What are you asked to do?

1. Join one of the three groups

2. Read through the case studies (10 min)

3. Through discussion within your group, try to answer the following questions (30 min):
   a. Give one example of a low cost change to make production more efficient. You can give examples from the case studies provided or from other sectors related to your own experience
   b. Give one or two examples of a cleaner production measures that leads to improvements in workplace/working conditions for workers. You can give examples from the case studies or from other sectors related to your own experience
   c. What are the constraints/challenges for companies to take up cleaner production measures?
   d. How can government policies support cleaner production?
   e. How can unions support cleaner production measures?
   f. How can employers’ organisations support cleaner production?
   g. Why is dialogue and cooperation among workers and employers important to promote cleaner production and better workplaces?
   h. Give two points to convince a local factory union to support cleaner production in their factory
   i. Give two points to convince a local factory manager/owner to adopt cleaner production measures

4. One group member reports back to the plenary on the following (5 min per group)
   - two points to convince a local factory union to support cleaner production in their factory
   - two points to convince a local factory manager/owner to adopt cleaner production measures

Material available: flipchart, coloured pens and coloured post-its
I. Introduction

Green jobs are decent jobs that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity; reduce energy, materials, and water consumption through high-efficiency strategies; de-carbonize the economy; and minimize or altogether avoid generation of all forms of waste and pollution. Green jobs may be found in a variety of sector from manufacturing, to agriculture, to service activities.

In the context of climate change and excessive use of scarce resources, green jobs form an essential component of proactive policies that respond timely and create pathways to sustainable development. Businesses and governments alike are looking to pursue sustainable and resource efficient strategies to remain efficient and competitive in a more resource constrained world.

Cleaner production has emerged as a promising mechanism in this respect. Cleaner production is defined as the continuous application of an integrated environmental strategy to processes, products and services to increase the overall efficiency and to reduce risks to humans and environment.

Traditional environmental thinking focuses on dealing with wastes and emission after they have been generated, while cleaner production aims at avoiding and minimizing wastes at source.

Cleaner production mechanisms range from simple housekeeping measures to technological changes. They range from low cost solutions to more substantial investments in new equipment.

Cleaner production mechanisms include:

1. Good Housekeeping: appropriate provisions to prevent leaks and spills and to achieve proper, standardized operation and maintenance procedures and practices;
2. Input Material Change: replacement of hazardous or non-renewable inputs by less hazardous or renewable materials or by materials with a longer service life-time;
3. Better Process Control: modification of the working procedures, machine instructions and process record keeping for operating the processes at higher efficiency and lower rates of waste and emission generation;
4. Equipment Modification: modification of the production equipment so as to run the processes at higher efficiency and lower rates of waste and emission generation;
5. Technology Change: replacement of the technology, processing sequence and/or synthesis pathway in order to minimize the rates of waste and emission generation during production;
6. On-Site Recovery/Reuse: reuse of the wasted materials in the same process or for another useful application within the company;
7. Production of Useful By-Products: transformation of previously discarded wastes into materials that can be reused or recycled for another application outside the company; and
8. Product Modification: modification of product characteristics in order to minimize the environmental impacts of the product during or after its use (disposal) or to minimize the environmental impacts of its production.¹

¹ http://www.unido.org/index.php?id=o5152
Through implementing cleaner production programmes, employers can substantially reduce their resource and energy consumption and therefore lower their production costs and improve the overall efficiency of their operations\(^2\).

Cleaner production initiatives can entail more effective management of material and energy in the manufacturing process, more efficient process control, optimization of reactor and process conditions, in-process recycle-reuse of by-products, and recovery of waste thermal energy etc.

Some of the benefits of cleaner production include, but are not limited to-

- Improved production efficiency,
- Improved resource use efficiency
- Less pollution
- Reduced environmental liability
- Improved image
- Improved working conditions

Cleaner production measures can make a significant contribution in rendering enterprises cleaner and safer places to work. Such benefits can derive, for example, from the reduction in emissions and wastes in the production process, from measures that lower heat dispersion, from improved management of chemical substances.

It has become increasingly recognized that in order to implement cleaner production effectively, it is highly important for factories to have for managers and workers to engage in joint problem-solving. It is also important to implement a system so that cleaner production is an ongoing process that is continually measured and updated. For this, managers and workers would have to engage in continual dialogue on ways to improve production processes at the factory level.

The following document cites examples of manufacturing businesses that have implemented cleaner production measures. They can help reflect on the ways cleaner production measures can result in gains in productivity and production costs, and can bring positive chances in terms of workplace environment and relations.

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\(^2\) For more case studies on cost-effectiveness through cleaner production, please refer to China-Canada Cleaner Production programme, UNIDO Cleaner Production programme, ILO’s Factory Improvement programme, and UNEP’s GERIAP programme.
Case study I: Roo Hsing Garment Factory, Cambodia

I. Introduction

The Roo Hsing factory is a privately owned, foreign investor garment manufacturing enterprise, located in Phnom Penh, Cambodia. The main products of the company include, but are not limited to, Denim cotton jeans and trousers. For production, fabric is imported from Taiwan and Hong Kong, and products are mainly exported to USA, EU, Japan, and Canada. The company has a workforce of over 3700 employees.

II. Production processes

While the Roo Hsing factory produces a range of fabrics, its main product is denim, making it the most energy and resource intensive product. Denim’s production process at Roo Hsing comprises the following steps-

**Hot washing** - this operation is done to remove any residual sizing chemicals, improve the fabric’s wettability and its absorption capacity.

**Soap washing and scouring** - soap washing is done to remove superfluous color, and impurities like gums, waxes and pectin. Scouring is done to improve the wettability of the fabric, improve its brightness and softness.

**Softening/ finishing** - softening and finishing operations are done to improve luster, evenness, dust-proofing, and anti-crease properties.

**Spinning and drying** - during this step, the garment is subjected to mechanical dewatering through centrifuges and steam. It is then ironed, accessorized, and dispatched.
It is evident that producing denim is highly water and energy intensive, with a high potential to generate large amounts of waste. The clean production team conducted a site study of the factory to assess areas for improving resource and energy use efficiency. It was observed that consumption of energy sources such as fuel oil and electricity was very high relative to benchmarks in other countries. The factory processes were also marked by high water and chemical use, resulting in high liquid and gaseous waste generation. These can be attributed to factors such as poor combustion, low efficiency of steam generation, poor steam distribution, and high cloth to liquor ratio.

III. Actions and impacts

- Improving efficiency in water use- The factory started recycling treated waste water for scrubbing flue gases (fly ash). This solution both decreased water usage and waste-water generation. Another mechanism to improve collection of condensate as boiler feed water also reduced water use.
- Reducing waste and associated treatment costs- The factory invested in optimizing cloth to liquor ratio, reducing treatment costs for waste water and sludge handling at the treatment facility.
- Reducing energy use- The Company also invested in insulating the steam pipe distribution network, reducing fuel consumption for steam generation, and reducing both gaseous and greenhouse gas emissions. Installation of an electricity meter led to better monitoring and control in usage, resulting in more efficient use of energy in the production process.

- Improvements in workplace conditions - The insulation of steam pipes reduced gaseous emissions in the factory. Moreover, implementation of these mechanisms has led to better monitoring of resources and waste by the staff of the factory. Through the process, both managers and employees have been involved in cleaner production activities. Additionally, housekeeping measures such as insulation of steam pipes has reduced SOx and NOx emissions at the workplace.

In addition to the above, the factory implemented other options for energy savings that are summarized in the table below.
## IV. Summary

### Table 1-Summary table for Roo Hsing Garment factory

<table>
<thead>
<tr>
<th>Action taken</th>
<th>Impact</th>
<th>Investment</th>
<th>Return</th>
<th>Payback period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycling of treated waste water for flue gas scrubber</td>
<td>Reduced water usage</td>
<td>Include in investment below</td>
<td>Not quantified separately</td>
<td>Less than 1 year</td>
</tr>
<tr>
<td>Substitution of three fuel oil boilers with one wood fired boiler</td>
<td>Reduced emissions</td>
<td>US $600427</td>
<td>US $568696</td>
<td>Less than one year</td>
</tr>
<tr>
<td>Optimization of cloth to liquor ratio</td>
<td>Reduced waste water, emission, and pollution load</td>
<td>Nil</td>
<td>US $15864</td>
<td>Less than one year</td>
</tr>
<tr>
<td>Insulation of steam pipes</td>
<td>Reduced fuel oil consumption</td>
<td>US $19526</td>
<td>Include in action 2</td>
<td>Less than one year</td>
</tr>
<tr>
<td>Combining production processes (e.g. hot bleaching)</td>
<td>Reduced pollution volume</td>
<td>Nil</td>
<td>Not quantified separately</td>
<td>Less than one year</td>
</tr>
<tr>
<td>Installation of electricity meter</td>
<td>Reduced Electricity consumption</td>
<td>Negligible</td>
<td>US $68341</td>
<td>Less than one year</td>
</tr>
<tr>
<td>Improved collection of condensate</td>
<td>Reduced water usage</td>
<td>US $15132</td>
<td>Not quantified separately</td>
<td>Less than one year</td>
</tr>
</tbody>
</table>
Case study II: Medigloves Ltd., Thailand

I. Introduction

Medigloves Limited is a company in Thailand that produces quality surgical and cleaning latex gloves. Medigloves is certified to a number of ISO standards, also meeting the EN 46001, CE mark, RWtV-Bauart, and USDA requirements, catering to both national and international clients. The company has a workforce of 640 people.

Medigloves participated in the Greenhouse Gas emission Reduction from Industry in Asia and the Pacific (GERIAP) project of UNEP to build its staff’s capacity to improve energy efficiency through clean production mechanisms; improve its environmental and social performance; and to maintain its competitiveness by reducing energy costs.

II. Production processes

The production of gloves at Medigloves entails the following steps-

Preparation and molding- the latex compound is prepared by mixing chemicals with natural rubber, which is cured into molds to form gloves.

Washing and drying- the gloves are treated and washed a few times and are then dried using steam.

Testing and packing- during this step the gloves are tested for strength and leakages. They are then packed and sterilized with gamma rays before they are sent to customers. During the GERIAP study, it was found that there were large leakages of compressed air due to worn gaskets, and broken pipes and joints. Leakage was also due to workers using the compressed air to clean equipment and their clothes.

There were also reports of wasteful water practices in Medigloves. Manufacturing Latex gloves is a highly water intensive process. After chlorination, latex gloves are washed several times, and it was found that after the third rinse, the water was clean enough for reuse. This water however, was being discharged for treatment, causing wasteful use of chemicals and energy for treatment. Water is also wasted, in a similar fashion, for washing glove molds. Relatively clean water that is fit for reuse was sent to the treatment plant.

The team also found that the intake air for the compressors was indoor air that was higher in temperature than outside air, making it more energy intensive to compress. It was estimated that 9% of the electricity for the compressors was needlessly wasted.

III. Actions and impacts

- **Improving efficiency in water use**- To capture reusable water (up to 29 cubic meters/ day) from the chlorination process, the company constructed an 18 cubic meter tank. The water from the dipping process however could only be captured at 15 cubic meters/ day. This has still led to considerable savings in water use for Medigloves.

- **Reducing waste and associated treatment costs**- from the above two measures of not sending reusable water to the treatment plant have decreased these costs for Medigloves.

- **Reducing energy use**- The leaks were repaired and staff were trained on cleaning instructions to

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minimize compressed air losses. Moreover, the ducting was changed so that outside air was used as intake air.

- Improvements in working conditions and workers’ skillsets - As capacity building is one of the goals of the GERIAP project, the level of staff training and awareness about energy increased significantly during the project.

IV. Summary

<table>
<thead>
<tr>
<th>Action taken</th>
<th>Impact</th>
<th>Investment</th>
<th>Return</th>
<th>Payback period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compessed air leak repair and reduction in intake air temperature</td>
<td>Reduced electricity consumption</td>
<td>US $1500</td>
<td>US $7450/yr</td>
<td>2.5 months</td>
</tr>
<tr>
<td>Water consumption/ recovery and reuse of water and chemicals from dipping process</td>
<td>Reduced consumption of water, electricity, and fuel oil</td>
<td>US $1250</td>
<td>US $6388/yr</td>
<td>2.3 months</td>
</tr>
<tr>
<td>Water consumption/ Recovery and reuse of drainage from wash and chlorination process</td>
<td>Reduced consumption of electricity, and water</td>
<td>US $5250</td>
<td>US $5406/yr</td>
<td>1 year</td>
</tr>
</tbody>
</table>
Case study III: Steel Asia Manufacturing Corporation, Philippines  

I. Introduction

Steel Asia Manufacturing Corporation is a joint venture with TATA steel from India. SAMC produces reinforcing steel bars that are used in construction. With a capacity to produce 400,000 tons annually, the company produces 360,000 tons of steel bars, most of which is consumed by the domestic market. SAMC participated in the GERIAP project to improve operations, decrease production costs, and to prepare for Integrated Management System certification (ISO 9001, ISO 14001 and OSHAS 18000). The plant has 400 employees.

II. Production processes

The following processes are involved in the production of steel bars at SAMC

**Preheating:** Steel billets are received and charged in a walking hearth furnace through the charging door. They are reheated for 75 minutes to 1100 degrees Celsius using fuel oil.

**Rolling:** as the billets reach the optimum temperature for rolling, they are rolled along a series of 18 continuous rolling mills. These are controlled by a computerized control system.

**Cutting and testing:** The bars are then cut into lengths required by the customers and samples are subjected to physical, mechanical and chemical tests.

**Bundling and tagging:** the product is then bundled, tagged and stored.

A plant assessment of SAMC premises was done for the GERIAP project. However, as SAMC was preparing for the integrated management system certification, it had already created an energy management committee to oversee energy use. The existence of this committee facilitated the GERIAP process.

It was found that the company did not have any water metering systems, or any means to measure water usage along various steps in the production process. Moreover, due to lack of effective measures to conserve heat, more fuel was being consumed, and more greenhouse gases were being emitted.

III. Actions and impacts

- **Improving efficiency in water use** - by installing water meters, the company was able to identify and implement water conservation measures. This also increased awareness of production staff to water use and conservation.

- **Reducing energy use** - by installing ceramic fiber insulation inside the furnace, and heat resistant canvass on the charge and discharge doors of the furnace, SAMC reduced their energy consumption drastically.

- **Improvements in working conditions** - by installing ceramic fiber insulation inside the furnace, and heat resistant...

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canvass on charge and discharge doors of the furnace, lowering the temperature, thus improving working conditions around the furnace.

IV. Summary

Table 3-Summary table for Steel Asia manufacturing Corporation

<table>
<thead>
<tr>
<th>Action taken</th>
<th>Impact</th>
<th>Investment</th>
<th>Return</th>
<th>Payback period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation of ceramic fiber insulation inside the furnace wall</td>
<td>Reduced fuel consumption</td>
<td>US $180</td>
<td>US $2,410</td>
<td>.9 months</td>
</tr>
<tr>
<td>Installation of water meters to monitor water consumption</td>
<td>Reduced consumption of water, electricity</td>
<td>US $454</td>
<td>US $1284/yr</td>
<td>4 months</td>
</tr>
<tr>
<td>Installation of health resistant cloth canvass on charge and discharge door of the furnace to reduce heat loss</td>
<td>Reduced fuel consumption</td>
<td>US $2545</td>
<td>US $148028/yr</td>
<td>1 week</td>
</tr>
</tbody>
</table>
Cleaner production and occupational health and safety: Examples from chemical industries, India

I. Introduction

As part of the decent work agenda, the ILO sets forth principles for protection of workers from sickness, disease and injury arising from their employment. Hazardous and injurious work has immense social and economic costs. The suffering caused by such accidents and illnesses to workers and their families is incalculable. In economic terms, the ILO has estimated that 4% of the world's annual GDP is lost as a consequence of occupational diseases and accidents. Employers face costly early retirements, loss of skilled staff, absenteeism, and high insurance premiums due to work-related accidents and diseases.

The chemical industry is especially important in this regard. Of all industry sectors, the chemical industry accounts for 70% of annual total hazardous waste generation. It is also the largest source of toxic chemical release. The Environmental Protection Agency (EPA) states that organic chemicals constitute the largest source of toxic release at 150000 tons/year with methanol and xylenes being the top two released chemicals. Volatile organic compounds, in the form of emissions, effluent water contaminated with soluble and suspended organic compounds, solid or semi-solid organic sludge generated in processes are the main sources of release of organic pollutants in the production process.

II. Actions and impacts

In the study carried out in 16 manufacturing units in two states of Maharashtra and Gujarat in India, it was found that cleaner technologies in the production process not only added to the bottom line of the company but also minimized the exposure of workers and staff to toxic chemicals like Ammonia, phenol, carbon tetrachloride, toxic dust, etc.

Some of the chemical manufacturing units that were examined in this study included a company that produced pesticides in Mumbai. The company implemented three measures from 1994 to 1998. These are depicted in the following table.

<table>
<thead>
<tr>
<th>CP mechanisms</th>
<th>Cost Heads</th>
<th>Costs (INR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation of vent condensers to reduce vent loss of Carbon Tetrachloride solvent, This led to the recovery of 150 tons of CTC (50% of what was used the previous year)</td>
<td>Investments</td>
<td>10.5 lakhs</td>
</tr>
<tr>
<td></td>
<td>Operating costs</td>
<td>2.3 lakhs</td>
</tr>
<tr>
<td></td>
<td>Net benefit</td>
<td>42.7 lakhs</td>
</tr>
<tr>
<td></td>
<td>Payback period</td>
<td>2.95 months</td>
</tr>
<tr>
<td>Installation of graphite scrubber system for neutralizing HCl gas produced as by product</td>
<td>Operating costs</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Benefit</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Net benefit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Payback period</td>
<td></td>
</tr>
<tr>
<td>Substitution of CTC with Toluene. (CTC is more expensive, carcinogenic, and inflammable)</td>
<td>Operating costs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Benefit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Net benefit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Payback period</td>
<td></td>
</tr>
</tbody>
</table>

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8 Ibid.
Towards greener jobs in factories: Case studies from Asia (DRAFT)

These three mechanisms have led to a safer working environment. The installation of the graphite scrubber system has reduced effluent generation. Replacement of CTC with toluene, a less hazardous substitute, has also improved conditions. The following table summarizes some of the other CP initiatives taken by manufacturing industries in Maharashtra and Gujarat.

III. Summary

Table 5- Improvements in working place through cleaner production

<table>
<thead>
<tr>
<th>Type of unit</th>
<th>Process change or CP implemented</th>
<th>Nature of change and its impact on health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paint shop of switchgear component unit</td>
<td>Switch to powder painting from spray painting method</td>
<td>Less hazardous, as exposure to primers and thinners have reduced</td>
</tr>
<tr>
<td>Fertilizer unit</td>
<td>Installation of purge gas recovery plant</td>
<td>Less hazardous, exposure to ammonia reduced</td>
</tr>
<tr>
<td>Fertilizer unit</td>
<td>H2S stripping from process condensate and recovery of ammonia</td>
<td>Less hazardous to health as ammonia is recovered and more environmental friendly</td>
</tr>
<tr>
<td>Pharmaceutical unit</td>
<td>In the tablet processing stage, conventional coating pans replaced by Neocota systems</td>
<td>Less exposure to isopropyl alcohol</td>
</tr>
<tr>
<td>Health care products unit</td>
<td>Replaced reciprocating air compressor with a screw compressor</td>
<td>More energy efficient</td>
</tr>
<tr>
<td>Chemical Unit</td>
<td>Modification in the nitration of P-chloro benzoic acid—done with nitric acid now</td>
<td>Less hazardous as sulfuric acid is not used in the modified system</td>
</tr>
<tr>
<td>Insecticides unit</td>
<td>Installation of new brine plant (chilling plant)</td>
<td>Less hazardous as use of solvents like acetone reduced</td>
</tr>
</tbody>
</table>
Workplace Cooperation, quality and efficiency at SEICO, Hanoi, Vietnam

I. Introduction

SEICO is a company founded in 2003 that produces pre-engineered steel structures for industrial buildings. The company employs a total of 190 people.

The company had signed up for ILO’s Factory Improvement Programme with a goal of improving their performance and workplace relations. The example shows how improved workplace relations and worker-management cooperation can lead to significant gains in terms of productivity, including lower raw wastages, quality and working conditions.

At the beginning of the program, SEICO underwent an assessment. During the factory assessment it was discovered that the workforce at the factory was young and inexperienced due to the low wages that were offered by the factory. Additionally, while there was a lot of focus on marketing and advertising, there was very little attention paid to the design, drawing and engineering of building components. There were also no joint problem-solving initiatives or performance assessment programmes.

Based on the assessment, FIP, amongst other suggestions, recommended the following to SEICO:

- Installing a notice board;
- Introduction of a short (5 to 10 minute) meeting among supervisors / team leaders and workers on a daily / shift basis;
- Weekly meetings between CEO and supervisors / team leaders while ensuring that senior management are more visible on factory floor;
- The introduction of joint problem-solving techniques for communication, and working conditions;
- Implementing a clean-up day for the factory;
- Introducing a suggestion box;
- Using visual factory improvement tools to highlight the potential for change. This includes photographs taken before and after the clean-up day as well as ‘visual tools’ such as fishbone analysis and Pareto charts.

II. Actions and Impacts

The factory acted on all the above recommendations

The introduction of joint problem solving resulted in groups of workers analysing problem areas using fishbone analysis. The output from this exercise was then displayed on the newly installed notice board so that all workers could see the root causes of problems that had been identified – and some of the solutions. Workers and management became more open and receptive to change. This has, in the view of management, resulted in greater motivation and a more effective workforce;

SEICO not only introduced but also expanded the role of the short daily meetings so that the groups not only talk about the current / next shift but they also pick a specific topic from the fishbone analysis for discussion and how they may implement solutions. The factory manager has been taking a greater role in terms of two-way communications with the workers and management and is much more visible and approachable. This has led to improved communication in the factory – people are keen to talk, voice their opinion and listen.

Management has also instituted a review of employee terms and conditions, resulting in higher direct wages for
all workers. These measures have led to a healthier, better, working environment.

In addition to the above qualitative improvements, as depicted in the graph below, waste has measurably decreased.

III. Summary

Although the changes above are difficult to measure or attribute directly to the workplace cooperation initiatives of FIP, the company is quite clear that the quantifiable results listed below would not have been possible if the workers and management had not gone through the Workplace Cooperation module first.

- Average raw material wastage per month has reduced by approximately 61% against the 2006 base line figure;
- On time deliveries have, on average, improved by 24.75% over the 2006 baseline figure;
- Average actual output as a percentage of target output per month has increased by 36.75% against the 2006 baseline; and
- Average monthly end-of-line defects have reduced by 58% against the 2006 baseline.

- Average monthly salaries increased by approximately 40% during the nine month period of the programme;