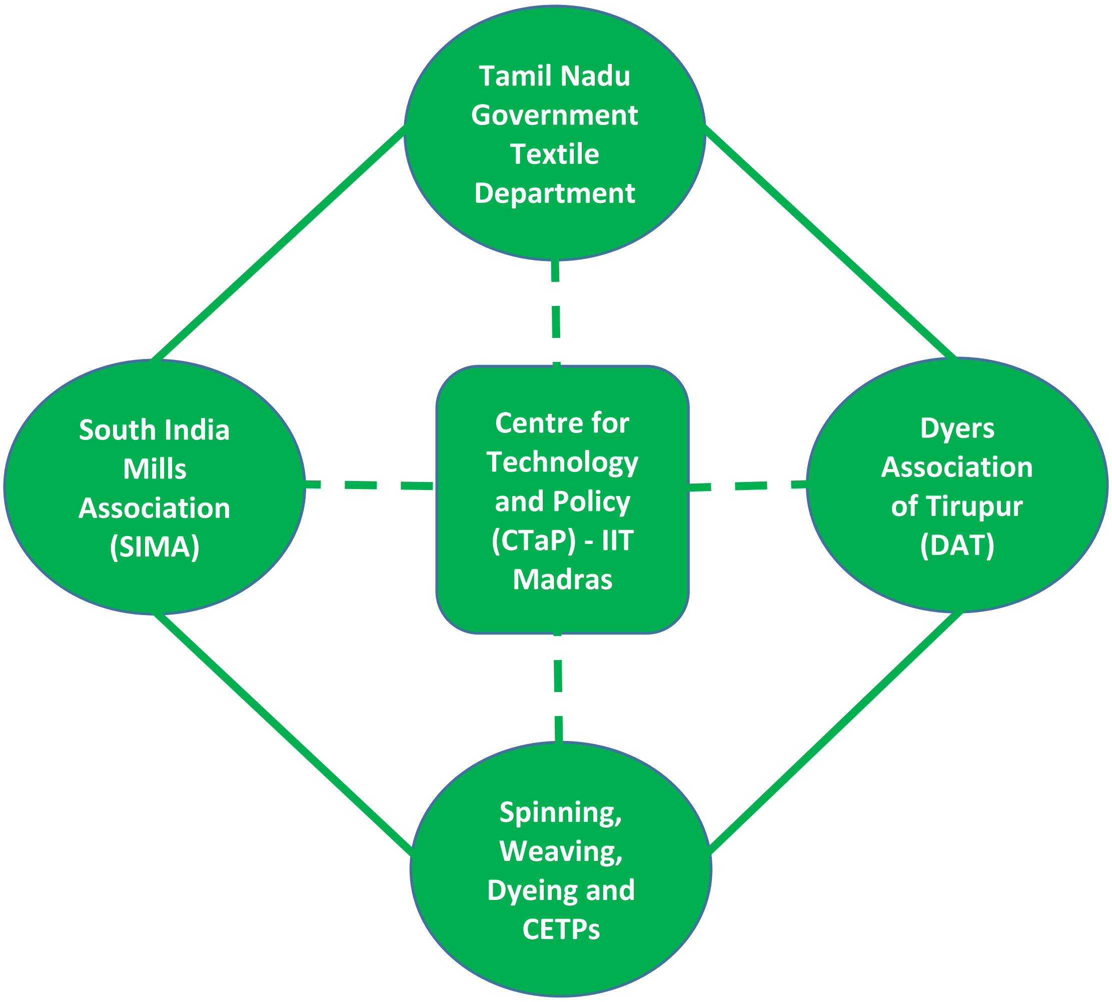
ROUND TABLE ON SUSTAINABILITY IN INDUSTRIAL ENERGY USE IN TAMIL NADU

Energy Conservation Measures: Hits & Misses - Scope for Techno-Economic and Policy Interventions

Date: **23rd November 2019**

Venue: **IIT Madras, Chennai**



From our Director's Desk

Energy efficiency and energy conservation have been the mantra for sustainable manufacturing during the last decade and more. The low-hanging fruit in terms of avoiding wastage, replacing old machinery with more efficient models, etc have already been plucked. However, larger gains are to be had if one is willing to delve deeper and look for recouping energy that was hitherto thought to be unrecoverable.

New technologies in sensors, controls, power electronics, etc enable cost-effective energy recovery methods that were till recently economically or technically unviable. Much of the recovered energy can be used in the manufacturing process itself thus reducing the withdrawal of energy from external sources. However, the discovery of such feasible opportunities, and customisation of technical solutions to exploit these opportunities calls for a new evidence-based approach to the discovery and solution-development processes.

This report gives one example of such an evidence-based discovery of an opportunity in steam-based process industries, and the development of a cost-effective and technically feasible solution to recover the hitherto wasted energy and its usage in the process itself.

This represents a new paradigm for research and development at our Institute and the Centre for Technology and Policy (CTaP) is to be commended for exploring it.

Prof. Bhaskar Ramamurthi

Message from Textile Secretary – Thiru. Kumar Jayant, I.A.S.

"Textile Industry is a very important sector of Tamil Nadu's economy. It provides employment to maximum number of people after agriculture. In the current market scenario, this industry has to compete with a lot of emerging developing countries. Hence, it is essential that various sectors of this industry keep abreast of technological advancement and utilize technology to reduce their operating cost. Improving energy efficiency is an extremely important step in this direction. This effort by IIT Madras to provide a technical solution to utilize the energy available in low power / pressure steam systems with variable cost is a commendable step in this direction. I hope that this project will be able to demonstrate higher efficiency in power generation even at the variable operating condition of textile sector. The processing industries will be particularly benefitted as they will be able to reduce their energy cost to a greater extent. I wish all the best to the stakeholders. Government will be ready to support such innovative initiatives".

Kumar Jayant, I.A.S

Message from South India Mills Association (SIMA)

The textile industry is one of the most complicated manufacturing industries because it is a fragmented and heterogeneous sector dominated by Small, Medium and Large (SML) enterprises. Next to raw material, energy is one of the main cost factor in the textile industry as it consumes more energy 24 x 7. About 34% of energy is consumed in spinning, 23% in weaving, 38% in chemical processing and another 5% for miscellaneous purposes.

During times of high energy cost, the know-how energy-efficiency technologies, measures, improvements, opportunities and best practices need be prepared and disseminated to textile plants. Improving energy efficiency is the primary concern for textile plants. Only by adopting energy efficiency methods, the textiles industry could withstand both the domestic and Global competition. In spite of various energy-efficiency opportunities that exist in every textile plant, many are cost-effective, but they are not widely implemented in textile plants mostly because of limited information on how to implement those measures.

Through various case studies through energy conservation audits in textile mills across the country, the potential for energy savings shall be explored and disseminated to the textile industry. More renewable energy usage in the textile industry shall be encouraged.

Message from Dyers Association of Tirupur (DAT)

The members of Dyers Association of Tirupur (DAT) are involved in dyeing activity which is the backbone of garment industry. Zero Liquid Discharge (ZLD) system is implemented in all the 18 Common Effluent Treatment Plants (CETPs) which are treating the effluent being generated by their member dyeing units numbering 300. Apart from this, there are about 100 bigger dyeing units called Individual Effluent Treatment Plants (IETPs) treating their effluent in-house.

All the dyeing units are using boilers and many numbers of motor pumps during the course of dyeing and effluent treatment process. Effluent from the member units is sent to the CETPs through underground pipelines and purified water is sent back to the member units in separate underground pipelines. For all these operations, electric motor pumps are used. Evaporators used for effluent treatment in CETPs consume more energy, In fact, about 50% of effluent treatment cost goes to energy and this enhances the processing cost of member dyeing units. To become viable and improve the profitability of dyeing units, energy conservation is the need of the hour.

Having understood the importance of energy conservation, DAT has already initiated steps to impart training to the boiler operators and electricians employed in the member units and completed training to more than 200 workers. To achieve sustainability, energy conservation in Dyeing units and CETPs is inevitable.

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Acknowledgments

The Energy Group at CTaP, IIT (Madras) is grateful to Thiru. Kumar Jayant, I.A.S., Principal Secretary to Department of Handlooms, Handicrafts, Textiles and Khadi for his encouragement and constant support. We are grateful to him in particular for forging a healthy relationship with South India Mills Association (SIMA) and Dyers Association of Tirupur (DAT) and their affiliates. We thank SIMA and DAT for enabling our Field Survey among their member-units.

We would like to thank Mr. V. Regurajan - Deputy Secretary General and Mr. K M G. Ganaesh - Joint Secretary, of SIMA, for their time and efforts in coordinating our field work in various spinning & weaving units. We thank Mr. S. Nagarajan – President, Mr. B.M. Boopathi – CEO, Mr. M. Mahesh – Vice President, Mr. B.A. Madeshwaran – Joint Secretary, Mr. K. BalaSanthanam, Mr. C.B. Bhaskaran and Mr. K. Sudhakaran of DAT for coordinating our field work among dyeing units and CETPs.

Thanks to all the Spinning, Weaving, Dyeing and CETP units (Refer Table 15 in Annexure for the complete list of units participated in the survey) who have come forward to participate in this survey, spending their productive time, sharing data and most importantly for all their hospitalities extended to us during our visits.

Special thanks to Mr. P. Rajan – Energy Auditor, Mr. T.S Subramanian – Chartered Energy Advisor, Mr. S.N Bharathi – Energy Consultant and Mr. D. Kanagaraj – Energy Manager for their valuable inputs and suggestions in validating the Energy Conservation Measures (ECMs) collected through our surveys.

We thank all our students and project staffs from various departments at IIT Madras for their involvement and sincere efforts in carrying out the field work.

1. Introduction

In the Indian textile industry, it is observed that the major expenditure, next to raw material, is on energy (up to 35%) and this clearly indicates the energy intensive nature of the sector. In the past 10 – 15 years, with the energy consciousness increasing, several Energy Conservation Measures (ECMs) have been practised in many spinning & power loom weaving units across the country. This has brought about significant energy and cost savings. However, with greater awareness, technical knowhow, management support and supportive policy guidelines and incentives, ECMs will be adopted by a much wider cross-section of Textile sector units as well as by other Tamil Nadu Industrial sectors.

This booklet briefs the efforts made so far by the Energy group of Centre for Technology and Policy (CTaP) at IIT Madras towards energy conservation in Tamil Nadu textile sector. The primary purpose of this initiative is to have an assessment of the current energy usage pattern of the most energy intensive sub -sectors of the textile industry (namely, the Spinning, Power loom Weaving, Dyeing and CETPs), and to document the efforts made by them towards energy conservation. We believe the “method” we have used and insights we have gained from a unit-wise energy assessment and evaluation of the data/information collected will be helpful to the Industry to proactively move forward (with necessary policy support) towards wider adoption of ECMs.

In sections 2-5, we present the methodology used for assessment of energy use, and sub-sector wise current use of energy and ECMs. In section 6, we present our follow-up on the status of implementation of EMCs in select units. In section 7, we present an assessment of the energy consumption based on field data collected from select units. In section 8, we locate where we are as on date on the overall energy conscious pyramid and what needs to be done going forward. In section 9, we present the expectations of the Industry from policy makers.

We conclude (in sections 10-11) with suggestions on what the Energy Group (at CTaP) can do towards wider adoption of ECMs by the Industry in Tamil Nadu, through sustained partnership with various stakeholders.

2. Methodology

Work started with the collection of secondary data on various textile industry sub-sectors through company annual reports. The analysis led to primary survey in 28 firms across Tamil Nadu in two phases. In phase 1, a walk through and preliminary data collection was done by interacting with top management, engineers & supervisors. In phase 2 detailed energy assessment was performed by using appropriate energy audit equipment and an assessment report was submitted. Refer Table 14 in Annexure for specific time line details of our activities.

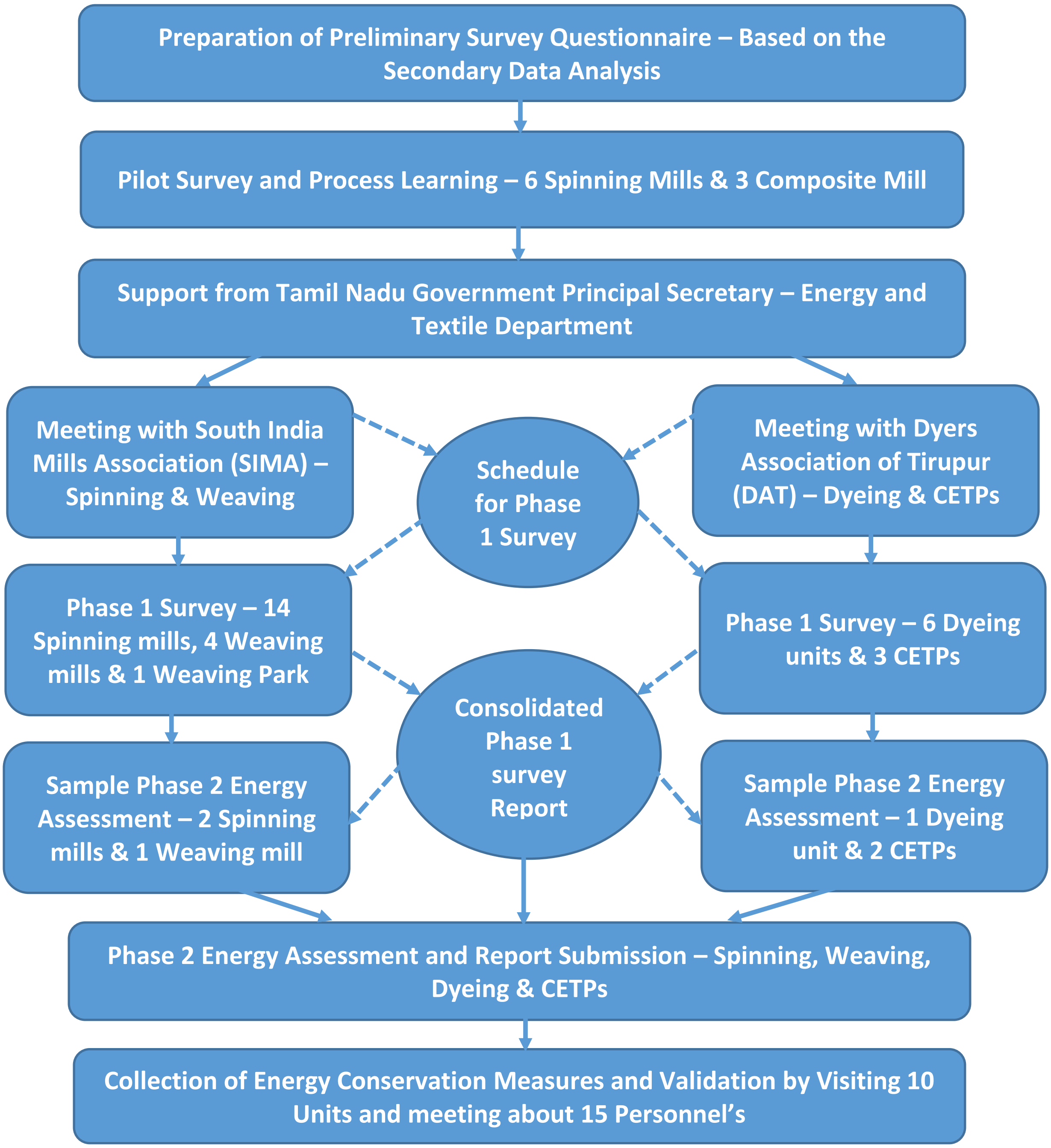


Figure 1 – Work Flow

3. Spinning

Spinning is the process in which any raw Fibre (Cotton, Polyester, Viscose, etc) is converted into Yarn of desired counts (2s to 250s). There are two major types of spinning – Ring Frame & Open End (Rotor). The nature of raw material, process & product quality varies accordingly.

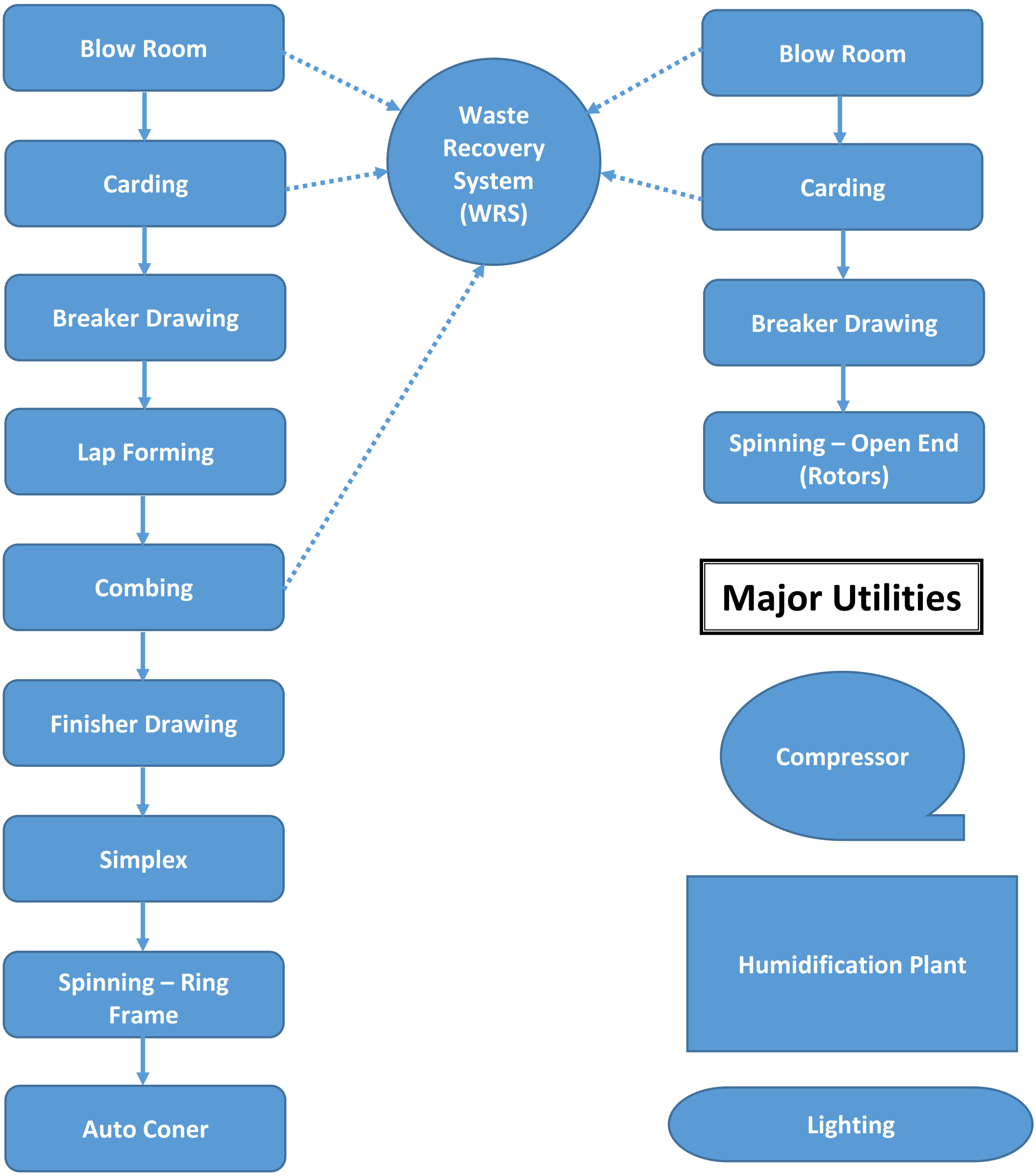
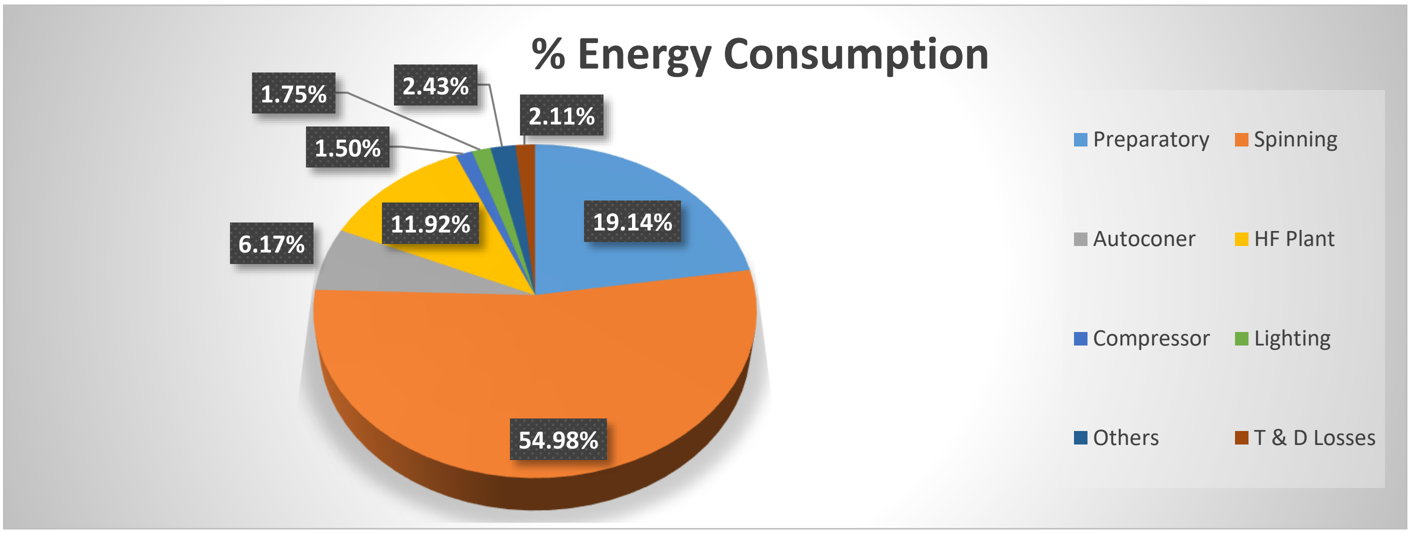


Figure 2 – Spinning Process Flow and Its Major Utilities

3a. Energy Consumption Pattern in Spinning Mills**

Department	% Energy Consumption
Preparatory	19.14%
Blow room	*3.20%*
Carding	*6.38%*
WRS	*4.75%*
Drawing	*1.52%*
Lap Former & Comber	*2.74%*
Simplex	0.55%
Spinning	54.98%
Autoconer	6.17%
HF Plant	11.92%
Compressor	2.43%
Lighting	1.50%
Others	2.11%
T & D Losses	1.75%
Total	**100%**

Department	Specific Energy (UKG)
Preparatory	0.844
Blow room	*0.065*
Carding	*0.253*
WRS	*0.160*
Drawing	*0.092*
Lap Former & Comber	*0.094*
Simplex	0.180
Spinning	2.241
Autoconer	0.265
HF Plant	0.405
Compressor	0.146
Lighting	0.051
Others	0.075
T & D Losses	0.053
Total	**4.08**



**Note:

The above data represents average values of a sample of about 20 semi-modernized spinning mills producing ***40s count cotton combed hosiery yarn***. There could be about ±10% variation from the values mentioned above as it depends on machine make, maintenance, age, raw material quality, working atmosphere, working efficiency, machine utilization & efficiency , output quality, achieved production, count, type of yarn, value added products, machine parameters, production parameters and percentage of waste.

3b. Summary of Energy Conservation Measures Proposed

Preparatory (Blow room to Simplex) – (Code – PRPS $_{(xx)}$)

1. The leakages in blow room material feed line and carding waste collection ducts have to be closely monitored and arrested as and when identified;
2. In blow room and Waste Recovery System (WRS) the ventilator fan capacity should be effectively utilized based on the actual process requirement;
3. Optimum suction pressure has to be maintained in the material feed lines of blow room as well as the licker-in and flats of carding;
4. Instead of throttling air in feed lines, appropriate system design parameters (air volume, pipe size & material, pressure, etc.) must be used;
5. Deploy light weight material (Poly Propylene & Nylon) for primary & secondary filters in WRS;
6. Flap control systems should be provided in individual carding and combing machines in order to optimize their WRS suction pressure, and it can be achieved by operating blowers and centrifugal fans through VFD by providing signal from Differential Pressure Transmitter (DPT);
7. The suction pressure difference between initial and final carding machines should be less than 50Pa;
8. Maintain proper pressure difference in the primary (50Pa) and secondary (100Pa) filters in WRS;
9. Flat belt must be considered in the place of V belt for WRS centrifugal fan motors and depending upon the space availability, direct coupling is also preferred;
10. Periodic cleaning of primary & secondary filters in WRS and suction filters in Draw Frame machines is essential;
11. Process interlock between blow room, carding & the WRS is highly recommended;
12. The cylinder speed in carding machines should be optimized based on raw material, machine settings and certain sliver parameters;
13. Provide interlock between doffing motor & cylinder motor in carding machine;
14. Optimize Bobbin Lift, Bobbin Diameter, Creel Length, number of Creel, Top Arm pressure in simplex machines and
15. Simplex machines must be operated using VFD to increase productivity and reduce breakages to a larger extent.

Observation: Among 14 firms surveyed, there were top two companies who have implemented 9 of the above ECMs; but both these have not implemented measures 2, 4, 6, 7, 8 & 11, which none of the sample firms had implemented.

Why??

Reasoning: Based on the survey experience, non-implementation of Point 2 & 4 is mainly due to highly over designed equipment (probably considering the future expansion requirement) and heavy under-utilization of the same. Point 6 may be considered as expensive due to longer period of ROI. Point 7 & 8 requires very close and continuous monitoring which may be considered as impractical. For implementation of point 11 a proper mapping of WRS to individual section is a prerequisite which is yet to be achieved.

Spinning and Autoconer – (Code – SPAC $_{(xx)}$)

1. Pressure optimization is required in drafting, pneumafil suction and compacting operations;
2. Periodic study on compressed air leakages and suction air (pneumafil and compacting) leakages should be done in individual Spinning & Autoconer machines;
3. Parking system for OHTC should be done in machine idle conditions and at the time of doffing;
4. Optimum compressed air pressure reduction should be done in Autoconer machines;
5. Install spindle monitoring system along with energy monitoring;
6. Pneumafil suction fan motor should be operated through closed loop system;
7. Reduce pneumafil suction tube size and fan diameter by providing group suction arrangement;
8. Periodic performance study should be done for Main motor, OHTC motor, Pneumafil suction motor & Compacting motor;
9. Perform multiple doffing study at each and every count change to optimize energy based on respective TPI, Lift Diameter, Wharve Diameter, Ring Diameter, Spindle weight, Spindle Diameter, Spindle speed, etc;
10. Deploy energy efficient spindle oil, light weight spindle tapes and light weight cops;
11. Variator drive motor should be operated through VFD and with flat belt drive;
12. In case of ring frame with auto doffing along with link coner, production of maximum cop content gives better energy savings;
13. Arrangements of machines should be taken care of, which plays a major role in effective natural heat dissipation and
14. Periodic thermal study in ring frame individual spindles and main motors is essential.

Observation: Among 14 firms surveyed, four firms have implemented 11 of the above ECMs and all the four have not implemented measures 6, 7 & 12

Why??

Reasoning: On point 6, the current level of automation is not yet fully complete; there is a lot of manual intervention in practice as of now. The units need to be made aware of the closed loop system concept. On point 7, general awareness just beginning to grow; which needs to be more actively spread across the sector. For point 12, the effectiveness can be realized only if auto doffing and link coner are available.

Compressor – (Code – COMP $_{(xx)}$)

1. The actual plant CFM load should be calculated accurately and there should be one compressor meeting the base air load by running at full load and the other for meeting peak/fluctuating loads by operating it with a VFD;
2. Separate compressor should be used for cleaning activities and if possible, instead of blowing through compressed air, the cleaning activities can be done through suction principle;
3. The compressor should be effectively operated in a manner that it should have minimum number of unloading cycles;
4. Individual air flow meters should be installed in machines with high air consumption;
5. Airline leakage study should be performed continuously in order to arrest leakages;
6. Compressor Specific Energy Consumption should be monitored periodically;
7. Sufficient air receiver capacity, pipe sizing and frictionless pipe material should be used for main compressed air line throughout the plant;
8. At the air inlet point of compressor (air suction point in inlet filter) it is better to use pascal meters to ensure sufficient suction pressure is maintained;
9. Ring main system must be used for air lines in specific high consumption departments or it can be looped accordingly;
10. Air inlet point for the compressor should be maintained at low temperatures or at least at atmospheric temperature;
11. Additional storage tanks should be used as buffer tanks nearby to the process with high air pressure requirement;
12. Air pressure boosters must be deployed at certain specific points where low volume high pressure air is required, instead of maintaining entire line with high air pressure;
13. Instead of direct tapping of air lines from main line to secondary lines, it should be designed in a way by creating turbulence in order to minimize pressure drop;
14. Replace old compressor with energy efficient low specific energy consumption (kW/CFM) compressor;
15. Heat recovery from compressors must be implemented to meet certain plant heat loads by installing appropriate Waste Heat Recovery system and
16. Service factors in compressor motors should be addressed very carefully when opting for new energy efficient compressors.

Observation: While many of the points have not been taken care of by most of the firms, measures 6, 12 and 15 have not been adopted by any firm.

Why??

Reasoning: Point 6 – Awareness is very poor on correct establishment of specific energy consumption. For point 12 the ignorance on usage of boosters has to be limited to low volume requirements. As far as point 15 is concerned, its real potential is unknown in spinning sector, and in weaving sector, the lack of technology know how is the hindrance.

Humidification Plant – (Code – HFPT $_{(xx)}$)

1. The HF plant design should be adequate enough to meet the actual plant heat load;
2. It is necessary to monitor the efficiency of the HF plant periodically through calculating CMH delivered per kWh;
3. Air filters at both the supply fan side and exhaust fan side should be cleaned at least thrice a day and the pressure difference must be less than 50Pa;
4. Exhaust filters must be cleaned at least once a day and in case of louver & eliminator sheet, the cleaning should be done based on the drop in air volume in the department;
5. Fur cloth filters must be replaced with nylon mesh for better filter and energy efficiency;
6. Instead of changing the blade angles of the supply fans, it is better to go for aerofoil blade fans and operate it through VFD;
7. Continuous energy monitoring of all the fans & pumps is essential to understand the load pattern, based on which it can be operated efficiently;
8. The pump motor should not be throttled using gate valve, instead VFD must be used;
9. The required water changes and TDS values should be maintained properly for effective water nozzle operation and to avoid unnecessary scale formation;
10. The air wash efficiency must be maintained at 98%;
11. The exhaust openings & underground ducts must be cleaned twice a week to ensure proper suction and flow so that the exhaust fan does not gets overloaded;
12. Instead of square or rectangular GI air ducts, circular FRP ducts must be used;
13. The air supply must be 5% more than the air exhaust and this is to be maintained in all the departments;
14. Essential exhaust grill velocity (4 to 5 m/s) and supply air changes (25 to 30) should be monitored and maintained in a proper way;
15. It is essential to monitor the air velocity and air pressure at supply intake damper, before louver and after eliminator;
16. HF plant automation can be achieved by making it a closed loop system with VFD and
17. It is good to increase the surface area of the supply side air intake point until a certain threshold point, to increase CMH/KWh delivery.

Observation: As far as the HF plant is concerned, the only optimization done in this area is for maintaining the required RH in the respective departments and there is no focus on the energy conservation perspective.

Why??

Reasoning: The two main reasons are - lack of awareness and the longer Return on Investment (RoI) period which makes them less focused.

Lighting – (Code – LITN $_{(xx)}$)

1. As far as the plant lighting is concerned, first one should try for natural roof lighting; if not possible, opt for solar lamps, and if solar lamps are not feasible/possible the go for LED lamps;
2. The lights should be positioned in a way that it maintains optimal LUX level and
3. A separate stabilizer can be deployed for lighting to minimize the voltage.

Transmission and Distribution – (Code – TMDB $_{(xx)}$)

1. Effective utilization of the sanctioned demand is essential; excess demand should be surrendered based on plant expansion plans and other constraints;
2. The transformer loading should be maintained within 60%;
3. Existing old transformers (If the transformer loss is more than 2%) should be replaced with energy efficient transformers with low no or no-load losses and impedance values to minimize transformer losses;
4. Proper cable size should be maintained and the cable losses should be monitored through voltage drop study. The allowable cable loss limit is around 0.75%;
5. Once in a month thermal study of main EB yard structure, Transformers, all the Circuit Breakers, MV panels, PDB’s, Capacitors, etc are essential;
6. The operating voltage should be maintained properly without much fluctuation in order to avoid more cable losses and
7. Appropriate capacitor banking and harmonic filters should be deployed in order to maintain power quality.

General Recommendations

1. Try to minimize the breaks/failures in the process value chain, as it subsequently affects the entire value chain;
2. In general, the effective capacity utilization of the installed machineries at each and every department is essential;
3. Machine to machine energy (Power Consumption/Hr) benchmarking with similar process parameters in the respective departments is essential;
4. For complete plant energy monitoring ensure energy meters of same class throughout the plant;
5. Existing old motors should be replaced with IE3 standard energy efficiency motors;
6. It is better to go for interior permanent magnet motors with higher efficiency and lower energy consumption and
7. Day to day energy balance has to be made by tallying the plant total consumption versus the individual departments.

4. Weaving

Weaving is the process in which any yarn (Cotton, Polyester, Viscose, etc) is converted into fabric of desired pattern. There are four major types of looms in the market – Rapier, Projectile, Airjet and Waterjet. These can be further classified into Narrow Width, Wider Width and Jumbo looms based on the width of the beam used in it.

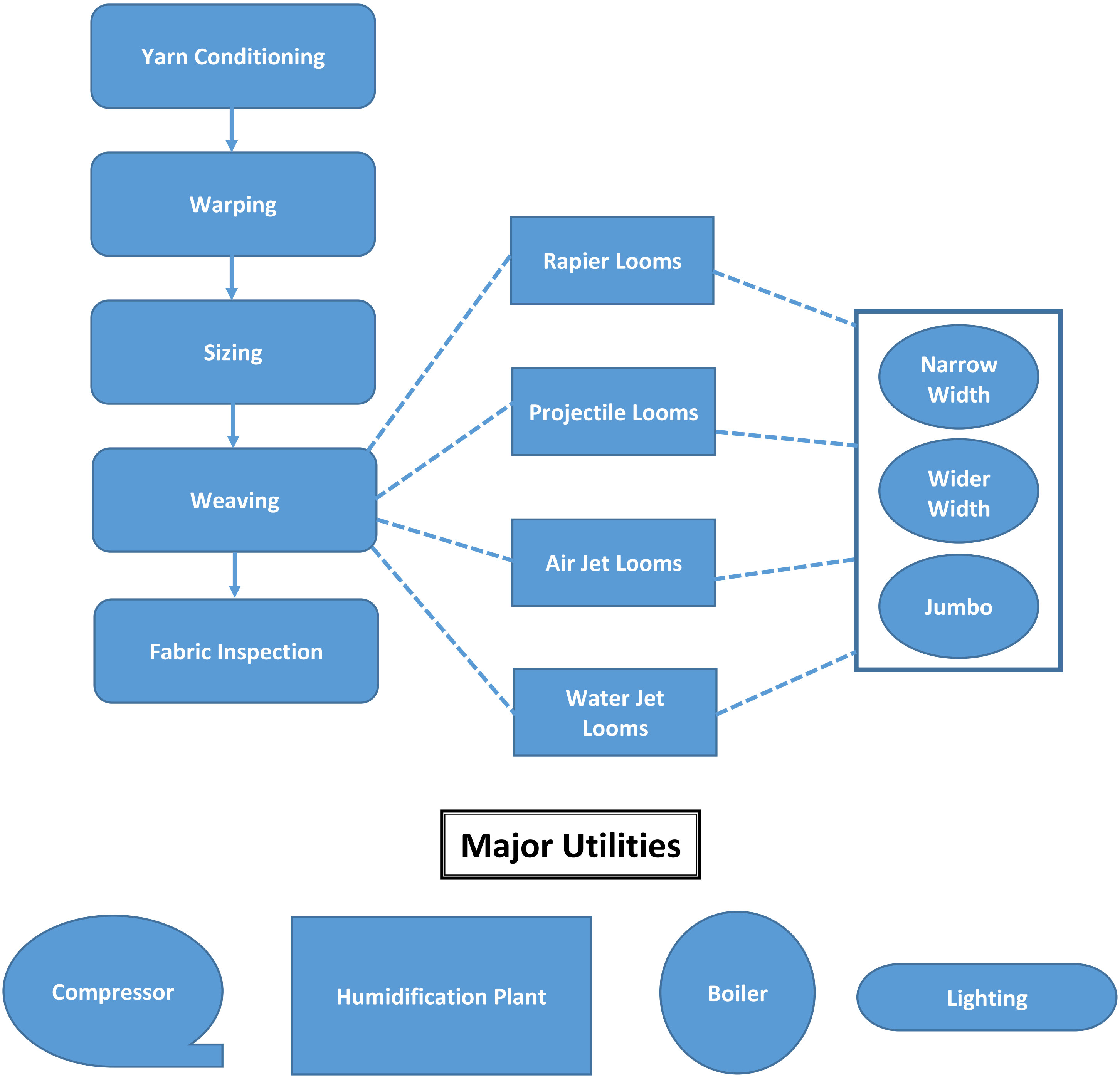
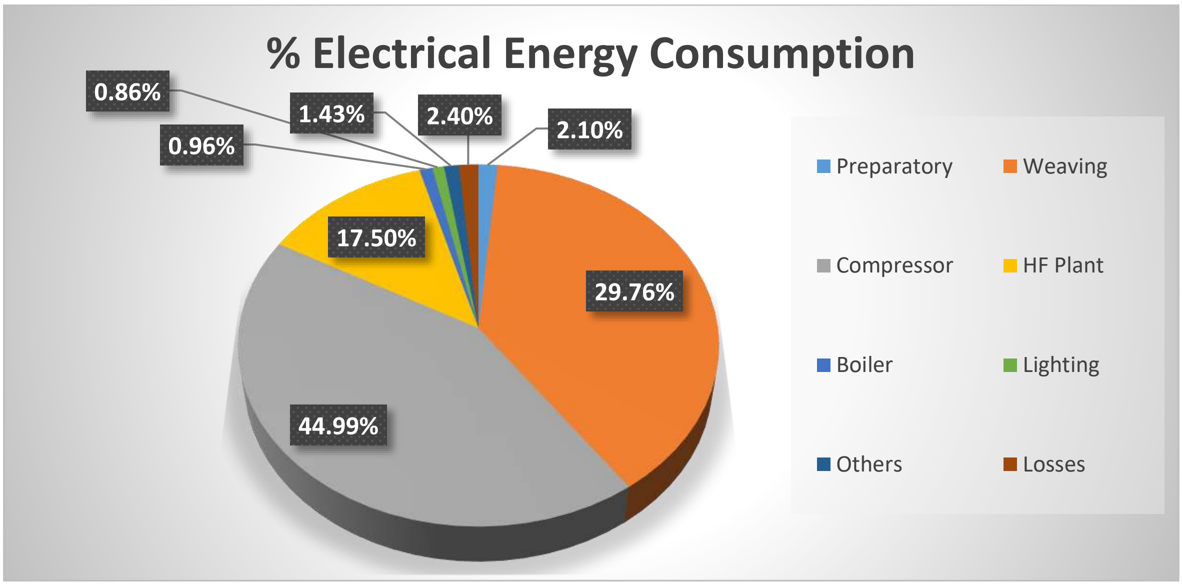


Figure 3 – Weaving Process Flow and Its Major Utilities

4a. Energy Consumption Pattern in Weaving Mills**

Department	% Electrical Energy Consumption
Preparatory	2.10%
Weaving	29.76%
Compressor	44.99%
HF Plant	17.50%
Boiler	0.96%
Lighting	0.86%
Others	2.40%
Losses	1.43%
Total	**100%**



**Note:

The above data is indicative, representing average values of a sample of 4 weaving mills having all types of looms including wider width and narrow width beams. Currently Airjet looms are used widely and this reflects the energy consumption in looms and compressor.

4b. Summary of Energy Conservation Measures Proposed

In the weaving process, loom selection and utilization plays a major role in energy conservation. The loom utilization should be more than 90%. For every 10% drop in utilization, the specific energy consumption increases by 3-4%. Maintaining optimum air pressure in the Airjet looms and using high quality yarn with proper hairiness and maximum beam width utilization saves considerable amount of energy in a weaving mill, thereby enhancing energy efficiency and reducing units per kilo pick.

Apart from weaving department (looms), the most energy intensive areas are compressor and HF plant. Refer page 11, 12 & 13 for ECMs that can be adopted for compressor, HF plant, lighting, and transmission & distribution side. Other than electricity, thermal energy in the form of steam consumption is significant for sizing process in the weaving mills. We list below are some of ECMs that can be deployed in the boiler house and steam distribution systems;

Boiler House and Steam Distribution – (Code – BHSD $_{(xx)}$)

1. We should have a proper selection of boiler & firing equipment (based on plant steam load pattern) along with fuel , supply air, feed water, flue gas and steam line monitoring system;
2. Proper insulation in boiler house and in the entire steam circuit is essential;
3. Proper sizing and insulation of the feed water tank is essential;
4. Train the boiler operators on effective boiler operation and steam line maintenance;
5. Deploy condensate and flash recovery systems, to reduce use of fresh water and maintain the feed water at higher temperature and
6. Proper selection and periodic performance evaluation of steam trap is essential.

5. Dyeing

Dyeing is the process of adding colour to the fabric by subjecting it to multiple hot water baths of dyes and then drying it either naturally or in a Stenter machine by blowing hot dry air. Based on the customer requirement, the fabric is subjected to various treatments to incorporate special characteristics in it.

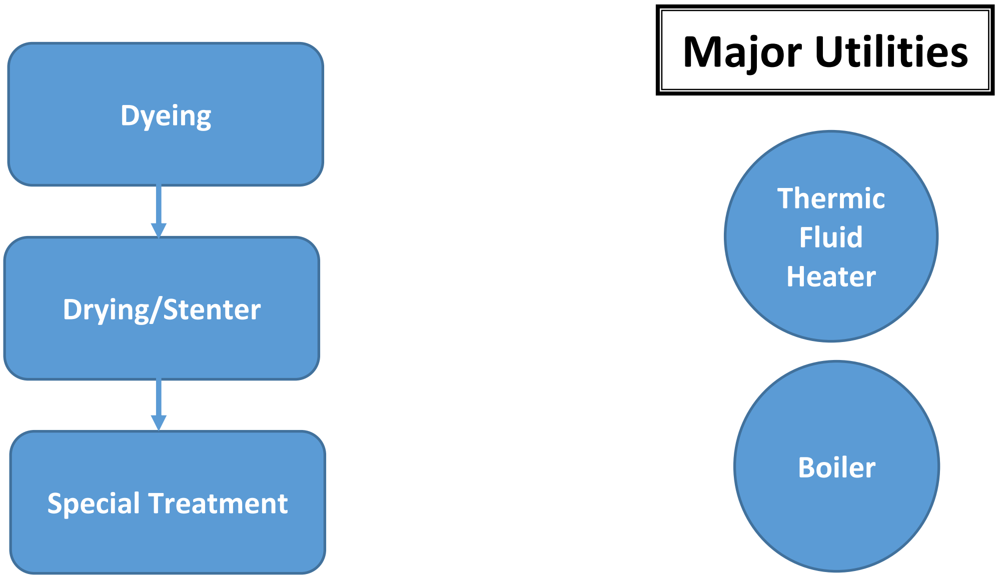


Figure 4 – Dyeing Process Flow and Its Major Utilities

5a. Summary of Energy Conservation Measures Proposed – *(Code – DYNG $_{(xx)}$)*

In addition to the ECMs in boiler & steam side mentioned in the previous section, we suggest the following measures for the dyeing process;

1. Maintain proper combustion efficiency in Thermic Fluid Heater furnace by selecting suitable bed, efficient fuel, proper air supply and flue gas monitoring;
2. Use suitable waste heat recovery systems to recover heat from stenter exhaust air and
3. Use suitable waste heat recovery systems to recover heat from hot bath reject water.

6. Common Effluent Treatment Plant (CETP)

Common effluent treatment plant is the facility which is installed jointly by number of individual dyeing units (about 60 – 70) to treat their respective effluents. There are about 18 CETPs in Tirupur belt and the dyeing units are called member units. They are operating under the principle of Zero Liquid Discharge (ZLD).

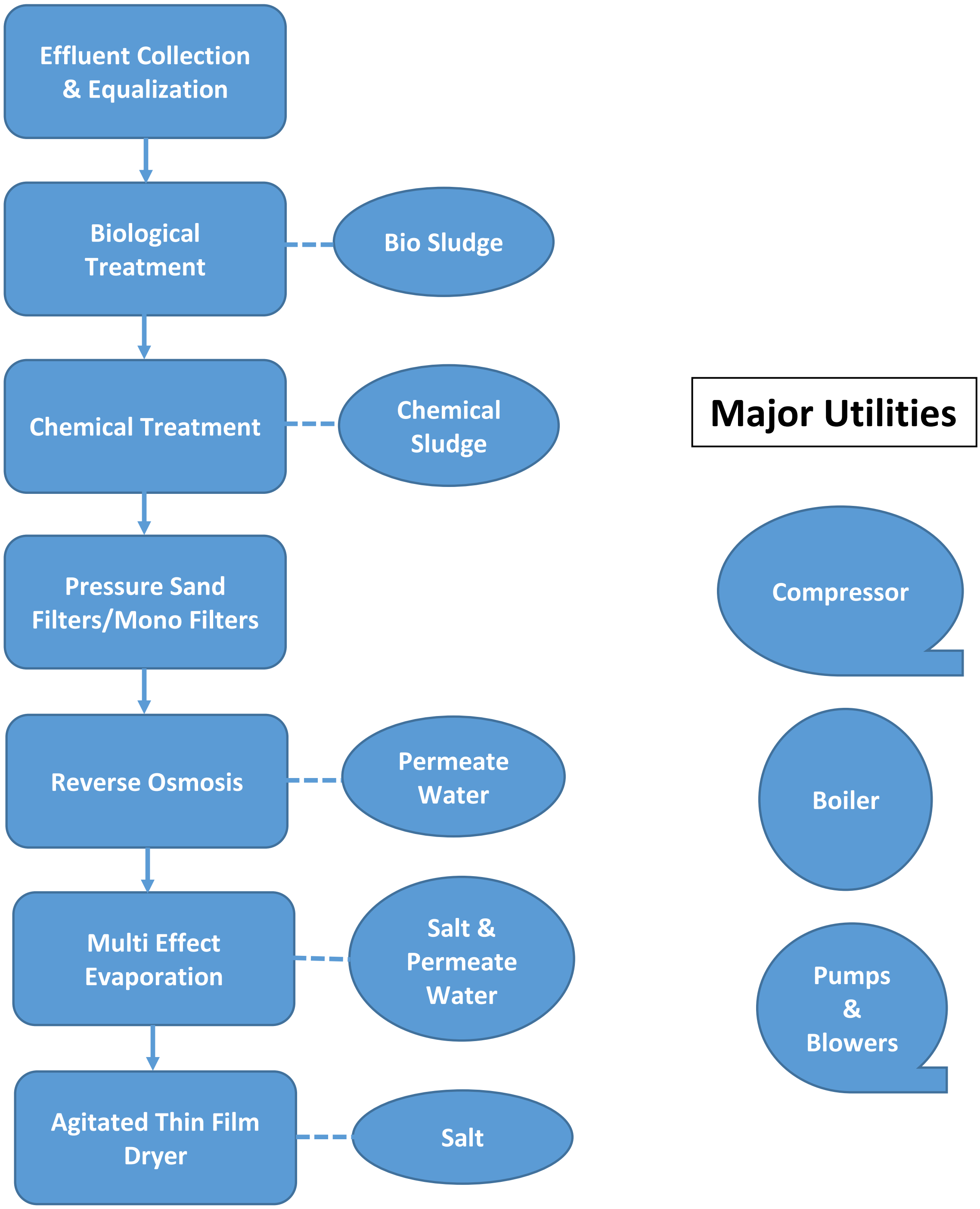


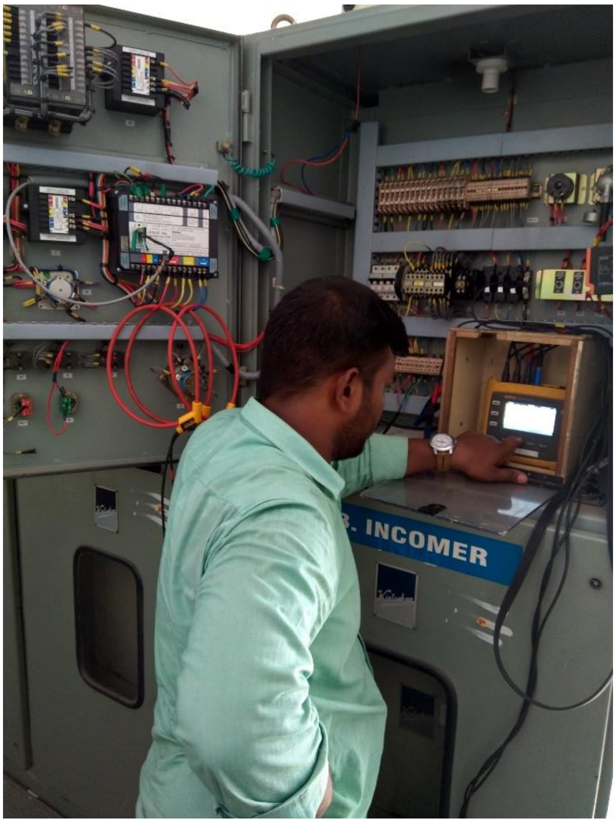
Figure 5 – CETP Process Flow and Its Major Utilities

6a. Summary of Energy Conservation Measures Proposed – *(Code – CETP $_{(xx)}$)*

In general CETPs are heavy consumers of both electricity and steam. When it comes to energy savings, all the ECMs mentioned in the previous pages are applicable to CETPs and have enormous scope for energy savings.

CETPs however should take the measures as early as possible to realise immediate energy savings:

1. Proper capacity selection of pumps and blowers;
2. All the pumps & blowers (including stand by) to be operated in rotation, evenly so as to avoid repetitive operations and failure;
3. Throttling of pump valves should be avoided by using VFDs;
4. Since CETPs have long distance power distribution (power house to process), it is recommended to install capacitors at the load end to avoid voltage drop and distribution losses and
5. Ensure effective capacity utilization of evaporators and dryers to make steam utilization effective which in turn would help reduce the overall fuel consumption.



ECM Code Abbrevation

PRPS	Preparatory (Blow room to Simplex)
SPAC	Spinning and Autoconer
COMP	Compressor
HFPT	Humidification Plant
LITN	Lighting
TMDB	Transmission & Distribution
BHSD	Boiler House & Steam Distribution
DYNG	Dyeing - Specific
CETP	Common Ellfuent Treatment Plant - Specific

7. Status on Implementation of the Energy Conservation Measures

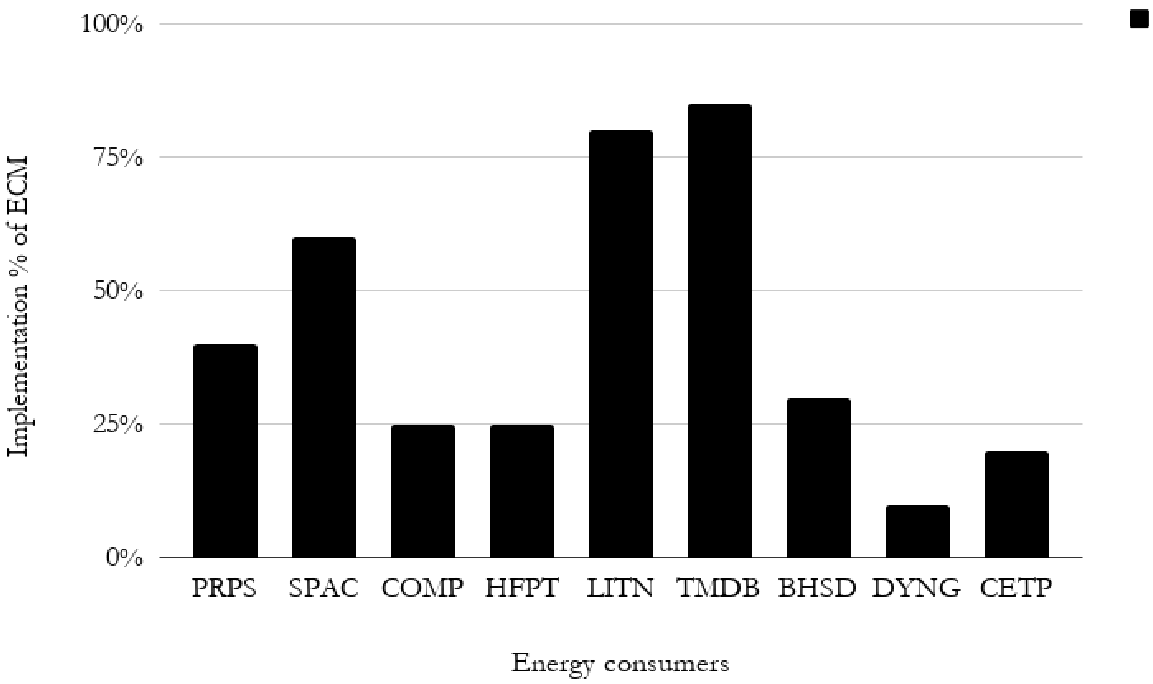


Figure 6 – Energy Consumers vs Implementation% of ECM

- Survey of about 30 firms across various sub-sectors in textile industry indicates higher level of implementation of ECMs in Spinning and Autoconer (SPAC), which is supposed to be the highest energy consumer among these.

- Replacing old compressors with new low specific energy (kW/CFM) compressors with VFD – this is the highest level of implementation accuring 0.5 to 1.5% savings in the overall plant energy cost. This indicates high awarness in the industry and fairly mature implementation capability.

- Providing flap control systems in individual carding and combing machines to optimize their WRS suction pressure by making it a closed loop system through VFD and Differential Pressure Transmitter (DPT) – it is the highest untapped potential in the spinning sector which guarantees minimum 0.2 to 0.7% savings in the overall plant energy cost.

- Among the various sub-sectors, Dyeing and CETPs are found to be least in implementation of ECMs, which may be due to lack of technical knowhow, awareness and access to funds/incentives.

8. Energy Assessment

Further to the phase 1, a detailed energy assessment (phase 2) was performed in individual firms, one from each sub-sector viz. Spinning, Weaving, Dyeing and CETP. This involved an initial one/two days (depending upon the size of the firm) walk through with a team comprising of a professor, two energy assessors, project associates and one/two students, spending about 30 to 40 man hours. The data collected was analysed and then a detailed energy assessment was carried out with due prior planning based on the mutual convenience. A similar assessment team as for walk through was constituted, working at site for 4 to 5 days in the plant, spending about 200 to 250 man hours. The on-site data collection was done using appropriate energy audit instruments such as 1. Power Quality Analyser, 2. Ultrasonic Air Leak Detector, 3. Thermal Imager, 4. Vane Anemometer, 5. Flue Gas Analyser, 6. Temperature & Humidity Meter and 7. Ultrasonic Water Flow Meter.

The collected data was analysed in detail through which the possible energy and corresponding cost savings were calcuated seperately for specific process units and utilities. The calculated savings along with the recommendations/ observations including investment cost and ROI (Refer table 1 to table 4 in the Annexure) were validated by the professors from the concerned departments. The assessment findings were then made into a detailed assessment report and the draft copy of the same was shared with the customer for their initial feedback and finally, a report was submitted to the customer. This entire process of report generation was carried out by the assessment team, spending about 250 to 300 man hours.

After submission of the energy assessment report to the customer, follow up with individual customer was taken up in order to know the respective customer's action plan on implementation of the recommendations and their efforts in monitoring the actual savings achieved out of these recommendations. The assessment team continues to support the customer by providing necessary inputs on periodic and as required basis until the recommendations are implemented and authenticated. Some of the customer feedbacks on the detailed energy assessment is reproduced below:

Angeripalayam CETP, Tirupur:

"Dear Sir,

We thank you very much for your detailed & valuable Energy Assessment Report on study of our CETP. We are sure that your report will help in improving our production and reduce unnecessary maintenance expenditure.

We have already implemented the following improvements based on your study report.

1) Based on your study and recommendation, we had applied and received Deemed Demand Order from Hon'ble High Court and have applied for reduction of the demand charge.

2) Higher efficiency motor pumps are running in first priority and lower efficiency pumps are running on standby mode or requirement basis.

We would also like to focus in the below areas within three months:

1) Setting up VFD and servicing valves & NRVs in Receiving sump and also we are running pump 1 continuously and pump 3 as standby.

2) Setting up VFD in Equalization Tank to control the flow to Aeration tank.

3) Setting up VFD in OR reactor Feed Tank to control the flow to OR Reactor tank.

4) We are calling service engineer to service the SRS pumps in clarifier section.

5) Getting quote to fix Harmonics Filter in Transformer 1.

6) An additional compressed air receiver has to be installed.

7) We are attending the minor air leakages in pneumatic line.

8) We are placing order to replace the existing nozzles in Boiler bubbling bed.

9) In future, we are planned to replace the low efficiency motors one by one while it comes to service."

Murugampalayam CETP, Tirupur:

"Dear sir,

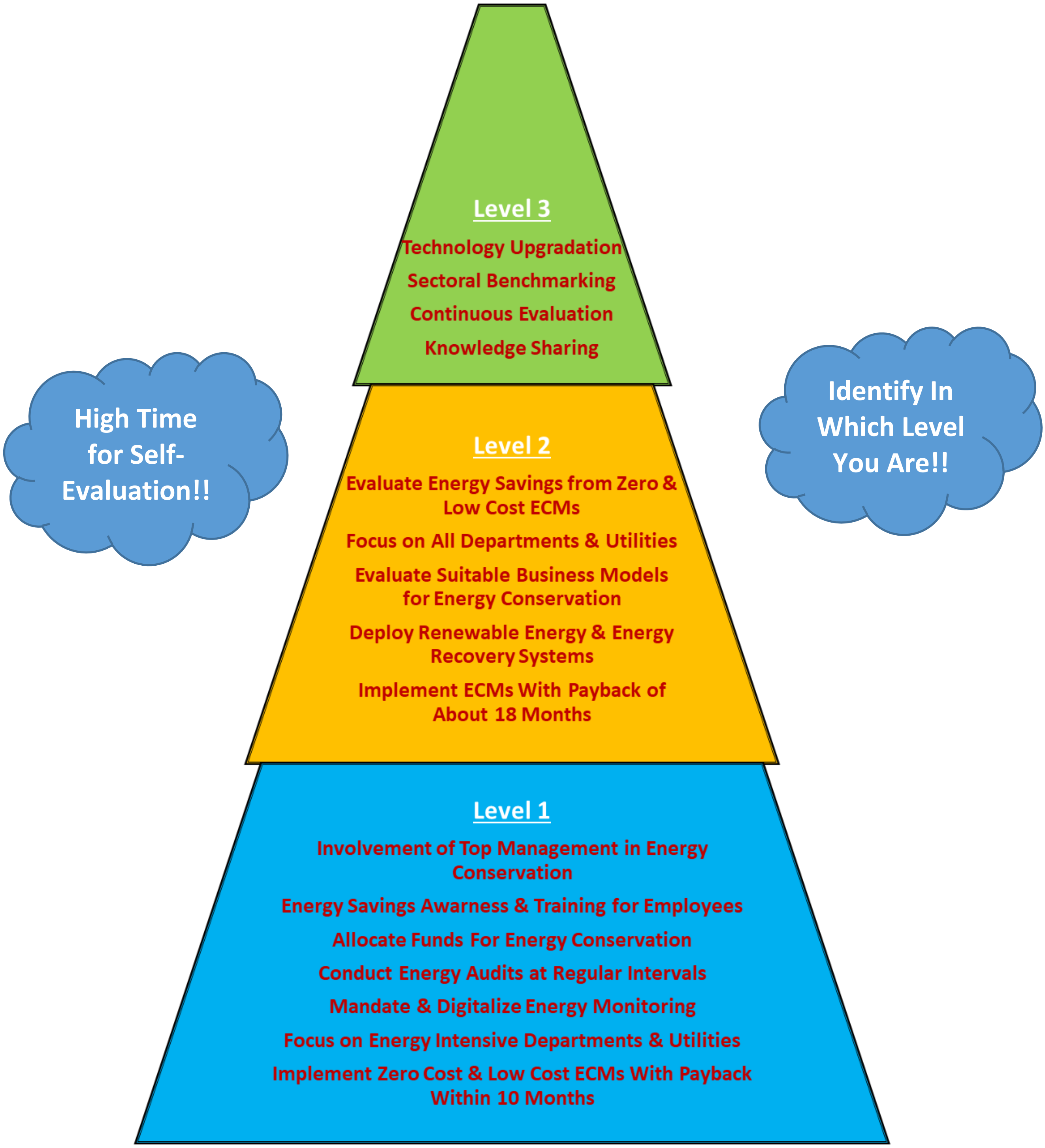
We thank you for your Energy Assessment reports to our CETP, from this report we come to know the cost saving Rs 1,25,000 per month by minimum demand cost of TNEB. All our directors are happy by this saving.unfortunately we unable to arrange the man power supports to your team, we felt sorry for this inconvenience.If any possible we will plan next time with all supports and arrangements from our end.

Once again thank you for you and your team."

IBPL (Britannia), Oragadam- Chennai:

"The recommendations have been taken up for execution. The Air leakeages identified were arreseted immediately. The compressor change is being effected. The unisulated pipings have been insulated. This has clearly resulted in energy saving as well as the ambient temperature in that area has dropped by 3-4°C. Transformer replacement is also taken up. The customer has invited for review of the execution of recommendations."

9. Energy Consciousness Pyramid



The Pyramid above depicts the levels of Energy conservation consciousness. Level 1 is the basic level wherein there is fair level of awareness and ECMs are identified and implemented for all short term gains. Level 2 is wherein the management is ready to look into medium range benefits with longer ROI, and good energy gains. Level 3 is wherein the management is fully conscious of all types of ECMs including Long term benefits.

10. Policy Support

Expected Support from Tamil Nadu Government as Observed by the Units

1. Flexibility from TNEB in sanctioned demand management in textile units;
2. Adequate power quality from TNEB with low current & voltage harmonics;
3. Instead of penalty for the industries exceeding their harmonics limits, consider subsidy for the industries within the harmonics limit;
4. Government to support industries on energy conservation activities by providing soft loans for conducting energy audits and installing energy efficient equipment;
5. TNEB should be self-sufficient in maintaining adequate infrastructure in their sub stations and feeders without depending on industries and end users, to provide timely support;
6. Enabling net metering facilities for industrial HT tariff slab to integrate more renewable power like solar and
7. Since textile industry (spinning & power loom weaving) runs 24*7 and consumes 90% of sanctioned demand, it has to be considered for relaxed tariff.

Existing Tamil Nadu Textile Policy 2019 – Energy/ Water/ Environmental Compliance (*Source – Tamil Nadu New Integrated Textile Policy 2019)*

1. The scheme will be known as One Time Assessment for Energy, Water conservation and Environmental Compliance with the existing textile units in operation for more than three years;
2. Assistance up to 50%, subject to a maximum ceiling of INR 50,000/- for Energy Audit / Water Audit / Environmental Compliance, applicable on case to case basis will be provided;
3. Assistance up to 20% of cost of equipment required for energy and water conservation, subject to a maximum of INR 10,00,000/- applicable on case to case basis will be provided;
4. Realizing that technology is the key element contributing to productivity, quality, competitiveness and market acceptability of products that technology and business incubators have emerged as useful instruments for innovation, the Government will encourage development of "Centres of Excellence & Innovation" in collaboration with academic institutions of excellence, industry and the Government of India;
5. The scheme will be known as Assistance to Enterprises for Technology Acquisition, Upgradation and Innovation and
6. The enterprises acquiring the technology will be provided financial assistance of up to 25% of the investment for technology acquisition / collaboration, subject to a maximum ceiling of INR 25, 00,000/- per process / product once during the currency of the policy period.

11. Key Takeaways

Government – A dedicated nodal agency should be established through IITM for continuous energy monitoring and evaluating PAT schemes in the textile industry. Special focus, support and schemes to be brought in for Dyeing and CETPs to make them more organized on the energy front.

South India Mills Association – To act as a representative of the spinning and weaving firms, translating their challenges and expectations on energy conservation to the nodal agency and enabling them to provide the necessary support.

Dyers Association of Tirupur – To act as a representative of the dyeing and CETPs, translating their challenges and expectations on energy conservation to the nodal agency and enabling them to provide the necessary support.

Spinning and Weaving Units – Engage themselves continuously along with the associations and nodal agencies and work towards achieving energy efficiency.

Dyeing Units and CETPs – Engage themselves continuously along with the associations and nodal agencies and work towards achieving energy efficiency.

Centre for Technology and Policy – To get the Government approved body set up through IITM for Energy usage monitoring and act as conduit between the units, association and Government to set applicable energy conservation benchmarks within sub-sectors. Provide necessary technical support and bring about new policies/changes as required.

12. Way Forward

- A dedicated centre for energy assessment (Industrial Energy Assessment Cell) must be formed within IIT Madras by the Government of Tamil Nadu;

- SIMA and DAT should be a part of this energy assessment centre by coordinating with the individual firms to collect data and to plan energy assessments;

- The frequency of implementation of each and every ECM across the textile industry must be surveyed and ranked;

- The success rate behind each and every ECM must be evaluated by conducting long term impact assessment study;

- Continuous efforts should be made to identify new system and process based ECMs to enhance energy savings across textile industry and

- The Centre for Technology and Policy (CTaP) to act as a nodal agency in coordinating all the above mentioned activities through the guidance of Government of Tamil Nadu.

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Annexures

- **Tables 1 to 4 - Detailed Energy Assessment Findings**
- **Tables 5 to 13 - Status on Implementation of the Energy Conservation Measures**

Table 1 - Spinning

Rec/ Obs Code	Recommendations / Observations	Saving in Rs.	Savings (kWH)	Investment cost Rs.	ROI months
R-E-TR-01	Replace the Transformers and adopt new distribution system	2,036,970	323,329	6,000,000	35.3
R-M-CA-01	Arrest Air leakges	787,500	125,000	30,000	0.5
R-M-CR-01	Reset the set point Pressure of compressor	33,750	5,357	-	0.0
R-M-HF-01	Completely Overhaul the HF plant as per following Recos	1,350,000	214,286	1,000,000	8.9
R-M-HF-01a	Supply and Exhaust fan blades to be lightweight material like FRP				
R-M-HF-01b	The Ducts to be replaced with less weight and less friction material like FRP				
R-M-HF-01c	Proper cleaning and maintenance of Filters and sheets				
R-M-HF-01d	Exhaust openings and ducts to be cleaned and maintained regularly				
R-M-HF-01e	Water changes and pH values to be maintained for proper nozzle operation				
R-M-HF-01f	RH values at all sections to be monitored continuously				
R-M-HF-01g	Operate the Fans and pumps with VFD				
R-M-HF-01h	HF plant to be automated by having closed loop system with VFD				
R-M-F-01	Reduce the Blow room fan speed by going in for next lower size set of pulleys	135,000	21,429	40,000	3.6
R-M-WR-01	Modify the Waste Recovery System	464,000	73,651	50,000	1.3
O-M-MC-01	Install closed loop control system for control of suction pressure in the Pneumafil operation by installation of DPT and VFD on all machines	477,000	75,714	450,000	11.3
O-M-MC-02	Provide Technological suction for BD 200 balance 6 machines	427,836	67,910	210,000	5.9
O-M-MC-03	Check and rectify the hose damages in BD 200	375,000	59,524	50,000	1.6
	TOTAL	**6,087,056**	**966,199**	**7,830,000**	**15.4**

Table 2 - Weaving

Rec/ Obs Code	Recommendations / Observations	Saving in Rs.	Savings (kWH)	Investment cost Rs.	ROI months
R-M-CR-01	Replace the Compressors and adopt new distribution system	8,421,336	1,362,676	10,000,000	14.3
R-M-CA-01	Arrest Air leakges			10,000	
R-E-GEN-01	Surrender Excessive Demand Load	840,000	135,922	-	0.0
R-M-HF-01	Completely Overhaul the HF plant as per following Recos	1,350,000	218,447	1,000,000	8.9
R-M-HF-01b	The Ducts to be replaced with less weight and less friction material like FRP				
R-M-HF-01c	Proper cleaning and maintenance of Filters and sheets				
R-M-HF-01d	Exhaust openings and ducts to be cleaned and maintained regularly				
R-M-HF-01e	Water changes and pH values to be maintained for proper nozzle operation				
R-M-HF-01f	RH values at all sections to be monitored continuously				
R-M-HF-01g	Operate the Fans and pumps with VFD				
R-M-HF-01h	HF plant to be automated by having closed loop system with VFD				
O-M-CT-01	Install VFD for the pumps	113,000	18,285	60,000	6.4
O-M-HF-02	Check VFD for Exhaust 1 Fan	107,136	17,336	-	0.0
R-M-GEN-01	Replace Ceiling Fans with Energy efficient fans	374,976	60,676	500,000	16.0
	TOTAL	**11,206,448**	**1,813,341**	**11,570,000**	**12.4**

Table 3 - Dyeing

Rec/ Obs Code	Recommendations / Observations	Saving in Rs.	Savings in Coal (kgs)	Investment cost Rs.	ROI months
R-T-BR-01	Reset and monitor Air to fuel ratio for proper combustion	1,078,097	194,954	140,000	10.5
R-T-BR-02	Install fuel flow measuring systems			800,000	
O-T-MC-01	Insulate the Stenter and Curing Ducts	194,865	35,238	60,000	3.7
R-T-BR-03	Insulate the Uninsulated Lines or areas	379,328	68,595	150,000	4.7
O-M-ETP-01	Install DO monitoring system	116,000	20,976	100,000	10.3
	TOTAL	**1,768,290**	**319,763**	**1,250,000**	**8.5**

Table 4 – Common Effluent Treatment Plant

Rec/ Obs Code	Recommendations / Observations	Saving in Rs.	Savings (Units)	Investment cost Rs.	ROI months
O-T-BR-01	Setting up of Air to Fuel Ratio for proper combustion	2,191,831	384,532	140,000	0.8
O-T-BR-02	Install Fuel flow and Air flow measuring devices			800,000	
R-T-BR-02	Insulate the uninsulated areas	183,745	32,236	60,000	3.9
O-E-HAR-01	Install Active or Passive Filter	-		400,000	
R-M-CA-01	Arrest Air leakges	96,810	12,960	5,000	0.6
R-M-CR-01	Reset Unloading Pressure setting optimally	942,501	126,171	200,000	2.5
R-M-CR-02	Install Reciever Tank				
O-M-P-01	Run Pumps of various systems as suggested	984,844	131,840	100,000	1.2
O-E-GEN-01	Action for Deemed Demand Charges	1,500,000		-	0.0
	Total Electrical Power Savings in kWH		**416,768**		
	Total Fuel savings in kgs of Fuel		**270,971**		
	TOTAL	**5,899,731**		**1,705,000**	**3.5**

Table 5 - Preparatory (Blow room to Simplex)

	FIRM - 01	FIRM - 02	FIRM - 03	FIRM - 04	FIRM - 05	FIRM - 06	FIRM - 07	FIRM - 08	FIRM - 09	FIRM - 10	FIRM - 11	FIRM - 12	FIRM - 13	FIRM - 14	
PRPS - 01	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2
PRPS - 02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRPS - 03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
PRPS - 04	0	0	0	0	0	0	1	1	0	0	0	0	0	0	2
PRPS - 05	0	0	0	0	1	1	1	0	0	0	0	1	1	0	5
PRPS - 06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRPS - 07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRPS - 08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRPS - 09	0	0	0	0	1	0	1	1	0	0	0	1	1	1	6
PRPS - 10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
PRPS - 11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRPS - 12	1	1	1	1	1	1	0	1	1	1	0	1	1	1	12
PRPS - 13	0	1	1	1	0	1	1	1	1	0	1	1	1	0	10
PRPS - 14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
PRPS - 15	0	0	0	0	1	1	1	1	1	1	1	1	1	1	10
	4	5	5	5	7	7	8	8	6	5	5	9	9	6	

Table 6 - Spinning and Autoconer

	FIRM - 01	FIRM - 02	FIRM - 03	FIRM - 04	FIRM - 05	FIRM - 06	FIRM - 07	FIRM - 08	FIRM - 09	FIRM - 10	FIRM - 11	FIRM - 12	FIRM - 13	FIRM - 14	
SPAC - 01	0	0	0	0	1	1	1	1	0	0	0	1	1	1	7
SPAC - 02	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
SPAC - 03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
SPAC - 04	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
SPAC - 05	0	0	0	0	1	1	1	1	1	0	0	1	1	1	8
SPAC - 06	0	0	0	0	0	1	0	0	1	0	0	0	0	1	3
SPAC - 07	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
SPAC - 08	0	0	0	0	1	0	1	1	0	0	1	0	0	0	4
SPAC - 09	0	0	0	0	1	1	1	1	1	1	1	1	0	0	8
SPAC - 10	0	0	0	0	1	0	1	1	1	0	0	1	1	1	7
SPAC - 11	0	0	0	0	0	0	1	1	1	0	0	1	1	1	6
SPAC - 12	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2
SPAC - 13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
SPAC - 14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
	5	5	5	5	11	10	11	11	10	6	7	11	9	10	

Table 7 - Compressor

	FIRM - 01	FIRM - 02	FIRM - 03	FIRM - 04	FIRM - 05	FIRM - 06	FIRM - 07	FIRM - 08	FIRM - 09	FIRM - 10	FIRM - 11	FIRM - 12	FIRM - 13	FIRM - 14	FIRM - 15	FIRM - 16	FIRM - 17	FIRM - 18	
COMP - 01	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
COMP - 02	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
COMP - 03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	17
COMP - 04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMP - 05	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	4
COMP - 06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMP - 07	0	0	1	0	1	1	1	1	0	1	0	1	1	1	0	1	1	1	12
COMP - 08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMP - 09	0	0	0	0	1	0	1	0	1	0	0	0	1	0	0	1	0	1	6
COMP - 10	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
COMP - 11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	17
COMP - 12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMP - 13	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
COMP - 14	0	0	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	14
COMP - 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMP - 16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	2	4	3	8	5	6	5	5	4	2	4	5	5	0	5	4	5	

Table 8 - Humidification Plant

	FIRM - 01	FIRM - 02	FIRM - 03	FIRM - 04	FIRM - 05	FIRM - 06	FIRM - 07	FIRM - 08	FIRM - 09	FIRM - 10	FIRM - 11	FIRM - 12	FIRM - 13	FIRM - 14	FIRM - 15	FIRM - 16	FIRM - 17	FIRM - 18	
HFPT - 01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	18
HFPT - 02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HFPT - 03	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	1	1	1	7
HFPT - 04	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	18
HFPT - 05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HFPT - 06	0	0	0	0	1	1	0	0	1	1	0	0	0	1	0	1	1	1	8
HFPT - 07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HFPT - 08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HFPT - 09	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
HFPT - 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HFPT - 11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	18
HFPT - 12	0	0	0	0	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
HFPT - 13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	18
HFPT - 14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
HFPT - 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HFPT - 16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HFPT - 17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	4	4	4	7	7	4	4	6	5	4	5	5	7	4	8	7	7	

Table 9 - Transmission and Distribution

	FIRM - 01	FIRM - 02	FIRM - 03	FIRM - 04	FIRM - 05	FIRM - 06	FIRM - 07	FIRM - 08	FIRM - 09	FIRM - 10	FIRM - 11	FIRM - 12	FIRM - 13	FIRM - 14	FIRM - 15	FIRM - 16	FIRM - 17	FIRM - 18	FIRM - 19	FIRM - 20	
TMDB - 01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	18
TMDB - 02	0	0	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	1	1	1	15
TMDB - 03	0	0	0	0	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	14
TMDB - 04	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
TMDB - 05	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
TMDB - 06	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
TMDB - 07	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
	4	4	5	5	6	6	6	6	4	5	6	6	6	5	5	5	6	6	6	6	

Table 10 - Boiler House and Steam Distribution

	FIRM - 01	FIRM - 02	FIRM - 03	FIRM - 04	FIRM - 05	FIRM - 06	FIRM - 07	FIRM - 08	FIRM - 09	FIRM - 10	FIRM - 11	FIRM - 12	
BHSD - 01	0	0	0	0	0	0	0	0	0	0	0	0	0
BHSD - 02	1	1	1	0	0	0	0	0	0	0	0	0	3
BHSD - 03	1	1	1	1	1	0	0	0	0	0	0	0	5
BHSD - 04	1	1	1	1	1	1	0	0	0	0	1	1	8
BHSD - 05	1	1	1	0	0	0	0	0	0	0	0	0	3
BHSD - 06	1	1	1	1	0	0	0	0	0	0	0	0	4
	5	5	5	3	2	1	0	0	0	0	1	1	

Table 11 - Lighting

	FIRM - 01	FIRM - 02	FIRM - 03	FIRM - 04	FIRM - 05	FIRM - 06	FIRM - 07	FIRM - 08	FIRM - 09	FIRM - 10	FIRM - 11	FIRM - 12	FIRM - 13	FIRM - 14	FIRM - 15	FIRM - 16	FIRM - 17	FIRM - 18	
LITN - 01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	18
LITN - 02	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	18
LITN - 03	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	3
	2	2	2	2	3	3	2	2	2	2	2	2	2	2	2	3	2	2	

Table 12 - Dyeing – Specific

	FIRM - 01	FIRM - 02	FIRM - 03	FIRM - 04	FIRM - 05	FIRM - 06	
DYNG - 01	0	0	0	0	0	0	0
DYNG - 02	0	0	0	0	0	0	0
DYNG - 03	1	1	0	0	0	0	2
	1	1	0	0	0	0	

Table 13 - CETP - Specific

	FIRM - 01	FIRM - 02	
CETP - 01	1	1	2
CETP - 02	0	0	0
CETP - 03	0	0	0
CETP - 04	0	0	0
CETP - 05	0	0	0
	1	1	

Table 14 – Work Flow-Time Line Details

S.No	Activity	Duration	Sample Size	Purpose & Sources of Data Collection
1	Secondary Data Collection on Energy Consumption Trends in Textile Industry	December 2017 to October 2018	About 50 Companies	Through Company Annual Reports from CMIE Prowess & Zauba Data Corp
2	Formulating Survey Questionnaire for Various Sub-Sectors	November 2018 to December 2018	Nil	To Evaluate Secondary Data & Get more Primary Data
3	Pilot Survey & Process Learning	December 2018 to January 2019	About 10 Companies	To Get Feedback from Companies about the Survey and get Exposed to the Process
4	Phase 1 Primary Survey Across Various Sub-Sectors	March 2019 to April 2019	About 30 Companies	To Collect Data on Energy Conservation Measures Adopted and Scope for Further Deployment
5	Phase 2 Primary Survey - Detailed Energy Assessment	May 2019 to June 2019	5 Companies	Firm Level on-field Data Collection using Appropriate Energy Audit Equipment
6	Validation of Collected Energy Conservation Measures	September 2019 to October 2019	About 10 Companies & 15 Personnels	Validation of Energy Conservation Measures Consolidated from Primary Survey

Table 15 – List of Participants for the Survey

S.No	Company Name	Location
Spinning		
1	M/s Premier Textile Mills	Coimbatore
2	M/s Precot Meridian Textile Mills	Coimbatore
3	M/s GHCL - Meenakshi Textile Mills	Madurai
4	M/s Thiagarajar Mills	Virudhunagar
5	M/s K G Balaji Spinning Mill	Annur
6	M/s K G Naidu Spinning Mill	Coimbatore
7	M/s Srinivasa Spinning Mill	Sirumugai
8	M/s Palani Andavar Spinning Mill	Udumalpet
9	M/s Suguna Textile Mill	Coimbatore
10	M/s Loyal Textile Mill	Kovilpatti
11	M/s Valli Textile Mill	Sattur
12	M/s Chintamani Textile Mill	Madurai
13	M/s Dattatreya Textile Mill	Madurai
14	M/s KKP Spinning Mill	Namakkal
15	M/s Shiva Tex Yarn	Sulur
16	M/s Southern Cot Spinners	Coimbatore
17	M/s Adwaith Textiles	Coimbatore
18	M/s Sambandam Spinning Mill	Salem
19	M/s Jegathguru Textile Mills	Vellakovil

S. No	Company Name	Location
Weaving		
1	M/s K G Fabriks Ltd	Perundurai
2	M/s K G Denim Ltd	Sirumugai
3	M/s VTM Ltd	Virudhunagar
4	M/s KKP Textile Mills	Salem
5	M/s Bannari Amman Weaving Mills	Sulur
6	Palladam Hi-Tech Weaving Park	Palladam
Dyeing		
1	M/s Divyar Processors	Tirupur
2	M/s Kongoor Processors	Tirupur
3	M/s Balaji Processors	Tirupur
4	M/s Vimal Colour Houses	Tirupur
5	M/s Palani Andavar Processors	Tirupur
6	M/s Vedha Colours	Tirupur
Common Effluent Treatment Plant (CETP)		
1	Angeripalayam CETP	Tirupur
2	Murugampalayam CETP	Tirupur
3	Veerapandi CETP	Tirupur

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