Tea Research Institute of Sri Lanka

Sri Lanka Sustainable Energy Authority

Energy Management Programme in Tea Sector

Summary Report

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Preface

Sri Lanka Sustainable Energy Authority (SLSEA), established under the Parliament Act, No. of 35 of 2007, has the mandate of promoting Energy Management and Renewable Energy Development in the country. Energy Management Division of SLSEA conducts many programmes to improve energy efficiency in end use sectors. Among these, tea sector is one of the areas in which energy management measures have been introduced in the past couple of years.

As a pilot project, SLSEA in collaboration with Tea Research Institute (TRI) selected 60 factories from three regions (up-country, mid-country and low-country), and Factory Officers of those tea factories were trained as Energy Management Officers in 2013. The objective of this particular training programme was to develop the capacity of in-house staff of the tea factories towards energy conservation, and thereby to promote rational use of energy. The outcome will contribute towards long-term energy conservation goals at national level.

On completion of one-year period after the training programme, SLSEA and TRI carried out an impact assessment of the programme in order to review the progress and further streamline the deliverables. Under this, energy performances of the factories before and after the programme were compared based on the Specific Energy Consumption figures of 2012 and 2013. Findings of the review were presented to the factory officials at a Progress Review Programme conducted on 12th and 13th of September 2014.

Energy consumption data and the observations made in the review are included in this report. Energy saving activities implemented, recommendations for further improvements, and future plan for the year 2015 are also presented.

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1. Background

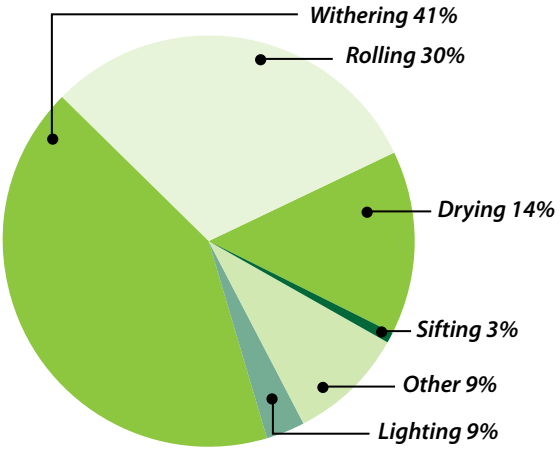
As the fourth largest tea producer and second largest tea exporter in the world, Sri Lanka lies on the for front of tea processing business in the global market. Tea industry continues to occupy a dominant position in the national economy, with considerable amount of foreign exchange earnings and employment. More than two million people in Sri Lanka (10% of the population) depend on the tea industry and it contributes to approximately 2% of island's GDP while generating 65% of export agriculture revenue. Tea industry consumes around 235 GWh per annum, which is around 7% of the total industrial electricity consumption of the country.

2. Energy Consumption in Tea Industry

Around 8% of the production cost of tea industry accounts for energy. Main energy resources utilized in the tea industry are electricity, biomass, and fuel oils such as diesel and furnace oil. Withering, rolling, drying, sifting and lighting are the major energy consuming areas, where withering and rolling are the major electricity consumers and drying is the key area requiring heat.

Figure 1:

Typical electrical energy balance of a tea factory



The higher energy consumption in tea industry is mainly due to the presence of old, used & inefficient motors, machines and inefficient lights, fans, etc. Some improper process aspects such as improper loading and loosening of leaf in the trough, fan starvation owing to improper adjustments of air dampers and inappropriate ducting in front of the fan also lead to inefficiencies in the industry. Use of air with high humidity for withering, leaving the fan switched on even after withering is completed, improper firewood management system, improper utilization of day light, etc. too lead to energy waste.

3. Energy Management Initiatives in Tea Sector

Sri Lanka Sustainable Energy Authority (SLSEA) commenced facilitation of energy management in industries just after its inception in 2007, and sector specific industrial programmes were introduced to some of the key sectors. Programme in the tea sector was initiated in collaboration with Tea Research Institute (TRI). It enabled to introduce energy management systems to the tea industry and also to inculcate attributes towards energy conservation among factory personnel.

In addition to the technology dissemination activities carried out on continuous basis, capacity building for factory officers along with training for energy auditing was conducted from time to time. Details of those programmes are given below.

Table 01: Capacity building under sector specific programme

Programme	Dates	No. of Participants
Building in-house capacity of the tea factory technical staff at TRI - Talawakelle	12th - 15th February 2008	25
Building in-house capacity of the tea factory technical staff at TRI - Talawakelle	7th - 11th July 2008	27
Building in-house capacity of the tea factory technical staff at TRI - Rathnapura	7th - 11th September 2008	24
Building in-house capacity of the tea factory technical staff at TRI - Talawakelle	23rd - 25th March 2009	32
One Day Refresher Programme on Energy Conservation	8th January 2010	25

In order to strengthen the energy management programmes that had been carried out so far, SLSEA introduced "National Energy Management Action Plan" (EnMAP) encompassing industrial and commercial sectors, and energy management in tea industry has been included therein. Under that, it is expected to help the tea industries to increase energy productivity, and reduce Specific Energy Consumption-SEC (energy consumption per kg of made tea on average) and thereby to reduce their production cost. As a final outcome of the programme, making tea industry internationally competitive while helping Sri Lanka to reduce its burden on incurring high foreign exchange expenditure on energy resource imports, are expected.

4. Programme Outline

As the first phase of the programme 60 factories were selected from three regions of the country (up-country, mid-country and low-country). Main objective of the above programme was to build the capacity of factory managers, factory officers and technical staff towards the achievement of high level professionalism in energy utilization efficiency. Factory Officers of those tea factories were trained as Energy Management Officers.

Key elements of the programme are given below.

(i) Developing capacities of factory managers, factory officers and technical staff in efficient energy utilization

(ii) Implementing energy efficiency measures and thereby reducing energy cost in tea production

(iii) Minimizing energy wastage in the tea sector in order to support realizing national energy saving targets

To develop their capacity on energy conservation and management, three-day capacity building programmes were conducted by SLSEA for the selected participants with the coordination of TRI, and the details are given below.

Table 02: EnMAP initiatives for tea sector

Programme	Dates	No. of Participants
1st programme	14th, 15th and 27th February 2013	35
2nd programme	27th, 28th March and 19th April 2013	25

Three-day capacity building programme was structured in two segments in such a way that, initially Energy Management Officers were made aware about the energy conservation on the first two days,and then their current energy performance were evaluated after two week period.

Under the first phase, the importance of energy conservation, their responsibilities towards energy usage and conservation, cost of energy and the importance of energy accounting in controlling energy cost were explained on the 1st day. Further, electrical & thermal energy conservation opportunities in tea manufacturing were highlighted. On the 2nd day, Energy Auditing and Implementation of the Energy Management programme were explained. At the end of the 2nd day, two week period was given them to collect energy data and to find out the current problems related to energy conservation in their factories.

In the second phase, after the two-week period, participants were guided on data formulation, energy calculation and reporting. Further Energy Management Officers were trained to maintain energy management systems and to develop energy management teams in their own factories. Finally, an action plan was prepared including the suggestions of the participants.

Action plan included the activities for energy saving, time period for implementation and the assistance provided by SLSEA and TRI.

Accordingly, SLSEA assisted them to carry out the energy measuring in their own factories and to implement identified energy saving measures.

In addition to the above, SLSEA and the International Finance Cooperation (IFC) carried out detailed energy audits for 5 tea factories under this programme. With the implementation of energy efficiency measures identified in the energy audits, there was a potential saving of 800 MWh, 175 kVA of electricity and 2800 Tonnes of firewood.

5. Impact of the programme

After one-year period of the capacity building programme, SLSEA and TRI carried out an impact assessment of the programme in order to further streamline the deliverables under that. The impact assessment survey was conducted during the period of March to June, 2014.

SLSEA and TRI visited each factory to collect their energy consumption data, and gave suggestions to improve activities on energy saving. Collected data was analysed, and their SEC values of 2012 and 2013 were compared to find out the savings achieved through the programme.

6. Observations and Data Analysis

Current Status of Specific Energy Consumption (SEC)

Table 03: Current Specific Energy Consumption

No	Factory	Specific Electrical Energy Consumption (SEEC) - (kWh/kg of MT)		Specific Firewood Consumption (SFWC) - (kg/kg of MT)	
		2012	2013	2012	2013
1	Abbotsleigh	0.88	0.96	2.28	2.00
2	Athukorala	0.77	0.82	0.67	1.01
3	Cee Tee Hills	0.76	0.72	1.53	1.55
4	Cooroondoowatte	0.70	0.78	1.38	1.12
5	Dambatenne	0.87	0.91	0.87	1.32
6	Dellawa	0.63	0.56	1.85	1.73
7	Deranagala	0.68	0.66	1.56	1.53
8	Dishan Valley	0.74	0.71	1.77	1.77
9	Dunsinane	-	1.03	-	1.58

10	Fairlawn	0.92	0.90	2.08	1.97
11	Galaboda	1.05	0.84	2.13	1.66
12	Geragama Estate	0.72	0.68	1.02	1.03
13	Haputale	0.90	0.91	1.05	1.17
14	Harangala	0.51	0.54	0.53	0.56
15	Henfold	0.73	0.60	1.18	1.10
16	Jayasinghe	0.73	0,98	1.20	1.40
17	Kelaniya	1.12	1.62	1.31	1.40
18	Liyota	0.88	0.92	2.88	2.52
19	Lumbini	0.80	0.86	1.28	1.54
20	Mattakele	0.90	1.00	1.06	1.16
21	Mulatiyana	0.87	0.87	2.97	2.84
22	Nilidiya Valley	0.82	0.74	1.65	1.72
23	Nilwala	0.70	0.66	2.13	1.97
24	Ranmeer	0.65	0.67	1.30	1.25
25	Rothschild	0.81	0.89	1.43	1.53
26	St. Coombs	0.61	0.62	2.85	3.23
27	Strathdon	0.63	0.72	1.59	1.40
28	Thalgaswala	0.90	0.94	0.93	0.93
29	UvaHalpeWatta	0.58	0.62	0.68	0.79
30	Wanarajah	0.99	0.96	1.75	1.93

Table 03 above depicts Specific Electrical Energy Consumption (SEEC) and Specific Firewood Consumption (SFWC) of tea factories in 2012 and 2013.

Figure 02 and Figure 03 show the SEEC and SFWC in 2012 and 2013 compared to the SLSEA baseline [1,2] respectively.

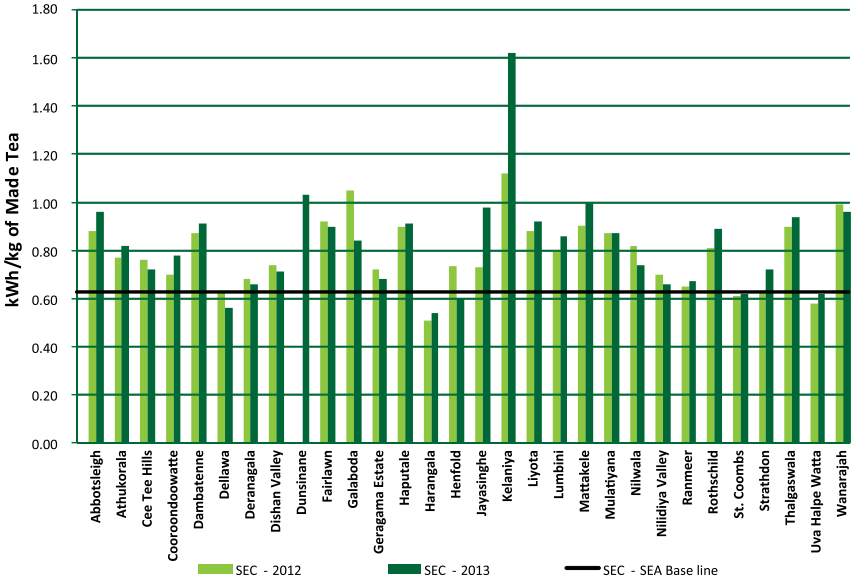


Figure 2: Specific Electrical Energy consumption (SEEC)

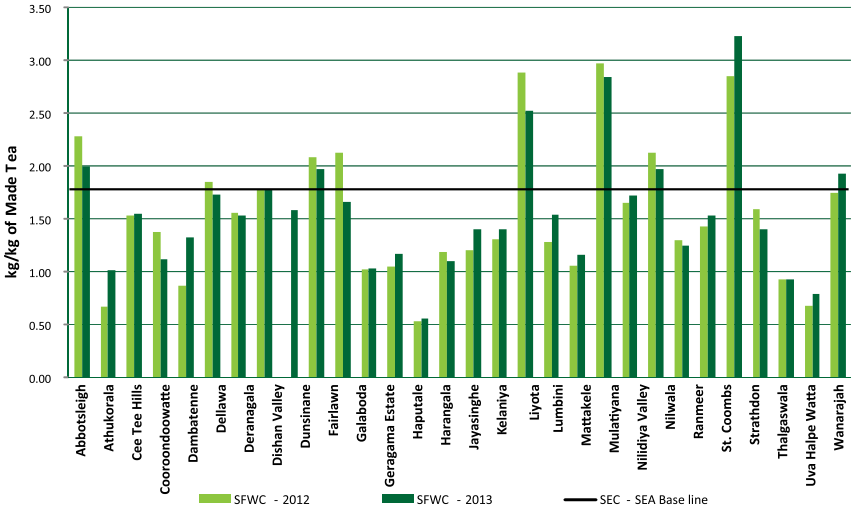


Figure 3: Specific Firewood Consumption (SFWC)

Specific Energy Consumption (SEC) is an indicator commonly used in evaluating the productive use of energy which measures the amount of energy used per unit output of the product. SLSEA has published "Energy Consumption Baseline Analysis" for six major sectors in 2009, by analysing a pool of national data. Tea is one sector included among there.

Since tea industries derive energy by utilising firewood and electricity as the primary sources, SEC values were calculated separately for firewood and electricity. The details of the SEC values established in 2009 are given in the table below.

Description	Sample size	Minimum	Maximum	Mean	Std. Deviation (σ)
Specific Electrical Energy Consumption - SEEC (kWh/ 1kg of Made Tea)	153	0.10	0.98	0.63	0.20
Specific Firewood Consumption - SFWC (kg/ 1kg of Made Tea)	23	0.26	4.45	1.78	0.97

Note: Mean value is considered as the baseline SEC value.

[1]Specific Electrical Energy Consumption, SEEC - 0.63 kg /kg of made tea

[2]Specific Firewood Consumption, SFWC - 1.78 kg /kg of made tea

Out of the factories considered in this programme, Harangala Tea Factory has achieved the best SEEC and SFWC values, i.e. 0.54 kWh/kg of Made Tea and 0.56kg / kg of Made Tea respectively. Being the best among the audited tea factories in terms of energy performance, Harangala Tea Factory had completed several energy efficiency projects to achieve the same. The most important project contributed to savings, is the implementation of heat recovery system to recover the heat from flue gas. Also the close monitoring of energy related parameters with separately installed sub-meters associated with excellent employee awareness initiatives in each department also helped to improve the electrical energy efficiency.

7. Energy Savings

7.1 Energy Savings Achieved in 2013

Final outcome of this programme is indeed commendable, wherein most of the participatory factories marked a significant reduction in energy consumption. Table 04 depicts the energy savings (electricity and firewood) achieved in 2013 with respect to 2012.

Table 04: Annual Energy Savings Achieved

No	Factory	Electricity saving (MWh)	Firewood saving (Tonnes)
1	Abbotsleigh Tea Factory	-	468
2	Cee Tee Hills Tea Factory	22	-
3	Cooroondoowatte Tea Factory	-	150
4	Dellawa Tea Factory	58	105
5	Deranagala Hills Tea Factory	13	25
6	Dishan Valley Tea Factory	24	-
7	Fairlawn Tea Factory	9	64
8	Galaboda Tea Factory	94	186
9	Geragama Estate Tea Factory	14	-
10	Henfold Tea Factory	103	59
11	Liyota Tea Factory	-	153
12	Mulatiyana Tea Factory	-	110
13	Nilidiya Valley Tea Factory	22	-
14	Nilwala Tea Factory	28	125
15	Strathdon Tea Factory	-	209
16	Wanarajah Tea Factory	27	-
Total		**414**	**1,654**

Amount of annual electrical energy saving achieved through this programme was 414 MWh, while the annual firewood saving was 1,654 tonnes.

7.2 Energy Saving Potentials

With the implementation of suitable energy saving approaches, each of the factories will be able to save a considerable amount of energy. Annual electrical energy saving potential with reference to the SLSEA baseline value, 0.63 kWh/kg of MT as well as the best achievement value, 0.54 kWh/kg of MT (obtained by Harangala Tea Factory) are given below.

Table 05: Electrical Energy Saving Potential

No	Factory	Annual Electrical Energy Saving Potential (MWh)	
		Reference to SLSEA Baseline Value (0.63 kWh/kg of MT)	Reference to Best Achievement Value (0.54 kWh/kg of MT)
1	Abbotsleigh	500	636
2	Athukorala	221	326
3	Cee Tee Hills	53	106
4	Cooroondoowatte	69	110
5	Dambatenne	326	431
6	Dellawa		17
7	Deranagala	20	79
8	Dishan Valley	70	148
9	Dunsinane	383	470
10	Fairlawn	127	169
11	Galaboda	116	166
12	Geragama Estate	25	69

13	Haputale	193	255
14	Henfold		54
15	Jayasinghe	122	154
16	Kelaniya	141	154
17	Liyota	124	163
18	Lumbini	133	185
19	Mattakele	249	310
20	Mulatiyana	179	246
21	Nilidiya Valley	48	87
22	Nilwala	23	91
23	Ranmeer	24	77
24	Rothschild	474	638
25	St. Coombs		31
26	Strathdon	94	189
27	Thalgaswala	123	159
28	Uva Halpe Watta		125
29	Wanarajah	290	369

Similarly, Table 06 depicts the amounts of annual firewood saving potential with reference to the SLSEA baseline value, 1.78 kg of FW/kg of MT and with reference to the best achievement value, 0.56 kg of FW/kg of MT obtained by Harangala Tea Factory.

Table 06: Fire wood Saving Potentials

No	Factory	Annual Firewood Saving Potential (Tonnes)	
		Reference to SLSEA Baseline Value (1.78 kg of FW/kg of MT)	Reference to Best Achievement Value (0.56 kg of FW/kg of MT)
1	Abbotsleigh	333	2179
2	Athukorala		524
3	Cee Tee Hills		582
4	Cooroondoowatte		258
5	Dambatenne		885
6	Dellawa		1021
7	Deranagala		640
8	Dishan Valley		1052
9	Dunsinane		977
10	Fairlawn	89	663
11	Galaboda		609
12	Geragama Estate		230
13	Haputale		421
14	Henfold		467
15	Jayasinghe		294
16	Kelaniya		120
17	Liyota	317	838
18	Lumbini		567

19	Mattakele		402
20	Mulatiyana	789	1698
21	Nilidiya Valley		502
22	Nilwala	144	1066
23	Ranmeer		411
24	Rothschild		1769
25	St. Coombs	584	1077
26	Strathdon		881
27	Thalgaswala		147
28	Uva Halpe Watta		360
29	Wanarajah	132	1204

8. Implementation of Energy Saving Measures

8.1 Electrical Energy System

Installation of capacitor bank was the most common measure observed in the central electrical systems.

In tea industry, a majority of the electrical equipment such as withering trough motors, rolling motors and other processing motors have inductive loads. These inductive loads cause poor power factor in tea factories. A poor power factor indicates ineffective utilization of electricity and leads to increase the total energy costs. This problem can be solved by introducing capacitor banks. Installation of capacitor bank to the main supply increases the power factor to unity and it leads to reduce the electricity demand (kVA), thereby the energy cost. In introducing capacitor banks, proper selection and sizing are very important to achieve the targeted reductions in maximum electricity demand.

Followings are the other load management measures adopted in central electrical systems.

- Installation of sub meters to monitor electrical energy consumption of individual sections
- Load shifting from peak hours to off peak hours
- Isolation of private lines from the CEB factory supply line

Withering

Installation of Variable Speed Drives (VSDs) for withering fan motors was observed in quite a satisfactory number of tea factories, and it is a measure leading to substantial electricity savings.

Withering is the process with the highest electricity consumption in tea industry. In the withering process full flow of air is required only during initial 3 to 5 hours to facilitate fast removal of free moisture in green leaf, and subsequent air flow can be reduced after some of the inner moisture in green leaf is being removed. Normally this change of air flow requirement is done by adjusting the dampers provided in the inlet air grill. Dampers do the work, but at the expense of energy consumed by the fan motors. In addition, the dampers are adjusted manually, making it dependent on human intervention which may not be available at the correct time. Alternatively, flow of air can be easily controlled by regulating the speed of the fan, instead of the damper. In this case any lowering of the flow of air will be achieved by lowering the speed of the fan motor, and of course with associated energy savings. In order to vary the motor speed, a VSD should be used. According to the norms in the tea industry, VSDs can save 20 -30% of electrical energy in the withering process, if VSDs are operated in a regular manner. Training of staff on the operation of the VSDs and how the benefits could be accrued, together with proper monitoring of VSD

operations would address the problem effectively. Such savings could be substantial because withering process consumes the highest percentage of electrical energy in tea industry.

Figure 4: VSD Controlled withering troughs

Followings are the other energy conservation measures observed in the withering process:

- Installation of low weight fibre and die cast aluminium fans for trough motors
- Installation of energy saving bearings (ball bearings) for withering fan motors, which will reduce the energy and maintenance cost
- Replacement of oversized/ inefficient motors, with properly sized/ high efficient motors in withering troughs at the same air flow rate for the withering process
- Installation of separate duct line for the withering process such that, withering fans draft the heat from the radiator and ID fan is not in operation

- Repairing of trough leakages
- Installation of kVA controller for withering trough fan motors (when the power is on after a power cut, troughs are switched on one by one)

Rolling

- Auto feeding and pressure applying system in rollers
- Installation of auto humidifier system.

  In the conventional system humidifier runs continuously, irrespective of the temperature of the rolling area. In auto humidifier system, it senses the temperature and controls the pump accordingly.

Drying

- Installation of VSD for the FD fan motor in furnace for avoiding manual damping.

Sifting

- Old reciprocating type compressors have been replaced with energy saving screw type compressors. Individual compressors have been eliminated with central compressed air system.

Figure 5:

VSD controlled screw type compressors

Lighting

- Changing the switching system to one bulb to one switch, avoiding grouping of switches
- CFL lighting and LED lighting in office and production areas
- Introduction of energy efficient fluorescent lamps of T5 type instead of T8 type
- Improving day lighting by means of transparent roof tiles, taller windows with double glazed glasses, etc.


Figure 6: Daylights used at the production facility

Day lighting is stated as the most energy efficient and cost free form of lighting which can be utilized to the maximum in tea industry in the sections like withering, rolling, sorting, packing, etc. Use of transparent sheets, skylights, glass windows and sun control films were the most common methods used to capture the day lighting.

8.2 Thermal Energy System

- Implementation of heat recovery system to recover the heat from flue gas, the recovered energy is used to heat the intake air
- Installation of firewood sheds for storing firewood
- Maintaining a 2 month stock of firewood (1000 m^3); firewood is split and kept for drying

Figure 7: Splitted firewood storing for 2 months

- Firewood storing facilities are very important. Keeping excess firewood in open spaces causes to increase the moisture content due to rainy weather conditions and ultimately firewood becomes wet, and the wet firewood has to be fed into the furnace.

Firewood storage systems have been installed to avoid open storage, along-with a system for utilizing exhaust air from sifting room main fan, waste heat from the furnace and solar energy to dry firewood. In addition to that, firewood was stored after splitting.

Following measures lead to more effective and efficient firing process:

- Weighing of firewood before firing
- Use of Rubber wood is used instead of jungle firewood
- Use of saw dust and briquettes for Biomass boilers instead of logs
- Use of reject tea to produce briquettes for the use of Biomass boiler. By using a local manufactured or imported machine briquettes are made using refused tea in a few factories
- Use of condensate recovery systems for steam boilers

8.3 Enhanced management intervention for process optimization

- It was noticed that some of the factories have done behavioural change in their staff so that they could contribute to energy savings by reducing wastages in their factories

Figure 8: Maintenance schedule for dryer

- Some of the factories focused on reducing operating time of machineries and minimizing the labour resources which will ultimately save energy and cost, by way of strict management practices and modern automation
- Some of the factories use strong monitoring techniques

8.4 Energy Management System

- Energy Team is formulated within the factory and the team discusses every week the progress of energy saving activities, house keeping and maintenance activities of the factory. Awareness of the factory staff is enhanced on energy saving practices
- Maintenance schedules for the machineries and guidelines for the workers are prepared and disseminated
- Maintenance details, energy efficiency guidelines, etc. related to machinery and equipment are displayed

9. Recommendations for further improvements

9.1 Establishment of Energy Management System

First and foremost all factories shall establish a functional energy management system within their organizations. To do the same they may refer such guidelines provided by SLSEA or the guidelines given in ISO 50001 standards. Such system could dynamically assist the energy efficiency implementation process and induce a result oriented energy management team. Further an ISO 50001 compatible Energy Management System would have the following PDCA cycle for continual improvement.

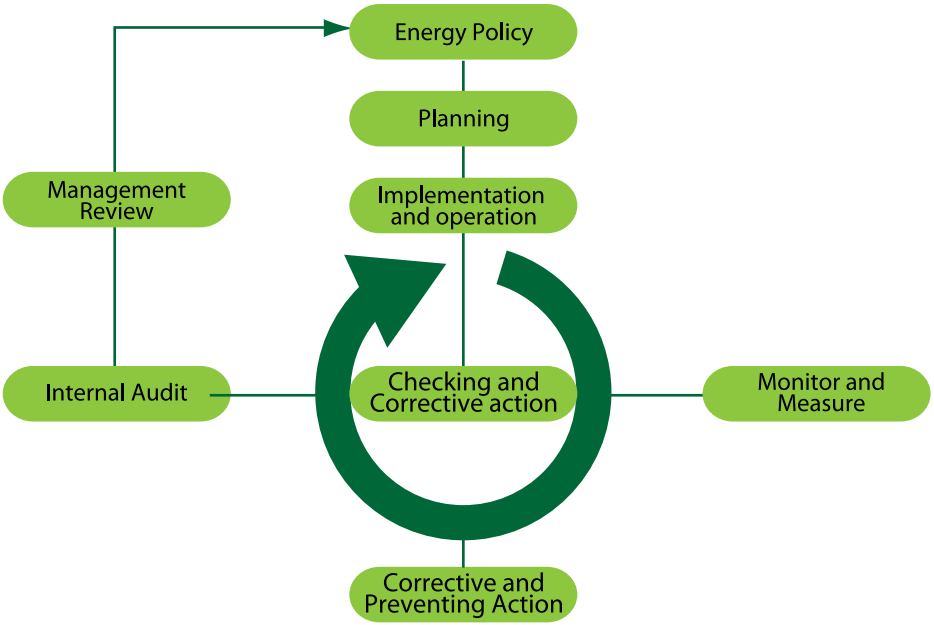


Figure 9: PDCA cycle

9.2 Improvements in Electrical Systems

There are many factories that have not made an effort in implementing the basic steps to trap the waste of electrical energy. Some are given below:

- Installing VSD units for motors of withering troughs
- Lighting efficiency improvements, such as phasing out of incandescent bulbs and use of higher efficiency T5 Fluorescent lamps, CFLs or LEDs, maximize the use of day lighting, etc
- Avoiding machine idling times
- Load shifting to improve the productivity
- Install properly sized capacitor banks

- Install high efficient motors (E1 rated motors instead of E2/E3)
- Tea industry uses compressors for the colour sorting machines, which are mostly equipped with separate reciprocating type compressors. Screw type compressors with VSD are energy efficient than reciprocating type compressors and it utilizes electricity according to the variable load. Therefore, it is recommended to use centralized compressed air systems for the colour sorters. Also, in general, the efficiency of an air compressor is reduced by about 1% for every 4ºC change in inlet air temperature. Therefore, it is recommended to keep compressor inlets allowing proper ventilation.

9.3 Improvements in Thermal Energy Systems

There are factories that have installed heat recovery systems to improve the efficiency of firewood consumption. But on the other hand it was observed that most of the factories have not followed the basic steps to improve the firewood utilization. Below are some of the general guidelines for further improvement.

- Make sure to have a moisture free firewood storage facility
- Check the burner efficiency regularly and replace the fire tubes if necessary
- Check the steam leaks and boiler efficiency if such are being used
- Try to use the exhaust heat by means of heat recovery systems
- Use of condensate heat recovery systems
- Keep a record of consumed firewood rather than the inventory records

10. Concerns and Barriers

10.1 Barriers in Establishing Communication

The assistance and support provided by TRI availed a meaningful contribution for the successful execution of this programme. However, SLSEA and TRI had difficulties in establishing a proper communication framework with the beneficiary parties (tea factories). Even though at the end SLSEA has managed to establish a functional contact point with the assistance from TRI, the following factors which were beyond the scope of both institutions had dragged the time schedules throughout the programme.

(a) Geographical Location of Establishment

Geographical location of a tea factory plays a key role in accessing the establishment during the site visit. Most of the factories are held in remote sites with limited road networks. There was no database of geographical location of factories.

The evaluators often found them based on the physical address, which was very difficult in limited road networks.

(b) Lack of ICT Infrastructure

This is not applicable for most of the establishments, but there were number of factories that had limited access and exposure to modern information and communication technologies such as internet and E-mail. SLSEA posed difficulties to keep-up with its schedules due to the time taken to establish communication with such tea factories.

(c) Decentralized Nature of the Establishments

There were number of institutions with different strategy to serve the tea sector. SLSEA with the help of TRI managed to contact most of them during the times of difficulties during the programme. The Tea Board of Sri Lanka and the Association of Private Tea factory Owners are such institutions that provided valuable inputs when needed. The distributed nature of tea factories and lack of participation in such forums left the available database outdated.

(d) Displacement of Contact Person in Certain Factories

It shall be noted that SLSEA had established a channel of communication during the training programme conducted in 2013. Some of the efforts made by collecting contact details of appointed Energy Management

Officers had no returns since they have switched their position or profession and no longer available with the establishment.

(e) Participation in the Progress Review Programme

This type of progress review immensely helps to identify the drawbacks and to conduct the programme in a more productive manner. However, participation of Progress Review Programme held on 12th-13th September 2014 is not satisfactory.

(f) Difficulties Faced in Data Acquisition and Processing

Most of the factories were not able to provide the required data instantly. And the establishing communication was the major reason for it.

Following are the other reasons for improper data acquisition and facing difficulty in providing accurate data.

i. Poor record keeping

ii Lack of interest in providing data

iii No dedicated energy data records

10.2 Causes for Zero Energy Efficiency Implementations in Certain Establishments

There were number of energy efficiency improvement interventions observed by SLSEA following the training workshop conducted in 2013. Such includes installation of VSD units, efficiency improvement in lighting and even some complex projects such as design and installation of heat recovery systems. On the other hand there were number of institutions that had no record of such implementations. Following are some factors in perception of SLSEA, which may have caused this situation.

(a) Lack of financial resources

(b) Lack of human resources

(c) Absence of adequate knowledge and awareness

(d) Low exposure to technological advancements.

(e) Some of the factories are of the impression that energy is not the priority to spend money and the more concern is in production.

(f) Lack of research and development work.

11. Recommendations for further improvement of the programme

It is important to clearly identify the causes of above barriers & difficulties involved and define a strategic frame work to eliminate them for further improvement of the programme.

1. Develop ICT (Information and Communication Technology) infrastructure for the benefit of all parties involved in the programme.
2. Develop a web based energy efficiency data management system.

12. Conclusion

Although most of the industries have marked a reduction in energy consumption levels, further measures should be adopted to bring them down to best achievement value of SEC of electricity (0.54 kWh/kg of MT) and firewood (0.56 kg/kg of MT), and the respective saving potential would be 6,000 MWh of electricity and 21,800 tonnes of firewood per annum respectively.

There are factories that had put tremendous effort in energy management and attained the state of art technologies such as heat recovery systems, VSDs, etc. But most of the facilities were still lagging in implementation. Ultimately as the final outcome of the project it will reduce the energy consumption, cost and carbon foot print.

13. Future Plan

1. Introduce web based data management system to disseminate information related to energy conservation in tea sector.

   Since most of the people use ICT infrastructure, it is convenient to develop a web based energy Information management system to make aware about the new technologies, energy saving measures and other energy related aspect continuously. Further energy consumption data can be collected, processed and analyzed through a web based database without utilizing a considerable time. At the same time issues in tea industry can be solved by communicating through the web site.

2. Establish Sustainable Firewood Supply Chain

   Six biomass supply chains including production, handling, processing and supply will be developed under the UNDP (United Nations Development Programme) project on "Promoting Sustainable Biomass Energy Production and Modern Bio-Energy Technologies in Sri Lanka" which is to be implemented by SLSEA and Department of Forest. Main objective of this programme is to meet quality standards and buyer specifications of firewood. In addition to that established biomass supply chains will be monitored and evaluated, and also assist them in trouble-shooting and corrective technology solutions. Further innovative approaches for drying, processing, storing, handling and transport of biomass(incl. semi-mechanization such as producing pellets and briquettes) will be introduced to reduce cost and improve quality.

3. Regional Energy Efficiency Programme for Tea Sector

   In order to improve the regional level activities in energy management and renewable energy, SLSEA has taken initiatives to work in collaboration with provincial institutes, mainly the provincial energy ministries. Such programmes have been initiated in the Southern, Central and Uva provinces. It has been found that 500 tea factories are there in these provinces, and dissemination of information and capacity building, for the tea factories will be coordinated by the provincial energy ministries.

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