RECENT TRENDS TOWARDS SUSTAINABLE ENERGY IN SPINNING INDUSTRY

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***Abstract**: Spinning Industry in India is one of the vital components of the Indian economy and contributing around 13% of total industry production, about 4% of India's Gross Domestic Product (GDP), about 16% of the gross export earnings and employing about 35 million people being the second largest provider of employment after agriculture. Taking the installed capacity of spinning machinery only, it ranks second (with 19.7% of total spindles globally), after China. In Spinning mill, electricity consumption and power cost is in increasing trend due to modernized machines and continuous usage of the machines in inefficient operating parameters. Especially in times of high energy price volatility, reduction in energy consumption is primary concern for textile plants. There are various energy-efficiency opportunities that exist in every textile plant, many of which are cost-effective. Further, traditionally fossil fuel has been the prime source of energy but concern is for their rapid depletion and their contribution towards growing global warming. So adoption of renewable energy sources like wind and solar energy to meet present and future projected global energy demands without inflicting any environmental impacts is necessary.*

***Keywords:** Sustainable energy, PAT, Wind energy, Solar energy, Spinning*

1. Introduction

Energy is the prime source of human activities in all sectors of life. Traditionally fossil fuel has been the prime source of energy. However, there are two major concerns regarding fossil fuels, i.e. their rapid depletion and their contribution towards growing global warming. It is being widely realized that for sustainable development presently used energy mediums such as fossil fuel and nuclear power have to be quickly reduced and replaced by renewable energy sources. The latter are sustainable and have the potential to meet present and future projected global energy demands without inflicting any environmental impacts.

2. Approach towards sustainable energy:

a. Reduction in energy consumption
b. Adoption of renewable energy sources

3. Reduction in energy consumption [1,2]

In a bid to combat increasing energy consumption and related carbon emissions, the Government of India released the National Action Plan on Climate Change (NAPCC) in 2008 to promote and enable sustainable development of the country by promoting a low carbon and high resilience development path. Perform Achieve and Trade scheme (PAT) is a component of the National Mission for Enhanced Energy Efficiency (NMEEE) which is one of the eight missions under the NAPCC. PAT is a regulatory instrument to reduce specific energy consumption (SEC) in energy intensive industries, with an associated market-based mechanism to enhance cost effectiveness through certification of excess energy savings, which could be traded. Energy Savings Certificate (ESCerts) are issued to the industries which reduce their SEC beyond their target. Those companies which fail to achieve their target are required to purchase ESCerts for compliance, or are liable to be penalised. PAT Cycle - I, which was operationalized in April 2012, included 478 units, known as "Designated Consumers" (DCs), from eight energy-intensive sectors viz. Aluminium, Cement, Chlor- Alkali, Fertilizer, Iron &Steel, Pulp & Paper, Thermal Power Plant and Textile were included. The annual energy consumption of these DCs in eight sectors was around 164 million TOE. The overall SEC reduction target in the eight sectors was about 4.05% with an expected energy saving of 6.68 million TOE by the end of 2014-15. With the completion of the PAT Cycle - I in 2015, the reported overall achievement was 8.67 million TOE, exceeding the target for cycle 1 by almost 30%. The total energy saving of 8.67 million TOE is equivalent to saving of about 20 million tonnes of coal and avoided emissions of about 31 million tonnes of CO2 . In terms of monetary value, saving in energy consumption corresponds to Rs. 95,000

million. PAT Cycle - I has witnessed an exceptional performance from all the sectors in terms of reducing their energy consumption. Textile sector is the second lowest consumer of energy in PAT Cycle - I, with an annual energy consumption of 1.2 million TOE. The summary of the achievement by the textile sector in PAT Cycle - I is presented in Table 1. The outcome of scheme also resulted in energy saving of more than Rs 9500 crores, investment by industry of about Rs 26,000 crore and capacity building of more than 5,000 engineers and operators. The DCs have made commendable efforts to achieve energy efficiency targets by adopting various improvement measures in technology, operational and maintenance practices, and application of management techniques (Table 2).

Table 1: Textile sector- achievement in PAT cycle-I [1]

Parameter	Units	Values
Number of DCs in the sector	Number	90
Total energy consumption of DCs in the sector	million TOE	1.2
Total energy savings target for Textile sector in PAT Cycle – I	million TOE	0.066
Total energy savings achieved by Textile sector in PAT Cycle – I	million TOE	0.13
Energy savings achieved in excess of target (PAT Cycle – I)	million TOE	0.064
Reduction in GHG emission for PAT Cycle – I	Million T CO_2 equivalent	0.62
Cumulative energy savings of PAT Impact till 2030[1] (over BAU)	million TOE	4.28

The key focus of Textile sectoral report is on the energy savings resulting from PAT scheme as compared to the business as usual scenario (BAU).

The Indian textile market is very large, about USD 150 billion as of July 2017, and plays a vital role in the Indian economy. It contributes to 4% of India's GDP, 14% of India's total manufacturing output, 14% of overall index of industrial production (IIP)3 and 13% of India's export earnings. India has 6% share in world textile export market, amounting to 37.74 billion USD during FY 2017-18, and is the third largest exporter of Textiles. The textile market is growing at a CAGR of 13.58% during 2009-2018. Indian Textile sector employs over 45 million people in about 3,400 mills.India's Textile Industry plays a vital role in terms of contribution to Indian economy through export. India's textile export was 37.74 billion USD during FY 2017-18. Indian Textile sector contributes to 13% of India's export earnings. India has approximately 3,400 textile mills ranging from large to small to micro scale industries. Out of these, 90 units were identified as DCs under PAT Cycle – I, based on the minimum threshold of energy consumption of 3000 TOE. Energy Consumption of DCs of textile sector covered in PAT Cycle-I is 1.2 million TOE, amounting to 0.73% of the total energy consumption by the DCs in PAT cycle-I . The contribution of DC's to overall energy intensity of India's GDP is 0.26% for baseline year. The sector has achieved 0.13 million TOE savings under PAT cycle-I. The contribution of this energy savings to overall energy intensity of India's GDP is 0.02 % for assessment year (Figure 1).

PAT cycle-I came into force from 2012, with financial years 2007–08 to 2009– 10 as the baseline. Under PAT cycle-I, the total reported annual energy consumption of the 90 designated consumers was about 1.2 million TOE in the baseline period. These DCs were given SEC target reduction of 5.5% and energy saving target of 0.066 million TOE, which was 0.99% of the total national energy saving target under PAT cycle-I. Subsequently, after the completion of PAT Cycle-I, 99 units in Textile sector were notified as DCs with total energy consumption of 1.47 million TOE in PAT cycle-II. The targeted energy saving for PAT Cycle - II is 0.09 million TOE. In PAT Cycle-III, 34 DCs were notified with an annual energy consumption of 0.66 million TOE and target of 0.04 million TOE. Textile sector has achieved 0.129 million TOE in comparison to the target of 0.066 million TOE in Cycle-I. This achievement has resulted in avoided emissions of 0.62 million tonnes of CO2 equivalent. The savings are attributed to a number of measures adopted by the DCs. Some of the DCs have implemented short term measures with minimal investment, others have opted for medium and long-term measures requiring considerable investment. Investment was reported by 71% Energy Savings 2.1 million tonnes of oil equivalent 4.9 million tonnes of coal 6.51 million tonnes of Co2 equivalent Savings 23 billion INR Reported Investment 61.75 billion INR ` of DCs in the sector against implementation of energy conservation.

Table 2: List of Energy-efficiency Measures and Technologies for the Spinning Process [3]

No.	Energy-efficiency Technologies and Measures	Fuel saving	Electricity saving	Capital Cost (US$)	Payback Period (Year)**
5.1	**Spinning**				
5.1.1	**Preparatory process**				
1	Installation of electronic Roving end-break stop-motion detector instead of pneumatic system		3.2 MWh/year/machine	180/roving machine	< 1
2	High-speed carding machine			100,000/carding machine	<2
5.1.2	**Ring Frame**				
3	Use of energy-efficient spindle oil		3% - 7% of ring frame energy use		
4	Optimum oil level in the spindle bolsters				
5	Replacement of lighter spindle in place of conventional spindle in Ring frame		23 MWh/year/ring frame	13,500 /ring frame	8
6	Synthetic sandwich tapes for Ring frames		4.4 - 8 MWh/ring frame/year	540 -683/ring frame	1 - 2
7	Optimization of Ring diameter with respect to yarn count in ring frames		10% of ring frame energy use	1600 /ring frame	2
8	False ceiling in Ring spinning section		8 kWh/ year/spindle	0.7/spindle	1.2
9	Installation of energy-efficient motor in Ring frame		6.3 -18.83 MWh/year/motor	1950 - 2200 /motor	2 - 4
10	Installation of energy-efficient excel fans in place of conventional aluminum fans in the suction of Ring Frame		5.8 - 40 MWh/year/fan	195 - 310 /fan	< 1
11	The use of light weight bobbins in Ring frame		10.8 MWh/year/ring frame	660 /ring frame	< 1
12	High-speed Ring spinning frame		10% - 20% of ring frame energy use		
13	Installation of a soft starter on motor drive of Ring frame		1 – 5.2 MWh/year/ring frame		2
5.1.3	**Windings, Doubling, and finishing process**				
14	Installation of Variable Frequency Drive on Autoconer machine		331.2 MWh/year/plant	19500/plant	< 1
15	Intermittent mode of movement of empty bobbin conveyor in the Autoconer/cone winding machines		49.4 MWh/year/plant	1100/plant	< 1
16	Modified outer pot in Tow-For-One (TFO) machines		4% of TFO energy use		
17	Optimization of balloon setting in Two-For-One (TFO) machines				
18	Replacing the Electrical heating system with steam heating system for the yarn polishing machine	increased 31.7 tonnes steam/year/machine	19.5 MWh/year/machine	980/ humidification plant	< 1
5.1.4	**Air conditioning and Humidification system**				
19	Replacement of nozzles with energy-efficient mist nozzles in yarn conditioning room		31MWh/year/humidification plant	1700/ humidification plant	< 1
20	Installation of Variable Frequency Drive (VFD) for washer pump motor in Humidification plant		20 MWh/year/humidification plant	1100/ humidification plant	< 1
21	Replacement of the existing Aluminium alloy fan impellers with high efficiency F.R.P (Fiberglass Reinforced Plastic) impellers in humidification fans and cooling tower fans		55.5 MWh/year/fan	650/ fan	< 1
22	Installation of VFD on Humidification system fan motors for the flow control		18 -105 MWh/year/fan	1900 -8660/ fan	1 - 2
23	Installation of VFD on Humidification system pumps		35 MWh/year/ humidification plant	7100/ humidification plant	2.7
24	Energy-efficient control system for humidification system		50 MWh/year/ humidification plant	7300 to 12,200/ humidification plant	2 - 3.5
5.1.5	**General measures for Spinning plants**				
25	Energy conservation measures in Overhead Travelling Cleaner (OHTC)		5.3 - 5.8 MWh/year/ OHTC	180 -980/ OHTC	0.5 - 2.5
26	Energy-efficient blower fans for Overhead Travelling Cleaner (OHTC)		2 MWh/year/fan	100/fan	< 1
27	Improving the Power Factor of the plant (Reduction of reactive power)		24.1 MWh/year/plant	3300/plant	1.8
28	Replacement of Ordinary 'V – Belts' by Cogged 'V – Belts'		1.5 MWh/year/belt	12.2/belt	< 1

* The energy savings, costs, and payback periods given in the table are for the specific conditions cited. There are also some ancillary (non-energy) benefits from the implementation of some measures. Read the explanation of each measure in the report text to get a complete understanding of the savings and costs.
**Wherever the payback period was not provided, but the energy and cost were given, the payback period is calculated assuming the price of electricity of US$75/MWh (US$0.075/kWh).

The reduction in specific energy consumption in the baseline year from 2007 – 08, 2008 – 09 and 2009 – 10, has been calculated and considered as Business as Usual scenario (BAU). The total energy consumption for textile sector in the year without the impact of PAT is estimated to be 1.98 million TOE, which may reduce 1.65 million TOE considering the impact of PAT (Figure 2).

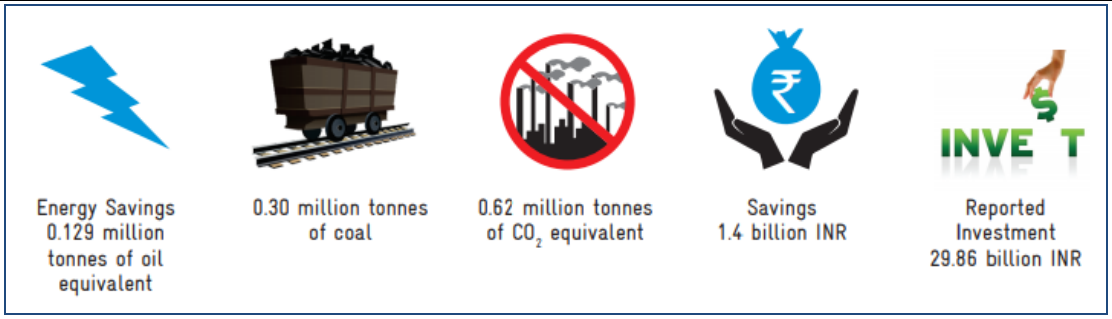

Figure 1: Savings achieved by textile sector in PAT [2]

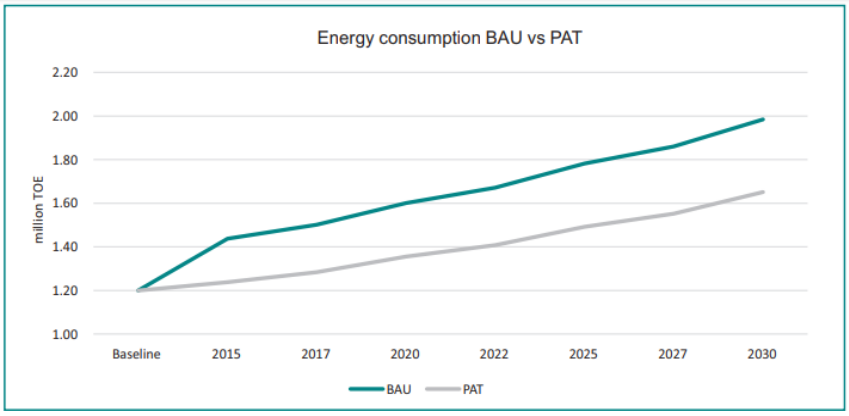

Figure2: Total energy consumption trend –BAU v/s PAT [2]

4. Adoption of renewable energy sources

The Indian Textile Industry has always been amenable in adapting newer and more efficient technologies. Electricity is most necessary input that mill needs today and it has always remained area of concern in this segment. Textile industry has been early adopter of renewable energy in India and has contributed largely in the growth of clean energy in the country. Many textile mills have set-up captive power plants, wind mills and now solar power plants.

4.1 Wind energy

The textile industry has contributed significantly to the growth of renewable energy in the form mostly of wind installations in the country. The textile industry has about 2700 MW of wind generation capacity in Tamil Nadu alone. In today's scenario where the power purchased from state electricity boards works out to be much higher than solar or wind energy, it is not surprising that more and more players in this energy-intensive industry are opting for cost-effective green energy. This is more so in a state like Tamil Nadu that leads the country in the textile sector and, at the same time, is the highest producer of wind energy. The state has a total installed wind capacity of 8,764 MW and its solar capacity at the end of 2018 stood at 2,055 MW [4].

It must be noted that the coastal state witnesses wind flows for almost six months in a year; the winds peak during the southwest and northeast monsoon months and experience a moderate flow for four months. It also receives 300 days of clear sunshine. A large number of textile-related industries, especially spinning mills, are making use of this and other renewable sources of energy for captive power generation. Measures such as the bundling of wind power projects, the policy of accelerated depreciation (AD) and the Technology Upgradation Fund attracted the power-intensive industries in the southern state to invest in captive wind power plants.

GHCL, which is one of India's leading manufacturers of home textiles, also decided to start captive wind power generation for its spinning and textile mills almost 15 years back. Sree Meenakshi Mill, which was amalgamated with GHCL in 2002, is on the ambitious path of using green energy for 90 percent of its total requirements. According to GHCL's CEO [5], the company's dependence on thermal power has reduced from 64 million units to 34 million units in respect of the total requirement of 120 million units for the year 2019-20. Thus, it is able to avoid carbon emissions of 24,300 CO2e metric tonnes. Today, the solar power

investment cost is Rs 40 million per MW, almost half that of wind power (Rs 70 million/MW). So, the company decided to add solar power to its portfolio in its quest to use more green energy.

4.2 Solar energy

With the evolution of solar ecosystem in India and knowing the numerous advantages of solar energy, textile industry has embraced the solar power and started to deploying solar systems in a fairly big way. The advantages are quite obvious [4]:

- *Cost reduction* – The electricity tariff for industrial consumers is the highest among all sectors. In most States, solar power is much cheaper. Prices are going to remain almost the same throughout the lifetime of the solar plant (except for degradation and some replacement), whereas the rates for power from conventional sources are expected to escalate year on year

- *Compliance of renewable purchase obligations (RPO)* – Several industrial consumers of electricity have to meet their RPO, and setting up of a solar plant is one of the simplest ways to comply with the RPO.

- *Availability of roof space* – Unlike commercial establishments, most of the automotive factories have vast unshaded roof area and vast tracts of unused land. Setting up of solar plants in these unshaded and unused areas is a relatively easy task.

- *Energy savings* – Solar power generated in the site can offset electricity that needs to be drawn from the grid and reduce the reliance on diesel gensets. This, in turn, leads to further cost reduction.

- *Reducing carbon footprint* – Most of the companies operate with explicit carbon footprint reduction. Solar plants help in environmental protection and also reduce carbon footprint.

- *Subsidy* - Government has recently approved a new scheme to provide financial assistance in the form of capital subsidy to small power loom units for installation of solar PV plants. The scheme aims to alleviate the problem of power cuts faced by the decentralized power loom units in the country. Under the scheme, the plants have two options – (i) On-Grid Solar Power Plant in areas where power cuts and shortages are negligible and power tariff is high. (ii) Off-Grid Solar Power Plant in areas where there is a power shortage and on-grid power is not continuously available. The subsidy is expected to make power cost economical for the looms and make the units self-sufficient on the power front while the government can supply grid power to other industries. Captive solar power plants and rooftop solar energy are best routes for electricity cost reduction for textile industry [6].

5.Conclusions

Energy is one of the main cost factors in the textile industry. Especially in times of high energy price volatility, improving energy efficiency is a primary concern for textile plants. The Perform, Achieve and Trade (PAT) Scheme launched by the Bureau of Energy Efficiency helped textile industries to reduce energy consumption and to promote enhanced energy efficiency. The analysis of energy-efficiency improvement opportunities in the textile industry through PAT scheme includes both opportunities for retrofit/process optimization as well as the complete replacement of the current machinery with state-of-the-art new technology. Also, textile spinning industry has been early adopter of renewable energy like solar and wind energy in India and has contributed largely in the growth of clean energy in the country.

6.References

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