

ENERGY SAVING ANALISYS AT BUILDING FOR CENTER OF SCIENCE AND TECHNOLOGY DEMONSTRATION (PP. IPTEK) IN THE TAMAN MINI INDONESIA INDAH COMPLEX

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Crisis energy in Indonesian has gived an effect for several Sector Activities, especially energy sector. For the implementation of energy saving activity, reposition of Management Building that related to energy sector, must be held on.

Energy saving in the Building can be conducted either through several analysis of supply energy system or modification of Operational Loads of the Equipment Building or Substitute the supply energy system with Alternative energy.

Energy saving that was held in the PP IPTEK Jakarta, gave the result for the Implementation Energy saving, it can reduce the energy cost per Month with total amount Rp19.497.000.

1. Back Ground

Building for Center of Science and Technology Demonstration located in the area of Taman Mini Indonesia Indah (TMII) which opened in October 10th 1995, designed by one of notable architecture consultant in Indonesia broadly totalize about 23.000 m² cannot function which has been planned before. Building PP-IPTEK consist of three floor with radian form which occupy farm 4,5 ha. Building has adopted state scheme concept that have cool climate or tropical sub by using building roof which is 80% made from transparent materials (carbonate poly). It unintentionally let direct solar radiation enter into building that can create green house effect. Though sunlight reduce usage of lighting load can give natural lighting, direct sunlight input redundantly into building represent wrong action, because it causing overheating into the area.

Physics phenomenon, where sunlight in the form of short wave enter into glasses and heat object in it, later; then turn into long wave which cannot infiltrate again out of glasses area. As a result, it can cause hot accumulation in room. Room in building become very hot, abysmal of human being thermal conformity tolerance range sill in it, air temperature in building can increase significantly. Room become very hot with temperature exceed 36^oC (without AC) whereas external temperature around 32 ^oC. In order to degrade room temperature, it needs Air Conditioning (AC) with big capacity

Warm-Up effect of green house effect in this PP Iptek building made worse with existence of precise basin below/under the transparent roof. The architect might probably hope that this pool can increase the building interior esthetics values. However, that ideas goes wrong. Effect of air temperature height above pool, water condenses quickly which increasing humidity inside of the building. It can cause high air conditioning load capacity, so that can rise high

maintenance cost of the building approximately 80 millions Rupiah per month, even only operated 30% from the air conditioning maximum capacity.

Based on the above matter explained above, it needed the research of energy saving through the several steps:

1. Energy Saving Model, which the aims are to suppress the electricity, cost per months.
2. Electrical installation and power supply system in PP IPTEK building
3. Load characteristics in PP IPTEK
4. Building Management systems in PP IPTEK

2.2 Research Methodology

There was no information about the daily and weekly load profile in PP IPTEK so that it was difficult to learn and research the systems. In order to make research study, it is important to obtain the load condition and daily load characteristics.

Some of the steps below used to make research study about energy saving in PP IPTEK:

1. Measurement Methods
These ways are used to learn the operational system performances and load characteristics in PP IPTEK:
 - a. Measurement of Operational Electricity cost for 24 hour
 - b. Measurement of Power Factor ($\cos\phi$) .
2. Electrical appliances classification based on:
 - a. Electrical load for lighting
 - b. Electrical load for air conditioning
 - c. Electrical load for water pumping systems
 - d. Load Classification system in PP IPTEK.

III. POWER SUPPLY SYSTEM IN PP-IPTEK

3.1 PLN Power Supply

Power Supply in PP-IPTEK is PT PLN as the main supply with the installed capacity 2.300 kVA. with the raising of the electricity load tariffs hence in the year 1998 electricity capacities from the PLN degraded to become 1,7 kVA, and in the year 2001 electricity capacities from PLN is reduced become 1,140 kVA until right now. The power supply distribution from PLN through normal main supply panel by underground cable 20 kV. From Voltage of 20 kV hereinafter degraded to become 380 / 220 V by using 2 (two) Transformer which is each installed capacity about 1.600 kVA

3.2 Diesel Generator Power Supply

Beside obtained electricity from main supply from PLN, PP-IPTEK also use electricity from back up diesel Generator power supply with installed capacity about 450 kVA. Generator Set provided with the equipments of Automatically Starting that called Automatic Main Failure (AMF). It set for the time delay of 3 second, after electricity supply from PLN is black out.

3.3 Electrical System Distribution in PP-IPTEK

System Distribution electricity in PP-IPTEK supply from PLN with Medium Voltage Network 20 kV. From the MDP (Main Distribution Panel) panel hereinafter step into two down step Transformer voltage is step down from 20 kV become 380 Volt line to line. From two down step Transformer, which is each installed capacities 1.600 the kVA next step into panel bus bar and from this panel can be divided for Lighting, Air Condition and Load Equipment

3.4 Electrical Load System in the Building PP-IPTEK

Installation Capacity of Electrical by PP-IPTEK as according to Single diagram line divided become two part which consist of Normal Main Panel and Emergency Main Panel.

Normal Main Panel consists of:

1. Panel Air Handling Unit (AHU) with capacities is 367.450 VA
2. Panel Demonstration Unit with capacities 1.058.250 VA
3. Panel Chiller with 8-unit 1.wit capacity 324.700 VA

Panel of Emergency consist of

- 1 Panel Emergency
- 2 Panel Room Utility
- 3 Panel Submersible Pumping
- 4 Panel Lighting

Installation Capacity of Electrical for normal Main Panel is 1.425.700 VA, and for Emergency Panel is 607.651 VA

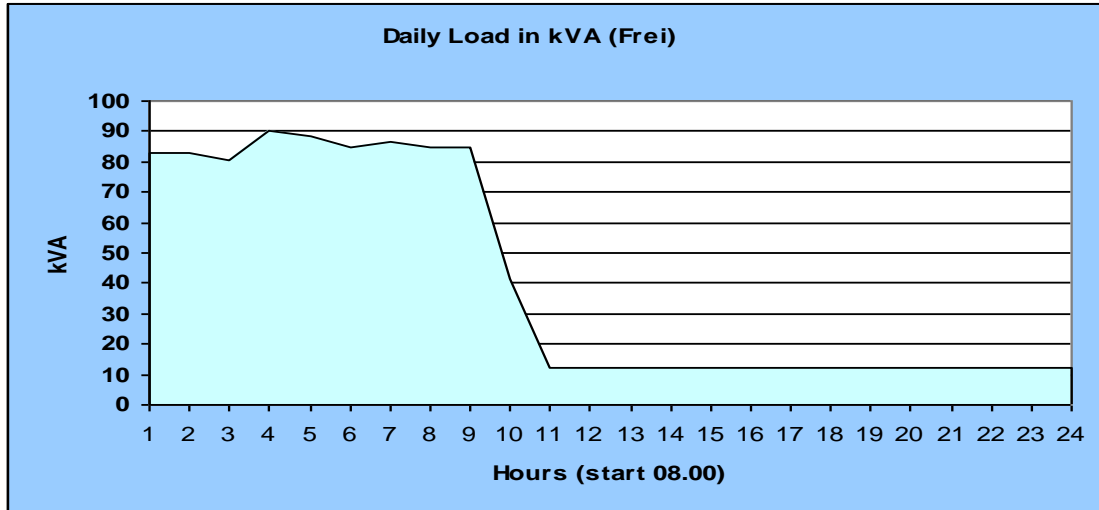
3.5. Capacitor Bank

Capacitor Bank used in PP-IPTEK consist of 16 unit, each of its capacities 50 kVAr, so that total capacities of Bank Capacitors in PP –IPTEK is 800 kVAr, and Bank capacitor brand in Building PP-IPTEK is Lifasa, at the time of research of Capacitor Bank cannot operate normally / having damage

3.6. Result of Measurement Daily load in PP-IPTEK

Measurement of daily load Electricity in PP-IPTEK on holiday (without Visitor) with peak load happened at 11 noon with Capacities energy 90 kVA

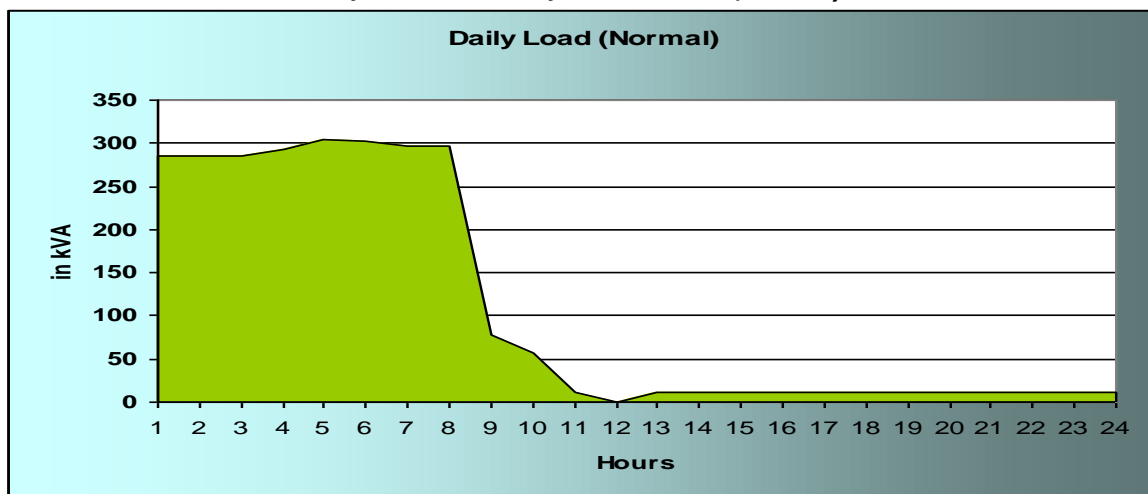
Picture 3.1
Daily load Electricity in PP-IPTEK (Friday)



Source: Author

While data result of measurement at normal condition namely the amount of visitor in the PP-IPTEK quite a lot, consisting of SD, SLTP and SLTA students. For that, many physic appliance operated, added by compressor and chiller (3 unit) operated for the Cooling of room, Lighting and other equipments.

Picture 3.2
Daily load Electricity in PP-IPTEK (Normal)



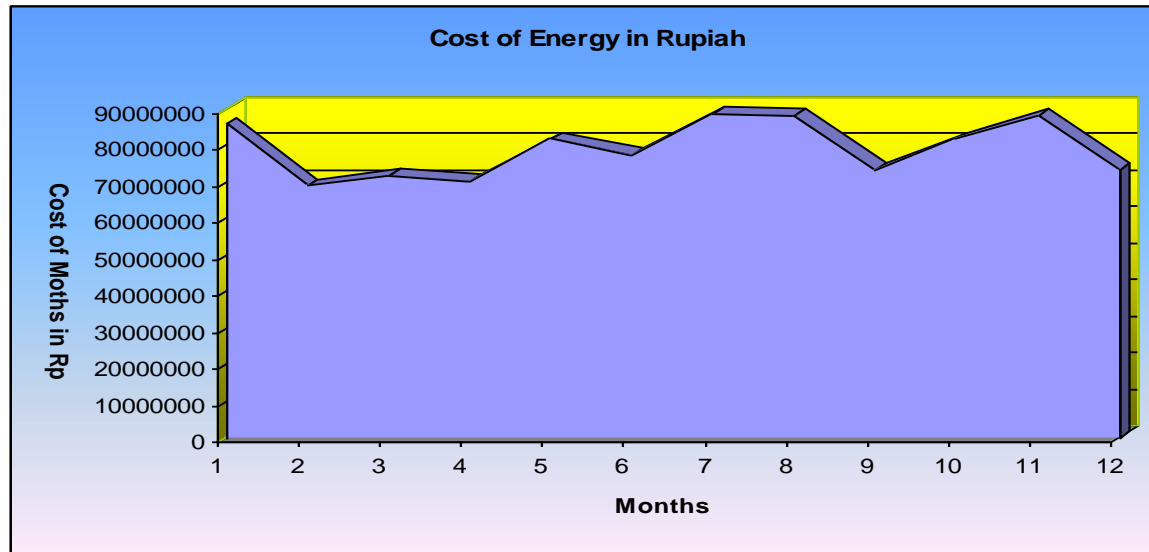
Source: Author

At 8.00-15.00, load condition is fluctuated, while phase R, S and T and Power Factor is enough balanced .But at 16.00 physic appliances and chiller have been switched off.

3.7. Electrical Data Account PP-IPTEK Year 2003

Electricity tariff in general determined by two components. Those are fixed cost and variable cost

Picture 3.3
Tariff of Electricity by PP-IPTEK



Source: Author

Fixed cost is the expense of energy attached or more knowledgeable as Cost of Demand/Load which is calculated in Rupiah per VA or kVA. While variable cost represent the expense of which is imposed as according to amount of usage of electricity per day (kWh) used by customer. PP-IPTEK have to pay. Monthly electricity cost for 80 million Rupiah.

IV. ENERGI SAVING ANALISYS PP-IPTEK

4.1 Lighting Energy Saving Analysis

Lighting in PP-IPTEK building supplied from Main panel. Lighting loads consist of eighteen panel with load capacity equal to 266.797 VA, with amount of lamp counted 2.861 lamp, where lighting type consist of Lamp TL, , Down Light, lamp for Wasteful, Lamp Baret, Lamp Mercury, Fluorescent Lamp, Spotlight Or Track, Lamp Garden, Street lighting and etc.

As for its electric socket amount to 124 units with load capacities 25.500 VA, compose - electric socket located in the basement with the amount of 82 units 16.400 VA, Mezzanine Floor 9 units, floor with capacities 1.800 VA, top floor with 27 unit 5.400 VA, and PRU 6 dot with capacities 1.900 VA

For the energy, saving for lighting can be done through:

- 1 Replacing existing lamp lighting with Energy Saving lamp
- 2 Reducing the amount lamp lighting and accommodated by existing physic appliance without reducing esthetical values

4.2 Analysis Energy Saving Arrange Air (AC)

To arrange air (AC) represent one of the Load getting supply from Normal Main Panel with energy capacities 1.425.700 VA, to arrange Air Conditioning (AC) operation by 5 Unit Pump Chiller, 8 Unit Chiller, 16 Unit Compressor, 16 Air Handling Unit (AHU). And there are spread over AC Split some room

The operational of AC in PP-IPTEK is very big in usage of electricity, because 80 % of building roof made from transparent materials (carbonate poly) unintentionally let direct sun radiation enter into building result of glasshouse effect. Though sunlight lessen usage of lamp because giving natural Lighting, but direct sunlight input redundantly into building represent wrong action, because causing abundant warm-up.

Based on the result of research in the reality Chiller, AHU and AC Split, its operational can be done with method:

1. Develop Partitioning of room to avoid abundant more AC Chiller operational
2. Making circulation of Air by the Floor 2nd, to reducing heat effect of Polly Carbonate roof or glasshouse effect
3. Adding AC Split at several room
- 4 Take care of and clean routinely Ducting AC, AHU
- 5 Setting Cooling AC Chiller systems

4.3 Analysis Usage of Capacitor Bank

At the time of research the existing Capacitor bank have damaged on its automatic, so that after repaired by Bank capacitor can operate optimally, to the fore treatment of Capacitor represent one of the especial priority, bank capacitor PP-IPTEK still is up to standard

The condition of peak load is such as those which presented by data result of measurement with normal daily load of Bank capacitor operating only 9 unit/ step or equal to 450 Total kVAR. From the total Capacity Bank Capacitor is 800 kVAR

4.4 Load Accumulation Analysis

As for analyses accumulate Load compose - from Lighting, Air Handling Unit (AHU), Air conditioner, Chiller and to be more sharpness can be shown on the tables below.

Table 4.1
Load Accumulation Before and After Energy Saving Conducted

	Load Type	Before	After
1.	Lighting	266.787 VA	118.175 VA
2.	Air Handling Unit (AHU)	239.317 VA	55.760 VA
3.	Air Conditioner (AC)	76.500 VA	76.500 VA
4.	Chiller	778.848 VA	194.712 VA
Total Amount		1.361,452 VA	445.147 VA

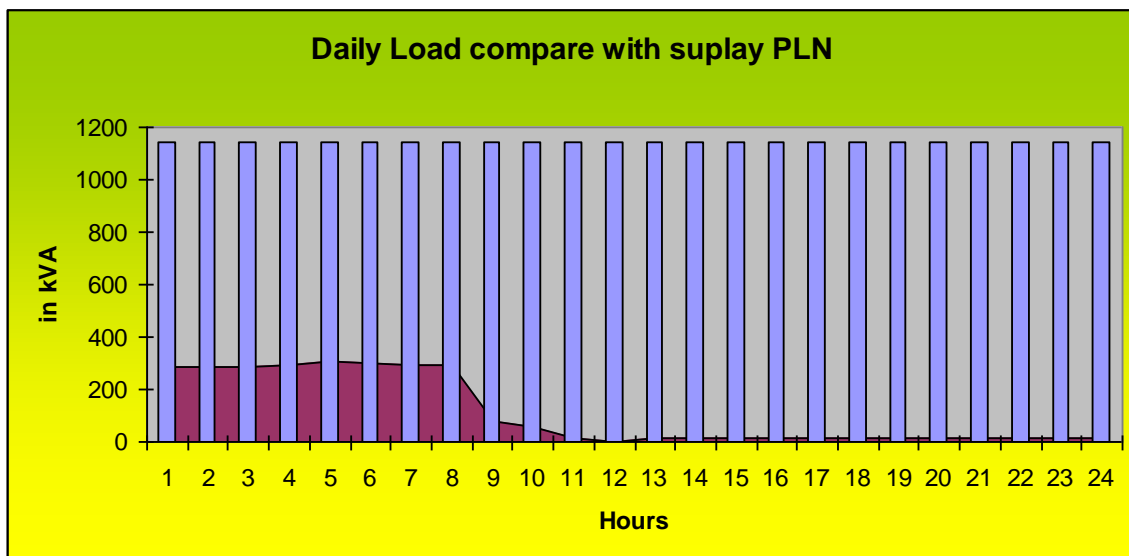
Source: Analysis Result

Energy saving analysis at lighting load, Air Handling Unit (AHU), Air conditioning (AC), Chiller, hence PP-IPTEK can raise degradation of energy to PLN. in other side suggested to PP-IPTEK to utilize optimal Building Management system, Technique control and operational conducted by building maintenance in arrangement of electrical load like enkindling of lamp, AHU, AC and Chiller can economize usage of electricity. So that with equipments which is economic and technical consideration and the mentioned in this time is still conducted by PP-IPTEK building maintenance

4.5 Daily Load Analysis

Based on the data result measurement of daily Load at normal condition operational have to reduced the monthly electricity cost, PP IPTEK can raise degradation electric capacities from 1140 kVA become 630 kVA.

Picture 4.1
Daily Load Graph at PP-IPTEK Building



Source: Analysis Result

Hence seen from used daily load only equal to 301, 79 kW, while energy supply from PLN equal to 1,140 kVA. If it analysed from PLN side, energy supply is very abundant, so that its Alternative of PP-IPTEK expected by diffraction degradation of its electric capacity, from Analysis capacities 630 kVA still adequate enough, and when this matter is executed by PP IPTEK will economize electricity cost rate with governmental tariff classification (P2 Tariff Classification), will be got by Energy saving for governmental electricity tariff equal to Rp. 113.969.665 or 13,6% (Total Payment Electrics per Rp year 835.123.225 with capacities 630 kVA)

5. RECOMMENDATION

Based on the Information of PP-IPTEK that payment of electricity cost is enough high because the number of inductive load which is consisting of induction motor, AC, water pump, and 8 chiller unit, apart from inductive load is not influenced by bank capacitor.

With existence of Power Factor, improvement at bank capacitor expected can reduce usage of electrical consumption as well as expense of electricity cost. Besides with power factor improvement can also conducted by doing Management Building System through technical consideration and operational. Management Building also arrange enkindling load lighting so that can economize its electric Load . Therefore, with equipments of the other which have to pass economic and technical consideration. In addition, the mentioned in this time is doing by PP-IPTEK Management Building.

Besides with PP-IPTEK Building management can be reducing the capacity of power supply PLN, from Capacity 1140 kVA to 630 kVA reducing with classification Government Prices (P2 classification)

The Last Information frump-IPTEK after performed at improvement some partitioning at electricity tariff become Rp 70.000.000 / months, equally there is reducing prices or tariff 10.000.000 / months and when PP-IPTEK willing to reduce of its energy capacities become 630 kVA, hence will happened total reducing in one year equal to Rp 233.969.665,- or happened saving total of electricity consumption with the amount Rp 233.969.665.

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