

# Purchasing Energy Efficient Appliances: A Qualitative Investigation using Text Analysis

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## Abstract

This study was undertaken to understand individual residential behavior towards awareness of Energy Efficient Appliances (EEA) and most commonly held interpretations of star ratings on household appliances. Using a qualitative study approach, 31 personal interviews were conducted with selected individuals across varied demographics. The qualitative responses were transcribed and analyzed using methods of text analysis using the R statistical software along with the Python based Natural Language Processing Toolkit (NLTK). Our main findings suggest that there is significant awareness of the need for using star-rated appliances and energy saving devices. Conclusions were drawn by analyzing the top features in the text, along with analysis of bigrams. Further, sentiment analysis on the sentences containing the words “appliance” and “star-rated” reveal more positive sentiments than negative thereby suggesting that users of EEAs are satisfied with the performance of such appliances. Finally, Natural Language Processing (NLP) techniques along with the method of concordances showed that consumers are well aware of the benefits of using EEA, and identify star ratings as quality indicators of the appliance. Text network analysis reveals that consumers strongly associate energy efficiency with appliances that are covered under the mandatory labeling program. We find that while consumers are aware that use of EEAs lead to energy savings, they are unable to quantify the said savings. Higher adoption of such appliances can be ensured if the consumer is directly able to estimate the exact savings in monthly electricity bills, at the time of purchase, which is currently not the practice. It is also recommended that more appliances should be brought under the mandatory labeling program, such that adoption of EEAs can be accelerated.

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## I. INTRODUCTION

Energy is an important component of global, social and economic infrastructure [1]. Consumption of energy is considered as the main source for pollution and environmental degradation [2]. Energy needs, to support such a fast-paced economic growth agenda, has been provided by increasing fossil fuel based electricity generation, and as a result, India now

ranks as the fourth largest emitter of carbon emissions in the world, as of 2016 [3]. Coal fired power plants have fed the ever-increasing demands of electricity and have been the primary reason behind rising emissions for India [4]. While other major emitting countries exhibited reduction in their carbon emissions in 2015 (when compared to 2014 emission levels), India recorded an increase of 5.4%

[5]. Increasing population, improvements in the standards of living, and rapid industrialization, have resulted in multi-fold increases in India's electricity consumption, in the last 30 years [6]. Not only is this increased demand, contributing to increased atmospheric emissions, it leads to major health hazards as well. Research suggests releases of harmful greenhouses gases, from thermal power generation, are proving disastrous to human health [7]. Data available suggests that close to 80,000 – 115,000 pre-mature deaths were attributed to the emissions released from coal based power generation, in 2010-11 [8].

Majority of the electricity demand in India comes from the industrial and residential consumer segments. In 2015-16, the industrial (42.3%) and residential sectors (23.9%) accounted for close to 66% of the total electricity consumption on India [9]. Contributing to 25% of total electricity consumption in India, Residential Electricity Consumption (REC) is poised to multiply further, owing to increasing income levels of residential consumers, rapid pace of getting access to electricity and introduction of modern technology/appliances [10]. The leading government think tank of India, National Institution for Transforming India (NITI Aayog) estimates that by 2047, the residential sector will account for almost 40% of total electricity demand in India [11]. The resultant increases in electricity consumption are not without its own consequences, as highlighted above.

Given the above, a need is felt to look at electricity consumption solutions that are 2 fold in nature: one that promises electricity usage without resulting in higher emissions. Investments in energy efficient technology and adoption of energy conservation are two such practices. While energy conservation undoubtedly contributes in reducing the greenhouse gas emissions and energy demand [12], adoption of Energy Efficient Appliances (henceforth referred to as EEAs) has also been associated with curtailed energy consumption levels [13].

Considering the merits of EEAs, the Indian government has introduced policies to accelerate the adoption of such appliances. Amongst the most noted governmental interventions in the Indian context, has been the Energy Conservation Act (ECA) [14], launched in 2001. The act aims at trimming the energy intensive consumption patterns in the economy. Subsequently, the Bureau of Energy Efficiency (BEE) was set up in 2002, as an implementation agency for the objectives set under the ECA 2001. The BEE launched the Standards and Labeling (S&L) program [15], with the aim of providing full information of energy saving potential, of some of the most commonly used residential appliances. The program envisaged that with this information available with the consumer, energy intensity of residential consumption maybe reduced. The labeling program has a current expanse of over 33 products, wherein mandatory disclosure of energy savings potential is applicable for 10 appliances, while voluntary rating is applicable on 23 appliances. This list is revised frequently by the BEE to include new and upcoming appliances. The government has taken steps from time to time to ensure that key appliances, that contribute to high electrical consumption by residences are covered under the mandatory labeling program (such as lighting) [10]. Along with the S&L program, many other complimentary government schemes have also been rolled out, to reduce residential energy intensity – such as the theBachat Lamp Yojana announced by the government in 2011. Under this, Compact Florescent Lamp (CFL) were distributed at reduced prices, replacing the energy-inefficient Incandescent bulbs [16]. This step was taken keeping in mind merits of CFLs – one that leads to lower electricity demand, while reducing emissions alongside [17]. Scaling up this initiative further, the UnnatJeevan by Affordable LEDs for Appliances for All (UJALA) program, distributed close to 250 Million smart and LED bulbs as of July 2017. Savings from this scheme are estimated at 2.7 Crore tons per year [18]. It is thus clear that a sufficient policy framework and governmental support co-

exist, towards boosting adoption of EEAs by residences.

Adoption of EEAs amongst residences, assume even more importance now, when the costs of electricity consumption for the end consumer is likely to increase. India has long followed the system of cross – subsidization of end consumer tariffs [19]. Residential, along with agricultural consumers, have serially consumed electricity at cheaper rates than industries and commercial establishments. However the government is now keen to put an end to this practice. The local power utilities are facing financial distress on account of supplying power at prices, lesser than what it costs, for some consumer categories. This practice is no longer financial sustainable for the power suppliers [19]. With this intention in place, residential consumption of electricity is set to become more expensive. This provides a more compelling reason to adopt EEAs, which will result in lower electricity consumption. However, while the need to adopt EEAs is widely known, studies have indicated that adoption is the least observed amongst residences. Reddy & Shreshtha [20] find that residential users of electricity showed very low awareness levels of EEAs. Willingness to adopt such appliances, at current costs was scanty, and payback expectations on the investments made on such appliances, was less than 2 years. Lack of awareness, high initial costs, non – availability in the market, and savings uncertainty were found as important deterrents to wider adoption rates. Financial motivation was another major determining factor, as observed through a study conducted in urban households in Bangalore [21].

As is evident from the above, studies already exist that prove the lagging adoption of EEAs. However, to our knowledge no study exists, especially in the Indian context, that investigates consumer’s awareness, perception and most widely held interpretation of the star-labels displayed on EEAs.

This necessitated our investigation on two primary concerns:

1. Are consumers aware of star rated energy appliances?
2. What are the most commonly held interpretation of the star ratings and how different are they from the objective of the star – rated program?

This research gap guides the study at hand. The main tool used to answer the concerns above was the analysis of text obtained from in-depth interviews conducted with residential households in Pune – one of the largest urban centers in Maharashtra, a state that ranks highest in total residential electricity consumption [10].

The rest of the paper is organized as follows. Section II provides a literature review of studies conducted towards use of energy appliances amongst residential consumers. Section III details the research methodology adopted for this study. Next in Section IV, data analysis and related discussions are provided, from thirty one in-depth interviews with urban residential households in Pune. Rich qualitative analysis has been conducted through concordance analysis, sentiment analysis using key-words-in-context (KWIC), and text network analysis. Insights from the above provide the reader with an understanding of the most commonly held views on star-rated energy appliances. Key findings and conclusions are presented in section V and finally, limitations and future scope of research is contained in section VI and section VII respectively.

## II. LITERATURE REVIEW

Energy demand in India is likely to multiply in the coming years, owing to rapid pace of urbanization. The United Nations in its report on ‘World Urbanization Prospects, 2014’ predicts that the Indian urban population would grow from 410 million (in 2014 representing 32% of population) to

806 million (in 2050 representing 50% of population) [22]. It is expected that over 100 million new households would be added between 2016 and 2030, with three-fourths of them in urban areas. Rising urbanization and shrinking household sizes would have an impact on the overall electricity and energy use from urban India [23].

To ease the process of urbanization and enable cities accordingly, Government of India has launched the Smart City Mission, which is a pan-India initiative is a step to enhance the quality of life and the social fabric [24], for its citizens through this urban development agenda [25]. As the cities become smarter and bigger, there will be increase in demand for fulfilling the anthropogenic activities like water, transport and industry. Hence providing unrestricted energy access for carrying out these activities would be a priority. Residential Electricity Consumption (REC) will also rise as a result. Energy consumed in space heating and cooling and water heating amongst residential households, accounts for half of the energy consumed in building sector today [26], and will only rise further with increased urbanization. India's Residential Electricity Consumption (REC) will multi-fold on 2 accounts – Firstly on account of Indian government's commitment to provide electricity 24 x 7 to households that currently lack electric connection and face frequent outages. Secondly, improved economic status of household will enable the consumer to invest in home appliances/equipments. Both of these would mean a tremendous increase in the electricity requirement, by at least by five to six times [27]. The resultant increase in electricity consumption, if met by the currently planned increases in thermal-based electricity generation, will further exacerbate climate change issues. Rapid increase in carbon emissions is the most obvious result, and thus urgent measures are required to be taken, such that emission intensity of energy consumption is reduced. Within this framework, reduction in residential electricity consumption should become of prime focus.

Investments in energy efficient technology such as Energy Efficient Appliances (EEAs) present a quick answer to the problem at hand. EEAs, as defined earlier, are those electrical appliances that use less amount of electricity to deliver same level of performance, with convenience and comfort of use [28]. Energy usage in the household sector has been observed to be substantial [29], contributing to one-fifth of global energy demand [30] and has thus been associated with higher carbon emissions [31]. Hence residential adoption of EEAs will go a long way to curb carbon emissions and help transition to a cleaner future. Associated Chamber of Commerce and Industry (ASSOCHAM) reports that more than Rs.12 lakh crores can be saved using EEAs which is equivalent to 20,000MW of power per year. Thus conserving energy through usage of appliances can be seen as an effective medium through which households can contribute towards reduction of greenhouse emissions, without curtailing current electricity consumption levels [32].

While the widespread adoption of EEA is warranted, it has been seen that consumers not only lack knowledge about energy products, they also fail to understand that energy consumption causes harm to the environment [33]. Literature on energy household products reveal barriers like higher costs associated with saving electricity, lack of feasible alternatives [34], environmental attitudes, beliefs and behavior [32]. Attitudes towards energy usage been seen of special interest in research studies [35]. With a large sample of 1724 respondents across urban India, the study explored consumer's motivations and barriers that dissuaded them from investing in energy measures. The study concluded that barriers like convenience and comfort, inhibit consumers from undertaking conservational practices. [36] find that usage of fans, air-conditioners and air coolers increased with the increase in temperature and the usage was impeded by poor efficacy of the appliances, noise and the occupant's adaptability, his attitude and his economic condition. Further, evidences were found

that residents from higher economic strata indulged in the possession of the energy guzzling appliances. Behaviorally, women were found to be more involved in energy saving practices and were willing to pay more for lighting [37]. In Malaysia, 70 percent of respondents have moderate level of green practices despite of have high level of environmental consciousness [38] This could be due to the consumer's lack of understanding the benefits of the EE appliances and the inadequate communication of the advantages. Effective communication of the advantages of EE products would result in reducing the ambiguity associated with these products [39].

In the Indian context, Parikh & Parikh [40] opined that a consumer will spend more on a higher star-rated product only if the energy savings exceeds the initial cost. This will depend not only on the expected life of the appliance but also the cost of electricity consumption and the discount rate at which future savings in the electricity bills are valued. The high price of energy technologies is often seen as a big deterrent to adoption [41]. Another barrier is the insufficient push from power suppliers. Power suppliers do not find it in their interest to promote the use of such appliances, since they view the same as a threat – due to the resultant reduction in revenues for the local power suppliers, (resulting from consumption of fewer units of electricity) [42]. Widespread adoption of such appliances may encourage “non-adopters” to adopt. Information exchanges take place, and more information dissemination leads to more adoption [41].

While the literature studied does point to a rich understanding of household's usage and some of the barriers to adoption, the authors were encouraged to study the same in more depth in the Indian context, and with special focus on studying the interpretations of star-ratings on household appliances that come under the ambit of S&L program – a program that is India's way to increase adoption of EEA.

### III. RESEARCH METHODOLOGY

The interview participants were selected using stratified random sampling method. The population of Pune city was divided into different strata based on the new consumer classification scale (as prescribed by BARC in 2006). As per this scale the socio-economic status of the consumers is based on the educational qualifications of the chief wage earner of the family and the number of consumer durables possessed by him/her. A list of 11 durables comprises of the following -Electricity connection, ceiling fan, Gas stove, Fridge, 2-wheeler, Washing machine, Colour TV, Computer, 4-wheeler, Air conditioner and Agricultural land. Thus, based on this classification, consumers in the A1, A2, A3 and B1 categories were selected for in-depth interview. The personal interviews were done to minimize the self-presentational concerns [43] and to eliminate the pressure on the interviewers to ‘do and say the right thing’ [44]. The interviews were conducted in the comfort of the respondent's home. This facilitated the interviewee and the interviewer. The interviewee could check the availability of energy star rated products at the respondent's residence and could also observe the respondent's behavior towards energy.

The interviews were conducted based on a discussion guide with questions ranging from being general to being specific Initially, questions related to respondent's demographics like number of members in the household, approximate annual income, status of the residence (owned/rented) and number and kinds of appliances used at home, were used as ice-breaker questions. Thereafter the consumer's awareness on the electricity bill and the rate per unit of electricity was checked. This was followed by checking the consumer's awareness on the contribution of various appliances in the electricity bill. This was followed by checking consumer's awareness on the power consuming appliances in his household. This indirectly led to checking consumer's awareness on star rated

products and non-star rated products and the importance he placed on using star rated appliances in reducing his monthly bills. Subsequently the discussion moved to the purchase decision of the appliance and the factors that enabled/deterred the purchase decision. The consumers were also questioned on the actions (if any) taken by them to reduce the monthly bill.

In depth interviews ranging from 45 minutes to an hour were undertaken with all participants. Studies indicate that energy use and acceptance of energy conservation strategies are positively related to educational level of the respondent [45] [46]. Although it is found that an individual's occupation had no significant impact on households' energy conservation actions [47], individuals with higher-status occupations are more open and accepting about energy conservation practices [46]. Hence our sample involved respondents who belong to educated and high-income bracket to further investigate the practices and decision making involved in buying energy efficient appliances.

Text data collected were recorded transcribed and then analyzed using R and Python text analysis software. Methods of text analysis are useful in discerning patterns and sentiments in text. Text analysis can be done at various levels, starting from analysis of word frequencies and cluster analysis of text to more advanced methods using techniques from Natural Language Processing (NLP). The latter involves parsing text to identify parts of speech. Our analysis below presents the same, where we parse adjectives in the context of a specified word related to star rated appliances and assess the sentiment expressed by the adjectives. Such sentiment analyses are made possible by the use of widely available sentiment dictionaries. In this study, similar analyses were done using the statistical software R (version 4.0) together with the R libraries *quanteda* and *tidytext*. More advanced methods involving parsing sentences for parts of speech were done using the Natural Language Toolkit (NLTK) in Python.

Sufficient care was taken while conducting text mining using the statistical software by following guidelines by Julia and David [48]. Therefore, sentiment analysis, network analysis, and concordance analysis [49] were used to draw meaningful insights on the study objectives, which are presented in the next section.

#### IV. ANALYSIS AND DISCUSSION

In this section, the paper provides insights on the respondent's awareness of star rated products, and an analysis of how people interpret star ratings on the appliances.

##### a) Awareness of star-rated appliances:

One of the prominent objectives of the study was to understand the level of awareness about star rated appliances among respondents. A majority of the respondents (28/31 respondents) were aware of what star ratings on appliances signified. This finding is aligned to a study done by Parikh & Parikh [40] that signify awareness creation towards EEAs and its energy saving potential, amongst consumers of electricity. Further, we found that the most commonly held perception was that star-ratings translate to reduced electricity bills, which is commensurate with the objective of the star-rating program.

Examples of remarks indicating that respondents understood the significance of star ratings:

“Star rating tells me that these appliances will be consuming less electricity as compared to the other appliances so the more the number of stars the lesser the consumption of electricity the appliances will be using”

“A higher star rating means less energy/ less electricity consumption. So ultimately it will reduce the cost of electricity”

Very few respondents (3/31) were unaware of the meaning of star rating:

“Something to do with the electricity saving”

“Though these appliances are of different ratings, it makes little difference to power consumed by the appliance”

**b) Interpretation of Star-ratings through qualitative text analysis**

**i. Concordance Analysis:**

That “words are known by the company they keep” is an old aphorism in text analysis. Technically, this refers to the concept of “key words in context”. This technique involves specifying a word and then finding all occurrences of this (referred to as the key) word in the text of interest, with a specified number of neighboring words (also known as the context). This technique helped in understanding the context in which certain words were being used by the respondents. The context was defined as ten words on either side of one of these (key) words. The use of concordances to study the meaning of text is one of the oldest techniques of text analysis [50]. The *quanteda* package in R allowed us to extract the concordances associated with words, specified by us, related to star rated appliances.

Select examples of concordances for the word star appear in Table 1 below:

Definitely I would <b>prefer</b> to buy	<b>star</b>	rated appliance , first because it looks good and secondly
amount and a huge <b>saving</b> when I buy a 5	<b>star</b>	rated AC with a 3 star AC
have a relative rating starting from no star to 5	<b>star</b>	depending upon <b>energy</b> consumed and the good quality of energy
less power . Also I think electric appliances with <b>good</b>	<b>star</b>	rating use superior <b>quality</b> built in materials so their quality

**Table 1: Concordance analysis for the word “star”**

We assessed the meanings of concordances for a few chosen word combinations (pair of words together) of interest to us, and present them as following:

- Save (or saving) and Star-Rated

The objective here was to check if consumers associate the use of EEA with energy savings or bill

savings. It emerged that respondents could relate star-ratings to energy saving, and correctly held the opinion that higher star-ratings indicated higher savings. However, they were unsure of exact amount of savings (in monthly electricity bills), which gives rise to uncertainty in decision making while purchasing such appliances. No such information system exists as of date that helps the consumer directly calculate electricity bill savings due to use of star rated appliances.

- Quality and Star-Rated

Higher star rated appliances appeared to be associated with higher quality, as well as durability of the appliance. However, this may not be in line with ground reality. Higher ratings only mean lower electricity consumption and are not necessarily a validation of the appliance quality and durability. Consumers also believe that higher star rated appliances will come at a higher cost – a premium for higher quality and durability.

- Prefer and Star-Rated

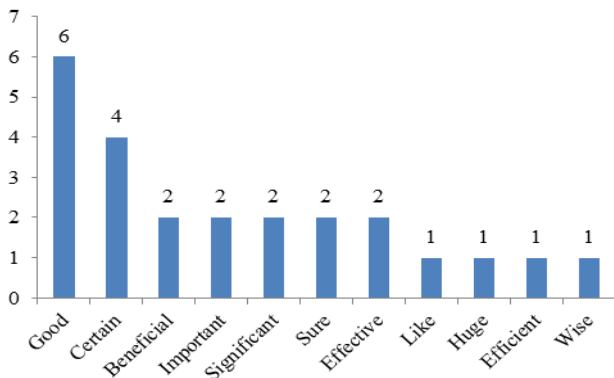
This concordance was assessed in order to understand if there was any preference for star rated appliances, or whether consumers are star-ratings agnostic. We found that preference for star rated EEAs was due to perceived higher durability, quality, as well as appliance efficiency. Consumers did show preference for such appliances, and widely held the belief that higher upfront costs, in purchasing EEAs would be recovered through savings in monthly electricity bills. Although, this preference for EEAs is bounded by budget, in which family decisions play an important role.

- Power (or energy) and Star-Rated

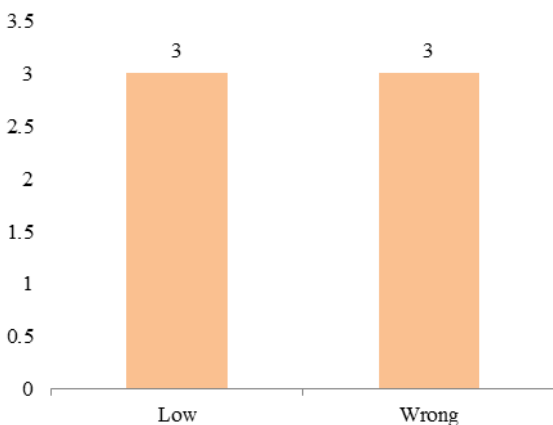
Similar to financial savings, consumers are aware that electricity consumption stands reduced with increasing use of EEAs, however exact quantification is difficult.

**ii. Sentiment Analysis using Key Words in Context:**

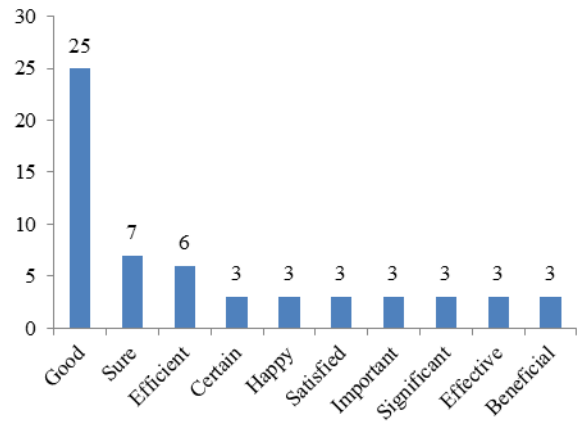
The method of concordance analysis can be extended to a more useful analysis using the sentiments expressed in a group of words and this is discussed next. The words whose context we chose to examine were appliance, and star, as this would help provide a context to consumer’s perceptions. Natural Language Processing techniques were then used to pick out the adjectives from the context and classify them as being of positive or negative sentiment. The parsing of text for adjectives was done with the use of the NLTK Python library. Sentiments were then assessed using the tidytext library in R. The sentiments associated with the words “appliance” and “star” are depicted below (Figure 1 – Figure 4):



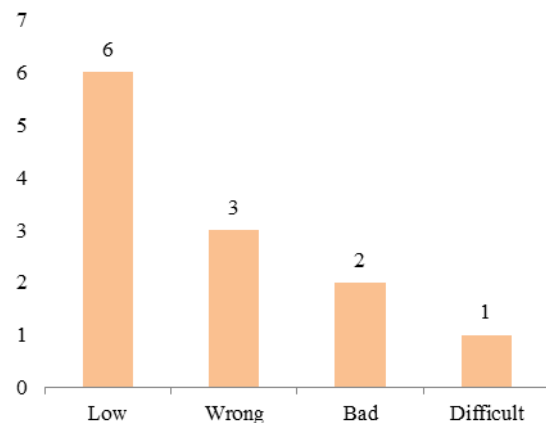
**Figure 1: Positive Sentiments for the word "Appliances"**



**Figure 2: Negative Sentiment for the word "Appliances"**



**Figure 3: Positive Sentiment for the word "Star"**



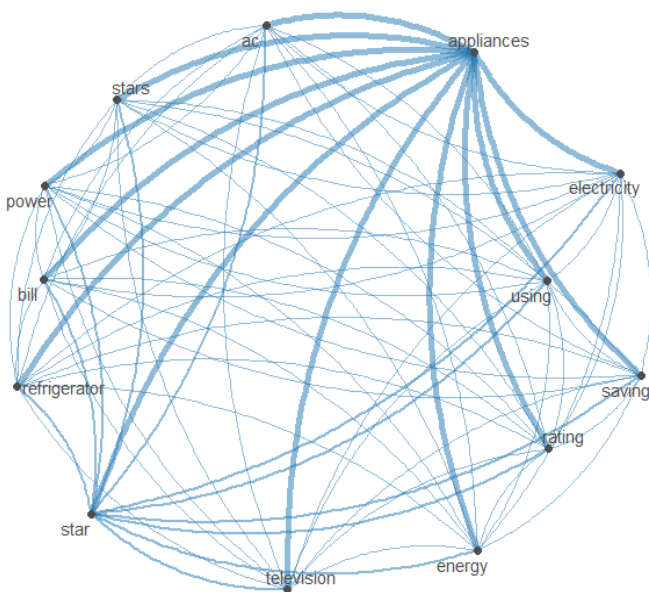
**Figure 4: Negative Sentiments for the word "Star"**

For both the words, we find more positive sentiments than negative, which was encouraging to note. The word star is most often associated with the words Good, Sure and Efficient. This can be interpreted to mean that consumers are convinced that EEAs will be of good use, and are sure of the appliance’s efficiency. Some of the other positive sentiments associated with star indicate that consumers are found happy and satisfied with the EEA use. However the negative sentiments indicate that there may be “wrong” interpretation of savings, in some cases. On closer investigation we find that many people find availability of EEAs in desired aesthetics a hindrance. One respondent was found saying “I find it difficult to get the color of my choice in star rated appliances most of the time” and “Aesthetics are limited when looking for 3 stars or 5

star products”. This points to a possible barrier that has yet not been explored in previous studies.

### iii. Analysis with Text Networks:

Social networks are widely used in the social sciences to describe the relationships between entities of interest – often people or organisations [51]. The same idea has been applied to relationships between words in a body of text [52]. Understanding patterns of connections between words, called a text network, helps in understanding the themes behind a body of text. The resulting network can also help to understand the strength of the relationship between words, using a measure called the co-occurrence matrix [53]. We display the network of words commonly occurring with household appliances, in Figure 5. In the figure, a line joining two words indicates that they occur together and the thickness of the line indicates the strength of the co-occurrence. Figure 5 can be interpreted as representative of strength of relationships between words.



**Figure 5: Network diagram of words in the body of texts.**

The network diagram suggests that star rated household appliances are closely associated with electricity bills and power saving – an observation

which is verified through the use other techniques described earlier. What is more interesting is that consumers associate strong relationships between star ratings and appliances that are under mandatory labeling program – namely air conditioners, refrigerators, and televisions. Other appliances in voluntary labeling namely, laptops, ceiling fans and washing machines (amongst others) do not feature in the respondent’s perception. This is an important observation and suggests future policy changes.

## V. KEY FINDINGS AND CONCLUSIONS

The adoption of energy efficient technologies by households would be an important move to reduce the greenhouse emissions and limit climate change. In this context product labeling indicating energy efficiency of a product, plays a major role in helping consumers make an informed choice. This study was a broader attempt to take insights from educated individuals, investigating the most commonly held interpretations/ meanings of the star labels that are exhibited on household appliances. Key observations from the study undertaken appear as follows:

- Consumers, by and large, are aware that higher star-ratings translate to lesser electricity consumptions, and thereby lower electricity bills. While this is aligned with the objective of the S&L program, some observations also suggest unclear understanding about star-ratings. This calls for more information dissemination/ knowledge creation. We recommend this knowledge and information dissemination be done through consumer’s monthly electricity bills, where the consumer can be informed of the various environmental and economic benefits of using EEAs. This may enhance the adoption of EEAs.
- Overall perception of EEA is positive. Uses of EEAs are associated to be good and respondents are sure of the appliance efficiency. However, respondents also find availability of desired aesthetics a problem. More detailed research needs

to be undertaken to adjudge if appliance aesthetics form a major barrier to adoption or not. This objective can guide further research.

- Users are sure that use of EEAs will reduce electricity consumption, and thereby will reduce monthly bills. However, no respondent was able to identify the exact savings, as no such system exists that aids in a direct and easy calculation, at the time of appliance purchase. A mechanism that can help consumers identify exact savings from use of EEAs (assuming typical star ratings and electricity consumption), would be useful.

- EEAs that have mandatory star labeling (TVs, ACs and Refrigerators) are most commonly associated as power saving/ energy saving appliances by consumers. However, other household appliances also exist that are star-labeled, but the labeling information is voluntary. It is observed that consumers do not associate such products as being sufficiently energy efficient, which is undesirable. It is recommended that if all products can carry mandatory label information, awareness of the labeling program can be heightened, along with enabling consumers to make informed decisions.

## VI. RESEARCH LIMITATIONS

The study was undertaken in a stipulated time span of 1-2 hours during the home visits of the respondents. The study may run the risk of relying too heavily on respondent's description mentioned about their own consumption practices which may differ from their actual day to day practices/behavior. Another limitation of the study was the respondents belonged to educated and working section of the society, in the state of Maharashtra. The findings of the study shall be restricted to similar kind of respondents and cannot be generalized to a larger set of population.

## VII. FUTURE SCOPE OF STUDY

The present research was a primary study to assess the understanding of star-rated products and

commonly held interpretation of such ratings. The findings have been derived based on qualitative analysis of in-depth interviews. To increase the validity of the study, the research can be extended and can be undertaken on higher number of respondents, using a quantitative approach. Data from different sections and different regions can also be included to represent the population.

## REFERENCES

- [1] S Filippov, N Mikova, and A Sokolova, "Green Energy Prospects: Trends and Challenges," *International Journal of Social Ecology and Sustainable development*, p. 20, 2015.
- [2] Mohamed El HediArouri, Adel Ben Youssef, HatemM'henni, and Christophe Rault, "Energy consumption: Economic growth and CO2 emissions in Middle East and North African countries," *Energy Policy*, pp. 342 - 349, 2012.
- [3] G., Crippa, M., Guizzardi, D., Muntean, M., Schaaf, E., Olivier. Janssens-Maenhout, "Fossil CO2 and GHG emissions of all world countries," *Publications Office of the European Union, Luxembourg*, 2017.
- [4] Robert Fofrich, Steven J. Davis Christine Shearer, "Future CO2 emissions and electricity generation from proposed coal-fired power plants in India," *Earth's Future*, pp. 408 - 416, 2017.
- [5] Jos G.J. Olivier, G. Janssens-Maenhout, M. Muntean, and JeroenA.H.W.Peters, "Trends in Global CO2 Emissions - 2016 Report," *PBL Netherlands Environmental Assessment Agency*, 2016.
- [6] S. Kumar, B. Bhattacharyya, and V. K. Gupta, "Present and Future of Energy Scenario in India," *Journal of The Institution of Engineers (India): Series B*, pp. 1-9, 2014.
- [7] Conservation Action Trust, "Coal kills- Health impact of air pollution from India's coal power expansion," *Mumbai*, 2012.
- [8] SarathGuttikunda and Puja Jawahar, "Atmospheric emissions and pollution from the coal-fired thermal power plants in India," *Atmospheric Environment*, pp. 449-460, 2014.

- [9] Central Statistical Institute, "Energy Statistics," Ministry of Statistics and Program Implementation, Delhi, 2017.
- [10] AdityaChunekar, S. Varshney, and Shantanu Dixit, "Residential electricity consumption in India," Prayas Energy Group, Pune, 2016.
- [11] NITI Aayog, "A Report on Energy Efficiency and Energy Mix in the Indian Energy System 2030," NITI Aayog, 2015.
- [12] Stephen EnyinnayaEluwa and Ho Chin Siong, "Behaviour of Ibadan City Households Towards Energy Conservation: A Discriminant Analytical Approach," International Journal of Social ecology and sustainable development, vol. 7, no. 2, pp. 39-55, 2016.
- [13] S Pacala and R Socolow, "Stabilization wedges: Solving the climate problem for the next 50 years with current technologies," Science, pp. 968-972, 2004.
- [14] Justice and Company Affairs Ministry of Law.(2001) Ministry of Power.[Online]. <http://powermin.nic.in/sites/default/files/uploads/ecact2001.pdf>
- [15] Government of India Ministry of Power. Bureau of Energy Efficiency.[Online]. <https://beeindia.gov.in/content/standards-labeling>
- [16] Government of India. (2011, November) Press Information Bureau. [Online]. <http://pib.nic.in/newsite/PrintRelease.aspx?relid=77612>
- [17] Arun Kumar, Sudhir Jain, and NK Bansal, "Disseminating energy-efficient technologies: a case study of compact fluorescent lamp in India," Energy Policy, pp. 259-272, 2003.
- [18] SaumyPrateek. (2017, August) MERCOM India - clean energy news and insights. [Online]. <https://mercomindia.com/energy-efficient-appliances-sold-fuel-stations-across-india/>
- [19] Amrita GangulyRanajoy Bhattacharyya, "Cross subsidy removal in electricity pricing in India," Energy Policy, pp. 181 - 190, 2017.
- [20] Sudhakara Reddy and Ram Shreshtha, "Barriers to adoption of efficient electricity technology: a case study of india," International Journal of Energy Research, pp. 257 - 270, 1998.
- [21] Srinivasan et al., "Deep conservation in urban india and its implications for the design of conservation technologies," in ACM Conference on Human Factors in Computing Systems, Paris, 2013, pp. 1969-1978.
- [22] ShashankaShekhar Panda, "Sustainable Energy Integration in Smart Cities," 2015.
- [23] Sahir Ali, "The future of Indian electricity demand: How much, by whom and under what conditions?," 2018.
- [24] ShashankShekhar Panda, "Sustainable Energy Integration in Smart Cities in India," 2015.
- [25] Bloomberg Philanthropies. (2017, August) <https://www.bloomberg.org/program/government-innovation/india-smart-cities-mission>.
- [26] RavichandranPurushothamam, "Why urban efficiency is key for India's smart cities," 2016.
- [27] AdityaChunekar, S. Varshney, and Shantanu Dixit, "Residential electricity consumption in India," Prayas Energy Group, 2016.
- [28] A. S., Ahmed, "Purchase Behaviour Of Women Consumers Towards Energy Efficient Household," 2014.
- [29] Stewart Barr, Andrew W Gilg, and Nicholas Ford, "The household energy gap: examining the divide between habitual- and purchase-related conservation behaviours," Energy Policy, vol. 33, no. 11, pp. 1425 - 1444, 2005.
- [30] Mark R. Gleim, Jeffery S. Smith, DemetraAndrews , and J. Joseph Cronin Jr., "Against the Green: A Multi-method Examination of the Barriers to Green Consumption," Journal of Retailing, vol. 89, no. 1, pp. 44 - 61, 2013.
- [31] T., Dietz, G. T., Gardner, J., Gilligan, P. C., Stern, and M. P. Vandenberg, "Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions.," in Proceedings of the National Academy of Sciences, 106(44),, 2009, pp. 18452-18456.
- [32] Nadia Ameli and Nicola Brandt, "Determinants of households' investment in energy efficiency and renewables: evidence from OECD household environmental behaviour and attitudes," Environmental Research Letters, April 2015.
- [33] Accenture, "Sustainable Energy for all," 2010.

- [34] Linda Steg, "Promoting Household energy conservation," *Energy Policy*, pp. 4449-4453, October 2008.
- [35] Mohit Jain, Deepika Chhabra, Jennifer Mankoff, and Amarjeet Singh, "Energy Usage Attitudes of Urban India," in *Proceedings of the 2014 conference ICT for Sustainability*, 2014, pp. 208 - 217.
- [36] Madhavi Indraganti, Ryozo Ooka, and Hom. B. Rijal, "Thermal comfort in offices in India: Behavioral adaptation and the effect of age and gender," *Energy And Buildings*, vol. 103, pp. 285-295, 2015.
- [37] U., Al-mulali, H. G., Fereidouni, J. Y., Lee, and C. N. B. C. Sab, "Exploring the relationship between urbanization, energy consumption, and CO2 emission in MENA countries.," *Renewable and Sustainable Energy Reviews*, 23, pp. 107-112, 2013.
- [38] O. J., Mei, K. C., Ling, and T. H. Piew, "The antecedents of green purchase intention among Malaysian consumers.," *Asian Social Science*, 8(13), p. 246, 2012.
- [39] J., Bull, "Loads of green washing—can behavioural economics increase willingness-to-pay for," *Energy Policy* 50, , pp. 242-252, 2012.
- [40] K.S., Parikh and J.K. Parikh, "Realizing potential savings of energy and emissions from efficient appliances in India," *Energy Policy*, pp. 102-111, 2016.
- [41] Soma Bhattacharya and Maureen L. Cropper, *Options for Energy Efficiency in India and Barriers to their Adoption*, 2010, Discussion paper.
- [42] J.P. Painuly Reddy and B. Sudhakara, "Electricity Conservation Programs: Barriers to Their Implementation," *Energy Sources*, pp. 257-267, 1996.
- [43] D. B., Wooten and A. Reed, "A conceptual overview of the self-presentational concerns and response tendencies of focus group participants," *Journal of Consumer Psychology*, 9(3), pp. 141-153, 2000.
- [44] Terry Bristol and Edward F. Fern, "The Effects of Interaction on Consumers' Attitudes in Focus Groups," *Psychology and Marketing*, pp. 433 - 454, 2003.
- [45] M Held, "Social impacts of energy conservation," *Journal of Economic Psychology*, pp. 379-394, 1983.
- [46] M. E Olsen, "Public acceptance of consumer energy conservation strategies," *Journal of Economic Psychology*, pp. 183-196, 1983.
- [47] Fred A. Curtis, P. Simpson-Housley, and S. Drever, "Communications on energy Household energy conservation," *Energy Policy*, pp. 452-456, 1984.
- [48] David Robinson and Julia Silge, *Text Mining With R.: O'Reilly Media Inc.*, 2017.
- [49] Wikipedia. (2018) Wikipedia.[Online]. [https://en.wikipedia.org/Concordance AnkeLüdeling and MerjaKytö, Corpus Linguistics: An International Handbook](https://en.wikipedia.org/Concordance_AnkeLüdeling_and_MerjaKytö_CorpusLinguistics:_An_International_Handbook). Berlin: Walter de Gruyter GmbH & Co., 2008.
- [50] Christopher Andrew Bail, "Combing natural language processing and network analysis to examine how advocacy organizations stimulate conversation on social media," *Proceedings of the National Academy of Sciences*, vol. 113, no. 42, pp. 11823 - 11828, 2016.
- [51] David Robinson Julia Silge, *Text Mining with R: A Tidy Approach.: O'Reilly Media*, 2017, vol. 83.
- [52] S Yang, FB Keller, and L Zheng, *Social network analysis: methods and examples.:* Sage, 2016.