THE GENERAL SECRETARIAT OF THE NATIONAL COUNCIL FOR SUSTAINABLE DEVELOPMENT
MINISTRY OF ENVIRONMENT

# CASE STUDY ON IMPLEMENTATION OF THE INCREASE OF THE BOILER EFFICIENCY BY GOOD OPERATIONAL PRACTICES IN FOOD AND BEVERAGE INDUSTRY IN CAMBODIA

FOR IMPLEMENTATION OF OUTPUT 1.1.4:

AWARENESS RAISING AND LESSON LEARNED DISSEMINATION WITH FOCUS ON RESOURCE EFFICIENCY IN CAMBODIA

UNDER THE FRAMEWORK OF THE UNIDO PROJECT
LOW CARBON DEVELOPMENT FOR PRODUCTIVITY AND CLIMATE CHANGE MITIGATION THOUGH THE TRANSFER OF ENVIRONMENTALLY SOUND TECHNOLOGY (TEST) METHODOLOGY

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# CASE STUDY ON IMPLEMENTATION OF THE INCREASE OF THE BOILER EFFICIENCY BY GOOD OPERATIONAL PRACTICES IN FOOD AND BEVERAGE INDUSTRY IN CAMBODIA

## I. Introduction of Transfer of Environmentally Sound Technology (TEST)

In the last three decades, a number of conceptual ideas and tools have been created to assist industry with being more manageable and sustainable in its production and more efficient in its utilization of resources. These incorporate pollution prevention, waste minimization, cleaner production, eco-efficiency, and eco-innovation; with a particular depend on waste, energy, and materials. These conceptual ideas and tools have the shared objective of bringing two apparently clashing purposes together, financial profit and environmental improvement. The term Resource Efficient and Cleaner Production (RECP) is to the appropriated adaption of cleaner creation methods to speed up the use of preventive environmental techniques to processes, products and services, with the purpose of improving material and energy efficiency and diminishing dangers and risks to people and the environment. Resource efficiency approaches are looked for as building blocks of the Circular Economy (UNIDO, 2018).

The approach anticipated in these guidelines, which it is called the TEST approach, builds on all the concepts and tools mentioned above. TEST stands for Transfer of Environmentally Sound Technologies in which is an integrated approach that provides industries and small and medium enterprises (SMEs) with a combined set of tools to initiate a cycle of continuous improvements within their business operations to manage the transition towards a sustainable production. By combining combines internationally proven preventive environmental practices in Resource Efficient and Cleaner Production (RECP), the core elements of an Environmental Management System (EMS) and an Energy Management System (EnMS), which include exploring new eco-efficient technologies and an effective and supportive information system for material and energy flows based on Material Flow Cost Accounting (MFCA). TEST integrates all levels of the business management through creative thinking and effective collaboration. The project participant's companies applying TEST methodology follow the learning cycle "Plan-Do-Check-Act" to evaluate their processes and facilities to determinate improvement measures and feasible technologies as shown in the table 1.

Table 1: TEST methods and their tools

| TEST Methodology | TEST Integrated tools |
|---|---|
| Build on "one-stop improvement" approaches to resource efficiency in the system | Resource Efficient and Cleaner Production |
| Facilities creative thinking and effective collaboration through teamwork | Material Flow Cost Accounting/ Environmental Management Accounting |
| Match the needs of an enterprise within its operating framework conditions and enhance organizational learning | Environmental/Energy Management System |
| Address all levels of a business (operational, managerial, and strategic). Follow the learning cycle in line with ISO standard PLAN-DO-CHECK-ACT. | Corporate Social Responsibility |

On the other hands, the effectiveness of TEST integrated approach contributes to the Sustainable Development Goals (SDGs) 7: Affordable and Clean Energy, 9: Industry, Innovation and Infrastructure, 12: Responsible Consumption and Production, and 13: Climate Action as shown in the figure 1 below.


Figure 1: TEST towards to achieve SDGs

## II. Support mechanisms through policies and alignment with relevant ministries

Cambodian industry is highly energy inefficient, with energy consumption per unit of outputbeing higher than in many countries in the region and more than double that of the developed countries. Moreover, through the industrial production process and activities, there has been generate a lot of solid waste, hazard waste, wastewater pollution significantly into the environment and atmosphere. For instant, the food and beverage (F&B) sector will generate around 2,410,034 tons of waste in 2020, mostly in the form of industrial wastewater (IWW). Garment waste represents 70% of industrial waste going to landfill and includes textile, footwear and leather offcuts and rejects. To cope with those issues, the current UNIDO's project called TEST project is designed with the purposes to analyze energy consumption data and trends, and identifies Significant Energy Users (SEU) to recommend potential energy saving practices, opportunities, and technological improvements.

Beside this, the Royal Government of Cambodia has formulated, developed, and implemented a series of national policies, strategies, action plans, and programs in order to ensure holistic social development and sustainable development, to promote green environment and renewable energy, to encourage efficient use of energy and to minimize detrimental environmental effects resulting from energy supply and use, and to encourage private investment on the green business, etc. The table 2 the briefly description of the Cambodia's policies, law, strategies, action plans, guidelines, other programs on/related to the promotion of renewable energy, power sector, green environment, waste management, and green industry, etc.

Table 2: List of policies, law, strategies, and action plans

| No | Name | Period | Remark |
|---|---|---|---|
| 1 | Power Sector Strategy | 1999-2016 | |
| 2 | Cambodia's Law on Electricity | 2000 | |
| 3 | Renewable Electricity Action Plan (REAP) | 2002-2012 | |
| 4 | National Policy, Strategy and Action Plan for Energy Efficiency | 2013 | |
| 5 | National Policy on Green Growth | 2013-2030 | |
| 6 | Strategic Plan for Green Growth | 2013-2030 | |
| 7 | National Strategic Development Plan (NSDP) | 2019-2023 | |

[1] The Economic, Social and Environmental Impacts of Greening the Industrial Sector in Cambodia, GGGI, 2018

| | | | |
|---|---|---|---|
| 8 | Cambodia Climate Change Strategic Plan (CCCSP) | 2014-2023 | |
| 9 | Climate Change Action Plans (CCAPs) | 2014-2018 | |
| 10 | Intended Nationally Determined Contribution (INDC) | 2015 | |
| 11 | Environment and Natural Resource Code | - | Draft |
| 12 | National Energy Efficiency Policy | 2018-2035 | |
| 13 | Sub-decree on energy efficiency standards and labeling for electrical appliances and equipment | - | Draft |
| 14 | National Waste Management Strategy and Action Plan | 2018-2030 | |
| 15 | National Policy on Solid Waste Management in Cities | 2018 | Official in Khmer version |
| 16 | Sub-decree on Solid Waste Management in the Cities | 2015 | Official in Khmer version |
| 17 | Sub-decree on Plastic Bags Management | 2017 | Official in Khmer version |
| 18 | Guideline on E-Waste Management | 2017 | |
| 19 | Sub-decree on E-Waste Management | 2016 | |
| 20 | Water Resources Management Law | 2007 | |
| 21 | Sub-Decree on Water Pollution Control | 1999 | |

Government has a critical role in accelerating the energy transition. Government has the responsibility to enact an enabling policy framework that provides long-term certainty for the private sector and ensures a positive environment for the energy transition. The roles of the main actors in the power sector and wastewater management are set out in the below table 3.

Table 3: The roles of the main actors in the power sector and wastewater management

| No | Ministry/Institute's Name | Duties |
|---|---|---|
| 1 | Ministry of Economy and Finance (MEF) | Involves in allocating the budgets. |
| 2 | Ministry of Mines and Energy (MME) | Is responsible for developing policies and strategies, power development plans, overseeing the electricity trade with neighboring countries, major investment projects and management of the rural electrification sector. |
| 3 | Ministry of Industry, Science, Technology and Innovation (MISTI) | Is responsible for developing policies and strategies related to green industry and involves in providing drinking water in 11 provincial capitals and for approximately 60 medium sized and small towns. |
| 4 | Ministry of Public Works and Transport (MPWT) | Involves in wastewater management. |
| 5 | Electricité du Cambodge (EDC) | Involves in generating, transmitting and distributing electricity throughout Cambodia. Its main functions are supplying electricity, developing the transmission grid and facilitating import and export of electricity to and from neighboring countries. |
| 6 | Electricity Authority of Cambodia (EAC) | Is the power sector regulator, and is responsible for granting licenses, approving and enforcing performance standards, and determining tariffs, rates and charges for electricity. The EAC may grant various types of electricity license, including licenses for generation, transmission, distribution, retail, or a combined license. |
| 7 | Ministry of Environment (MoE) | Reviews and approves Environmental Impact Assessments (EIAs) and Environmental Management Plans (EMP) for all energy and water related projects, etc. |

| | | |
|---|---|---|
| 8 | National Council for Sustainable Development (NCSD) | Is a cross-sectoral and multi-disciplinary body with the mandate to prepare, coordinate and monitor the implementation of policies, strategies, legal instruments, plans and programs related to climate change in Cambodia. The NCSD aims to improve the coordination of climate change activities in Cambodia and to support a stronger, comprehensive and effective climate change response. |
| 9 | Ministry of Water Resources and Meteorology (MOWRAM) | Issues water licenses for hydropower projects. |
| 10 | Forestry Administration of the Ministry of Agriculture, Forestry and Fisheries (MAFF) | Is responsible for the management of wood-fuel and the production of crops as a source of renewable energy. |
| 11 | Ministry of Rural Development (MRD) | Involves in master plans and water supply and sanitation management in rural areas and towns. |
| 12 | Ministry of Interior and municipalities | Involve in master plans, operation and maintenance wastewater treatment system. |

According to the above-mentioned national regulations, laws, policies, etc. as well as following to all the relevant ministries and institutions' mandates and responsibilities related energy and power generation, waste management, and water supply and management, there are the fundamental ways and mechanisms in which allow for all stakeholders and private sector to access to water and energy consumption dramatically. In addition; so far, there were many supported activities and programs were provided and supported to those private sector and stakeholders for their businesses' program and activities as well. For example: Financial supports, capacity buildings, taxation reduction and exception for some imported equipment, issuing the licenses and certifications, and other services, etc. were provided.

## III. Integrating the best practice pproach into the factory environmental roadmap

In 2013, as collaboration with 11 enterprises, the UNIDO project on low carbon development for productivity and climate change mitigation though TEST methodology in Cambodia has been applied various technology cases or approaches in which mainly focus on energy consumption to help those enterprises to reduce their energy consumption, to improve their business activities and productions, and to make a better surrounding environment.

50 factories in the first phase from the garment including laundry, textile, footwear, and the food and beverage sectors were selected as demonstration companies and will benefit from the comprehensive project technical support and other services, such as the provision of trainings both collectively and in-house on the TEST tools, followed by RECP assessment and energy audits of the production facilities, which will be carried out jointly by the factory's TEST team and project experts to identify or find out the causes of inefficiencies as well as recommended improvement measures. Moreover, there are a lot of technologies were selected and applied to deal with those causes as well as integrated into each factory environmental policy during the project implementation, and these technologies can be considered as the best practice approach to help each factory not only to achieve the environmental policy target but also can help each project participant's factory to reduce resources consumption, financing expenditure, and greenhouses emissions, etc.

The below five measures can be the best practices that every factory owner could consider and apply:

- ✓ Increase the boiler efficiency by cleaning both water and fire side and optimize air fuel ratio,
- ✓ Optimize Compressed Air Usage by Repairing the Compressed Air Leakage and Optimizing Compressor Operating,
- ✓ Opportunities of installing Solar PV with Li-Battery System,
- ✓ Advantages of replacing AC in the embroidery room with evaporative cooling, and

✓ Optimize resistive ovens for cooking, drying and baking with steam from LPG.

Note: There are more appropriate technologies can be used and applied to improve each company's business. Please consult with UNIDO's project team for more information.

## IV. Overview of the boilers

### 1. What is boiler?

Boiler is a pressure vessel used for transferring the heat in the form of the combustion of fuel into water either to generate hot water or steam. The function of a boiler is to either produce hot water or steam. Hot water boilers heat water for the purpose of domestic or commercial heating and hot water supply. Steam boilers generate steam in order to power turbines for power generation and various other industrial heating applications. In many countries, the boilers were used for cooking, boiling and cleaning processes in the food and drink industry, but in many other countries used them in paper, building, chemical or textile industry.

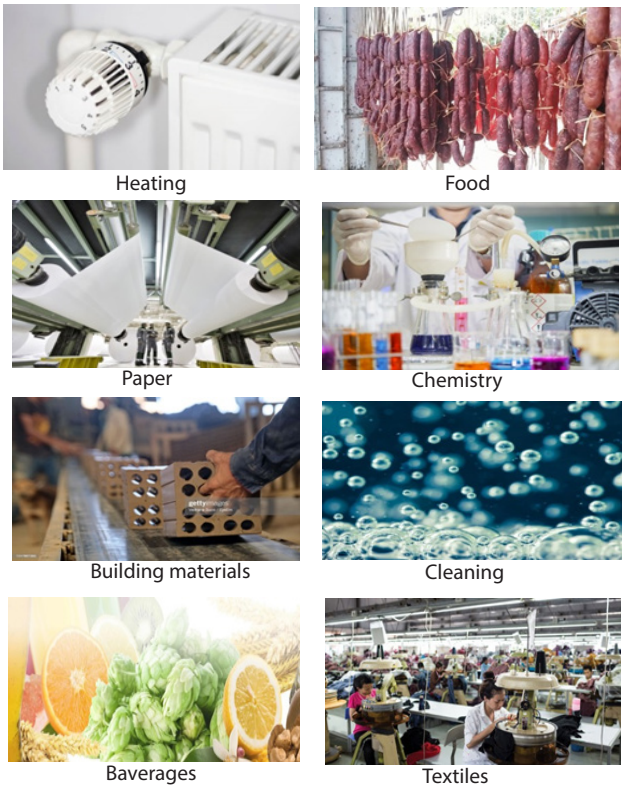


Figure 2: Boilers use in the various fields for industry sector

### 2. Boiler types?

Boiler design can be classified into three types such as fire-tube boiler, water- tube boiler, and electric boiler (Sullivan, Pugh, Melendez, & Hunt, 2010).

A. Fire-tube boilers: Rely on hot gases circulating through the boiler inside tubes that are submerged in water. These gases usually make several passes through these tubes, thereby transferring their heat through the tube walls causing the water to boil on the other side. Fire-tube boiler is generally available in the range 20 through 800 boiler horsepower (bhp) and in pressures up to 150 psi [2].

B. Water- tube boilers: Most high-pressure and large boilers are of this type. It is important to note that the small tubes in the water-tube boiler can withstand high pressure better than the large vessels of a fire-tube boiler. In the water-tube boiler, gases flow over water-filled tubes. These water-filled tubes are in turn connected to large containers called drums. Water-tube boiler is available in sizes ranging from smaller residential type to very large utility class boiler. Boiler pressures range from 15 psi through pressures exceeding 3,500 psi.

C. Electric boilers: are very efficient sources of hot water or steam, which are available in ratings from 5 to over 50,000 kW. They can provide sufficient heat for any HVAC requirement in applications ranging from humidification to primary heat sources.

### 3. Boiler safety's situation in Cambodia

Recently in Cambodia, there were some cases of boiler explosions that led to fatalities. These high risks happened because:

- Use recycling boilers, old boilers, and second-hand boilers with no clear standard license;
- Lack of clear boiler inspection program as well as monitoring, maintenance, and repairing program or system;
- Lack of high quality spare-parts or accessories;
- The skills of boiler operation staff are limited;
- Limitation of operation and maintenance documentaries;
- Lack of boiler safety training programs and its materials; and
- Lack of rules and regulations on boiler safety and efficiency, etc.

To define and secure boilers safely, some professional specialized organizations such as the American Society of Mechanical Engineers (ASME ) develop standards and regulation codes. For instance, the ASME Boiler and Pressure Vessel Code is a standard

[2] Psi:Pound per square inch

providing a wide range of rules and directives to ensure compliance of the boilers and other pressure vessels with safety, security and design standards.

## 4. General Requirements for a Safe and Efficient Boiler Room

a. Keep the boiler room clean and clear of all unnecessary items. The boiler room should not be considered an all-purpose storage area. The burner requires proper air circulation in order to prevent incomplete fuel combustion. Use boiler operating log sheets, maintenance records, and the production of carbon monoxide. The boiler room is for the boiler!

b. Ensure that all personnel who operate or maintain the boiler room are properly trained on all equipment, controls, safety devices, and up-to-date operating procedures.

c. Before start-up, ensure that the boiler room is free of all potentially dangerous situations, like flammable materials, mechanical, or physical damage to the boiler or related equipment. Clear intakes and exhaust vents; check for deterioration and possible leaks.

d. Ensure a thorough inspection by a properly qualified inspector.

e. After any extensive repair or new installation of equipment, make sure a qualified boiler inspector re-inspects the entire system.

f. Monitor all new equipment closely until safety and efficiency are demonstrated.

g. Use boiler operating log sheets, maintenance records, and manufacturer's recommendations to establish a preventive maintenance schedule based on operating conditions, past maintenance, repair, and replacement that were performed on the equipment.

h. Establish a checklist for proper startup and shutdown of boilers and all related equipment according to manufacturer's recommendations.

i. Observe equipment extensively before allowing an automating operation system to be used with minimal supervision.

j. Establish a periodic preventive maintenance and safety program that follows manufacturer's recommendations.

## 5. Boiler case of the project participant's factory

There are three fire-tube boilers at one factory which uses wood to generate steam mainly for the ironing process. During the on-site energy audit, the efficiency of only one boiler was assessed, together with the amount of steam generation, since the other two boilers are only used as back up when the main boiler stops for maintenance. Figure 2 shows the 4-TPH fire-tube boiler at the factory which is assessed for its performance in term of efficiency. The boiler does not have a steam meter and water feed water meter. The other two boilers are shown in Figure 3.

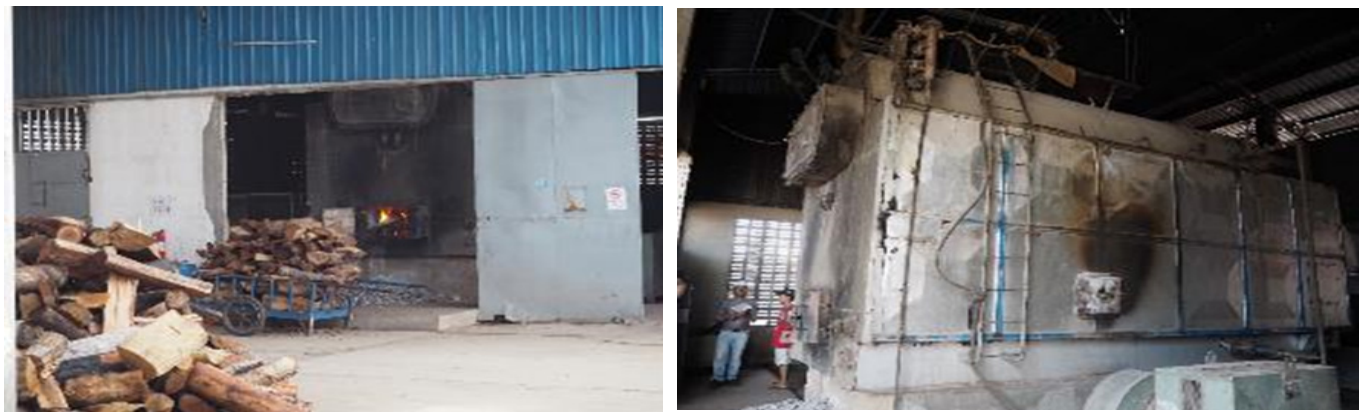

Figure 3: 4-TPH fire-tube boiler

[3] https://www.asme.org/codes-standards/training-and-events/engineering-student-resources

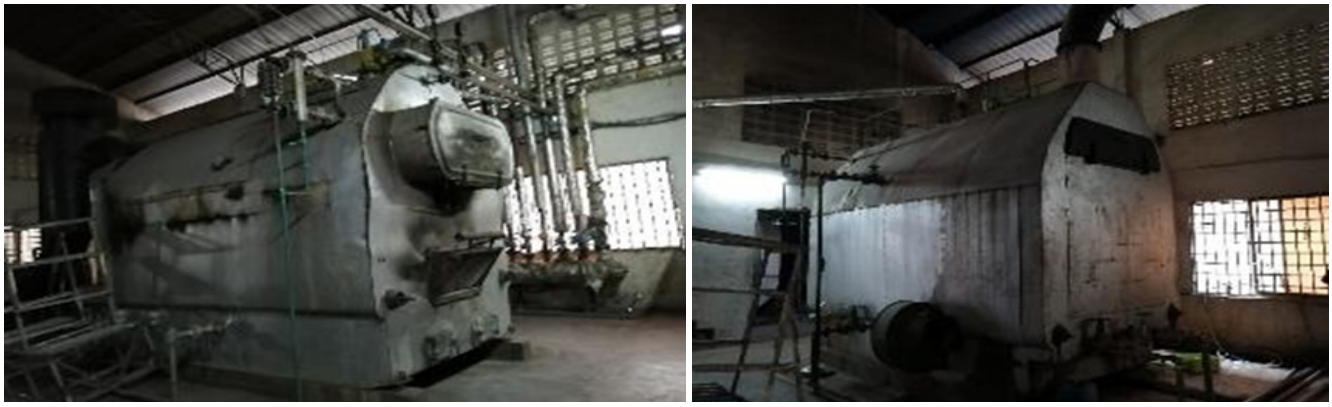

Figure 4: Two backup fire-tube boilers (2 TPH)

To assess the boiler efficiency, the amount of boiler feed water and wood consumption are estimated based on annual wood consumption and running time of the boiler. Annual wood consumption is used to calculate the efficiency. Table 4 shows the boiler's assessment result. The energy efficiency of the boiler is approximately 40% which seems a bit low compared with new energy efficiency boiler but not so bad considering the type of boiler and purpose of its steam usage. Intermittent operation of the boiler is a cause of relatively low efficiency because major apparel produced at the factory does not need ironing. Thus, the boiler was not operating. When needed, the boiler starts from ambient temperature, but requires significant amount of fuel to warm up the whole body (OECC, 2019).

Table 4: Boiler assessment at the factory

| Compressor information | Wood Boiler 4TPH | |
|---|---|---|
| Model Number | DZG4-1.25-M | |
| Capacity | 4 | TPH |
| Max steam pressure | 1 | MPa |
| Steam temperature | 165 | $^{o}C$ |
| Water consumption | 21 | $m^3$/day |
| Steam consumption | 8369.2 | ton/year |
| Fuel consumption | 6744 | $m^3$/year |
| Calorific value of steam (1) | 23124099.6 | MJ/year |
| Calorific value of fuel (2)[5] | 57200719.7 | MJ/year |
| Efficiency [(1)/(2)] x 100% | 40 | Percent |
| Fuel consumption per ton of steam | 0.80581179 | $m^3$/ton |
| Steam cost | 12.22 | USD/ton |

## V. The general maintenance or improvement opportunities for better boiler operation system

One of the simplest methods for every business to reduce operating expenses, resources, and risks is to increase boiler efficiency. In addition, in every single day that the boiler operation staff should start with is to check how boiler your boiler efficiency and its working system are. Below are the general tips to improve boiler efficiency[6].

1. Lowering stack temperatures: Is a very simple way to lower the operating pressure for steam boilers and the operating temperature for the boilers when idling at night or mild days.

2. Install an economizer: Can save fuel and prevent damaging effects of feeding the boiler with cold water.

[4] https://www.thermaxglobal.com/boilers-and-heaters/packaged-boilers/pdf/combipac.pdf
[5] https://betterwork.org/cambodia/wp-content/uploads/2013/05/Energy-Performance-in-the-Cambdia-Garment-Sector.pdf
[6] This information is retrieved from https://www.rasmech.com/blog/ways-increase-boiler-efficiency/

3. Tune the burner regularly: In order to provide just enough air for the fuel to burn safely.

4. Install a variable frequency drive: To control flow with fan or pump speed.

5. Insulate your valves: In case you had removed the insulation on valves in the boiler room for maintenance, put them back with a Heatmizer Removable Blanket as it can reduce the risk of burns while still allowing easy access for maintenance as well as to improve boiler room comfort.

6. Clean the fireside: Clean and inspect the soot that had stored in the boiler tubes, particularly the old equipment.

7. Clean the water side: Clean out any mud legs or mud drums and other dirty matters to ensure good heat transfer from the metal to the water.

8. Preheat combustion air: Make sure that the heat from the combustion air is transferred properly to the burners. The source of this heat energy is the exhaust gas stream, which leaves the process at elevated temperatures.

9. Return the condensate to boiler: As more condensate is returned, less make-up water is required, saving fuel, makeup water, and chemicals and treatment costs. Less condensate discharged into a sewer system reduces disposal costs. Return of high purity condensate also reduces energy losses due to boiler blowdown.

10. Recover heat from boiler blowdown: Heat can be recovered from boiler blowdown by using a heat exchanger to preheat boiler makeup water.

11. Control blowdown rate: Can substantially reduce energy losses, as the temperature of the blown-down liquid is the same as that of the steam generated in the boiler. Minimizing blowdown will also reduce makeup water and chemical treatment costs.

12. Control excess air: Boilers require excess air in order to complete combustion. Too little excess air and the boiler will build up soot and dangerous carbon monoxide, while too much excess air reduces efficiency.

13. Reduce carry-over: Carry-over is boiler water that leaves the boiler in the steam but is still water. To reduce the carry-over can lead to avoid of the causes of damage and increase maintenance.

14. Survey steam traps: To ensure your boilers are running at peak efficiency, please survey your steam traps regularly and replace broken or sticking traps.

15. Reduce steam usage: is the best way to save on fuel and electricity to your boiler.

## VI. Best measures to improve the boiler systems provided by the TEST project

Boiler systems are major financial investments, yet the measures for protecting these investments may difference according to the context and situation of the countries. Proper maintenance and operation of boiler systems is important with regard to efficiency and reliability. Without this approach, boilers can be very dangerous. As the project implementation policy, all of the project participant's companies were given a free service for energy audit as well as the measurements or best approaches to minimize the costs, resources, and other fatalities with focusing on the energy efficiency. Therefore, below measures in table 5 were applied for each participant's factory to cope with the finding issues around the boiler operation.

Table 5: Best measures to improve the boiler systems through UNIDO project's implementation

| Description of the best solutions for boiler optimization | Investment | Financial Saving | SPB[7] | GHG Saving | Energy Saving | |
|---|---|---|---|---|---|---|
| | | | | | Wood | Water |
| | USD | (USD/Yr.) | (Yrs.) | ($tCO_2e$/Yr.) | ($m^3$/Yr.) | ($m^3$/Yr.) |
| Recover condensate water for boiler feed waters | 1,200.00 | 3,173.64 | 0.38 | 151.95 | 159.96 | 384.00 |
| Recover condensate to preheat the boiler feed water | | | | | | |
| Increase the boiler efficiency by cleaning both water and fire side and optimize air fuel ratio | 1,500 | | 0.09 | 873 | 919 | - |
| Install economizer for waste heat recovery | 1,500.00 | 3,746.04 | 0.40 | 187.29 | 197.16 | - |
| Modify current boiler to add additional water tube number | 15,000.00 | | 1.35 | 54.54 | 583.76 | - |
| Replace new boiler | 15,000.00 | | 1.35 | 54.54 | 583.76 | - |
| Substitute Diesel boiler with wood boiler | 20,000.00 | | 1.98 | 238.94 | - | |
| Install economizer at boiler's chimney to increase boiler feed water temperature | 1,500 | 986 | 1.52 | 40.71 | 42.86 | |
| Install new bigger more efficiency boiler & keep the current one for backup | 80,000 | 9,708 | 8.24 | 401 | 422 | - |

## VII. Conclusion and recommendations

Boiler is a pressure vessel used for transferring the heat in the form of the combustion of fuel into water either to generate hot water or steam. In many countries, the boilers were used for cooking, boiling and cleaning processes in the food and drink industry, but in many other countries used them in paper, building, chemical or textile industry. In Cambodia context, many factories such as food and beverage and garment factories widely use steam boiler for their production processes.
Poorly understanding of engineering principles through boilers operation and maintenance, there can generate very high risks, for example, boiler explosion hazard that led to fatalities. In other words, the weak of boiler operation and maintenance is the waste of energy, costs, and resources. Therefore, to secure boilers safely and efficiently the boiler efficiency approaches are crucially needed.

By joining with the project implementation, all of the project participant's companies will be offered a free energy audit in which company owners can be able to understand and get to know electricity consumption breakdown, what the issues and their locations are in their boiler system, their expense on the electricity consumption and the financial saving from fixing those issues, the scope and size of their investment cost to fix those issues, and the payback period of their investment cost, etc. With that, those companies' owner will be able to build the concreted business plan holistically and can realize what the challenges for their production processes' cycle are, and things they need to invest and improve as well as to enable their decision making quickly and in the right way.

As the case stated in this case study, the UNIDO's project team had identified and provided various measurements or best approaches (there are around 9 specific energy saving opportunities for boilers' operation systems) to minimize the costs, resources, and other fatalities with focusing on the energy efficiency for each participants' factory to cope with the issues that happened in their boiler systems. In addition, by implementing these saving opportunities, each factory owner is not only able to save the money from 1000 US$ up to about 17,000 US$ per year, but also is able to reduce at least around 40 $tCO_2e$ up to around 873 $tCO_2e$ per year. That is the big contribution to either the effort of the Royal Government of Cambodia to reduce GHGs emission or government policies such as, Nationally Determined Contribution Update (NDC-Update).

[7] SPB:Simple payback period of investments

Besides, there are also many ways to improve energy efficiency in which every company owners or boiler operation and maintenance staff should take into consideration such as: lowering stack temperatures, install an economizer, tune the burner regularly, install a variable frequency drive, insulate your valves, clean the fireside and waterside, preheat combustion air, return the condensate to boiler, Recover heat from boiler blowdown, Control blowdown rate, control excess air, reduce carry-over, survey steam traps, and reduce steam usage, etc.

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FOR MORE DETAIL INFORMATION ABOUT THE PROJECT PLEASE CONTACT:

DEPARTMENT OF CLIMATE CHANGE CONTACT:

Dr. Hak Mao
Director of the Department of Climate Change and Project Manager
maohakccd.se@gmail.com

Mr. Doeun Dara
National Project Coordinator
doeun_dara@yahoo.com

Mr. Pich Sokhim
Technical Advisor
sokhim_rua@yahoo.com

UNIDO CONTACT:

Mr. Sok Narin
Country Representative
UNIDO
n.sok@unido.org

Dr. Rey Sopheak
National Project Coordinator
UNIDO
s.rey@unido.org