Energy Efficiency Opportunities and Challenges in Water Supply System

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Energy and Resource Efficiency in Urban Water Management

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ALLIANCE TO SAVE ENERGY

Using less. Doing more.

watergy WATER & ENERGY EFFICIENCY

What is the Alliance to Save Energy?

Mission:

- To promote energy efficiency worldwide to achieve a healthier economy, a cleaner environment, and greater energy security.

- ***Organization:***
- Non-profit organization with HQ in U.S.; operations world-wide
- Staffed by 80+ professionals

Who is the Alliance to Save Energy?

- Established in 1977
- Non-Profit
- A **leader** in energy efficiency in all sectors:
  - **municipal**
  - utilities
  - research
  - federal government (e.g., FEMP)
  - **industry**
  - appliances
  - policy
  - **buildings**
  - transportation
  - education
- Experience in more than 35 countries
- Office in India (Bangalore) for more than a decade

Watergy- Program designed for municipal water supply system

Overview- Indian Municipal Sector

- Second Largest Municipal System in the World
- India's Municipal sector consumes 4% of total electricity

- Energy Consumption by Public Water Works
  - ✓**18,927 Million Units (2012-13)**
  - ✓**36,3297** Million Units (Estimated for 2021-22)
  - ✓Growth approx. 92% in 9 year

Data source: BEE/CEA 18EPS

Watergy Facts

- Every liter of water that passes through a system has a significant energy cost, compounded by the money invested to produce it.
- In developing countries, the cost of energy for supply of water may easily consume up to half of a municipality's budget (40-60%)
- Energy expenditure is the second largest cost after manpower.
- 1/3 of India's urban population lacks direct access to clean, affordable and reliable water services

Why Municipal Water Energy Efficiency ?

Water Supply is Energy-Intensive

What's happening?

Energy Efficiency Challenges for Indian Cities

- Cities lack technical, managerial and financial capacity to design & implement projects
- Lack of metering & monitoring systems - *difficult to establish baseline*
- High rates of unaccounted for water; unreliable water services
- Procurement is based on 'first cost' (L1) NOT on **Life Cycle Cost**

What's happening …..reasons for Poor Efficiency

- Over design - in view of catering future need (*factor of safety margin*)
- Changes in operating practices/schedules – to cater the current needs (*pumping head changes*)
- Efficient component NOT installed and/or operated properly
- No existing Government policy/incentive for reducing energy consumption in water delivery;

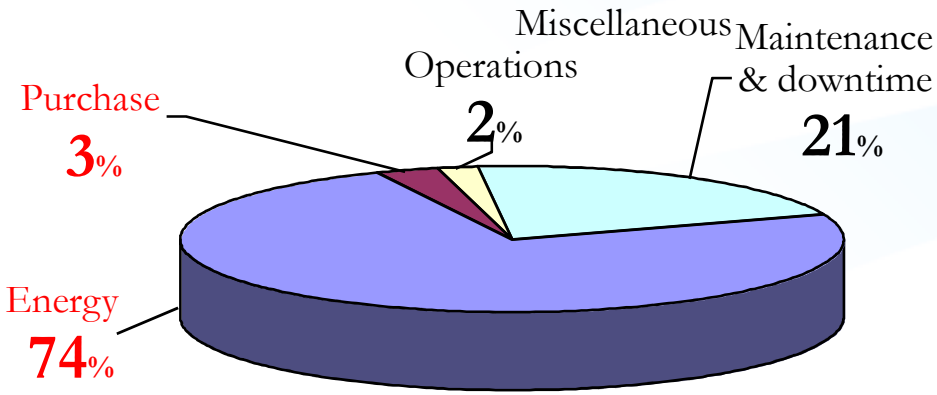
Why Oversized Pump ?

- Safety margins were added to the original calculations. Several people are involved in the pump buying decision and each of them is afraid of recommending a pump that proves to be to small for the job.
- It was anticipated that a larger pump would be needed in the future, so it was purchased now to save buying the larger pump later on.
- It was the only pump the dealer had in stock and you needed one badly. He might have offered you a "special deal" to take the larger size.
- You took the pump out of your spare parts inventory. Capital equipment money is scarce so the larger pump appeared to be your only choice.
- You purchased the same size pump as the one that came out of the application and that one was over sized also.

How Oversized Pump ?

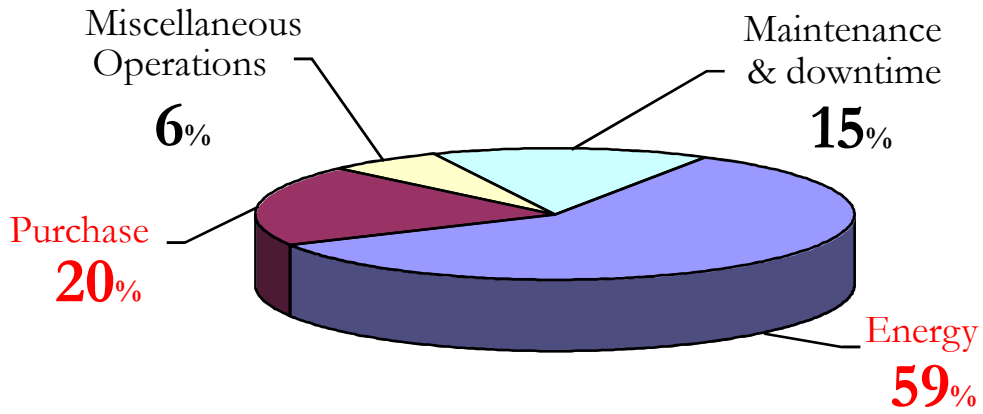
- Required flow- 150 LPS – after final calculation
- Design Engineer – 10-15 % extra – 12% (approx.)
- New Flow- 168 LPS
- Approval Committee – keeping future demand into consideration – Suggest – 10 % more
- Revised Flow – 185 LPS
- Purchasing Department – In View of better commercial deal Supplier suggest higher capacity pump in Same price range- again flow increases by 10 - 12 % approx.
- Final Flow- 207 LPS
- Net Increase in Flow – **38 %** - at the time of procurement
- **Final effect at operation end- Throttling to get reduced flow**

Life Cycle Cost of an Efficient vs. Inefficient Pump



- Purchase Price: $28,000
- 1st Yr Energy Cost: $69,000
- Total in Year One: $ **97,000**

Life Cycle Costing: Inefficient Pump



- Purchase Price: $56,000
- 1st Yr Energy Cost: $19,600
- Total In Year One : $75,600

Life Cycle Costing: Energy Efficient Pump

Benefits - Municipal Energy Efficiency

- **Extremely Cost Effective (20 to 40% saving potential)**
  - at least 4000 Million Units of energy savings
  - Simple Payback 2 to 3 years
  - Reduces the need for new infrastructure
- **Improved Municipal Services**
  - Time to incorporate best practices
  - Reduces the cost recovery margin
  - Enhanced service level

In National /State Interest

- Reduced energy intensity will help climate change mitigation efforts
- Reduce demand and supply gap at the national/state level

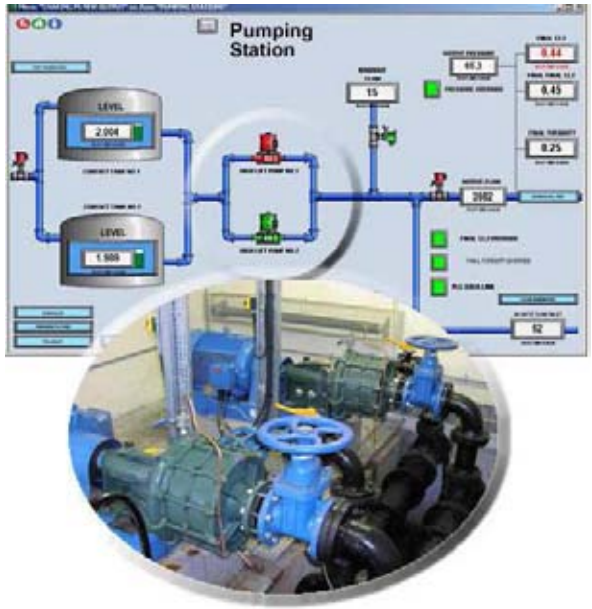
Energy Efficiency Measures – Water Supply Systems

Cost-Effective Interventions

- Pumps & Motors
- Leak Management(NRW)
- Automated Controls

Pipelines(Pressure Management)

Metering & Monitoring



No/Low Cost Measures – Easy to implement

- ✓ Surrendering of Excess Contract Demand (KVA)
- ✓ Power factor Improvement (PF) (0.98)
- ✓ Improvement in O & M Practices
- ✓ Separation of LT & HT Load
- ✓ Leak Detection and Repair
- ✓ Rescheduling of pumping operation (*TOD tariff*)
- ✓ Star Mode operation: *Under-loaded motors*

Medium Cost Measures

- Impeller Trimming
- Replacement of inefficient Pumps
- Installation of Energy Efficient Motors
- Improvement in Piping – Suction & Header
- Application of Soft Starters
- Application of VFDs – for variable demands(Sewage systems)

Measures to Improve Efficiency and Typical Payback Periods

Measure	Function		PB (yrs)
Reduce peak use	Control demand during peak rate hours		0 – 2
Optimizing electric installations	Power factor optimization		0.8 - 1.5
	Reduction in voltage imbalance		1 – 1.5
Improved O&M	Routine pump maintenance		2
	Deep well maintenance and rehabilitation		1 - 2
Production and pumping	Automated controls		0 – 5
	Replace oversized pumps with more appropriate and efficient pumps		2-3
	Optimize pumping systems efficiencies		0.5 – 1.5
	Trim the impeller		0.1 - 1
Distribution system	Use of highly efficient motors		2 -3
	Redesign of the grid		2-3
	Control pressure and output in the networks	Sectoring; variable speed drives; regulating valves	1.5-3
Technological improvement on the demand side	Flow recovery program		0.5 - 3
	End-use efficiency		1 - 3
	Metering systems		1 - 2
	Efficient wastewater technologies		1 - 2

Case Studies

Energy Saving Potential & Implementation

Energy Saving Potential in Delhi Jal Board

Type of Proposal	Nos.	Saving Potential, Rs. Lakh	Investment Required, Rs. lakh
No/low Cost	9	179	17 (Payback: 1 month)
Investment Oriented proposals	6	355	448 (Payback: 15 months)
Total	**15**	**534**	**465 (Payback: 10 months)**

- ✓ Low and medium cost measures implemented; Accruing Annual Savings of Rs. 7 Crore
- ✓ Established Energy Management Cell

Based on the Alliance Watergy study results (2004-05)

Energy Saving Potential in Four Towns in Karnataka

Type of Proposal	Nos.	Saving Potential, Rs. Lakh	Investment Required, Rs. lakh
No Cost (immediate)	20	67	Nil
Short Term (1 -12 months)	18	178	78 (Payback: 5 months)
Medium Term (1 – 2 years)	6	63	77 (Payback: 15 months)
Total	**44**	**308**	**155** **(Payback: 6 months)**

Mysore, Bellary, Hubli –Dharwad, Tipture-Arsikere

Energy Saving Potential in Two Towns in Andhra Pradesh

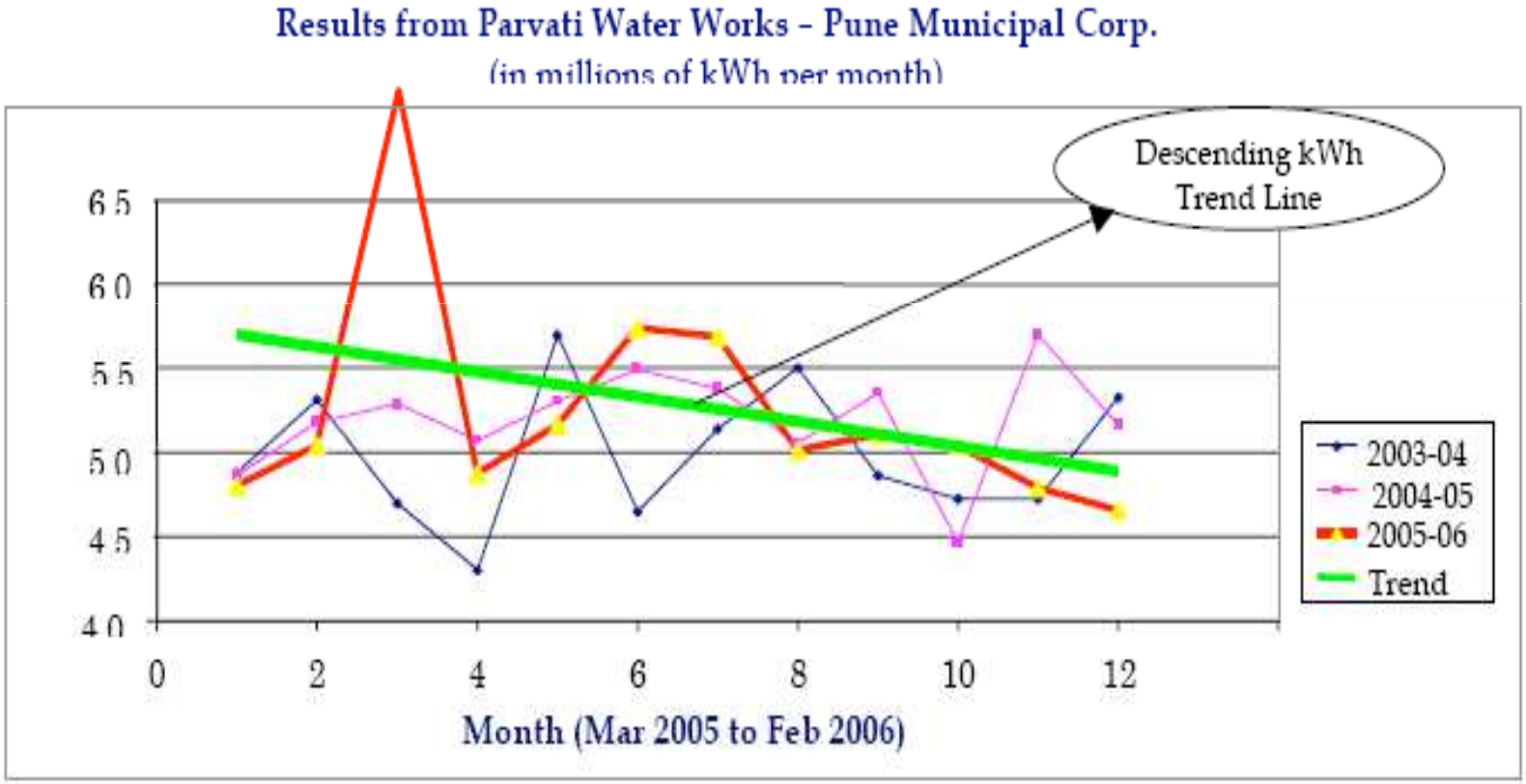
Type of Proposal	Nos. of EE Measures	Saving Potential, Rs. Lakh	Investment Required, Rs. lakh
No Cost (immediate)	10	31.1	0
Short Term (1 -12 months)	6	31.0	20 (Payback: 8 months)
Medium Term (1 – 2 years)	2	1.8	2.5 (Payback: 17 months)
Total	**18**	**63.9**	**22.5 (Payback: 5 months)**

Vijaynagarm, Karimnagar

Energy Saving Potential Pune Municipal Corporation

Type of Proposal	No. of EE Measures	Annual Saving Potential Rs. Lakh	Cost of Implementation Rs. Lakh	Payback Period, months
Short term,	11	103.7	32	4
Medium term	4	42.1	55	16
Total	**15**	**145.8**	**87**	8

Pune Municipal Corporation



- Additional 10% Water Delivered from existing infrastructure

A few Implementation Models

- In-house funding to implement EE project
- EE aspects incorporated into procurement policy
- Performance based contracts – ESCO implementation (self paid contracts)
- EE to be included as part of water supply infrastructure project
- Grant supported – government, development agencies, (pilot)

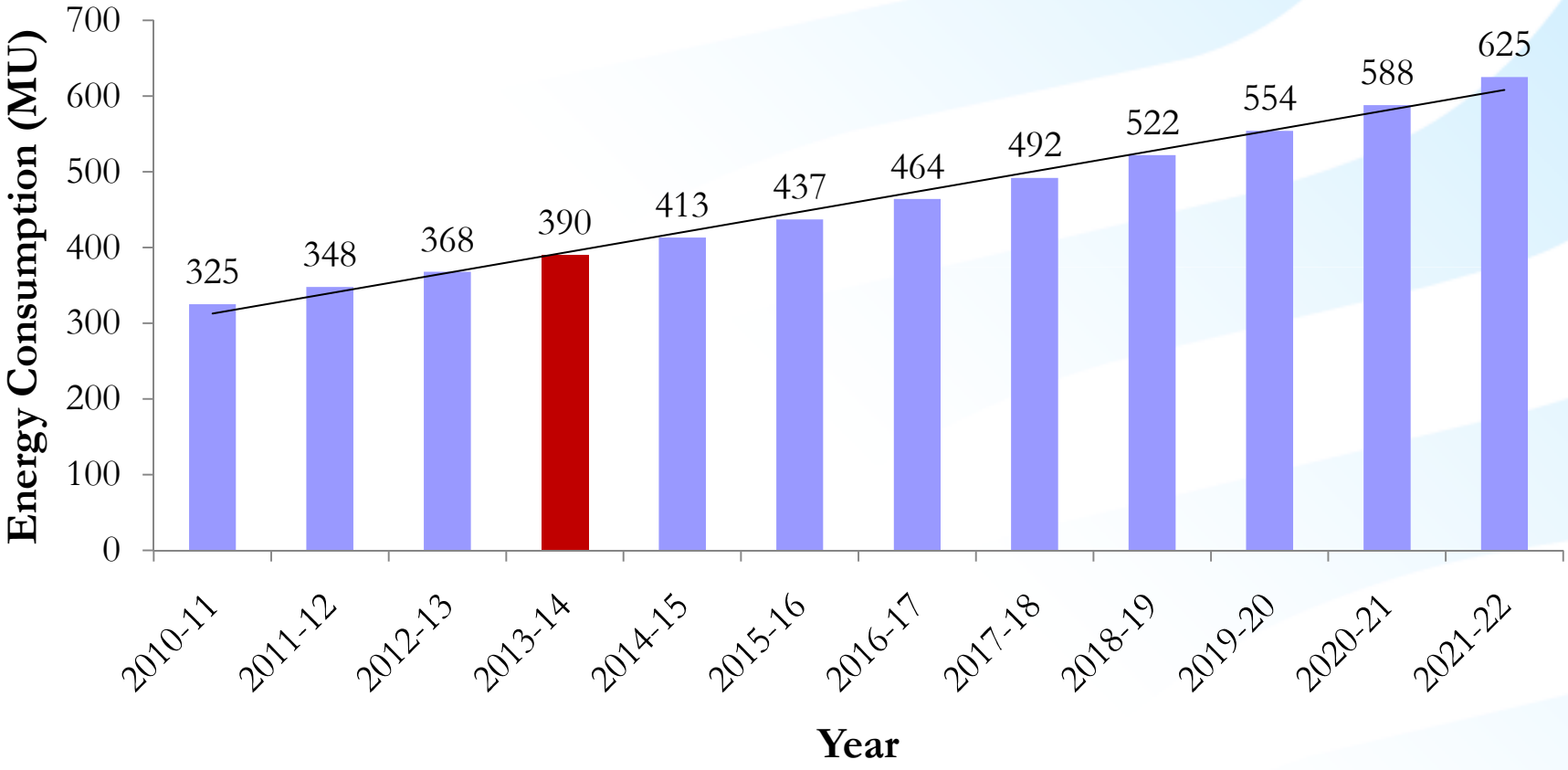
Delhi Water Supply System

Delhi Water Supply System

As per Central Electricity Authority(CEA) – 18th EPS report

- Water Works Energy Consumption
  - 2010-11- 325 Million Unit (MU)
  - 2013-14 – 390 MU
  - 2021-22 – 625 MU (approx. 93 % growth over ten year)

Water Works Energy Consumption Growth Pattern- Delhi



Estimated Energy Saving Potential @ 25% = 97 Million Unit (for year 2013-14)

Opportunities …..

- Total water supplied = 835 MGD i.e 3157 MLD
- Energy consumption as per CEA data= 390 MU (2013-14)
- Efficiency gain @ 25% = 97 MU (lighting and other load excluded for estimation purpose)
- Cost savings in the tune of 29 Crore per annum (energy cost @3/kwh)

η improvement will play a significant role in making cost recovery

Kwh/MLD is key…

- *CEA 18th EPS data*

DJB Initiatives …..

- Smart metering
- Leakage management & water audit
- PPP approach in NRW programs (3 pilots)
- Central monitoring system/SCADA in place for monitoring
- NRW reduction program in place – Presently 55% to targeted for 30% (in 12th five year plan)*
- Promote PPP approach in the water and waste water management

Key Drivers

DJB would like to cover all areas with water supply system from current coverage of 72%

That means,

- implementation of new water supply projects
- New pumping system, expanded pipeline,
- Integrated sewage handing and treatments facilities

- Energy price is expected to keep increasing
- Water tariff – continued to be lowest ??

►►All these will lead to added expenditure on energy , required more budgetary allocation

What needs to be done …

A. Optimization of the existing pumping system and machineries (*energy audit, baseline establishment-kwh/ mld, efficiency improvement, better O&M practices*, etc..)

B. Augmentation/Rehabilitation of the old pumping systems (*correct sizing of pumps and motors, remove capacity mismatch in parallel operation of pumps, pipeline replacement, re-routing of the transmission mains, application of booster pumps for farthest point)*

What needs to be done …cont..

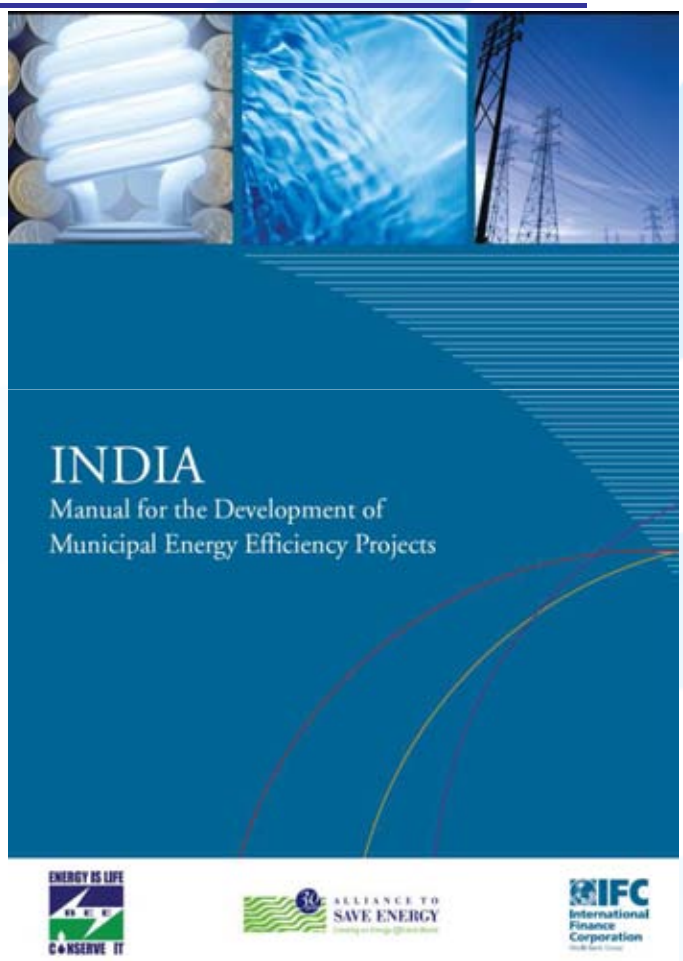
A. Integrated energy efficiency design approach – for implementing new water pumping and sewage project

- ✓ Efficient design and procurement of pumps and motors
- ✓ Adopt modular approach while considering forecasting (*pumps to be added periodically over a period of time, bigger pumps selection with small size impellers*, *adequate pressure mgmt. to avoid leakages, etc*..)
- ✓ Application of VFDs in variable load condition(*very effective for sewage pumping*)

►► JnNURM Phase II will gives importance to all these while selecting and approving projects..

Guidelines to Develop and Implement Municipal EE Projects

- Released with Bureau of Energy Efficiency and the Alliance
- Targets:
  - Municipalities/ULB
  - EE services providers
  - Financial institutions
- Contains:
  - Step by step guidelines
  - Templates (RFPs, PCs, etc)



www. ase.org/resources/manual-development-municipal-energy-efficiency-projects

Define energy efficiency as a "Requirement" Not as an "Option" or "Choice"

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