Demand Side Management in India: Status & Future Prospects.

Summary Report of Workshop Proceedings

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Contents

Introduction

IIT Bombay organised a workshop on Demand Side management in conjunction with and the support of Shakti Sustainable Energy Foundation (SSEF). A representative group of 32 experts and officials from state electricity regulatory bodies, utilities, ESCOs and academia attended the event. The workshop was designed to be interactive and to stimulate conversation and exchange of ideas across the different groups. A number of panel discussions were conducted to address the challenges facing large scale deployment of DSM programs. Sessions participants were encouraged to pose solutions and identify the next steps forward. The concept note sent to the participants is available in Annexure 1.

The workshop was inaugurated by **Prof. Santanu Bandyopadhyay**, Head of Department, Department of Energy Science and Engineering, IIT Bombay. He gave a brief introductory talk about the department and the undergoing research activities.

Prof. Suryanarayana Doolla briefly mentioned the key objectives of the DSM project in which IIT Bombay is currently involved, in association with Shakti Sustainable Energy Foundation. He enumerated capacity building along with landscape and technology assessment as the major research themes of the project.

Ms. Natasha Bhan gave a brief introduction about Shakti Sustainable Energy Foundation (SSEF) and its activities. She mentioned that SSEF has been active in the space of clean energy for a period close to four years now. It aids design and implementation of policies that promote efficient use of existing resources and at the same time promote the development of new cleaner resources. The areas of work include DSM, renewable energy and improving energy access through cleaner resources, energy efficiency in appliances, industries, buildings and transportation. In DSM, the foundation works both at state level and at the national level. At national level, the foundation is working with BEE and central

regulator on designing the programs that would actually mark the transition to MW scale in DSM implementation in the country.

Panel 1: Experiences of Distribution Companies and Utilities

Panelists:

- Mr. Pramod Deo, Reliance Infra.
- Mr. Dinesh B. Biwalkar, BEST.
- Mr. Rajib Kumar Das, CESC.
- Mr. Shekhar Khadikar, Tata Power.
- Prof. Suryanarayana Doolla, IIT Bombay (Moderator).

The purpose of this panel discussion is to get insight into the perspective of DISCOMs about the potential, status, barriers, and possible solutions in regard to DSM in Indian context. The following questions were given a priori to the panelists:

Questions:

- What DSM programs have you tried? What are the successes and failures? What are the lessons learnt?
- Are there any technical and manpower constraints involved? What are they?
- What is the transaction costs involved for different DSM programs? Is the amount of these costs known?
- Are there any financial barriers involved?
- Is information regarding DSM (DSM cell, Programs implemented or ongoing) available on public domain?
- Do we have roadmap /strategies to go from Pilot to Large scale DSM programs?

Mr. Pramod Deo, Reliance Infra.

Reliance Infra, Mumbai distribution, covers an area of 400 Sq.km serving roughly 2.9 million customers with maximum system demand of 1,697 MVA and total energy sales of 7,448 MU. It is committed to encourage energy conservation and energy efficiency practices amongst employees and customers. It has pursued many DSM pilots with an objective to create awareness amongst the target customer base on the benefits of 5 Star /EE Appliances and to remove barrier to purchase of such appliances.

A CFL program was launched in FY 2006-07 in collaboration with M/s Bajaj Electricals during which energy saving CFL with cost Rs. 165 was offered at a discounted price of Rs. 63 with the provision for payments in instalments. The program had a consumer participation of 2.05 lacs with 6.17 lacs CFLs sold and savings till date add up to 38 MU. Capacitor installation program was done with small and medium scale commercial and industrial consumers in FY 2010-11. This was a bulk volume installation program and negotiations were done with two capacitor manufactures to install the capacitors at customer's establishments. Other DSM pilot projects implemented by Reliance Infra include 5 star ceiling fans, 5 star split ac program and 5 star refrigerator program.T5 FTL program that could not take off due to the high end specifications regarding power factor and THD in the tender contract. Reliance Infra has also gone for automation in air conditioning through smart end use management system in association with M/s Amplebit energy. The program has a target capacity of 2500 TR with target savings of 1.3 MU.A Street light

conversion program was also implemented in FY 2008-09 during which HPMV (125W) lamps were replaced with 70 W HPSV lamps leading to savings of 16.8 MU. Energy audit scheme was also launched in FY 2008-09 targeting commercial and industrial consumers. Program cost is shared between the utility and customer on a 75 to 25% basis. Even 25 % was also waived off if customer adopted 50 % of the recommendations of the energy audit. Surveys were conducted by a third party marketing agency at locations were test pilot was implemented.

Poor response from manufacturers is a big issue. Generally the cost of products, offered under a DSM program, is lower than their usual market price and hence the manufacturers or vendors fear that this cost may become the declared price for the product in future and thus making it difficult to sell their product later at market price. Other issues and findings can be found in the presentation in Annexure 3.

Mr. Dinesh B. Biwalkar, BEST.

DSM cell was established in BEST undertaking in the year 2008. Best has a LMC (Load Management Charge) fund that it utilizes for DSM activities with approval from MERC. BEST being a public utility is currently facing procedural delays in launching the MERC approved DSM pilot programs. Current status and other details of DSM pilot projects like EE 5 star ceiling fan program, 5 star split AC program and T5 FTL program, undertaken by BEST are described (details in the slides (Annexure 3)). A thermal storage demonstration project of 5 TR capacity is under observation. On success of demonstration project, one more 5 TR capacity thermal storage unit installation in BEST premises will be considered. Thermal storage cost being Rs.

50,000/TR, the project fails to pass the cost benefit tests suggested by MERC and the recovery of investment is also low under the operational TOD tariff rates.

Mr. Rajib Kumar Das, CESC.

CESC is in distribution business since 1899 and serve 567 sq km area in and around Kolkata with customer base of 2.7 million. Intra State ABT (Availability Based Tariff) is in operation in West Bengal since 2008 and hence all stakeholders are required to submit day-ahead demand projections to the SLDC. This presents a challenge. Peak demand during summer is occurring at afternoon instead of the usual evening time due to the air conditioning load from domestic sector. This has posed problem for designing ToD tariff rates which earlier took into account evening time as summer peak. During other seasons, monsoon and winter, peak demand occurs during evening time. It is also evident from the load duration curve that the highest demand in the range of 1900MW is occurring only for few (say, 12 to 15) occasions. If these occasions can be managed well, a lot of Capex investment can be saved. Capex for thermal generating station is 5 to 6 crores (INR) and there is Capex for transmission and distribution which is no less than that for generation. This saved capital can be utilized to improve service quality to the customers. ToD tariff is optional to various consumer categories viz. Commercial, Industrial, Public Utility etc. There are three time zones for ToD scheme for Industry (06:00 to 17:00 hrs, 17:00 to 23:00 hrs and 23:00 to 06:00 hrs – Normal, Peak and Off-peak) and energy charge during peak is 50% higher than normal and 30% less during Off-peak).

As per directives from WBERC, CESC has taken up load research activities and encouraged energy audits at customer establishments. There is huge incentive for improving power factor for HT consumers and majority derive benefit by maintaining high power factor. Installation of capacitors was strongly encouraged by CESC, as well. Loss control is one of the most important areas of operation and there is regular active drive against theft of electricity. Programs are taken up to make consumer aware on theft of electricity. These activities over the years have yielded results and there is loss reduction - from 22% in 2000 to 12 % in 2012. There is a state of art metering in operation for street light supply- GSM based AMR, dawn and dusk controller, overload controller, remote switching are some of the technologies used for street lighting and its metering. The investment has been huge but it has proved beneficial for the utility as revenue has improved. There is also a drive to educate the customers through bills and one to one interaction in the area of energy efficiency. CESC believes that unless customers are properly informed about the energy efficiency measures, it is difficult to sustain such measures.

Load research activities have brought to light useful data about the demand in different load categories. Scope for power factor improvements has been identified during the study. Smart grid pilot feasibility study is being carried out and a demand response program is also under consideration. DSM investment is not much and can be placed before the Regulatory Commission for consideration. Total expenditure towards DSM initiatives, would be miniscule comparing to ARR. Challenge that lie ahead is identifying the right knowledge partner and/or DSM technologies.

Mr. Shekhar Khadilkar, Tata power.

Tata power has implemented many DSM programs in past 3 years. Most of these have been appliance exchange programs. Major concern for utilities in Mumbai is increase in morning peak and decline in load during night. Peak demand shortages are only during daytime and require importing power through exchange and renewable. Load drops drastically during

night time and this drop is more during nights in winter. Air conditioning load contributes mainly to the morning peak demand and Tata power has promoted thermal storage program with a view to shift this air conditioning load to night time.

Demand response program is also under implementation with participation from 60-70 consumers. DR program expects the consumers to voluntarily reduce its load during peak shortages, transmission line tripping, generator set tripping and when power purchase costs are high. Tata power sells the power at the same fixed tariff as it purchases it. Tata power has carried out about 18 DR events of 2 hours each where 16 MW of load curtailment is achieved. The participation to program is completely optional and customer can opt out any time. DR program is being run on an aggregator based model and consumer cooperation is used to run the program. Hence no investment is required in this model. An auto demand response program that requires installation of equipment for communication link between utility and customer has also been tried. Customers that participate for DR are mostly hospitals, shopping malls and five star hotels. They consider installing equipment at their establishments interferes with their functioning and hence do not want to give controls to the utility, even if the cost of installation is covered by utility. Manual DR Program has been found to be very economical and should provide the way forward.

Discussion:

The presentations were followed by a discussion session during which the following questions were posted to the panelists.

Questions:

- Last session had some excellent presentations about the experiences with the pilot DSM projects. Are DISCOMs doing it because they were mandated by the regulators?
- It was reported during the presentations that there is lack of interest by the manufacturers and communications issues with the consumers. Is it because of the lack of rebate or the lack of proper communication of information?
- What are the barriers that utilities are tackling? Are they targeting DSM at a right scale? Are these pilots merely few token projects or does the utility have the strategy to move to a larger target?
- Do they feel DSM not worthwhile in terms of cost? Is there a lack of information or does lack of incentives pose issues? What is the wish list in terms of how do the utilities like to scale up DSM? What are the barriers they are facing?
- What are the possible solutions that the utilities believe that doesn't reside with them but may exist with the regulators or ESCO's?

Mr. Dinesh Biwalkar mentioned that the huge penetration of CFL happened due to the low system voltage in interior, remote and town areas where conventional FTL are not functioning and of CFL's are functioning proper at those voltages. Although it lead to many neutral failure problems in rural distribution areas due to high THD level (30to 35%) of non-branded/non-standard CFL's, but it must be noted that understanding the consumer requirements and level of awareness could be a major step towards increasing the penetration of BEE labelled energy efficiency products in market.BEE should initiate 5 labelling for CFL to avoid non-standard products.

Mr. Pramod Deo mentioned that customers being not aware of the life cycle costing of energy efficient products and the payback period associated with it, some DSM programs have not witnessed good response. Moreover there is lack of interest from manufacturers as their products sale is already high. Since the rebate provided by the utilities is not communicated to the distributers by the manufactures leading to the price of the product offered through DSM programs becoming the declared price for future sale, thus discouraging manufactures to enrol in such programs and sell EE products to distributers. But of late, there has been market transformation and now manufactures have agreed to install and sell products directly without the involvement of distributers.

Mr. Dinesh Biwalkar stated that 5 star refrigerators have witnessed a better response than 5 star AC, reason being the labelling associated with the products. For 5 star refrigerators the labels clearly mention the amount of units saved per year while labels in case of 5 star AC mention the EER ratio which is not understood by the consumer. Dr. M.T. Arvind responded that since refrigerators are working on a 24 hours basis and domestic ACs are not, such labels do make sense. But he also suggested the need of some innovative marketing to promote such products as well. Mr. Pramod Deo added that there is a presence of grey market in case of domestic ACs that are inefficient and customers should be informed that such inefficient products consume more power and hence increase the electricity bill.

Prof. Rangan Banerjee mentioned that most of the programs implemented have been targeted to domestic sector and asked the panel their stand on targeting the commercial and industrial sectors where tariff is usually high and the issue of first cost associated with EE products is absent. He also asked the panel that if they believe in DSM meeting a significant part of their total future requirement of power and is it possible to design programs, not necessarily in form of rebate, for other

load segments as well. He stated that currently the DSM programs are being targeted at a very subcritical level, and if scaled up, manufacturers might be interested then.

Mr. Pramod Deo mentioned that the land cost being high in urban areas, the central AC plant is built where the area is not usable. Although there have been guidelines as per the EEBC but they are not followed at the new construction sites. If the HVAC is given priority while planning the architecture, the capacity can be significantly reduced and efficiency will also go up. Prof. Rangan Banerjee responded that if savings can be quantified through some case studies, it can form the basis for scaling up and deciding the issues associated with the HVAC programs. Mr. Pramod Deo added that some case studies can be certainly done on few shopping malls through energy auditing and be published on a wider scale.

Prof. Suryanarayana Doolla mentioned that during the DSM Consultation Committee meetings at MERC, the private utilities were found to be more proactive in comparison to public utilities and one of the reasons discovered being the cost of power purchase being relatively lower for public utilities as compared to that in case of private utilities. Mr. Pramod Deo responded that it has a lot to do with the decision making procedure that is different for public utilities and a lot of committees are involved in case of decision making for public utilities causing procedural delays. He added that giving incentives to large customers presents challenge for utilities like BEST as in case of government bodies rebate is provided on a mass scale and for poor people only. Prof. Rangan Banerjee mentioned that there is an implicit acceptance of subsidy in the argument but if a program is well designed to enable savings in terms of avoided cost, peak demand and energy consumed, it will lead to revenue generation and some part of which can be shared with the stakeholders. In such scenario, when programs happen to be cost effective, there won't be any issue of providing subsidy as there is clear reason to

voluntarily pursue DSM programs by the customers. He suggested that as per design, the targets associated with the program and actual savings post implementation need to be documented in a transparent fashion equivalent to the manner in which a power plant construction is designed and the cost and benefits are projected.

Ms. Priya Bhargava responded that MERC regulations clearly specify the cost benefit tests associated with the DSM programs and does take care of benefits to utilities as well as customers. Prof. Rangan Banerjee replied that such tests take care of cost and benefit before the program is sanctioned and there is a requirement to monitor the cost and saving base on participate rate once the program is implemented.

Ms. Natasha Bhan replied to the argument provided by Mr. Pramod Deo where he mentioned that pilot projects that are being done are at very small scale to monitor the impact associated with the programs. She stated that utilities seem to be stuck in a cycle of not targeting large scale DSM programs because they are not sure of the success and on the other hand facing difficulty associated with monitoring impact of small scale programs.

Mr. Pramod Deo stated that through the experience of pilots implemented, they have observed the possibility of implementing ceiling fan and refrigerator program on a larger scale and it is a matter of time that such programs eventually happen.

Panel 2: Regulatory Commission Perspective

Panelists:

- Mr. V. L. Sonawane, Member, MERC, Mumbai.
- Mr. P. Parameswaran, Member, KSERC, Kerala.
- Mr. P. K. Chaturvedi, Secretary, MPERC, Bhopal.
- Mr. Parmanand Singh, Secretary, BERC, Patna.
- Prof. Rangan Banerjee, IIT Bombay (Moderator).

The purpose of this panel discussion was to get insight into the perspective of regulators about the potential, status, barriers, and possible solutions in regard to DSM in Indian context. A series of key questions were provided a priori in order to moderate panel discussion.

Questions:

- What is the status of DSM regulation in state? What type of regulations is needed?
- Is the DSM status satisfactory in state?
- Is the DISCOM response to DSM adequate?
- Is there a need of policy intervention to facilitate DSM implementation?
- What are the constraints involved in proper assessment of executed DSM programs?

Mr. V. L. Sonawane, MERC, Mumbai.

MERC notified two regulations to promote DSM in Maharashtra that are DSM implementation framework regulations 2010 and DSM measurement and program cost effectiveness assessment regulation 2010. Maharashtra was the first state to notify DSM regulations to utilities in the state. Distribution licensees have been mandated to make DSM as a part of day to day operations.MYT regulations mandate the utilities to go for power purchase only after setting targets for DSM program. All the utilities have factored this in their MYT application. Recovery of DSM cost in the ARR is done after ensuring cost

effectiveness of approved program. There is a DSM consultation committee meeting every month headed by the secretary of MERC, chairman and representatives from all stakeholders and Prof. Suryanarayana Doolla from IIT Bombay. Load levelling through dynamic price program is under consideration and TOD tariff for HT consumers is also in place. Maximum rebate applicable for HT consumers is around26 % and the effect is evident in the load curve.

All Distribution licensees in Maharashtra have been proactive towards DSM implementation. They all are running different DSM programs. There is a need to stress on HVAC programs for making MW deployment a reality in DSM space. There is a need of thought leadership at the top, transparency in all transactions and BEE, MEDA and MERC to become knowledge organisations. MERC has taken the approach of incentive based regulations but now there is also need of some penalty measures through regulations.

Mr. P. Parameswaran, KSERC, Kerala.

Promotion of sales has been the major thrust of any commercial activity and reduction of sales being the outcome of DSM activity, there is clearly some conflict of interests that is evident. Kerala, being a consumer state, 50% of total consumption is from domestic sector. The rate of growth is highest in commercial followed by domestic and industrial sector. The rate of growth followed a 450 line with time for the past 10-15 years but interestingly it has come down in last 2-3 years with reduction in peak demand and energy consumption. On analysis, it was found that this might have happened due to the price signal sent by the regulator. Sending appropriate price

signal could be a good methodology of controlling and managing demand. Kerala has no tariff provisions from 2002 to 2012. On April 10, 2012, tariff provisions were adopted with affirm belief that price signal can be the most effective way of DSM. In domestic and commercial sector, the consumer consumes beyond a particular limit are required to pay tariff at a very high per unit rate. This has helped in arresting the peak demand. Such rates cannot be implemented for industrial customers and there is a need for alternate strategy. Apart from Maharashtra, Kerala was the other state that included ToD tariff in 2000.Before two years, the scope of ToD was enlarged to include LT customers. Below 20 kW every industrial customer comes under ToD tariff and is thus incentivised to go off from peak hours and consume more during off peak hours. Kerala would be the first state in the country to have ToD tariff for domestic consumers. Domestic consumers are propelled to reduce their consumption during peak hours if the tariff rates pinch their pockets. Based on a case study by Prayas energy group, Pune, a middle class family using air conditioners consumes approximately 300 units per month. This data was used to set a limit of 500 units for domestic consumers to get incentive from ToD structure. Every consumer consuming more than an average 500 units will come under the ambit of ToD tariff. All these measures have probably brought a decline in peak demand.

Power purchase is still the most important component in every distribution company. For KSEB, power purchase comprises of 60% of the total ARR. Power is dispatched based on price, so ultimately when DSM programs are effectively implemented across the country, costly power has to be backed out. In Kerala, around 85 to 90 %, demand is met by cheap power from thermal and Hydel power stations; remaining 10 to 15 % is either met by power purchase through exchange or peak power stations, which is a costly affair. This is a prime factor that drives Kerala for DSM. Model DSM regulations by Forum of Regulations are lacking in practical measures to counter peak demand and Kerala has come up with some measures to tackle peak demand through tariff provisions. KSEB, as of now, is not concerned about DSM. They will be concerned when they have to go for costly power purchase.

Mr. P.K. Chaturvedi, MPERC, Bhopal.

The gap between demand and supply for electricity triggered the need for DSM. A different approach to DSM is required for states that are surplus in power. Like Kerala, MP has also not made DSM regulations. But in MYT regulations, MPERC has referred to DSM projects and asked DISCOMs to take into account DSM projects, if any, before any power projections. While encouraging utilities to support DSM programs, regulators have to ensure that benefits of the program justify the cost. MPERC has so far used tariff as an effective tool to deal with the issue of DSM. There is ToD tariff in place in which surcharge of 15% is applicable to the customers and during off peak time rebate is offered. Power factor incentive is also available at 95% P.F. and above. Load factor incentive is also to flatten the load curve. MPERC has adopted a differential tariff rates for different level of consumption for LT domestic consumers. Telescopic rates apply for domestic tariff, however at the time of power shortage, non-telescopic rates are imposed. Agriculture tariffs are relatively higher in MP with Rs. 3.2 per unit up to first 300 units and Rs. 4.05 per unit for consumption beyond 750 units. This rebate is applicable Star labelled motors for irrigation pumps. There is 5% in energy charges on installation of EE devices street lights such as programmable on-off/dimmer switches, etc. Under Canadian International Development Agency assistance, pumps of 45 farmers in the west DISCOM were replaced by the utility. A pilot project on street lights was also undertaken with assistance from CIDA. With the results of pilot project available, new projects of EE street lighting are under consideration and is planned to be completed by March, 2015. The project is planned at a cost of Rs. 12 crores at Bhopal, Gwalior, Indore and Jabalpur municipalities.

DSM cells are formed at all DISCOMs and are operational too. Capacitor banks are installed at all transmission and distribution substations. Feeder separation scheme in rural area has changed pattern of energy use and has resulted in shift of evening peak.

In states like MP and Gujarat where power is surplus, a different load management program may work unlike what may be applicable for other states. MP is looking at development in the area of smart grid which can enable the possibility of increasing the demand rather than decreasing it. Demand has to be managed efficiently. Currently, Mr. Alok Gupta, Member, MPERC is in a committee which is going to propose smart grid regulations. Draft regulations are already prepared and currently there are around 40 pilot smart grid projects underway across the country. Smart grid can provide measures that may work for power surplus states. Deliberations on smart meters specifications, load research methodology, design of interruptible and uninterruptible tariffs and smart grid regulations should start so that the ground is laid to adopt the technology when it arrives. In smart grid lies the possibility to provide away forward for both power deficit and power surplus states.

Mr. Parmanand Singh, BERC, Patna.

Many generation plants and cold mines went with the newly formed state Jharkhand post state bifurcation. Currently Bihar gets most of its power, about 1994 MW, from central sector. BERC has made draft regulations for DSM and that has been circulated for the views and suggestions. ToD tariff is applicable to all HT consumers having demand of 200 kVA and above with a rate of 20% tariff during peak power. Power factor surcharge for p.f. below 90% is also applicable. Instructions to install solar water heaters in large public buildings, multi-storeyed buildings, hotels and hospitals are given. Program under Bachat lamp Yojana is also under implementation. Priority for Bihar currently lies in increasing its generation capacity.

Discussion:

The presentations were followed by a discussion session during which the use of DSM implementation for debt restructuring was debated. The constraint of low generation capacity for not implementing DSM was also discussed at length. The discussion concluded with myth busting of few fears that utilities have for not initiating efforts in the DSM space.

Dr. Mahesh Patankar raised the issue of financial restructuring of debt that is carried on the books of power sector companies and asked the panel of regulators that is there any mechanism by which DSM can be looked as a key attribute by way of which debt restructuring can be triggered. He also queried if it would be possible from regulator's perspective to have some targets related to DSM along with some innovative incentive structure to benefit the utilities that positively respond to DSM.

Mr. V.L. Sonawane said that considering DSM as a regular Capex program will only bring additional burden on the customers. If DSM schemes pass all the regulatory tests, then Capex for DSM won't be an additional burden. No doubt increase in Capex benefits utilities by giving them profit from return on equity, but DSM Capex loans should be considered different in a sense that it leads to future savings and could be incorporated in financial restructuring plan.

Mr. Rajib Kumar Das mentioned that the subsidy in Bihar being highest in the country, implementing DSM would directly benefit state government with the savings. In reply, Mr. Parmanand Singh reiterated the priority of building generation capacity in Bihar and said even if the state gets ample power, currently it lacks the transmission infrastructure to supply that power to the customer. He also mentioned that there is some effort in the DSM space. Prof. Rangan Banerjee suggested that although transmission and generation capacity may

pose challenge, the implementation of DSM is such scenario makes all the more sense. It is the judicious mix of demand and supply that will work best. There is a need to articulate and aggregate and since aggregation is not automatic, there is a need for the intervention by a regulator. Ms. Natasha Bhan also voiced a similar view that DSM is considered important once everything else is taken care of. She suggested that it is high time that efficiency and DSM is considered as a resource in the whole power mix.

Prof. Banerjee suggested that the utilities must understand that it is not the energy that they are selling but the energy service. Encouraging customers to consume more even if it is done inefficiently doesn't make sense. Utilities, fearing DSM to cause reduction is sales and hence decrease in whole sphere of influence, need to make a paradigm shift in a way they see DSM. There is a contradiction in a way whole energy business is structured with each component trying to maximise its interests without looking at the overall perspective. DSM should come in the integrated resource planning as a least cost option. There are many cost effective schemes that don't see the light of the day. Someone who is most cost sensitive has very high discount rates and schemes that are not viable for an individual may happen to be viable for society. Hence there is a need to aggregate and make a large scale shift. Large scale pilots will provide valuable learning experience about the transaction cost and the adoption rate for DSM programs which would help relate the cost to savings for future projects.

Ms. Neelima Jain suggested that the reduction in sales or energy demand owing to DSM can be seen as an opportunity cost especially in a power deficit states. This saved energy can be sold at a higher price to commercial and industrial customers. Ms. Natasha Bhan added that the net cost of power procurement can still be reduced for power surplus states buying power from spot markets where cost is usually high. Investment in DSM projects can enable utilities to reduce their power purchase from spot markets.

Mr. Balawant Joshi clarified that utilities get money i.e. return on equity on the capital base and since the reduction in capital base with reduction sales, owing to DSM, if at all exists, is extremely marginal. Actually, it is the T&D losses that reduce owing to less power going through the power lines. Revenue cap and price cap regulations are not present in the

country. There is regulation that is asset based and return on equity is on that capital asset. He also suggested the need for change in the regulator's perception while dealing with the fear of utilities that DSM leads to reduction is sales. It is the utility that is the biggest beneficiary to the DSM implementation. He also urged the need to change the perception for introduction of DSM programs in the subsidised category against the subsidising category.

Panel 3: Case Studies - Implementation Agencies and Energy Consultants

Panelists:

- Dr. M.T. Arvind, PhD, Cofounder, Amplebit Energy, Bangalore.
- Ms. Neelima Jain, Program Coordinator, EESL, New Delhi.
- Dr. Mahesh Patankar, Founder and Managing Director, MpEn systems, Mumbai.
- Mr. Balawant Joshi, Managing Director, Idam Infra, Mumbai.
- Ms. Natasha Bhan, Senior Programme Associate, SSEF (Moderator).

The purpose of this panel discussion was to get insight into the perspective of ESCOs and other implementation agencies about the potential, status, barriers, and possible solutions in regard to DSM in Indian context.

A series of key questions were provided a priori in order to moderate the panel discussion.

Questions:

- How has been the experience with utilities and regulatory bodies regarding DSM?
- What is the volume of scope in DSM space? What are the challenges involved in achieving it?
- Are the DSM technologies available in the country? How affordable are they?
- Where do we see DSM in future? Can large scale projects become a reality? What are the initiatives required?
- What are the barriers (administrative/financial /technical) to DSM?

Dr. M. T. Arvind, Amplebit Energy, Bangalore

Customers are motivated to invest in DSM measures only if they see reduction in energy cost. Other reasons are secondary to them. But they do appreciate transparency in measurement, reporting and base lining. Access to a lot of data and analytics is much appreciated by the customers. They may not be electrical engineers but they have sound business sense and are aware of the patterns of their load. They have a pulse of how it works and how it is changed. Customers are always willing to participate if a system is designed that meets their requirements and the base lining and measurement issues are approached properly. Complex strategies for base lining and savings computation discourage customers and IPMVP methods of curve fitting are not really appreciated. There is also a lot of scepticism about ESCOs and use of subjective criteria by them to calculate savings have caused loss of respect among customers.

Amplebit's experience with private utilities in Mumbai has been good and encouraging. With government utilities, not just in Mumbai but in other parts of the country too, the experience has been in the order of neutral to disinterest to opposition. Most of the government utilities believe that DSM is an occupational hazard which is imposed on them by policies and regulations. It is neither considered important nor something that is required. There are utilities that believe that DSM measures work only with big customers and hence implementing DSM will cut that revenue for them. During the meetings conducted with regulators and utilities, it was suggested that DSM should be practiced in agriculture sector as the power there is either free or subsidised. In another instance, one of the regulators believed that they are 10 to 20 years behind Mumbai in implementing something as "Exotic" as DSM.

DSM is relevant especially in Indian context as there is energy supply-demand gap at a national level. Although at state level, arguments for not participating in DSM may be different but for a national interest, DSM should be given appropriate importance. Wherever the need for, DSM can be articulated in a simple economical fashion to the customers stressing the fact that DSM would lead to financial savings, the path to implementation can become easier.

Some customers argue that power factor control has been implemented as a DSM measure, and there is not much to do in that space. The reason for such an argument comes from the fact that the effect of power factor control is evident on the tariff bill, there is always a strong reason to practice it as there is penalty if not done and incentive if done. The effect of most DSM measures does not translate to incentive or penalty on the bill, and it is one of the major reasons why DSM has taken a backseat in the country. Kerala and Madhya Pradesh have done this to an extent by way of introducing differential tariff through TOD structure and penalty for certain higher consumption which acts as both carrot and stick. There is strong need for such policy to be implemented in DSM context.

There is presence of appropriate DSM technology in the country and those are not difficult to implement. Even the cost is economical and shouldn't be a constraint. It has been proposed to regulators and utilities that the first way to encourage customers to implement any DSM measure is to provide them with data about their consumption pattern. Implementing such strategies through utilities is not a great idea as a lot of Capex allocation and tendering process are involved. Third parties can be encouraged to deploy cost effective simple technologies at customer location that can enable data about different sections of the load accessible to customers at all times. This can help customers make decisions regarding if DSM is good for them. Moreover, if the top 20 % of the customers are consuming, say 60-70% of the total energy consumed, educating that 20 % section of the customers will fulfil most of the objectives. Amplebit has a lot of customer data and case studies that can be shared on the public domain and it is believed that information about DSM technologies and

analytics on what can be done when coupled with IT solutions can benefit the cause in a big way.

Ms. Neelima Jain, Energy Efficiency Services Limited, New Delhi

EESL was administered under Ministry of Power and set up as an implementing arm of BEE with a larger objective of creating and sustaining the energy efficiency market.DSM opportunity is present in all energy consuming processes but significant opportunities exist in municipal, agriculture and domestic sectors. According to an estimate, there are about 33 million street light points and 20 million agricultural pumps in India. If this potential can be tapped through DSM measures, it would lead to reduction in energy consumption by 24% translating to about 3.5 billion dollars. Any DSM measure requires substantial upfront investment in exchange of savings that can be accrued over the lifetime of the deployed measure. Delay in payments or no payments results in high capital cost or risk. The detailed monitoring and verification cycles are linked to these payments, thus, prompting non-implementation of the DSM measure. EESL's solutions require addressal of all the barriers in a holistic approach rather than in a piecemeal fashion. With the credible backing and the mandates that EESL has, it is looking at providing financial solutions at a very attractive rates and designing risk mitigation solutions to address the financial, technical and regulatory risks. It is involved in many capacity building workshops across the country in partnership with many bilateral and multilateral international organisations.

EESL proposes deemed saving model to overcome the detailed monitoring and verification exercises. DELP (DSM based Efficient Lighting Program) uses this approach to facilitate monitoring and verification. High cost of LED poses a challenge to its market penetration as

an efficient lighting option. As a solution, EESL is providing LEDs at a much subsidised rate of Rs.25, almost same as that of ICLs. Deemed saving approach used for this program doesn't require detailed metering and hence investment on large labour force and huge metering equipment is saved. The savings are actually the difference between LED wattage and ICL wattage for same luminous intensity. LEDs are distributed in exchange of working ICLs and then the collected ICLs are destructed using environmentally safe methods. DELP is being implemented in Puducherry under Standard offer mechanism under which the utility purchases the energy savings at the pre-determined price from the energy user or ESCOs that delivers the energy savings in lieu of pre-decided amount per unit of energy saved on completion of the DSM project after M&V is over. This ensures tracking of investments with savings. A sample survey revealed that 88% of houses in Puducherry have ICLs and every month almost 50,000 ICLs are sold. Replacement of ICLs with LEDs would lead to savings on T&D losses translating to 5700MW.This could mean a transition from kW to MW Scale for a DSM program. After DELP implementation, Puducherry will become the first state in south Asia to switch household lighting to energy efficient LEDs.

Programs like DELP ensure win-win situation for all stakeholders. Under DELP, consumers are getting LEDs almost at the same cost as ICLs and this replacement of ICLs with LEDs in 2, 45,000 households would lead to savings of Rs. 96.45 crores due to reduction demand. For DISCOMs, the DELP implementation would lead to reduction in power procurement of about 47.96 MU per annum leading to Rs. 30.72 crores savings in power procurement cost over the period of 10 years. From social perspective, there is reduction in carbon footprint of 383.70 Million kgs. Investment from EESL is about 28 crores with project IRR of 16% over a period of 10 years.

Ms. Priya Bhargava, MpEn Systems, Mumbai

MpEn Systems have been instrumental in designing the draft M&V regulations for MERC, base lining methodology for demand response program and M&V methodology for a ceiling fan program of MSEDCL. M&V methodology for ceiling fan program implemented by MSEDCL uses stratified sampling for selecting a sample to be surveyed to understand the level of savings that could be achieved from the program. Various parameters like presence of different climatic zones within the implantation area, the effect of other cooling appliances, seasonality, etc., are taken into consideration to determine the sample. Hour meters are installed to record the number of hours in a day the appliance was used. Kilowatt-hour meters measure the number of units consumed by the consumer. The above two meters are used to collect data for a period of one year to determine the baseline for M&V. Inefficient old fans are replaced with five star rated ceiling fans. This retrofitting is done within the sample to calculate the savings by comparing the readings taken before the retrofit with the pre-calculated baseline data.

Demand response programs involve voluntary load curtailment by the customers in response to the trigger signal from the utility. For the amount of load reduced, the consumer is either incentivised or penalised. In this entire equation, estimation of baseline profile becomes very significant. Some of the customer baseline methods used worldwide include taking average of either 4 out of past 5 similar days' consumption or average of 9 out of pat 10 similar days' consumption. Weekends, holidays and DR event days which happen to have different load profile as compared to regular days are excluded from calculation. When DR event is executed, load curtailment is actually measured between the baseline and the actual consumption.

Maharashtra's draft M&V regulations cover impact, process and market effect evaluations. The Impact evaluation details actual demand and energy savings of DSM programs and process evaluation tries to evaluate the procedure adopted for execution of DSM programs. It also covered the strategies that worked or failed during the implementation. The idea is to promote these strategies as guidelines for implementation of DSM programs in future. Market effect evaluations tries to articulate the effect of program implementation on market performance. Free rider and spill-over effect is also looked at as a part of these evaluations. These evaluations, thus, look at DSM implementation in all three dimensions.

Mr. Balawant Joshi, Idam Infrastructure, Mumbai

Prior to the publication of Model DSM regulations by Forum of Regulators in 2010, utilities believed that their load shedding protocol as a DSM policy. Presently, there is a serious need for some policy intervention from the government in DSM space. There is no mention of DSM in Energy conservation act, 2001 or in its 2010 amendment. Electricity act, 2003, another piece of legislation that govern the power sector, there is still no mention of DSM or any another measure to be taken by the utility for energy efficiency. There is a need to bring amendment to electricity act to identify the body responsible for DSM and also to identify the steps to bring the efficiency on the consumer side within the ambit of the act.

In order to develop Model DSM regulations, it was important to define the contour of the DSM regulations, the constituents of DSM, the rules and responsibilities, and the activities as part of DSM. The draft regulations also divided the responsibilities among the various stakeholders. Certain functions regarding DSM still remain unanswered. There is no clear mandate on the body responsible for conducting the M&V. Presently M&V is done by the

regulators. If it is done by the IVC (Independent Verification Contractors), the conflict arises how they will be paid and by whom. There is a clear role for third parties to do the M&V. In the Model Draft regulations, no major roles have been given to BEE. Those activities that are in conflict with regulators and utilities should be done by independent agencies such as BEE or its state designated agencies. Barring the tariff natures such as TOD tariff and PF penalty, other active initiatives on the consumer side, have been taken by private utilities like Tata power, Reliance Infra, CESC and Torrent Power and may be BESCOM in public utility category. Very little activities are taken by public utilities that actually serve the 95% of the market. Regulations were thought of as the method to bring the utilities under the fold of DSM but unless the regulations are made the core process of the utilities. Aligning all the DSM processes with the regulation process of the utilities. That would mean that whenever there is MYT filing, the DSM filing should be done along with it. The Model draft regulations completely integrated the existing regulatory processes such as MYT process, Annual OATR filing, annual performance reporting and ARR filing. DSM targets on the lines of RPO (Renewable Purchase Obligation) can be devised by the regulators and these targets can be divided into different plans and submitted by the utilities to the regulators from time to time. These are the possible ways that could bring about large scale deployment of DSM programs.

Municipal DSM and agriculture Pump programs proposed by BEE didn't find many takers even when the potential for DSM were identified and known. The reason for failure of such programs lies in the inability of regulators to adapt to Model DSM regulations. Forum Of Regulators (FOR) developed cost benefit analysis guidelines which included NPV criteria (when utilities invest) and cost of energy saved (when consumers invest) as two tests for DSM programs has to qualify to be implemented. But regulators in different states came up with a series of tests for qualification of DSM programs. The capacity to evaluate DSM programs at utilities or regulators being quite low, a series of tests has not helped in implementation of some DSM programs. The Model DSM regulations were published by FOR in the year 2010-11. After Maharashtra, only 9 states have published final DSM

regulations and 5 more states are in a process of drafting the regulations. But unfortunately no states have fully adopted the cost benefit analysis guidelines of the Model DSM regulations. A database of DSM technologies for the different load categories can be developed at a national level. Market research should be done at regional level because that would provide clarity regarding if the technology should be made available through market or utilities to the customers.

Discussion:

The presentations were followed by a discussion session in which cost associated with M&V technologies, DSM programs for HVAC loads, implementations issues involved and market transformation policies required were discussed.

Prof. Suryanarayana Doolla asked the panel members about the cost associated with deployment of M&V technologies, cost of analytics of data and the insecurities related to sharing of customer data. Dr. M.T. Arvind replied that there is no insecurity involved with sharing with the customer his own data and the cost of sensing and telecommunication technology involved is pretty low and will be cost effective relative to implementation of a particular energy saving technology. He mentioned that there is something called Green Button data[1] format available and once the data is available, many service providers will actually compete to provide the analytics support either free of cost or paid.

Prof. Rangan Banerjee asked the panel that if there is sufficient volume of demand available for DSM technologies and if there is good competitive market that is developing to create demand on its own. He also added if the panel can provide some generic lessons that could help assess the transaction cost associated with some of these DSM technologies. Dr. Mahesh Patankar stated that type of businesses, like Amplebit, that provide some of these DSM technologies are not many in the market. But there are enough energy consultants that depend on regulators, utilities, bilateral and multilateral organisations for their business. It is

[1]Green Button Data
http://www.greenbuttondata.org/greenabout.html

easy to design a DSM program but it become increasingly difficult for utilities to identify the customers, vendors and complete the M&V part of the DSM program all on their own. He added that in terms of cost of saved energy, HVAC retrofits actually lead to not more than Rs. 1.5 per unit which happens to be quite less when compared to the transaction cost associated with lighting retrofit program. He mentioned that in 2030, at least 50% of the buildings will be constructed between now and then. Hence it is needed to be innovative in terms of kind of technologies that are promoted. There is need to change the course of DSM intervention with the use of right kind of policies and regulations that act as market enabler rather than an end to it. A direct B to B interaction facilitated by the utilities under the purview of regulations can play an important role rather than getting directly involved with the DSM implementation. He stated that utilities are not geared so far in that aspect and there is a need to look for third party initiated implementation as in the case of EESL.

Dr. M.T. Arvind added that targeting HVAC programs make more sense because the tariff for commercial and industrial sector is usually high and thus saving a unit has more impact as compared to that in case of agriculture sector from a customer's point of view. He mentioned that there are a lot of things that can be done for a subsidised sector such as agriculture but the issue is more political than economic or technological.

Mr. Balawant Joshi added that since DSM has to be employed at the consumer side of the meter and there is no consumer in case of new buildings, hence the way the entire policy ambit operates is different. He suggested that market transformation policies are required to be made operational through energy departments of government which could mandate the utilities to check if the new buildings are energy efficient the guidelines provided in ECBC[2] (Energy Conservation building Code) are being followed. He suggested that if large scale deployment of DSM programs is required, it has to be done in the subsidised sector because that is where the societal cost would be lower and hence the program would be cost

[2]Energy conservation Building Code, 2007
http://sgc-india.in/pdf/ECBC_final_May_2007.pdf
http://www.beeindia.in/schemes/schemes.php?id=3

effective for all stakeholders as a whole. Prof. Rangan Banerjee suggested that on both categories of customers, it is possible to design cost effective programs as barriers are not necessarily the cost.

Ms. Natasha Bhan mentioned that the unavailability of a proper M&V methodology is the usual excuse used by utilities for not going for DSM implementation and asked the panel about the allowable percentage of the total cost of project or benefits that could be spent on M&V. Dr. Mahesh Patankar replied that usually the M&V cost varies from 1% to 3 % of the total project cost and for some programs implemented by private utilities in Europe this has been found to be even 10 % of total project investment.

Dr. Mahesh Patankar added that there is a need of some independent entities like IITs to look at technology landscape available for DSM in the country and publish some independently validated reports that talk about the energy usage pattern and the amount of savings that could result from adoption of such DSM technologies.

Summary & Future course of action

Prof. Rangan Banerjee along with Ms. Natasha Bhan summarised the presentations and key points raised during the panel discussions towards the end of the workshop.

In order to decide the future course of action, a set of questions were provided a priori to the attendees to bring out the views and ideas that will be vital to carry forward the discussions and efforts in the DSM domain.

Questions:

- What is the perception of DSM among utilities and regulatory bodies?
- How can we facilitate sharing of best practices in DSM space? Will it be useful to have a DSM network/e-group/web portal?
- What should be the common basis of reporting of DSM successes and failures? How can that be decided?
- Should there be an annual DSM meet to discuss progress, issues and future course of action?
- How can IIT Bombay and other academic institutions provide support to Regulatory bodies /DISCOMs/ ESCOs?
- How can we enhance sharing of learning involved with implementation of DSM programs?
- How can we enhance financial support for DSM? How do we level the playing field for DSM?

The session started with Mr. V.L. Sonawane stressing the need for a core group to be formed that meets quarterly to discuss the incremental changes that happen over that period of time and it should be ensured that the same group of people meet every time. Mr. Parmeswaran suggested that there should be a discussion group or network where free interchange of ideas can happen. He also mentioned that most utilities lack the capability or capacity to prepare an effective DSM program and help is needed in that area. Mr.

Parmanand Singh also stressed the importance of a knowledge portal where the participants of the workshop can share their and observations. Mr. P.K. Chaturvedi suggested the formation of a DSM group or web portal to provide the utilities with case studies and technology assessment of end use equipments.

Mr. Shekhar Khadilkar mentioned the role that academic institutions can play in helping the utilities to choose the best of the technology provided by the vendors and other more efficient alternatives available in the market. The only source of knowledge for the utilities about the various energy efficient technologies happens to be the vendor and since a lot of developments keep happening over time, the technology provided by the vendor may be outdated. The knowledge support from academic institutions like IIT's can help incentivize and promote the best of technology available in the market.

Mr. G.G. Gokhale also stressed the need for a support by the IIT's in the area of technology analysis of end use equipment as the utilities lack the ability to evaluate the technologies provided by the vendors. In reply, Prof. Rangan Banerjee mentioned the issues related in coming up with a technology assessment of equipment that is exhaustive in nature, one of them being the constant update in the available technologies. But he assured that status on some metrics associated with the technologies can be provided for some specific technology domains which could be updated from time to time.

Ms. Neelima Jain mentioned the role that firms like EESL can play in designing the stringent legal framework for the energy contracts. She also stressed that firms like EESL can play the role of aggregator of projects that can help in reducing the transaction costs associated with DSM projects.

Mr. Balawant Joshi said that development of technology database from a deployment point of view would help the utilities with the knowledge support they require for deployment of DSM projects and other purposes. He also suggested the need to bring public utilities participate in the training workshops as their response to such events has been poor.

It was suggested that there is a need to document the learning from the implementation of the DSM proms in some form. Dr. Mahesh Patankar said that there is a requirement of a centre of excellence or a DSM knowledge network to provide the required independent validation of technologies and M&V plans. He mentioned the role of research and academic support in the successful rollout of DSM projects worldwide. A community of practitioners can be built with public domain sharing of experiences and case studies.

Dr. M.T. Arvind brought the notice of the participants towards the percentage of people who are either aware of DSM or appreciative and said that the people gathered for the workshop represent that handful lot of leaders. Hence there is a need of one to one interaction with the remaining percentage with a view to address their queries and myths that may be very legitimate for them. If the implementing agency or to be specific the operational manager of the project is not convinced about the DSM project and its outcome at a personal and organisational level, it becomes very difficult to successfully design and implement the program. The project implemented, savings achieved and monitoring data should be put on a public domain. This would serve as education for other utilities that are not engaged in DSM activities.

Dr. Mahesh Patankar suggested the hosting of a web portal through the mechanism of the group that attended the workshop and ensured that ESCO's will provide, if needed one to one courses in an e-learning format.

Ms. Natasha Bhan mentioned the importance of ensuring that such portal if formed remains active and people use it for sharing materials and experiences as there are a lot of web portals that are created during projects involved with energy efficiency and become inactive once the project is over.

Prof. Rangan Banerjee requested to put all the presentations and discussions on public domain, to which all the participants unanimously agreed. Prof. Banerjee, then, urged the need to see efficiency, from the societal point of view, as a cost effective way of providing the energy service and the need to articulate some broader vision and goals for DSM. He

mentioned the importance of learning by sharing model and the role of mandates, incentive, penalty and business interest in the DSM implementation. He concluded that the efforts in the DSM space are already on a growth path and now it is time to accelerate it.

Vote of thanks by Prof. Suryanarayana Doolla

The workshop concluded with a vote of thanks from Prof. Suryanarayana Doolla. He thanked all the participants on behalf of IIT Bombay and Shakti Foundation that they spared a day from their busy schedule to attend the workshop.

Sincere thanks to the people from Department of Energy Science and Engineering, IIT Bombay who assisted during the workshop.

Annexure 1: Concept Note

Background:

The monthly peak demand and energy required for the country is approximately 1,32,000 MW and 85,000 MU respectively with the value of peak demand met equal to 1,23,000 MW and energy available being 80,000 MU. This shows a deficit of 6.8% in peak demand and 5.9% deficit in energy required. Despite the efforts of power planners, these shortages are expected to continue. The energy and peak demand shortages and increasing power plants construction cost have made energy efficiency important for the cost conscious consumers, the regulators and utilities seeking new ways to plan future strategies.

There is significant potential for energy efficiency and DSM in the country but actual implementation has been limited and DSM projects have not been scaled up to meet this potential.

Objectives:

This workshop will present an opportunity to stakeholders from different states to share their experience and expertise related to the DSM measures implemented, thus stimulating discussions on the possibility of replicating similar DSM initiatives all over the country. The workshop aims to share experiences, identify best practices, and barriers and issues involved in the implementation of large scale DSM programs.

The objective is to create a platform to **discuss, network and accelerate** the necessary steps for design, development and implementation of large scale DSM projects.

Date: 2nd December 2013

Venue: Victor Menezes Convention Centre, IIT Bombay, Powai, Mumbai 400076.

Annexure 2: Workshop Program

9:30 to 10:00 am	Registration and Networking Tea
10:00 to 10:30 am	Welcome Address: Prof. Santanu Bandyopadhyay, HoD, Energy Science & Engineering. Workshop Introduction : Prof. S. Doolla / Prof. R. Banerjee Introduction about SSEF : Ms. Natasha Bhan
10:30 to 11:10 am	Panel 1:Experiences of Distribution Companies and Utilities 1. Mr. Shekhar Khadilkar, Tata Power, Mumbai 2. Mr. Pramod Deo, Reliance Infra, Mumbai 3. Mr. Dinesh B. Biwalkar, BEST, Mumbai 4. Mr. Rajib Kumar Das, CESC, Kolkata
11:10 to 11:40 pm	Discussion
11:40 to 12:20 pm	Panel 2: Regulatory Commission Perspective 1. Mr. V. L. Sonawane, MERC, Mumbai 2. Mr. P. Parameswaran, KSERC, Kerala 3. Mr. P. K. Chaturvedi, MPERC, Bhopal 4. Mr. Parmanand Singh, BERC, Patna
12:20 to 1:00 pm	Discussion
1:00 to 2:00 pm	Networking Lunch
2:00 to 2:30 pm	Panel 3: Case Studies: Implementation Agencies and Consultants Experience 1. Dr. M. T. Arvind, Amplebit Energy, Bangalore 2. Ms. Neelima Jain, EESL, New Delhi 3. Dr. Mahesh Patankar, MpEn Systems, Mumbai 4. Mr. Balawant Joshi, Idam Infra, Mumbai
2:30 to 3:15pm	Discussion
3:45: to 4:15 pm	Tea/Coffee Break
4:15 to 5:00	1. Summing up, Future Course of Action 2. Vote of Thanks

Annexure 3: List of Participants

S. No	Name	Organization	Email ID
1	Mr. Shekhar Khadilkar	Tata Power	sdkhadilkar@tatapower.com
3	Mr. Pramod Deo	Reliance Infra	pramod.deo@relianceada.com
4	Mr. Mukesh Bhanushali	Reliance Infra	
5	Dr. M. T. Arvind	Ample Bit Energy Solutions	anoop.kulkarni@amplebitenergy.com
6	Ms. Neelima Jain	EESL	njain@eesl.co.in
7	Mr. V. L. Sonawane	MERC	vlsonavane@merc.gov.in
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11	Mr. P. Parameswaran	KSERC	param158@gmail.com
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Workshop Group Photograph