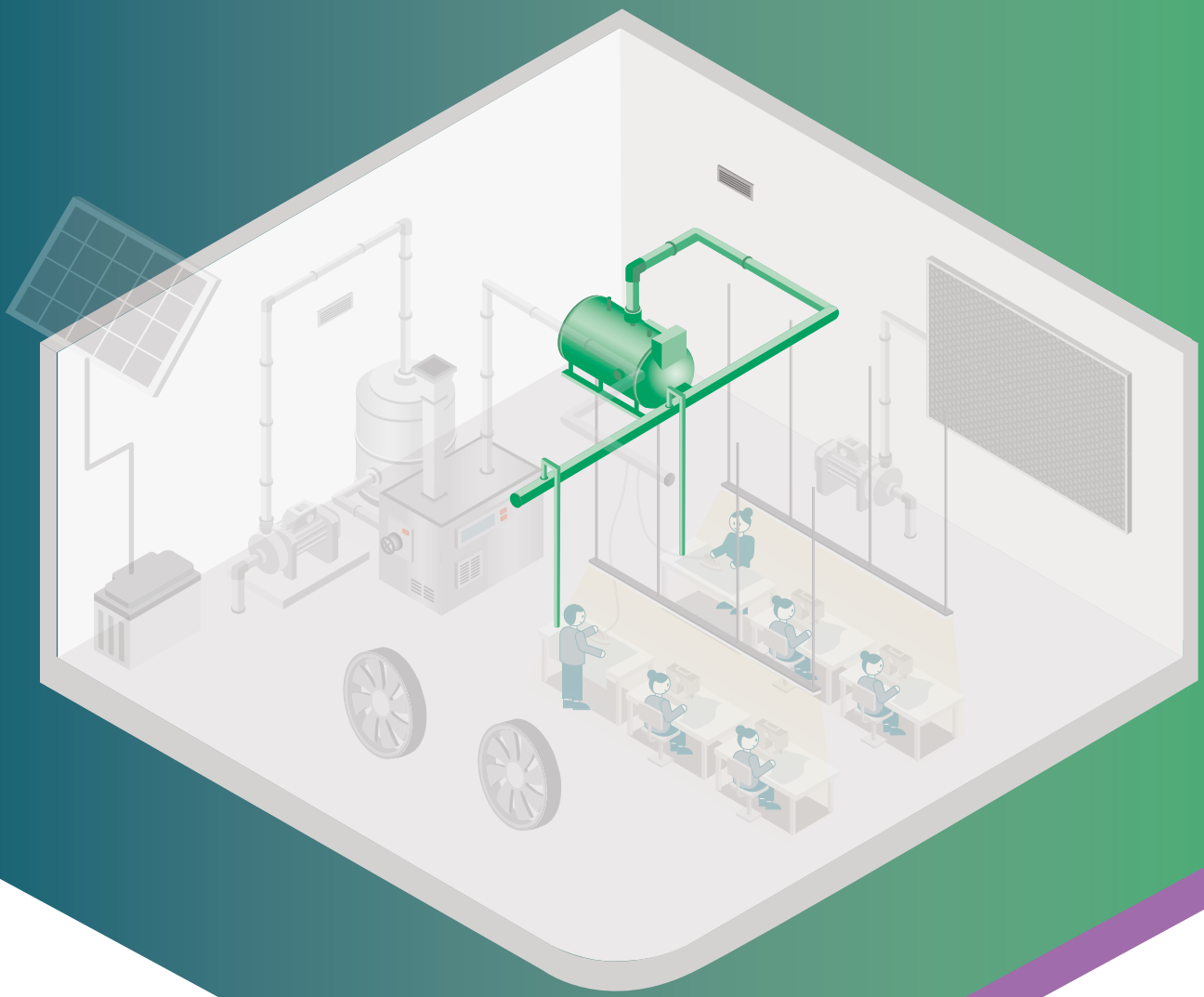
Technical Brief on Sustainable Energy

COMPRESSED AIR SYSTEMS



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switchasia GRANTS PROGRAMME

SWITCH GARMENT
PROMOTION OF SUSTAINABLE ENERGY PRACTICES IN THE GARMENT SECTOR IN CAMBODIA

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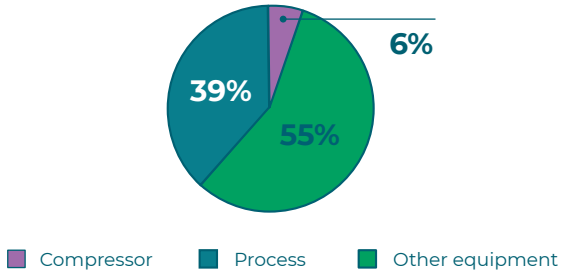
COMPRESSED AIR USE IN THE INDUSTRY

Compressed air has a higher pressure than atmospheric pressure and is used as energy in industrial processes. It is an excellent medium for storing and transmitting energy.

Compressed air is essential for the operation of industrial plants and is often considered the “fourth utility” after electricity, water, and steam.

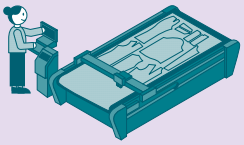
Electricity consumption in the Cambodian Garment Industry



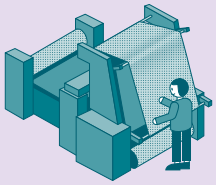
Source : Energy efficiency NAMA in the garment industry in Cambodia

Machines using compressed air in Garment factories:

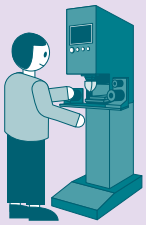
Sewing



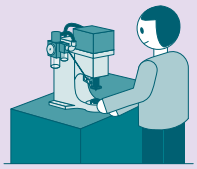
Cutting



Tensioning



Pad Print Machine



Pneumatic Snap Button Machine

Other examples: Heat seal, Heat transfer, Cleaning, Molding machine, Hanger system, Clamping etc.

Compressed Air Treatment 1

1. Pollutant Contaminants

When compressing the air, volume is reduced but the amount of particles remains the same. Thus, the concentration of contaminants is higher. It can damage the process machines and affect end product quality.

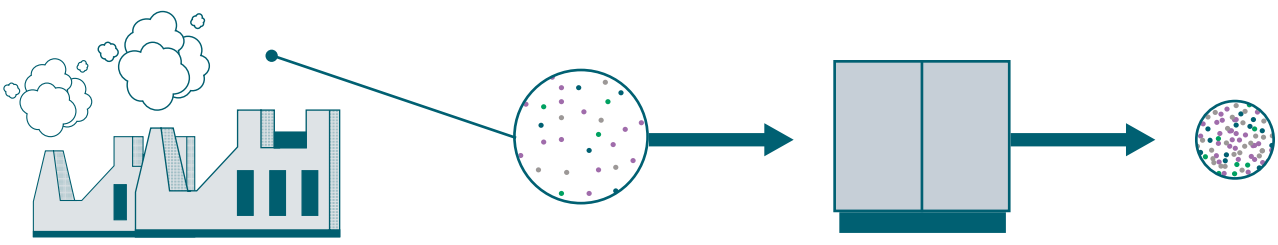
Main types of contaminants: atmospheric particles (dust, rust, air pollution), oil, water, microbiological.

With proper treatment and maintenance, air can be purified to protect the system.

2. Condensate

When air is compressed, the water vapor it contains turns into liquid condensates. At the outlet of the compressor, air is hot and saturated, when cooled into the pipes, water will condensate causing risks of corrosion, pressure drops and damaging the machines.

Drying the air after compressor protects the machines and end product from those risks.



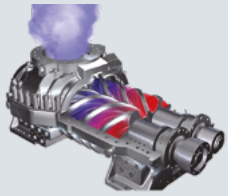
Industrial area | **Residual pollution in ambient air** | **Air compressor** | **Compressed air and pollution**

Main components of a Compressed Air System 2

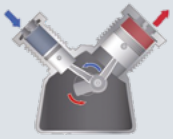
01. Air Compressor

Compress the air from atmospheric pressure to the required pressure for the process operation. The most popular compressor types used in the factories are the following:

1. Rotary screw compressor
A rotary screw compressor is a type of compressor that uses two rotating screws to compress the air.



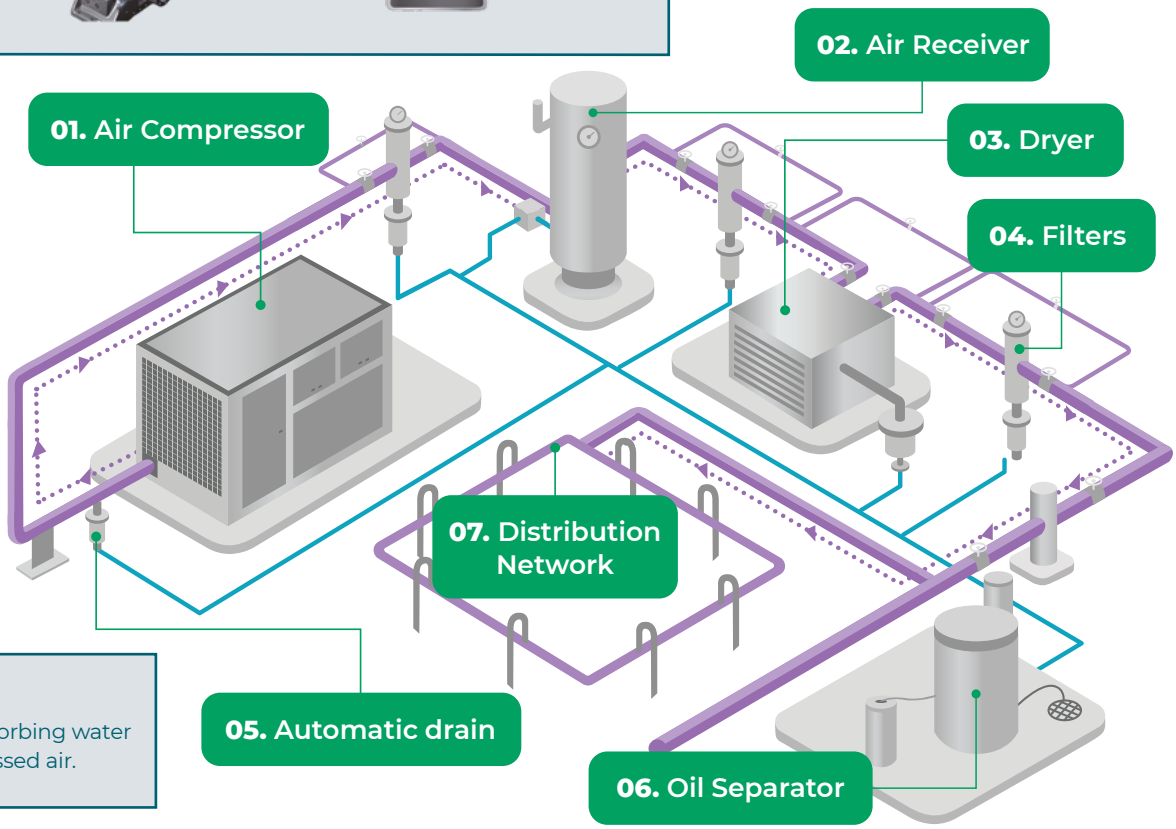
2. Reciprocating or piston compressor
This device is similar to a piston engine and provides intermittent pressure supply.



02. Air Receiver

Two main functions :

1. **Stores compressed air** for sudden or unusual heavy demands exceeding compressor capacity.
2. **Pre-drying the air:** in the tank, air will be cooled naturally and some vapor will condensate, facilitating dryer operation.



03. Dryer

Removes saturated vapor from compressed air to avoid any problem with condensate.

1. Refrigeration air dryer:
(Most seen in Garment sector in Cambodia)
Compressed air is cooled to very low temperatures, to remove moisture.

2.Absorption air dryer:
Chemical process is absorbing water vapor from the compressed air.

04. Filters

Removes compressed air from its contaminants coming from ambient air, such as particles, moisture and oil.

05. Automatic drain

Automatically drains the condensates out of the system, protecting the machines and equipment, and preventing corrosion.

06. Oil Separator

Separates oil and water from condensates: most common compressors use oil lubricant to operate. Oil and water are mixed in the condensates, and need to be separated to reuse the oil, and purify the wastewater.

07. Distribution network

Transports compressed air from the production to the point of use. The distribution network shall be designed properly:

- Minimum pressure drop, maximum flow, minimum leakage
- Swann neck
- Reduce corrosion risk by using proper pipes material (black steel is highly corrosive material and shall be avoided for compressed air, to prefer aluminum or treated steel material)

Energy savings in Compressed Air Systems

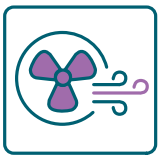
Maintenance	Modification	Optimization	Investment	Labour Time	Savings

1. Optimize the configuration of the Distribution network

A bad configuration of the installation can lead to higher energy consumption.

1. Have a closed loop for the distribution network to reduce pressure drop and consumption.
2. Use a corrosion resistant material for pipeline to reduce pressure drop, protect machines and avoid leak holes in the pipeline. Black Steel is to be avoided.
3. Ensure proper sizing of the piping network. Retrofit could be needed.
4. Locate compressor room near the production.

2. Optimize the configuration of the Compressor Room



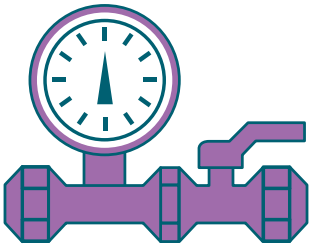
1. The system is more efficient with cool and clean air at the intake of the compressor:
   - Ventilated compressor room provides cooler and cleaner air intake.
   - Exhaust air from compressor prevents over heating air in compressor room.
2. Locate the Tank receiver before the dryer to pre-dehumidify compressed air. Then, the dryer uses less energy to dry the air.
3. Install auto drain valve for air receiver tank to instantly remove water condensate, reducing the load on the air compressor.

4. Ensure proper sizing of the equipment to limit pressure drops.

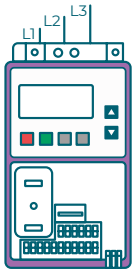
3. Adjust compressed air production to the machines need

More energy is needed to compress the air when the delivery pressure is higher: compressing air from 1 bar to 2 bar needs a lot less energy than from 8 to 9 bar.

- Adjust the delivery pressure of the compressor to the operating pressure of the machines to reduce consumption.
- Install a pressure booster before the machines that have higher operating pressure if any.
- To make more economy, pressure and flow control can be used to adapt the delivery settings to the needs automatically.

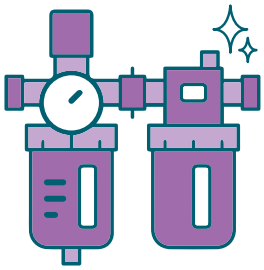


4. Change to more efficient technologies



1. Use a VFD (Variable Frequency Drive) compressor to adjust the consumption to the need.
2. Use an energy efficient dryer to reduce the consumption.
3. Use efficient filters to reduce pressure drops

5. Maintenance of the equipment

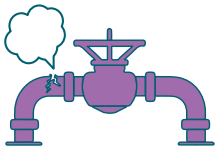


Operation and Maintenance is important to preserve equipment efficiency

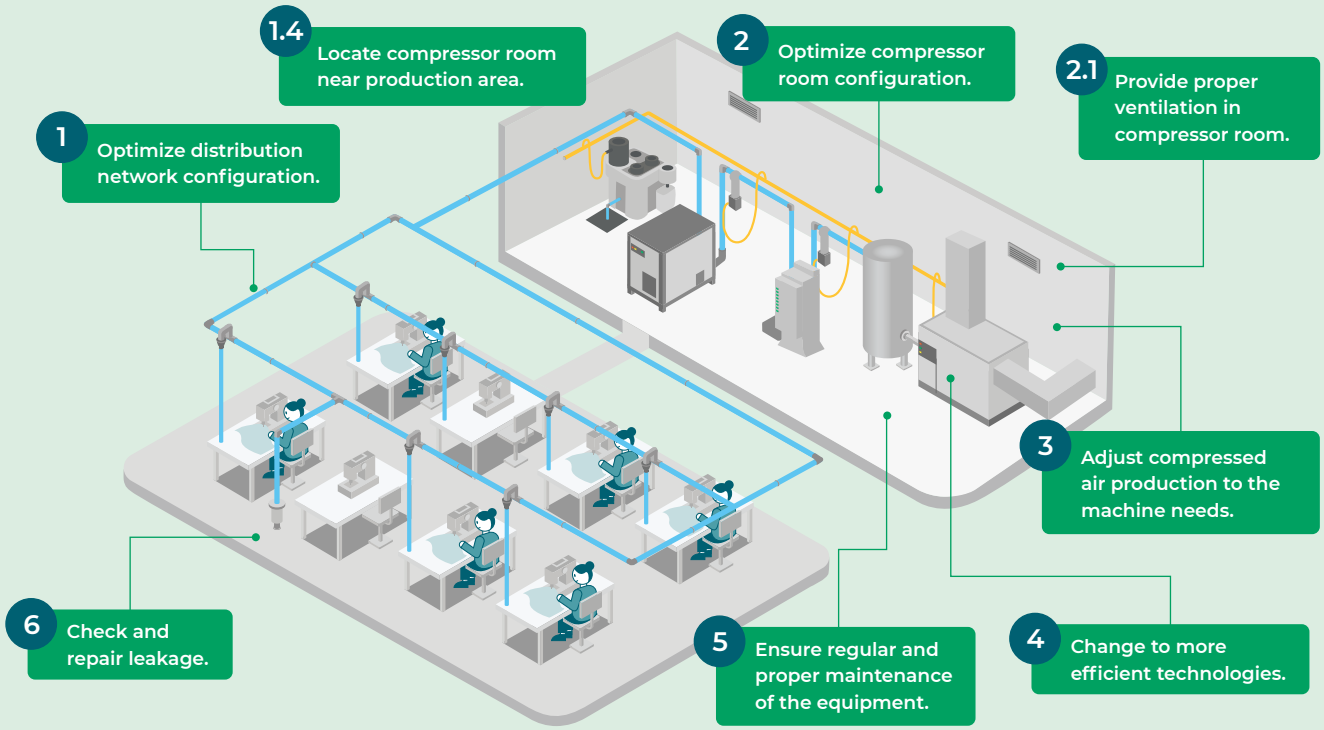
1. Clean filters periodically to reduce pressure drops and ensure their operational effectiveness
2. Inspect each compressor belt regularly to verify their wear.
3. Inspect the intake vents and clean them when necessary,
4. Control lubricant quality and quantity to ensure compressor efficiency with smooth and no corrosive movement.
5. Inspect the air compressor for oil or air leaks.

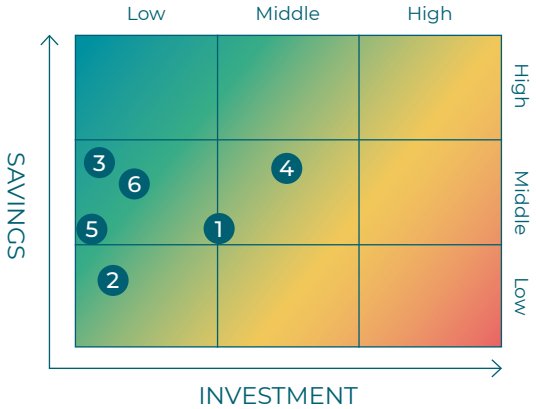
6. Checking and fixing compressed air leakages

Compressed air leaks leads to an important waste of energy and can be repaired to make quick and significant savings. Main leaks can be checked during quiet time, and located by listening for their sound. Leaks frequently occur at air receivers, relief valves, pipe and hose joints, shut off valves, quick couplings, tools and equipment.



Summary & Recommendation

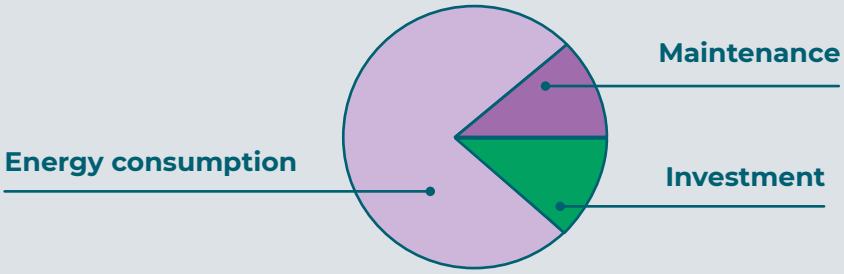




1. Optimize the configuration of the network
2. Optimize the configuration of the compressor room
3. Optimize the use of compressed air
4. Change to more efficient technologies
5. Maintenance of equipment
6. Check and repair compressed air leakage

Cost Breakdown of Compressed Air Operation 4

When looking at the operation cost of compressed air over the years, the initial investment is only a small part of the cost breakdown. Energy consumption is the most expensive area. Investing in energy efficient technologies and ensuring regular maintenance is highly recommended to make significant savings:



Energy flow for Compressed Air 5

Most of the energy used in a compressed air system is wasted in heat losses, and only 10% to 13% of the input energy is delivered in usable form as compressed air. From this, only about half is used as the remaining amount is wasted due to leaks and other losses. This can be easily prevented, ensuring significant savings.

Source: SCEM Reference Manual for Steam and Compressed Air Systems

Opportunities

Energy storage:
Compared to lithium batteries used for electricity, compressed air is easily stored in air receiver tanks and can be used even when power network fails.

Light, reliable and cheap tools:
With no need for heavy motors, air tools are cheaper, lighter, more compact and ergonomical for the worker. Moreover, it avoids the risk of electrical shock and requires less maintenance.

Increased productivity:
Compressed air provides quicker working cycles with fast conversion from energy to work.

Safe usage:
Tools are very safe in regard to fire, explosion and electrical hazards.

Barriers

Energy consumption:
From the energy needed in a compressed air system, a large part is lost, with only 10 to 13% of energy converted into useful energy.

Air treatment:
Atmospheric air that is compressed contains particles, water and other contaminants. Before being used, air needs to be treated to ensure its quality and safe operation for workers.

Disconnection:
If not maintained properly, the connection of compressed air tools can suffer from rust and disconnection, resulting in safety issues. It is important to properly maintain the equipment to avoid those risks.

Energy Management Steps 6

A step-by-step approach for investing in a compressed air system.

01. Current state of the installation

Inventory of the material and the use of the system. Knowing the components and requirements of the installation will help pre-identify potential improvement and prepare further analysis:

- Capacity and number of compressors
- Location of compressor and system installation
- Daily operating hour (h/day)
- Process machine needs (pressure, flow)

02. Measurement

Taking detailed measurements of the installation is the starting point for improvement and assessing its performance.

Measure and document the following:

- Power consumption
- Air flow and pressure
- Air leakage
- Loading and unloading time
- Temperature in compressor room
- Measure and document air leakage

03. Data Analysis

Once measurement is done, the analysis of the consumption gives information on possible improvements:

- Compare calculation in kW per m3 / min with the theoretical consumption of the compressor to assess its efficiency
- Air leakage below 10%, is acceptable. Starting from 10% and above, leakages shall be checked and repaired.
- Set baseline of consumption and monitoring

04. Equipment & System analysis

Analyzing the individual components to identify potential improvements on the installation, understand the actual lifetime of the products, and monitor their quality.

05. Implementation & improvement

Based on careful assessment and evaluation, identify improvement options.

- Considering the information gathered in this technical brief, propose improvement (technical improvement, possible investment, energy management, etc.), indicate the potential savings or impacts and set priority for the implementation of each improvement.

06. Verification & Monitoring

After implementation, start monitoring the efficiency and consumption of the system, and organize a maintenance plan for the system:

- Monitor energy consumption
- Monitor flow, pressure etc.
- Estimate energy saving compare to previous system
- Monitor compressed air leaks of the system
- Organize a maintenance plan

Edition:
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Developed by:
Geres

With the contributions of:

Geres, the Global Green Growth Institute (GGGI) and the Textile, Apparel, Footwear & Travel goods Association in Cambodia (TAFTAC) are implementing the project "Promotion of Sustainable Energy Practices in the Garment Sector in Cambodia", funded by the European Union (EU) through the Switch Asia grant program and co-financed by Agence française de développement (AFD) through the project "Towards a Sustainable and Inclusive Textile and Clothing Industry in Cambodia", VETHIC.

The project aims at increasing competitiveness and decreasing environmental impact towards sustainable production in the Cambodian garment industry and focuses on understanding the key barriers that inhibit the growth of the garment sector and will identify the opportunities that can help in the sustainable growth of the garment sector in Cambodia.

This will be achieved by providing hand-holding support to Garment manufacturing units in the country to identify and adopt sustainable energy practices.

This technical brief was produced with the inputs and extensive review provided by Global Green Growth Institute (GGGI) and Textile Apparel, Footwear and Travel Goods Association in Cambodia (TAFTAC).

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