BACHELOR THESIS & COLLOQUIUM – ME141502

# *STUDY ANALYSIS OF ENERGY MANAGEMENT FOR PRODUCTION IN SHIPYARD USING ISO 50001 STANDARDS*

MUHAMAD AMIN SENTOSA
NRP. 04211441000009

SUPERVISOR :
Ir. Amiadji, M.Sc.
Irfan Syarif Arief,ST., M.T

DOUBLE DEGREE PROGRAM
DEPARTMENT OF MARINE ENGINEERING
FACULTY OF MARINE TECHNOLOGY
INSTITUT TEKNOLOGI SEPULUH NOPEMBER
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**SKRIPSI – ME 141502**

# STUDI ANALISA SISTEM MANAGEMEN ENERGI PADA PRODUKSI DI GALANGAN KAPAL MENGGUNAKAN STANDAR ISO 50001

**Muhamad Amin Sentosa**

**NRP. 04211441000009**

DOSEN PEMBIMBING :

**Ir. Amiadji, M.Sc.**

**Irfan Syarif Arief,ST., M.T**

PROGRAM DOUBLE DEGREE

DEPARTEMEN TEKNIK SISTEM PERKAPALAN

FAKULTAS TEKNOLOGI KELAUTAN

INSTITUT TEKNOLOGI SEPULUH NOPEMBER

SURABAYA

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**APPROVAL FORM**

**STUDY ANALYSIS OF ENERGY MANAGEMENT FOR PRODUCTION IN SHIPYARD USING ISO 50001 STANDARDS**

**BACHELOR THESIS**

Submitted to Comply One of The Requirement to Obtain a Bachelor Engineering Degree
on
Marine Manufacturing and Design (MMD)
Bachelor Program Department of Marine Engineering
Faculty of Marine Technology
Institut Teknologi Sepuluh Nopember

Prepare by :
**MUHAMAD AMIN SENTOSA**
NRP. 04211441000009

Approved by Supervisor :

Ir. Amiadji, M.Sc. ( )
Irfan Syarif Arief,ST., M.T ( )

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Prepare by :
**MUHAMAD AMIN SENTOSA**
NRP. 04211441000009

Approved by
Head of Department of Marine Engineering

Dr. Eng. M. Badrus Zaman., ST., MT.
NIP. 197708022008011007

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Prepare by :
**MUHAMAD AMIN SENTOSA**
NRP. 04211441000009

Approved by
Representative of Hochschule Wismar in Indonesia

Dr.-Ing. Wolfgang Busse

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## DECLARATION OF HONOR

I hereby who signed below declare that :

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|---|---|
| Name | : Muhamad Amin Sentosa |
| NRP | : 04211441000009 |
| Bachelor Thesis Title | : Study Analysis of Energy Management for Production in Shipyard using ISO 50001 Standards |
| Department | : Marine Engineering |

If there is plagiarism act in the future, I will fully responsible and receive the penalty given by ITS according to the regulation applied.

Surabaya, July 2018

Muhamad Amin Sentosa

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**Study Analysis of Energy Management for Production in Shipyard using ISO 50001 Standards**


| | |
|---|---|
| Name | : Muhamad Amin Sentosa |
| NRP | : 04211441000009 |
| Department | : Marine Engineering |
| Supervisor I | : Ir. Amiadji, M.Sc. |
| Supervisor II | : Irfan Syarif Arief,ST., M.T |


## ABSTRACT


With technology became more and more advance each and every year. The demand for energy in industrial sector became higher than before. Because of the constantly growing energy prices, increased awareness of environmental issues, and linked political demands energy management has begun to be a factor of success and profit. The industry sector was responsible for approximately 37% of the world's energy consumption in 2006. In Indonesia industrial sector roughly uses 31% of energy that produce by PT.PLN (Persero)

shipyard is one of industrial sector that very needed of electrical consumption. All the process in shipyard that need electrical source are supplied by PT Perusahaan Listrik Negara (PLN). Thus, every shipyard needs to be applying ISO 50001 about Energy Management System. But many of the shipyard in Indonesia currently only applying ISO 9001 about QMS (Quality Management System), ISO 18001 about Occupational Health and Safety Management System, and ISO 14001 about EMS (Environmental Management System).

Using ISO 50001 as a standard and using another standard such as SNI and *Peraturan* pemerintah. According to Data the ECI of PT. ASSI Office Building is 251.35 kWh/m$^2$ per year, that value is still far from the ideal ECI in Indonesia. According to ASEAN-USAID for commercial purposed building is 240kWh/m$^2$. Final Value of OTTV is 48.685 W/m$^2$. while the Standard SNI for OTTV is SNI 03-6389-2011 35 W/m$^2$. So the OTTV did not fulfill the SNI standard Some changes to electrical component may have save some change making. ECI of PT. ASSI office building is lowered by 8.3% which mean the new ECI of PT. ASSI is 230.278 kWh/m$^2$ per year..



Keyword : Energy, Audit Energy, Management Energy, ISO 50001, Shipyard

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**Analisa Studi Manageent Energi untuk Proses Produksi pada Galangan Kapal Menggunakan Standart ISO 50001**

Nama : Muhamad Amin Sentosa
NRP : 04211441000009
Jurusan : Marine Engineering
Dosen Pembimbing I : Ir. Amiadji, M.Sc.
Dosen Pembimbing II : Irfan Syarif Arief, ST., M.T

## ABSTRAK

Dengan teknologi menjadi lebih dan lebih maju setiap tahun. Kebutuhan energi di sektor industri menjadi lebih tinggi dari sebelumnya. Karena harga energi yang terus bertumbuh, peningkatan kesadaran akan masalah lingkungan, dan tuntutan politik yang terkait, manajemen energi telah mulai menjadi faktor keberhasilan dan keuntungan. Sektor industri bertanggung jawab untuk sekitar 37% dari konsumsi energi dunia pada tahun 2006. Di Indonesia sektor industri secara kasar menggunakan 31% energi yang diproduksi oleh PT.PLN (Persero)

Galangan kapal merupakan salah satu sektor industri yang sangat membutuhkan konsumsi listrik. Semua proses produksi yang dilakukan di galangan membutuhkan sumber listrik dipasok oleh PT Perusahaan Listrik Negara (PLN). Dengan demikian, setiap galangan perlu menerapkan ISO 50001 tentang Sistem Manajemen Energi. Tetapi banyak galangan kapal di Indonesia saat ini hanya menerapkan ISO 9001 tentang QMS (Sistem Manajemen Mutu), ISO 18001 tentang Sistem Manajemen Kesehatan dan Keselamatan Kerja, dan ISO 14001 tentang EMS (Sistem Manajemen Lingkungan).

Dengan menggunakan ISO 50001 sebagai standart dan menggunakan standart lainnya sebagai bahan bantu. Menurut Data ECI dari gedung perkantoran PT. ASSI adalah 251,35 kWh/m$^2$ per tahun, nilai tersebut masih jauh dari ECI ideal di Indonesia. Menurut ASEAN-USAID untuk bangunan tujuan komersial adalah 240kWh/m$^2$. Nilai Akhir OTTV adalah 48.685 W/m$^2$. sedangkan SNI Standar untuk OTTV adalah SNI 03-6389-2011 35 W/m$^2$. Jadi OTTV tidak memenuhi standar SNI. Beberapa perubahan pada komponen listrik mungkin menyimpan perubahan. ECI PT. Gedung kantor ASSI diturunkan sebesar 8,3% yang berarti ECI baru PT. ASSI adalah 230.278 kWh/m$^2$ per tahun..

Keyword : Energy, Audit Energy, Management Energy, ISO 50001, Shipyard

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# PREFACE

Grateful to Allah SWT because of His grace, author can finish this bachelor thesis with the title "**Study Analysis of Energy Management for Production in Shipyard using ISO 50001 Standards**" in order to comply the requirement of obtaining a Bachelor Engineering Degree on Department of Marine Engineering, Faculty of Marine Technology, Institut Teknologi Sepuluh Nopember.

The author realizes that this writing can not be solved without the support of various parties both morally and materially. Therefore, the authors would like to express their gratitude to all those who have helped in the preparation of this bachelor thesis especially to :

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The author realizes that this bachelor thesis remains far away from perfect. Therefore, Finally, may Allah SWT bestow His grace, contentment and blessings to all of us. Hopefully, this bachelor thesis can be advantageous for all of us particularly for the readers.

Surabaya, 17 July 2018

Author

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# CHAPTER I
# INTRODUCTION

## 1.1. Background

With technology became more and more advance each and every year. The demand for energy in industrial sector became higher than before. Because of the constantly growing energy prices, increased awareness of environmental issues, and linked political demands energy management has begun to be a factor of success and profit. The industry sector was responsible for approximately 37% of the world's energy consumption in 2006[1]. In Indonesia industrial sector roughly uses 31% of energy that produce by PT.PLN (Persero) as shown in **Table 1.** below.

*Table 1 PLN Electrical Supply 2011-2015*

| Years | Households | | Industry | |
|---|---|---|---|---|
| | MWh | Customer | MWh | Customer |
| 2011 | 65.111.571,80 | 42.577.542 | 54.725.821,64 | 50.365 |
| 2012 | 72.132.538,78 | 46.219.780 | 60.175.960,38 | 52.661 |
| 2013 | 77.210.709,47 | 50.116.127 | 64.381.395,29 | 55.546 |
| 2014 | 84.086.464,74 | 53.309.325 | 65.908.675,67 | 58.350 |
| 2015 | 88.682.130,00 | 56.605.260 | 64.079.390,00 | 63.314 |

| Years | Commercial | | Public | |
|---|---|---|---|---|
| | MWh | Customer | MWh | Customer |
| 2011 | 28.307.207,83 | 2.049.361 | 9.848.059,19 | 1.217.877 |
| 2012 | 30.988.636,57 | 2.218.342 | 10.693.609,93 | 1.304.466 |
| 2013 | 34.498.384,97 | 2.418.431 | 11.450.528,66 | 1.406.104 |
| 2014 | 36.282.421,51 | 2.626.160 | 12.324.213,70 | 1.499.399 |
| 2015 | 36.978.050,00 | 2.894.990 | 13.106.250,00 | 1.604.416 |

| Years | Total | |
|---|---|---|
| | MWh | Customer |
| 2011 | 157.992.660,46 | 45.895.145 |

1 Hu. S, Liu F, He Y, Hu T. An on-line approach for energy efficiency monitoring of machine tools pg. 133-140. 2012

| | | |
|---|---|---|
| 2012 | 173.990.745,67 | 49.795.249 |
| 2013 | 187.541.018,39 | 53.996.208 |
| 2014 | 198.601.775,62 | 57.493.234 |
| 2015 | 202.845.820,00 | 61.167.980 |

Another problem that became an issues lately is renewable energy for electrical source. Because renewable energy power plant is not a based-load power plant like conventional power plant such as coal or natural gas power plant that use combustion process to produce electricity. The output of electricity is very dependent from the weather. Indonesian government already build around 600 units of renewable energy power plant that cost Rp 3,01 Trillion[2]. But Indonesia currently still using fix price for electrical energy is not big issues for energy management.

Because Indonesia is an archipelago country one of Indonesia biggest industry is the maritime sector. One of main business in maritime sector is ship-repair and ship-building. According to *Kementiran Perindustrian* Indonesia has 250 active shipyards that spread all around nationwide[3]. In **Figure 1.1** is shown that majority of Indonesian shipyard is in Java Island with 92 shipyards.

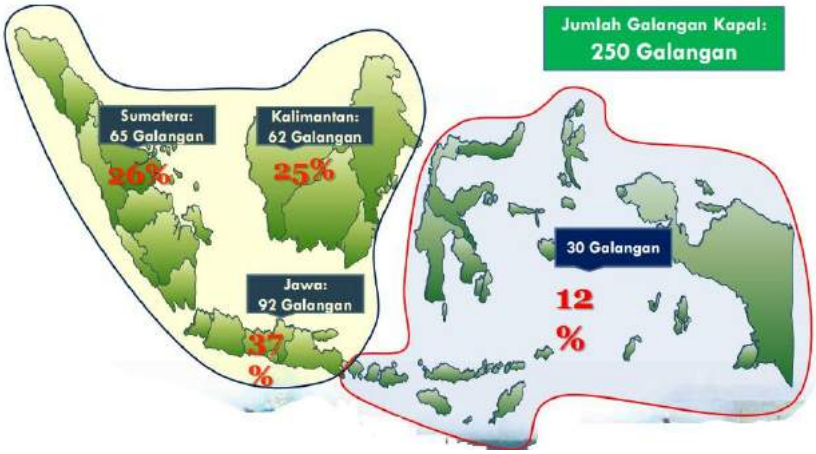


*Figure 1 Percentage Distribution of National Shipyard*

Shipyard contains some facilities to facilitate the ship production process. Many of the production used by the majority uses electricity

2 Tribun News. Penjelasan Dirjen EBTKE Mengenai Isu Pembangunan Pembangkit Energi Terbarukan. 18 December 2017

3 Widarto, Edy. Industri Galangan Kapal Nasional Dalam Mendukung Program Tol Laut. 09 August 2017

as the energy source. Such as welding machines, cranes, bending machines, and many more are examples of tools production using electricity power. And also computer as media design and production planning, therefore electricity plays a major role in production runs in the shipping industry.

That's why shipyard is one of industrial sector that very needed of electrical consumption. All the process in shipyard that need electrical source are supplied by PT Perusahaan Listrik Negara (PLN). Thus, every shipyard needs to be applying ISO 50001 about Energy Management System. But many of the shipyard in Indonesia currently only applying ISO 9001 about QMS (Quality Management System), ISO 18001 about Occupational Health and Safety Management System, and ISO 14001 about EMS (Environmental Management System).

PT. Adiluhung Saranasegara Indonesia (ASSI) is one of Shipyard that located in Madura Island, Jawa timur. As one of shipyard that fully supported government "*TOL LAUT"* program, PT. ASSI has all the facility that support its business. Almost all of their production work is using electricity powered equipment. But like another shipyard PT. ASSI still did not comply any standart for their energy management. PT. ASSI only comply ISO 9001, ISO 14001, and OHSAS 18001 as their management standard. Therefore, government already stated in PP no. 70 tahun 2009, every industry that used 6000 ToE/year must have some kind of energy management system. One of energy management system is ISO 50001.

To achieve company that fulfil ISO 50001 than it need to do some energy management program. In this research writer shall apply Energy audit that conduct the energy review and establish the baseline, energy performance indicators (EnPIs), objectives, targets and action plans necessary to deliver results in accordance with opportunities to improve energy performance and the organization's energy policy.

## 1.2. Problems

Based on the Background that stated above, it can be concluded some problems of this bachelor thesis are:

a. What components or equipment that caused PT. Adiluhung Sarasegara Indonesia needed big electrical power source?
b. How much production cost that can be saved from electrical consumption if PT. Adiluhung Sarasegara Indonesia applied ISO

50001 and using EnPI (Energy Performance Indicator) as one of their KPI (Key Performance Indicator)

## 1.3. Limitations

This bachelor thesis can be focused and organized, with limitation on the problems which are:

**a.** In this research all of energy audit done by using ISO 50001 and any standards that supporting ISO 50001

**b.** Research object focus only PT. Adiluhung Sarasegara Indonesia production process per section area.

**c.** Data of electricity consumption are taken within 4 years (during 2014-2018)

## 1.4. Objectives

Based on problems mention above, the objectives of this bachelor thesis are:

a. To identify components or equipment that causing PT. Adiluhung Sarasegara Indonesia need big electrical power source in production process.

b. To know how much company can get profit from saving electrical consumption by applying ISO 50001.

## 1.5. Benefits

This final project is expected to give benefits for the various kind of parties. The benefits that can be obtained are:

**a.** Provides information about the components are causing big power consumption in production process

**b.** Provides information about energy management to save cost in production and benefits from applying ISO 50001.

# CHAPTER II
# STUDY LITERATURE

## 2.1. Energy Management in Production

Energy Management can be interpret as managing process that focus on planning and operation of energy production and energy consumption units. And according to VDI-Guidelines 4602 (*Verein Deutscher Ingenieure*) (English: Association of German Engineers) Energy management is the proactive, organized and systematic coordination of procurement, conversion, distribution and use of energy to meet the requirements, taking into account environmental and economic objectives.

Production is the act of creating output, a good or service which has value and contributes to the utility of individuals. This central process may differ depending on the industry. Industrial companies have facilities that require a lot of energy. Service companies, in turn, do not need many materials, their energy-related focus is mainly facility management or office. Therefore, the energy-related focus has to be identified first, then evaluated and optimize.

And for supporting energy management system a company need to do some energy audit. Energy audit according to *Keputusan Presiden* no.43 *tahun* 1991 about Energy Conservation is some kind of activity for identify potential energy saving and determine cost that can be saved from available system, tools, and equipment[4]. And according to (Wilhasen, 2012) audit energy can be categorized by 3 type:

a. Walk through audit
   Walk through audit is the simplest energy audit, because it only focus on the main component only
b. Preliminary audit
   Preliminary audit done for obtaining general information about energy usage pattern, doing benchmark, and roughly identify saving potential also compile early recommendation for simple improvement. And output from preliminary audit can be base for detail audit
   Preliminary audit uses secondary data and questioner for background for doing evaluation of energy usage. And preliminary audit also does some measurement for verification

4 Keputusan Presiden 43/1991

some data that considered not rational. Time for preliminary audit is around 1-2 weeks.

c. Detail audit

Detail audit done for investigate more details about which part that waste energy more and doing analysis for energy saving opportunity that can be do more specific. And recommendation for follow up that can be done to overcome that.

In this audit all the measurement done more specifically as background for do more details evaluation. The interview done by asking the staff that responsible to the equipment. This audit need at least 1-2 months to finish.

In this bachelor thesis the audit which is conducted for the study analysis material is Detail audit. Part that being audit is production unit of shipyard. Usually, production is the area with the largest energy consumption within an organization. Therefore, also the production planning and control becomes very important. It deals with the operational, temporal, quantitative and spatial planning, control and management of all processes that are necessary in the production of goods and commodities. The "production planner" should plan the production processes so that they operate in an energy efficient way. For example, strong power consumer can be moved into the night time. Peaks should be avoided for the benefit of a unified load profile. All of energy management system that need to be applied in production are stated in ISO 50001.

### 2.1.1. ISO 50001 Energy Management Systems

ISO 50001 is the latest energy management standard which is a successor of ANSI/MSE 2000 and EN 16001. The standard guides an organization to develop and implement a policy to identify significant areas of energy consumption and commit to energy reductions. The standard does not require any specific performance criteria similar to any other management system standards published by the ISO. ISO 50001 is based on the management system model of continual improvement also used for other well-known standards such as ISO 9001 or ISO 14001. This makes it easier for organizations to integrate energy management into their overall efforts to improve quality and environmental management. Energy assessments an integral part of the process for complying with the standard.

ISO 50001 specifies requirements applicable to energy use and consumption, including measurement, documentation and reporting,

design and procurement practices for equipment, systems, processes and personnel that contribute to energy performances shown in **Figure 2.** It is applied to all the variables that affect energy performance. This standard provides methodology for continual improvement in energy performance without explicitly specifying any performance criteria that has to be satisfied with respect to energy. This standard is based on Plan-Do-Check-Act (PDCA) continual improvement framework in the context of energy management.

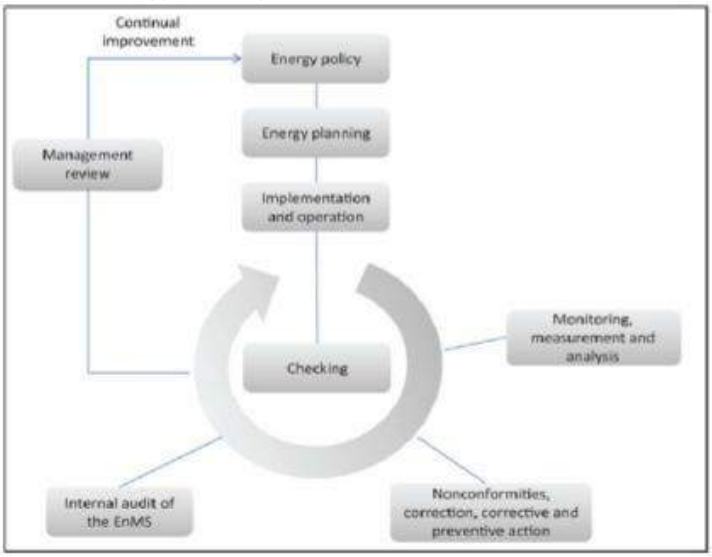


*Figure 2 Energy Management System Model for ISO 50001*[5]

Except ISO 50001 there are some other ISO standards that supporting ISO 50001 have been developed to complete ISO's energy management and energy savings standardization. These include:

- ISO 50002, Energy audits – Requirements with guidance for use
- ISO 50003, Energy management systems – Requirements for bodies providing audit and certification of energy management systems
- ISO 50004, Energy management systems – Guidance for the implementation, maintenance and improvement of an energy management system

5 International Organization for Standardization. Win the Energy Challenge with ISO 50001; 2011. page. 4 http://www.iso.org/iso/iso_50001_energy.pdf.

- ISO 50006, Energy management systems – Measuring energy performance using energy baselines (EnB) and energy performance indicators (EnPI) – General principles and guidance
- ISO 50015, Energy management systems – Measurement and verification of energy performance of organizations – General principles and guidance
- ISO 50047, Energy savings – Determination of energy savings in organizations
- ISO 17741, General technical rules for measurement, calculation and verification of energy savings of projects
- ISO 17742, Energy efficiency and savings calculation for countries, regions and cities
- ISO 17743, Energy savings – Definition of a methodological framework applicable to calculation and reporting on energy savings
- ISO/IEC 13273-1, Energy efficiency and renewable energy sources – Common international terminology – Part 1: Energy efficiency
- ISO/IEC 13273-2, Energy efficiency and renewable energy sources – Common international terminology – Part 2: Renewable energy sources

According to International Organization for Standardization (ISO). Currently ISO 50001 is being reviewed to ensure it's still up to date to market requirements. A revised version of the standard is expected to be published early 2019. In the revised version there are some numbers of standards will be added to supporting ISO 50001:

- ISO 50007, Activities relating to energy services – Guidelines for the assessment and improvement of the service to users
- ISO 50008, Commercial building energy data management for energy performance – Guidance for a systemic data exchange approach
- ISO 50021, General guidelines for selecting energy savings evaluators
- ISO 50044, Energy savings evaluation – Economics and financial evaluation of energy saving projects
- ISO 50045, Technical guidelines for evaluation of energy savings of thermal power plants

- ISO 50046, General quantification methods for ex ante or expected energy savings
- ISO 50049, Calculation methods for energy efficiency and energy consumption variations at country, region and city levels: relation to energy savings and other factors.

Energy that defined in ISO 50001 are Electricity, Fuels, Steam, Heat, Compressed Air, and any other like media. And also energy refers to all various form of energy including renewable energy, which can be purchased, stored, treated, use in equipment or in a production. For doing energy audit and energy management, auditor need energy baseline which is a quantitative reference providing a basis for comparison of energy performance.

## 2.2. Energy Baseline

Energy baseline is quantitative reference providing a basis for comparison of energy performance. Energy baseline can be determined from previous data of the company or from National or International standards. For energy auditing PT. Adiluhung Saranesegara Indonesia is divided into 3 categories. First is Overall Thermal Transfer Value that according to SNI 03-6389-2011 value of OTTV must did not exceed of 35 $W/m^2$. While OTTV is a measure of the energy consumption of a building envelope. Its formulation allows authorized persons, registered structural engineers and other persons responsible for the design and construction of buildings freedom to innovate and vary important envelope components such as type of glazing, window size, external shading to windows, wall color and wall type to meet the maximum OTTV criteria. Any measure to improve energy efficiency or to save energy should be considered in planning a building.

Siting a building to avoid extensive glazed facades with a southerly aspect or introducing shades to window areas can reduce solar heat gain. Appropriate choice of windows with a low thermal transmittance characteristic will also minimize solar heat transmission.

Artificial lighting consumes electricity and creates heat. This increases the cooling load of a building and in turn increases energy consumption. Consequently, when determining the size and location of windows as well as choice of glass in the envelope of a building, efforts should be made to provide as much natural lighting into the building as possible. For example, with glazing, the visible lighting transmittance should be acknowledged in addition to its thermal transmittance

properties; daylight can supplement artificial lighting and consequently reduce the cooling load.

To put it as simply as is OTTV is a value of thermal transfer between the building and the surrounding area. For calculating OTTV value there is some mathematical equation

$$OTTV = \{a \times [U_W \times (I - WWR)] \times T_{Dek}\} + (SC \times WWR \times SF) + (U_f \times WWR \times \Delta T)$$

Where,

| | |
|---|---|
| $a$ | is thermal absorption coefficient |
| $U_W$ | is thermal transmission for non-light penetrating wall (W/m$^2$. K) |
| WWR | is ratio between wall area and window area |
| $T_{Dek}$ | is difference in temp. equivalent (K) |
| SC | is window clarity coefficient |
| SF | is sun radiation factor (W/m$^2$) |
| $U_f$ | is thermal transmission for window (W/m$^2$. K) |
| $\Delta T$ | is temp. difference (K) |

The second baseline is Energy Consumption Intensity (ECI). ECI can also be determine as power needed for every area of the building (kWh/m$^2$). For calculating value of ECI the equation is shown in *Equation 2*.

$$ECI = \frac{\Sigma \text{ Total Energy Consumption}}{\Sigma \, Building \ area} \quad (\text{kWh/m}^2)$$

According to research that already done by ASEAN-USAID the value of ECI is dependent to the purpose of the building. The research is divided type of building by four categories. The categories are shown in Table 2.

*Table 2 Value of ECI depending from building purposes*[6]

| No. | Building Purpose | ECI Value |
|---|---|---|
| 1 | Commercial Purposes | 240 kWh/m$^2$ per year |
| 2 | Shopping Center | 330 kWh/m$^2$ per year |
| 3 | Hotel / Apartment | 300 kWh/m$^2$ per year |
| 4 | Hospital | 380 kWh/m$^2$ per year |

Indonesian government also has a standard for conserving energy. Where the value of ECI is categorize by its efficiency. Every category

[6] ASEAN-USAID, Building Energy Conservation Project, ASEAN-Lawrence Barkeley Laboratory, 1992

has two value of ECI for room with air conditioning or room without one. The categorization is shown in Table 3.

*Table 3 Value Category for ECI according to Department Pendidikan RI 2004*

| Criteria | ECI Value (kWh/m$^2$ per month) | |
|---|---|---|
| | Room with AC | Room Without AC |
| Highly Efficient | 4,17 – 7,92 | 0,84 – 1,67 |
| Efficient | 7,92 – 12,08 | 1,67 – 2,5 |
| Usually Efficient | 12,08 – 14,58 | - |
| Slightly Bad | 14,58 – 19,17 | - |
| Bad | 19.17 – 23,75 | 2,5 – 3,34 |
| Very Bad | 23,75 – 37,75 | 3,34 – 4,17 |

If the ECI value of a non-air-conditioned building is in very efficient criteria, then the building can still be undertaken Efficiency effort that is by applying energy management system. if the criteria is only efficient, then the use of energy is quite efficient but still has an opportunity to make energy savings again, that is by improving efficiency through maintenance on buildings and equipment that require energy. However, if the ECI value of the building has been said to be wasteful, it means that the building is in terms of design and maintenance and its operation has not considered the principle of energy conservation, so it is necessary to do an energy audit to determine the corrective measures so that waste can be avoided. Meanwhile, when the value of ECI has been categorized as very wasteful, it means the installation, maintenance, and operation not refer to the activity of energy saving, so the first step should to do is to conduct an energy audit to review all the installation and / or operating equipment that requires energy, and the implementation of energy management in the operation of the building.

Meanwhile, if the buildings that have been conditioned for temperature and humidity or that have been air-conditioned have ECI values are very efficient, then the building is in accordance with the standard of energy conservation technical planning. When the ECI value is in the range of 7.92 - 12.06kWh/m$^2$ per month or categorized as efficient then the building has maintenance of buildings and equipment that require energy that is in accordance with the procedure. The efficiency of energy use can also be improved by implementing an integrated energy management system. While the value of ECI including the criteria is quite efficient then the use of energy in the building is quite efficient by doing maintenance on buildings and equipment that require energy,

but its operation still not fully consider the principle of energy conservation. If the value of ECI has entered into criteria rather extravagant, then the building must be an energy audit to determine the efficiency improvements that may be made because both the design and maintenance of the building has not considered energy conservation. Meanwhile, if the ECI value of a building has entered the wasteful criteria, then it should also be held an energy audit as consideration of taking corrective measures so that waste can be avoided.

From the ECI value, then it can be assigned the main task of energy management system. If the ECI value isn't efficient enough. So the main task of energy management system is for improving the energy consumption. And from ECI value also can determine if "is the installation, maintenance, and operation already according to ISO 50001 or any other standards?"

And the third and last energy baseline is Energy benchmark for production process. Energy benchmark can be obtained from company previous audit or it can be obtained from international standards. Basically, energy benchmark is ratio between energy input and output product. For example, in shipyards many construction work is using steel or iron the input energy is still in electrical source in this case is kWh. The output product is mass of steel or iron from production line. So the units of steel and iron construction is kWh/Ton of steel. There are another type of energy benchmark for this purpose shown in Table 4.

*Table 4 Energy benchmark data for Shipyard Energy management system*

| No | Product | Output | Units | Standard Benchmark |
|---|---|---|---|---|
| **1** | Steel & Iron | Mass of steel & iron | kWh/ton | 525–715 kWh/ton |
| **2** | Non- Metal Product (Wood) | Mass of Wood | kWh/ton | |
| **3** | Paint | Area of painted area | kWh/m$^2$ | |

If the value from the measurement is greater than the standard benchmark. It need to takes some improvements by doing some adjustment of the installation. If the installation is good enough the improvement can be adjusting by the manpower or the management system.

## 2.3. Energy Management System Checklist

The energy management system checklist is an important instrument for review, either when initiating the EnMS or when close to completing the implementation process. Whether it already implementing ISO 50001 standard or just optimally introduced to ISO 50001.

The checklist includes a series of checkpoint which are formulated as question. If energy management system already implemented correctly almost of the system checklist is "YES". The checklists are consisting of 53 questions. On the left hand side of table is the question and the middle side is yes or no question, and the right hand side is the comments column. As shown as **Table 5.** The full Table shown in **Attachment A**

*Table 5 Example of Energy Management System Checkklist*

| No | Determining Elements | Implementation Yes/No | Comments |
|---|---|---|---|
| A | Management Responsibility | | |
| A1 | Top Management | | |
| 1 | Apakah kebijakan penggunaan energi sudah di ditetapkan dan di implementasikan oleh *Top Management?* | | |
| 2 | Apakah Manager kebijakan energi sudah di tetapkan oleh *Top Management?* | | |
| 3 | Apakah sumber daya yang di perlukan telah tersedia untuk pebentukan dan *maintenance* dari EnMS (Energy Management System)? | | |
| 4 | Apakah ruang lingkup dan batasan EnMS telah di tetapkan? | | |
| 5 | Apakah pentingnya EnMs untuk perusahaan sudah cukup jelas bagi karyawan? | | |
| 6 | Apakah tujuan strategis dan operasional telah ditetapkan? | | |
| 7 | Apakah kinerja energi (hasil yang dapat diukur dengan memperhatikan efisiensi, penggunaan dan konsumsi) telah dipertimbangkan dalam perencanaan jangka panjang? | | |

The comments column is use during the review process. This will help to quickly identify the areas that show an optimal implementation or, if necessary those that need further improvement.

Since ISO 50001 is an Energy management system were substantially developing from ISO 14001 and if a company already ratified ISO 14001 as their management program it's easier to ratified ISO 50001 in the future.

## 2.4. Shipyards

According to Oxford Dictionaries shipyard means an enclosed area of land where ships are built and repaired. The type of ship that being build or repair may various from size and material that being used in building process. Also shipyard (often called a dockyard) is a place where ships are built and repaired. These can be yachts, military vessels, cruise liners or other cargo or passenger ships. Dockyards are sometimes more associated with maintenance and basing activities than shipyards, which are sometimes associated more with initial construction. The terms are routinely used interchangeably, in part because the evolution of dockyards and shipyards has often caused them to change or merge roles.

Shipyards are constructed nearby the sea or tidal rivers to allow easy access for their ships. The site of a large shipyard will contain many specialized cranes, dry docks, slipways, dust-free warehouses, painting facilities and extremely large areas for fabrication of the ships. After a ship's useful life is over, it makes its final voyage to a shipbreaking yard, often on a beach in South Asia. Historically shipbreaking was carried on in dry-dock in developed countries, but high wages and environmental regulations have resulted in movement of the industry to developing regions.

In shipyard construction of the vessel is based on order / make to order as per certain specifications from customer. Construction of the ship is not done in bulk because the owner will provide certain specifications due the needs of the owner.

The shipbuilding process is a complex interaction among the shipyard organization, owner, partners, suppliers, class and authorities. The ship is in most cases a one-off product and is handled as a distinct project. The processes are recognizable, but vary slightly from shipyard to shipyard and based on the ship type involved.

Usually the shipbuilding process is described against the timeline of the actual building process. The main milestones are:

- Investment decision
- Contract date
- Start of manufacturing
- Keel laying
- Launching
- Delivery

While in shipbuilding process there are many stakes holder that contribute in that process. The amount of exchanged information varies naturally as the building of the ship advances, but communication between the yard and all the other parties is ongoing. The active parties in this process are:

- The owner
- The shipyard
- The classification society
- National authorities
- Consulting and engineering offices
- Equipment suppliers
- Subcontractors

The shipyard management must have access to the information necessary to make the right decisions. Good planning and an efficient ERP system should give the management the decision-making tools it needs. Once the ship contract has been made based on the developed master schedule, shipyard management has few additional opportunities to influence the success of the project. Therefore, a good planning organization and planning tools are even more important than top management. Even mediocre managers can run a successful business with good support, but even top managers are lost if the information they work from is wrong or misleading. A series of bad decisions can often cloud the original starting point, causing one to lose sight of the last valid point of reference. Unfortunately, when the original starting point is lost, and a new, revised plan is taken as a new starting point.

Usually, the shipyard handles a newbuilding as a project. This means setting up a full project organization, supported by the line organization. The project manager and his project team are in charge of the project. The project manager, who generally reports to the managing director, should have considerable decision power inside the project. The reality in a matrixed organization, however, is that the line managers will not necessarily concur with the priorities of the project manager, especially if several projects are running simultaneously. Generally, the project manager should be aware of all communication with the owner and authorities so that he can accommodate any change in the project.

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# CHAPTER III
## METHODOLOGY

The following methodology flowchart shows the process diagram of bachelor thesis.

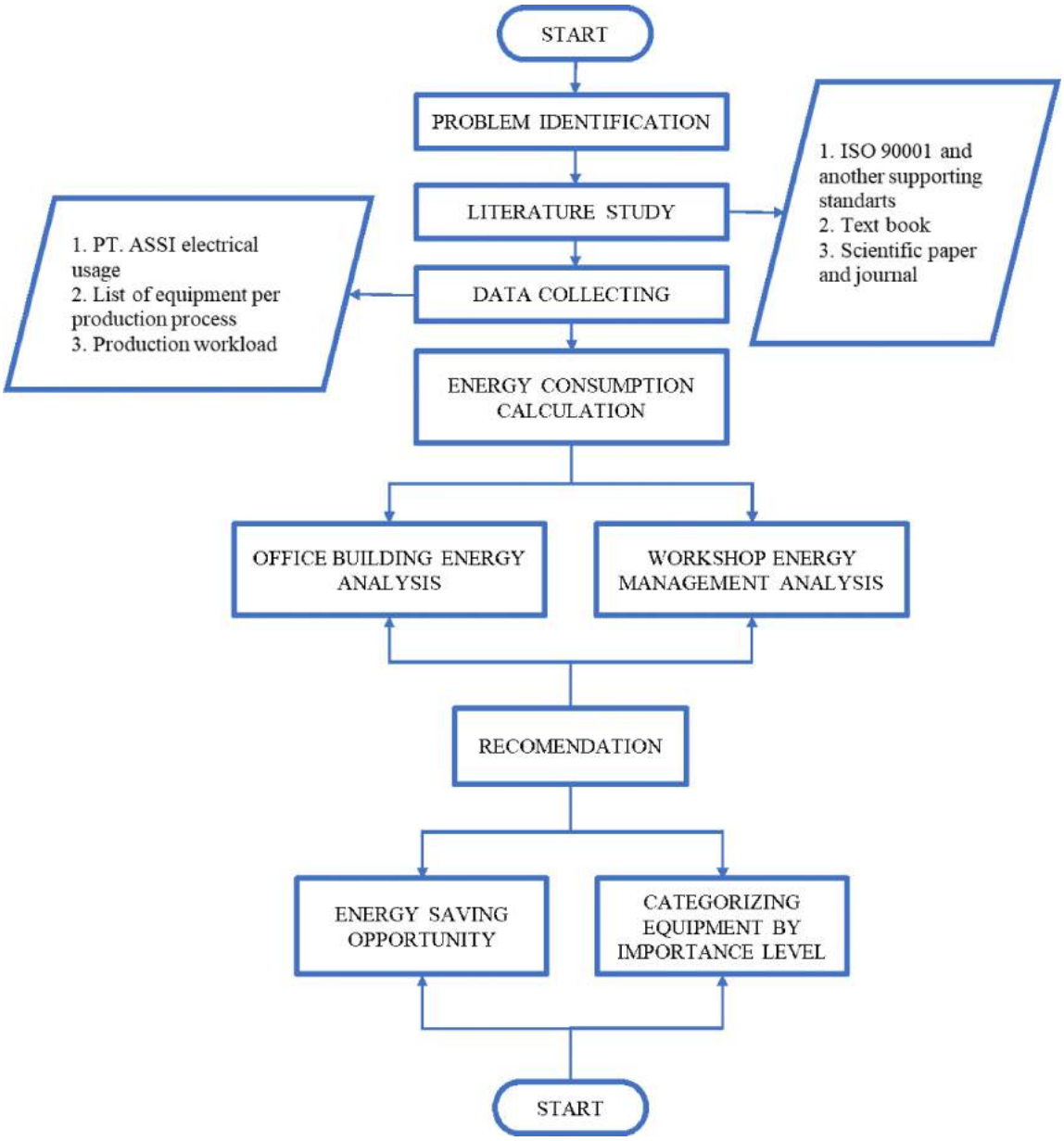


*Figure 3 Bachelor Thesis Methodology Flow Chart*

## 3.1. Problem Identification

The first step of writing bachelor thesis is started by problem identification, while conducting problem identification author use question method to determine the direction of the bachelor thesis. The topic of this bachelor theses start from the needed of electrical power in every part of manufacturing and production in shipyards. Most of shipyard spend many of their yearly spending in electrical. Therefore, it is necessarily to do study analysis of energy management to optimize the work of shipyards

## 3.2. Literatures Study

Literatures of bachelor thesis mostly taken from ISO 50001 and many other textbooks and paper for standard that being used in energy management system. In addition, it can also be discussing with competent person in this field of work. Theories needed are:

1. ISO 50001 and another supporting standard (I.e ISO 50004, ISO 17741, *Peraturan pemerintah, Keputusan Presiden)*
2. Energy-related audit

## 3.3. Data Collecting

At this step, author will collect data that related to Energy consumption in PT. Adiluhung Saranasegara Indonesia. The required data are:

1. PT. ASSI Electrical Usage
2. List of Equipment for Production Process
3. Production Workload

Except the data that can be obtain from the paper work such as data stated above. Data collecting also needed some manual data collecting such as collecting data about Lux from the lamp using lux meter as shown as **figure 4.**


*Figure 4 Lux Meter for measuring light intensity from lamp*

Beside measuring Lux another measurement that needed to be taken are current of some of equipment that aren't constantly work. So it need to be measured using clamp multi meter as shown in **figure 5.** the value of measured current are used to determine how much power the equipment consume per workload.


*Figure 5 Digital Clamp Multi Meter*

For collecting electrical consumption data in PT. ASSI it needed to be time schedule for a long period of time. The schedule for data collecting in PT. ASSI is shown in **Attachment C.**

With all the explanations above the data that obtained during this bachelor thesis process are shown as below:

3.31. Building Data

a. Company Profile

PT. ASSI is shipyard Company that focus in shipbuilding, ship repair, docking and maintenance. As a shipyard PT. ASSI is one of the company that fully supported government "*TOL LAUT"* program. Because of that PT. ASSI uses a lot energy for their business process in office or in the field. The office and workshop that being object to this bachelor thesis is located in Jl. Raya Kabupaten, Desa Ujung Piring, Bangkalan, Madura, Jawa Timur,

b. Office Building View

*Figure 6 PT. ASSI Front View*

*Figure 7 PT. ASSI Side View*

c. Office Building Dimension and Material

Office building of PT. ASSI is facing to south direction. And also the office building has two floors. And it has the dimension of 44.2 meter Of width, 10.5 meter of length, and for floor to floor is 3 meter.

PT. ASSI office's building is constructed using brick that has heat absorptance value of 0.89 and painted that has heat absorptance value of 0,88. So the total of heat absorptance that the building has is 0.885. For office building windows it uses clear coated glass, and for value of other material that being uses for the office building as shown as below:

- Transmittance of Brick wall, $U_w$ =3.34 W/m$^2$.K
- Transmittance of Glass, $U_f$ = 2.89 W/m$^2$.K
- Outdoor – Indoor equivalent temperature difference for heavyweight walls, $T_{Dek}$ = 11K
- Shading Coefficient SC = 0.64
- Sun radiation factor (SF), is depending on the point of compass that it faces. SF can be seen in **Table 6**. Below:

*Table 6 Sun Radiation Factor*

| Utara | Timur Laut | Timur | Tenggara | Selatan | Barat Daya | Barat | Barat Laut |
|---|---|---|---|---|---|---|---|
| 243 | 169 | 100 | 108 | 112 | 127 | 154 | 181 |

3.32. Building Comfort Profile

After general data about building physical data, next is building comfort profile. Comfort profile of a building can be divided by 3 categories. First is Light Intensity, second is temperature for each room and last is humidity for each and every room.

a. Light Intensity

Light Intensity data are obtaining by doing some measurement using lux meter that shown in **Figure 5.** a measurement equipment that used is for determine the natural light intensity in each and every room**.** In this measurement each room are measured for Main Measured Point (MMP) and Side Measured Point (SMP). The measurement technique is being regulated by SNI. The value of light intensity measured is shown in **Table 7**

*Table 7 Light intensity in office building*

| No | Room | Lux Metered |
|---|---|---|
| 1 | VVIP Room | 276 |
| 2 | QA/QC Room | 132 |
| 3 | HR Room | 184 |
| 4 | Engineering & Marketing Room | 205 |
| 5 | Maintenance Room | 121 |
| 6 | Marketing Room | 113 |
| 7 | finance room | 418 |

| No | Room | Lux Metered |
|---|---|---|
| 8 | VIP Meeting Room | 112 |
| 9 | Meeting Room | 108 |
| 10 | Medical room | 88 |
| 12 | Toilet VIP A | 473 |
| 13 | Toilet VIP B | 289 |
| 14 | Toilet VIP C | 263 |
| 15 | VIP Prayer Room | 318 |
| 16 | Hall | 87 |
| 17 | Lobby | 63 |

b. Temperature and Humidity

From the field survey about PT. ASSI Air Conditioning system. PT.ASSI uses split Air Conditioner for each and every room. In average in each room have two air conditioner. And because the location of PT. ASSI which is in the beach/nearby sea. The ambient temperate is quite higher than another place in higher ground. In **table 8** are shown all the details about PT. ASSI Temperature and Humidty for each room

*Table 8 Measurement data for temperature and humidity*

| No. | Room | Temperature | Humidity |
|---|---|---|---|
| 1 | VVIP Room | 24.78 | 41.02 |
| 2 | QA/QC Room | 23.04 | 56.42 |

| No. | Room | Temperature | Humidity |
|---|---|---|---|
| 3 | HR Room | 24.34 | 55.04 |
| 4 | Engineering & Marketing Room | 26.52 | 53.28 |
| 5 | Maintenance Room | 23.91 | 54.34 |
| 6 | Marketing Room | 24.67 | 61.3 |
| 7 | 2nd floor room | 23.12 | 48.48 |
| 8 | VIP Meeting Room | 23.16 | 54.08 |
| 9 | Meeting Room | 24.3 | 59.24 |
| 10 | Medical room | 21.8 | 65.26 |
| 11 | Ward (Nursing Room) | 21.8 | 65.26 |
| 12 | Toilet VIP A | 25.4 | 65.2 |
| 13 | Toilet VIP B | 25.9 | 66.6 |
| 14 | Toilet VIP C | 23.7 | 61.5 |
| 15 | VIP Prayer Room | 23.04 | 57.16 |
| 16 | Hall | 25.05 | 65.62 |
| 17 | Lobby | 27.83 | 63.21 |

3.33. Building Lightning Data

Lightning Data is data about type, quantity, also power consumption for each and every Lamp. This data is obtained by doing survey for each and every room and make a notes for every different type of lamp that use by each room. Basically PT.ASSI in their office Building only use 3 type of lamp. First is CFL Phillips lamp with 24Watt and the lumens value is 1450, next is TL Lamp with 40watt and last is LED lamp with 10.5 watt. The data are shown in table 3.3. below

*Table 9 Lightning data for each room*

| No | Room | Hours per day | Lamp Details | | |
|---|---|---|---|---|---|
| | | | Type | Qty | Power |
| 1 | VVIP Room | 4 | TL | 1 | 40 |
| 2 | QA/QC Room | 10 | CFL | 4 | 24 |

| | | | | | |
|---|---|---|---|---|---|
| 3 | HR Room | 10 | CFL | 4 | 24 |
| 4 | Engineering & Marketing Room | 10 | CFL | 3 | 24 |
| 5 | Maintenance Room | 10 | LED | 1 | 10.5 |
| | | | CFL | 1 | 24 |
| 6 | Marketing Room | 10 | CFL | 2 | 24 |
| 7 | finance room | 10 | LED | 5 | 10.5 |
| 8 | VIP Meeting Room | 5 | LED | 1 | 10.5 |
| 9 | Meeting Room | 5 | TL | 1 | 40 |
| | | | CFL | 1 | 24 |
| 10 | Medical room | 8 | CFL | 2 | 24 |
| 11 | Ward (Nursing Room) | 8 | CFL | 2 | 24 |
| 12 | Toilet VIP A | 5 | LED | 1 | 10.5 |
| 13 | Toilet VIP B | 5 | LED | 1 | 10.5 |
| 14 | Toilet VIP C | 5 | LED | 1 | 10.5 |
| 15 | VIP Prayer Room | 2 | LED | 2 | 10.5 |
| 16 | Hall | 20 | LED | 5 | 10.5 |
| | | | CFL | 5 | 24 |
| 17 | Lobby | 20 | TL | 1 | 40 |

3.34. Building Equipment Usage Data.
Besides the LUX, Temperature and humidity. Another data that can be obtain from the office building are, list of equipment data, quantity of equipment, operational time of equipment, the data can be seen in **Attachment E**.

3.35. PT ASSI Monthly Energy Usage Data
Another crucial data for this bachelor thesis is the amount that PT. ASSI pay for electrical bill per month for the last Six month. And the *Tarif dasar listik*. And PT. ASSI also using Diesel Generator set when there is some electrical shutdown from the PLN. The electrical invoice and the generator set schedule are shown in **Attachment D**

## 3.4. Office Building Energy Analysis

All the data which been collected and been calculated then it can be analyze to gives outcome such as energy saving opportunity and categorized the equipment based on the priorities level.

Beside calculating energy consumption in need to be consider to processing the data from light intensity, temperature and also humidity. Is it already complying the standard?

The standard that being used for Light Intensity is SNI 03-6197-2001 about Energy Conservation in Lightning System. In the SNI standard there are some average value that being recommended. As shown in **Figure 6.**

| Fungsi ruangan | Tingkat pencahayaan (Lux) | Kelompok renderasi warna | Temperatur warna | | |
|---|---|---|---|---|---|
| | | | *Warm white* <3300 K | *Cool white* 3300 K-5300K | *Daylight* > 5300 K |
| **Perkantoran :** | | | | | |
| Ruang Direktur | 350 | 1 atau 2 | | ♦ | ♦ |
| Ruang kerja | 350 | 1 atau 2 | | ♦ | ♦ |
| Ruang komputer | 350 | 1 atau 2 | | ♦ | ♦ |
| Ruang rapat | 300 | 1 | ♦ | ♦ | |
| Ruang gambar | 750 | 1 atau 2 | | ♦ | ♦ |
| Gudang arsip | 150 | 1 atau 2 | | ♦ | ♦ |
| Ruang arsip aktif | 300 | 1 atau 2 | | ♦ | ♦ |

*Figure 8 Avagerage Light Intensity for office room*

Meanwhile for the temperature and humidity the standard that being used is SNI 03-6390-2011. Where in this standard the perfect temperature and humidity is $24^0$c – $27^0$c and 55% - 56%.

Beside the equipment usage the building also losses some energy by bad building insulation. Called OTTV (Overall Thermal Transfer Value). According to SNI 03-6389-2011 the final value of OTTV must did not exceed from 35W/m$^2$.

After collecting all the calculated data from calculation, so identification of Energy Consumption Intensity can be done. The identification is done by comparing between calculated value and baseline that stated by ASEAN-USAID for ECI, SNI 03-6389-2011 for OTTV, and ISO 50001 for energy benchmark. And the value of energy baseline that stated are shown in **Table 10.**

*Table 10 ECI Value According to ASEAN-USAID*

| No. | Building Purpose | ECI Value |
|---|---|---|
| 1 | Commercial Purposes | 240 kWh/m$^2$ per year |
| 2 | Shopping Center | 330 kWh/m$^2$ per year |
| 3 | Hotel / Apartment | 300 kWh/m$^2$ per year |
| 4 | Hospital | 380 kWh/m$^2$ per year |

### 3.5. Workshop Energy Management Analysis

By using ISO 50001 Energy management system. To determine is it a good workshop or not. It not must have all the numerical data of the workflow process it also can be using some expert opinion, some system management self-assessment, and also some ISO 50001 system management checklist.

Because PT. ASSI is already ratified integrated management system. Even though PT. ASSI not yet comply ISO 50001 there are some similarities from ISO 14001. Which PT. ASSI easier to analysis because the report for ISO 14001 did exists for years 2017. For the management system checklist can be seen in **Attachment A**. and for the difference between ISO 50001 and ISO 14001 can be seen in **Attachment B**

### 3.6. Recommendation

Last step in this bachelor thesis are giving recommendation for PT. ASSI. After collecting all the data, calculating energy consumption, also determining is the system effective or not by using energy baseline. The next step is giving recommendation to PT. ASSI. The recommendation is according to initial data that being measured or given by PT. ASSI. The cost of energy saving investment, PHE (*Peluang Hemat Energi)* can be divided into three categories. First is low, in low category energy saving can be obtain with very small cost

or without cost at all. Such as lowering operational work hours. To lowering operational work hours can be obtaining by analyzing equipment priority. Second is medium, in medium investment some cost is needed for this kind of investment. Example of this case is if there any old equipment that use energy un-efficient so it needed to be replace or repair.

Last kind of energy saving investment is high cost investment. This kind investment need a large amount of investment because sometimes this kind of investment are replacing a current system.

While calculating PHE it need to be consider some value. Such as PP or payback period. If the PP can be finish as soon as possible. It means the PHE work properly

# CHAPTER IV
# DATA ANALISYS

## 4.1. Initial Data Processing

### 4.1.1. Lightning profile Identification

From initial that are measured, can be identify the value of lighting profile. By doing some comparison using SNI 03-6197-2001 as the baseline and the best practice. This happened because it needs to determine for each room are they already fulfil the standard or not. The comparison between the SNI and the measured value can be seen in Figure. Meanwhile from the value difference between the SNI a measured value is being analyzed and it shown in **Attachment G**.

Even PT. ASSI is located near the ocean where rich of sunlight that can be utilize for lightning. But the building construction is make sunlight more impenetrable

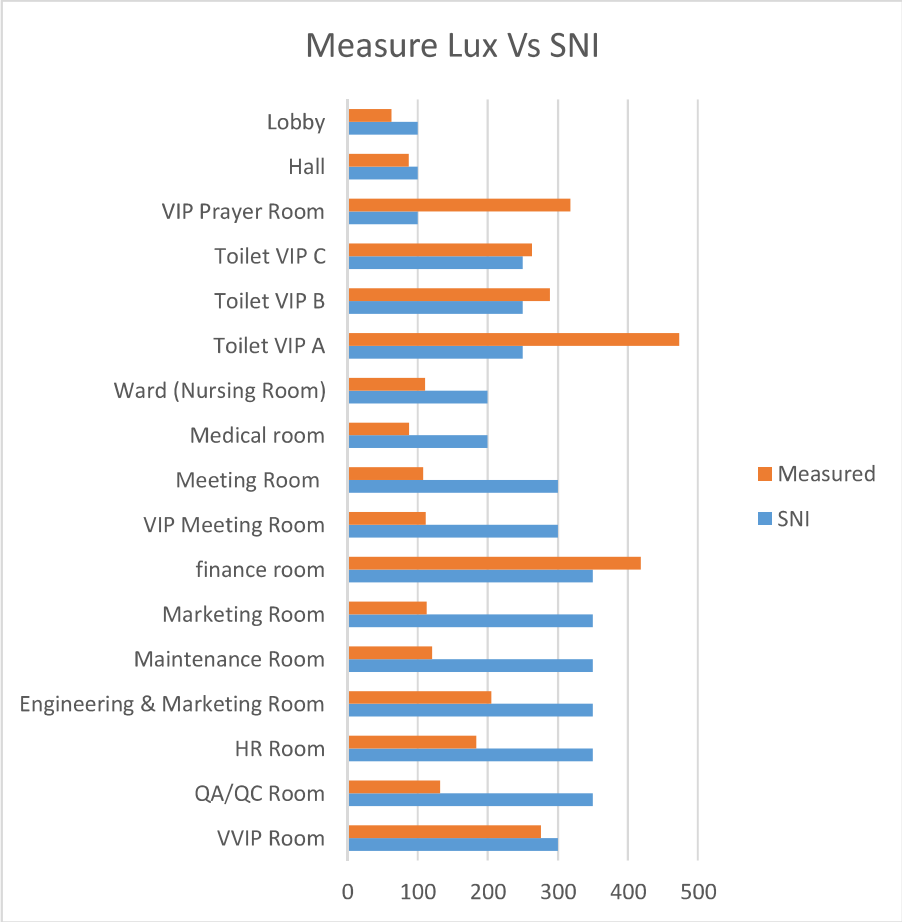


*Figure 9* Lux metered difference between Measured and SNI

From the **Figure 7.** can be seen that almost all of the room light intensity is lower than the SNI value. Only 5 out of 17 that fulfill the SNI Standard. And the bad part is 3 of them are Toilet room.

### 4.1.2. Thermal Comfort Profile Identification

Thermal comfort profile identification is comparing the humidity and temperature for each room with value that stated in SNI 03-6390-2011, which is 24 – 27$^0$C and 55-65% of humidity. The value for each room measurement are stated in **Figure 8** below.

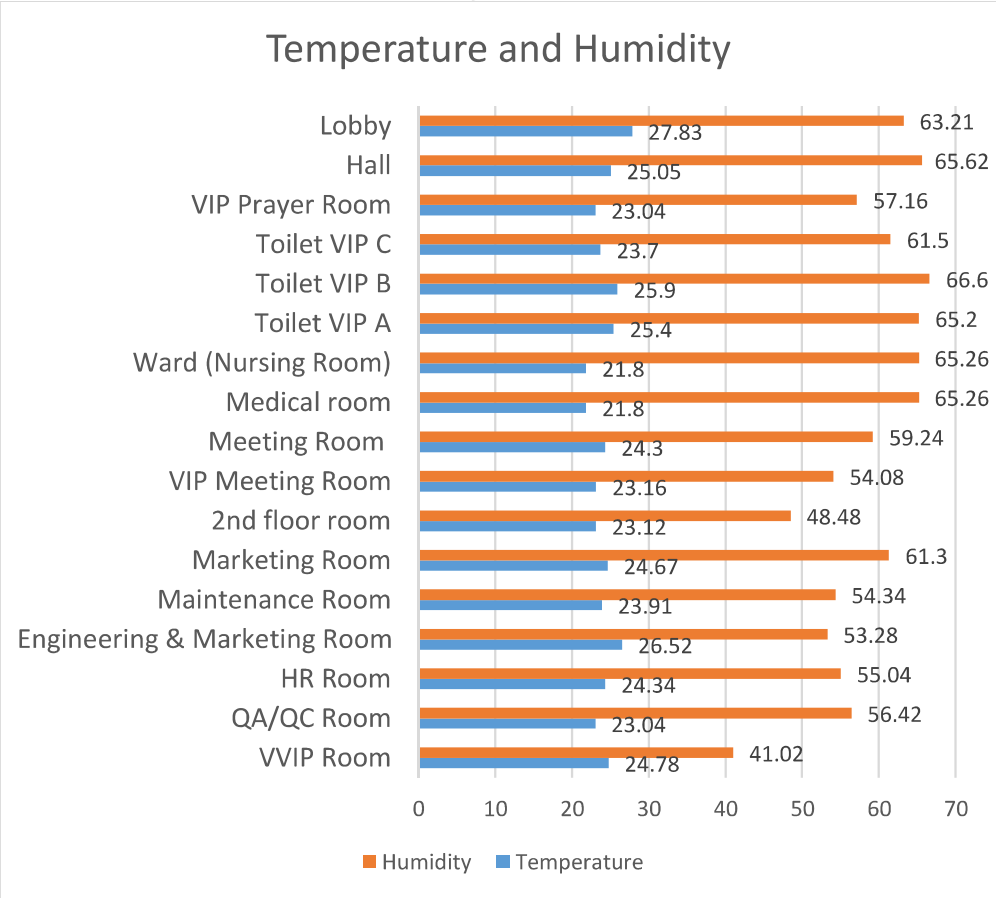


*Figure 10* Measurement of Thermal Comfort Profile

According to the data above every room that has temperature more than 24$^0$C and less than 27$^0$C it is already fulfill one of the SNI 03-6390-2011. And for the humidity is around 55% and 65%. From the data above many of the office room. It can be said that PT. ASSI good thermal comfort profile.

## 4.2. Office Building Energy Consumption Intensity

### 4.2.1. Energy Consumption for Building Insulation

Building Insulation Calculation for energy usage can be calculated using OTTV method. Using OTTV method Wall and Window area are needed that shown in **Table 11.** and also building data that already considered in Chapter 3.

*Table 11* WWR with Walls and Windows Area

| Direction | Wall Area | Window Area | WWR |
|---|---|---|---|
| North | 132.6 | 22.05 | 0.16629 |
| East | 31.5 | 5.475 | 0.17381 |
| West | 31.5 | 0 | 0 |
| South | 132.6 | 35.7525 | 0.26963 |

And by using equation 4.1 below OTTV per wall area can be obtained

$$OTTV = \{\alpha \times [U_W \times (1 - WWR)] \times T_{DEK}\} + (SC \times WWR \times SF) + U_f \times WWR \times \Delta T \quad (4.1)$$

And for Calculation Final OTTV is Shown **Table 12.**

*Table 12 OTTV Value*

| Direction | OTTV | OTTV. Wall Area |
|---|---|---|
| North | 55.52 | 7362.19 |
| East | 40.70 | 1282.02 |
| West | 31.54 | 993.55 |
| South | 47.82 | 6340.72 |

After the value is of OTTV for each direction is being determine now is determining final leave of OTTV. Final Value of OTTV is 48.685 W/m$^2$. while the Standard SNI for OTTV is SNI 03-6389-2011 35 W/m$^2$. So the OTTV did not fulfill the SNI standard

### 4.2.2. Energy Consumption for Electrical Equipment

For detail Equipment usage it can be seen in Attachment, from the detail breakdown about the equipment data it need to be analyze which equipment that cost PT. ASSI the most during its life cycle. In more general way electrical consumption are being categorized by their function. As shown as **Figure 9**.

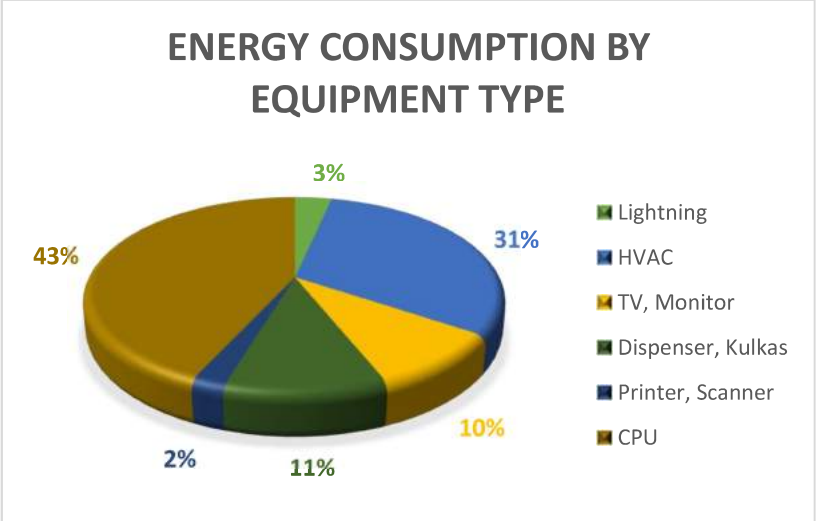


*Figure 11* Energy Consumption For office Building by Equipment Type

From **Figure 9**. above can be seen that lightning only needs 3% from all of energy usage from PT. ASSI Office Building. And the most highly demanding for electrical energy is CPU in 43% and HVAC in 31%.

### 4.3. Energy Consumption Intensity (ECI)

As already stated in Chapter II that ECI or Energy Consumption Intensity is Energy Usage per Product, which is in this case office building in Energy usage divided by building Area. And energy total that being use for PT. ASSI per month is Energy for the equipment and energy for building insulation. With the assumption there are 26 days of work per month. And 4 days is half- day work (Saturdays). And for each month there are about 23% overtime. So the energy usage for Building is as shown as below:

- Electrical Equipment for Office 9720.35 kWh /Month

The area of PT. ASSI building office as a whole is 464.1 $m^2$ if the energy usage for one whole years is 116644.18 kWh. So, the value of Energy Consumption Intensity (ECI) is 251.33 $kWh/m^2$ per year. Which means if referring to ECI standard in Indonesia according to ASEAN – USAID for commercial building is 240 $kWh/m^2$ per year.

### 4.4. Energy Saving Opportunity

Energy saving opportunity are being analyze by considering the amount that can be saved from the ECI and from OTTV. Both the values are more than it should be. The first is considering by ECI. From the detail equipment usage from the attachment. There are two things

to be considered. First is electrical usage from the lightning purposes, and second is electrical usage that can be cut off.

a. Energy saving Opportunity by Lightning Equipment

   According to the data usage from every room. There are some room that already use LED lamp. But there are more without the LED lamp. The saving using LED lamp is up to 50% saving. Because with the same Lumens LED is using less energy than any CFL lamp in the market.
   For the saving opportunity calculation can be seen in below:
   - Quantity of CFL Lamp: 22
   - Energy Usage Before Change = 297.64 kWh/day
   - Energy Usage After Change = 293.5 kWh/day
   - Saving opportunity is 1,3% Electrical Usage

b. Energy Saving Opportunity by another load

   According to the data Usage from every room. There is many electrical equipment that still in contact even after hour work, such as Printers, Fax, Scanner, and Water Dispenser. The saving opportunity if all the component above is un plug from the electrical Contact. The summary of the saving can be seen as below:
   - Energy Usage before any change = 297.64 kWh/day
   - Energy Usage After Change = 276.55 kWh/day
   - Energy Saving Opportunity = 7% of Electrical Usage.

From both calculations there are some electrical usage that can be saved. If both of this method are being considered. ECI of PT. ASSI office building is lowered by 8.3% which mean the new ECI of PT. ASSI is 230.278 kWh/m$^2$ per year.

Next is Considering OTTV for energy saving. From the equation of OTTV one of factor that make the OTTV value is so high is because the type of glass that being use. For lowering the OTTV value can be by changing the type of glass. The changing is using Double Glass (Stopsol + Sunergy) standard thickness 6mm Stopsol #2 + A12(Air) + 6mm Clear, SS type from PT. Asahimas Flat Glass. The Specification of the glass in seen in **Table 13**.

*Table 13 Specification of Double Glass from PT.Asahimas Flat Glass*

| | | |
|---|---|---|
| Energy Characteristic | Transmittance (%) | 28 |
| | Reflectance (%) | 15 |
| | Absorption (%) | 57 |
| | Ultra Violet Transmission (%) | 9 |
| Light Characteristic | Transmittance (%) | 47 |
| | Reflectance (%) | 27 |
| Solar Factor (%) | | 37 |
| Shading Coeficient | | 0.43 |
| U Value (W/m$^2$K) | | 2.8 |
| Cost (Rp/m$^2$) | | 795000 |

So, by changing the solar factor, shading coefficient, and also U Value from the first OTTV Calculation and using the data from **Table 13**. the OTTV value will fell into 34.822 W/m$^2$. So if the glass is change into the recommended glass. Will change OTTV value that fulfill SNI 03-6389-2011.

Meanwhile for knowing how much actually it can be saved from just changing the glass is using Equation 4.2 and Equation 4.3

$$Saving_{wbp} = \frac{(power_{before} - power_{new}) \times hours \times qt}{1000 \times TDL_{wbp}} \quad (4.2)$$

$$Saving_{Lwbp} = \frac{(power_{before} \times power_{new}) \times hours \times q}{1000 \times TDL_{Lwbp}} \quad (4.3)$$

The difference between equation 4.2 and 4.3 is the work hour. For equation 4.2 is from 11p.m – 5p.m and for equation 4.3 is from 5p.m until 10p.m.

Where:

$TDL_{wbp}$ = 1035.78 (June 2018)

$TDL_{Lwbp}$ = 1.5*1035.78 (June 2018)

If the area of PT. ASSI Office Building 464.1 m$^2$, the saving that PT. ASSI get for one day is Rp. 86.567, - and for one year is Rp. 31.597.223, -.

## 4.5. ISO 50001 system checklist and Field Assessment

Management system effectiveness was verified on site by means of random sampling by an appropriately selected auditor. This applies in particular to the compliance of workflows with standard requirements and the descriptions in management system documentation. The

special features of the organization's business activities, the applicable statutory and regulatory requirements and the requirements set forth in other generally applicable documents were also taken into account. This was done by means of a sampling approach, by conducting interviews and reviewing the appropriate documentation. Audit findings and recommendations regarding opportunities for improvement have been set forth. All the system management checklist can be seen in Attachment A, and for system management self-assessment can be seen in Attachment C.

Because from the management system checklist PT. Adiluhung Saranasegara Indonesia are mostly **NO** which means PT. Adiluhung did not comply all the necessary data, equipment, and personnel capability to applied ISO 50001 just yet.

But because PT. Adiluhung Saranasegara Indonesia already comply ISO 14001 standards. And ISO 14001 standards forms an important basis for ISO 50001. Also ISO 14001 defined energy as an important factor for EMS (Environmental Management System). So from RKL-RPL from 2017 Semester I and II of PT. Adiluhung Saranasegara Indonesia it shown that the EMS is doing well.

By using ISO 14001 as a comparison tool to determining the things that need to be added to PT. Adiluhung Saranasegara Indonesia for complying ISO 50001. There is some point of ISO 50001 that can be fulfilled.

For example, in ISO 50001 there are clauses about "*Continual improvement of energy performance and the EnMS*" and in ISO 14001 there are clause about "*Continual improvement of the EMS"* the improvement that can be make is in ISO 14001, an improvement of the EMS is expected, however it is not expected of environmental performance. Define the improvement of company energy performance as an important aspect and focus company activities on this area. In PT. Adiluhung Saranasegara Indonesia the focus activities are ship repair and ship building.

In ISO 50001 and ISO 14001 both of the standard need manager and management representative for management system. In PT. Adiluhung Saranasegara Indonesia the management representative is HR Department and Mr. Thony as the manager representative. Because PT. Adiluhung Saranasegara Indonesia is applied Integrated management system. So the Management representative and the manager representative is already determined.

Another example, in ISO 50001 there are clause about "*Identification of areas of significant energy use based on certain preparations"* and in ISO 14001 there are clause about *"Identification of environmental aspects with significant impact on the environment"* so the improvement process for complying ISO 50001 can be make is The requirements of ISO 50001 are considerably more detailed here. Take note of the inclusion of different points, such as the identification of relevant factors, the determination of energy performance or the estimation of future energy use.

And another example is in ISO 50001 there is clause about "*Identification of areas of significant energy use based on certain preparations"* and in ISO 14001 the clause is "*Identification of environmental aspects with significant impact on the environment*" so the additionally can be done with the existing ISO 14001 is The requirements of ISO 50001 are considerably more detailed here. Take note of the inclusion of different points, such as the identification of relevant factors, the determination of energy performance or the estimation of future energy use.

But there is some clause that is stated specially only is ISO 50001 and there is no similarity in ISO 14001 for example is in planning chapter in ISO 50001 there are clause that stated "*Consideration in the energy planning of activities that impact energy performance*" and in the ISO 14001 there isn't any. So the improvement is ensuring that all important activities that impact energy performance are considered in the energy planning.

During field assessment author seen the generator set that being used in PT. ASSI the generator set is only being used while PT. ASSI did not get supply from PLN which in one month not more than 12 hours in average. And the generator set only work in full load with 200 Litters/8hours or 25Litters/hour. The generator set is already being modified by PT.ASSI. Which has 580kVa shown in **figure 12.** Welding is the activity that require electrical energy the most in PT. Adiluhung Saranasegara Indonesia. Because weld is the most crucial activity in shipyard during repair or shipbuilding. Weld is non-continuous work and the electrical motor is using Direct On Line which has 4 – 8 times higher current value than normal work for each start. Lathe is another equipment that has same characteristic with weld. Is non-continuous activity so it has many high starting current during the work load. But lathe didn't as crucial as weld in shipyard.


*Figure 12 PT. ASSI Generator Set*

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# CHAPTER V
# CONCLUSION AND SUGGESTION

## 5.1. Conclusion

According to this research result can be concluded that:

1. According to Data the ECI of PT. ASSI Office Building is 251.35 kWh/m$^2$ per year, that value is still far from the ideal ECI in Indonesia. According to ASEAN-USAID for commercial purposed building is 240kWh/m$^2$.
2. Final Value of OTTV is 48.685 W/m2. while the Standard SNI for OTTV is SNI 03-6389-2011 35 W/m2. So the OTTV did not fulfill the SNI standard
3. Some changes to electrical component may have save some change making. ECI of PT. ASSI office building is lowered by 8.3% which mean the new ECI of PT. ASSI is 230.278 kWh/m$^2$ per year.
4. Welding is the activity that require electrical energy the most in PT. Adiluhung Saranasegara Indonesia. Because weld is the most crucial activity in shipyard during repair or shipbuilding. Weld is non-continuous work and the electrical motor is using Direct On Line which has 4 – 8 times higher current value than normal work for each start.
5. Lathe is another equipment that has same characteristic with weld. Is non-continuous activity so it has many high starting current during the work load. But lathe didn't as crucial as weld in shipyard.
6. PT. ASSI's generator set only being uses if PLN has a routine shutdown which in one month not more than 12 hours in average. And the generator set only work in full load with 200 Litters/8hours or 25Litters/hour
7. Sandblasting is activity that needs to be done in night which has higher electrical bill than the day time by 1.5 times higher than normal TDL which is Rp, 1035.78 in June

## 5.2. Suggestion

From all the calculation and consideration there are some suggestion that can be made for PT. ASSI to applied ISO 50001:

1. Energy saving Opportunity by Lightning Equipment by changing 22 lamps in Office building PT. ASSI save 1,3% Electrical Usage from 297.64 kWh/day for lighting to 293.5 kWh/day
2. Reduce un-used electrical load in office by unplugging Printers, Fax, Scanner, and Water Dispenser after wok hour. By doing this PT. ASSI can reduce 7% of Electrical Usage
3. Changing the window's glass using Double Glass (Stopsol + Sunergy) standard thickness 6mm Stopsol #2 + A12(Air) + 6mm Clear, SS type

from PT. Asahimas Flat Glass. That make the OTTV value down to 34.822 W/m$^2$ and have saving around Rp. 31.597.223, - in one year

4. By modification or changing the weld and lathe motor using Star-Delta Three Phase Motor not the DOL (Direct Online) Motor it can save from the multi high staring current
5. Doing Sand blasting in not around 5p.m – 10p.m because the peak hour from PLN made the electrical cost 1,5 times higher. The author recommendation is around 11p.m up until 1a.m because during that time there isn't the peak hour and people surround PT. ASSI not being disturbed by the paint scrap
6. Consider to have watt meter in every workshop or workbench for easy documentation of electrical usage
7. Determine the Energy baseline as soon as possible and also determine the significant energy use to make more saving opportunity

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# ATTACHMENT A

## Energy Management System Checklist

| No | Determining Elements | Implementation | Comments |
|---|---|---|---|
| A | Management Responsibility | | |
| A1 | Top Management | | |
| 1 | Apakah kebijakan penggunaan energi sudah di ditetapkan dan di implementasikan oleh *Top Management?* | No | Untuk sebagian dari perusahaan kebijakan energi sudah ditetapkan. Seperti pengunaan lampu dan pengaturan jam lembur |
| 2 | Apakah Manager kebijakan energi sudah di tetapkan oleh *Top Management?* | No | Akan tetapi sudah adanya manager represntativ untuk integrated management system. Dan energy management merupakan integrated management system |
| 3 | Apakah sumber daya yang di perlukan telah tersedia untuk pebentukan dan *maintenance* dari EnMS (Energy Management System)? | No | Masih kurangnya alat bantu ukur mellaksanakan EnMS |
| 4 | Apakah ruang lingkup dan batasan EnMS telah di tetapk | No | |
| 5 | Apakah pentingnya EnMs untuk perusahaan sudah cukup jelas bagi karyawan? | Yes | Pentingnya meng-konservasi energi sudah cukup jelas bagi seluruh karyawan. |
| 6 | Apakah tujuan strategis dan operasional telah ditetapkan? | No | |
| 7 | Apakah kinerja energi (hasil yang dapat diukur dengan memperhatikan efisiensi, penggunaan dan konsumsi) telah dipertimbangkan dalam perencanaan jangka panjang? | Yes | Dikarenakan kurangnya data tentang pengunaan energy selain dari invoice PLN maka effiiency hanya bisa dinilai dari hal tersebut |
| A2 | Management Representative | | |
| 8 | Apakah *Top Management* melaporkan tentang kinerja EnMs dan kinerja energi? | No | Dikarenakan belum menerapkan EnMS secara keseluruhan maka hanya pelaporan kinerja energy saja |
| 9 | Apakah standar kompetensi dan tanggung jawab di bawah EnMS telah ditentukan dan diInformasikan? | No | |
| 10 | Sudahkah kriteria dan metode untuk memastikan operasi yang efektif dan pemantauan EnMS telah ditentukan? | No | |

| | | | |
|---|---|---|---|
| B | Energy Policy | | |
| 11 | Apakah kebijakan energi meliputi komitmen untuk terus meningkatkan kinerja energi? | Yes | |
| 12 | Apakah itu termasuk komitmen untuk menyediakan informasi dan sumber daya yang diperlukan untuk mencapai tujuan strategis dan operasional? | Yes | |
| 13 | Apakah itu termasuk komitmen untuk mematuhi semua persyaratan hukum dan lainnya yang berlaku? | Yes | |
| 14 | Apakah kebijakan energi mendukung pengadaan produk dan layanan hemat energi? | Yes | Kebijakan pengandaan produk atau layanan hemat harus di sertakan dengan perhitungan waktu hingga return of investment |
| 15 | Apakah hal tersebut didokumentasikan dan dikomunikasikan ke seluruh perusahaan? | No | |
| 16 | Apakah itu termasuk dalam pembahasan pada peninjauan rutin? | No | |
| C | Energy Planning | | |
| C1 | General | | |
| 17 | Sudahkah perusahaan melakukan dan mendokumentasikan proses perencanaan energi? | No | |
| C2 | Legal and other reuierements | | |
| 18 | Apakah perusahaan telah mengidentifikasi dan menerapkan semua persyaratan hukum dan persyaratan lain yang berlaku? | Yes | |
| 19 | Apakah tinjauan rutin persyaratan hukum dan lainnya dilakukan? | Yes | |
| C3 | Energy Review | | |
| 20 | Apakah perusahaan telah melakukan tinjauan energi dan mendokumentasikan hasil, metodologi, dan kriteria? | No | |
| | Apakah aspek-aspek berikut dipertimbangkan dalam pengembangan tinjauan energi? | | |
| 21 | - Evaluasi penggunaan energi dan konsumsi | Yes | |
| 22 | - Identifikasi area penggunaan energi yang signifikan, peralatan penting, dan faktor-faktor relevan yang mempengaruhi penggunaan energi | Yes | |
| 23 | - Penentuan laju perkembangan dan estimasi kinerja energi masa depan | No | |
| 24 | Apakah kemungkinan perkembangan performa energi sudah di Identifikasi? | No | |

| | | | |
|---|---|---|---|
| C4 | Energy Baseline | | |
| 25 | Apakah baseline energi telah ditetapkan menggunakan informasi dari data penggunaan energi awal, dan apakah itu dikembangkan lebih lanjut jika diperlukan? | No | |
| C5 | Energy Performance Indicators | | |
| 26 | Apakah Energy Performance Indikator (EnPls) yang sesuai telah diidentifikasi, dan apakah mereka sudah ditinjau secara teratur? | No | |
| C6 | Energy Objectives, Energy Targets, and Energy Managament Action Plans | | |
| 27 | Apakah tujuan strategis dan operasional telah ditetapkan untuk kerangka waktu tetap berdasarkan pekerjaan utama (ship building & ship repair)? | No | |
| 28 | Apakah rencana pekerjaan telah ditetapkan, bersama dengan sumber daya dan kerangka waktu yang diperlukan untuk mencapai tujuan? | No | |
| 29 | Apakah tujuan dan rencana pekerjaan didokumentasikan dan diperbarui secara rutin? | No | |
| D | Implementation and Operation | | |
| D1 | Competence, Training and Awerness | | |
| 30 | Apakah semua karyawan yang bekerja untuk perusahaan telah cukup terlatih dalam hal bidang penggunaan energi pada equipment yang crucial? | No | |
| | Apakah semua pekerja faham dengan hal hal dibawah ini? | | |
| 31 | - Pentingnya mematuhi peraturan energy management | No | |
| 32 | - Proses dan syarat dalam memenuhi Energy management system | No | |
| 33 | - Tugas dalam memenuhi energy management sesuai dengan bidangnya | No | |
| 34 | - Keuntungan dalam menerapkan EnMS | No | |
| 35 | - Dampak yang mereka timbulkan terhadap penggunaan energi | No | |
| 36 | Apakah pelatihan energi management sudah dilakukan? | No | |
| D2 | Communication | | |
| 37 | Apakah kinerja energi dan EnMS dikomunikasikan secara internal ? | No | |
| 38 | Dapatkah semua karyawan secara aktif mengambil bagian dalam meningkatkan EnMS? | Yes | |
| 39 | Apakah perusahaan juga memutuskan untuk berkomunikasi secara eksternal (dan mendokumentasikan keputusan ini)? | Yes | |
| 40 | Jika ya, apakah rencana untuk komunikasi eksternal telah dikembangkan dan diimplementasikan? | No | |

| | | | |
|---|---|---|---|
| D3 | Operational Control | | |
| | Apakah aspek berikut diambil Menjadi pertimbangan ketika menentukan dan merencanakan proses energi management? | | |
| 41 | - Menentukan kriteria untuk operasi dan pemeliharaan yang efektif dari semua bidang yang relevan | Yes | |
| 42 | -Pengorperasian dan pemeliharaan pelaratan yang sesuai dengan criteria | Yes | |
| 43 | - Menyediakan informasi yang memadai tentang hal tersebut kepada semua pekerja | Yes | |
| D4 | Design and Procurement | | |
| 44 | Apakah peluang meningkatan efisiensi energi termasuk dalam perencanaan modifikasi design perlatan atau pengadaan peralatan baru? | Yes | |
| 45 | Apakah dalam proses pengadaan barang atau peralatan PT. ASSI menginformasikan kepada supplier bahwa penggunaan energi merupakan salah satu kriteria pengadaan? | Yes | |
| 46 | Apakah sudah di dokumentasikan? | No | |
| E | Checking | | |
| E1 | Monitoring, Measurement, and Analysis | | |
| | Apakah beberapa aspek dibawah ini termasuk dalam kriteria monitoring penggunaan peralatan? | | |
| 47 | - Perbandingan hasil pekerjaan dengan energi yang di gunakan | No | |
| 48 | - Faktor-faktor yang mempengaruhi pengunaan energi | Yes | |
| 49 | - Evaluasi dari penggunaan energi aktual dengan ekspektasi PT. ASSI | No | |
| 50 | Apakah hal-hal tersebut di dokumentasikan? | Yes | |
| 51 | Jika ada sector yang menggunakan energi jauh lebih tinggi dari ekpektasi apakah PT. ASSI sudah melakukan tindakan? | Yes | |
| F | General | | |
| F1 | Output From Management Review | | |
| 52 | Apakah semua keputusan dan tindakan untuk meningkatkan kinerja energi sejak peninjauan terakhir dipertimbangkan? | Yes | |
| 53 | Apakah semua keputusan dan tindakan yang berkaitan dengan kebijakan energi, tujuan strategis dan operasional serta penyediaan sumber daya dipertimbangkan? | Yes | |

# ATTACHMENT B

**Comparative Table ISO 50001 and ISO 14001**

| ISO 50001:2011 | | Requirements ISO 14001:2009 | | |
|---|---|---|---|---|
| Chapter | | Chapter | | |
| **4.** | **Energy management system requirements** | **4.** | **Environmental management system requirements** | |
| **4.1.** | **General requirements** | **4.1.** | **General requirements** | |
| | Establishment, documentation, implementation and maintenance of the EnMS | | Establishment, documentation, implementation and maintenance of the EMS | |
| | Definition and documentation of the scope and boundaries of the EnMS | | Definition and documentation of the scope of the EMS | |
| | Continual improvement of energy performance and the EnMS | | Continual improvement of the EMS | |
| **4.2.** | **Management responsibility** | **4.4.1 and 4.2** | **There is no exactly corresponding item; some provisions are nonetheless included in other items, in particular in 4.2 and 4.4.1** | |
| **4.2.1.** | **Top management** | | | |
| | Top management is responsible for the definition, establishment, implementation and maintenance of the energy policy | | Definition of the environmental policy by top management | |
| | Responsibility for appointing an energy management representative and approving the energy management team | | Appointment of an EMS representative by top management | . |
| | Responsibility for the provision of necessary resources for the establishment, implementation, maintenance and improvement of the EnMS and energy performance | | Top management must provide the necessary resources for the establishment, implementation, maintenance and improvement of the EMS. | |
| | Responsibility for the definition of the scope and boundaries of the EnMS | | No requirements | |
| | Responsibility for the internal communication of the importance of the EnMS | | No requirements | |
| | Responsibility for the establishment of strategic and operational objectives regarding energy performance | | No requirements | |
| | Responsibility for appropriate EnPIs | | No requirements | |
| | Responsibility for taking energy performance into consideration in long-term planning | | No requirements | |
| | Responsibility for the execution of management reviews | | Implicitly covered by the provisions on management review. | |
| **4.2.2.** | **Management representative** | | | |

| | What should additionally be done with an existing ISO 14001? |
|---|---|
| | |
| | |
| | Energy must basically be defined as an important factor under ISO 14001. |
| | Generally included |
| | Define the boundaries of your EMS. |
| | In ISO 14001, an improvement of the EMS is expected, however it is not expected of environmental performance. Define the improvement of your energy performance as an important aspect and focus your activities on this area. |
| | |
| | |
| | Generally included |
| | Covered in principle. Depending on the size of the organisation, the energy manager and the in-charge officer for environmental management can be one and the same person. |
| | Generally included |
| | Generally this point is already included, although the defined boundaries of the EnMS must be taken into account (see also 4.1); it is important to ensure the involvement of top management. |
| | It is important to ensure the involvement of top management in internal communication of the EnMS; in general, this should already be the case. |
| | It is important to ensure the involvement of top management in establishing the objectives; in general, this should already be the case. |
| | It is important to ensure the involvement of top management. |
| | Ensure that energy performance is taken into consideration in long-term planning. |
| | Generally included |
| | |

| ISO 50001:2011 | | Requirements ISO 14001:2009 | | |
|---|---|---|---|---|
| Chapter | | Chapter | | |
| | Responsibility for ensuring the conformity of the EnMS with the standard | | Responsibility for ensuring conformity of the EMS with the standard | |
| | Responsibility for forming an energy management team | | No requirements | |
| | Reporting to top management on energy performance | | No requirements | |
| | Reporting to top management on EnMS performance | | Reporting to top management on EMS performance | |
| | Ensuring the appropriateness of the planning of energy management activities in support of the energy policy | | No requirements | |
| | Definition and communication of competencies and responsibilities to support energy management | | No requirements | |
| | Determination of criteria and methods for ensuring the effective monitoring and operation of the EnMS | | No requirements | |
| | Promotion of awareness of the energy policy and strategic energy objectives | | No requirements | |
| **4.3.** | **Energy policy** | **4.2.** | **Environmental policy** | |
| | Appropriateness to the nature and scale of energy use and consumption | | Appropriateness to the nature, scale and environmental impacts of activities and products/services | |
| | Consideration of the commitment to continually improve energy performance | | Consideration of the commitment to continual improvement | |
| | Consideration of the commitment to provide the information and resources necessary for achieving objectives | | No requirements | |
| | Consideration of the commitment to comply with all legal and other requirements | | Consideration of the commitment to comply with all applicable legal and other requirements | |
| | Establishment of a framework for the definition and review of strategic and operational objectives | | Establishment of a framework for the definition and review of environmental objectives | |
| | Promoting the purchase of energy-efficient products and services | | No requirements | |
| | Ensuring the documentation and internal communication of the energy policy | | Ensuring documentation | |

| | What should additionally be done with an existing ISO 14001? |
|---|---|
| | |
| | Generally included |
| | Ensure that the energy management representative appoints an energy management team. |
| | Ensure that energy performance is also considered in the context of the reporting requirements. |
| | Generally included |
| | Assign the appropriate responsibility to the energy management representative. |
| | Assign the appropriate responsibility to the energy management representative. |
| | Assign the appropriate responsibility to the energy management representative. |
| | Assign the appropriate responsibility to the energy management representative. |
| | |
| | Generally included |
| | Generally included. Ensure that the commitment also specifically refers to the improvement of energy performance. |
| | Ensure that the environmental policy includes corresponding commitments. |
| | Generally included |
| | Generally included |
| | Ensure that the environmental policy includes stipulations on the purchase of energy-efficient products and services. |
| | Communication of the energy policy is already partly required due to the necessary training measures (see 4.2). Ensure that the energy policy is adequately communicated. |

| ISO 50001:2011 | | Requirements ISO 14001:2009 | | |
|---|---|---|---|---|
| Chapter | | Chapter | | |
| | Ensuring regular review and needs-based updating | | Implicitly included in requirements in other items | |
| **4.4.** | **Energy planning** | **4.3.** | **Planning** | |
| **4.4.1.** | **General** | | | |
| | Commitment to conduct and document an energy planning process | | Not explicitly asked | |
| | Consideration in the energy planning of activities that impact energy performance | | Not explicitly asked | . |
| **4.4.2.** | **Legal and other requirements** | **4.3.2.** | **Legal and other requirements** | |
| | Identification and implementation of applicable legal and other requirements | | Establishment and implementation of a procedure for identifying applicable legal and other requirements | |
| | Consideration in the establishment and implementation of the EnMS | | Consideration in the establishment and implementation of the EMS | |
| | Regular review of legal and other requirements | | - | |
| **4.4.3.** | **Energy review** | | **Partial correspondence to 4.3.1: Environmental aspects** | |
| | Conducting and maintenance of an energy review | | Not explicitly asked | |
| | Identification of energy sources and evaluation of energy use and consumption | | Not explicitly asked | |
| | Identification of areas of significant energy use based on certain preparations | | Identification of environmental aspects with significant impact on the environment | |
| | Identification and prioritisation of opportunities for improving energy performance | | Not explicitly asked | |
| **4.4.4.** | **Energy baseline** | | **Not included** | |
| **4.4.5.** | **Energy performance indicators** | | **Not included** | |
| **4.4.6.** | **Energy objectives, energy targets and energy management action plans** | **4.3.3.** | **Objectives, targets and programme(s)** | |
| | Establishment and implementation of documented strategic and operational objectives | | Establishment and implementation of documented environmental objectives and targets | |

| | What should additionally be done with an existing ISO 14001? |
|---|---|
| | |
| | Generally included |
| | |
| | |
| | Ensure that you conduct and document an energy planning process. |
| | Ensure that all important activities that impact energy performance are considered in the energy planning. |
| | Generally included. Ensure conformity with all energy-related laws. |
| | Generally included |
| | Generally included |
| | In substance largely included in the regulations on review. |
| | |
| | Ensure that an energy review is conducted regularly and document your methodology and criteria. |
| | Generally this should already have been done, but make sure. |
| | The requirements of ISO 50001 are considerably more detailed here. Take note of the inclusion of different points, such as the identification of relevant factors, the determination of energy performance or the estimation of future energy use. |
| | Identify and prioritise opportunities for improving your energy performance. |
| | Ensure that you establish an energy baseline and adjust it as needed, and keep the necessary records of this. |
| | Ensure that you identify energy performance indicators, document your corresponding methodology and regularly review the data and compare it to the energy baseline. |
| | Generally included. Ensure that your objectives are aimed at improving energy performance. |
| | Generally included |

| ISO 50001:2011 | | Requirements ISO 14001:2009 | | |
|---|---|---|---|---|
| Chapter | | Chapter | | |
| | Consistency of the objectives with the energy policy | | Consistency of the objectives with the environmental policy | |
| | Establishment and implementation of action plans including the identification of responsibilities, means, time-frames and review methods | | Establishment and implementation of programmes including the designation of responsibility, means and time-frame | |
| | Documentation and updating of the action plans | 4.3.4. | Included in principle as part of the requirements for documentation | |
| **4.5.** | **Implementation and operation** | **4.4.** | **Implementation and operation** | |
| **4.5.1.** | **General** | | | |
| **4.5.2.** | **Competence, training and awareness** | **4.4.2.** | **Competence, training and awareness** | |
| | Ensuring the necessary competence of employees and other relevant persons | | Ensuring the necessary qualification of all persons with a potentially significant environmental impact | |
| | Determination and documentation of training measures | | Identification and implementation of training measures; maintenance of relevant documentation | |
| | Ensuring the knowledge of all employees and relevant persons of: | | Establishment and implementation of a process to ensure that all relevant persons are aware of: | |
| | – The importance of complying with the energy policy and EnMS requirements | | – The importance of complying with the environmental policy and EMS requirements | |
| | – Individual roles and responsibilities with regard to the EnMS | | – Individual roles and responsibilities with regard to ensuring compliance with the EMS requirements | |
| | – The advantages of improved energy performance | | – The advantages of improving their own performance | |
| | – The actual and potential impact of their own activities on energy use and consumption<br><br>– Individual contribution to achieving energy objectives" | | – The actual or potential impact of their own activities on important environmental aspects | |
| | – Potential consequences of nonconformity with established procedures | | – Potential consequences of nonconformity with established procedures | |
| **4.5.3.** | **Communication** | **4.4.3.** | **Communication** | |
| | Internal communication of energy performance and the EnMS | | Internal communication of environmental aspects and the EMS | |

| | What should additionally be done with an existing ISO 14001? |
|---|---|
| | |
| | Generally included |
| | Ensure that you also consider the review methods. |
| | Generally included; ensure that action plans are updated. |
| | |
| | |
| | |
| | Ensure that your organisation especially fulfils the energy requirements. |
| | Generally included |
| | Generally included |
| | Generally included |
| | Generally included |
| | Ensure that the advantages of improved energy performance are generally known. |
| | ISO 50001 specifies a bit further; ensure that employees are aware of their own contribution to achieving the energy objectives. |
| | Generally included |
| | Generally included; ensure that energy performance is included. |
| | Ensure that you especially facilitate suggestions for improvement. |

| ISO 50001:2011 | | Requirements ISO 14001:2009 | | |
|---|---|---|---|---|
| Chapter | | Chapter | | |
| | Facilitation of employees' suggestions for improvement | | Receipt and documentation of and response to external communication | |
| | Decision on external communication and documentation of the decision | | Decision on external communication and documentation of the decision | |
| | If necessary, establishment of a method for external communication | | If necessary, establishment of a method for external communication | |
| **4.5.4.** | **Documentation** | **4.4.4.** | **Documentation** | |
| **4.5.4.1** | **Documentation requirements** | | | |
| | Implementation of documentation of the core elements of the EnMS | | | |
| | Consideration of: | | The documentation of the EMS must include: | |
| | – Scope and boundaries of the EnMS | | – Description of the scope | |
| | – Energy policy | | – Environmental policy | |
| | – Strategic/operational energy objectives and action plans | | – Objectives and targets | |
| | – Other documents required by the standard | | – Documents required by the standard | |
| | – Other necessary documents | | – Other necessary documents | |
| **4.5.4.2** | **Control of documents** | **4.4.5.** | **Control of documents** | |
| | Establishment and maintenance of a procedure for: | | Establishment and maintenance of a procedure for: | |
| | – Reviewing the adequacy of documents prior to use | | – Approving the suitability of documents prior to use | |
| | – Regular evaluation and updating of documents | | – Evaluation and updating of documents as necessary | |
| | – Indication of changes and the current revision status | | – Indication of changes and the current revision status | |
| | – Availability of applicable documents where necessary | | – Ensuring the availability of documents | |
| | – Legibility and identifiability of documents | | – Legibility and identifiability of documents | |

| | What should additionally be done with an existing ISO 14001? |
|---|---|
| | |
| | Generally included |
| | Generally included |
| | Generally included; ensure that all energy-relevant documents are available. |
| | |
| | |
| | Implicitly included |
| | |
| | Generally included. Ensure that you consider the boundaries of the EnMS. |
| | Generally included |
| | Generally included. Ensure that the action plans are included. |
| | Generally included |
| | Generally included |
| | Generally included. Ensure that all relevant documents for the EnMS are integrated. |
| | Generally included |
| | Generally included |
| | Generally included |
| | Generally included |
| | Generally included |
| | Generally included |

| ISO 50001:2011 | | Requirements ISO 14001:2009 | | |
|---|---|---|---|---|
| Chapter | | Chapter | | |
| | – Identification and distribution of relevant external documents | | – Identification and distribution of relevant external documents | |
| | – Prevention of the use of obsolete documents and retention of relevant older documents | | – Prevention of the use of obsolete documents and labelling if retained | |
| **4.5.5.** | **Operational control** | **4.4.6.** | **Operational control** | |
| | Identification and planning of relevant operations and maintenance activities | | Identification and planning of relevant operations | |
| | Establishment of criteria for effective operation and maintenance in areas of significant energy use<br><br>Operation and maintenance according to the criteria | | Establishment and implementation of procedures to prevent deviation from the environmental policy and objectives<br><br>Stipulation of operational criteria in the procedures | |
| | Information on operational control provided to all employees and other relevant persons | | Documentation of procedures | |
| **4.5.6.** | **Design** | | **No separate item** | |
| | Consideration of opportunities for improving energy performance in the design of relevant equipment and processes | | No requirements | |
| | Consideration of the results of the energy performance evaluation in the design of relevant projects | | No requirements | |
| | Documentation of the design results | | No requirements | |
| **4.5.7.** | **Procurement of energy services, products, equipment and energy** | | **No separate item** | |
| | Informing of suppliers on energy-related purchasing criteria | 4.4.6. | Introduction and implementation of procedures for purchasing and the communication thereof to suppliers | |
| | Establishment and implementation of energy-related purchasing criteria | | No specific requirements | |
| | Definition and documentation of specifications for energy purchasing | | No specific requirements | |
| **4.6.** | **Checking** | **4.5.** | **Checking** | |

| | What should additionally be done with an existing ISO 14001? |
|---|---|
| | |
| | Generally included |
| | Ensure that all relevant older documents are retained. |
| | If necessary, broaden the control of your processes and procedures to include energy efficiency. |
| | Ensure that maintenance activities are included. |
| | Generally included; ensure that maintenance activities are included. |
| | ISO 50001 places greater emphasis on communication in the context of operational control; expand your communication in this area to all relevant employees and other persons. |
| | Requirements not included in ISO 14001. |
| | Take note of the relevant requirements in ISO 50001. |
| | Take note of the relevant requirements in ISO 50001. |
| | Take note of the relevant requirements in ISO 50001. |
| | |
| | ISO 50001 requirements are more detailed; ensure that energy is considered here in your EMS. |
| | Integrate energy efficiency and energy consumption as additional criteria into your purchasing procedures. |
| | Ensure to you define and document requirements for the purchasing of energy. |
| | |

| ISO 50001:2011 | | Requirements ISO 14001:2009 | | |
|---|---|---|---|---|
| Chapter | | Chapter | | |
| **4.6.1.** | **Monitoring, measurement and analysis** | **4.5.1.** | **Monitoring and measurement** | |
| | Regular monitoring and evaluation of key characteristics that impact energy performance | | Regular monitoring of key characteristics of operations | |
| | Consideration of: | | The procedure must include: | |
| | – Areas of significant energy use and the results of the energy review | | Not explicitly asked | |
| | – Relevant influential factors in areas of significant energy use | | Not explicitly asked | |
| | – EnPIs | | – Performance | |
| | – The effectiveness of action plans with regard to strategic/operational objectives | | – Conformity with objectives and targets | |
| | – Evaluation of actual energy consumption relative to expectations | | Not explicitly asked | |
| | Documentation of the results of monitoring | | – Documentation of the information | |
| | Definition and implementation of an energy measurement plan | | Not explicitly asked | |
| | Definition of measurement needs and regular monitoring, including the review of measurement equipment and calibration | | – Ensuring the calibration and monitoring of measurement equipment | |
| | Investigation and documentation of any significant deviations in energy performance | | Not explicitly asked | |
| **4.6.2.** | **Evaluation of legal and other requirements** | **4.5.2.** | **Evaluation of compliance** | |
| | Regular evaluation of compliance with legal and other relevant requirements | | Regular evaluation of compliance with legal requirements; evaluation of other relevant requirements | |
| | Maintenance of records of the results | | Maintenance of records of the results | |
| **4.6.3.** | **Internal audit of the EnMS** | **4.5.5.** | **Internal audit** | |
| | Conducting internal audits | | Conducting internal audits | |
| | Development of an audit plan and schedule under consideration of the results of earlier audits | | Establishment of an audit programme with requirements for planning and implementation; consideration of the results of earlier audits | |

| | What should additionally be done with an existing ISO 14001? |
|---|---|
| | |
| | Ensure that monitoring also encompasses energy performance. |
| | Generally included |
| | |
| | Implicitly covered, as well as in item A.3.1; make sure that this point is ensured. |
| | Take this into consideration in monitoring and measurement. |
| | |
| | Generally included. Ensure that monitoring is based on the energy performance indicators. |
| | Generally included |
| | Generally included. Ensure that you consider the results of monitoring of energy-related performance. |
| | Ensure that an energy measurement plan is developed. |
| | Largely covered; ensure that you have defined the measurement needs and review them regularly. |
| | Be sure to investigate and document any significant deviations in energy performance. |
| | |
| | Generally included |
| | Generally included |
| | |
| | Generally included; the objectives are somewhat more highly differentiated in ISO 50001. |
| | Requirements are very similar; ensure that the plans are developed in accordance with the requirements of ISO 50001. |

| ISO 50001:2011 | | Requirements ISO 14001:2009 | | |
|---|---|---|---|---|
| Chapter | | Chapter | | |
| | Selection of objective auditors | | Selection of objective auditors | |
| | Documentation of the audit results | | Documentation of the audit results | |
| **4.6.4.** | **Nonconformities, correction, corrective action and preventive action** | **4.5.3.** | **Non-conformity, corrective action and preventive action** | |
| | Review of nonconformities | | Procedure for addressing nonconformities | |
| | Determination of causes | | Determination of causes | |
| | Identification of the need for action, also with a view to preventing nonconformities or their potential reoccurrence | | Measures to prevent occurrence and reoccurrence | |
| | Determination and implementation of necessary countermeasures | | Identification and correction of nonconformities | |
| | Documentation of corrective and preventative measures | | Documentation of the results of corrective and preventative measures | |
| | Reviewing effectiveness | | Reviewing effectiveness | |
| | Ensuring the necessary changes to the EnMS | | Ensuring the necessary changes to the EMS documentation | |
| **4.6.5.** | **Control of records** | **4.5.4.** | **Control of records** | |
| | Establishment of records on conformity with the EnMS requirements and the standard | | Establishment of records on conformity with the EMS requirements and the standard | |
| | Documentation of energy performance achievements | | Documentation of results achieved | |
| | Establishment of control mechanisms for identifying, retrieving and retaining records | | Procedures for identifying, protecting and retrieving records | |
| | Legibility, identifiability and traceability of records | | Legibility, identifiability and retrievability of records | |
| **4.7.** | **Management review** | **4.6.** | **Management review** | |
| **4.7.1.** | **General** | | | |
| | Regular review of the EnMS by top management | | Regular review of the EMS by top management | |
| | Documentation of the management review | | Documentation of the management review | |

| | What should additionally be done with an existing ISO 14001? |
|---|---|
| | |
| | Generally included |
| | Generally included |
| | |
| | Generally included |
| | Generally included |
| | Generally included |
| | Generally included |
| | Generally included |
| | Generally included |
| | You may need to ensure that the necessary changes are made to the EMS yourself. |
| | |
| | Generally included |
| | Generally included |
| | Generally included |
| | Generally included |
| | |
| | |
| | Generally included |
| | Generally included |

| ISO 50001:2011 | | Requirements ISO 14001:2009 | | |
|---|---|---|---|---|
| Chapter | | Chapter | | |
| **4.7.2.** | **Input to management review** | | | |
| | Follow-up activities | | Follow-up activities | |
| | Energy policy review | | Environmental policy review | |
| | Review of energy performance and EnPIs | | The organisation's environmental performance | |
| | Conformity with legal and other requirements | | Conformity with legal and other requirements | |
| | Degree of achievement of operational and strategic objectives | | Degree of achievement of objectives and targets | |
| | Results of internal audits | | Results of internal audits | |
| | Status of corrective and preventative measures | | Status of corrective and preventative measures | |
| | Predicted energy performance | | Projected developments are not explicitly mentioned. | |
| | Recommendations | | Suggestions for improvement | |
| **4.7.3.** | **Output from management review** | | **No specific sub-item but results arise from input parameters** | |

| | What should additionally be done with an existing ISO 14001? |
|---|---|
| | |
| | Generally included |
| | Generally included |
| | Generally included; you may need to add EnPIs. |
| | Generally included |
| | Generally included |
| | Generally included |
| | Generally included |
| | Integrate planned energy use/consumption in your management review. |
| | Generally included |
| | Generally included. Add the improvements made since the last management review to the results/output. |

# ATTACHMENT C
**Data Collecting Timeline**

| Day(s) | Agenda | Hasil yang di harapkan |
|---|---|---|
| **Day 1** | Pengumpulan data Awal untuk profil gedung kantor | - Dimensi gedung |
| | | - Detail Material bangunan |
| | | - Denah Ruangan |
| **Day 2** | Pengukuran Intensitas Cahaya pada beberapa ruangan gedung kantor | - Kuat pencahayaan **(**Lux**)** |
| **Day 3** | Pengukuran Intensitas Cahaya pada beberapa ruangan gedung kantor | - Kuat pencahayaan **(**Lux**)** |
| **Day 4** | Pengukuran Intensitas Cahaya pada beberapa ruangan gedung kantor | - Kuat pencahayaan **(**Lux**)** |
| **Day 5** | Pengukuran Suhu dan kelembaban udara pada beberapa ruangan gedung kantor | - Tingkat kelembaban udara (%) |
| | | - Suhu ($^oC$) |
| **Day 6** | Pengukuran Suhu dan kelembaban udara pada beberapa ruangan gedung kantor | - Tingkat kelembaban udara (%) |
| | | - Suhu ($^oC$) |
| **Day 7** | Pengukuran Suhu dan kelembaban udara pada beberapa ruangan gedung kantor | - Tingkat kelembaban udara (%) |
| | | - Suhu ($^oC$) |
| **Day 8** | Pengukuran Suhu dan kelembaban udara pada beberapa ruangan gedung kantor | - Tingkat kelembaban udara (%) |
| | | - Suhu ($^oC$) |
| **Day 9** | Pengumpulan data penerangan gedung kantor | - Kuantitas Lampu |
| | Pengumpulan data Peralatan penunjang aktivitas | - Kuantitas Equipment |
| **Day 10** | Pengumpulan data Peralatan pada Construction Workshop | - Jenis Equipment yang digunakan |
| | | - Kuantitas Equipment yang digunakan |
| | Pengukuran workload pada Construction Workshop | - Daya yang digunakan **(**kWh**)** |
| | | - Product yang di Hasilkan **(**Ton**)** |
| **Day 11** | Pengukuran workload pada Construction Workshop | - Daya yang digunakan **(**kWh**)** |
| | | - Product yang di Hasilkan **(**Ton**)** |
| **Day 12** | Pengumpulan data Peralatan pada Machine Workshop | - Jenis Equipment yang digunakan |
| | | - Kuantitas Equipment yang digunakan |
| | Pengukuran workload pada Machine Workshop | - Daya yang digunakan **(**kWh**)** |
| | | - Product yang di Hasilkan **(**Ton**)** |
| **Day 13** | Pengukuran workload pada Machine Workshop | - Daya yang digunakan **(**kWh**)** |
| | | - Product yang di Hasilkan **(**Ton**)** |
| **Day 14** | Pengumpulan data Peralatan pada Painting & Sand-Blasting Workshop | - Jenis Equipment yang digunakan |
| | | - Kuantitas Equipment yang digunakan |
| | Pengukuran workload pada Painting & Sand-Blasting Workshop | - Daya yang digunakan **(**kWh**)** |
| | | - Luasan area yang dikerjakan ($m^2$) |
| **Day 15** | Pengukuran workload pada Painting & Sand-Blasting Workshop | - Daya yang digunakan **(**kWh**)** |
| | | - Luasan area yang dikerjakan ($m^2$) |
| **Day 16** | Pengumpulan data Peralatan pada CNC & Outfitting Workshop | - Jenis Equipment yang digunakan |
| | | - Kuantitas Equipment yang digunakan |
| | Pengukuran workload pada CNC & Outfitting Workshop | - Daya yang digunakan **(**kWh**)** |
| | | - Product yang di Hasilkan **(**Ton**)** |
| **Day 17** | Pengukuran workload pada CNC & Outfitting Workshop | - Daya yang digunakan **(**kWh**)** |
| | | - Product yang di Hasilkan **(**Ton**)** |
| **Day 18** | Pengumpulan data Peralatan pada Non Metal Workshop | - Jenis Equipment yang digunakan |
| | | - Jenis Product yang di hasilkan |
| | | - Kuantitas Equipment yang digunakan |
| | Pengukuran workload pada Non Metal Workshop | - Daya yang digunakan **(**kWh**)** |
| | | - Product yang di Hasilkan **(**Ton**)** |
| **Day 19** | Pengukuran workload pada Non Metal Workshop | - Daya yang digunakan **(**kWh**)** |
| | | - Product yang di Hasilkan **(**Ton**)** |

| Day(s) | Agenda | Hasil yang di harapkan |
|---|---|---|
| **Day 20** | Pengumpulan data pada Ship Docking Area | - Jenis Equipment yang digunakan |
| | | - Jenis Kapal Docking |
| | | - Sumber energi pada Area Docking |
| | | - Jenis workload pada area docking |
| **Day 21** | Pengukuran Workload pada Ship Docking Area | - Daya yang di gunakan **(**kWh**)** |
| **Day 22** | Pengukuran Workload pada Ship Docking Area | - Daya yang di gunakan **(**kWh**)** |
| **Day 23** | Pengukuran Workload pada Ship Docking Area | - Daya yang di gunakan **(**kWh**)** |

# ATTACHMENT D
**System Management Self-Assestment**

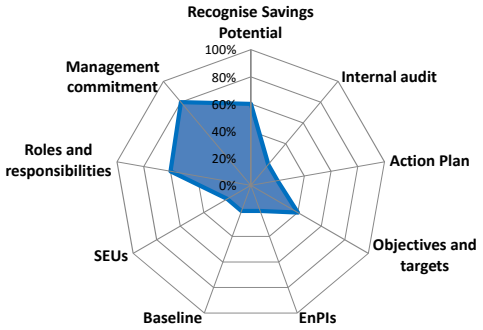
## Energy Management System Tools

### Self Assessment

Instructions:
Score is 0 to 5. 0 means very poor marks and 5 full marks.
In the Evidence column examples and/or explanation of the score given should be provided.

| Question | Titles | | Score | Evidence | Consider |
|---|---|---|---|---|---|
| Does the top management know that significant energy cost savings can be achieved by simple low cost measures without necessitating financial investment? | Recognise Savings Potential | 60% | 3 | | Has the organisation exhausted all low cost opportunities before stating to invest in capital projects? |
| Is the top management committed to energy cost reduction and is there an approved energy policy in place? | Management commitment | 80% | 4 | | When a compromise is needed to reduce energy consumption, what normally takes the priority? |
| Have roles, responsibility and authority been identified for all persons having an influence on significant energy use and is this documented? | Roles and responsibilities | 60% | 3 | | Are "I'm too busy" or "I have more important things to do" common excuses? |
| Have the significant energy uses been quantified and documented? | SEUs | 20% | 1 | | Do you know where at least 80% of your energy is used? |
| Has a baseline of energy performance been established against which progress can be measured? | Baseline | 20% | 1 | | Are you able to estimate energy use based on variables before bills arrive? |
| Have indicator(s) or metrics been identified to use in measuring progress against your baseline? | EnPIs | 20% | 1 | | Do you respond pro-actively when actual consumption exceeds expected? |
| Have the organisation's energy objectives and targets been identified and documented? | Objectives and targets | 40% | 2 | | Are they quantified and monitored regularly for success? |
| Have energy action plans been established? | Action Plan | 20% | 1 | | Are they approved and resourced adaquately and will they result in targets being met? |
| Is the energy management system evaluated at least once a year and are improvements made based on the results of the evaluation. | Internal audit | 20% | 1 | | Do you have a list of improvement ideas for the mangement system (non-technical ideas)? |

## Energy Management Assessment



# ATTACHMENT E
**Equipment Usage Before Audit**

Energy usage per-room assumption

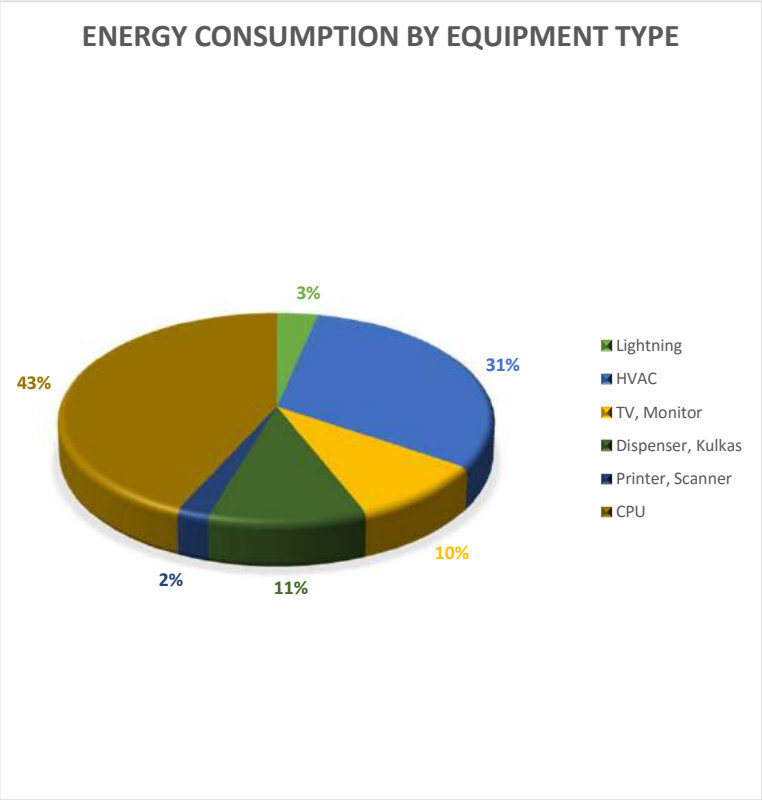
- 26 work days
- 4 days is half day work
- 23% of overtime per month

| No. | Room | Equipment & Brands | Qty | Operating Condition | Usage (Hour(s)) | Power (watt) per equipment | Total Energy Consmtion (kWh) | Energy consumtion each Room/day | Energy consumtion each Room/Month | Energy consumtion each Room/year |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | VVIP Room | LG LED TV 49LH570T | 1 | On | 3 | 276 | 0.83 | 0.99 | 31.60 | 379.15 |
| | | TL Lamp | 1 | On | 4 | 40 | 0.16 | | | |
| 2 | QA/QC Room | CFL Lamp | 4 | On | 10 | 24 | 0.96 | 29.11 | 931.05 | 11172.64 |
| | | AC Panasonic 1,5 PK | 1 | On | 8 | 820 | 6.56 | | | |
| | | AC Panasonic 1 PK | 1 | On | 8 | 630 | 5.04 | | | |
| | | Ben Q G610HDAL Monitor | 3 | On | 8 | 75 | 1.80 | | | |
| | | LG 16M37A - B Monitor | 2 | On | 8 | 75 | 1.20 | | | |
| | | Samsung 633NW Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | Epson Printer L1300 | 1 | Printing | 4 | 20 | 0.08 | | | |
| | | | | Stand-by | 4 | 16 | 0.06 | | | |
| | | | | Power-off | 16 | 0.6 | 0.01 | | | |
| | | CPU | 4 | On | 8 | 400 | 12.80 | | | |
| 3 | HR Room | CFL Lamp | 4 | On | 10 | 24 | 0.96 | 56.70 | 1813.42 | 21761.03 |
| | | AC Daikin 1,5 PK | 2 | On | 8 | 480 | 7.68 | | | |
| | | AOC 16195w Monitor | 2 | On | 8 | 75 | 1.20 | | | |
| | | LG 16M37A - B Monitor | 4 | On | 8 | 75 | 2.40 | | | |
| | | Ben Q G610HDAL Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | Samsung 633NW Monitor | 2 | On | 8 | 75 | 1.20 | | | |
| | | Samsung UA32FH4003 LED TV | 1 | On | 24 | 130 | 3.12 | | | |
| | | Panasonic KX-MB2090 FAX | 1 | Stand-by | 16 | 65 | 1.04 | | | |
| | | | | Printing | 3 | 800 | 2.40 | | | |
| | | | | Copy | 5 | 300 | 1.50 | | | |
| | | Epson Printer L210 | 1 | Printing | 4 | 12 | 0.05 | | | |
| | | | | Stand-by | 4 | 8 | 0.03 | | | |
| | | | | Power-off | 16 | 0.3 | 0.005 | | | |
| | | Panasonic NR-A17KX Refigrator | 1 | On | 24 | 75 | 1.80 | | | |
| | | CPU | 10 | On | 8 | 400 | 32.00 | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Engineering & Marketing Room | CFL Lamp | 3 | On | 10 | 24 | 0.72 | 39.95 | 1277.72 | 15332.59 |
| | | AC Panasonik 1.5PK | 2 | On | 8 | 820 | 13.12 | | | |
| | | LG M2241AN Monitor | 2 | On | 8 | 100 | 1.60 | | | |
| | | LG 20MP48A - P Monitor | 2 | On | 8 | 85 | 1.36 | | | |
| | | LG 16M35A - A Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | Epson Printer L1300 | 1 | Printing | 4 | 20 | 0.08 | | | |
| | | | | Stand-by | 4 | 16 | 0.06 | | | |
| | | | | Power-off | 16 | 0.6 | 0.01 | | | |
| | | CPU | 7 | On | 8 | 400 | 22.40 | | | |
| 5 | Maintenance Room | LED Lamp | 1 | On | 10 | 10.5 | 0.11 | 32.40 | 1036.03 | 12432.37 |
| | | CFL Lamp | 1 | On | 10 | 24 | 0.24 | | | |
| | | AC Panasonik 1.5PK | 1 | On | 8 | 820 | 6.56 | | | |
| | | Ben Q G65HDPL Monitor | 2 | On | 8 | 75 | 1.20 | | | |
| | | Samsung LS16CMYSF Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG 16M355AA Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | Epson Printer L220 | 1 | Printing | 4 | 12 | 0.05 | | | |
| | | | | Stand-by | 4 | 3.8 | 0.02 | | | |
| | | | | Power-off | 16 | 0.3 | 0.005 | | | |
| | | Epson Printer LX 300 + II | 1 | Printing | 4 | 23 | 0.09 | | | |
| | | | | Stand-by | 4 | 8 | 0.03 | | | |
| | | | | Power-off | 16 | 1.2 | 0.02 | | | |
| | | Miyako Dispenser WD-289H | 1 | Hot&Cold | 24 | 420 | 10.08 | | | |
| | | | | Hot Only | 0 | 350 | 0.00 | | | |
| | | | | Cold Only | 0 | 70 | 0.00 | | | |
| | | CPU | 4 | On | 8 | 400 | 12.80 | | | |
| 6 | Marketing Room | CFL Lamp | 2 | On | 10 | 24 | 0.48 | 33.94 | 1085.324448 | 13023.89338 |
| | | AC Panasonik 1.5PK | 1 | On | 8 | 820 | 6.56 | | | |
| | | Samsung LS16CMYSF Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG 16EN338A Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG 53S-BF | 1 | On | 8 | 75 | 0.60 | | | |
| | | Epson Printer L1300 | 1 | Printing | 4 | 20 | 0.08 | | | |
| | | | | Stand-by | 4 | 16 | 0.06 | | | |
| | | | | Power-off | 16 | 0.6 | 0.01 | | | |
| | | Dispenser Uchida MD-12 | 1 | Hot&Cold | 24 | 410 | 9.84 | | | |
| | | | | Hot Only | 0 | 250 | 0.00 | | | |
| | | | | Cold Only | 0 | 60 | 0.00 | | | |
| | | Lenovo Idea Pad 110 Laptop | 1 | On | 8 | 288 | 2.30 | | | |
| | | CPU | 4 | On | 8 | 400 | 12.80 | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 7 | finance floor room | Lampu LED | 5 | On | 10 | 10.5 | 0.53 | 38.95 | 1367.15 | 16405.82 |
| | | AC Panasonic CS-PN12SKJ 1,5PK | 2 | On | 8 | 1090 | 17.44 | | | |
| | | LG W16428-PF Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG 16M38-A Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG E1641S Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG 16M37A - B Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG 20MP48A - P Monitor | 2 | On | 8 | 85 | 1.36 | | | |
| | | AOC 16195w Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | Epson Printer L1300 | 1 | Printing | 4 | 20 | 0.08 | | | |
| | | | | Stand-by | 4 | 16 | 0.06 | | | |
| | | | | Power-off | 16 | 0.6 | 0.01 | | | |
| | | HP Printer Deskjet 1515 | 1 | Printing | 4 | 10 | 0.04 | | | |
| | | | | Stand-by | 4 | 7 | 0.03 | | | |
| | | | | Power-off | 16 | 0.2 | 0.00 | | | |
| | | Epson Printer LX 300 + II | 1 | Printing | 4 | 23 | 0.09 | | | |
| | | | | Stand-by | 4 | 8 | 0.03 | | | |
| | | | | Power-off | 16 | 1.2 | 0.02 | | | |
| | | Epson Printer L110 | 1 | Printing | 4 | 10 | 0.04 | | | |
| | | | | Stand-by | 4 | 2.2 | 0.01 | | | |
| | | | | Power-off | 16 | 0.3 | 0.00 | | | |
| | | Canon Canoscan Scanner LiDE110 | 1 | Scanning | 2 | 3.8 | 0.01 | | | |
| | | | | Stand-by | 6 | 1.2 | 0.01 | | | |
| | | | | Power-off | 16 | 0.3 | 0.005 | | | |
| | | ZSA - 1511 Money Counter | 1 | Counting | 2 | 70 | 0.14 | | | |
| | | | | Stand-by | 22 | 2 | 0.04 | | | |
| | | CPU | 5 | On | 8 | 400 | 16.00 | | | |
| 8 | VIP Meeting Room | LED Lamp | 1 | On | 5 | 10.5 | 0.05 | 12.83 | 410.19 | 4922.30 |
| | | AC Panasonic CS-PN12SKJ 1,5PK | 1 | On | 3 | 1090 | 3.27 | | | |
| | | Panasonic Kx - VS 300 Router | 1 | On | 24 | 110 | 2.64 | | | |
| | | HK Vision CCtv Router | 1 | On | 24 | 286 | 6.86 | | | |
| 9 | Meeting Room | TL Lamp | 1 | On | 5 | 40 | 0.20 | 4.67 | 149.35 | 1792.16 |
| | | CFL Lamp | 1 | On | 5 | 24 | 0.12 | | | |
| | | Panasonic AC Split 2 PK - PN18RKP | 1 | On | 3 | 1450 | 4.35 | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | Medical room | CFL Lamp | 2 | On | 8 | 24 | 0.38 | 24.37 | 779.35 | 9352.23 |
| | | AC Panasonic CS-PN12SKJ 1,5PK | 1 | On | 8 | 1090 | 8.72 | | | |
| | | Samsung LS16CMYSF Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG E1641S Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | Ben Q G610HDAL Monitor | 2 | On | 8 | 75 | 1.20 | | | |
| | | Epson Printer L360 | 1 | Printing | 4 | 13 | 0.05 | | | |
| | | | | Stand-by | 2 | 3.8 | 0.01 | | | |
| | | | | Sleep | 2 | 0.8 | 0.002 | | | |
| | | | | Power-off | 16 | 0.3 | 0.005 | | | |
| | | CPU | 4 | On | 8 | 400 | 12.80 | | | |
| 11 | Ward (Nursing Room) | CFL Lamp | 2 | On | 8 | 24 | 0.38 | 18.32 | 586.00 | 7032.02 |
| | | AC Panasonic CS-PN12SKJ 1,5PK | 1 | On | 8 | 1090 | 8.72 | | | |
| | | Sanken HWD-730N Water Dispenser | 1 | Hot&Cold | 22 | 390 | 8.58 | | | |
| | | | | Hot Only | 2 | 320 | 0.64 | | | |
| | | | | Cold Only | 0 | 70 | 0.00 | | | |
| 12 | Toilet VIP A | LED Lamp | 1 | On | 5 | 10.5 | 0.05 | 0.05 | 2.46 | 29.48 |
| 13 | Toilet VIP B | LED Lamp | 1 | On | 5 | 10.5 | 0.05 | 0.05 | 2.46 | 29.48 |
| 14 | Toilet VIP C | LED Lamp | 1 | On | 5 | 10.5 | 0.05 | 0.05 | 2.46 | 29.48 |
| 15 | VIP Prayer Room | LED Lamp | 2 | On | 2 | 10.5 | 0.04 | 1.00 | 46.89 | 562.72 |
| | | AC Daikin 1,5 PK | 1 | On | 2 | 480 | 0.96 | | | |
| 16 | Hall | LED Lamp | 5 | On | 20 | 10.5 | 1.05 | 3.45 | 161.46 | 1937.52 |
| | | CFL Lamp | 5 | On | 20 | 24 | 2.40 | | | |
| 17 | Lobby | TL Lamp | 1 | On | 20 | 40 | 0.80 | 0.80 | 37.44 | 449.28 |
| Total | | | | | | | | 297.64 | 9720.35 | 116644.18 |
| | | | | | | | Building ECI | | | 251.3341573 |
| | | | | | | | | | 13043.87 | 156526.4824 |
| | | | | | | | | | **ECI per tahun** | **337.2688696** |


ENERGY CONSUMPTION BY EQUIPMENT TYPE
3%
31%
10%
11%
2%
43%
Lightning
HVAC
TV, Monitor
Dispenser, Kulkas
Printer, Scanner
CPU

# ATTACHMENT F
**Equipment Usage After Audit**

Energy usage per-room assumption

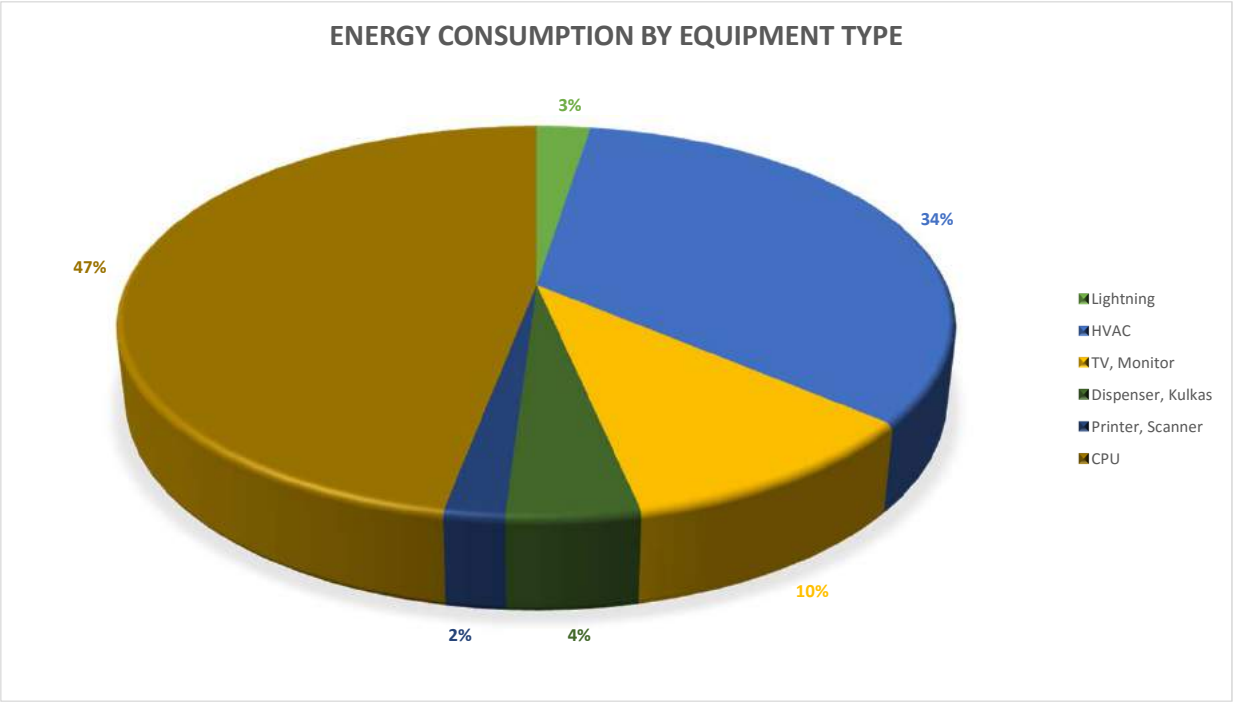
- 26 work days
- 4 days is half day work
- 23% of overtime per month

| No. | Room | Equipment & Brands | Qty | Operating Condition | Usage (Hour(s)) | Power (watt) per equipment | Total Energy Consmtion (kWh) | Energy consumtion each Room/day | Energy consumtion each Room/Month | Energy consumtion each Room/year |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | VVIP Room | LG LED TV 49LH570T | 1 | On | 3 | 276 | 0.83 | 0.99 | 31.60 | 379.15 |
| | | TL Lamp | 1 | On | 4 | 40 | 0.16 | | | |
| 2 | QA/QC Room | CFL Lamp (Change to LED) | 4 | On | 10 | 10.5 | 0.42 | 28.56 | 913.48 | 10961.72 |
| | | AC Panasonic 1,5 PK | 1 | On | 8 | 820 | 6.56 | | | |
| | | AC Panasonic 1 PK | 1 | On | 8 | 630 | 5.04 | | | |
| | | Ben Q G610HDAL Monitor | 3 | On | 8 | 75 | 1.80 | | | |
| | | LG 16M37A - B Monitor | 2 | On | 8 | 75 | 1.20 | | | |
| | | Samsung 633NW Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | Epson Printer L1300 | 1 | Printing | 4 | 20 | 0.08 | | | |
| | | | | Stand-by | 4 | 16 | 0.06 | | | |
| | | | | Power-off | 0 | 0.6 | 0.00 | | | |
| | | CPU | 4 | On | 8 | 400 | 12.80 | | | |
| 3 | HR Room | CFL Lamp (Change to LED) | 4 | On | 10 | 10.5 | 0.42 | 54.72 | 1749.79 | 20997.43 |
| | | AC Daikin 1,5 PK | 2 | On | 8 | 480 | 7.68 | | | |
| | | AOC 16195w Monitor | 2 | On | 8 | 75 | 1.20 | | | |
| | | LG 16M37A - B Monitor | 4 | On | 8 | 75 | 2.40 | | | |
| | | Ben Q G610HDAL Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | Samsung 633NW Monitor | 2 | On | 8 | 75 | 1.20 | | | |
| | | Samsung UA32FH4003 LED TV | 1 | On | 24 | 130 | 3.12 | | | |
| | | Panasonic KX-MB2090 FAX | 1 | Stand-by | 0 | 65 | 0.00 | | | |
| | | | | Printing | 3 | 800 | 2.40 | | | |
| | | | | Copy | 5 | 300 | 1.50 | | | |
| | | Epson Printer L210 | 1 | Printing | 4 | 12 | 0.05 | | | |
| | | | | Stand-by | 4 | 8 | 0.03 | | | |
| | | | | Power-off | 0 | 0.3 | 0.000 | | | |
| | | Panasonic NR-A17KX Refigrator | 1 | On | 24 | 75 | 1.80 | | | |
| | | CPU | 10 | On | 8 | 400 | 32.00 | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Engineering & Marketing Room | CFL Lamp (Change to LED) | 3 | On | 10 | 10.5 | 0.32 | 39.55 | 1264.76 | 15177.17 |
| | | AC Panasonik 1.5PK | 2 | On | 8 | 820 | 13.12 | | | |
| | | LG M2241AN Monitor | 2 | On | 8 | 100 | 1.60 | | | |
| | | LG 20MP48A - P Monitor | 2 | On | 8 | 85 | 1.36 | | | |
| | | LG 16M35A - A Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | Epson Printer L1300 | 1 | Printing | 4 | 20 | 0.08 | | | |
| | | | | Stand-by | 4 | 16 | 0.06 | | | |
| | | | | Power-off | 16 | 0.6 | 0.01 | | | |
| | | CPU | 7 | On | 8 | 400 | 22.40 | | | |
| 5 | Maintenance Room | LED Lamp | 1 | On | 10 | 10.5 | 0.11 | 25.52 | 816.04 | 9792.48 |
| | | CFL Lamp (Change to LED) | 1 | On | 10 | 10.5 | 0.11 | | | |
| | | AC Panasonik 1.5PK | 1 | On | 8 | 820 | 6.56 | | | |
| | | Ben Q G65HDPL Monitor | 2 | On | 8 | 75 | 1.20 | | | |
| | | Samsung LS16CMYSF Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG 16M355AA Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | Epson Printer L220 | 1 | Printing | 4 | 12 | 0.05 | | | |
| | | | | Stand-by | 4 | 3.8 | 0.02 | | | |
| | | | | Power-off | 0 | 0.3 | 0.000 | | | |
| | | Epson Printer LX 300 + II | 1 | Printing | 4 | 23 | 0.09 | | | |
| | | | | Stand-by | 4 | 8 | 0.03 | | | |
| | | | | Power-off | 0 | 1.2 | 0.00 | | | |
| | | Miyako Dispenser WD-289H | 1 | Hot&Cold | 8 | 420 | 3.36 | | | |
| | | | | Hot Only | 0 | 350 | 0.00 | | | |
| | | | | Cold Only | 0 | 70 | 0.00 | | | |
| | | CPU | 4 | On | 8 | 400 | 12.80 | | | |
| 6 | Marketing Room | CFL Lamp (Change to LED) | 2 | On | 10 | 10.5 | 0.21 | 27.10 | 866.59404 | 10399.12848 |
| | | AC Panasonik 1.5PK | 1 | On | 8 | 820 | 6.56 | | | |
| | | Samsung LS16CMYSF Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG 16EN338A Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG 53S-BF | 1 | On | 8 | 75 | 0.60 | | | |
| | | Epson Printer L1300 | 1 | Printing | 4 | 20 | 0.08 | | | |
| | | | | Stand-by | 4 | 16 | 0.06 | | | |
| | | | | Power-off | 0 | 0.6 | 0.00 | | | |
| | | Dispenser Uchida MD-12 | 1 | Hot&Cold | 8 | 410 | 3.28 | | | |
| | | | | Hot Only | 0 | 250 | 0.00 | | | |
| | | | | Cold Only | 0 | 60 | 0.00 | | | |
| | | Lenovo Idea Pad 110 Laptop | 1 | On | 8 | 288 | 2.30 | | | |
| | | CPU | 4 | On | 8 | 400 | 12.80 | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 7 | finance floor room | Lampu LED | 5 | On | 10 | 10.5 | 0.53 | 38.88 | 1364.57 | 16374.82 |
| | | AC Panasonic CS-PN12SKJ 1,5PK | 2 | On | 8 | 1090 | 17.44 | | | |
| | | LG W16428-PF Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG 16M38-A Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG E1641S Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG 16M37A - B Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG 20MP48A - P Monitor | 2 | On | 8 | 85 | 1.36 | | | |
| | | AOC 16195w Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | Epson Printer L1300 | 1 | Printing | 4 | 20 | 0.08 | | | |
| | | | | Stand-by | 4 | 16 | 0.06 | | | |
| | | | | Power-off | 0 | 0.6 | 0.00 | | | |
| | | HP Printer Deskjet 1515 | 1 | Printing | 4 | 10 | 0.04 | | | |
| | | | | Stand-by | 4 | 7 | 0.03 | | | |
| | | | | Power-off | 0 | 0.2 | 0.00 | | | |
| | | Epson Printer LX 300 + II | 1 | Printing | 4 | 23 | 0.09 | | | |
| | | | | Stand-by | 4 | 8 | 0.03 | | | |
| | | | | Power-off | 0 | 1.2 | 0.00 | | | |
| | | Epson Printer L110 | 1 | Printing | 4 | 10 | 0.04 | | | |
| | | | | Stand-by | 4 | 2.2 | 0.01 | | | |
| | | | | Power-off | 0 | 0.3 | 0.00 | | | |
| | | Canon Canoscan Scanner LiDE110 | 1 | Scanning | 2 | 3.8 | 0.01 | | | |
| | | | | Stand-by | 6 | 1.2 | 0.01 | | | |
| | | | | Power-off | 0 | 0.3 | 0.000 | | | |
| | | ZSA - 1511 Money Counter | 1 | Counting | 2 | 70 | 0.14 | | | |
| | | | | Stand-by | 6 | 2 | 0.01 | | | |
| | | CPU | 5 | On | 8 | 400 | 16.00 | | | |
| 8 | VIP Meeting Room | LED Lamp | 1 | On | 5 | 10.5 | 0.05 | 12.83 | 410.19 | 4922.30 |
| | | AC Panasonic CS-PN12SKJ 1,5PK | 1 | On | 3 | 1090 | 3.27 | | | |
| | | Panasonic Kx - VS 300 Router | 1 | On | 24 | 110 | 2.64 | | | |
| | | HK Vision CCtv Router | 1 | On | 24 | 286 | 6.86 | | | |
| 9 | Meeting Room | TL Lamp | 1 | On | 5 | 40 | 0.20 | 4.60 | 147.19 | 1766.26 |
| | | CFL Lamp (Change to LED) | 1 | On | 5 | 10.5 | 0.05 | | | |
| | | Panasonic AC Split 2 PK - PN18RKP | 1 | On | 3 | 1450 | 4.35 | | | |

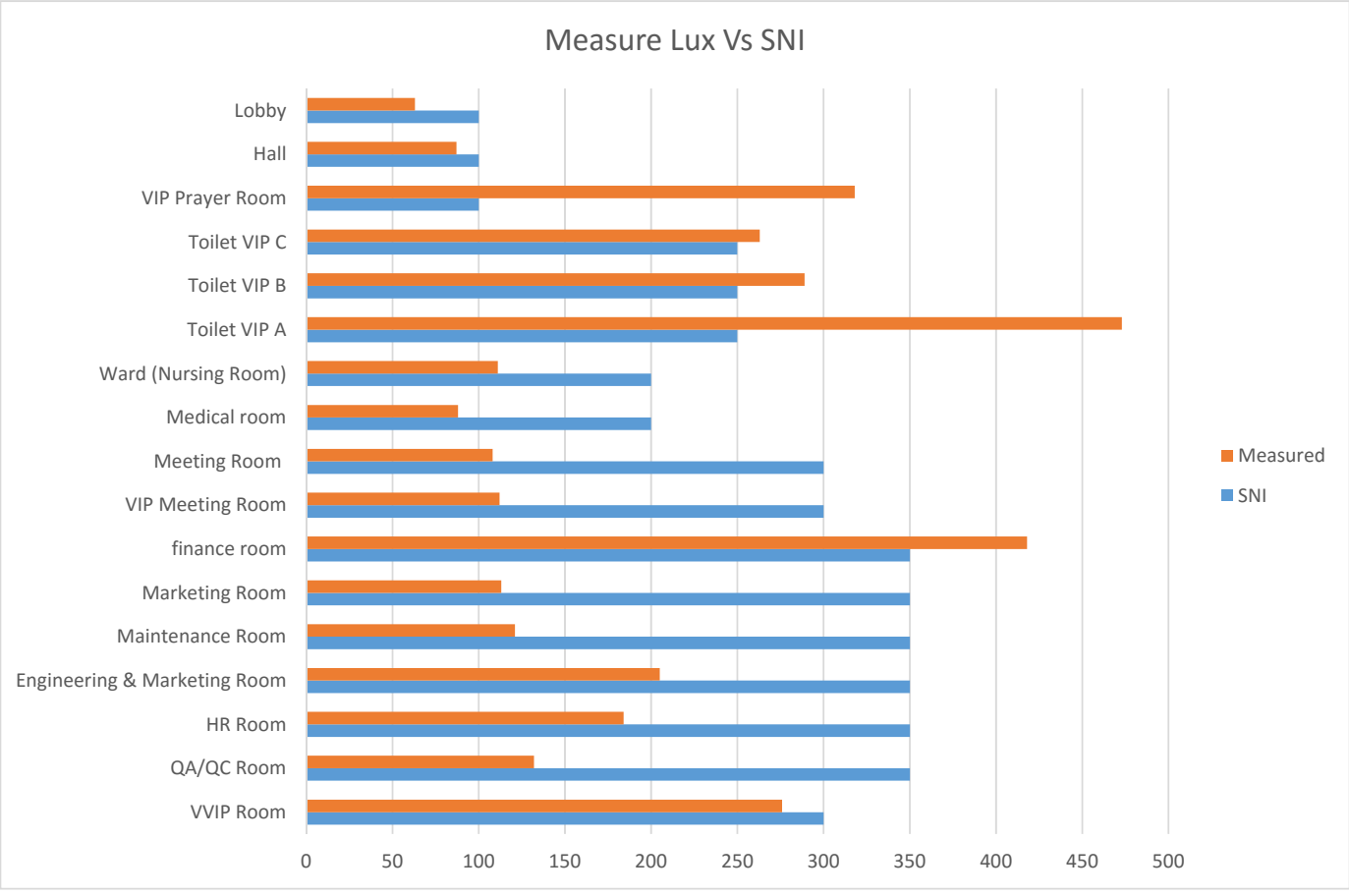
| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | Medical room | CFL Lamp | 2 | On | 8 | 10.5 | 0.17 | 24.15 | 772.29 | 9267.50 |
| | | AC Panasonic CS-PN12SKJ 1,5PK | 1 | On | 8 | 1090 | 8.72 | | | |
| | | Samsung LS16CMYSF Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | LG E1641S Monitor | 1 | On | 8 | 75 | 0.60 | | | |
| | | Ben Q G610HDAL Monitor | 2 | On | 8 | 75 | 1.20 | | | |
| | | Epson Printer L360 | 1 | Printing | 4 | 13 | 0.05 | | | |
| | | | | Stand-by | 2 | 3.8 | 0.01 | | | |
| | | | | Sleep | 2 | 0.8 | 0.002 | | | |
| | | | | Power-off | 0 | 0.3 | 0.000 | | | |
| | | CPU | 4 | On | 8 | 400 | 12.80 | | | |
| 11 | Ward (Nursing Room) | CFL Lamp (Change to LED) | 2 | On | 8 | 10.5 | 0.17 | 11.87 | 379.54 | 4554.46 |
| | | AC Panasonic CS-PN12SKJ 1,5PK | 1 | On | 8 | 1090 | 8.72 | | | |
| | | Sanken HWD-730N Water Dispenser | 1 | Hot&Cold | 6 | 390 | 2.34 | | | |
| | | | | Hot Only | 2 | 320 | 0.64 | | | |
| | | | | Cold Only | 0 | 70 | 0.00 | | | |
| 12 | Toilet VIP A | LED Lamp | 1 | On | 5 | 10.5 | 0.05 | 0.05 | 2.46 | 29.48 |
| 13 | Toilet VIP B | LED Lamp | 1 | On | 5 | 10.5 | 0.05 | 0.05 | 2.46 | 29.48 |
| 14 | Toilet VIP C | LED Lamp | 1 | On | 5 | 10.5 | 0.05 | 0.05 | 2.46 | 29.48 |
| 15 | VIP Prayer Room | LED Lamp | 2 | On | 2 | 10.5 | 0.04 | 1.00 | 46.89 | 562.72 |
| | | AC Daikin 1,5 PK | 1 | On | 2 | 480 | 0.96 | | | |
| 16 | Hall | LED Lamp | 5 | On | 20 | 10.5 | 1.05 | 2.10 | 98.28 | 1179.36 |
| | | CFL Lamp (Change to LED) | 5 | On | 20 | 10.5 | 1.05 | | | |
| 17 | Lobby | TL Lamp | 1 | On | 20 | 40 | 0.80 | 0.80 | 37.44 | 449.28 |
| Total | | | | | | | | 272.81 | 8906.02 | 106872.24 |
| | | | | | | | Building ECI | | | 230.2784672 |
| | | | | | | | | | 12229.54 | 146754.5366 |
| | | | | | | | | | **ECI per tahun** | **316.2131795** |


ENERGY CONSUMPTION BY EQUIPMENT TYPE
3%
34%
47%
10%
2%
4%
Lightning
HVAC
TV, Monitor
Dispenser, Kulkas
Printer, Scanner
CPU

# ATTACHMENT G
## Lux Measurement and Analysis

| No | Room | Lux Metered | | | | | Analisys |
|---|---|---|---|---|---|---|---|
| | | Measured | SNI | Type | Qty | Power | |
| 1 | VVIP Room | 276 | 300 | TL | 1 | 40 | The value of measured LUX it is **not fullfill SNI standarts** because when measuring this room it is not being fully used. Even though the room is facing south the curtain is blocking all the light |
| 2 | QA/QC Room | 132 | 350 | CFL | 4 | 24 | The value of measured LUX it is **not fullfill SNI standarts.** QA/QC Room is almost empty when the measurement process. Because the job desc of QA/QC it is possilble to not in the room all the time |
| 3 | HR Room | 184 | 350 | CFL | 4 | 24 | The Value of measured LUX it is **not fullfill SNI standarts.** Because the room is facing North while in PT. ASSI in the north side of the building there so many threes that blocking the light |
| 4 | Engineering & Marketing Room | 205 | 350 | CFL | 3 | 24 | The Value of measured LUX it is **not fullfill SNI standarts.** Even though the room alrady has good amount of lamp. Because it is still using cfl lamp the lumens from cfl lamps 24 watt is still small enough comparing with led 10.5 watts |
| 5 | Maintenance Room | 121 | 350 | LED | 1 | 10.5 | The value of measured LUX it is **not fullfill SNI standarts**. Even though the room is facing south the curtain is blocking all the light |
| | | | | CFL | 1 | 24 | |
| 6 | Marketing Room | 113 | 350 | CFL | 2 | 24 | The Value of measured LUX it is **not fullfill SNI standarts.** Because the room is facing North while in PT. ASSI in the north side of the building there so many threes that blocking the light |
| 7 | finance room | 418 | 350 | LED | 5 | 10.5 | Value of measured LUX is **Fullfill SNI standarts**. This room has good amount of lamp and good lamp posisioning makes it not only bright in one side of the room but all side of the room |
| 8 | VIP Meeting Room | 112 | 300 | LED | 1 | 10.5 | room does not have good amount of lamp. Especially for meeting room |
| 9 | Meeting Room | 108 | 300 | TL | 1 | 40 | The value of measured LUX it is **not fullfill SNI standarts** the room does not have good amount of lamp. Especially for meeting room. But when measueing this room the TL lamp it is not turned on |
| | | | | CFL | 1 | 24 | |

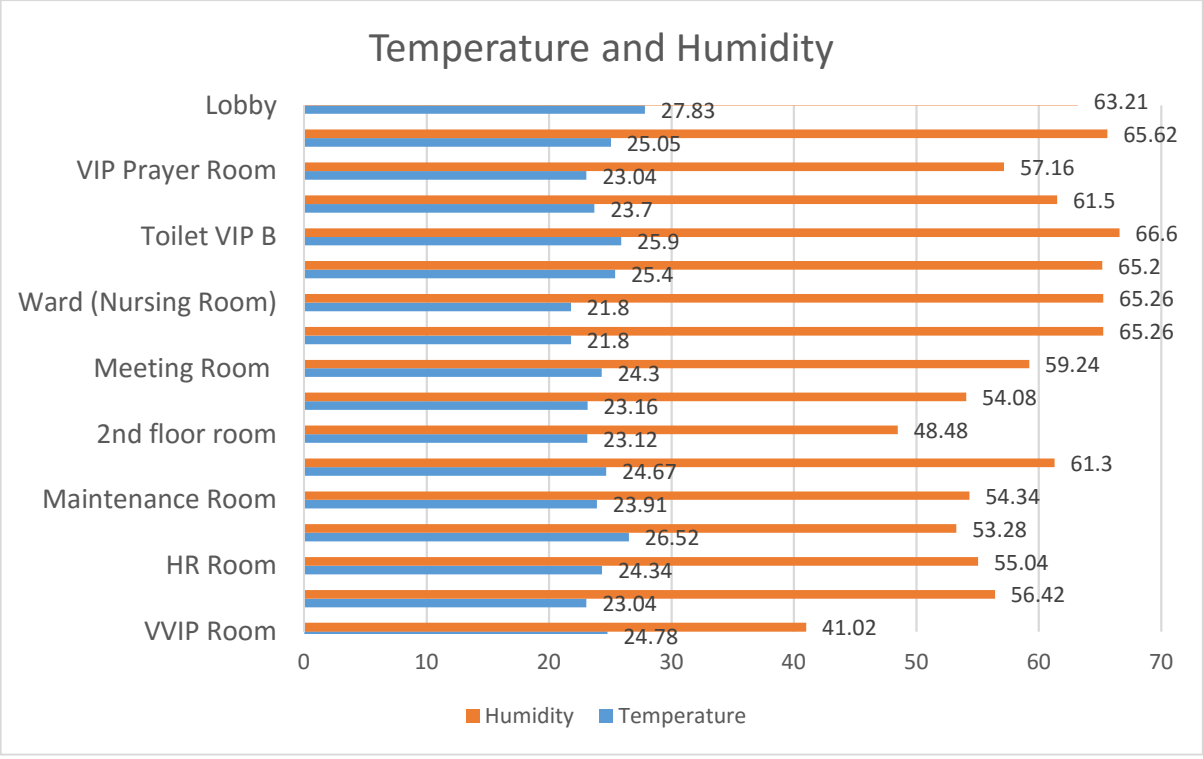
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 10 | Medical room | 88 | 200 | CFL | 2 | 24 | The value of measured LUX it is **not fullfill SNI standarts** because this room is facing the west side. And beccause this room is not in the same building. The light from the sun is being block by the main office building |
| 11 | Ward (Nursing Room) | 111 | 200 | CFL | 2 | 24 | The value of measured LUX it is **not fullfill SNI standarts** because this room is facing the west side. And beccause this room is not in the same building. The light from the sun is being block by the main office building |
| 12 | Toilet VIP A | 473 | 250 | LED | 1 | 10.5 | value of measured LUX is **Fullfill SNI standarts**. This room has good amount of lamp and good lamp posisioning and also the small window is helping the amount of lighting that came to the room |
| 13 | Toilet VIP B | 289 | 250 | LED | 1 | 10.5 | value of measured LUX is **Fullfill SNI standarts**. This room has good amount of lamp and good lamp posisioning and also the small window is helping the amount of lighting that came to the room |
| 14 | Toilet VIP C | 263 | 250 | LED | 1 | 10.5 | value of measured LUX is **Fullfill SNI standarts**. This room has good amount of lamp and good lamp posisioning and also the small window is helping the amount of lighting that came to the room |
| 15 | VIP Prayer Room | 318 | 100 | LED | 2 | 10.5 | |
| 16 | Hall | 87 | 100 | LED | 5 | 10.5 | |
| | | | | CFL | 5 | 24 | |
| 17 | Lobby | 63 | 100 | TL | 1 | 40 | |


Measure Lux Vs SNI
Lobby
Hall
VIP Prayer Room
Toilet VIP C
Toilet VIP B
Toilet VIP A
Ward (Nursing Room)
Medical room
Meeting Room
VIP Meeting Room
finance room
Marketing Room
Maintenance Room
Engineering & Marketing Room
HR Room
QA/QC Room
VVIP Room
0
50
100
150
200
250
300
350
400
450
500
Measured
SNI

# ATTACHMENT H

**Temperature and Humidity Measurement and Analysis**

| No. | Room | Temperature | Humidity |
|---|---|---|---|
| 1 | VVIP Room | 24.78 | 41.02 |
| 2 | QA/QC Room | 23.04 | 56.42 |
| 3 | HR Room | 24.34 | 55.04 |
| 4 | Engineering & Marketing Room | 26.52 | 53.28 |
| 5 | Maintenance Room | 23.91 | 54.34 |
| 6 | Marketing Room | 24.67 | 61.3 |
| 7 | 2nd floor room | 23.12 | 48.48 |
| 8 | VIP Meeting Room | 23.16 | 54.08 |
| 9 | Meeting Room | 24.3 | 59.24 |
| 10 | Medical room | 21.8 | 65.26 |
| 11 | Ward (Nursing Room) | 21.8 | 65.26 |
| 12 | Toilet VIP A | 25.4 | 65.2 |
| 13 | Toilet VIP B | 25.9 | 66.6 |
| 14 | Toilet VIP C | 23.7 | 61.5 |
| 15 | VIP Prayer Room | 23.04 | 57.16 |
| 16 | Hall | 25.05 | 65.62 |
| 17 | Lobby | 27.83 | 63.21 |


Temperature and Humidity
Lobby
VIP Prayer Room
Toilet VIP B
Ward (Nursing Room)
Meeting Room
2nd floor room
Maintenance Room
HR Room
VVIP Room
27.83
63.21
25.05
65.62
23.04
57.16
23.7
61.5
25.9
66.6
25.4
65.2
21.8
65.26
21.8
65.26
24.3
59.24
23.16
54.08
23.12
48.48
24.67
61.3
23.91
54.34
26.52
53.28
24.34
55.04
23.04
56.42
24.78
41.02
0
10
20
30
40
50
60
70
Humidity
Temperature

# ATTACHMENT I
## PT ASSI. ELECTRICAL INVOICE FROM PLN

HUAWEI Mate 9 Pro
LEICA DUAL CAMERA

**PT PLN (Persero)**

Jalan Trunojoyo Blok M I/135 Kebayoran Baru – Jakarta 12160
Telepon (021) 7261875, 7261122, 7262234 Facsimile : (021) 7221330 Website : www.pln.co.id
(021) 7251234, 7250560

**PENETAPAN**
**PENYESUAIAN TARIF TENAGA LISTRIK *(TARIFF ADJUSTMENT)***

**BULAN APRIL - JUNI 2018**

| NO | GOL. TARIF | BATAS DAYA | REGULER | | PRA BAYAR (Rp/kWh) |
|---|---|---|---|---|---|
| | | | BIAYA BEBAN (Rp/kVA/bulan) | BIAYA PEMAKAIAN (Rp/kWh) DAN BIAYA kVArh (Rp/kVArh) | |
| 1 | R-1/TR | 1.300 VA | *) | 1.467,28 | 1.467,28 |
| 2 | R-1/TR | 2.200 VA | *) | 1.467,28 | 1.467,28 |
| 3 | R-2/TR | 3.500 VA s.d. 5.500 VA | *) | 1.467,28 | 1.467,28 |
| 4 | R-3/TR | 6.600 VA ke atas | *) | 1.467,28 | 1.467,28 |
| 5 | B-2/TR | 6.600 VA s.d. 200 kVA | *) | 1.467,28 | 1.467,28 |
| 6 | B-3/TM | di atas 200 kVA | **) | Blok WBP = K x 1.035,78<br>Blok LWBP = 1.035,78<br>kVArh = 1.114,74 ****) | |
| 7 | I-3/TM | di atas 200 kVA | **) | Blok WBP = K x 1.035,78<br>Blok LWBP = 1.035,78<br>kVArh = 1.114,74 ****) | |
| 8 | I-4/TT | 30.000 kVA ke atas | ***) | Blok WBP dan<br>Blok LWBP = 996,74<br>kVArh = 996,74 ****) | |
| 9 | P-1/TR | 6.600 VA s.d. 200 kVA | *) | 1.467,28 | 1.467,28 |
| 10 | P-2/TM | di atas 200 kVA | **) | Blok WBP = K x 1.035,78<br>Blok LWBP = 1.035,78<br>kVArh = 1.114,74 ****) | |
| 11 | P-3/TR | | *) | 1.467,28 | 1.467,28 |
| 12 | L/TR, TM, TT | | | 1.644,52 | |

Catatan
*) Diterapkan Rekening Minimum (RM):
RM1 = 40 (Jam Nyala) x Daya tersambung (kVA) x Biaya Pemakaian
**) Diterapkan Rekening Minimum (RM):
RM2 = 40 (Jam Nyala) x Daya tersambung (kVA) x Biaya Pemakaian LWBP
Jam nyala : kWh per bulan dibagi dengan kVA tersambung.
***) Diterapkan Rekening Minimum (RM):
RM3 = 40 (Jam Nyala) x Daya tersambung (kVA) x Biaya Pemakaian WBP dan LWBP
Jam nyala : kWh per bulan dibagi dengan kVA tersambung.
****) Biaya kelebihan pemakaian daya reaktif (kVArh) dikenakan dalam hal faktor daya rata-rata setiap bulan kurang dari 0,85 (delapan puluh lima per seratus).
K : Faktor perbandingan antara harga WBP dan LWBP sesuai dengan karakteristik beban sistem kelistrikan setempat (1,4 ≤ K ≤ 2) ditetapkan oleh Direksi Perusahaan Perseroan (Persero) PT Perusahaan Listrik Negara.

WBP : Waktu Beban Puncak
LWBP : Luar Waktu Beban Puncak



http://www.pln.co.id/statics/uploads/2018/05/Tariff-Adjustment-April-Juni-2018-1.jpg

TOTAL BIAYA
# PEMAKAIAN TENAGA LISTRIK
## PT ADILUHUNG SARANASEGARA INDONESIA
Bulan : Januari 2018

| TANGGAL | LWBP | | WBP | | KVaRh | | | |
|---|---|---|---|---|---|---|---|---|
| | KWH | RUPIAH | KWH | RUPIAH | KWH | FREE | OVER | BIAYA |
| | | | | | | | | |
| | | | | | | | | |
| 01-Jan-18 | 1.740,00 | 1.802.257,20 | 270,00 | 419.490,90 | 1.500,00 | 1.206,00 | 294,00 | 327.733,56 |
| 02-Jan-18 | 2.070,00 | 2.144.064,60 | 390,00 | 605.931,30 | 1.650,00 | 1.476,00 | 174,00 | 193.964,76 |
| 03-Jan-18 | 4.710,00 | 4.878.523,80 | 930,00 | 1.444.913,10 | 3.780,00 | 3.384,00 | 396,00 | 441.437,04 |
| 04-Jan-18 | 4.620,00 | 4.785.303,60 | 1.110,00 | 1.724.573,70 | 3.690,00 | 3.438,00 | 252,00 | 280.914,48 |
| 05-Jan-18 | 4.050,00 | 4.194.909,00 | 690,00 | 1.072.032,30 | 2.760,00 | 2.844,00 | | - |
| 06-Jan-18 | 3.990,00 | 4.132.762,20 | 690,00 | 1.072.032,30 | 2.700,00 | 2.808,00 | | - |
| 07-Jan-18 | 3.930,00 | 4.070.615,40 | 630,00 | 978.812,10 | 2.640,00 | 2.736,00 | | - |
| 08-Jan-18 | 4.140,00 | 4.288.129,20 | 690,00 | 1.072.032,30 | 2.880,00 | 2.898,00 | | - |
| 09-Jan-18 | 5.340,00 | 5.531.065,20 | 1.200,00 | 1.864.404,00 | 3.960,00 | 3.924,00 | 36,00 | 40.130,64 |
| 10-Jan-18 | 5.280,00 | 5.468.918,40 | 1.200,00 | 1.864.404,00 | 3.900,00 | 3.888,00 | 12,00 | 13.376,88 |
| [illegible]-Jan-18 | 5.460,00 | 5.655.358,80 | 1.200,00 | 1.864.404,00 | 4.080,00 | 3.996,00 | 84,00 | 93.638,16 |
| 12-Jan-18 | 4.770,00 | 4.940.670,60 | 630,00 | 978.812,10 | 3.330,00 | 3.240,00 | 90,00 | 100.326,60 |
| 13-Jan-18 | 3.630,00 | 3.759.881,40 | 630,00 | 978.812,10 | 2.370,00 | 2.556,00 | | - |
| 14-Jan-18 | 3.570,00 | 3.697.734,60 | 570,00 | 885.591,90 | 2.310,00 | 2.484,00 | | - |
| 15-Jan-18 | 3.720,00 | 3.853.101,60 | 720,00 | 1.118.642,40 | 2.460,00 | 2.664,00 | | - |
| 16-Jan-18 | 5.670,00 | 5.872.872,60 | 1.410,00 | 2.190.674,70 | 3.720,00 | 4.248,00 | | - |
| 17-Jan-18 | 4.560,00 | 4.723.156,80 | 1.380,00 | 2.144.064,60 | 3.030,00 | 3.564,00 | | - |
| 18-Jan-18 | 3.960,00 | 4.101.688,80 | 660,00 | 1.025.422,20 | 2.610,00 | 2.772,00 | | - |
| 19-Jan-18 | 3.900,00 | 4.039.542,00 | 600,00 | 932.202,00 | 2.550,00 | 2.700,00 | | - |
| 20-Jan-18 | 3.840,00 | 3.977.395,20 | 540,00 | 838.981,80 | 2.490,00 | 2.628,00 | | - |
| 21-Jan-18 | 3.960,00 | 4.101.688,80 | 660,00 | 1.025.422,20 | 2.610,00 | 2.772,00 | | - |
| 22-Jan-18 | 4.140,00 | 4.288.129,20 | 960,00 | 1.491.523,20 | 2.850,00 | 3.060,00 | | - |
| 23-Jan-18 | 4.380,00 | 4.536.716,40 | 1.110,00 | 1.724.573,70 | 3.210,00 | 3.294,00 | | - |
| 24-Jan-18 | 4.440,00 | 4.598.863,20 | 1.140,00 | 1.771.183,80 | 3.240,00 | 3.348,00 | | - |
| 25-Jan-18 | 5.550,00 | 5.748.579,00 | 1.170,00 | 1.817.793,90 | 3.810,00 | 4.032,00 | | - |
| 26-Jan-18 | 4.350,00 | 4.505.643,00 | 720,00 | 1.118.642,40 | 2.820,00 | 3.042,00 | | - |
| [illegible]-Jan-18 | 4.290,00 | 4.443.496,20 | 660,00 | 1.025.422,20 | 2.760,00 | 2.970,00 | | - |
| 28-Jan-18 | 4.170,00 | 4.319.202,60 | 600,00 | 932.202,00 | 2.700,00 | 2.862,00 | | - |
| 29-Jan-18 | 4.680,00 | 4.847.450,40 | 960,00 | 1.491.523,20 | 3.060,00 | 3.384,00 | | - |
| 30-Jan-18 | 5.130,00 | 5.313.551,40 | 1.440,00 | 2.237.284,80 | 3.540,00 | 3.942,00 | | - |
| 31-Jan-18 | 5.730,00 | 5.935.019,40 | 1.200,00 | 1.864.404,00 | 3.870,00 | 4.158,00 | | - |
| | | 138.556.290,60 | | 41.576.209,20 | | | | 1.491.522,1 |
| | | | | | Grand Total | | | 181.624.021,9 |

Bangkalan, 1 Februari 2018

CTT :

Untuk tarif LWBP = 1.035,78
WBP = 1.5 * 1.035,78
kVarh = 1.114,74

( sesuai tarif PLN )

Nu'man Hamdani
Manager fasilitas

HUAWEI Mate 9 Pro
LEICA DUAL CAMERA

# TOTAL BIAYA
# PEMAKAIAN TENAGA LISTRIK
## PT ADILUHUNG SARANASEGARA INDONESIA
**Bulan : Februari 2018**

| TANGGAL | LWBP | | WBP | | KVaRh | | | |
|---|---|---|---|---|---|---|---|---|
| | KWH | RUPIAH | KWH | RUPIAH | KWH | FREE | OVER | BIAYA |
| 01-Feb-18 | 4.680,00 | 4.847.450,40 | 1.260,00 | 1.957.624,20 | 3.840,00 | 3.564,00 | 276,00 | 307.668,24 |
| 02-Feb-18 | 4.170,00 | 4.319.202,60 | 420,00 | 652.541,40 | 2.760,00 | 2.754,00 | 6,00 | 6.688,44 |
| 03-Feb-18 | 3.780,00 | 3.915.248,40 | 780,00 | 1.211.862,60 | 2.700,00 | 2.736,00 | | - |
| 04-Feb-18 | 3.750,00 | 3.884.175,00 | 720,00 | 1.118.642,40 | 2.640,00 | 2.682,00 | | - |
| 05-Feb-18 | 3.840,00 | 3.977.395,20 | 900,00 | 1.398.303,00 | 2.820,00 | 2.844,00 | | - |
| 06-Feb-18 | 5.340,00 | 5.531.065,20 | 1.080,00 | 1.677.963,60 | 3.840,00 | 3.852,00 | | - |
| 07-Feb-18 | 5.310,00 | 5.499.991,80 | 1.110,00 | 1.724.573,70 | 3.270,00 | 3.852,00 | | - |
| 08-Feb-18 | 4.770,00 | 4.940.670,60 | 720,00 | 1.118.642,40 | 3.090,00 | 3.294,00 | | - |
| 09-Feb-18 | 4.890,00 | 5.064.964,20 | 870,00 | 1.351.692,90 | 3.240,00 | 3.456,00 | | - |
| 10-Feb-18 | 3.300,00 | 3.418.074,00 | 690,00 | 1.072.032,30 | 2.490,00 | 2.394,00 | 96,00 | 107.015,04 |
| 11-Feb-18 | 3.420,00 | 3.542.367,60 | 840,00 | 1.305.082,80 | 2.610,00 | 2.556,00 | 54,00 | 60.195,96 |
| 12-Feb-18 | 4.560,00 | 4.723.156,80 | 720,00 | 1.118.642,40 | 3.060,00 | 3.168,00 | | - |
| 13-Feb-18 | 4.890,00 | 5.064.964,20 | 1.110,00 | 1.724.573,70 | 3.420,00 | 3.600,00 | | - |
| 14-Feb-18 | 4.920,00 | 5.096.037,60 | 1.050,00 | 1.631.353,50 | 3.120,00 | 3.582,00 | | - |
| 15-Feb-18 | 5.460,00 | 5.655.358,80 | 1.410,00 | 2.190.674,70 | 3.900,00 | 4.122,00 | | - |
| 16-Feb-18 | 3.810,00 | 3.946.321,80 | 540,00 | 838.981,80 | 2.340,00 | 2.610,00 | | - |
| 17-Feb-18 | 3.780,00 | 3.915.248,40 | 510,00 | 792.371,70 | 2.310,00 | 2.574,00 | | - |
| 18-Feb-18 | 3.750,00 | 3.884.175,00 | 480,00 | 745.761,60 | 2.280,00 | 2.538,00 | | - |
| 19-Feb-18 | 3.990,00 | 4.132.762,20 | 720,00 | 1.118.642,40 | 2.430,00 | 2.826,00 | | - |
| 20-Feb-18 | 5.760,00 | 5.966.092,80 | 1.140,00 | 1.771.183,80 | 3.630,00 | 4.140,00 | | - |
| 21-Feb-18 | 5.220,00 | 5.406.771,60 | 1.470,00 | 2.283.894,90 | 3.780,00 | 4.014,00 | | - |
| 22-Feb-18 | 4.980,00 | 5.158.184,40 | 1.320,00 | 2.050.844,40 | 3.360,00 | 3.780,00 | | - |
| 23-Feb-18 | 3.900,00 | 4.039.542,00 | 480,00 | 745.761,60 | 2.520,00 | 2.628,00 | | - |
| 24-Feb-18 | 3.810,00 | 3.946.321,80 | 780,00 | 1.211.862,60 | 2.670,00 | 2.754,00 | | - |
| 25-Feb-18 | 3.780,00 | 3.915.248,40 | 750,00 | 1.165.252,50 | 2.310,00 | 2.718,00 | | - |
| 26-Feb-18 | 3.750,00 | 3.884.175,00 | 720,00 | 1.118.642,40 | 2.670,00 | 2.682,00 | | - |
| 27-Feb-18 | 3.960,00 | 4.101.688,80 | 960,00 | 1.491.523,20 | 3.120,00 | 2.952,00 | 168,00 | 187.276,32 |
| 28-Feb-18 | 4.500,00 | 4.661.010,00 | 1.020,00 | 1.584.743,40 | 3.300,00 | 3.312,00 | | - |
| | | 126.437.664,60 | | 38.173.671,90 | | | | 668.844,0 |
| | | | | | Grand Total | | | 165.280.180, |

Bangkalan, 2 Maret 2018

Setyo Agung, BE
PLT Manager fasilitas

**CTT :**

Untuk tarif LWBP = 1.035,78
WBP = 1.5 * 1.035,78
kVarh = 1.114,74

( sesuai tarif PLN )

HUAWEI Mate 9 Pro
LEICA DUAL CAMERA

Bulan : Juni 2018

TOTAL BIAYA

# PEMAKAIAN TENAGA LISTRIK

## PT ADILUHUNG SARANASEGARA INDONESIA

**Bulan : Maret 2018**

| TANGGAL | LWBP | | WBP | | KVaRh | | | |
|---|---|---|---|---|---|---|---|---|
| | KWH | RUPIAH | KWH | RUPIAH | KWH | FREE | OVER | BIAYA |
| 01-Mar-18 | 4.710,00 | 4.878.523,80 | 1.080,00 | 1.677.963,60 | 3.630,00 | 3.474,00 | 156,00 | 173.899,44 |
| 02-Mar-18 | 4.800,00 | 4.971.744,00 | 1.110,00 | 1.724.573,70 | 3.690,00 | 3.546,00 | 144,00 | 160.522,56 |
| 03-Mar-18 | 3.630,00 | 3.759.881,40 | 690,00 | 1.072.032,30 | 2.490,00 | 2.592,00 | | - |
| 04-Mar-18 | 3.600,00 | 3.728.808,00 | 660,00 | 1.025.422,20 | 2.430,00 | 2.556,00 | | - |
| 05-Mar-18 | 3.690,00 | 3.822.028,20 | 780,00 | 1.211.862,60 | 2.610,00 | 2.682,00 | | - |
| 06-Mar-18 | 6.030,00 | 6.245.753,40 | 1.260,00 | 1.957.624,20 | 5.040,00 | 4.374,00 | 666,00 | 742.416,84 |
| 07-Mar-18 | 6.180,00 | 6.401.120,40 | 1.380,00 | 2.144.064,60 | 5.130,00 | 4.536,00 | 594,00 | 662.155,56 |
| 08-Mar-18 | 5.670,00 | 5.872.872,60 | 900,00 | 1.398.303,00 | 5.040,00 | 3.942,00 | 1.098,00 | 1.223.984,52 |
| 09-Mar-18 | 6.540,00 | 6.774.001,20 | 1.260,00 | 1.957.624,20 | 5.040,00 | 4.680,00 | 360,00 | 401.306,40 |
| 10-Mar-18 | 5.130,00 | 5.313.551,40 | 1.110,00 | 1.724.573,70 | 3.930,00 | 3.744,00 | 186,00 | 207.341,64 |
| 11-Mar-18 | 5.070,00 | 5.251.404,60 | 1.110,00 | 1.724.573,70 | 3.900,00 | 3.708,00 | 192,00 | 214.030,08 |
| 12-Mar-18 | 5.220,00 | 5.406.771,60 | 1.140,00 | 1.771.183,80 | 3.960,00 | 3.816,00 | 144,00 | 160.522,56 |
| 13-Mar-18 | 6.270,00 | 6.494.340,60 | 1.470,00 | 2.283.894,90 | 4.890,00 | 4.644,00 | 246,00 | 274.226,04 |
| 14-Mar-18 | 6.870,00 | 7.115.808,60 | 1.410,00 | 2.190.674,70 | 4.770,00 | 4.968,00 | | - |
| 15-Mar-18 | 7.350,00 | 7.612.983,00 | 1.590,00 | 2.470.335,30 | 5.790,00 | 5.364,00 | 426,00 | 474.879,24 |
| 16-Mar-18 | 7.350,00 | 7.612.983,00 | 1.620,00 | 2.516.945,40 | 5.820,00 | 5.382,00 | 438,00 | 488.256,12 |
| 17-Mar-18 | 5.010,00 | 5.189.257,80 | 1.110,00 | 1.724.573,70 | 4.140,00 | 3.672,00 | 468,00 | 521.698,32 |
| 18-Mar-18 | 4.980,00 | 5.158.184,40 | 1.110,00 | 1.724.573,70 | 4.110,00 | 3.654,00 | 456,00 | 508.321,44 |
| 19-Mar-18 | 5.040,00 | 5.220.331,20 | 1.170,00 | 1.817.793,90 | 4.200,00 | 3.726,00 | 474,00 | 528.386,76 |
| 20-Mar-18 | 7.170,00 | 7.426.542,60 | 1.680,00 | 2.610.165,60 | 5.640,00 | 5.310,00 | 330,00 | 367.864,20 |
| 21-Mar-18 | 6.900,00 | 7.146.882,00 | 1.950,00 | 3.029.656,50 | 5.580,00 | 5.310,00 | 270,00 | 300.979,80 |
| 22-Mar-18 | 7.350,00 | 7.612.983,00 | 1.830,00 | 2.843.216,10 | 5.910,00 | 5.508,00 | 402,00 | 448.125,48 |
| 23-Mar-18 | 5.520,00 | 5.717.505,60 | 1.080,00 | 1.677.963,60 | 4.500,00 | 3.960,00 | 540,00 | 601.959,60 |
| 24-Mar-18 | 4.590,00 | 4.754.230,20 | 1.050,00 | 1.631.353,50 | 3.900,00 | 3.384,00 | 516,00 | 575.205,84 |
| 25-Mar-18 | 4.560,00 | 4.723.156,80 | 1.050,00 | 1.631.353,50 | 3.900,00 | 3.366,00 | 534,00 | 595.271,16 |
| 26-Mar-18 | 4.680,00 | 4.847.450,40 | 1.080,00 | 1.677.963,60 | 3.960,00 | 3.456,00 | 504,00 | 561.828,96 |
| 27-Mar-18 | 6.480,00 | 6.711.854,40 | 1.470,00 | 2.283.894,90 | 4.920,00 | 4.770,00 | 150,00 | 167.211,00 |
| 28-Mar-18 | 6.480,00 | 6.711.854,40 | 1.530,00 | 2.377.115,10 | 6.360,00 | 4.806,00 | 1.554,00 | 1.732.305,96 |
| 29-Mar-18 | 5.790,00 | 5.997.166,20 | 960,00 | 1.491.523,20 | 4.800,00 | 4.050,00 | 750,00 | 836.055,00 |
| 30-Mar-18 | 5.850,00 | 6.059.313,00 | 1.020,00 | 1.584.743,40 | 4.890,00 | 4.122,00 | 768,00 | 856.120,32 |
| 31-Mar-18 | 5.820,00 | 6.028.239,60 | 990,00 | 1.538.133,30 | 4.860,00 | 4.086,00 | 774,00 | 862.808,76 |
| | | 180.567.527,40 | | 58.495.675,50 | | | | 14.647.683,60 |
| | | | | Grand Total | | | | 253.710.886,50 |

CTT :

Untuk tarif LWBP = 1.035,78

WBP = 1.5 * 1.035,78

kVarh = 1.114,74 ( sesuai tarif PLN )

Bangkalan, 2 April 2018

Setyo Agung, BE

Manager fasilitas

HUAWEI Mate 9 Pro
LEICA DUAL CAMERA

Bulan : Juni 2018

TOTAL BIAYA

# PEMAKAIAN TENAGA LISTRIK

## PT ADILUHUNG SARANASEGARA INDONESIA

Bulan : April 2018

| TANGGAL | LWBP | | WBP | | KVaRh | | | |
|---|---|---|---|---|---|---|---|---|
| | KWH | RUPIAH | KWH | RUPIAH | KWH | FREE | OVER | BIAYA |
| 01-Apr-18 | 3.540,00 | 3.666.661,20 | 720,00 | 1.118.642,40 | 3.000,00 | 2.556,00 | 444,00 | 494.944,56 |
| 02-Apr-18 | 3.600,00 | 3.728.808,00 | 810,00 | 1.258.472,70 | 3.090,00 | 2.646,00 | 444,00 | 494.944,56 |
| 03-Apr-18 | 6.210,00 | 6.432.193,80 | 1.170,00 | 1.817.793,90 | 5.010,00 | 4.428,00 | 582,00 | 648.778,68 |
| 04-Apr-18 | 6.300,00 | 6.525.414,00 | 1.380,00 | 2.144.064,60 | 5.490,00 | 4.608,00 | 882,00 | 983.200,68 |
| 05-Apr-18 | 6.390,00 | 6.618.634,20 | 1.410,00 | 2.190.674,70 | 4.260,00 | 4.680,00 | | - |
| 06-Apr-18 | 5.400,00 | 5.593.212,00 | 1.140,00 | 1.771.183,80 | 300,00 | 3.924,00 | | - |
| 07-Apr-18 | 5.160,00 | 5.344.624,80 | 1.380,00 | 2.144.064,60 | 870,00 | 3.924,00 | | - |
| 08-Apr-18 | 5.160,00 | 5.344.624,80 | 1.350,00 | 2.097.454,50 | 840,00 | 3.906,00 | | - |
| 09-Apr-18 | 5.220,00 | 5.406.771,60 | 1.470,00 | 2.283.894,90 | 900,00 | 4.014,00 | | - |
| 10-Apr-18 | 6.630,00 | 6.867.221,40 | 1.830,00 | 2.843.216,10 | 4.950,00 | 5.076,00 | | - |
| 11-Apr-18 | 7.590,00 | 7.861.570,20 | 1.890,00 | 2.936.436,30 | 5.370,00 | 5.688,00 | | - |
| 12-Apr-18 | 6.180,00 | 6.401.120,40 | 1.350,00 | 2.097.454,50 | 3.930,00 | 4.518,00 | | - |
| 13-Apr-18 | 5.910,00 | 6.121.459,80 | 1.110,00 | 1.724.573,70 | 3.540,00 | 4.212,00 | | - |
| 14-Apr-18 | 5.880,00 | 6.090.386,40 | 1.080,00 | 1.677.963,60 | 3.510,00 | 4.176,00 | | - |
| 15-Apr-18 | 5.850,00 | 6.059.313,00 | 1.050,00 | 1.631.353,50 | 3.510,00 | 4.140,00 | | - |
| 16-Apr-18 | 6.090,00 | 6.307.900,20 | 1.200,00 | 1.864.404,00 | 3.690,00 | 4.374,00 | | - |
| 17-Apr-18 | 6.870,00 | 7.115.808,60 | 1.620,00 | 2.516.945,40 | 4.560,00 | 5.094,00 | | - |
| 18-Apr-18 | 7.200,00 | 7.457.616,00 | 1.680,00 | 2.610.165,60 | 4.560,00 | 5.328,00 | | - |
| 19-Apr-18 | 6.000,00 | 6.214.680,00 | 1.230,00 | 1.911.014,10 | 3.570,00 | 4.338,00 | | - |
| 20-Apr-18 | 6.090,00 | 6.307.900,20 | 1.320,00 | 2.050.844,40 | 3.630,00 | 4.446,00 | | - |
| 21-Apr-18 | 5.280,00 | 5.468.918,40 | 1.140,00 | 1.771.183,80 | 3.060,00 | 3.852,00 | | - |
| 22-Apr-18 | 5.250,00 | 5.437.845,00 | 1.110,00 | 1.724.573,70 | 3.030,00 | 3.816,00 | | - |
| 23-Apr-18 | 5.370,00 | 5.562.138,60 | 1.200,00 | 1.864.404,00 | 3.090,00 | 3.942,00 | | - |
| 24-Apr-18 | 7.110,00 | 7.364.395,80 | 1.110,00 | 1.724.573,70 | 4.560,00 | 4.932,00 | | - |
| 25-Apr-18 | 7.380,00 | 7.644.056,40 | 1.800,00 | 2.796.606,00 | 4.980,00 | 5.508,00 | | - |
| 26-Apr-18 | 6.000,00 | 6.214.680,00 | 1.320,00 | 2.050.844,40 | 3.780,00 | 4.392,00 | | - |
| 27-Apr-18 | 6.060,00 | 6.276.826,80 | 1.380,00 | 2.144.064,60 | 3.840,00 | 4.464,00 | | - |
| 28-Apr-18 | 5.190,00 | 5.375.698,20 | 900,00 | 1.398.303,00 | 3.450,00 | 3.654,00 | | - |
| 29-Apr-18 | 5.160,00 | 5.344.624,80 | 900,00 | 1.398.303,00 | 3.420,00 | 3.636,00 | | - |
| 30-Apr-18 | 5.280,00 | 5.468.918,40 | 930,00 | 1.444.913,10 | 3.480,00 | 3.726,00 | | - |
| | | 181.624.023,00 | | 59.008.386,60 | | | | 2.621.86 |
| | | | | | Grand Total | | | 243.254.27 |

Bangkalan, 2 Mei 2018

CTT :

Untuk tarif LWBP = 1035,78

WBP = 1.5 * 1035,78

kVarh = 1114,74

( sesuai tarif PLN )

Setyo Agung, BE

Manager fasilitas

# TOTAL BIAYA
# PEMAKAIAN TENAGA LISTRIK
## PT ADILUHUNG SARANASEGARA INDONESIA
**Bulan : Mei 2018**

| | LWBP | | WBP | | KVaRh | | | |
|---|---|---|---|---|---|---|---|---|
| TANGGAL | KWH | RUPIAH | KWH | RUPIAH | KWH | FREE | OVER | BIAYA |
| | | | | | | | | |
| | | | | | | | | |
| 01-Mei-18 | 7.530,00 | 7.799.423,40 | 1.440,00 | 2.237.284,80 | 5.130,00 | 5.382,00 | | - |
| 02-Mei-18 | 7.620,00 | 7.892.643,60 | 1.500,00 | 2.330.505,00 | 5.220,00 | 5.472,00 | | - |
| 03-Mei-18 | 7.560,00 | 7.830.496,80 | 1.620,00 | 2.516.945,40 | 5.280,00 | 5.508,00 | | - |
| 04-Mei-18 | 6.600,00 | 6.836.148,00 | 1.560,00 | 2.423.725,20 | 4.530,00 | 4.896,00 | | - |
| 05-Mei-18 | 4.980,00 | 5.158.184,40 | 1.170,00 | 1.817.793,90 | 3.330,00 | 3.690,00 | | - |
| 06-Mei-18 | 4.950,00 | 5.127.111,00 | 1.140,00 | 1.771.183,80 | 3.300,00 | 3.654,00 | | - |
| 07-Mei-18 | 5.010,00 | 5.189.257,80 | 1.200,00 | 1.864.404,00 | 3.420,00 | 3.726,00 | | - |
| 08-Mei-18 | 5.730,00 | 5.935.019,40 | 1.110,00 | 1.724.573,70 | 3.960,00 | 4.104,00 | | - |
| 09-Mei-18 | 4.530,00 | 4.692.083,40 | 1.050,00 | 1.631.353,50 | 3.180,00 | 3.348,00 | | - |
| 10-Mei-18 | 5.070,00 | 5.251.404,60 | 900,00 | 1.398.303,00 | 3.570,00 | 3.582,00 | | - |
| 11-Mei-18 | 5.130,00 | 5.313.551,40 | 990,00 | 1.538.133,30 | 3.600,00 | 3.672,00 | | - |
| 12-Mei-18 | 5.730,00 | 5.935.019,40 | 1.140,00 | 1.771.183,80 | 3.870,00 | 4.122,00 | | - |
| 13-Mei-18 | 5.700,00 | 5.903.946,00 | 1.110,00 | 1.724.573,70 | 3.840,00 | 4.086,00 | | - |
| 14-Mei-18 | 5.820,00 | 6.028.239,60 | 1.170,00 | 1.817.793,90 | 3.960,00 | 4.194,00 | | - |
| 15-Mei-18 | 6.930,00 | 7.177.955,40 | 1.440,00 | 2.237.284,80 | 5.340,00 | 5.022,00 | 318,00 | 354.487,32 |
| 16-Mei-18 | 6.120,00 | 6.338.973,60 | 1.530,00 | 2.377.115,10 | 4.350,00 | 4.590,00 | | - |
| 17-Mei-18 | 6.210,00 | 6.432.193,80 | 1.620,00 | 2.516.945,40 | 4.440,00 | 4.698,00 | | - |
| 18-Mei-18 | 6.270,00 | 6.494.340,60 | 1.110,00 | 1.724.573,70 | 2.430,00 | 4.428,00 | | - |
| 19-Mei-18 | 6.330,00 | 6.556.487,40 | 1.290,00 | 2.004.234,30 | 5.340,00 | 4.572,00 | 768,00 | 856.120,32 |
| 20-Mei-18 | 5.670,00 | 5.872.872,60 | 1.140,00 | 1.771.183,80 | 4.710,00 | 4.086,00 | 624,00 | 695.597,76 |
| 21-Mei-18 | 5.730,00 | 5.935.019,40 | 1.200,00 | 1.864.404,00 | 4.800,00 | 4.158,00 | 642,00 | 715.663,08 |
| 22-Mei-18 | 5.850,00 | 6.059.313,00 | 1.290,00 | 2.004.234,30 | 3.150,00 | 4.284,00 | | - |
| 23-Mei-18 | 6.540,00 | 6.774.001,20 | 1.320,00 | 2.050.844,40 | 3.240,00 | 4.716,00 | | - |
| 24-Mei-18 | 6.210,00 | 6.432.193,80 | 1.260,00 | 1.957.624,20 | 1.920,00 | 4.482,00 | | - |
| 25-Mei-18 | 6.180,00 | 6.401.120,40 | 1.230,00 | 1.911.014,10 | 1.890,00 | 4.446,00 | | - |
| 26-Mei-18 | 6.150,00 | 6.370.047,00 | 1.200,00 | 1.864.404,00 | 1.890,00 | 4.410,00 | | - |
| 27-Mei-18 | 6.120,00 | 6.338.973,60 | 1.170,00 | 1.817.793,90 | 1.860,00 | 4.374,00 | | - |
| 28-Mei-18 | 6.480,00 | 6.711.854,40 | 1.560,00 | 2.423.725,20 | 2.130,00 | 4.824,00 | | - |
| 29-Mei-18 | 6.390,00 | 6.618.634,20 | 1.230,00 | 1.911.014,10 | 4.950,00 | 4.572,00 | 378,00 | 421.371,72 |
| 30-Mei-18 | 6.420,00 | 6.649.707,60 | 1.230,00 | 1.911.014,10 | 4.980,00 | 4.590,00 | 390,00 | 434.748,60 |
| 31-Mei-18 | 6.480,00 | 6.711.854,40 | 1.470,00 | 2.283.894,90 | 2.100,00 | 4.770,00 | | - |
| | | 194.768.071,20 | | 61.199.061,30 | | | | 3.477.988,80 |
| | | | | | Grand Total | | | 259.445.121,30 |

Bangkalan, 4 Juni 2018

Setyo Agung, BE
Manager fasilitas

**CTT :**

Untuk tarif LWBP = 1035,78
WBP = 1.5 * 1035,78
kVarh = 1.114,74 ( sesuai tarif PLN )

HUAWEI Mate 9 PRO
LEICA DUAL CAMERA

**TOTAL BIAYA**

# PEMAKAIAN TENAGA LISTRIK

## PT ADILUHUNG SARANASEGARA INDONESIA

**Bulan : Juni 2018**

| TANGGAL | LWBP | | WBP | | KVaRh | | | |
|---|---|---|---|---|---|---|---|---|
| | KWH | RUPIAH | KWH | RUPIAH | KWH | FREE | OVER | BIAYA |
| | | | | | | | | |
| | | | | | | | | |
| 01-Jun-18 | 7.050,00 | 7.302.249,00 | 1.410,00 | 2.190.674,70 | 2.340,00 | 5.076,00 | | - |
| 02-Jun-18 | 6.030,00 | 6.245.753,40 | 1.230,00 | 1.911.014,10 | 780,00 | 4.356,00 | | - |
| 03-Jun-18 | 6.060,00 | 6.276.826,80 | 1.230,00 | 1.911.014,10 | 780,00 | 4.374,00 | | - |
| 04-Jun-18 | 6.060,00 | 6.276.826,80 | 1.230,00 | 1.911.014,10 | 840,00 | 4.374,00 | | - |
| 05-Jun-18 | 6.030,00 | 6.245.753,40 | 1.260,00 | 1.957.624,20 | 420,00 | 4.374,00 | | - |
| 06-Jun-18 | 6.210,00 | 6.432.193,80 | 1.380,00 | 2.144.064,60 | 540,00 | 4.554,00 | | - |
| 07-Jun-18 | 4.680,00 | 4.847.450,40 | 960,00 | 1.491.523,20 | 90,00 | 3.384,00 | | - |
| 08-Jun-18 | 4.650,00 | 4.816.377,00 | 930,00 | 1.444.913,10 | 90,00 | 3.348,00 | | - |
| 09-Jun-18 | 4.680,00 | 4.847.450,40 | 900,00 | 1.398.303,00 | 90,00 | 3.348,00 | | - |
| 10-Jun-18 | 4.590,00 | 4.754.230,20 | 870,00 | 1.351.692,90 | 90,00 | 3.276,00 | | - |
| 11-Jun-18 | 4.560,00 | 4.723.156,80 | 840,00 | 1.305.082,80 | 90,00 | 3.240,00 | | - |
| 12-Jun-18 | 4.920,00 | 5.096.037,60 | 1.410,00 | 2.190.674,70 | 150,00 | 3.798,00 | | - |
| 13-Jun-18 | 3.210,00 | 3.324.853,80 | 720,00 | 1.118.642,40 | - | 2.358,00 | | - |
| 14-Jun-18 | 3.180,00 | 3.293.780,40 | 690,00 | 1.072.032,30 | - | 2.322,00 | | - |
| 15-Jun-18 | 3.270,00 | 3.387.000,60 | 750,00 | 1.165.252,50 | - | 2.412,00 | | - |
| 16-Jun-18 | 2.880,00 | 2.983.046,40 | 660,00 | 1.025.422,20 | - | 2.124,00 | | - |
| 17-Jun-18 | 2.970,00 | 3.076.266,60 | 660,00 | 1.025.422,20 | - | 2.178,00 | | - |
| 18-Jun-18 | 2.880,00 | 2.983.046,40 | 660,00 | 1.025.422,20 | - | 2.124,00 | | - |
| 19-Jun-18 | 3.570,00 | 3.697.734,60 | 660,00 | 1.025.422,20 | - | 2.538,00 | | - |
| 20-Jun-18 | 4.290,00 | 4.443.496,20 | 930,00 | 1.444.913,10 | - | 3.132,00 | | - |
| 21-Jun-18 | 2.520,00 | 2.610.165,60 | 810,00 | 1.258.472,70 | 1.590,00 | 1.998,00 | | - |
| 22-Jun-18 | 2.520,00 | 2.610.165,60 | 810,00 | 1.258.472,70 | 1.620,00 | 1.998,00 | | - |
| 23-Jun-18 | 3.390,00 | 3.511.294,20 | 720,00 | 1.118.642,40 | 2.850,00 | 2.466,00 | 384,00 | 428.060,16 |
| 24-Jun-18 | 3.420,00 | 3.542.367,60 | 750,00 | 1.165.252,50 | 2.880,00 | 2.502,00 | 378,00 | 421.371,72 |
| 25-Jun-18 | 4.590,00 | 4.754.230,20 | 1.110,00 | 1.724.573,70 | 4.620,00 | 3.420,00 | 1.200,00 | 1.337.688,00 |
| 26-Jun-18 | 4.560,00 | 4.723.156,80 | 960,00 | 1.491.523,20 | 4.080,00 | 3.312,00 | 768,00 | 856.120,32 |
| 27-Jun-18 | 4.530,00 | 4.692.083,40 | 930,00 | 1.444.913,10 | 4.050,00 | 3.276,00 | 774,00 | 862.808,76 |
| 28-Jun-18 | 4.770,00 | 4.940.670,60 | 990,00 | 1.538.133,30 | 4.110,00 | 3.456,00 | 654,00 | 729.039,96 |
| 29-Jun-18 | 4.890,00 | 5.064.964,20 | 750,00 | 1.165.252,50 | 3.690,00 | 3.384,00 | 306,00 | 341.110,44 |
| 30-Jun-18 | 5.850,00 | 6.059.313,00 | 1.290,00 | 2.004.234,30 | 3.870,00 | 4.284,00 | | - |
| | | 137.561.941,80 | | 44.279.595,00 | | | | 4.976.199,36 |
| | | | | Grand Total | | | | 186.817.736,16 |

Bangkalan, 1 Juli 2018

**CTT :**

Untuk tarif LWBP = 1.035,78

WBP = 1,5 * 1.035,78

kVarh = 1.114,74 ( sesuai tarif PLN )

Setyo Agung, BE

Manager fasilitas

HUAWEI Mate 9 Pro
LEICA DUAL CAMERA

PT. ADILUHUNG SARANASEGARA INDONESIA

# Laporan Pemakaian Genset

FM:

Type: Mercy 200 KVa.

Rev:

| Hari/ Tanggal | Jam Mulai | Jam Selesai | Operator | Penting |
|---|---|---|---|---|
| Jum'at / 29-9-17 | 04:00 | 6:30 | peralatan | 1. Check oli mesin |
| Sabtu / 30-9-17 | 24:30 | 4:30 | peralatan | 2. Check air radiator |
| Minggu / 1-10-17 | 19:30 | 22:00 | peralatan | 3. CheckK ACW |
| Senin / 2/10/17 | 21:00 | 23:00 | peralatan | |
| Selasa / 3/10/17 | 17:10 | 20:45 | peralatan | |
| Kamis / 5/10/17 | 17:10 | 20:40 | peralatan | |
| Jum'at / 6/10/17 | 17:10 | 19:00 | peralatan | |

HUAWEI Mate 9 Pro
LEICA DUAL CAMERA

Mengetahui,

## BIOGRAPHY

The author's name is Muhamad Amin Sentosa and was born on 7th of November 1996 in Jakarta, Indonesia. Born to be the first child from a couple with the father named Prasta Wahyu Hidayat and mother named Mauly Rakhmawaty. Author completed formal Studies at SDS Putra 1 Jakarta (2002 – 2008) for elementary school and continued study at SMP Global Islamic School (2008 – 2011), and for senior high school author proceed to SMAN 71 Jakarta (2011 – 2014). In 2014, author proceed to pursue bachelor degree at Department of Marine Engineering (Double Degree Program with Hochschule Wismar), Faculty of Marine Engineering, Institut Teknologi Sepuluh Nopember Surabaya specializes in Marine Manufacturing and Design. During the study period, Author did activities in campus organizations such as: Staff of Marine Technology and Innovation Club (2015-2016) and. The Autor also joined in several event organizers such as Marie Diesel Assembly Marine Icon 2015 and 2016. Besides school and organization author also co-owner of a retail shop named @Jasatitipkeliling which is focus on Man and Woman Fashion and also Woman's Make-up

**Muhamad Amin Sentosa**

zakisentosa@gmail.com.

Motto: I know that, I know nothing