PT Papandayan Cocoa Industries
Bandung – West Java
Energy Audit Report

21th August 2023

DIREKTORAT JENDERAL ENERGI BARU TERBARUKAN DAN KONSERVASI ENERGI (EBTKE)
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Danish Energy Agency

EMBASSY OF DENMARK
Jakarta

Project no:	**Mapping/benchmark on Energy Efficiency in Industries under the Energy Partnership Programme between Indonesia and Denmark (INDODEPP)**
Report:	**Energy Audit Report PT Papandayan Cocoa Industries**
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Executive Summary

1.1 Introduction

The Directorate of Energy Conservation (DEC) under the Ministry of Energy, Mineral and Resources (MEMR) in Indonesia has embarked on a mapping of energy intensive industries which is in its early phase. The aim is to update information on energy consumption in a selection of industries starting with a focus on the food and beverage sector (F&B). This will support work on developing national industry benchmarks for energy efficiency and set a future direction for industries with high energy consumption. MEMR coordinates with the Ministry of Industry (MOI) on existing available data and is the key partner for this activity. This activity will specifically support empirical data gathering through review of available information on energy consumption and conducting energy audits within the selected F&B sub-sector.

The first objective of this project supported by INDODEPP is to conduct a relevant number of energy audits to get an empirical reference for energy consumption as well as the potential value of implementing energy efficiency measures in the food and beverage sector. The potential will be highlighted for reduction of energy consumption, reduction of energy costs and reduction of CO2 emissions.

The second objective of the project is to share findings from the energy audits through a workshop/seminar with the private sector and relevant stakeholders from food and beverage sector.

The outcome of this project will provide input to the efforts of strengthening national and regional focus on energy efficiency at energy intensive industries and at the same time provide valuable suggestions and ideas for specific energy saving projects to be implemented in selected industries.

This energy audit report for PT Papandayan Cocoa Industries (PCI) documents the main findings and results for the energy audit that was carried out in June 2023 with great assistance from PT PCI (Barry Callebaut Group).

1.2 Plant description

Papandayan Cocoa Industries (PCI) is a subsidiary of Barry Callebaut which is one of the largest chocolate and cocoa company in the world. This factory is located in Bandung – West Java which has 2 plant sites ie: 84 site and Mengger site. It has been founded in 1968 and part of Barry Callebaut since its acquisition from Delfi in 2013. Beside fulfil domestic market, PCI also export more than half of output to all around the world, to 35 destination countries. 84 and Mengger sites were selected to be audited object due to location in West Java and total energy consumption above 4000 ton oil equivalent (TOE) that is mandatory to implement Government Regulation Number 33 Year 2023. Factory layout is shown in Figure 1.

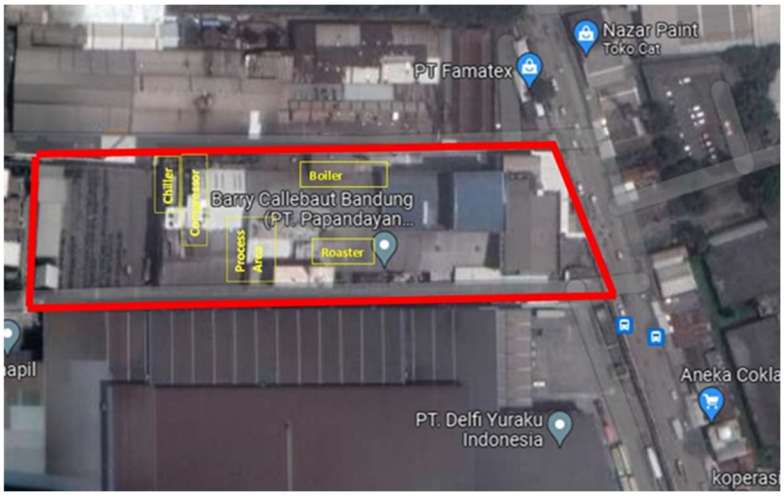


Figure 1. Factory Layout

1.3 Operation

The Papandayan Cocoa Industrie facility operation is 24 hours per day in 360 days per year resulting in 8,640 operation hours per year. Each day 3 working shifts are present 8 hours. The production has historically amounted as shown in Table 1.

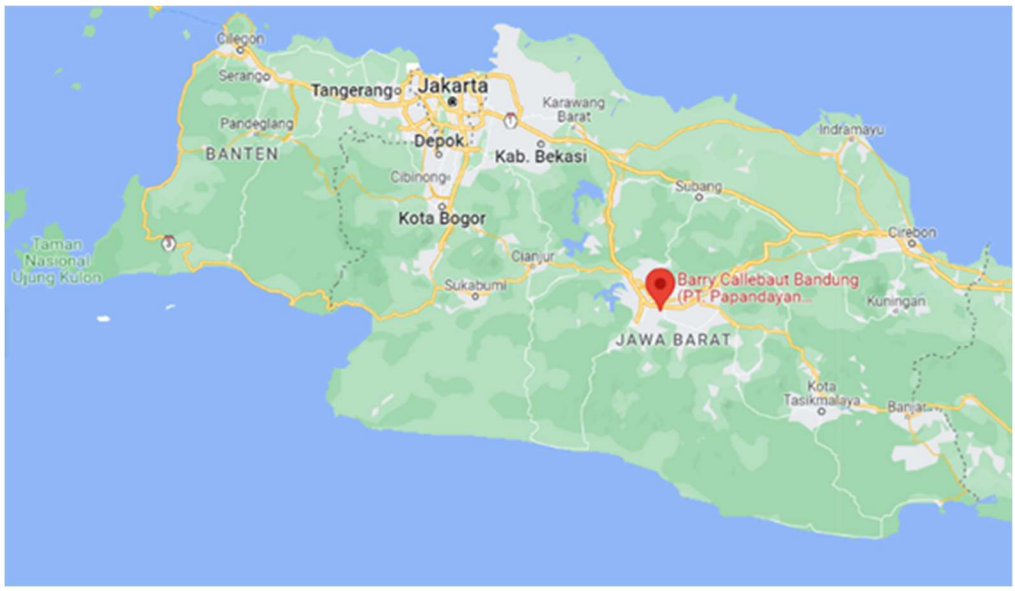
Table 1. Production in 2022

Years	Production, ton
2022	188,781
2023 (Jan-May)	144,102

1.4 Location

Address:

Jl. Raya Dayeuhkolot No. 48,
Pesawahan, Kecamatan Dayeuhkolot
Kota Bandung, Jawa Barat (West Java) 40258
Indonesia



1.5 Methodology

The objective of the energy audit is both to provide the data necessary to establish the baseline for the energy consumption for Papandayan Cocoa Industrie and to estimate the potentials for increasing energy efficiency in the F&B sector. The site visit was prepared with main data collected in a questionnaire.

A three-day site visit was planned and conducted from the 19th to 21st of June 2023. In the site visit the local consultant PT. Langgeng Ciptalindo fielded seven people, five engineers and two technicians under the leadership of Pak Rusmanto.

The site visit was commenced with a meeting between the PCI management and team, representatives from EBTKE and the auditing team. At the meeting, information was given about PCI as well as the EBTKE and DEA cooperation and the objective of the audit.

The auditing started with a line walk for understanding the process and get an overview. During the audit information was gathered from PCI, data was taken from meters and measurements was conducted when needed. Every morning and evening a status meeting was held with the PCI team to coordinate the next steps. The site visit was concluded with a common recapitulation.

1.6 Overall findings

1.6.1 Specific energy consumption

Papandayan Cocoa Industries – Bandung Plant plant is lolated in 84 site and Mengger site. The cocoa process flow chart is show in Appendix A, that comprises of main processes ie: Deodorizer, Press, Alkalizer and Roaster, Grinder and Refiner, and Powder.

Total energy distribution for the plant based on Year 2022 is shown in Table 2. By relating the total energy consumption with the ton production, the specific energy consumption is found. Therefore, specific energy consumption (SEC) is shown in Table 2 based on 2022, while Table 3 shows SEC in the last 2 years. During Jan-July 2023, SEC was reduce a little bit against 2022. This indicates that there is improvement implemented in 2023 through energy conservation programme. Total energy consumption of PT PCI is 70,775 MWh or 6,086 ton oil equivalent (TOE) that is mandatory to implement energy management at 4000 TOE above refered to Government Regulation Number 33 Year 2023.

Table 2. Total Energy Distribution in 2022

Remarks	Total Energy (MWh)
Electricity	26,155
Thermal (Natural Gas)	44,620
Total	70,775

Total energy distribution for the plant based on Year 2022 is shown in Table 3. Total accumulation of SEC in year 2022 was found to be 0,38 MWh/ton production. This SEC can be analysed further in the future using Energy Performance Indicator (EnPI) to get better view in how EnPI is a function of production volume only or other variables such as utility performance and etc.

Table 3. Specific energy consumption SEC

Year	Total Energy (MWh)	Total Production (Ton)	SEC (MWh/Ton)
2022	70,775	185,781	0.38
2023 (Jan-July)	51,449	144,102	0.32

**) Total Energy is sum of electricity and thermal energy*

1.6.2 Energy saving potential

The energy savings are assessed in relation to Best Available Technology (BAT) and will therefore also include savings that are not financially profitable with current energy prices, but which may become so in the future.

The subsequent energy saving proposals are based on estimations. As an example, the energy efficiency for all motors compared with the BAT motor with the same rated power and a standardised investment per motor has been used. The feasibility of a replacement shall be examined with the actual conditions of the individual motor. In case of replacement due to break down it is always advisable to substitute with a motor according to BAT as motors have a long lifetime.

Thermal energy

Saving potential for thermal energy from boiler delivered into the plant are included in the Table 4.

Electricity

Saving potential for electricity consumption delivered into plant is included in the Table 5.

Table 4. Thermal energy distribution to production line and saving potential

THERMAL ENERGY	Estimated Consump-tion, MWh	Share of consump-tion, %	Saving potential, MWh	Estimated CO2-emission reduction, ton	Estimated Investment, mill. IDR	Estimated payback period, years
Gas User						
Gas Steam Boiler BOSCH (TDS control system)	20,716	46,4	306	55	250	1.6
Gas Steam Boiler LOOS (Economiser to preheat water make up) *Electronic burner control system*	6,122	13,7	599 218	109 40	950 600	2.5 4.4
Gas Roaster *Air Preheater + New High Thermal Burner Control System* *Economiser to generate hot water system*	17,782	39,9	- 323 2,012	- 58 583	- 3,000 4,800	- 15.0 4.4
IN TOTAL	**44,620**	**100**				
Demand Side (Steam User) with boiler efficiency at 82.4%						
Hot Water Generator Heat Pump	1,447	6.5	965	173	3,000	3.3
Remelter	1,879	8.5	-	-	-	-
Alkaliser	7,152	32.3	-	-	-	-
Level Control System Tank	2,732	12,4	-	-	-	-
Press	1,214	5,5	-	-	-	-
Steam Injection Deaerator	603	2.7	-	-	-	-
Deodorizer	437	29.7	-	-	-	-
Running Load	79	2.0	-	-	-	-
Leak Trap	6,572	0.4	81	14	110	1.6
IN TOTAL	**22,115**	**100**				
Compressor DSDX140 (heat recovery as preheating hot water)			134	23	300	4.1

THERMAL ENERGY	Estimated Consump-tion, MWh	Share of consump-tion, %	Saving potential, MWh	Estimated CO2-emission reduction, ton	Estimated Investment, mill. IDR	Estimated payback period, years
Compressor DSDX160 (heat recovery as preheating hot water)			162	28	350	3.9
TOTAL SAVINGS			**4,800**	**1,083**	**13,360**	**4,3**

Table 5. Electricity distribution to production line and saving potential

ELECTRIC ENERGY	Estimated Consump-tion, MWh	Share of consump-tion, %	Saving potential, MWh	Estimated CO2-emission reduction, ton	Estimated Investment, mill. IDR	Estimate d payback period, years
Main Distribution Panel Line A	**6,328**	**24.19**	-	-	-	-
Compressor 140	648	2.48				
Compressor 160	676	2.59				
Compressor 160 (supply side controller)	676	2.59	54	48	200	2.8
Compressor AC 75 (demand side controller)	1,176	4.50	137	122	367	2.1
RTAC 350	1,450	5.54	658	537	No cost	-
Pulverizer A	93	0.36	-	-	-	-
Pulverizer B	2	0.01	-	-	-	-
Press B	1,057	4.04	-	-	-	-
Deoderiser	673	2.57	-	-	-	-
Lighting A	363	1.39	-	-	-	-
Lighting D	188	0.72	-	-	-	-
Main Distribution Panel Line B	**3,833**	**14.65**	-	-	-	-
Refiner 15 & 16 dan BB 5	1,043	3.99	-	-	-	-
Alkaliser F	2	0.01	-	-	-	-
Alkaliser Roaster C	257	0.9	-	-	-	-
Pre Grinder & Roaster C	696	2.6	-	-	-	-
Pre Grinder 6 & 7	1,251	4.7	-	-	-	-
Utillity Upstream	240	0.9	-	-	-	-
Roaster F	343	1.3	-	-	-	-
Main Distribution Panel Line C	**5,522**	**21.1**	-	-	-	-
Grinder & Refiner E	594	2.2	-	-	-	-
Chiller A Pump Butter	2,169	8.2	77	68	200	2.2
Alkaliser & Roaster D	223	0.8	-	-	-	-
Alkaliser & Roaster E	295	1.1	-	-	-	-
Grinder & Refiner D	572	2.1	-	-	-	-
Alkaliser & Roaster B	90	0.3	-	-	-	-
Alkaliser & Roaster A	194	0.7	-	-	-	-
Grinder & Refiner A/B (Motors)	1,385	5.3	566	461	2,402	3.6
Main Distribution Panel Line D	**4,519**	**17.2**	-	-	-	-
Brain Chiller / Chiller 185	1,741	6.6	-	-	-	-
Brain Chiller Pump	581	2.2	39	34	119	2.6
ACM & Blower	2,197	8.4	-	-	-	-

Main Distribution Panel Line E	**3,301**	**22.7**	-	-	-	-
Chiller RTAC 300	1,029	7.8	599	488	No cost	-
Chiller RTAC 350 (pump)	1,029	3.9	91	81	244	2.3
Chiller RTAC 375 (pump)	1,243	4.7	91	81	244	2.3
Others	**2,653**	10.1	-	-	-	-
Trafo			71	63	500	5.4
Raw Water Pump			60	53	75	1.0
Transfer Pump			70	62	90	1.1
IN TOTAL	**26,155**	**100**	**2,513**	**2,098**	**4,441**	**1.4**

1.7 Electrification and renewable energy

1.7.1 Present situation

Currently, PCI has used 100% electricity from the PLN grid, while thermal energy resource is coming from compressed natural gas (CNG). The use of electricity reached 37% of total energy demand of the plant, while CNG was 63%. Electricity is used for main equipment of production line from raw material to packaging, utilities, and lighting, while CNG is used for steam generation of boiler at 6-7 barg and 12 barg distributed to processing lines and for Roasting processing line.

1.8 Electrification of the processes

All thermal energy consumption is allocated mainly for 2 unit of gas boiler 8 ton per hour (TPH) at 6 barg and 2.6 TPH at 10,5 barg as well as roaster. are running while 5 TPH at 6 barg standby. Steam users are mainly for hot water generator, deodorizer, press, roasting and etc. The hot water generation of each processes were operated at temperature of 70 - 90 oC, while cooling or chilled water is generated from chiller or cooling tower. To replace the use of steam as heating medium and chilled water as cooling medium, heat pump can be introduced in which it can produce hot and chilled water simultaneously with single electric energy source. The hot product is cooled by the evaporator of the heat pump while the cold raw material is heated by the condenser of the heat pump. The measured COP of the heat pump is ranged from 2.3 to 3.1.Today commercial heat pumps can deliver at 90 oC output on the hot side, but different vendors have heat pumps that can deliver 120 oC or more in operation in industrial applications. It will be reasonable to assume that the entire thermal energy demand in the hot water generation process can be covered by heat pumps in the future.

1.9 Different ways of electrification

Currenty PT PCI is still using CNG as fossil fuel to generate steam at their boiler and for roasting processing line. To achieve net zero emission, electrification of gas boiler can be proposed since PCI will upgrade later to non-fossil power generation by using Renewable Energy Certificate (REC) issued by PLN (state electricity provider). Therefore, in this case, electrodes boiler can be considered instead of gas boiler. However, cost of steam using electrodes boiler will be approximately double againts gas boiler due to double energy cost. To compensate on increasing energy bill in case of using electrodes steam boiler applied, it can be explored to do further steps such as follows:

- energy conservation program such as steam and heat distribution losses reduction, steam trap monitoring, and etc to reduce steam system losses,
- conversion from steam used hot water generator to commercial heat pump hot water generator.
- heat recovery of screw-compressor to preheat make up water boiler or generate hot water process
- installation of solar PV panels with supply from the grid to further reduce the overall electrical consumption per annum.

For that, it is required further feasible study on boiler conversion from current gas boiler to electric steam boiler.