Energy Efficiency Monitoring in Textile Industries for Achieving GHG Emission Reduction Target in Indonesia

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OUTLINE

- Why textile industry is important
- Energy efficiency potential in textile industry
- GHG emissions from energy use in industry
- Modeling to estimate GHG emissions reduction potential from energy efficiency in textile industry
WHY Textile Industry is important

The roles of textile industry in Indonesian economic
Economic: contribution of textile industry

GDP contribution of major industry (non Oil&Gas), 2016
Textile 6%
Source: MoI 2017

✧ GDP: Textile is among top 5
✧ Number of factory: large
✧ Type of company: vary

Company Type

| Natural Fiber | 7 |
| Spinning     | 165 |
| Weaving      | 104 |
| Knitting     | 20 |
| Embroidery   | 3 |
| Dyeing Finishing | 26 |
| Printing Finishing | 9 |

Source: BPS and MoI

Company Type

| Yarn | 22 |
| Spinning | 300 |
| Sewing | 1400 |

Source: Industry Association
ENERGY COST

Fiber Making (Man Made)
Spinning
Weaving / Knitting
Garment
Cotton Yarn, China
Cotton Yarn, India
Cotton Yarn, Korea
Cotton Yarn, Turkey

In Percentage

Cost Structure

- Waste
- Aux Material
- Capital
- Depreciation
- Interest
- Administration & Marketing
- Labor
- Energy
- Raw Material
Energy Efficiency in Textile Industry
Energy use in textile industry by process (JICA, 2009)

Energy use in the US textile industry (U.S. DOE, 2004)
**Actions Description for general industry**

**Combined Heat and Power (CHP) systems**
CHP systems produce heat and power at the same time. Heat is driving a generator to produce electricity and the remaining waste heat is recovered from flue gases.

**Lighting**
Lighting is also an important sector for mitigation options, as efficient lighting can lead to energy and emission savings.

**Compressed Air Systems**
Compressed air systems provide a plethora of EE opportunities like pressure drop minimization, inlet air temperature reduction, heat recovery systems etc.

**Motor Systems, Pumps and Fan systems**
Mechanical systems like motor, pumps and fan systems are widely used in the pulp and paper industries, thus providing opportunities for EE.

**Boiler Energy Efficiency Measures**
Boilers systems are highly energy intensive, thus provide vast opportunities for EE, like heat recovery, insulation upgrades etc.

**Process Integration**
Process Integration is a sector, where many processes could be integrated in a manner, so that the overall process consumes less energy. This can be done through intelligent arrangement and sequencing of processes.

**Steam Distribution System**
Steam Distribution Systems provide ample EE opportunities, as heat loss is a major and a common factor in this system. For example, poor insulation, steam trap leaks etc. are some of the common issues in the system.

### Textile industry energy saving potential in Indonesia (JICA, 2009)

<table>
<thead>
<tr>
<th>Year</th>
<th>Fiber making &amp; Spinning</th>
<th>Knitting &amp; Weaving</th>
<th>Dyeing &amp; Finishing</th>
<th>Sewing &amp; Garments</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>2.50%</td>
<td>2.50%</td>
<td>12%</td>
<td>0%</td>
<td>10%</td>
</tr>
<tr>
<td>2025</td>
<td>20%</td>
<td>20%</td>
<td>35%</td>
<td>0%</td>
<td>30%</td>
</tr>
</tbody>
</table>

Possible mitigation options in the textile production process:
- VFD/VSD utilization for motors
- Waste heat recovery system
- Conversion from electrical heating to thermic heating
- EE control system for humidification system
- Ring diameter optimization
- EE in Motors
- Temperature and pressure optimization
- Cold bath patch pre-treatment
- Water flow setting optimization
- Better insulation
- Process integration
- Steam patch pre-treatment
- Water flow setting optimization
- Better insulation
GHG Emissions from Energy Use in Industry

Contribution of textile industry
Others Manufacturing Industry is still the greatest

Direct GHG Emissions from Energy Use in Industry

Indirect GHG Emissions from Energy Use in Industry

Direct Energy 2016

- Pulp & paper: 34%
- Cement: 27%
- Food & beverage: 0%
- Iron & Steel: 11%
- Chemical: 7%
- Textile: 6%
- Ceramic & Glass: 4%

145 MtCO₂-e

Indirect Energy 2016

- Food & beverage: 56%
- Chemical: 10%
- Ceramic & Glass: 10%
- Cement: 0%
- Fertilizer: 1%
- Iron & Steel: 7%
- Textile: 17%
- Pulp & paper: 6%
The main source of emissions in 8 industry is energy use. Direct energy is still bigger than indirect source.

Though surpassed by others sub sector, still second biggest among 8 group.

Share of energy emissions in manufacturing industry in 2016

Second biggest contributor among 8 energy intensive industries

Source: GHG emissions profile from Indonesia’s industry sector, MoI-UNDP 2018

Share of BaU emissions from overall manufacturing industry in 2030
Energy emissions from textile industry is dominated by indirect sources.

Top 3 of direct energy emitter.

51% indirect energy emission comes from textile.
Projection of Energy and The Associated GHG Emissions

To estimate GHG emission reduction potential from energy efficiency in textile industry
2010 vs 2030

Population: 1.2  2030
GDP: 3.2  2030
Energy Demand: 2.5  2030
  CM1: 2.4
  CM2: 2.4
CO2 Emission: 3.9  2030
  CM1: 3.2
  CM2: 3.0

Value at 2010 = 1
Methodology: ExSS

1. Driving Force Settings
2. Final Energy Demand
3. Primary Energy Demand
4. CO2 emissions
## Assumed parameters in the model

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Baseline</th>
<th>CM1</th>
<th>CM2</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP growth</td>
<td>5.5%</td>
<td>5.5%</td>
<td></td>
</tr>
<tr>
<td>Economics structure</td>
<td>Economics structure in 2030 is the same as that of 2010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of energy in power</td>
<td>Share of energy in 2030 is the same as that of 2010</td>
<td>Following RUPTL</td>
<td>Following RUPTL and more renewables</td>
</tr>
<tr>
<td>Share of transportation modes</td>
<td>Share of transportation modes in 2030 is the same as that of 2010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency</td>
<td>Efficiency of equipment in 2030 is the same as that of 2010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BAT penetration</td>
<td>15% in industry, 20% in household, 20% in commercial and 20% in transportation</td>
<td>25% in industry, 30% in household, 30% in commercial and 30% in transportation</td>
<td></td>
</tr>
<tr>
<td>Biofuel</td>
<td>5%</td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>Others</td>
<td>kerosene is extinct</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CM1: efficient technology  
CM2: efficient technology + renewables  
*RUPTL: general plans of power generation issued by state owned electricity company*
Energy Demand in 2010 dan 2030

Energy Demand by Sub-Sector in Energy Sector

Energy Demand by Type in Energy Sector

Energy Demand in Industry Sector

Energy Demand in Textile Industry
Textile vs Industry - projection

BaU: increase ~3.3 times
CM1: 3.7%
CM2: 5.9%

BaU: increase ~3.5 times
CM1: 3.8%
CM2: 6.1%
Projection of Energy Demand by Fuel in Textile Industry (2030)

**Coal**
- CM1: 2-6%
- CM2: 3-10%

**Oil**
- CM1: 2-6%
- CM2: 3-10%

**Gas**
- CM1: 2-6%
- CM2: 3-10%

**Electricity**
- CM1: 2-6%
- CM2: 3-10%
**Projection of Energy Demand by Device in Textile Industry (2030)**

### Direct Heat
- **BaU**: 355
- **CM1**: 333
- **CM2**: 320
- **CM1**: 6%
- **CM2**: 10%

### Steam
- **BaU**: 366
- **CM1**: 360
- **CM2**: 356
- **CM1**: 2%
- **CM2**: 3%

### Motor Driver
- **BaU**: 37
- **CM1**: 36
- **CM2**: 35
- **CM1**: 4%
- **CM2**: 6%

### Other
- **BaU**: 5
- **CM1**: 5
- **CM2**: 4
- **CM1**: 2%
- **CM2**: 3%

**Notes:**
- Coal
- Oil
- Gas
- Biomass
- Electricity

**Device Specifics:**
- Dh
- Mt ele
- Mt oil
- Oth
Conclusion and Remarks

- Since textile industries have large contribution into the national GDP and export, these industries have to meet competitive markets in international, therefore supporting these type of industries to increase their energy efficiency at least to achieve energy intensity as similar to industries of other countries will also reduce the cost of production. It should be noted, the energy cost in Indonesian textile industries accounts for 15-25% of total production cost since the cost of similar industries of other countries only account for 5% of total production cost.

- There are still rooms for improvement in energy efficiency in industry sector, particularly textile industries. JICA Study (2009) shows energy savings potential in textile industry can be up to 30% In this study assumes BAT penetration at 15% (CM1) and 25% (CM2).

- From the ExSS results, efficient technology in direct heat is contributing the biggest GHG emission reduction followed efficient motor equipments.