Appendix 13. Textile

Sector Specific Annex to Audit Guideline under the EE Incentive Scheme for energy intensive industries in Vietnam

1 Introduction

The purpose of this annex is to secure that the most important opportunities for energy efficiency improvements in the textile sector are investigated.

The annex is prepared to provide more sector-specific guidance than what is presented in the general energy audit guideline prepared under the Danish/Vietnamese cooperation.

As such, the guideline describes the most important focus areas within the key technologies of:

1. The **Harvesting, Spinning and Yarn** process consists of several steps, harvesting, ginning/cleaning, carding/formation, spinning and winding. The raw material for the yarn process can be virgin/synthetic cotton or recycled fibers. The spinning process takes the textile fibers and filaments and makes then into yarn. The processes are primarily mechanical processes driven by electricity – some cleaning process include thermal input for heating water.

2. The **Weaving** process is a process where two distinct sets of yarns or threads are interlaced at right angles to form a fabric or cloth. Alternative to the weaving knitting, tufting, needle-felting etc. Printing is an alternative to the weaving process. The weaving process is a mechanical process driven by electricity.

3. **Dyeing** of textiles is a process in which color is transferred to a finished textile or textile material (like fibers and yarns) to add permanent and long-lasting color. The dying permanent can both by natural or synthetic. The dyeing process depends very much on the raw material and application. The dying process is both mechanical and thermal (heating up water for dying and bleaching).

4. **Washing** is normally carried out in hot water (40-100 °C) in the presence of a wetting agent and a detergent. The detergent emulsifies the mineral oils and disperses the undissolved pigments. The choice of the surfactants may also vary depending on the type of fibre. Mixtures of anionic and non-ionic surfactants are commonly used. An important factor in the selection of a surfactant is its effectiveness in strong alkaline conditions. Washing always involves a final rinsing step to remove the emulsified impurities.

   Dry cleaning is an alternative to using a wetting agent.

5. **Drying** is necessary to eliminate or reduce the water content of the fibres, yarns and fabrics following wet processes. Drying is highly energy intensive. Drying is often done both mechanical and thermal.

   The thermal removal of water is done by evaporation. Heat for the evaporation can be transferred by:

   - Convection
   - Inferred radiation
   - Direct contact
   - Radio frequency

6. **Cutting, sewing and ironing** is a part of transforming the textile into readymade garments by cutting them into shapes and joining the shapes together to form the final garments. The joining can be done by sewing with needle and thread or by other means e.g. "gluing".

7. From the garments process there are several **Wastewater** streams, mainly from dying, washing and drying process.

8. **Steam or hot water boilers and distribution** are used to convert energy and distribute the energy for specific processes across the facilities.

9. **Compressed air** is used to power the machinery of the facilities and is therefore applicable to all processes powered by heavy machinery.

10. **Heat recovery systems** are applied to recover heat either at individual processes or to supply waste heat across several heat users. Heat recovery can be applicable to some of the key technologies individually, while overall

systemic mapping of heat recovery is also important, as energy recovered from one process may be used in another.

11. **Electrical systems** are applied to all parts of the production and for a long range of different supporting functions, where some of them are mentioned in the above section, e.g. compressed air. Besides the systems mentioned then there at motors, pumps, fans/ventilation, and lighting that must also be addressed.

2 Technology review compared with Best Current Practice

In the table below, best practice energy efficiency projects are listed for each of the technologies above. The energy audit should consider the possible viability of each of the measures in the specific context.

The energy audit report should document how these potential measures have been considered. For each measure it should be stated whether it is practically relevant for the specific enterprise. If it could be relevant, the report must make a pre-assessment of the technical and financial viability.

In the textile production several production methods are applied depending on the specific product. Therefore, it must be emphasized that the recommendations below do not apply for all the process steps.

No.	Technology	Energy efficiency measures
1	Harvesting, Spinning and Yarn	• Electricity is the main energy consumer in this process step. Therefore, the recommendations made with regard to Electrical systems (number 11) also apply for this step. • There are several methods applied for these processes. Ther energy efficiency primarily depends on the production type, technology and maintenance. Some examples are: - Using optimal spindle oil in the ring frame. - Using light spindles. - Optimizing ring diameter.

No.	Technology	Energy efficiency measures
		• The yarn polisher used thermal energy – evaluating the best source of energy (steam/electricity). • Poor waste (e.g. fluff) management impacts production quality and therefore the specific consumption. By removing waste (machine cleaning and in process (OHTC) incurs best fabric quality. • Overhead Traveling cleaner (OHTC) can be optimized both in terms of controlling time and demand by sensors, securing that cleaning is adjusted to the demand.
2	Weaving	• Electricity is the main energy consumer in the weaving process. Therefor the recommendations made with regard to electrical systems (number 11) also apply for the weaving process. • The weaving machines themselves account for 50-60% of the consumption in the weaving process, the remaining part involves dehumidifier, compressed air and lighting. • The dehumidifier can be optimized by proper control by VFD, that controls the spray nozzles and fans.
3	Dyeing	• Dying directly on wet fabric, thus avoiding the intermediate dyeing step. • Securing even and rapid absorption of water, by total removal of cotton seed husks, and - the ability to absorb dyes and chemicals uniformly. This will reduce product losses.

No.	Technology	Energy efficiency measures
		• Dyeing water can be preheated from the process itself or by other surplus heat sources – to secure timing then buffer systems could be introduced.
4	Washing	• Washing water can be preheated from the process itself or by other surplus heat sources – to secure timing then buffer systems could be introduced. • Reusing washing water directly or by first filtering in membrane systems, thus recovering both heat and washing enzymes.
5	Drying	• Use of mechanical dewatering to minimize thermal dewatering. • Controlling the drying to make sure that the textile is not dried below their natural moister content. • Optimizing the drying control by controlling based on: - Humidity and temperature of the inlet air. - Temperature of the textile and air in the dryer. - Humidity and temperature of the exhaust air. • Considering alternative drying methods e.g. microwave or radio frequency dryers. • Preheating the drying air e.g. waste heat from the dryer itself or other waste heat sources. • Flash steam recovery could be considered on inline drying processes. • Vapor recovery can also be considered in the inline drying process, where the vapor from one step is used to dry other process steps.

No.	Technology	Energy efficiency measures
6	Cutting, sewing and ironing	• Continuous running sewing machines can be replaced by servo motor-based machines that only operate when sewing takes place. • Blowing through losses in steam ironing can cause flash problems. This can be solved by better system control and maintenance.
7	Wastewater	• Is the wastewater properly sized – no bypass. • Are the air blowers properly controlled? • Are the blowers used the most efficient. E.g. using turbo blowers. • Is there a potential for producing biogas on the wastewater?
8	Steam boilers and distribution	• See Technology Catalogue for boiler and heating systems. Here are some additional recommendations: • Heat recovery on exhaust pipe from the boiler. The recovered heat can be used for: - Air preheating. - Feed and makeup water preheating. - Other hot water demands. • Introducing combustion control to reduce the thermal losses. This can be done by automated control or by periodic trimming. • Improving thermal insulation in boilers, pipes, valves, etc. • Reducing starts and stops to reduce blow through.

No.	Technology	Energy efficiency measures
		• Reducing convective losses during standby by installing a damper in the exhaust pipe. • Improving blow down control by conductivity control instead of manual or timer-based blow down. The need for blow- down can also be reduced by improving the makeup water quality. • Heat can be recovered from blow-down and used for heating e.g. the makeup water. • Reducing the condensate losses by improving insulation and steam traps and optimizing the condensate return pipe.
9	Compressed air	• See Technology Catalogue for compressed air systems. Here are some additional recommendations: • Challenging the pressure level – 7-8% saving per bar reduced. • Investigating if the compressed air system can be operated at different pressure levels and/or if any of the users can be decentralized. • Optimizing compressor control (master/slave in the case of several compressors). • Optimizing the compressed air buffer (if there is any). • Recovering surplus heat. • Evaluating alternative methods to compressed air for single users.

No.	Technology	Energy efficiency measures
		• Having routines for leak detection and repair (consumption outside production is a good indication of the magnitude of leakages).
10	Heat recovery	• Heat can be recovered from several areas: - Heat from compressed air. - Heat from flue gas (boilers). - Dyeing process. - Washing process. - Steaming process. - Wastewater plant. - Other specific heat sources can be present. In all cases the surplus heat can either be reused on the process itself or used across the processes. The recovered heat can be used for low temperature purposes or upgraded by heat pumps for higher temperature processes. To balance heat demand and supply then buffer systems can be considered to improve the utilization of surplus heat.
11	Electrical systems	• Using energy efficient light e.g. LED. • Introducing light control systems e.g. sectioning, motion sensors, timers, daylight control etc. • Using highly efficient motors. • Replacing all mechanical drives with variable speed drives (VSD).