NATIONAL WORKSHOP
ON
DEVELOPING ROADMAP
FOR
DSM IN INDIA

Organized by

BUREAU OF ENERGY EFFICIENCY

Government Of India

&

MAHARASHTRA ENERGY DEVELOPMENT AGENCY

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at

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NATIONAL WORKSHOP ON DEVELOPING ROADMAP FOR DSM IN INDIA

National Workshop

On

Developing

Demand Side Management (DSM)

Road Map for India

1st and 2nd October
Hotel Le Meridien, Pune

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Technical Session I: Road Map for Demand Side Management **Session Chairman – Shri. Gireesh B. Pradhan, Joint Secretary (IC), MOP, Government of India**	
DSM as a policy tool	Joint Secretary (EC), MOP
Role of various stakeholders	Pr. Secretary (Energy), Maharashtra
International Experience in DSM	Balwant Joshi, Indian Expert in IEA DSM Task XV

Demand Side Management (DSM)- Road Map

Background: Electricity plays a major role in India's development, both as an enabler of quality-of-life enhancement, especially in the lives of the poor, as well as an essential input to economic growth. It is estimated that electricity demand to meet these two key national objectives would more than double every decade and consequently the increased production and supply of electricity will continue to be a major goal of state policy so as to meet national social and economic goals.

1.1 Demand Side Management or DSM is the mechanism using which utility assists the consumer to modify its load and/or usage. DSM assumes great importance as it can cause significant reduction in energy requirement without reducing energy services. The Integrated Energy Policy Report (IEPR) prepared by the Planning Commission has also identified DSM as one of the important options for energy planning. However, as of date, very little experience exists in India regarding development, implementation and monitoring of the DSM programmes.

1.2 Several definitions have been used to describe DSM. However, what, perhaps, captures the broad range of activities that are being undertaken by utilities the world over as DSM is a definition that describes DSM as a set of initiatives undertaken by the utility on the consumer side of the "meter" to bring about a desired change in consumer demand and/or demand profile maintaining or even enhancing the quality of service provided to the consumer in terms of quality, reliability and cost of service[1]. What is important to note here is that emphasis is on 'utility initiatives' or 'utility organized' efforts and that too on the 'consumer side of the meter'. It is a partnership between the utility and customer with benefits to both. Demand side options involve reducing the demand for electricity by implementing suitable DSM initiatives that call for adoption of energy conservation (EC) & energy efficiency improving (EE) measures and practices by consumers of electricity that result in saving of electricity consumption and reducing demand for electricity. Since electricity saved is better than electricity generated or purchased, any savings in electricity consumption or demand achieved as a result of DSM initiatives, directly contributes to balancing the electricity demand-supply equation. Following table depicts the benefits of DSM programme to various stakeholders.

	Stake Holder		
Parameter	**Customer**	**Society**	**Utility**
Cost	Lower bills	Reduced foreign debt	Lower cost of service
Quality	Improved service	Improved service	Improved customer service
Capex	Non-energy business benefits	Lower business costs, Capital freed for other projects	Less generation and transmission capacity required

[1] EPRI (TR-102556s, August 1993) defines it as "organized utility activities that are intended to affect the amount and timing of customer electricity use"

Environment	Reduced pollution	Reduced pollution	Improved operating efficiency
Corporate Sustainability Reporting		Conservation of indigenous energy resources	

1.3 DSM offers utilities an opportunity to address several operational and management issues such as improvement of power quality and reliability, reduction in system losses, easing network constraints etc. DSM will ultimately result in saving electricity, in keeping with the concept of energy conservation. DSM is feasible in situations where the cost of DSM is lower than the cost of supply. In India, though per capita availability of energy is very low, in absolute terms, energy consumption is quite high. As a result, India is facing a problem of meeting the energy requirement with available resources. Therefore, the approach to mitigating power shortages, even partially, has to be based on DSM.

1.4 It is however, noticed that while electricity supply to meet rising consumption keeps increasing, the rational use of electricity – both on the demand and supply sides – has remained an under-utilized strategy. This occurs because of a host of market failures, including inadequate capacity of energy users to adopt energy efficient equipment and practices, because of lack of adequate knowledge to make the appropriate decisions, or because of lack of access to appropriate technologies or finance, or because of the lack of competitive pressures to reduce energy bills. In addition to these market failures which restrict the ability of an end-use consumer to adopt the most appropriate energy efficient practices, **there also exist a wide range of underutilized opportunities through which the electricity utilities can incentivize consumers to adopt measures to reduce electricity demand so as to reduce and flatten their own load curves**. These DSM interventions can be categorized into two, based on their prime mover, as under:

(a) Market Transformation driven DSM; and
(b) Utility driven DSM

1.5 While market transformation based DSM is based on interventions or market distortions created by enabling policies with or without regulatory or utility interface at the end use level. Examples of this are enforcement of standards and labeling programme, energy efficient building codes or other market based retrofit programme in lighting, pumps, etc. Utility based DSM would mean incentives, measures and load-curve changes benefit not only the electricity bill of the consumer (through lower energy bills), as well as the utility (through lower investment in peak load generation and supply), and occur primarily because of the incentives provided by the utility to consumers under regulatory oversight.

2. The Indian Experience

2.1 **Utility Driven DSM**: The utility or regulatory driven measures to incentivise DSM are:

a. Tariff Reforms
b. Load Management Directives

c. Regulatory Directives to the consumers/licensees
d. Public awareness campaigns
e. Funding Options for DSM

2.1.1 *Tariff Reforms*

In India, electricity tariffs are skewed and involve high level of cross-subsidies. Further, tariffs to certain categories of consumers such as agriculture, are far below the cost of supply, which instead of providing incentive to efficient consumption; encourages inefficient consumption. Further, charges such as minimum consumption charge do not provide any incentive to reduce demand on the system. It is an established principle that monetary incentives result in the most effective implementation of any policy. Therefore, it is necessary to provide incentive for demand side management by way of appropriate tariff structures. Following structures have been utilised to provide incentive for demand side management and energy efficiency already by some distribution companies in the country:

i. Two part tariffs
ii. Time of Day tariffs
iii. Power Factor incentive and penalty/Reactive Power Charges
iv. Penal Charges for overdrawal
v. Cost reflective tariffs

Since, tariff determination for retail consumers is a core function of the Electricity Regulatory Commissions (ERCs) under Sections 61 to 64 and 86 of the EA 2003, the ERCs can play a critical role in introducing the above measures. It would be necessary to develop and implement specific strategies for Tariff Rationalization purposes.

2.1.2 *Load Management Directives*

The ERCs have been empowered to give directives to the licensees to ensure efficient supply and regulate consumption by the consumers. These powers could be effectively utilized by the ERCs to develop State specific DSM policies. For e.g., in the State of Maharashtra, MERC issued directives to the State Utility to restrict consumption by the continuous process industries to 90% and non-continuous process industries to 80% of their average monthly consumption during previous one year. For instance, MERC has levied Load Management Charges on those consumers who did not restrict their consumption within the stipulated limits, and prescribed Load Management Rebate for consumers who restricted their consumption to below the stipulated limits. Depending upon the load curve and generation availability, the ERC may design suitable directives for licensees in the respective State.

2.1.3 *Regulatory directives to the licensees / consumers*

ERCs regulate the electric supply industry in the State and have general powers to give directives to the licensees in the State. Several State ERCs have utilised these powers to give directions to licensees on varied issues such as reduction in transmission and distribution losses, rationalization of manpower, etc. However, these powers have been rarely used for development of DSM projects. APERC in its "Guidelines for Load Forecasts, Resource Plans, and Power Procurement" has directed licensees to take into account DSM measures and has also provided for recovery of DSM related costs. MERC

has issued directives to all licensees in the State to develop DSM Plan and to undertake load research, in the Retail Tariff Orders issued in April and May 2007.

2.1.4 *Public Awareness Campaigns*

In any DSM and/or Energy Conservation program, participation of the end consumers is critical. It is usually necessary to create awareness about these issues amongst the consumers. Regulatory Commissions, because of their consultative and transparent approach, are a good medium for creating such awareness. Further, publicity campaigns may be undertaken under guidance of the ERC. While, strictly speaking, it is not the responsibility of the ERC to undertake or guide such campaigns, ERCs could be the dominant force in guiding such campaigns because of their quasi-judicial nature. Recently, licensees in Mumbai, namely Reliance Energy, Tata Power and BEST, are undertaking such a campaign which was guided by the MERC.

2.1.5 *Funding Options for DSM*

Due to the uncertain nature of outcomes and inherent conflict with the objective of achieving increase in sales, licensees are usually reluctant to undertake DSM measures. In most cases, either Government or the Regulator has to push the licensee to undertake DSM measures. In such a scenario, it becomes all the more important to provide for costs associated with DSM measures. The simplest way to provide for costs is to allow these costs as an expense in revenue requirement filings of the licensee. However, some of the activities require upfront collection of cash, which could be done by way of surcharge on existing consumption or by way of cess or tax. It would be necessary to explore options for funding DSM and develop definitive mechanisms for implementation of the same.

Several state electricity regulatory commissions and distribution companies have initiated DSM programs. These programs, aimed at reducing peak load, flattening the load curve, and reducing the supply inefficiencies, have been carried out by a mix of price signals (such as time of Day tariff, penalties / incentives for power factor and harmonics, investments in efficient distribution (such as HVDS), and incentivizing consumers to adopt energy-efficient devices and equipment (such as CFLs, electronic chokes, and solar lighting and water heating). Annexure-I provides a list of some of the DSM measures adopted in India, along with the sponsoring distribution companies.

2.2 **Market Transformation driven DSM**: This measure is based on creating market distortion in favour of energy efficient end use products that have enormous potential for reducing consumption. These usually span across the country through various utility service areas. The scope for achieving end-use efficiency through DSM is large. Table -1 highlights the potential for electricity-demand reduction due to DSM measures as brought out in a 2003 study. Subsequent end-use consumption data seems to indicate that the potential is now even larger than in Table-1, except for the large industry sector where competitive pressures are bringing about significant increases in energy efficiency.

Table-1: Potential for DSM-led Electricity Demand Reduction

S. No.	Sector	Potential
1.	Industry	10 – 25 %

2.	Lighting	30 – 35 %
3.	Commercial Buildings	50 %
4.	Agriculture	40 – 45 %
Source: ADEE, Econeler, IREDA and TERI, Demand Side Management from a sustainable development perspective, 2003.		

Given the diversity of the country in a sectoral perspective, a combination of the two interventions is necessary for achievement of the desired result. A sectoral perspective of the same is briefly outlines hereunder.

2.2.1 **Industry**: As has been mentioned earlier, the industry sector, especially the large industry, has been exhibiting a steady increase in energy efficiency over the past decade. In addition, large energy-intensive industrial users are also being addressed through the "Designated Consumer" provision of the Energy Conservation Act, 2001, and are required to appoint energy managers, carry out periodic energy audits, report on energy usage and on the implementation of energy audit recommendations, and conform to the specified energy consumption norms. DSM measures to further stimulate energy efficiency improvement include time-of-day tariffs and power factor incentives, which have been adopted by some distribution companies, and could be adopted by all. Further, enabling purchase of electricity from captive generation by the grid can further stimulate industrial energy efficiency, as has occurred in the sugar industry where the industries have upgraded their energy efficiency so that more power is available for sale to the grid, thus enhancing this additional revenue stream.
Additional measures could include:

- Introducing and promoting Time-of-day tariffs and power factor incentives
- Incentivising purchase of electricity from captive generation by the grid for energy efficient units

2.2.2 **Lighting:** In the lighting sector, DSM measures have large scope. The large contribution of (domestic, commercial and street) lighting to peak loads makes it attractive to the utility to offer incentives for the adoption of efficient lighting practices by consumers as this would directly reduce their costly peak-load power procurement. This has led some distribution companies to incentivise the purchase of CFLs by consumers. Since the high cost of CFLs is the major barrier to their adoption, DISCOMs have reduced the cost through subsidies, bulk procurement and recovery of cost in installments through ten or twelve monthly electricity bills. It is recommended that all DISCOMs should adopt DSM programme for replacement of incandescent lamps by CFLs. Alongwith such utility driven initiatives in lighting, the need to remove barriers for mass adoption of efficient lighting appliances like CFLs is paramount. Innovative policy instruments to reduce the first cost of CFLs will create the market for the household sector where the penetration is abysmally low (4-5% as compared to about 90% in commercial sector).

To stimulate market transformation the Ministry of Power, through the Bureau of Energy Efficiency (BEE), is proposing to launch a scheme through which high-quality CFLs would be available at a rate comparable to that of incandescent bulbs (GLS). This would remove the barrier of high CFL price (which is currently Rs. 80 to 100 per lamp) which is constraining its penetration into households. It is expected that over a five-year period, CFLs would then effectively replace all the 400-million incandescent bulbs

in use in the country, leading to potential reduction of 20,000 MW of electricity demand, and a reduction of about 24 million tones of CO_2 emissions every year.

The price reduction would be achieved by utilizing the Clean Development Mechanism (CDM) of the Kyoto Protocol through which the CFL manufacturers would earn Certified Emissions Reductions (CERs) on the basis of the CO_2 emissions reductions that would occur because of the low electricity consumption of CFLs compared to incandescent bulbs. Each CFL saves about 85 kWh of electricity a year, which in India, implies a reduction of about 60 kg of annual CO_2 emissions reductions. At a conservative price of about €8 for a tonne of CO_2 emissions reductions, this would lead to a revenue stream of about Rs. 25 per year for CFL installed and used in the country. Thus, over a period of less than three years, the CFL manufacturers would be recompensed for the full price of a lamp which is sold to a consumer at a price comparable to that of an incandescent lamp.

The large contribution of (domestic, commercial and street) lighting to peak loads makes it attractive to the utility to offer incentives for the adoption of efficient lighting practices by consumers as this would directly reduce their costly peak-load power procurement. Some measures that need to be taken are:

- Promoting CFLs amongst consumers by incentivising mechanisms like price reduction through bulk purchases (as done by Delhi, Haryana and being contemplated by Assam)
- Reducing VAT to 4% on CFLs and making it uniform across states
- Issue of notifications/ orders by central authorities/ states for use of CFLs and equipments that are rated 3 STAR or above only.

2.2.3 **Commercial Buildings:** The commercial sector offers large potential for energy efficiency. There are a large number of initiatives that can be adopted by builders and by building owners to reduce energy consumption in buildings, including compliance with the Energy Conservation Building Code, and the utilization of Energy Service Companies (ESCOs) to reduce energy demand. Distribution companies could enhance and accelerate this transformation by providing tariff incentives to buildings where specific energy consumption (in terms of kWh/Sq.m day) is less than accepted benchmarks. This will incentivize builders and building owners to reduce energy demand.

The building sector also offers tremendous potential for efficient use of energy and its conservation. Simulation studies have indicated a potential of reducing energy use by as much as 30-40% by following the Energy Conservation Building Code (ECBC). ECBC is being launched by the Minister of Power on 27th May, 2007 and will be put out on voluntary basis initially and will target large buildings having connected load of 500 kW. Since ECBC compliance buildings will have a lower connected load as well as lower peak demand that others, distribution companies could consider providing rebate in tariff for such buildings, much in the same way as rebates for use of solar hot water systems is being given by some utilities.

As far as old buildings are concerned, the Government has initiated programme to promote energy conservation through the Public Private Partnership model of

performance contracting through an Energy Service Company (ESCO). Measures that could be taken in this regard are:

- Adoption of ECBC by central and states, at least for all new government or semi government buildings
- Sustained awareness and information campaign to ensure that the long term benefits of energy cost are taken into consideration by the consumers
- Incentives to persons who adopt ECBC on voluntary basis.
- Promoting, by way of incentives, performance contracting PPP model for existing buildings through the ESCO route
- Provision of adequate financial resources and models to ringfence risks of performance contracts of ESCOs.

2.2.4 **Agriculture:** Agriculture accounts for about 27% of electricity consumption in the country, and this is increasing because of increasing rural electrification. This electricity is largely used in agricultural pump set energization. However, pump set efficiency is very poor, as indicated by the savings potential in Table 1, largely because free or subsidized electricity for the agricultural sector provides no incentives for energy savings. DSM can, therefore, be a second – best measure to promote pump set energy efficiency.

BEE is preparing an Agricultural DSM (Ag. DSM) program in which pump set efficiency upgradation could be carried out by an Energy Service Company (ESCOs) or the distribution company. The ESCO/DISCOM would invest in energy efficiency upgradation on a rural pump set feeder on which supply quality enhancements such as HVDS) have already been carried out. The intervention would lead to lower energy supply on the feeder, and hence to lower subsidy by the state government to the DISCOM. Part of the savings in the subsidy would be paid to the ESCO/DISCOM on an annual basis, over a 5 year period, to pay for their investment in pump set upgradation. To ring fence the payment security mechanism, a large Financial Institution having sufficient leverage with the states (like PFC, REC) can be brought in to provide loan to the project and ensure returns by way of instruments like ESCROW, etc. This has the ability to reduce significantly the risk associated with the project. The role of the DISCOM could be that of a Monitoring and Verification on payment of fee as a part of the project.

It is proposed to pilot an Ag DSM scheme on pump set feeders from one substation in 6 states. The pilot feeder could be those where HVDS have already been implemented through APDRP, and so the Ag DSM program can piggy lack on the APDRP project in the states so as to benefit from the APDRP institutional mechanisms for implementation, monitoring, and oversight. The program can be replicated across the country after pilot implementation experience.

The measures that need to be taken in this are:

- Isolating agricultural feeders by DISCOMS and 100% metering (with preferably HVDS)
- Providing information/ awareness about the need to conserve energy and water to the farmers by states
- Provision of incentives to farmers as well as Utility to adopt the scheme
- Regulatory incentives to DISCOMS to promote energy efficiency on such agricultural feeders

- Mitigation of risk of ESCO by proper monitoring and verification protocols, binding contracts and a robust payment security mechanism.
- Ring fencing the risk of such Agricultural DSM (Ag DSM) by linking it to the reduction in the overall subsidy burden of states.

3. **International Experience**: Indian DSM programmes have taken note of international experience in implementation of both utility driven and market transformation driven DSM. The Standards and Labeling programme, ECBC are examples of adopting international best practices in India. India's engagement with International Energy Agency (IEA) DSM Task Force seeks to provide utilities important lessons of network driven DSM.

4. **Road Map for DSM in India**: DSM initiatives in the lighting, industry, building and agriculture have the potential to both flatten and reduce the load curve of distribution companies, while moderating the growth in demand. However, specific opportunities available and the quantum and benefits of these opportunities vary from one Distribution Company (DISCOM) to another, as do the tools required to leverage these opportunities. DISCOMs need to assess these opportunities and ERCs need to incentivise them take up such initiatives. It is therefore necessary for each DISCOM to establish a dedicated DSM Cell as a nodal agency to take up such projects. The Ministry of Power and BEE will provide necessary support for this purpose to these DSM Cells in furtherance of their feasibility studies, technical support, etc. These DESM Cells must prepare a state level road map with deliverable and time bound outcomes.

Annexure-I

DSM measures taken by various Utilities

S.No.	Measures	Utilities
1	Two part tariff/ TOD	1. Himachal Pradesh Electricity Regulatory Commission,Shimla-2 2. West Bengal State Electricity Board Vidyut Bhawan 3. Torrent Power AEC Limited Electricity House, Lal Darwaja, Ahmedabad 4. Assam Electricity Regulatory Commission
2	Power factor correction capacitor	1. North Delhi Power Limited 2. Ajmer Vidyut Vitran Nigam Limited. DELHI 3. Torrent Power AEC Limited, AHMEDABAD 4. The BEST Undertaking, MUMBAI 5. Reliance Energy Limited, MUMBAI 6. 6.The Mula Pravara Electric Co-op, Society Ltd. Shrirampur, AHMEDNAGAR, MAHARASHTRASouthern Power Distribution Company of A.P. Ltd. (APSPDCL), A.P 7. Cochin Special Economic Zone (CSEZ), COCHIN Purvanchal Vidyut Vitaran Nigam Ltd., Vidyut Nagar, PO: D.L.W, Varanasi
3	Penalties for harmonic injection	Himachal Pradesh Electricity Regulatory Commission, Keonthal Commercial Complex, Khalini , Shimla-2
4	Solar lighting	Uttaranchal Jal Vidyut Nigam Limited, "Ujjwal", Maharani Bagh, GMS road, Dehradun-248 001
5	HVDS	1. North Delhi Power Limited, DELHI 2. West Bengal State Electricity Board, KOLKATA 3. Southern Power Distribution Company of A.P. Ltd. (APSPDCL), A.P 4. Purvanchal Vidyut Vitaran Nigam Ltd., VARANASI 5. Noida power company Ltd.
6	Installation of electronic meters	1. North Delhi Power Limited, DELHI 2. Noida power company Ltd. 3. Chhattisgarh State Electricity board
7	Energy audit	1. North Delhi Power Limited 2. Central Electricity Supply Company of Orissa Ltd. IDCO Tower 3. Tamil Nadu Electricity Board 4. Noida power company Ltd.

		5. Chhattisgarh State Electricity board
8	Providing Energy Efficient equipments to consumers by ESCO	Jaipur Vidyut Vitran Nigam Limited Vidyut Bhawan , Janpath ,Jaipur-302 004
9	Dedicated feeders for agriculture sector	West Bengal State Electricity Board
10	Pilot projects	1. M.P.Madhya Kshetra Vidyut Vitaran Co. Ltd 2. M.P.Poorva Kshetra Vidyut Vidyut Vitaran Company 3. Madhya Pradesh Paschim Kshetra Vidyut Vitran Co.
11	Energy Efficient lighting program	1. BESCOM Corporate Office, Bangalore • MSEB/ BSES
12	Replacement of GSL by CFL	1. Cochin Port Trust, Willingdon Island, Kochi-682 009 2. Assam Electricity Regulatory Commission 3. Chhattisgarh State Electricity board 4. NDPL/ BSES 5. Haryana
13	Installation of solar water heater	1. Cochin Port Trust , Willingdon Island, Cochin 2. Assam Electricity Regulatory Commission
14	Installation of electronic choke	1. Cochin Port Trust , Willingdon Island, Cochin 2. Chhattisgarh State Electricity board

Technical Session II: Residential DSM **Session Chairman – Dr. Ajay Mathur, DG, BEE**	
Indian CFL Program	DG, BEE
Role of Utilities in Indian CFL program	MD, DHVVN (Vijayendra Singh)
Supplier's perspective	OSRAM- Gagan Mehra

CDM Based CFL Scheme for Market Transformation
Bachat Lamp Yojana (BLY)

I. Overview: Lighting accounts for almost 20% of the total electricity demand in the country, and contributes almost fully to the peak load as well. The vast amount of lighting in the country is provided by incandescent bulbs, which are extremely energy inefficient. Only about 5% of the electricity is converted into light, the rest is lost as heat.

In recent years, energy efficient lamps have been introduced into the Indian market, with the Compact Fluorescent Lamp (CFL) providing an energy-efficient alternative to the incandescent lamp. A CFL uses only one-fifth as much electricity as an incandescent lamp to provide the same level of illumination. CFLs have almost completely penetrated the commercial market, and the sales of CFLs in India have grown from about 20 million in 2003 to more than 90 million in 2006.

However, penetration into households has been very limited, largely because of the high price of the CFLs. The price of CFLs has decreased considerably with the increasing market volumes, but is still in the Rs.80-100 price range. On the other hand, incandescent bulbs are in the Rs.10-15 price range.

Initiatives to help decrease the price of CFLS to be comparable with that of incandescent bulbs are therefore necessary in order to enhance the penetration of CFLs in households. It is estimated that about 400 million light points in India today are lighted by incandescent bulbs; their replacement by CFLs would lead to a reduction of over 20,000 MW in electricity demand.

The proposed scheme seeks to utilize the Clean Development Mechanism (CDM) of the Kyoto Protocol to bring-down the price of CFLs. This public-private partnership would provide the framework for private-sectors CFL manufacturers to sell CFLs at about Rs.10-15 per piece and recover the balance of costs from CDM revenues.

The Government would develop a programmatic approach within which individual CFL manufacturer would develop CDM projects. In addition, the Government would also monitor CFL use in sample households across the country to provide the data on usage required to verifying carbon emission reductions under the CDM regime.
The scheme also requires that the CFL manufactures provide a buy back scheme for used CFLs so as to enable their collection and safe disposal of the mercury contained in them

II. The Context: The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1992 with the objective of stabilizing emissions, based on the principle of, "common but differentiated responsibilities and respective capacities", amongst nations. The UNFCCC adopted the Kyoto Protocol in 1997 which mandates quantitative limits on GHG emissions from developed countries in the 2008-2012 timeframe, and creates the Clean Development Mechanism (CDM) framework through which the developed countries can purchase additional, certified emissions reductions from developing countries to meet their reduction commitments. Current global negotiations focus on the post-2012 period, and seek

to engage the large developing countries in the Green House Gas (GHG) emissions limitation commitments regime.

III. **The Methodology**: The methodology proposed is such that it captures the energy savings of a Demand Side Management (DSM) project which is translated in reduction in carbon emissions and thereby creating Certified Emission Reductions (CER). These CERs are issued after monitoring and verification based on Clean Development Mechanism (CDM) framework and methodologies under the Kyoto Protocol (Article 12) and are then traded. The funds so generated are ploughed back to the DSM project. The key elements of such a methodology involving replacement of incandescent bulbs with Compact Florescent Lamps (CFL) are:

- *Developed countries committed to reduce greenhouse gases assist developing countries in achieving sustainable development*
- *CERs generated will be traded with developed countries which will contribute to this compliance with part of their quantified emission limitations and reduction requirements*
- *The methodology must be approved by the CDM Executive Board of the UNFCCC. Project must use CDM methodology approved by the CDM Executive Board.*
- *Programmatic CDM framework is developed by GOI and approved by CDM Executive Board; subsequently each CFL manufacturer joining the scheme develops a CDM project which is registered with the CDM Board with the approval of the CDM programmatic framework.*

IV. **CFL- DSM Project mechanics**: Sell CFLs (labeled with the scheme logo) in the market at around Rs. 10-15 per lamp;

- Ensure that the lamp has a life of at least 10,000 hours (so that it lasts at least till 2012 till when the current CDM regime is in effect);
- Establish buyback mechanisms for about Rs. 2 for each used CFLs at the end of its life (so that it can be collected and sent to disposal facilities where the mercury contained in them can be safely disposed), and
- Prepare and secure registration of their activity as a CDM project, within the framework of the approved programmatic CDM activity of the BEE. Programmatic CDM framework is developed by GOI and approved by CDM Executive Board; subsequently each CFL manufacturer joining the scheme develops a CDM project which is registered with the CDM Board with the approval of the CDM programmatic framework.
- CERs generated will be traded with developed countries which will contribute to this compliance with part of their quantified emission limitations and reduction requirements

IV. **Role of the three parties:** The project will have to be jointly done by the CFL Manufacturer, DISCOM and BEE. The parties are required to:

CFL Manufacturer:

- Providing a CFL at nominal prices comparable to those of GLS lamps in exchange for a working GLS lamp

- Preparing CDM Programme Activity Design Documents (CPA-DDs) for CDM project and submitting them to BEE.
- Arrange collection of fused CFLs through buy-back schemes, and arrangements for their safe disposal.
- Distribution of CFLs in association with DISCOM
- Initial investment for the cost differential
- Free Replacement of CFL during the life of project

DISCOM IN PROJECT AREA

- Database of households to include name of users/address/average electricity consumption of various electricity consumption class.
- Assist in selection of **Project sample group (PSG)**, **Project sample buffer group (PSBG)**, **Project cross-check group (PCCG)** as required under AMS-II.C
- Information on Grid voltage supplied to CFL-using households
- Distribution of CFL Lamps and exchange of incandescent lamps
- Safe keeping of replaced GLS for independent inspection
- Determination of the power correction factor as per AMS-II.C.
- Estimation of technical distribution losses in the electricity grid
- Confirm that no other CFL based CDM project will be taken up in the CPA area.

BEE:

- Awareness and information
- Development of Programme of Activities Design Document (POA-DD)
- Registration of Programme of Activities with UNFCCC CDM Executive Board.
- Monitoring of CFL use in sample households
- Support the CFL manufacturers/ DISCOMs to prepare CDM Programme Activity Design Documents (CPA-DDs)
- Inclusion of CPA-DDs under the PoA after validation
- Allocation of CERs to the CFL manufacturers / DISCOM according to their share in emissions reductions in a specified period

A model tripartite Agreement is at Appendix-II

VI. <u>Preparedness:</u> The scheme was announced by the Hon'ble Minister of Power during the Chief Ministers' conference chaired by Hon'ble Prime Minister on 28th May, 2007. BEE has completed the following actions:

- The scheme for BLY is under consideration by GOI. The scheme also enables the DISCOM to make the upfront investment and claim the CERs;
- Three meetings have been held with ELCOMA (the lighting manufacturers association) where most of the major CFL manufacturers attended. Details of the scheme and its implementation issues were discussed;
- Based on there consultations, 7 CFL Suppliers have declared their intent in joining the scheme.
- Appointment of Monitoring & Evaluation Agency for BLY (MEAB) for monitoring usage of CFLs as required under AMS-II.C using smart meters under progress.

- Designated Operating Entity (DOE), M/s. TUV-NORD appoibted as validator.

VII **Next Steps:** The suggested road map for implementation of the scheme is as under:

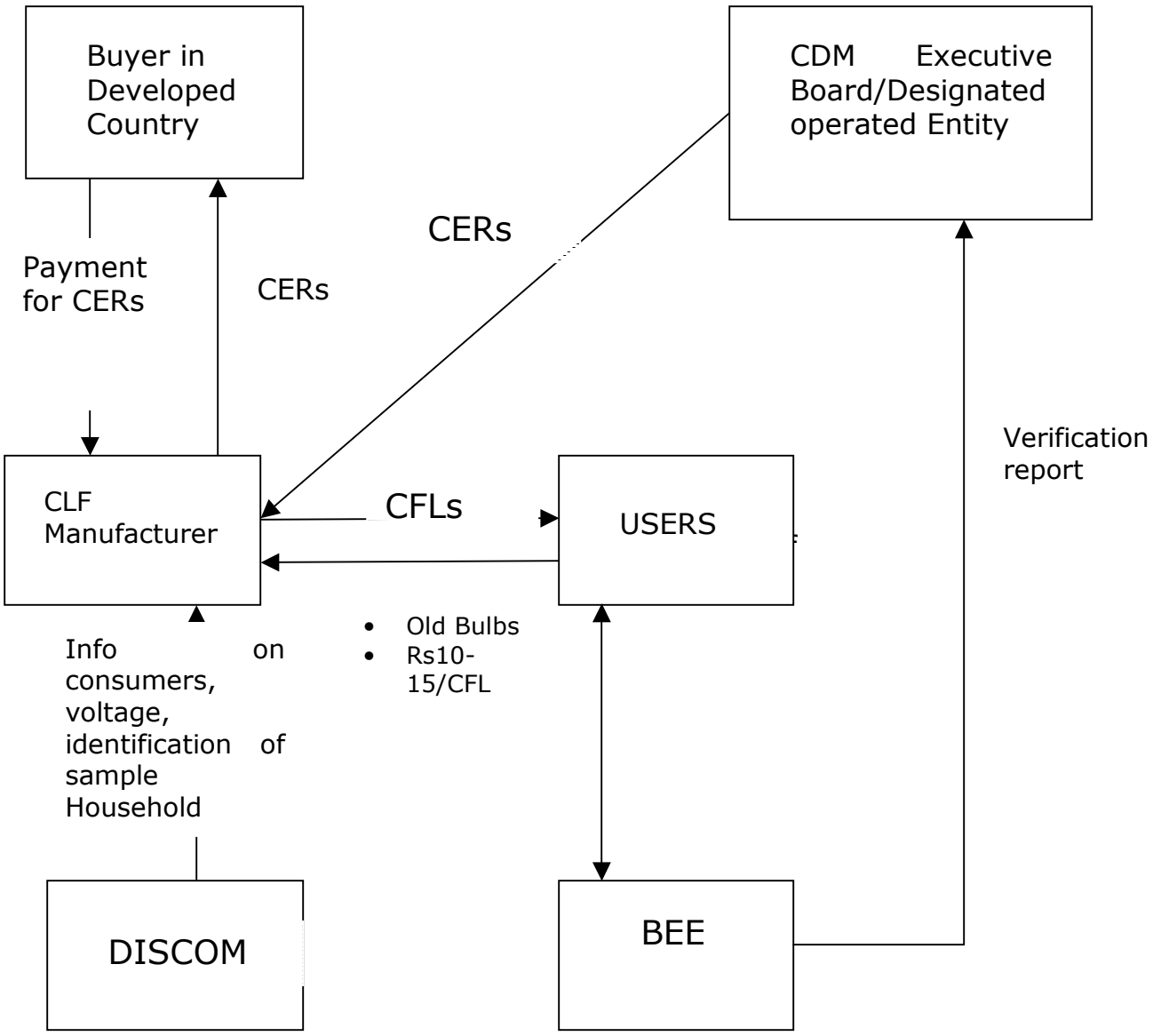
- Preparation of PoA to cover the entire country-
- After the PoA is prepared, the selected DOE will validate the project document.
- The PoA will be posed to the EB after it is recommended by the Designated National Authority (DNA) which is the MOEF.
- The two initial projects in Haryana and Andhra Pradesh that are on advanced stages expected to commence by November, 2007- they will have the option of converging with the PoA later.
- In order to undertake monitoring of the programme, a National Project Management Unit (NPMU) has been constituted as under:

  Joint Secretary (EC), MOP – Chairman
  DG, BEE Member
  Director (EC) Member
  One Representative each from Members
  NTPC, PGCIL, NHPC
  Permanently dedicated for programme
  Management and stationed in BEE.
  One Expert of CDM Member

- The NPMU will supervise the entire programme as an apex decision making body and will be responsible to ensure adequate monitoring and verification as required under the approved CDM methodology. The servicing of the committee will be charged to the project for which the EC may request MOP for expeditious approval.

VIII. **Potential:** This methodology could enable many users to switch to CFLs, which use 80% less electricity than normal bulbs. At present high cost of CFL is the major barrier for their proliferation- the cost of incandescent bulb is around Rs. 10 while that of CFL is around Rs.100-130 per piece. A complete switch over from normal light bulbs to CFLs is estimated to lead to a reduction in demand of over 20,000 MW in the country. In Delhi alone, the reduction of demand could be as high as 400 MW, which is equivalent to the peak shortage.

Appendix 1


Buyer in Developed Country
CDM Executive Board/Designated operated Entity
Payment for CERs
CERs
CERs
Verification report
CLF Manufacturer
CFLs
USERS
Old Bulbs
Rs10-15/CFL
Info on consumers, voltage, identification of sample Household
DISCOM
BEE

Appendix-II

Tripartite Agreement

Between

Bureau of Energy Efficiency

hereinafter referred to as "BEE"

and

DISCOM

– hereinafter referred to as "*xxx*" –

and

CFL Manufacturer

– hereinafter referred to as "MANUFACTURER" –

1. In course of the discussions between the parties to conclude the Agreement, the parties intend to consider the following measures:

1.1. BEE is statutory body formed under the Energy Conservation Act, 2001 for promoting energy conservation and efficiency in the country.

1.2. XXX is engaged in the generation & distribution of electricity power units, and MANUFACTURER is engaged in the business of manufacturing and selling energy saving lighting appliances.

1.3. Now therefore, the Parties are contemplating the formation of joint activities for the purpose of implementing an approved methodology or small scale methodology pursuant to the Clean Development Mechanism of the Kyoto Protocol ("Methodology") applied to residential lighting for the reduction of greenhouse gas emissions, resulting in sustainable energy savings in the State of XXX (hereinafter called the "Project"). BEE will be the monitoring agency for the project.

1.4. The three parties will be responsible for the activities as mentioned in clause 1.5. MANUFACTURER will be responsible Project owner and will be in charge of the measures as of 1.5. In return, to cover all costs and risks, MANUFACTURER will benefit from Certified Emission Reduction units (which meaning is to be read in context of the Clean Development Mechanism of the Kyoto Protocol, hereinafter called "CERs") generated from the Project. BEE will monitor the reduction in energy consumption that will lead to the above. The role of BEE and XXX is as in clause

1.5.

1.5. The presently known main measures & cost factors for the Project are as follows:

CFL Manufacturer/ Trader:

- Providing a CFL at nominal prices comparable to those of GLS lamps in exchange for a working GLS lamp
- Preparing CDM Programme Activity Design Documents (CPA-DDs) for CDM project and submitting them to BEE.
- Collection of fused CFLs through buy-back schemes, and arrangements for their safe disposal.
- Distribution of CFLs in association with DISCOM
- Initial investment for the cost differential
- Free Replacement of CFL during the life of project

DISCOM IN PROJECT AREA

- Database of households to include name of users/address/average electricity consumption of various electricity consumption class.
- Assist in selection of **Project sample group (PSG)**, **Project sample buffer group (PSBG)**, **Project cross-check group (PCCG)** as required under AMS-II.C
- Information on Grid voltage supplied to CFL-using households
- Distribution of CFL Lamps and exchange of incandescent lamps
- Safe keeping of replaced ICB for independent inspection
- Determination of the power correction factor
- Estimation of technical distribution losses in the electricity grid

BEE:

- Awareness and information
- Development of Programme of Activities Design Document (POA-DD)
- Registration of Programme of Activities with UNFCCC CDM Executive Board.
- Monitoring of CFL use in sample households
- Support the CFL manufacturers/ DISCOMs to prepare CDM Programme Activity Design Documents (CPA-DDs)
- Inclusion of CPA-DDs under the PoA after validation
- Allocation of CERs to the CFL manufacturers / DISCOM according to their share in emissions reductions in a specified period

1.6XXX will benefit from sustainable energy savings in the state of XXX, in return XXX and BEE will support MANUFACTURER to execute the Project.

1.7XXX accepts that MANUFACTURER may sign a separate agreement with a third party to share costs and risks according to 1.5. above as well as CER returns generated in the Project.

2 Miscellaneous

2.1. Save for the limited exclusivity stipulated in 1.5 above, the Parties shall not be legally committed to concluding the Agreement and the above intentions are not binding upon them until all details have been laid down in the respective agreements and signed by them.

2.2. Each Party shall treat the Negotiations and the content of this MoU as confidential unless the other Party gives its prior written consent to its (or any part thereof) disclosure.

Each Party shall use any information which it receives from the other Party during the course of discussions or Negotiations, only for the purposes for which it has been provided, and shall prevent third parties from gaining access to it and treat it in the same way as its own business secrets. This confidentiality obligation shall not apply to information which is generally known, which can be shown to have been independently developed by the recipient, or which has been acquired from a third party without nondisclosure obligation. This obligation shall likewise not apply if a Party is required by statutory regulations to reveal any of the information it has obtained. This obligation shall survive for a period of five years after this MoU lost its force.

2.3. Each party has the right to discontinue discussions and negotiations at any time without any liability to or responsibility for cost and expenses or damages of whatever nature of the other party to this MoU. Except with respect to the provisions regarding confidentiality and the parties each being responsible for their own expenses and fees, this MoU does not create any binding legal obligation. Neither party makes any express or implied representation or warranty as the accuracy or completeness of the information supplied to the other pursuant to this MoU. Each party and their respective officers, affiliates, controlling persons, representatives, agents and stockholders expressly disclaim any and all liability which may be based on such information, errors therein or omissions therefrom. Each party is entitled to rely solely on any representations and warranties made in any final agreement, if any.

2.4. Each party shall bear its own legal, accounting and administrative expenses in connection with the negotiation and consummation of the transactions proposed in this MoU. Either party shall have responsibility for the fees and expenses of any broker or advisor retained by the other.

2.5. Additions and amendments to this MoU shall only be valid if made in writing. The requirement of the written form can itself only be waived in writing.

2.6 Arbitration

The parties shall endeavour in good faith to resolve amicably all questions, differences or disputes whatsoever which may arise between the parties, in connection with this MoU or its validity.

Manufacturer, BEE and XXXX shall nominate one arbitrator. Both arbitrators shall agree on the third arbitrator within 30 days. Should the two arbitrators fail, within the above time-limit, to reach agreement on the third arbitrator, he/she

shall be appointed under the Arbitration and Conciliation Act, 1996. The provisions of Indian Arbitration & Conciliation Act, 1996 or any re-enactment or statutory modification thereof for the time being in force shall be applicable for the settlement of the dispute. The decision of the arbitrator shall be final and binding on the parties.

The seat of arbitration shall be New Delhi.

2.7 This MoU shall become effective upon signature by all parties. It shall terminate when the Agreement has been concluded or if otherwise notice of termination was given according to 2.3 above. In case of termination Clauses 2.2, 2.3, 2.4 and 2.6 shall survive the termination.

2.8 This MoU summarizes the basis upon which the parties intend to negotiate to the definitive agreement(s). Consummation of the proposed transaction(s) as outlined in this MoU is expressly subject to the parties reaching agreement on any necessary definitive agreements, to the approval of the Board of Directors [or equivalent] of each of the parties, and to any necessary governmental approvals.

XXX	MANUFACTURER
Date: Signature:	Date: Signature:
Name	Authorised Signatory
BEE	
Date: Signature:	
Name Title:	

Technical Session III: Agricultural DSM Session Chairman – MR. Ghosh – Chairman – MPERC	
Proposed Agricultural DSM Model	Secretary, BEE
Agriculture DSM Case Study	MD, KPTCL
Water and Energy Nexus	Jim Hogan, WENEXA project of USAID
Financing Agricultural DSM	Shashi Sekhar, EVP, PTC

Agricultural Demand Side Management (Ag DSM)
Strategic Implementation Plan

1. **Background**: India's Agricultural Sector consumes 30-40% of total electricity, up from 10% during the 1970s. The high rate of growth in agricultural electricity consumption results from aggressive rural electrification coupled with a policy of below-cost pricing to farmers. The agricultural tariff has not grown while the industrial and household tariffs have increased (from 1992) at an average rate of over 11%, that is much more than the average inflation during the same period. The trend is captured in Chart-1, 2 and 3 at Annexure. It has been one of the factors contributing to inefficiencies and thereby high AT&C losses of the State Utilities. The rural agricultural supply is characterized by the following:

(a) Low reliability due to high cost of service and low or no revenue;

(b) Use of inefficient pumps by farmers due to lack of incentives, given the low or no cost power supplied;

(c) The average extraction of water by such pumps is less than half that of China and is about 1.8% that of USA. (Chart -1, Annexure).This is despite the fact that the numbers of installed ground water extraction pumps/ tubewells are (at 20 million) the highest in the world[2].

(d) The unsustainable growth rate, low prices inevitably lead to a high subsidy burden on states, estimated at about Rs. 40,000 crores (Economic Survey, 2006-07).

2. **The Opportunity**: Ag DSM promises immense opportunity in reducing the overall power consumption, improving efficiencies of ground water extraction and reducing the subsidy burden of the states without sacrificing the service obligation to this sector. It also presents a promising prospect of targeting subsidy to the beneficiary farmer as this paper will outline. In terms of electricity saved, given that most of the pilot projects as well as other studies project potential savings of 45-50% by mere replacement of inefficient pumps, the overall electricity savings (from 20 million pumps) is estimated at 62.1 billion units annually.

3. **Dimensions of the Challenge**: The simplistic replacement methodology of inefficient pumps by efficient one is fraught with many practical impediments. Some of them are listed hereunder:

(a) **Technological**: The desired working of efficient pumps is contingent upon a reliable power supply, else the promised output may not be available. A reliable distribution network, like HVDS, in a rural area becomes of dominant interest. In addition, supply chain of efficient pumps, adequate maintenance expertise of such pumpsets in rural areas are the associated issues linked to the technology intervention.

[2] This part of the paper is based on the research and implementation experience of PA Consulting under the WENEXA project of USAID (India). The figures quoted here as well as in other parts of this document are based on the discussion paper title 'Concept Note on Agricultural DSM' by Mr. Jim Hogan, Chief of Party.

(b) **Economic**: The efficient pumps come with a higher first cost. Given the lack of incentives of the farmers on conservation of efficient use of electricity, the first cost bias enhances the barrier. Concomitantly, the low or no cost of electricity and uncertain availability of government subsidy does not enthuse the Utilities either to step up efforts towards upgradation of rural distribution network.

(c) **Analysis of location specific Baseline**: Potential savings are location-specific requiring adequate up-front analysis, extensive inspection, measurement and analysis of the existing stock of pumps, etc. Significant amounts of data collection are necessary to set a baseline to measure whether benefits were achieved and sustained. Measuring success often requires data on the number of acres under irrigation, total rainfall, cropping patterns, the type of irrigation (e.g. flood vs. drip) and other factors that influence the need for water and, thus, the amount of electricity used.

(d) **Monitoring**: This perhaps reflects the greatest concern in effective implementation of the Ag DSM. This is because of the following reasons:

(i) Lack of incentives of farmers and Utilities

(ii) The quantification of results requires metering, which in the present regime of subsidy, is unlikely to be accepted by the farmers.

(iii) Lack of awareness and information as well as low appreciation of the need to conserve water and electricity for sustainability.

(e) **Tragedy of Commons**: A "tragedy of the commons" occurs when property rights over a productive asset are ill defined or cannot be enforced. Thus, even if all the pumpsets are replaced, after setting the necessary baseline water requirements, absence of incentives diffuse the rights and obligations of its use. Several pilots have, after an initial success, failed to sustain in the medium or long run due to inability of organizing collective action to harness reckless proliferation of private good in the area.

(f) **Risks**: The above challenges inevitably enhance the risks associated with it and thereby preventing private investment on the performance contracting pay back model. The risks that need to be ring fenced are:

(i) ***Monitoring Risks***: Due to absence of standardized and verifiable protocols for monitoring, lack of incentives of key stakeholders, etc.

(ii) ***Commercial Risks***: Due to lack of adequate financing, high upfront investment, uncertain revenues and risk mitigation instruments (like ESCROW).

(iii) ***Political Risks***: As a result of the political economy of the agricultural sector poses a huge risk particularly in metering of feeders, individual pumpsets. Lack of collective action at the farmer level adds to this risk.

(iv) ***Regulatory Risk***: Due to absence of regulatory incentives, oversight and uncertainty over favourable policy (if any)

4. **Need for a Holistic Approach**: A successful implementation model must address all the above variables. In order to do so, the engagement of stakeholders must be enlarged to address all the issues mentioned in para 3. The key stakeholders that need to be engaged are:

- State Governments
- Ministry of Power
- Bureau of Energy Efficiency
- Ministry of Water Resources
- One or more Financial Institutions (e.g. PFC)
- Electricity Distribution Companies
- Farmers or Farmers Groups
- Energy Service Companies (ESCOs)

These stakeholders need work together to ensure that the plethora of variables is captured in a manner that provides a sustainable solution. The scheme needs to:

- Assess potential savings of electricity and water
- Create incentives for farmers as well as the state utility
- Analyze and plan the implementation of efficient pumps
- Conduct load research and establish a base line
- Provide a suitable funding mechanism with due incentives for an appropriate Public Private Partnership (PPP) model to work.
- Provide sufficient measures to ringfence all the risks associated with such projects. This would include, providing adequate payment security cover for investments by ESCOs, pro-active regulatory initiatives to promote investments, linkage of subsidy reduction with payment security instruments and strong policy framework at the state government level.
- Encourage measures that create awareness and education amongst farmers.
- Harness the collective action amongst local farmer community to diminish the effects of the free riders.

5. **Project Mechanics**: The project must have the following methodology inbuilt; the actual project design may vary to take note of local conditions. The key stakeholders listed out must partake one or more of the components of the mechanics as indicated hereunder.

(a) ***Project Identification Protocol (PIP)***: The identification of the project must based on the pre-requisites listed out in para 3 (a). The **prerequisites** that need to be evaluated are:

(i) The rural electricity distribution backbone- whether it provides adequate reliability of power supply essential for the scheme; eg. Installation of HVDS, segregation of agricultural feeders.

(ii) Availability of pumps of requisite efficiency in the region.

This **evaluation/ranking** must be done by the following steps:

(i) Those areas that have already migrated to HVDS to be taken *ab-initio*

(ii) In the second phase, areas that are covered under APDRP and/ or RGGVY to be shortlisted

(iii) Supply chain of equipment manufacturers, *pari-passu* with the Standards and Labeling programme of BEE must be firmed up.

The **responsibility** of stakeholders in this context will be as under:

Central and State Governments: Details of distribution upgrade in rural sector

BEE: Finalisation of Standards and Labeling programme and ensuring adequate supply chain of equipments in the designated project area alongwith maintenance facilities in consultation with the pump manufacturers.

(b) ***Incentive Conception Protocol (ICP):*** Efforts must be made to create ample incentives for the farmers as well as the state utility to take up the scheme. They could be:

Farmers: Sharing a part of the saved electricity, improvement in irrigated facilities or taking up part of the implementation responsibility.

State Utilities: Providing market based payments for monitoring and verification, allowing trading of 'surplus' power.

The responsibility to create this incentive lays squarely on the project sponsors namely Central & State Governments and BEE. The PPP partner (the ESCO) must ensure community participation as a part of its efforts to implement the project in an area. This could be done through farmers cooperatives, local panchayats or by franchisees at the village/ block level.

(c) ***Baseline Formulation Protocol (BFP)***: Baseline formulation must take note of:

(i) The appropriate level of water required, depending upon the cropping pattern.
(ii) The base level of electricity needed to provide (i) above, given the specification of the efficient pump set.

The **responsibility** of firming up the baseline wrests with the ESCOs, or in case of favorable policy environment facilitation, with the State Utility with support from BEE.

(d) ***Monitoring and Verification Protocol (MVP)***: As the acronym suggest, this is the heart of the sustainable project model. Monitoring requires:

(i) Metering of energy flowing into the agricultural feeder that is isolated;
(ii) Monitoring of energy consumption of each of the pumps in the designated project area.

The **responsibility** for monitoring of feeders could be that of the state utility while that of individual pumps that of ESCOs or farmers (through the ESCO).

(e) ***Collective Action Protocol (CAP)*** This ensures collective action to tackle the dual menace of the tragedy of commons and free riders. The primary **responsibility** of doing so must be of the ESCO with adequate support of farmers. The ESCO must engage the

local community in the day to day monitoring of the scheme. Selection of ESCO must be made contingent upon creating such linkage so that longer term sustainability can be achieved. The Government and BEE will take up the issues of awareness and education of the farmers in the area to supplement the efforts. One method which can help seal this issue of monitoring and collective action is the creation of incentives for the farmers. Given the background conditions that payment for electricity is a non-issue, initiative from the state government must commence this effort. The steps involved could be:

- Load limiters/ pre-paid meters to be installed at individual farmers level;
- The subsidy to be paid through these pre-paid meters upfront by the state to individual meters based on the baseline;
- The farmers may be provided incentive for reimbursement of any amount that they save from such pre-paid meters periodically.

(f) ***Risk Mitigation Protocol (RMP)***: The risk mitigation is proposed to be done in the following manner:

(i) ***Monitoring Risks***: BEE/ State Utility will provide standard monitoring methodology in keeping with the baseline evolved for the respective region. The monitoring will be done by Utility on payment basis with the verification oversight of BEE though an independent agency.

(ii) ***Commercial Risks***: Development Financial Institutions (DFI) like PFC/ REC will be included in the scheme to provide for the following:

(a) Finance at competitive rates- in case of otherwise, Central Government may consider interest subsidy to promote the scheme;
(b) Payment security mechanism by instruments like ESCROW to attract investment under the PPP route;
(c) Last mile equity if the need so arise.

The responsibility, apart from the project sponsors (GOI/ BEE) will be that of these DFIs.

(iii) ***Political Risks***: The state government has to take responsibility to mitigate this risk. This could be done by creating awareness, removing information asymmetry about the use of individual meters and appropriate policy announcements.

(iv) ***Regulatory Risk***: The State Regulators (SERCs) must take initiative to collate all the above in form of an attractive business model. The must ensure:

(a) Linkage of reduction of energy consumption with the overall subsidy payable by the state;
(b) A part of such saved subsidy is earmarked to an ESCROW account under the control of the DFI for servicing investments;
(c) Stable regulatory oversight for a period necessary for servicing the investment.
(d) Encourage measures to promote incentives to farmers, targeting of subsidies, due payment to the utility for services rendered and credit for electricity saved.

6. **Financing Requirements**: Given the estimate of 20 million pumps and an average cost of replacement of Rs. 30,000 per pump, the overall investment requirement is close to Rs 30,000 crores, presuming that 50% of the pumps may actually vget covered initially over a 2-3 year period. Concurrently, the yearly energy saving that would result in after making such investment will be to the tune of around 30 billion units per annum. Given the average cost of retail power to around Rs. 3 per unit, this would translate into Rs. 9,000 crores per year. Even if half of this saving is ringfenced, it would be sufficient to service the investments based on 70:30 D:E ratio presuming 14% ROE and 12% interest rate (to DFI). The two together will account for Rs. 3780 crores while another Rs. 2100 crores (first year) will be used for debt repayment. The total fixed charge on such investment will come to Rs. 5880 crores. In case two-thirds of the saved subsidy is earmarked for this purpose in the first year, the same will be sufficient to service the investment, with the balance amount of Rs. 120 crores could be used as a part to secure incentives to the farmers and utilities for operation and monitoring of the programme. The inevitable result is a saving of Rs. 3000 crores as subsidy by the state governments in the first year that progressively will increase with the reduction in the interest/principal repayment year to year. The flow of funds is at Annexure-II. It is estimated that the cost of maintenance/ O&M will be around Rs. 1000 per pump, translating into a requirement of Rs. 1,000 crores annually. The state governments will have to provide for this through the efficiency gains arising out of the scheme (of about savings of Rs. 3000 crores of subsidy, increasing progressively). Such reduction of subsidy, including the commitments made towards O&M of the scheme, must qualify for incentives under the APDRP scheme. Since the present dispensation does not provide this window, as cash losses are compared net of subsidy, the new instrument of APDRP incentive, under discussion, must provide for the same.

7. **The Way Forward**: The Central Government, States and BEE must create the favourable policy environment. To facilitate this programme, the following steps are suggested:

(a) Central Government must engage the states to pronounce necessary policy framework;
(b) The two governments, alongwith BEE, must identify the project areas, rank them.
(c) Central Government, BEE must ensure participation of DFIs. Also, it should fund monitoring and verification protocols in demonstrative pilots in some states; Targeting 1% of the pumps, this would translate into a funding requirement of around Rs. 50 crores for the XI plan period. This could be done by considering a scheme of BEE by the Ministry of Power/ Finance under the extant guidelines for investment approvals.
(d) BEE must facilitate, in close coordination with the state governments, utilities, promotion of private investment, collective action at farmers level. Provision of resources, including securing last mile equity required for financial closure must be facilitated, at least in the demonstrative pilots.
(e) States must, after appropriate policy pronouncements, must engage with the SERCs to provide appropriate regulatory environment indicated above for the investment to flow in.
(f) Key linkage with the existing APDRP scheme by:

(a) Facilitating monitoring and evaluation of projects in the states;
(b) Identification of appropriate sites *pari-passu* with the segregation of agricultural feeders and their IT enabled monitoring/ metering

(c) Creation of favourable environment to finance eligible projects through PFC and REC who have considerable experience and expertise in dealing with states;
(d) Providing guidance and support for appropriate payment security mechanisms to facilitate private investment, given the fact that the project can be sustained from the energy savings and its linkage to subsidy reduction.
(e) The resources for this purpose could be charged to the scheme under formulation by BEE.

The Central Government, after approval of the scheme, may create a project appraisal and approval committee comprising of stakeholders from the states, utilities, Planning Commission, Ministry of Finance, Ministry of Water Resources, DFIs to consider individual projects. BEE could service the committee with Director General being the Convenor. For this purpose, a three tier implementation instrumentality is suggested as under:

(a) **Ag DSM Steering Committee (Ag DSC)**: To be chaired by Secretary (Power), it must have representation from EC, Finance and Distribution Wings of MOP, Ministry of Water Resources, Planning Commission, Ministry of Finance, PFC, REC. The sponsoring state government will be an invitee member. DG, BEE will act as the convener of the Steering Committee. This Committee will give in principle approval to the projects. It will also stimulate financial closure of projects, once recommended by the Ag DSM Appraisal Committee.
(b) **Ag DSM Appraisal Committee (Ag DAC)**: Will be the appraising body for projects posed before the Ag DSC. It will comprise of working level officials from BEE, DFI, Ministry of Water Resources, Planning Commission, and Finance Ministry. The Joint Secretary incharge of EC in MOP could chair this committee. The committee will conduct the due-diligence by appraising the business model, revenue sustainability and risk mitigation measures as spelt out.
(c) **Ag DSM Implementation Committee (Ag DIC)**: For day to day monitoring of projects approved by the Ag DSC. This will be housed in BEE and will coordinate with the implementing partners to ensure successful implementation of the projects.

Annexure-I

Trend in Agricultural Demand

Chart-1

Structure of national groundwater economies of selected countries

Country	Annual groundwater use (km^3)	Millions of groundwater structures	Extraction/structure (m3/year)	% of population dependent on groundwater
India	185-200	20.0	9000-10000	55-60
Pakistan	45	0.5	90000	60-65
China	75	3.5	21500	22-25
Iran	29	0.5	58000	Dec-18
Mexico	29	0.07	414285	05-Jun
USA	110	0.2	550000	<1-2

Source: Tushaar Shah, IWMI

USAID | INDIA Water and Energy Nexus (WENEXA) II Project

Representative Tariff Increases

Tariff Comparison: Agriculture v. Industry (Paise)

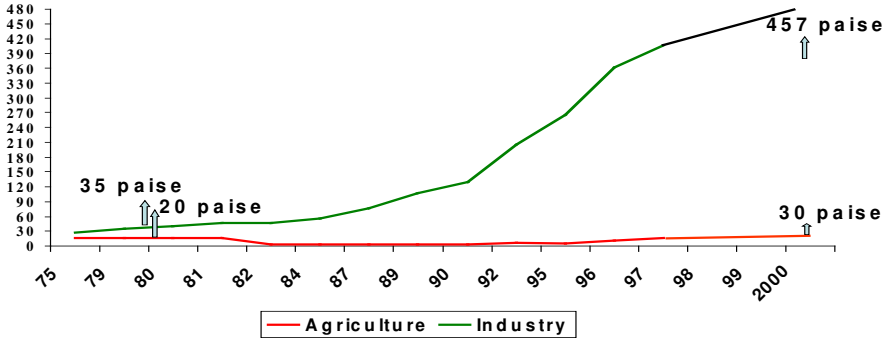
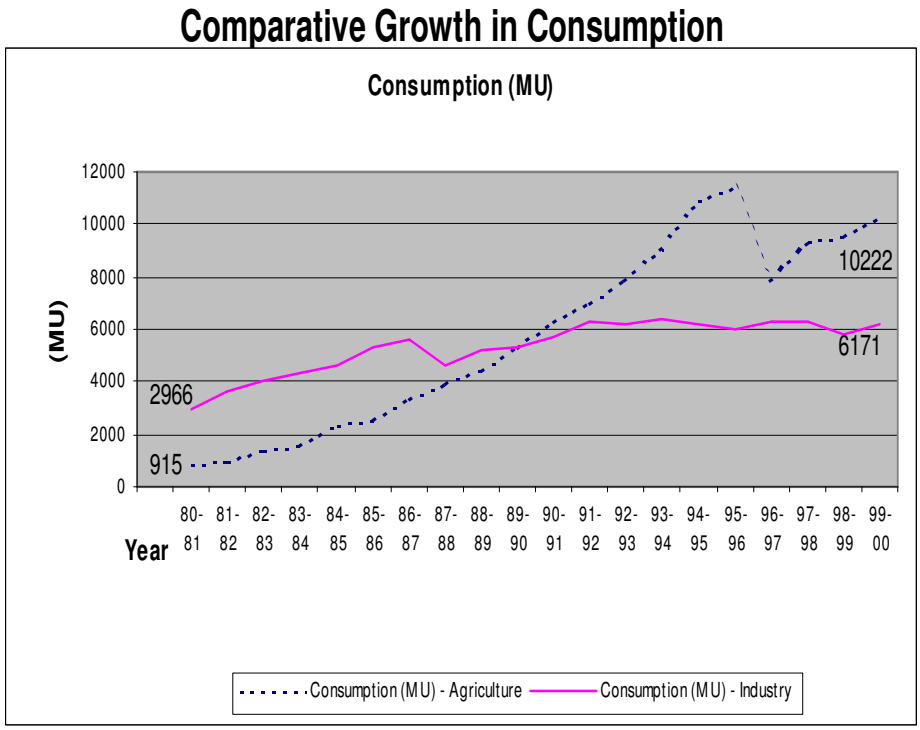


Chart 3


Comparative Growth in Consumption
Consumption (MU)
12000
10000
8000
6000
4000
2000
0
(MU)
10222
6171
2966
915
80-81
81-82
82-83
83-84
84-85
85-86
86-87
87-88
88-89
89-90
90-91
91-92
92-93
93-94
94-95
95-96
96-97
97-98
98-99
99-00
Year
Consumption (MU) - Agriculture
Consumption (MU) - Industry

Annexure-II

Financing Model

	1	2	3	4	5	6	7	8	9	10
Loan Amount	21000	18900	16800	14700	12600	10500	8400	6300	4200	2100
Repayment	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100
Interest	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%
Int. Amount	2520	2268	2016	1764	1512	1260	1008	756	504	252
ROE	1260	1260	1260	1260	1260	1260	1260	1260	1260	1260
ISR	5880	5628	5376	5124	4872	4620	4368	4116	3864	3612
Additional Subsidy of states#	120	372	624	876	1128	1380	1632	1884	2136	2388

This is over and above Rs. 3,000 crores that the state keeps in year 1 as indicated in para 6.

Key Assumptions:

(a) Loan for a 10 year period;
(b) Fixed rate of interest of 12% over the tenor of the loan;
(c) Cost price of electricity remains unchanged (frozen) over the life of the project;

Technical Session IV: Municipal DSM **Session Chairman – Shri G Subba Rao – Chairman GERC**	
Institutional and Policy Issues in Municipal DSM	DG, MEDA
PMC Case Study	Pune Municipal Corporation
Financing Municipal DSM	Mr. A.K. Jain, ED, PFC

Municipal DSM (Mu DSM)

1. **Background**: Energy costs constitute up to 60-70 percent of an Indian municipality's total cost of pumping water to its residents. This financial constraint, coupled with inadequate or antiquated infrastructure and the lack of adequate managerial and technical capacities, greatly limits the ability of municipalities to improve water services while allowing inefficient usage of electricity. The electricity bills of the municipalities accounts for a significant part of its expenditure, given that an estimated 10% of electricity is consumed for urban water pumping. The cash starved municipalities are, therefore unable to meet the service delivery standards that are fast growing urban area demands. The fact that efficient water delivery systems can translate into measurable energy savings due to reduced pumping requirements and improved performance is vastly unknown to most of the municipal authorities. Absence of enabling state level policies or regulatory interventions to implement water and energy efficiency measures to improve service and reduce costs, while on the other hand, reduce power consumption of the utility does not help matters. The need is to:

- Raise awareness among municipalities of the cost savings potential of Mu DSM.
- Build in-house technical and managerial capacity of municipalities to undertake energy audits and implement energy savings measures.
- Encourage state and regulators to provide conducive policy and regulatory regime to enable municipal level initiatives in this regard.

2. **Relevance of DSM to Municipal Sector**

The global trend is towards increased urbanisation wherein more than half of the world's population nowadays lives in cities and towns. Municipal Bodies[3] are responsible for providing various essential services to this urban population. These entities not only provide water to the urban residents but are also provide services such as streetlights, solid waste management, sewage treatment & disposal etc. All these activities consume significant amount of electricity in electricity system.

A report called "Watergy" published by the 'Alliance to Save Energy' provides certain startling facts about the usage of energy in water system.

- Pumping & treatment of water for urban residents and industry consumes about 2-3% of world's energy.
- Energy consumption in most water supply systems can be reduced by at least 25% through cost effective efficiency action.
- In developing countries, the cost of energy for supply of water may easily consume up to half of a municipality's budget.
- In developed countries, municipal water system, energy is the second largest cost after labour.
- Traditionally, little attention is paid to reduce energy use in municipal water system. Of late Municipalities have started identifying simple and cost effective course to reduce energy use while maintaining or even improving services.

[3] Municipal Bodies and Urban Local Bodies are being used interchangeably.

The above observations are equally applicable to India. In fact, India's urban system is the second largest in the world. The past five decades have seen a phenomenal increase in the growth of urban population in India. The level of urbanisation was 11% to 12% in the first three decades of the 20th century but it has surged noticeably from 17.3% in 1951 to 25.7% in 1991. According to the Census of India, the urban population in the country as on March 1, 2001 was 285 million which constituted 27.75% of the total population of 1027 million. It is important to note here that the contribution of urban sector to GDP is currently at 60% and accounts for more than 90% of government's revenues. Further, recent growth in GDP is likely to have given further impetus to this trend of urbanization.

It is not surprising that electricity consumption in municipal sector is increasing steadily over the last few years. Municipal corporation must not only consider financial & resource security benefit from DSM measures, but also need to recognize impact on environment created by burning of fossil fuels. The burning of fossil fuels such as coal, oil & natural gas to generate the energy used to supply municipal services affects mainly air quality. Emission from power plants like SO_2 & NO_x contribute high levels of pollutants in environment & emission of pollutants like carbon dioxide, contribute significantly in global climate change. Global climate change has the potential to reduce water tables and disrupt water supply in many areas, making water even scarcer. DSM measures have a key role in eliminating power shortage. There is need to address these issues on priority through integrated and comprehensive approach and by adopting latest techniques and technologies with active participation of all stakeholders. The following points will give more emphasize on need of DSM in municipal sector in India:

- A better use of resources equals lower cost of services. A balanced use of resources means a more secure and reliable energy supply. An expansion for products / services using less energy is an injection for future business. These three are the imperative logics of demand side management.
- Improving energy efficiency is the only way to achieve wide spread welfare without resources depletion. One unit of energy saved at consumption level avoids 2.5 times to 3 times fresh capacity addition.
- Almost all municipal bodies depend on the government support to meet their development & operating expenses.
- Usage of energy for providing services like water & street lighting is one of the major heads of ULBs.
- Several studies have highlighted that energy consumption in water systems could be brought down by 25 to 30% through cost effective energy efficiency action. Despite such a high potential for savings through energy efficiency measures, relatively little attention has been given to reduce energy cost.
- ULBs have seen increase in water demand, due mostly to population growth, burgeoning rural to urban migration & industrialization.
- Municipal water utilities can now take advantage of Clean Development Mechanism (CDM) to implement vital upgrades to their system. All activities that reduce water losses and improve the efficiency of electricity consumption in municipal water system can be eligible for emission credit.

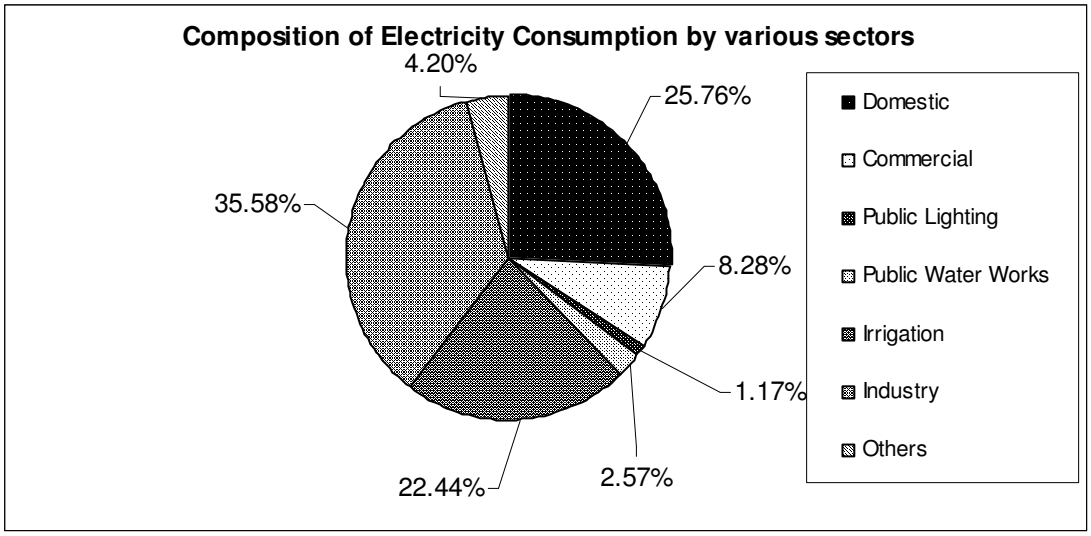
3. Electricity Consumption in Municipal Sector

In order to estimate potential for DSM programmes in the municipal sector, it is essential to understand the consumption by these sectors in total electricity consumption. In this section, ABPS Infra has analysed the consumption by municipal utilities over the past few years. While analysing the consumption, data provided in the '*Report on Seventeenth Electric Power Survey of India*' published by Central Electricity Authority, Ministry of Power, Government of India in March 2007.

While reading this data, following limitations of the data set should be kept in mind:

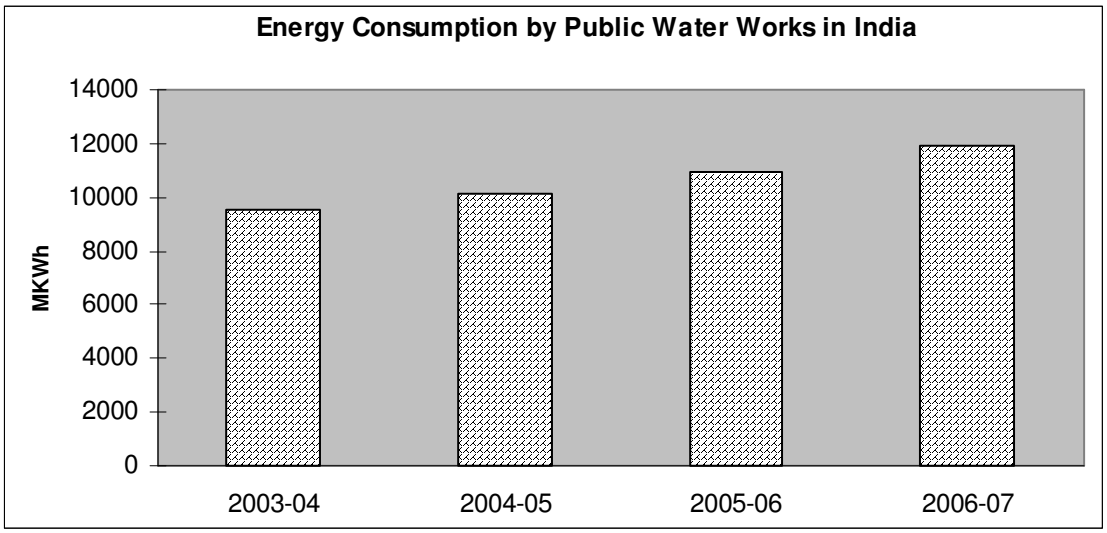
1. Data for urban and rural areas has not been segregated. Numbers provided for public lighting and public water works in the section are for both urban and rural areas together and not alone for urban areas.
2. Further, no separate data is being maintained sewage water systems. Since, in most States, water supply and sewage management is the responsibility of the same agencies, it can be safely assumed that electricity consumption of sewage treatment systems has been included in the consumption of public water works.

The following graph depicts the consumption of electricity by various consumer categories in India.

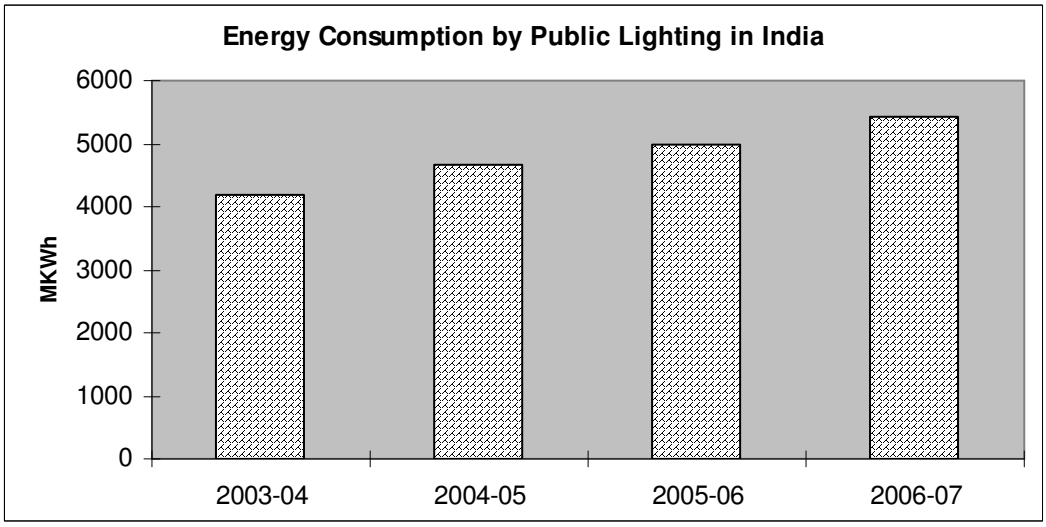


Source: ABPS Research

It can be seen from above graph that Public Water Works (PWW) & Public Lighting (PL) constitutes about 2.57% & 1.17% of total electrical energy consumption of India respectively. Energy While the quantum of electricity in percentage terms appears small, in absolute terms, these sectors consume significant amount of energy. Public water works consumes more than 12000 MUs while public lighting consumes more than 5000 MUs of electricity. If the estimates prepared by Watergy are accepted to be true and assume energy saving potential to be approx 25%, potential for energy saving is more than 4000MUs. With saving of the said energy, it should be possible to avoid capacity addition of more than 600MW. The following graphs depict the trend of electricity consumption by these two categories.



Source: ABPS Research



Source: ABPS Research

4. Energy Usage in Municipal Sector

4.1 Water Supply Pumping System

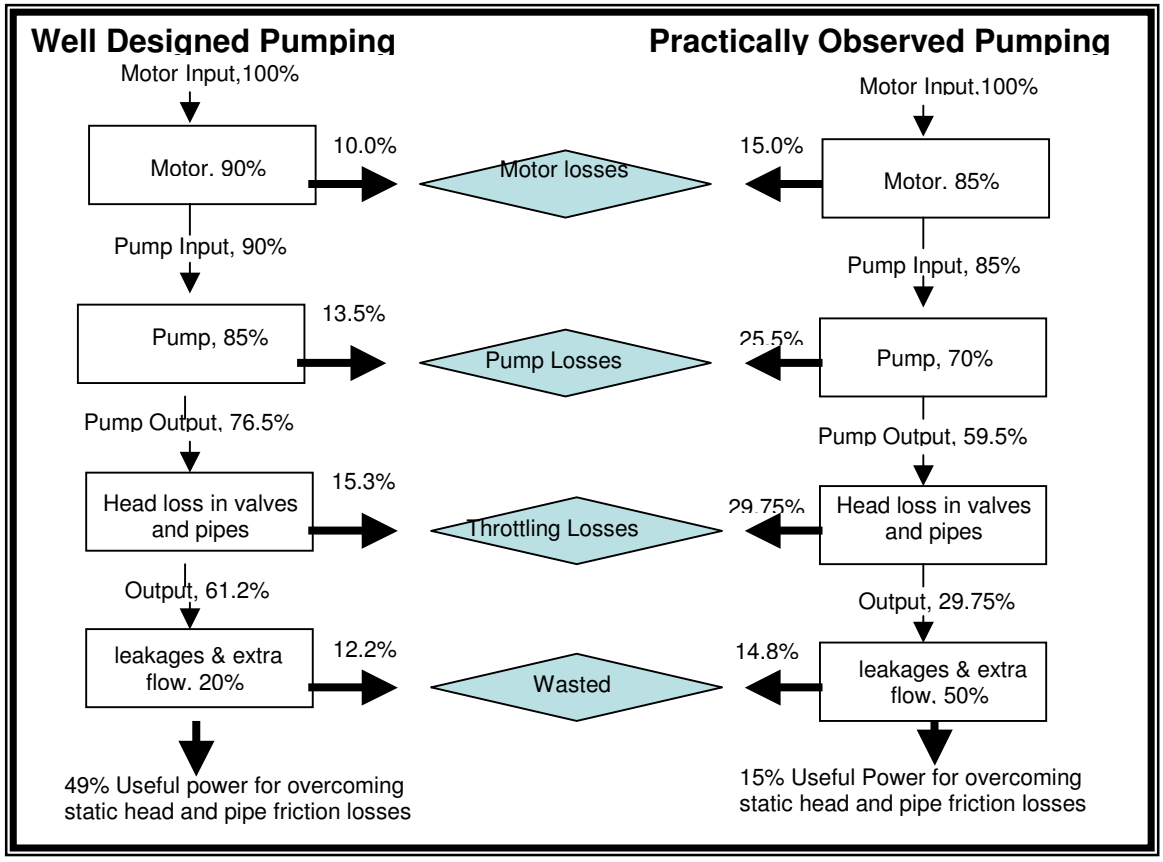
Several energy efficiency improvement projects like Vishakhapatnam Municipal Corporation Watergy Efficiency Programme, Pune Municipal Corporation - DSM & Energy Efficiency Watergy Programme, Identification of energy conservation measures in various sewage pumping stations of Delhi Jal Board, Detailed energy audit of Tiptur & Arasikere Municipal Water Pumping System & Detailed Energy Audit of water pumping stations & sewage pumping stations of Surat Municipal Corporation have been executed by Indian Urban Local Bodies to identify the areas where energy is wasted & suggested measures to improve energy efficiency in a pumping system.

This research has shown that the efficiency of energy utilisation in municipal pumping systems is low due to inefficient operation & maintenance practices, poor system

design, over sizing of equipment, improper selection of equipment, degradation of equipment due to age, etc. The main component of water supply pumping system includes:

- Pumping Stations
- Motors
- Pumps
- Transmission Mains
- Treatment Plants
- Electrical Installations

Following figure illustrates the overall efficiency in practical pumping systems in the industry and the achievable efficiency by careful selection and operation of the equipment.



Energy efficiency measures are characterized by diminishing rate of return on investment implying that the payback of first investment in energy savings measures will be faster in comparison of that for further improving energy efficiency of the same unit. Following table gives a detailed overview of various components of water supply system with functions, general problems & possible suggestions to improve supply side efficiency of municipal water pumping system.

Sr.	Component	Function	Problems	Suggestions/ Energy

No.		s		conservation Measures
1	Motor	Drives the pump	• Frequent Burning • Frequent Rewinding • Low Efficiency	• Correct Load, proper operation & Maintenance Practice • High efficiency Motors
2	Pump	Elevates the water	• Failure of Shaft / Impeller and less discharge, • Over Sizing of Pump • Improper Selection of Pump, • Degradation of Equipment due to age and poor operational practice	• Proper selection of pump to match head and flow requirement • Selection of high efficiency pump • Use of Variable frequency drive, Replacement of Trimming of Impeller, • Proper Operational & maintenance practice
3	Transmissio n mains	Carries the water	• Bursting & Leakages • Poor System design	• Tightening of Joints, Regular Maintenance, Leak detection & loss reduction, • Designing of new system with low friction losses, Selection of correct size and pressure of pipe, Optimising pipe line size

Sr. No.	Component	Functions	Problems	Suggestions/ Energy conservation Measures
4	Treatment Plants	Purification of water	• Chocking of filter media	• Timely washing of beds
5	Electric Installations	Power Supply	• Lower Power factor • Lower voltage • Fluctuation of MD • Burning of Cables	• Fixing of proper size capacitors • Addressing Discoms • Addressing discoms for refixing of MD • Use of adequate size with good quality and standard make cable

4.2 Street Lighting

Street lighting is one of the major functions of ULBs in terms of providing security to its residents. This is second to public water works in terms of contribution to the overall electricity bill of ULB. The efficiency of street lighting in ULB is low due to inefficient lighting system, lack of controls & poor management practices. The efficiency of existing street lighting system can be improved through use of new energy efficient lighting system combined with the controls. Energy audit studies of public lighting systems in the states of Rajasthan, Andhra Pradesh, Maharashtra & Madhya Pradesh (Under USAID, CIDA & DFID assistance) indicate that on an average 15-20% of the electricity consumed in public / street lighting can be saved by employing and adopting suitable conservation measures. Since little data exists on the relative merit of above listed conservation measures, no single DSM option is being suggested for targeting. Instead, depending on local conditions, whichever measures are found to be the most beneficial from consumer, utility & societal perspective is the one that needs to be targeted under this end use. Certain common problems & corrective measures that can be adopted to improve energy efficiency in street lighting system are given below:

Sr. No.	Description	Problems	Suggestions
1	Street Lights	• Inefficient Lighting System	• Replacement of Lights • Replacement of convectional choke with electronic choke • Installation of voltage controller
		• Lack of Control	• Installation of time controller for lighting feeders
		• Poor maintenance Practice	• Efficient operation and maintenance

		• Improper arrangement of luminaries	• Proper arrangements of luminaries
		• Unnecessary lighting in a day time & Excessive illumination during off peak periods	• Installation of time controller for lighting feeders & installation of voltage controller

4.3 Traffic Signals

Road traffic signals are used as a cost effective measures for controlling traffic safely and efficiently at intersections. Incandescent bulbs are being used as light sources in traffic signal heads for a long time now. LED (Light Emitting Diodes) have been used in place of incandescent lamps in traffic signals of late due to its energy efficiency and longevity. India is no exception to this and number of cities having LED retrofitted traffic signals functioning now. In India local self governing bodies are in charge of installing and maintaining traffic signals with the active involvement of local traffic police.

Conventional Incandescent lamps generate light by applying voltage across a tungsten wire filament in a glass enclosure and making it hot. Most of the energy is dissipated as heat and hence incandescent lamps are not energy efficient. Light emitting diodes (LED) are semiconductor based light sources where light is generated by an electron energy transition across a p-n junction by passing a current through a junction. LED can produce monochromatic light and hence there is no need for using external light filters to change the colours. Comparison of Incandescent lamp based traffic signals & LED based traffic signals is given below:

Description	Incandescent Signals	LED Signals
Power Consumption	100W	5~10W
Sun Phantom	Need colour light filter cover, easily produce sun phantom	High, brightness, pure colour light, apparent brightness contrast, no sun phantom
Operating Life	4,000 hours	70,000 ~ 100,000 hours
Cost of Maintenance	High	Low(95% cost reductive)
Environmental	Increase of CO2, the pollutant as well	Environment-friendly

Certain advantage of installing LED in traffic signal is given below:

- LED signals are energy efficient & consume 90% less electricity, reduce government liabilities by saving precious electricity.
- LED s is maintenance free up to 50,000 hours of long life resulting in a reduction of maintenance charges.
- LED s can be operated with Solar & UPS resulting in an operation of signals even during power failure & reducing traffic jams & accidents.

- LED is also come with dimmer, which further reduces the power consumption in night time.

5. Major barriers to DSM in Urban Local Bodies

Following are the main barriers to improvement of energy efficiency in Indian municipal sector:

- Inefficient data on existing energy usage pattern
- Absence of Energy Management Cell within municipal bodies.
- Lack of awareness on technologies for improving energy efficiency (EE).
- Limited availability of capital for investing in EE.
- Poor credit rating of many municipalities that makes financing of EE difficult, especially with the private sector Involvement.
- Management priorities do not focus on EE as other service provisions (health & infrastructure) take precedence.

6. Suggested Approach for Future DSM Projects

Municipal bodies often lack sufficient institutional capacity to develop practical approach for maximizing efficiency, even after recognizing the potential benefits. ULB has to develop proper approach & proper model to identify energy efficiency projects & implementation strategy for the efficient energy management. Following approach is suggested for the future DSM projects in ULB. The goal of energy management must be on provision of services like drinking water & street lights with the least cost and least environmental effect.

(1) Build Infrastructure & Energy Management Skills

- Designate the Energy Manager or Project In charge and build a Team
- Set goals and develop strategies
- Educate and involve employees in efficiency efforts
- Motivate people at all level & bring awareness about energy efficiency
- Generate a pool of technical know how to identify and implement projects
- Create a targeted budget for efficiency improvement

(2) Mapping of Systems & process

The objective of this task is to map the existing facilities & an accurate understanding of current operating system like water pumping stations, Water distribution system, electrical distribution system & lighting system in municipality. Build the institutional capacity to analyze system and locate efficiency opportunities. Data format sheet would be designed for inventory collection and historical data on energy consumption by various categories & installation wise. Data would be analyzed which would help in identifying system for detailed measurement and monitoring.

- Create metering and monitoring system
- Develop a base line of energy and water use
- Develop Internal Norms & standard
- External Benchmarking

(3) Detailed Energy Audit

An energy audit is a systematic exercise to identify end-uses that consume a significant amount of energy, estimate the efficiency in each of these end-uses and devise methods for improving efficiency and curbing losses and wasteful use. Comprehensive energy

audit study should be conducted on Water pumping system, street lighting, sewage pumping systems, & electrical distribution system. Detailed measurement of the systems may be carried out for identification of the projects. An energy audit report should also contain recommendations on priority for implementation of various measures.

(4) Development of Projects

This will include loss identification, concept design and basic engineering, technical analysis, preliminary cost benefit analysis, base line, monitoring & verification plan proposal for each of the identified projects. Selection of vendors is also very critical aspect from project development point of view. Various measures like contract and visit the agencies which have already executed/supplied similar types of projects from reliability and operation point of view, detailed study of equipments benefits and drawback shall be taken to assess the technology and vendors for project risks and finalizing the best investment.

(5) **Cost Benefit & Financial analysis & Prioritization**

Based on detailed cost estimates received from the equipment supplier, financial modelling would be done to obtain exact project financial. While identifying project cost and savings, the calculation of payback period and return on investment shall be calculated. Costs like additional manpower & provision of training should also be included into the overall project cost. These proposals should be classified and prioritized into short term, medium term & long term based on their importance, cost reduction potential, time frame of implementation & cost of implementation.

(6) Installations & Implementations of Energy Conservation Measure

After identification of sizable energy conservation measures in different areas, utility must make well informed decision on which opportunities to implement & how to make project happen. Team of energy management cell must prepare a list with all critical information which will make project more attractive to potential funders. A project proposal should address following key issues

- Equipment Specifications & Sizing
- Impact of the project on other parts of the system
- Maintenance scheduling & accounting for depreciations
- Prioritization in accordance with (Overall Capital Investment Needed, Technical Constraints, Company's finance resources, Available financing etc.)

(7) Project funding

To fund a project, municipal bodies may have to investigate broad array of internal and external funding options. Several innovative approaches have been developed to provide greater flexibility to implement water pumping & street lighting energy efficiency improvement projects. Following possible options exists for funding of energy efficiency measures:

- **Internal Funding**: ULB shall invest its own money into energy conservation project with no or little external support.
- **External Loans**: ULB shall take a loan from external agencies to execute energy conservation project. Several external agencies are providing loans for execution of energy efficiency project.

- **Equipment Leasing**: ULB that lacks funding or access to credit are more interested in testing technologies before making large purchases, especially interested in leasing energy efficient equipment. Equipments suppliers who manufacture equipment such as Capacitors, Pumps, Energy Efficiency Motors, Variable Speed drives are ready to give their equipment on lease basis.

- **Financing through ESCO Models**: An energy saving company (ESCO) is a company that is engaged in developing, installing and financing performance based project aimed at energy efficiency or load reduction of facilities owned/operated by customers. It offers the customer a single window to address all areas of energy efficiency. For an energy efficiency project, an ESCO offers the following services:
  - Energy Audit & formulating detailed energy audit report
  - Implementation of Energy Efficiency project (Includes undertaking implementation & project monitoring)
  - Procurement of equipments to be installed
  - Arranging finance for the project in select cases
  - Equipment maintenance and operations

If the ULB lacks the needed financial resources as well as technical capacity to implement an energy efficiency project, Financing through ESCO Model is a better option. The selection of ESCO shall be carried out in a transparent manner.

- **Grants from Government Agencies:** Several Grants from government is available to promote energy efficiency in various sectors. As per Energy Conservation Act 2001, State government shall constitute a fund to be called the state energy conservation fund for the purpose of promotion of efficient use of energy and its conservation within the state.

The water supply & Sanitation department, Government of Maharashtra, has passed a resolution for providing financial assistance to Municipal corporation and A Class Municipal councils for undertaking water audit, energy audit, water leakage detection and reduction programs. The imperative behind such a policy decision is that, all the municipal corporations and class councils should undertake a time bound programme for water audit, energy audit and an action plan to reduce unaccounted for water and achieve energy conservation.

Annexure: I Demand Side Management & Energy Efficiency Project in Pune Municipal Corporation

Background

Pune lies in western Maharashtra, the second largest city in the state after Mumbai with a population of over 3.5 million. The Alliance began its Watergy Program in India by partnering with Pune Municipal Corporation(PMC) in 1997.

The Alliance conducted an Energy audit on the Cantonment Water Works, and PMC implemented the suggested low-cost Measures in 2000.

The savings totalled 4,230,000 KWh with an average payback of 16 months.However, the project came to a standstill due to various reasons in 2000 and resumed when PMC came under new administration and rekindled its partnership with the Alliance.

This case study describes only the second phase of the Pune water efficiency effort, implemented in 2005 and 2006.

Key Results

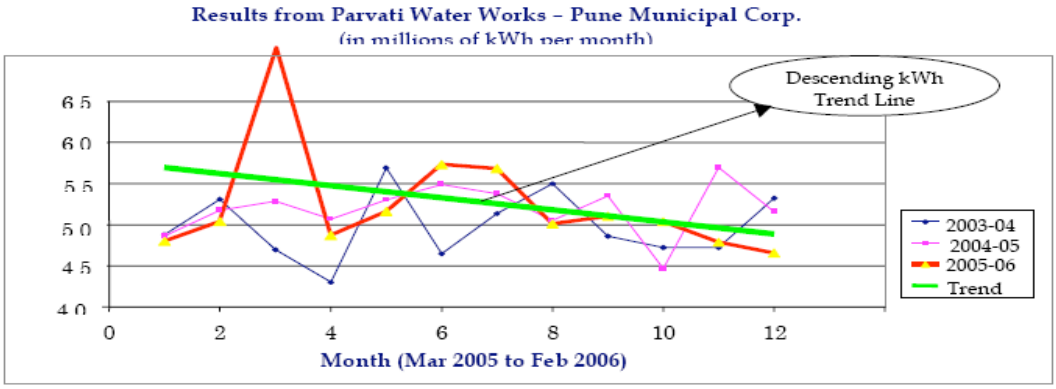
- Energy Savings : 3.8 Million kWh/year
- Cost Savings: US 3,36,000/year
- Water Pumped: 10% more water delivered to community with no additional new capacity.
- CO2 Emission Avoided: 38000 Tonnes/year

OBJECTIVES

The main objective of the Alliance partnership with PMC was to demonstrate that harnessing efficiencies at the nexus between municipal water and energy can greatly help municipalities in India and other developing countries address their urban water and energy challenges.

PROJECT

The Alliance partnered with the Urban Development Department of Government of Maharashtra and in January 2005, the Alliance conducted energy audits on PMC's bulk water supply systems. Coupled with the audit process, in order to build technical and managerial capacity at PMC, the Alliance also conducted hands on training for 45 PMC engineers that involved ten days of classroom and field work. Also participating in the Training was the state institutional partner, the Maharashtra Energy Development Agency (MEDA), All India Local Self-Government (AIILSG) and engineers from Nagpur Municipal Corporation. The draft audit report was discussed with PMC officials and once the municipal engineers agreed upon on the measures to be implemented, the report was finalized. The Energy Audit report suggested that PMC could accrue energy cost savings of Rs. 146 lakhs ($332,000) with an investment of Rs. 87 lakhs ($198,000). Nearly 70% of the suggested measures had payback periods of less than one year. Under the aegis of the Municipal Commissioner, PMC contributed a total of US$189,000 (Rs. 8.5 million) to implement a series of capital-intensive efficiency measures.



RESULTS

As a result of these measures, PMC is experiencing annual energy savings of 3.78 million kWh and annual cost savings of over $336,000 (148 lakhs Rupees). The savings achieved at PMC are higher than projected in the energy audit report since the PMC municipal engineers implemented additional low and no cost energy efficiency measures at the pumping stations including distribution pumping stations. This is a direct result of the training provided to the municipal engineers by the Alliance to Save Energy. The implementation of EE measures also resulted in 10% additional delivery of water to community without adding any new capacity. In addition to direct reductions in energy costs, the utility also saved money by qualifying for a rebate program offered by the Maharashtra State Electricity Board to facilities maintaining a good power factor and reducing usage during peak hours. The efficient operation of the largest pumping station, Parvati Water Works, reduced the energy intensity of water supply by 6%, from 375 kWh/million litres of water to 352, and increased its rebate by almost 8% since fiscal year 2003-04, from $110,000 (48.57 lakhs Rupees) to $196,000 (86.27 lakhs Rupees). The success of the PMC energy efficiency program has encouraged PMC to sustain its energy efficiency activities. The Municipality is currently discussing with consultants an extension of energy audits to other pumping stations in the network.

The PMC Watergy Program ignited the EE movement in Maharashtra as various other Urban Local Bodies—such as Thane, Nagpur and Municipal Corporation of Greater Mumbai—undertook similar efforts. The Alliance assisted the UDD, AIILSG and MEDA prepare the "Roadmap for Energy Efficiency in Urban Local Bodies in Maharashtra". The Chief Minister of Maharastra released the Roadmap in February 2005. The National Urban Renewal Mission (NURM) Cities in Maharashtra also added Watergy initiative as infrastructure development project in their City Development Plan for seeking funds for implementation of the project.

(Source: Watergy, Taking advantage of untapped energy and water efficiency opportunities in municipal water system, Alliance to save energy & USAID)

Annexure : II Identification of Energy Conservation Measures in Various Sewage Treatment Plants & Sewage Pumping Systems in Delhi Jal Board, India.

Key Results

- **Estimated Savings Potential :** Rs. 127 lakhs/annum
- **Investment Required:** Rs. 14.5 lakhs/annum
- **Simple Payback Period**: 2 Months

Areas for Improvement:

(1) Maintain Unity PF at main Incomer

(2) Demand Management

Delhi Jal Board has appointed one of the energy auc of their different sewage pumping stations & sewage Treatment plants in Trans Yamuna area. The Purpose of study is to examine existing energy Use pattern of the system, assess potential areas & To identify scope for reducing energy cost. Dallupura, Mandawali, Kondli Gharoli, Preet Vihar, Jagriti, Kalyanpuri, Geeta Colony sewage Pumping stations & Kondi phase I, II & III sewage Treatment plants has been covered during energy Audit study to identify energy conservation measures. Almost all sewage pumping stations maintaining very low power factors & having Improvement in Power Factor by addition of more capacitors & surrender of demand to the BSES will help in reducing total electricity bill of Sewage Pumping stations & Sewage Treatment plants of Delhi jal Board. Various data such as contract demand, actual billing demand & power factor has been analysed for last twelve months & proposed power factor & demand is given in the following table:

Sr. No.	Area	Existing Parameters			Proposed Parameter	
		Contract demand, kVA	Actual Demand, kVA	PF	Demand, kVA	PF
1	Dallupura Sewage Pumping Station	232	156	0.64	175	0.99
2	Mandawali Sewage Pumping Station	254	232	0.51	250	0.99
3	Kondli Gharoli Sewage Pumping Station	483	276	0.64	320	0.99
4	Preet Vihar Sewage Pumping Station	473	360	0.88	400	0.99
5	Jagriti Sewage Pumping Stations	936	300	0.92	350	0.99
6	Kalyanpuri Sewage Pumping Stations	1399	520	0.83	600	0.99
7	Geeta Colony Sewage Pumping Stations	286	81	0.85	90	0.99
8	Kondli Phase I & II Sewage Treatment Plant	1817	801	0.87	900	0.99
9	Kondli Phase III	914	390	0.86	430	0.99

	Sewage Treatment Plant					

Executive Summary of the detailed energy audit report is given in below table.

Sr. No.	Area	Energy Conservation Measures Identified	Savings Potential, KVAh/annum	Savings Potential, Rs./annum	Investment, Rs.	Payback Period, Months
	Delhi Jal Board					
1	Dallupura Sewage Pumping Station	Maintain Unity Power Factor at Main Incomer	78016	382277	13750	1
		Demand Management		102000	120000	14
2	Mandawali Sewage Pumping Station	Maintain Unity Power Factor at Main Incomer	189701	929536	45,500	1
		Demand Management		25200	120000	57
3	Kondli Gharoli Sewage Pumping Station	Maintain Unity Power Factor at Main Incomer	94651	463000	46250	1
		Demand Management		293400	120000	5
4	Preet Vihar Sewage Pumping Station	Maintain Unity Power Factor at Main Incomer	124284	600000	40000	1
		Demand Management		131000	120000	11
5	Jagriti Sewage Pumping Stations	Maintain Unity Power Factor at Main Incomer	56339	276000	25000	1
		Demand Management		1054800	120000	1
6	Kalyanpuri Sewage Pumping Stations	Maintain Unity Power Factor at Main Incomer	206867	1013651	18750	1
		Demand management		1438200	120000	1
7	Geeta Colony Sewage Pumping Stations	Maintain Unity Power Factor at Main Incomer	14886	72943	40000	7
		Demand Management		352000	120000	4
8	Kondli Phase I & II Sewage Treatment Plant	Maintain Unity Power Factor at Main Incomer	345165	1691000	94500	1
		Demand Management		1650000	120000	1
9	Kondli Phase III Sewage Treatment Plant	Maintain Unity Power Factor at Main Incomer	276506	1354000	44500	1
		Demand Management		871000	120000	2

Total Savings potential projected from detailed energy audit of Sewage Treatment plant & Sewage Pumping systems of Delhi Jal board is around 127 lakhs per annum with an investment of only 14.5 lakhs per annum resulting in a simple pay back period of just 2 months.

Detailed energy management plan has to be worked out to implement the all above mentioned energy conservation measures to reduce the overall operating cost.

Annexure: III Retrofitting Road Traffic Signal with LED- an evaluation for Surat Municipal Corporation, Gujarat, India.

Traffic in the city of surat is growing at a fast pace due to its divergent and flourishing business activities like textiles, chemicals, dyes and diamond cutting. The traffic here is mix in composition; a higher percent is comprised by motorised two wheelers and three wheelers. A typical junction in surat is shown in below figure.

Surat Municipal Corporation has embarked upon a program of retrofitting the traffic signals with LED. This paper envisages the evaluation of the LED retrofitting done in various intersections falling under Surat municipal corporation bodies. Data were collected for various intersections where the retrofitting with LED was done.

Data related to monthly power consumption & maintenance expenses were also collected from Surat Municipal Corporation. 268 red signal faces, 391 amber signal faces and 522 green signal faces were replaced with LED signals. In addition to this Pedestrian signal faces of 187 numbers each of red and green were also retrofitted with LED signals. Considering 60%, 35% & 5% as the usage time of red, green and amber signal faces respectively, annual savings were calculated as shown in below table. Initially, Incandescent lamps were having wattage of 100 each and the same was reduced to 10 wattage for red and amber, 4 wattage for green & 3 wattage for pedestrian green and pedestrian red.

Parameters	Unit	With LED	With Incandescent Bulb	Savings in Rs.	% Savings
Energy Expenses	Rs./month	8,940	74,582	65,642	88
Energy Cost per annum	Rs./annum	107,280	894,984	787,704	

Maintenance Expenses	Rs./month	33,000	67,235	34,235	
Maintenance Cost per annum	Rs./annum	3,96,000	806,820	410,820	51
Total Expenses	Rs./ annum	5,03,280	17,01,804		
Net Savings	**Rs./annum**			**11,98,524**	**70**

Pay Back Analysis	
Total Initial Retrofit LED Investment	**- Rs. 39,63,492/-**
Payback Period	**- 3.31 Years**
Life of LED Signals	**- 7 Years**
Total Savings over the life of LED	**- Rs. 83,89, 668/-**

An evaluation of LED Signals was done by extrapolating the actual power savings accrued for one month due to the operation of LED signals. It was found that the retrofitting with LED has resulted in 88% savings in power consumption and 51% savings in maintenance cost. In addition to these, there are intangible benefits like benefits accrued for the non disruption of traffic due to 100% utilisation of the system during the warranty period, reduction in accidents, savings in insurance sum etc. Also it has to be noted that with the research and development in the field of LED, the price of LED are going further down in the coming years, which will improve the economical viability of retrofitting with LEDs.

(Source: Retrofitting road traffic signals with LED, an Evaluation By Nitin Vaidya, Krishna Kumar & Suresh P.S.)

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