cent) pay between INR 300–600 per servicing (Figure 1b). The willingness to pay, on average, is not very different, with most consumers (45 per cent) willing to pay similar costs; however, 24 per cent would prefer paying less than INR 300 per servicing. Almost a third of all respondents indicated a willingness to pay higher charges. Interestingly, a similar proportion of respondents expressed an interest to pay less than what they are currently paying (Figure 1d). There is a clear and obvious trend in the number of people who want to pay less than what they currently do. Of those who currently pay over INR 900 per servicing, more than half would like to reduce this expense by at least INR 100, whereas of those who currently pay more than INR 300, 10 per cent would like to reduce this by at least INR 100.

3.1.3 Time spent on AC servicing

Time is a valuable commodity, and servicing ACs is a time-consuming process. In our survey, 58 per cent of the respondents mentioned they spent 1–1.5 hours of their time monitoring AC servicing in their homes (Figure 1c), whereas 29 per cent mentioned spending 2–2.5 hours. Almost a third indicated a desire to spend less time on AC servicing, whereas the majority (71 per cent) indicated that they would prefer not spending more than 1–1.5 hours. This result is very important, because adhering to all key GSPs during one servicing could take at least 2 hours. Consumers need to be willing to allocate at least this amount of time, but this willingness is not evident from the responses in our survey.

3.1.4 Choice of servicing technicians

The process of choosing a servicing technician is critical as it affects the consumer's experience, satisfaction, and comfort, as well as the performance of the AC. A large number of consumers depend on their personal network of family and friends as an information source for hiring technicians (Figure 1e). Trust, as a factor, is very important in this process, and our result shows that consumers place much more trust in their private networks than any other reference—retailers, companies, or online sources. At a distance second are retailers. Traditionally, in India, internet penetration has been low, and online services have only started making a mark over the last two years, even in large cities. The randomly chosen cities in our survey are smaller cities that are truly representative of a large part of the Indian urban customer base. Online application-based services have not yet made a significant mark in these cities, which is also reflected clearly in our survey results. However, this trend could change in the future with the continued boom in internet access across the country.

Regarding the factors that influence the choice of servicing technician, the technician's knowledge is the most important, as highlighted by the respondents (Figure 1f). The majority of respondents (73 per cent) indicated that servicing technicians informed them of servicing practices undertaken during servicing. However, regarding awareness of the various servicing practices listed in the survey questionnaire, 70 per cent of the respondents indicated familiarity with 'filter cleaning' and 'measure current and voltage', but all the other servicing practices were typically recognised by less than 50 per cent. Along with providing information, most respondents (63 per cent) indicated that servicing technicians also advised them on good maintenance practices. However, a common response by our survey respondents for such practice(s) that were suggested was regular cleaning of the AC. A few participants also responded that they practice frequent filter cleaning and annual maintenance by technicians as good maintenance practices. Thus, whereas consumers perceive the technician's knowledge as the most important variable, it is clear that they are not well placed to evaluate the quality and depth of information being provided by the technician, because the knowledge related to GSPs is technical in nature.

Price is another important variable ranked as 'very important' by three-fourths of the respondents. Other factors are rated as far less important. Thus, these two variables could be collectively taken to determine the choice of servicing technician (Figure 1f).

3.2 The effect of the intervention on consumer awareness levels

In this section, we present the results of our intervention on consumer awareness levels. We tested consumer awareness using two questions. The first question was related to their awareness level, and the second to the knowledge of how many GSPs they observed before and after the intervention. Our approach is based on Ciochetto and Haley (1995), who describe the difference between awareness questions and knowledge questions as the former being generic in nature and the latter being more specific. Through the first question, we aim to understand if our intervention affected the general consumer awareness level. During the baseline and end-line surveys, respondents were asked to rank their self-awareness using a three-point Likert scale with the options 'Well aware (3)', 'Somewhat aware (2)' and 'Not aware (1)'. As the dependent variable was an ordinal variable, we chose an ordinal logit regression model for this analysis.

Households that reported a decline in their first-order subjective awareness levels[6] (Timmermans and Cleeremans 2015) between the six months were excluded because this implies inconsistency between responses in the baseline and end-line surveys. The inclusion of these inconsistent responses would lead to spurious results. Only those households that showed a relative increase, or were at the same awareness level, were considered for this analysis, resulting in 115 respondents. The following regression equation was used.

$$Ln(Y_i) = \alpha_0 + \alpha_1 Age_R + \alpha_2 Edu_R + \alpha_3 Gen_R + \alpha_4 Treatment + \alpha_5 Pre\_awareness \quad \text{----- 1}$$

Where

Y_i represents the respondent's level of awareness after the intervention;

Age_R represents the respondent's age;

Edu_R represents the respondent's educational qualification classified into three levels: 1 = Did not complete high school, 2 = Completed high school but no tertiary education, and 3 = Tertiary education;

Gen_R represents the respondent's gender;

$Treatment$ takes three values depending on whether the household is in the control group, TG1 (environmental benefit), or TG2 (economic benefit); and

$Pre\_awareness$ represents the respondent's level of awareness at the baseline.

Deeper examination of the model proposed above showed that all the explanatory variables are not independent, leading to problems in parameter estimation. The multicollinearity test results are presented in Annexure 2. We removed explanatory variables one by one until the problems associated with multicollinearity and separation were resolved. Therefore, we used a reduced form of the model after removing variables as required for robust statistical estimation, as shown in Equation 2.

$$Ln(Y_i) = \alpha_0 + \alpha_4 Treatment + \alpha_5 Pre\_awareness \quad \text{----- 2}$$

The variable 'Treatment' contains information on whether the household is in the control group, in the treatment group to which the environmental benefit message was administered, or the treatment group to which the economic benefit related to the energy saving was considered. Pre-awareness was categorised into three levels. The reference level for the regression was 'not aware', and the other two levels were 'somewhat aware' and 'well aware'.

The results are given in Table 1:

Table 1 The effect of the intervention on awareness levels (results of the ordinal regression)

	Value	Std. Error	t value	p value
Somewhat_Aware	1.238438	0.5594414	2.2137045	0.027
Well_Aware	13.019013	43.0167156	0.3026501	0.762
EnvBenefitMsg	1.615960	0.6408693	2.5215122	0.012
EconBenefitMsg	1.104865	0.6099950	1.8112688	0.070
Intercept: 1|2	-1.698594	0.5436924	-3.1241822	0.002
Intercept: 2|3	2.546303	0.5928228	4.2952172	0.000

Source: Authors' analysis
Note: Reference value for awareness is 'Not Aware'

From Table 1 we conclude that both the interventions, motivating GSPs for environmental or economic benefits, have a significant (at the 10 per cent level) and positive effect on increasing consumers' awareness levels. We also note that the effect of the interventions is significantly higher for consumers who reported that they were 'Somewhat aware' during the baseline

6 See Timmermans and Cleeremans (2015) for a discussion on subjective and objective measurement approaches of awareness levels. We use a first-order subjective approach for measuring the general awareness of our respondents.

survey than for the group that reported they were 'Not aware'. Thus, we may conjecture that (i) consumers in this group ('not aware' group) were looking for more information about GSPs, and the interventions served to meet their information requirements; and/or (ii) some basic level of awareness in recipients is instrumental in magnifying the effect of an awareness campaign.

To test for respondents' knowledge of GSPs, we checked for the reported number of GSPs observed during servicing. This was measured for seven common activities performed by servicing technicians during a general AC servicing. Only responses from the end-line survey were considered for this analysis. Here, we did not distinguish between the environmental benefit and energy savings treatments, because information on the specific practice to be performed was the same. All respondents who had received and read the intervention messages—199 respondents—were considered for this analysis.

The results of the proportion test (Table 2) show that the treatment is not effective in significantly increasing the proportion of people who observe any of the GSPs, compared with the control group.

Table 2 Results of the proportion test

Good servicing practices	Control			Both treatments combined			p-value	Confidence Interval (90%)	
	Yes	Total	Prop	Yes	Total	Prop			
Current and voltage check	67	115	0.58	48	84	0.57	0.99	-0.13	0.16
Filter cleaning	99	115	0.86	76	84	0.90	0.47	-0.14	0.06
Leak testing	47	115	0.41	41	84	0.49	0.33	-0.23	0.07
Cleaning AC	92	115	0.80	66	84	0.79	0.95	-0.11	0.14
Earthing check	50	115	0.43	32	84	0.38	0.54	-0.09	0.2
Venting refrigerant	20	115	0.17	10	84	0.12	0.39	-0.05	0.16
Recovery of refrigerant	19	115	0.17	10	84	0.12	0.48	-0.06	0.15

Source: Authors' analysis

Considered together, these two results present an interesting insight. The intervention is successful in creating some general awareness in customers about the importance of GSPs. However, it does not lead to a higher share of consumers observing specific GSPs. We argue that this is because of the technical nature of the information associated with specific GSPs. The more technical the information, the more difficult it is for consumers to process and remember it. Thus, an awareness campaign with a high-level message could be successful in its objective, whereas it would be more challenging to achieve this objective with more technical messaging.

3.3 The effect of the intervention on servicing practices

Arguably, the most important question for us is what effect the awareness generation intervention has on actual servicing practices, because our ultimate goal is to change the actual behaviour of consumers through the GoI's awareness campaign. The survey collected information on the respondents' frequency of preventive servicing in 2018 and 2019. Essentially, we aimed to discover whether the number of AC servicings changed between April and November in 2018 and in 2019 as a result of the intervention.

To check the robustness of the responses related to this question, we included one specific question in the baseline and end-line surveys. In the baseline survey in May 2019, where we collected information for May–November 2018, we asked respondents to specify the months in which servicing was undertaken. In the end-line survey, we asked respondents to indicate the total number of servicings undertaken in the 2018 season, that is, May–November 2018. Wherever the responses varied between the baseline and end-line, we excluded that respondent from our analysis. Based on this check, 113 households were included for this analysis. Of these households, an overwhelming 75 per cent responded that they had undertaken no preventive servicing in 2018, whereas 24 per cent reported undertaking only one preventive servicing.

Responses were arranged such that the frequency of servicing both in the baseline and end-line were tested in the model against the various independent variables represented in Equation 1.

$$Yi \sim Poi(\lambda i) \text{ where } \boldsymbol{exp(\lambda i)} = \beta_0 + \beta_1 Post1\_Pre0 + \beta_2 Age_R + \beta_3 Edu_R + \beta_4 Gen_R + \\ + \beta_5 EnvBenefitAware + \beta_6 EconBenefitAware + \beta_7 EnvBenefitMsg + \beta_8 EconBenefitMsg + \\ \beta_{75} EnvBenefitMsg * EnvBenefitAware + \beta_{86} EconBenefitMsg * EconBenefitAware + \\ \beta_{76} EnvBenefitMsg * EconBenefitAware + \beta_{85} EconBenefitMsg * EnvBenefitAware$$

----- 3

Here,

β_0 represents the constant in the regression equation;

$Post1\_Pre0$ is a dummy variable that indicates whether the information is for 2018 (pre intervention) or 2019 (post intervention);

Age_R represents the respondent's age;

Edu_R represents the respondent's educational qualification classified into three levels: 1 = Did not complete high school, 2 = Completed high school but no tertiary education, and 3 = Tertiary education;

Gen_R represents the respondent's gender;

$EnvBenefitMsg$ represents households that received the treatment focused on environmental benefit;

$EconBenefitMsg$ represents households that received the treatment focused on economic benefit through energy savings;

$EnvBenefitAware$ represents households that indicated an awareness of the effect of GSPs on the environment in the baseline survey;

$EconBenefitAware$ represents households that indicated an awareness of the effect of GSPs on the economic benefit through energy savings in the baseline survey;

$EnvBenefitMsg * EnvBenefitAware$ represents households that received the treatment focused on the environmental benefit and displayed an awareness of the effect of GSPs on the environment in the baseline survey;

$EnvBenefitMsg * EconBenefitAware$ represents households that received the treatment focused on energy savings and displayed an awareness of the effect of GSPs on energy savings in the baseline survey;

$EnvBenefitMsg * EconBenefitAware$ represents households that received the treatment focused on environmental benefit and displayed an awareness of the effect of GSPs on energy savings in the baseline survey; and

$EconBenefitMsg * EnvBenefitAware$ represents households that received the treatment focused on energy savings and displayed an awareness of the effect of GSPs on the environment in the baseline survey.

A Poisson regression model is fitted to the observed data. The multicollinearity test results presented in Annexure 3 show that it is not an issue. We find that several variables in the model above were not significant at the 10 per cent level. In keeping with the principle of parsimony, we removed the non-significant variables one by one until we arrived at a model with only significant variables. We use this model for further analysis and interpretation.

$$Y_i = \beta_0 + \beta_1 + Post1\_Pre0 + \beta_6 EconBenefitAware$$

------ 4

Table 3 The effect of the intervention on the number of servicings (results from Poisson regression)

	Estimate	Std. Error	z value	Pr(>|z|)
Post1_Pre0	0.4394	0.2381	1.845	0.0650
EE_aware	0.4973	0.2435	2.042	0.0411

Source: Authors' analysis

The results (Table 3) reveal three interesting insights: (i) respondents who displayed an awareness of the economic benefit of servicing in the baseline survey were more likely to undertake preventive servicing than those who were not aware of it, with the expected number of services undertaken by consumers aware of the economic benefit 64% higher than consumers with no such awareness (ii) our interventions on both the environmental and economic benefits of servicing were unable to change the behaviour of the consumers included in our experiment, and (iii) the number of people who undertook preventive servicing is higher in 2019 than 2018. While we could not attribute the third insight to any of our interventions, we note that this

may be an early indication of the start of a healthy trend. However, our optimism needs to be guarded, as most AC users (62 per cent), even in the end-line survey, did not undertake any preventive servicing in 2019—although this figure was lower than that in our baseline survey (75 per cent). The first and second insights highlighted above are conflicting; we explain this further in section 4.1.

4. Discussions and key insights

4.1 Focusing on economic benefits could be key

Our estimates present conflicting results. On the one hand, we find that people who are aware of the economic benefits are more likely to undertake preventive servicing based on information in the baseline. On the other hand, although the interventions are effective in building awareness, they could not change behaviour within our experimental setup. These conflicting results are possible because our interventions cannot truly replicate massive government awareness campaign. In reality, such campaigns include an array of highly visible messages using mediums such as billboards, newspaper, television, and the internet, spread across multiple years to induce behaviour change. Though our frequent message and pamphlet interventions are successful in mimicking the real-world awareness campaigns to some degree, as supported by our results regarding the improvement in awareness levels, they are still only a partial representation of real-world government awareness campaigns. The results from the baseline clearly indicate that, when propagated through a consistent mass government campaign, messaging related to the economic benefit of regular and proper AC servicing would increase the likelihood of people adhering to GSPs. This should be an important element in the GoI's awareness campaign.

4.2 The lemons problem

Our survey has revealed an interesting insight related to information asymmetry and how it could influence decision making that impacts the climate. Our study found that whereas consumers perceive the technician's knowledge as the most important variable, they are not well placed to evaluate the quality and depth of information being provided by technicians (see section 3.1.4). This is because of the technical nature of information related to GSPs—very few consumers know anything more than filter cleaning and voltage/current testing, even after our dedicated intervention. Even the channel for selecting technicians is based on trust rather than an evaluation of their skills. The channel of trust is mainly based on past experience with a technician and whether the servicing has led to a satisfied customer experience, which is influenced by many variables. In our baseline survey, 91 per cent of respondents reported an improvement in AC performance after servicing, and 100 per cent reported satisfaction with the technician, which implies repeated use of the same technician irrespective of their level of formal training and expertise. This is particularly interesting considering most technicians in India are untrained and come from the informal sector, a common aspect of any developing economy (Sridhar and Chaturvedi 2017).

The inability to assess the quality of servicing technicians creates what is known as the problem of lemons in the market. This problem, first highlighted by Nobel laureate George Akerlof in his seminal work on information asymmetry (Akerlof 1970), arises because of the information asymmetry between the buyer and seller of a service/good about the value of that service/good. In our AC servicing sector context, it is impossible for the customer to differentiate between a high-quality, knowledgeable servicing technician and one who is below par. Their choice, as we show, is influenced mainly by personal trust networks. All freelance technicians claim to be good; however, only after the customer has selected the technician can he or she discern the quality of the technician. In fact, for basic servicing, the customer is mostly unable to decipher the difference.

This situation leads to 'adverse selection' in the market. The lemons, or sub-par/partially trained technicians, reduce the average market price as they offer cheaper services, and the buyer is only willing to pay the price that reflects the average quality of the market. This is evident from the result that over three-fifths of the respondents are only willing to pay what they currently pay or less than that. In this situation, the sellers of high-quality services (i.e. high-quality servicing technicians), who will undoubtedly not prefer selling their services at the average price, are compelled to do so in the face of competition from the lemons, forcing them to reduce their service quality to the average level. There is no incentive to perform better. Policymakers and planners need to devise ways to eliminate the information asymmetry in the market to improve the service quality and eliminate lemons.

4.3 Informing the Government's communication strategy

One of the key recommendations of the ICAP is an awareness generation plan for influencing the operational behaviour of AC users. Our study provides information on various aspects of AC users, as well as tests the impact of alternative interventions to inform the plan. The following findings are directly relevant to the GoI awareness generation program: (i) most AC users are unaware of the potential benefits of adopting good servicing practices and don't go for preventive servicing voluntarily; (ii) AC users aware of the energy savings and associated economic benefits of servicing are more likely to undertaken preventive servicing; (iii) most AC users do not want to spend more than 1.5 hours for servicing; (iv) most AC users do not want to pay more than INR 600 per servicing; and (v) both environmental and energy savings related messaging are successful in enhancing high level awareness of the importance of servicing, though these are not effective in enhancing technical awareness on good servicing practices. Based on these findings, the key messages in the GoI awareness generation program should: list the benefits of adopting preventive GSPs with a focus on the economic benefit while including both environmental and energy savings aspects in the communication strategy; emphasize that regular proactive servicing is a must; highlight that good basic preventive servicing needs at least two hours, the time expected for proper servicing; motivate customers to be ready to pay higher for good servicing, and ; emphasize the importance of a good servicing technician. A certification system, as explained in the next section, has to be a key complementary measure and if a universal certification system is adopted in the future, that should also become an element in the communication strategy.

4.4 From awareness to action: The need for standardised certification along with consumer awareness

Awareness is a prerequisite for behaviour change and a necessary condition for action. Our results find something very interesting in this regard; AC servicing requires technical knowledge. Almost 85 per cent of the respondents in the baseline survey find technicians' technical knowledge important or very important (Figure 1f). We find that although our intervention successfully resulted in increased consumer awareness levels, it did not lead to any change in action, given that our interventions can only partially represent the scale of government- or industry-led awareness campaigns. Moreover, it only led to a general awareness of the effects of servicing on the environment or energy savings, not a detailed understanding of the exact steps that need to be taken to ensure good servicing. We therefore conclude that, at least in the context of AC servicing: (i) awareness is a pre-requisite for action; and (ii) awareness in itself is not sufficient to change behaviour. The key elements of the GoI's awareness campaign, as highlighted above, are vital and seek to motivate AC users. Another critical element necessary to induce behaviour change is a standardised technician certification process that could differentiate a good technician from a subpar technician and address the challenges of 'lemons' and adverse selection highlighted above. As our results in section 3.1 show, the channel for selecting technicians is based on trust rather than an evaluation of technicians' skills, and hence, a certification system that helps consumers differentiate between trained and untrained technicians is imperative. This is another key recommendation of the ICAP, and our findings highlight the criticality of this recommendation. Our recommendations for generating awareness, together with a standardised and robust certification scheme, would incentivise AC users in India to change their behaviour and lead to significant climate policy benefits for the country.

4.5 Time and money: Paying for Good Servicing Practices

Our results show a clear trend in the number of people who want to pay less than they currently do. Only one-third of respondents were willing to spend more money on servicing. Furthermore, more than three-fourths highlighted servicing cost as a critical factor affecting their choice of technician. Additionally, most consumers do not want to spend more time. Only 12 per cent were willing to spend more time on monitoring a servicing technician. Both time and money are important variables. Conducting GSPs take time, and technicians' remuneration needs to reflect their skills and the time spent; only then can the environmental and economic benefits related to servicing be harnessed. The industry, in collaboration with the GoI, should optimise the average time a technician spends on a good preventive servicing. The GoI's awareness campaign should also focus on enhancing consumers' willingness to pay for good servicings.

4.6 The complementary role of manufacturing companies in awareness generation

Manufacturing companies play an important role in the AC market structure. These, through their various sales channels, have been instrumental in spreading the word about the appliance star rating programme of the Government of India. Interestingly, however, there doesn't appear to be any concerted set of actions by the companies to make AC users aware of the importance of preventive servicing, and the information is largely shared by the servicing technicians to AC users. Manufacturing companies can play an important complementary role in awareness generation about the positive benefits of preventive servicing. For example, they can develop a short awareness generation brochure in vernacular languages focusing on good servicing practices and their benefits and share it as a part of the AC kit along with other documents like warranty card and user manual. Ideally, such a brochure should have standardised information across AC companies to ensure that a consistent set of information flows. Such actions by the manufacturers could go a long way in helping the GoI efforts in generating consumer awareness.

5. Conclusion

From the broader climate change awareness perspective, policymakers and researchers need to focus on specific actions to mitigate climate change. Behaviour change plays an important role in the overall strategy. Air conditioners are expected to account for a significant proportion of India's residential energy use. As identified in the GoI's ICAP, bad servicing practices lead to decreases in energy efficiency as well as higher leakages of high-GWP refrigerant gases. However, preventive servicing depends critically on the behaviour of end-use consumers. Hence, a consumer awareness programmeto change behaviour is a key ICAP recommendation.

Our research seeks to inform the ICAP's consumer awareness plan. We undertake a detailed survey and RCT experiment to understand the knowledge and behaviour of India's AC users and test the effects of some key messages on consumers' awareness levels and actions. We find that the average number of preventive servicings undertaken by AC users in India is much lower than required. Our RCT interventions are successful in enhancing the awareness of the importance of servicing practices. However, they are not successful in either enhancing awareness at a technical level or increasing the number of servicings used, because achieving these objectives would require a large-scale awareness campaign—something that only the government or industry could do. Our results simultaneously suggest that people are aware of the economic benefit of regular servicing are more likely to undertake it. Thus, we recommend that the GoI's awareness campaign emphasise the economic benefit of GSPs.

Furthermore, based on the results on willingness to pay and spend time, we recommend that the GoI's awareness campaign should list the benefits of adopting preventive GSPs, emphasise that regular proactive servicing is imperative, highlight that good basic preventive servicing needs at least 2 hours, motivate AC users to pay more for good servicing, and emphasise the importance of a good servicing technician.

Our findings also reveal that awareness generation in itself might not lead to behaviour change. The information asymmetry challenge has to be addressed, and a standardised certification system is vital to achieve this objective and differentiate good technicians from subpar ones. Together, higher awareness of different related elements and a robust certification system should lead to changes in AC users' behaviour and thus contribute to meeting India's climate policy objectives. In many other cases, addressing information asymmetry has led to transformation in market actors; for example, the introduction of star labelling has addressed an important information gap and affected the way consumers decide on AC purchases. The role of the Indian industry, as a partner of the GoI, will be critical in this transition.

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Annexures

Annexure 1: Comparison of the demographic and AC characteristics in the baseline and reduced datasets used for ordinal regression (testing the intervention effect on consumer awareness levels) and Poisson regression (testing the intervention effect on the number of services undertaken by consumers)

Table A1 Comparison of demographic and AC characteristics

Median Age			
	Baseline	Ordinal Regression	Poisson Regression
Age (years)	42	36	38
Gender Distribution			
	Baseline	Ordinal Regression	Poisson Regression
Male	82%	88%	94%
Female	18%	12%	6%
Median Income			
	Baseline	Ordinal Regression	Poisson Regression
Income (INR/month)	36000	35000	35000
Education			
	Baseline	Ordinal Regression	Poisson Regression
No formal schooling	1.4%	0.0%	0.9%
Up to 5th standard	1.2%	0.9%	1.8%
5-10 standard	12.0%	12.2%	11.5%
10-12 standard	29.2%	26.1%	25.7%
Graduate	48.8%	55.7%	56.6%
Diploma	3.7%	3.5%	2.7%
Masters and above	3.7%	1.7%	0.9%

Tonnage			
	Baseline	Ordinal Regression	Poisson Regression
Less than 1 tonne	4.9%	0.0%	5.3%
1 tonne	19.9%	9.6%	14.2%
1.5 tonne	73.1%	89.6%	78.8%
2 tonne	2.1%	0.9%	1.8%
More than 2 tonne	0.0%	0.0%	0.0%
Star Labelling			
	Baseline	Ordinal Regression	Poisson Regression
No star labelling	2%	0.0%	4.4%
1 star	0%	0.9%	0.9%
2 star	2%	0.9%	0.9%
3 star	48%	51.3%	48.7%
4 star	19%	23.5%	16.8%
5 star	28%	23.5%	28.3%

Sample size	
Baseline	432
Ordinal Regression	115
Poisson Regression	113

Source: Authors' analysis

Annexure 2: Multicollinearity check for the model testing for the increase in awareness due to the interventions

We tested multicollinearity for the model given in Equation 1 in the main text.

The full model did not run because of estimation issues. Therefore, we tested for multicollinearity in alternative model specifications by removing variables one by one. The table below gives the variance inflation factor (VIF) estimates. A VIF over 5 is considered high, indicating the possibility of multicollinearity.

Table A2 VIF estimates for alternative model specifications

	Specification 1	Specification 2	Specification 3	Specification 4
Treatment	1.13e+16	4.06e+15	1.13e+16	4.51
Pre_Awareness	5.65e+16	1.07e+17	2.94e+17	1.34
Age	6.07e+15	2.80e+14	9.20e+15	NA
Gender	4.27e+14	NA	NA	NA
Education	NA	1.50e+16	NA	NA

Source: Authors' analysis

Based on these VIF estimates, only specification 4, with two variables, is appropriate for our estimates.

Annexure 3: Multicollinearity test for the model testing for the increase in the number of services used due to the interventions

We tested multicollinearity for the model given in Equation 3 in the main text.

The full model did not run because the variable EnvMsg*EnvAware had a value of 0 for all households. In other words, there were no households that were aware of the environmental benefits in the baseline and that were also sent the intervention related to environmental benefits. We thus removed this variable.

The table shows the VIF estimates.

A VIF over 5 is considered high, indicating the possibility of multicollinearity.

Table A3 VIF estimates for alternative model specifications

	VIF estimates
Pre or Post Dummy	1.07
Age	1.14
Gender	1.15
Education	1.45
EnvMsg	1.42
EnerSaveMsg	1.07
EnvAware	1.45
EnerSaveAware	1.47
EnvMsg * EnvAware	1
EnerSaveMsg * EnerSaveAware	1
EnvMsg * EnerSaveAware	1.42

Source: Authors' analysis

The VIF estimates show that there is no multicollinearity issue in this specification.

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