VIDYUTRAKSHAKA

A CITIZEN INITIATIVE FOR SAVING ELECTRICITY IN HOUSEHOLDS

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ABSTRACT

Much of the expected benefits from demand side energy efficiency interventions are determined by end-user behaviour. Yet, the behaviour dimension of energy use and consequently the actual impact of efficiency programs is least understood globally. In India too there is limited empirical research done to understand how households use electricity and motivating factors for people to conserve or use energy efficiently.

Conceptualized as a citizen-led program to reduce electricity consumption in Bangalore, VidyutRakshaka (VR) was able to demonstrate a 16% reduction in monthly electricity consumption of about half of the participating households in a pilot over a period of six months. Analysis based on historical consumption trends shows that VR is able to shift households with increasing consumption trend to saving electricity. VR primarily worked by creating awareness, conducting energy consumption assessments, providing customized recommendations to save primarily through behaviour change followed by switch to efficiency measures. Resources were provided to the participants to overcome key information barriers. To drive behaviour change, VR adopted a peer / neighbourhood benchmarking approach to drive positive influences.

VR has demonstrated a successful demand side management initiative in electricity consumption. Its unique strengths are building capacity in local communities through one- on- one customized engagement and leveraging social / community influences. Our paper discusses the approach used under VR to engage with citizens, the data and the implications and strategies for a scale-up.

INTRODUCTION

Electricity is a critical energy source for any nation and its link to social wellbeing and thus the link to development has been well established (WEO, 2004). However, electricity generation is a large contributor to GHG emission and hence optimisation of production options is part of global agenda to counter climate change (Herring et. al., 2009). Energy sector contributed to about 71% of India's greenhouse gas (GHG) emissions in 2010 (MOEF report, 2015). Further, while electricity is positioned as a tool to alleviate poverty at the nation level, one cannot ignore the issues of *intra-country equity* in consumption standards. Dharmadikary and Rutuja in their report on assessing energy needs for a decent living conclude:

".. two conclusions are that we have to evolve more sustainable means of generating energy and that an equitable distribution of energy (at global and other levels) will probably be a necessary condition for sustainably meeting the energy needs of all for decent living."(Dharmadikari and Rutuja, 2015)

Human Development Index (HDI) computed by UNDP considers Universal access to electricity as one of the contributing factors. However it can be inferred that increasing consumption beyond a minimum threshold level of electricity does not contribute to increase in HDI. On one side India will need to strive and provide electricity access with minimum consumption (to meet the aspirations of decent living) to every citizen and on other side moderate the consumption levels of the rich and growing middle class, which is primarily an urban phenomenon.

The other key unanswered question in electricity distribution is arriving at the threshold for decent living and well being. While Dharmadhikary and Rutuja (2015) advocate a disaggregated approach for energy planners to address this gap, the infrastructure of electricity supply, distribution and current technologies may be serious limiters in providing enough planning data for micro level planning. Social consensus on understanding these limits is almost impossible in the given situation.

In addition to the generation and distribution exclusion, understanding economic exclusion is equally critical. Lowering of economic barrier to consumption can lead to unsustainable levels of consumption while continuous increases of tariff block the capacity of the underprivileged to even meet their needs. This balancing of optimal economic cost is another challenge.

UNDERSTANDING ELECTRIITY CONSUMPTION

Sustainable consumption is as significant if not more, compared to generation and distribution of electricity. Aspirations related to ownership of appliances have both critical use (falling under "necessary consumption" which positively correlate to wellbeing) and non-critical use (falling under "want based consumption"-which represents aspirational needs of the society). Non - critical consumption in addition to meeting needs of perceived well-being is also part of the process of identity formation, social distinction, cultural meaning and has aspirational value (Jackson, 2005). These two streams have to be addressed separately as well as in a differentiated manner, when it comes to any conservation effort.

Dietz's study (Dietz et al, 2009).highlights the different behavioural plasticity (understood as ease in eagerness to adapt/ change) for various categories of household electricity conservation efforts in US household. The challenge of identifying plasticity in behaviour for various electricity consumption actions, is not uniform across communities. Nudging consumers to replace assets with efficient ones through incentives has the highest adaptation possibility (High plasticity), while adaptation of non incentive driven assets have a low plasticity. Herring et. al. while critiquing the approach of efficiency ignoring the "rebound effect"[1], argue that sufficient attention is not paid towards sufficiency[2], which can lead to long term benefits (Herring et. al., 2009, PP-16). Herring et. al. in their observation on public policy on rebound effect, highlight the unwanted feedbacks developing out of policy incentives, if not thought through sensibly. (Herring et. al., 2009, PP-195).

UNDERSTANDING COMMUNICATION

Communication is the most effective tool in soliciting citizenry cooperation and participation for initiating a behaviour change as well as to sustain it. Anca et al (2012) in their report for European energy commission highlight various types of communication which help in energy savings.

Table ES.1 Potential energy savings due to measures targeting behaviour

Intervention	Range of energy savings
Feedback	5-15 %
Direct feedback (including smart meters)	5-15 %
Indirect feedback (e.g. enhanced billing)	2-10 %
Feedback and target setting	5-15 %
Energy audits	5-20 %
Community-based initiatives	5-20 %
Combination interventions (of more than one)	5-20 %

Figure 1: Behavioural change interventions proved effective for energy savings (Anca-Diana (EEA), 2012)

In another study, Fischer on the role of feedback on household electricity consumption gives two reasons for sustainable electricity consumption behaviour not coming into prominence for an individual. First, invisibility of consumption does not allow a consumer to be on top of the consumption in the absence of a feedback. Secondly, the nature of centralised electricity generation does not present the ecological damage to the consumer for a moral appeal. (Fischer, 2008).

There are very limited studies available on learning from programs addressing conservation efforts for electricity among residential consumer in India. Behaviour change experiment in a small community in Mumbai followed a novel method of printing smiley face and frown face on electricity bills for those lower and higher than neighbourhood average respectively (Behavioural design, 2014). It demonstrated that the intervention group started reducing their consumption, proving social influence does play a role.

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[1]A empirical observation where technology driven efficiency leads to increase in overall consumption of certain goods and services, like fuel , electricity.

[2] Defined broadly as limiting the consumption of goods and services either to better satisfy personal desires such as health or meaningful work or to contribute to collective goals such as long-term environmental sustainability (Herring et. al., 2009,PP-16)

VIDYUTRAKSHAKA (VR)

Given that the peak deficit in electricity supply keeps increasing (at about 70 GW in 2017), McKinsey & Company's report 'Powering India – The road to 2017' recommends that 'Adding capacity alone will not suffice as a response to India's soaring demand for power' and suggests to 'Create an action plan for an over 10% gain from Demand Side Management'.

Figure 1 shows the increasing demand supply gap in electricity as reported by Karnataka Electricity Regulation Commission (KERC) in 2014.

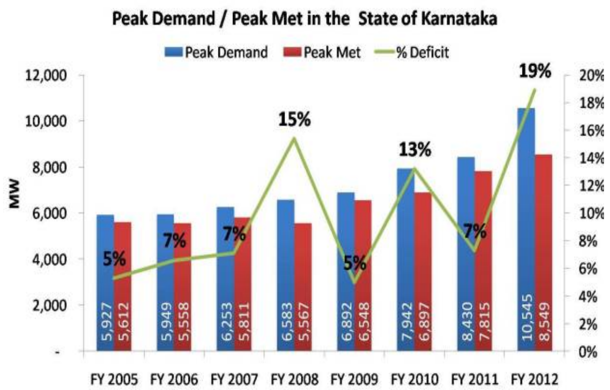

Figure 2: Demand supply gap in Karnataka, KERC 2014

In response to this need for driving electricity conservation from the demand side, and the glaring gap in data based evidence on household electricity consumption in the country, the VidyutRakshaka (VR) program was conceptualized. VR promotes and facilitates active citizen participation in not only electricity conservation effort but also to contribute to data driven models to understand disaggregated behaviour on consumption.

Programs like VR can contribute to electricity conservation efforts by nurturing aware citizenry with no negative implications. In fact, such programs will also reduce the burden (financial and otherwise) on the utilities to manage such demand side conservation programs (Vskv Harish et al, 2014). The disaggregated data thus collected will be a useful planning input which can optimise India's Energy plan towards a low carbon society.

VR attempts use of communication as a primary tool for initiating and sustaining change. A detailed data based logical appeal of individualistic nature is designed to initiate change while feedback processes are meant to enforce sustainable change. VR also attempts to address spatially differentiated community behaviours and individual attitudes towards electricity conservation. .

This paper discusses the approach used in VR to engage with citizens, the experiences in implementing this program, the outcome, and strategies for scale-up.

COLLABORATION WITH THE UTILITY SERVICE PROVIDER

A 2014 article looking at action plan, policies and regulations of DSM in India lists barriers for DSM program and suggests that collaboration between utility driven and non-utility driven programs can overcome some of these barriers (Vskv Harish et al, 2014).

The VR program was conceptualised as a collaborative effort with the utility's perspectives also contributing. The Utility has been sharing the historical consumption data of participants who have signed up for the program. Results are periodically shared with the utility for feedbacks and improvements.

CHOICE OF BANGALORE AS PILOT LOCATION FOR VR

The statistics for South Indian states reflect the increasing trend in demand supply gap. As per A. Gangopadhyay et al (2016) from National Institute for Advance Studies, the average energy deficit in Karnataka went up from 2% in 2006-07 to 10% in 2014-15, touching 20% in the summer month of April. It is projected to touch 17% in 2022. Bangalore consumes about one third of state's total power and this was pegged at 2300 MW or 42 Million units per day in 2012, with the demand supply gap ranging from 0 to 600 MW through any average day. Households form 77% of BESCOM consumers and contribute to 22% of electricity sales (KERC, 2014).

VidyutRakshaka phase I was launched for households in Bangalore, in two different localities – in Malleswaram, a locality in North east of Bangalore and a gated community south west of Bangalore.

The chosen two localities are demographically different in many aspects, including the history, development, culture and profession. Malleswaram is an old residential area populated with independent houses or low rise apartments. The area also represents a variety of socio-economic status with houses ranging of 1 to 4 + BHK (Bedrooms per households), which is representative of the size of house as well as the varied class of residents. Residents in Malleswaram are old timers having born and brought up in that area. On the other hand, the chosen layout in Sarjapur is only about a decade old, with independent houses occupied by residents working mostly with corporates, many of whom having moved to Bangalore for jobs. The houses range from 2 BHK to larger ones. This community is represented by a single association which manages their common amenities. Incidentally this community was one of the first to achieve rainwater harvesting in all households and were reusing all their sewage treated water for ancillary usage. The ecological awareness in this community is perceivably higher than Malleswaram.

By choosing these areas we expected VR to generate varied data points (disaggregated) for analysis of electricity consumption behaviour.

VR METHODOLOGY

The VR methodology can be summarized in distinct steps detailed in Figure 1 which are explained in sections below.

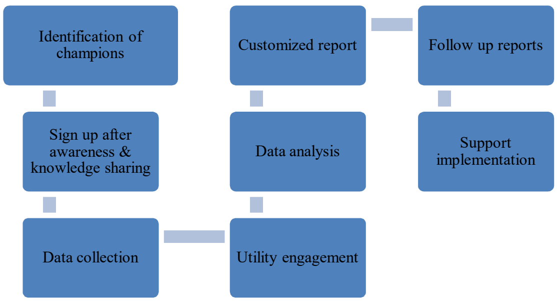

Figure 3: VR Methodology

Identification of champions and stewards: In Phase I of VR, we have signed up about 525 participants (households) from the two localities. The households within these localities were not selected as random samples or on the basis of any pre-defined economic or consumption criteria, but through a process of mobilisation through champions. The champions were meant to be residents from the community with record in active civil society representation or acted as evangelist for the cause of conservation and have a pull in the community.

As the program evolved, VR had good success in engaging with institutions and stewards as champions meeting the same criteria of active social engagement. For Phase I, for the gated community in Sarjapur, the Resident Welfare Association (RWA) played the role of the champion along with some of their members, while in Malleswaram, CSOs like Malleswaram Swabhimana Initiative, Rotary Club, Inner Wheel, Lions Club, Nightingale Club, and the local branch of the utility service provider BECOM acted as champions.

TIDE used trained youth (called Stewards) to act as champions, particularly in Malleswaram area, and also to do the sign ups and the survey. These stewards were picked up from places like vocational training institutes and local NGOs. They were given training in need for and aspects related electricity conservation, about VR methodology apart from soft skills. Going beyond sign ups, VR was able to bring interesting transformation in the stewards, in their outlook towards career advancement and environmental conservation.

Sign up after awareness and knowledge sharing: Whether to the champions or others, the appeal to join VR was in two streams, one economic (monetary savings as incentives) and second moral, an obligation to society at large and sustainability of well- being.

A pitch was used giving the background on the need for an electricity conservation program. This highlighted global, national and local concerns like GHG emissions, Energy poverty and inequality in the country, Demand supply gap in Bangalore among other points. To appeal on economic front, the rising cost of electricity and saving potential through nil cost, low cost and higher cost investments were highlighted.

During the sign up, each participant was given an awareness booklet with generic but detailed recommendations to save electricity in different consumption category. The booklet gives tips to save electricity, along with quantitative data on pay back where possible.

Data collection: After the sign up, stewards were deployed to collect baseline data. In Phase 1, this involved two components:

a) Electricity bill data for the past one year

b) A questionnaire was used to capture behaviour, asset ownership and usage patterns of electricity consumption in each house hold.

While most participants answered the questionnaire, it was a challenge to get electricity bill data for more than a few months at the most.

Utility engagement: As Phase I was proceeding to the data analysis stage, the local utility service provider BESCOM was informed about the VR program which immediately recognized it as a worthy initiative. An NDA was signed for data sharing. This enabled us to get historical consumption data for participants (after obtaining their No Objection). In return TIDE has committed to sharing the data analysis and the outcome of the VR program.

Data analysis: The data on consumption and usage were collected and processed in excel for locality wise analysis in different BHK categories. The consumption was looked at on a per month basis and a per capita basis (based on occupancy details shared by the participants).

The VR methodology uses three distinct novel self learning models to drive the behaviour change and switch to EE interventions.

a) Ideal model
b) Neighbourhood model
c) Historical model

While the first two are aggregated models, the third one is specific to each participant. And out of these three models, the neighbourhood and historic models were used for both per month average and per capita average consumption analysis.

Ideal Model:

While the Ideal model is city specific and remains the same for both the localities, it is different for each of the BHK category. It is built for a particular standard of living in a city for each BHK, building ideal electricity consumption across five usage categories namely Lighting, Heating, Cooling, Appliances and Entertainment. This model is built to be iterated, to self-learn and improve with actual consumption data from participants. Each participant's consumption is analysed under these categories and slotted as ABOVE or BELOW the IDEAL MODEL.

Neighbourhood model:

Among the myriad factors influencing household electricity consumption, Normative Social Influence is found to be playing a definitive role. Thus advising consumers that people similar to them (e.g., peers, neighbours) are using *less* energy or taking certain energy-saving actions, in addition to conveying social approval of such actions, will likely motivate them to conform to these positive 'energy saving' norms and reduce their consumption (Fredericks et al, 2015).

Thus a neighbourhood model was built for the two participating localities to bring in the local context. For each neighbourhood, the actual consumption data of the households was analysed BHK wise and distribution of consumption was plotted. A benchmark or average was computed after removing outliers. Each individual household's consumption was then compared with this neighbourhood distribution in the respective BHK category and was slotted as ABOVE, BELOW or AT NEIGHBOURHOOD MODEL.

Historical Consumption model:

With data available for most of the participants from December 2012 from BESCOM, a historical consumption model was built for each participant to catch the trend in their consumption. While providing a powerful insight for the individual consumer, at the aggregated level, it also gave evidence on how electricity consumption is changing (rising) year by year.

With the VR initiative as base timeline, historical data of 12 months prior period was used to create the pre VR category and 12 months subsequent to VR data was used for Post VR category.

Households whose trend of consumption when analysed monthly tended to be decreasing were categorised as savers and those whose consumption trends increased were categorised as spenders. The household where clear trends could not be observed from the data were termed inconsistent.

On this basis, five distinct shifts in consumption were observed as explained in Table 1.

Table 1: Characterization based on historic consumption trend

Category	Description
Consistent Savers	Pre VR Saver : Post VR Saver
Savers to Spenders	Pre VR Saver : Post VR Spender
Spenders to Savers	Pre VR Spender : Post VR Saver
Consistent Spenders	Pre VR Spender : Post VR Spender
Inconsistent	Keeps fluctuating , no consistent trend

Customized report with Characterization of participants: Using the models described above, while considering both monthly average and per capita levels helped arrive at a community level consumption benchmark for each BHK within the locality.

- Energy Savers (consuming below the community average)
- Energy Champions (consuming within +/- 5% of the average)
- Future savers (consuming above average)

It was deliberately decided to go with the lowest category if and when there is a conflict between per month and per capita consumption. This was done so as to provide an impetus to the participant to push to lower consumption where possible. This approach also removes the bias which can occur with very high or very low occupancies.

A customized report was generated for each participant which lists the characterization as described in previous section. This is followed by a detailed analysis of consumption based on the different categories of usage, described her as 'Usage category'. For each of these usage categories (lighting, etc), a comparison against ideal model was provided along with customizations applicable for that household were given for saving.

Some level of prioritization was also done while giving recommendations, starting from simple but effective ones to those requiring investments. While customizing recommendations based on the participant's usage, his or her preference for No cost, Low cost and High Cost interventions was also taken into account.

The report finally set a goal for saving for every participant, derived from either of the following:

- Different between average and participant consumption based on neighbourhood model or ideal model whichever value was the higher, and limited to 30 units
- Since BESCOM follows slab based billing, reduction to lower slab reduces the electricity bill considerably. To highlight this, difference between units consumed and units under the last tariff slab was given as the goal for saving for those households which exceeded the last slab by 30 or less units.

The threshold of 30 units was assumed so the goal is achievable with some simple interventions to begin with.

Apart from these, the report carried resource section on electricity saving and also a brief background on the analysis itself.

Follow up reports: About six months after the first report, a follow up report was generated for the participants after obtaining consumption data from BESCOM for the same participants. Their performance subsequent to the first report was analysed and status as 'Increased' or 'Decreased 'or 'Status quo'was arrived at.

Recommendations were reinforced where appropriate, to push for savings.

Support for implementations: VR is committed to provide product agnostic, knowledge led support for implementing recommendations. Based on the interest by the residents of the gated community a knowledge session on Solar PV roof tops was arranged with subject matter experts.

RESULTS AND DISCUSSION

The goals of the project were to

- Gather data based evidence on consumption patterns in households across different demographics in a city (Disaggregated consumption patterns)
- Explore energy reduction possibility through usage pattern changes, and introducing energy efficiency and renewable energy options where possible.

VR Phase I has succeeded in both and also brought out some very interesting data backed observations as detailed below.

- **VR has motivated participants to save and demonstrated that it is possible to take a consumer driven pathway to bring down consumption.**

Consumption data prior to VR and post VR shows a saving trend.

Total average monthly consumption in 452 households across different BHKs and in both the localities = 80,388 Kwh

We had estimated a Conservative saving potential through VR recommendations of 13711 Kwh

Actual saving seen in 6 months since program started = 13183 Kwh = 16.4%

252 out of 448 households reduced their consumption in the 6 months after receiving the report, as proved by consumption data.

- **VR provides evidence on differentiated or disaggregated consumption justifying differentiated planning for conservation.**

Spread of consumption among the two localities shows a trend where Malleswaram households are distinctly on the lower side of the consumption (Figure 4).

And among the same BHK category, one neighbourhood shows higher average (or benchmark) than the other as seen in Figure 5. As the size of households increase (1 BHK to 4 BHK) the trends of consumption per capita is differentiated, which can be seen in Figure 6.

It is also seen that the behaviour of the two localities varies with respect to the categories of electricity consumption, viz, Lighting, Heating, Cooling, Entertainment and Appliances are also very different, as illustrated in Figures 7 and 8.

This kind of behaviour trend brings out the need for a differential and customized community wise appeal for saving rather than fixed thresholds. Flexible community wise averages passively shared (through characterization) with a conservative appeal is probably more practical.

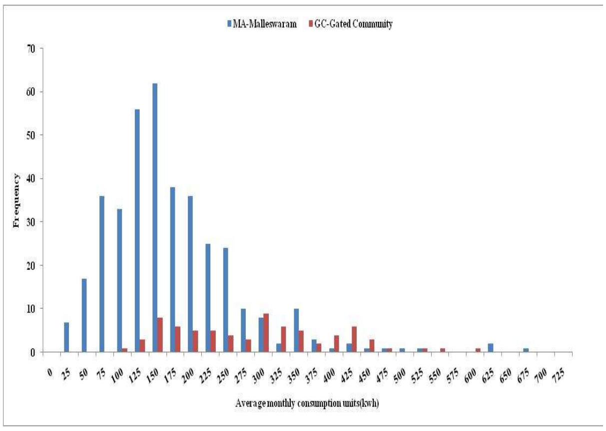

Figure 4: Spread of consumption in the two pilot localities

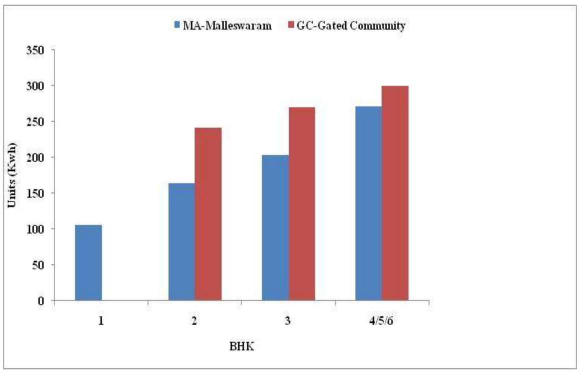

Figure 5: Average monthly consumption trend among the two pilot localities

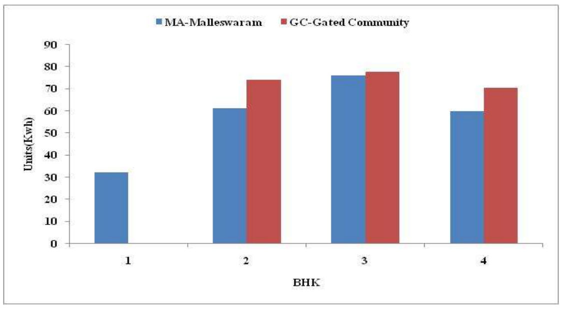

Figure 6: Per capita consumption trend amont the two pilot localities

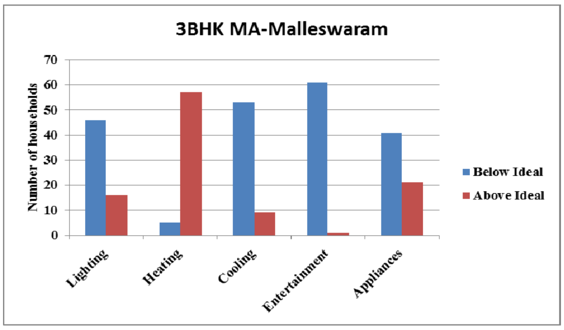

Figure 7: Usage wise consumption in Malleswaram against Ideal model

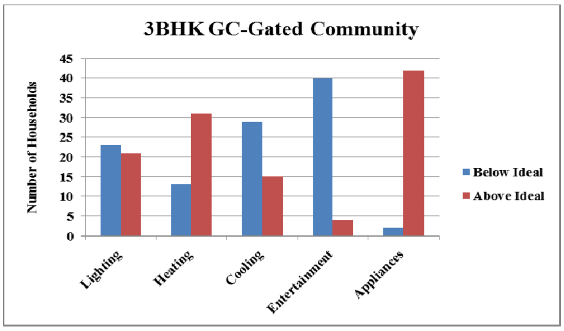

Figure 8: Usage wise consumption in Gated commu ity against ideal model

- **VR has influenced shifting consumption behaviour**

While analysing the historic trend in consumption for the participants, it was found that about 10% of the participants (42 numbers) appear to have shifted their historical behaviour of increasing consumption year by year to reducing consumption since signing up for VR**,** as shown in Figure 9.

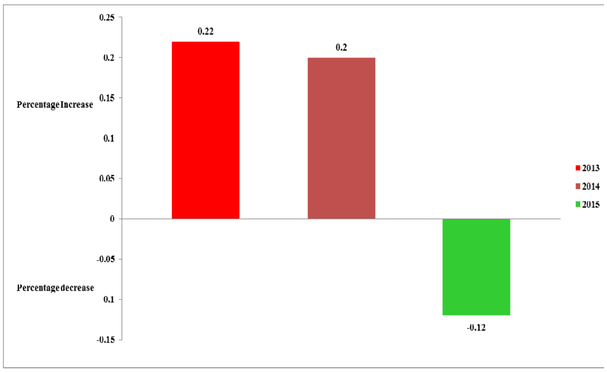

Figure 9: VR participants shifting consumption behaviour

- **VR may help to beat the trend in increasing consumption**

Though a steady rise in electricity consumption is expected and predicted for a developing country like India, VR shows an interesting possibility of arresting that trend, particularly with urban high end consumers. Figure 10 illustrates what should have been the consumption as per NITI AAYOG's prediction, and what actually was seen with VR participants.

In follow ups after Phase I after 6 months, it was found that about half of the participants are continuing in the same category of consumption (Energy saver or champion) which indicates lock-in. This however needs validation over a period of time.

A control group comparison is also being planned to validate direct impact due to the program.

CHALLENGES AND LEARNING

Closing feedback loop remains a challenge in VR in terms of understanding what led to the actual saving. The upcoming mobile app can capture this to some extent allowing the user to input such details.

It is expected that at the start of the program, a fair amount of savings may be achievable through behaviour change or low cost investments. But for the savings to sustain in spite of growing aspirations and rising tariffs, it would be essential to push participants to invest in energy efficient appliances and renewable energy solutions. Also constant engagement will be required till conservation habits are formed.

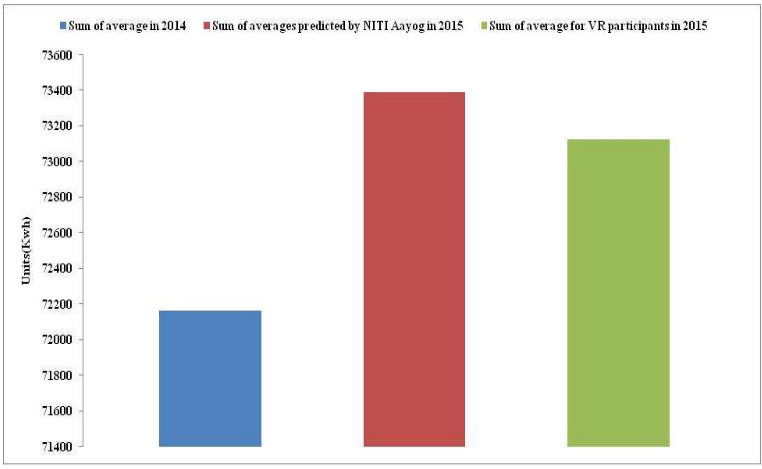

Figure 10: VR participants deflecting NITI Aayog predicted rise

IMPACT

VR's unique strengths are in building capacity in local communities through one- on- one customized engagement and leveraging social / community influences, ideas recommended for electricity conservation through behaviour economics.

By creating awareness and providing knowledge at individual and community level, VR is bridging the invisibility aspect of electricity consumption. Repeated communication over long period reinforces low plasticity behaviours thus attempting a sustainable change.

While implemented as a non-utility driven program, VR has sought active collaboration from the utility service provider. The exchange of data and knowledge will further strengthen the DSM initiatives BEE is advocating through ESCOMs.

While the program goals are focused on electricity conservation, the execution methodology has many other social dimensions as detailed below.

- The stewards deployed in the program are from the under privileged section who are provided training, including life skills which are helping them in aspiring and securing a good career in an urban set up.
- Introduction of VR to schools has helped create awareness among children while roping in those households as participants.

POLICY IMPLICATIONS

For several decades, energy efficiency program designers have relied on awareness generation and information campaigns to change consumer attitudes towards energy conservation and energy efficiency. However changing attitude does not necessarily lead to changing behaviour. Understanding behaviour of different categories of energy consumers is the key to determining options for shifting consumer behaviour in the desired direction.

Policy interventions based on behaviour: Fredericks et al. (2015) comprehensively reviewed the behavioural psychology of energy consumers and found that consumer behaviour is irrational but predictable despite the economically viable choices offered. They concluded that there are policy implications from this research and lessons learned that can be applied to identifying scalable, practical and cost-effective solutions for encouraging clean energy choices. They identified several policy recommendations from behaviour focussed program interventions, some of which emerged from VR also.

Simplification- As the complexity of information given to them increases, the likelihood of consumers to optimal decisions reduces. Consumers then tend to make satisfactory or ''good enough'' decisions for meeting minimum requirements. This may lead to perverse outcomes or avoiding action all together. Simple programs that reduce time in making decisions, minimize physical and psychological demands and perceived uncertainty will help achieve better results.. In VR, customized recommendations provided to each participating household helped build familiarity and ownership with the program.

Social influence- Social normative information that tells consumers that people similar to them are using less energy or taking energy saving actions has been found to improve efficacy of energy conservation programs. In VR also consumers were presented with data comparing their electricity bill with their neighbours or peers which resulted in energy savings.

Shifting from the status quo- Consumers tend to stick with the status quo than make decisions that otherwise make economic sense. VR provides several impetus to shift the behaviour and it has succeeded also.

Community engagement- Engaging neighbourhoods in highlighting collective outcomes of energy conservation programs instils a sense of ownership. Acknowledging the efforts of individual consumers motivates and encourages people to do more. In VR, communicating the results of their participation helped build trust in communities.

Role of utility: VR demonstrates that DSM programs need not always be utility driven or expensive to do. But scalability of VR interventions improves with utility involvement. We are exploring options with the uitiltiy for monitoring, validation and particularly on-time feedback, say along with the bill itself .

In India, residential energy consumption data is not collected systematically and is limited to insights gathered through utility commissioned load analysis studies. While such studies help utilities estimate quantity and timing of demand, they do not offer advice on specific end-uses to target. Data collected under VR provides recommendations on hitherto less-understood characteristics of end-uses dependent on consumer behaviour. Combination of quantitative data on consumption parameters and qualitative data on behaviour can be an asset for utilities to design Demand Response programs.

We expect that results from phase 2 of VR will provide additional policy recommendations.

WAY FORWARD

Phase II of VR is already under execution with goals to

- Expand the foot print of VR I to a large set of participants across communities and across cities
- Demonstrate sustained savings with participants through follow up and support for implementations, particularly in EE and RE.
- Automate data analysis and report generation to minimise errors and improve efficiency. A mobile app is also being developed to deliver live reports to participants and give access to knowledge resources.
- Eco system sensitization and capacity building through awareness and training programs.

We will also be looking to grow our association with the Utility service provider and use VR data to suggest consumer engagement strategies driving demand side management.

CONCLUSION

VR builds on the premise that that energy conservation is a prerequisite for energy efficiency. It corroborates and provides evidence on understanding and addressing consumer behaviour in DSM programs. It has laid the foundation for policy and regulatory support through involvement of utilities.

Programs like VR that provide insights into behaviour towards electricity use are helpful in designing policy and program based solutions that focus on messaging and designing the right type of incentives to shift human behaviour.

Finally we want to highlight the fact that the unchecked electricity consumption in the residential sector cannot be ignored from a climate and resilience perspective.

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REFERENCES

Anca-Diana Barbu (EEA) et. all ,Achieving energy efficiency through behaviour change: what does it take?;European environment agency,2012

Behaviour design, 2014: http://www.behaviouraldesign.com/2014/08/26/people-power-our-second-behaviour-change-experiment/#sthash.3rjEse9E.ZR1ZzQwx.dpbs

Dharmadhikary Shripad, Bhalerao Rutuja, "How much energy do we need (towards end us based estimation for a decent living)". Prayas Energy group, 2015

Dietz, T., Gardner, G. T., Gilligan, J., Stern, P. C., &Vandenbergh, M. P. (2009). Household actions can provide a behavioural wedge to rapidly reduce US carbon emissions. Proceedings of the National Academy of Sciences, 106(44), 18452-18456.

Elisha R. Frederiks, Karen Stenner. Elizabeth V. Hoban. "Household energy use: Applying behavioural economics to understand consumer decision-making and behaviour". Renewable and Sustainable Energy Reviews, Volume 41, January 2015, Pages 1385-1394

Gangopadhyay, A. Sampath, B. Velury, D. P. Sen Gupta and D. R. Ahuja. "Wind and solar energy for reducing electricity deficits in Karnataka". Current Science, Vol 111, No5, 10 September 2016

Harish, Vskv and Arun Kumar, 2014. "Demand side management in India: Action plan, policies and regulations." Renewable and Sustainable Energy Reviews 33:613-624

Herring, Horace, Steve Sorrell, and David Elliott, eds. "Energy efficiency and sustainable consumption: the rebound effect". Basingstoke: Palgrave Macmillan, 2009.(Chapter 8 and 11 - "Rebound effects and consumption pattern"

IEE, World Energy Outlook (WEO), 2004

Jackson, Tim. "Motivating sustainable consumption: a review of evidence on consumer behaviour and behavioural change: a report to the Sustainable Development Research Network." Centre for Environmental Strategy, University of Surrey, 2005.

Ministry of Environment, Forest and climate Change, Government of India, "India First Biennial Update Report to the United Nations Framework Convention on Climate Change". 2015

McKinsey, "Powering India – the road to 2017". http://www.mckinsey.com/~/media/mckinsey%20offices/india/pdfs/powering_india_the_road_to_2017.ashx

UNDP.(2013). "Human Development Report 2013" .New York: United Nations Development Program