

# Strategy For Developing Energy Saving Behavior Models In Inpatient Areas At Labuang Baji Hospital, Makassar City

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**Abstract:** Electrical energy is currently a basic need that cannot be abandoned. Energy needs continue to increase every year in line with increasingly rapid population growth. The problem of wasting electrical energy often occurs in public facilities such as government buildings, schools or universities, hospitals, mosques, and others. Hospitals are one of the public service buildings where the level of electrical energy usage is quite large due to service demands for visitors. Users of inpatient facilities are one of the determining factors in utilizing electrical energy sources. Therefore, researchers aim to create strategies for saving electrical energy. The method used is SWOT analysis involving hospital management and inpatient room users. The results of the analysis show that the strategies that must be used to save energy are energy-saving technology, regular equipment maintenance and the involvement of health workers in energy-saving education programs.

**Keywords:** Inpatient Room, Save Electricity, Hospital Management.

## I. INTRODUCTION

Energy utilization in service buildings aims to provide comfort for users. Buildings with high levels of traffic must be equipped with adequate lighting systems and air conditioning systems that suit user comfort needs. On the other hand, energy use is closely related to financing and environmental considerations. [1] explained that energy use for building service needs reaches 40% of total energy use. This energy is generally used for air conditioning systems, lighting systems, lifts and escalators as well as electronic equipment.

Regulating energy use in public service buildings is one of the strategies in reducing the risk of greenhouse gases. Types of buildings that waste energy include offices, government buildings, shopping centers, educational facilities, health facilities and hotels [2]. The causes of waste of electrical energy originate from human factors and technical factors. Therefore, technological and human cultural intervention is one of the strategic efforts to optimize energy use in public service buildings [3].

Hospitals as one of the public service buildings also face problems in the use of electricity [4][5]. The use of electronic equipment related to medical efforts and visitor comfort is the main support in the quality of hospital services [6]. Thus, efforts to reduce energy use in hospitals are relatively difficult due to the high demands of society. The results of the study show that the inpatient room is a type of installation with large energy usage, where the use of Air Conditioner (AC) is the largest energy source, namely 40% and lighting is 15% [7].

One of the hospitals with a high level of service in Makassar City is Labuang Baji Hospital. Data on energy use for the last two years shows an average figure of 20.12 Kwh/m<sup>2</sup>/month, where energy use is included in the Wasteful category (19.17 – 23.75). One way to save electrical energy is by encouraging energy-saving behavior by electrical energy users. Small things that have often been done over the years, perhaps without realizing it, have had a big impact and if they are carried out continuously, they will result in a decline in environmental quality. The resulting electrical energy costs have an impact on the costs that must be borne by inpatient facility users without realizing it. On the other hand, the cost burden arising from wasteful use of energy is not realized by the manager (hospital management) because the energy financing component is included in the maintenance cost component.

The facts show that energy-wasting behavior in inpatient rooms that often occurs and is not realized by room users includes user behavior in using AC continuously for 24 hours non-stop, setting the AC temperature in the room that does not meet the required standards. Apart from that, the duration of use/utilization of lights in the room reaches 20 hours/day, even though the room has enough openings to take advantage of natural lighting. The use of clean water in hospital buildings with vertical buildings also greatly influences the use of water energy. The process of distributing clean water from the ground floor to the top floor requires quite a lot of energy. Therefore, energy conservation efforts must also take into account water use.

Wasteful behavior often occurs in public facilities such as government buildings, schools or universities, hospitals, mosques, and others. One study conducted stated that energy consumption in office buildings consumes 70 to 300 kWh

or the same as 10 to 20 times greater than energy consumption in households. Energy-wasting behavior is not only shown by users, the facts show that energy-wasting behavior is also carried out by managers (hospital management). Energy-wasting behavior that arises and is unnoticed by hospital managers includes still using NEON lamps in room lighting, there is no regular maintenance of air conditioning (AC) equipment so that air conditioners are often found in rooms that are not functioning properly.

The above shows that the behavior of planners (Architects), building managers (Hospital Management) and inpatient room users (patient caretakers) greatly influences energy use in hospitals. Therefore, it is appropriate for managers and users to be aware of the conditions that occur so that the resulting energy load can be controlled with attitude and motivation so that it can produce energy-saving behavior in buildings.

## II. RESEARCH METHOD

The type of research used is quantitative descriptive research with a correlational approach, which is to analyze energy saving behavior models in inpatient rooms. To identify various factors, this research uses the SWOT data analysis technique. The research was carried out at the Labuang Baji Regional General Hospital, Makassar City and the decision on the research location was based on the availability of inpatient ward facilities consisting of Class III, Class II, Class I, VIP and VVIP wards which could represent the social strata of room users. Apart from that, the shape of the building is vertical (a multi-story building) and the dominant use of glass material on the building facade which influences energy use. Data collection was carried out through Focus Group Discussions (FGD) involving hospital management, architects and medical staff at Labuang Baji Hospital to find indicators of strengths, weaknesses, opportunities and threats in determining energy saving strategies.

## III. RESULT AND DISCUSSION

A description of the building facilities and classification of care in the inpatient room at Labuang Baji Hospital is presented in table 1.

| No | Building | Floor Position | Treatment Classification | Room type | Number of Beds |   |
|----|----------|----------------|--------------------------|-----------|----------------|---|
| 1  | B        | Floor IV       | General Care             | VVIP      | 3              |   |
|    |          |                |                          | VIP       | 8              |   |
|    |          |                |                          |           | <b>11</b>      |   |
| 2  | B        | Floor IV       | Lungs/<br>Tuberculosis   | VIP       | 2              |   |
|    |          |                |                          | Class I   | 10             |   |
|    |          |                |                          | Class II  | 12             |   |
|    |          |                |                          | Class III | 20             |   |
|    |          | <b>44</b>      |                          |           |                |   |
| 3  | C        | Floor III      | Child Care               | VIP       | 1              |   |
|    |          |                |                          | Class I   | 2              |   |
|    |          |                |                          | Class II  | 4              |   |
|    |          |                |                          | Class III | 12             |   |
|    |          | <b>19</b>      |                          |           |                |   |
| 4  | C        | Floor II       | Mother<br>child          | and       | VIP            | 2 |
|    |          |                |                          |           | Class I        | 2 |
|    |          |                |                          |           | Class II       | 2 |
|    |          |                |                          |           | Class III      | 3 |
|    |          | <b>7</b>       |                          |           |                |   |
|    |          | <b>14</b>      |                          |           |                |   |
| 5  | D        | Floor III      | General                  | Class I   | 12             |   |
|    |          |                |                          | Class II  | 18             |   |
|    |          |                |                          |           | <b>30</b>      |   |
| 6  | D        | Floor II       | Geriatrics               | VIP       | 1              |   |
|    |          |                |                          | Class I   | 2              |   |
|    |          |                |                          | Class II  | 2              |   |
|    |          |                |                          | Class III | 3              |   |
|    |          | <b>8</b>       |                          |           |                |   |

|              |   |           |              |           |            |
|--------------|---|-----------|--------------|-----------|------------|
| 7            | E | Floor III | Non-Surgical | Class III | 24         |
| 8            | E | Floor II  | Non-Surgical | Class II  | 20         |
| 9            | B | Floor V   | Covid        | Non Class | 27         |
| <b>Total</b> |   |           |              |           | <b>197</b> |

The use of electrical energy in inpatient rooms is considered ineffective. The need for ventilation in inpatient rooms is quite high due to the shape and orientation of the hospital building. Apart from that, the large size of the windows and the reflection of sunlight causes a high intensity of light to enter the room so that the room feels hot. This condition causes the need for artificial ventilation to become greater and even the use of AC in inpatient rooms lasts for 24 hours. The use of natural lighting is possible in spaces that are directly connected to the outside area of the building. With this condition, the use of lights can be minimized. The results of the analysis in Building B, all rooms show a good level of effectiveness in energy use, as well as in Building C, while in Building D the value of effectiveness in energy use exceeds the required limits. Apart from that, water use using PDAM water volume data throughout 2022 shows that water use is very wasteful. This is due to the lack of control over water use in the bathroom or some water taps that are not functioning properly. Energy consumption in hospitals is a challenge for managers because this increases operational costs and competitiveness. Therefore, sustainable hospital management must also adopt energy management and service standards for public policy. This serious challenge requires various studies both on technical and social aspects in efforts to provide public services that utilize efficient energy [6].

Specifically, Maleetipwan et al [8] explained that energy consumption in hospitals can be reduced through behavior change programs that also consider resident satisfaction. This program is implemented by integrating the theory of affordances and the theory of planned behavior to determine occupants' optimal lighting needs and optimal lighting use. This research also shows that technological interventions to reduce energy use in hospitals must consider individual factors and their perceptions of space quality.

These two studies are in accordance with the research results, thus further strengthening the researchers' suspicions about the importance of combining technical aspects and human behavior in efforts to save energy in inpatient rooms. Therefore, this study also attempts to describe the factors that influence the behavior of inpatient room users in energy use.

SWOT analysis begins with a qualitative approach to find external and internal factors. Factor identification was carried out by collecting secondary data from documents and based on the results of a focus group discussion (FGD) held at Labuang Baji Hospital, Makassar, which was attended by 13 people, namely the Director of Labuang Baji Hospital, Makassar, Deputy Director for Research and Development, six room heads, two the head of the installation and three people representing architecture.

Based on the FGD that was carried out, it was found that the largest expenditure incurred by the hospital was electricity financing with a financing burden of 60%. This happens not only because of hospital facilities, but also the habits of patients and patient caretakers who do not regulate the room temperature according to the instructions provided on the walls of the inpatient room. Apart from that, patient caretakers also often bring electronic equipment such as water heaters so that it can increase electricity usage by 10 lux/room. Furthermore, patient caretakers also do not save water, where they sometimes waste it by washing clothes.

The hospital also does not have related information regarding energy savings such as turning off the water and lights through pamphlets or information on the walls of each room, but the hospital has intervened to save energy but it is not working optimally. Apart from that, the hospital has also not maximized the empowerment of health resources to provide energy saving education to patients and their families.

Based on these results, the analysis of energy saving behavioral strategies in the inpatient room at Labuang Baji Hospital, Makassar City begins with determining internal and external factors. The formulation for the internal factor analysis summary (IFAS) contains seven factors, namely three strength factors and four weakness factors. Based on the formulation of strengths and weaknesses, seven items were obtained as internal factors.

Table 2. Internal Factor Analysis Summary (IFAS) Energy Saving Behavior

| IFAS           |   | Weight | Ratings | Score       |
|----------------|---|--------|---------|-------------|
| No             | Strength  |        |         |             |
| 1              | Intense interaction between management and visitors to the inpatient room | 0.2    | 4       | 0.8         |
| 2              | There are communication facilities that can be processed by management    | 0.2    | 3       | 0.6         |
| 3              | There are educational posters on energy use                               | 0.1    | 3       | 0.3         |
| <b>Average</b> |   |        |         | <b>1.70</b> |

| No                            | Weakness   | Bobot | Rating | Skor         |
|-------------------------------|--|-------|--------|--------------|
| 1                             | Building planning that does not support energy saving patterns                                   | 0.05  | 1      | 0.05         |
| 2                             | There is no internal management policy regarding energy saving education                         | 0.2   | 4      | 0.8          |
| 3                             | Weak involvement of health resources in energy saving education programs                         | 0.1   | 3      | 0.3          |
| 4                             | Weak regulation of visiting hours and limiting the number of visitors to a maximum of two people | 0.15  | 4      | 0.6          |
| <b>Average</b>                |  |       |        | <b>1.75</b>  |
| <b>Strengths - Weaknesses</b> |  |       |        | <b>-0.05</b> |

The results of the IFAS analysis found that the difference between the strength value and the weakness value was -0.05 or the weakness was greater than the internal strength that supports energy saving behavior in inpatient rooms. Thus, the weakness factor becomes an important focus in developing energy-saving behavior in inpatient rooms at Labuang Baji Hospital, Makassar City.

External factors in the analysis of energy saving behavioral strategies in the inpatient ward of Labuang Baji Hospital, Makassar City begins with determining internal and external factors. The formulation for the external factor analysis summary (EFAS) contains five factors, namely three threat factors and two opportunity factors. Based on the formulation of strengths and weaknesses, five items were obtained as internal factors.

Table 3. External Factor Analysis Summary (IFAS) Energy Saving Behavior

| IFAS                          |  | Weight | Ratings | Score       |
|-------------------------------|--|--------|---------|-------------|
| No                            | Threat   |        |         |             |
| 1                             | User perceptions about energy financing included in hospital rates         | 0.2    | 1       | 0.2         |
| 2                             | People's habit of visiting in large numbers (> 2 people)                   | 0.2    | 1       | 0.2         |
| 3                             | Habitual visit duration that exceeds the standard visit time               | 0.2    | 1       | 0.2         |
| <b>Average</b>                |  |        |         | <b>0.60</b> |
| No                            | Opportunity  | Bobot  | Rating  | Skor        |
| 1                             | Utilization of energy-saving technology devices                            | 0.2    | 4       | 0.8         |
| 2                             | Development of information technology that supports energy saving behavior | 0.2    | 4       | 0.8         |
| <b>Average</b>                |  |        |         | <b>1.60</b> |
| <b>Strengths - Weaknesses</b> |  |        |         | <b>1.0</b>  |

The results of the EFAS analysis found that the difference between opportunities and threats was 1.0 or the opportunity was an important indicator in developing energy-saving behavior strategies in inpatient rooms. The formulation between IFAS and EFAS produces a decision based on the quadrant image in the SWOT analysis of energy saving behavior which is presented in the following image:

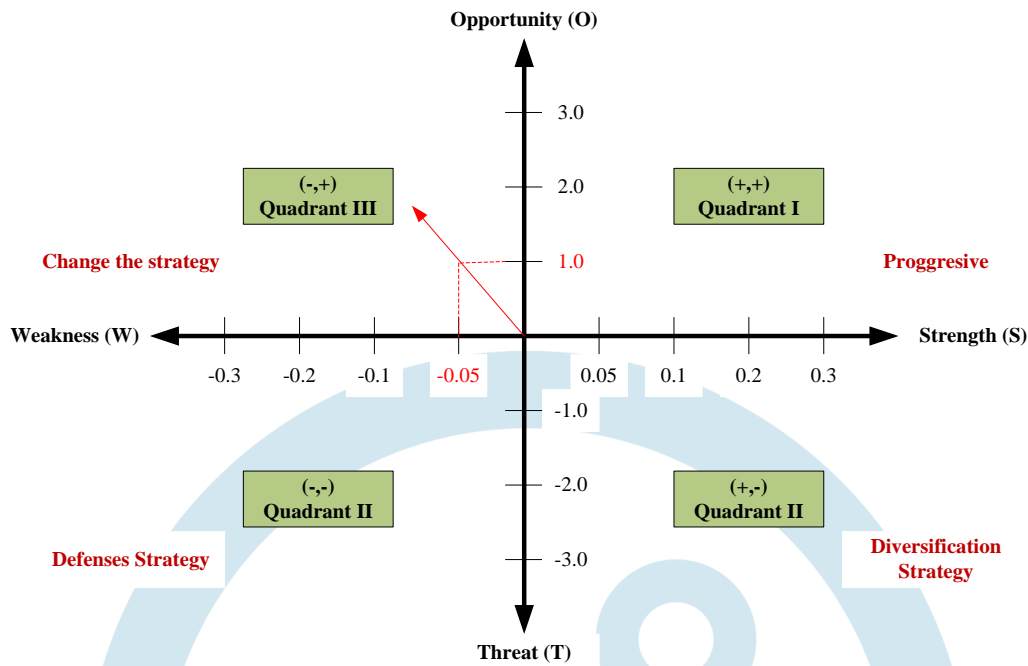


Figure 1. Energy Saving Behavior SWOT Analysis Chart

The results of the SWOT analysis show that the SWOT strategy found, namely the strategy for developing energy-saving behavior among inpatient room users, refers to the conclusion of quadrant III. Hospital management has a great opportunity to foster energy-saving behavior, but behind that, hospital management also finds internal problems [9][10]. Therefore, the strategy chosen is to develop energy-saving technological devices and regular equipment maintenance. Apart from that, hospital management also involves human resources, in this case health workers, to educate users to implement energy-saving patterns.

The results of the SWOT analysis found strategies that can be implemented to develop energy saving behavior. These results show that hospital management has a great opportunity to foster energy-saving behavior, but behind that, hospital management also finds internal problems. These findings give rise to strategies for using environmentally friendly devices and education on energy saving patterns.

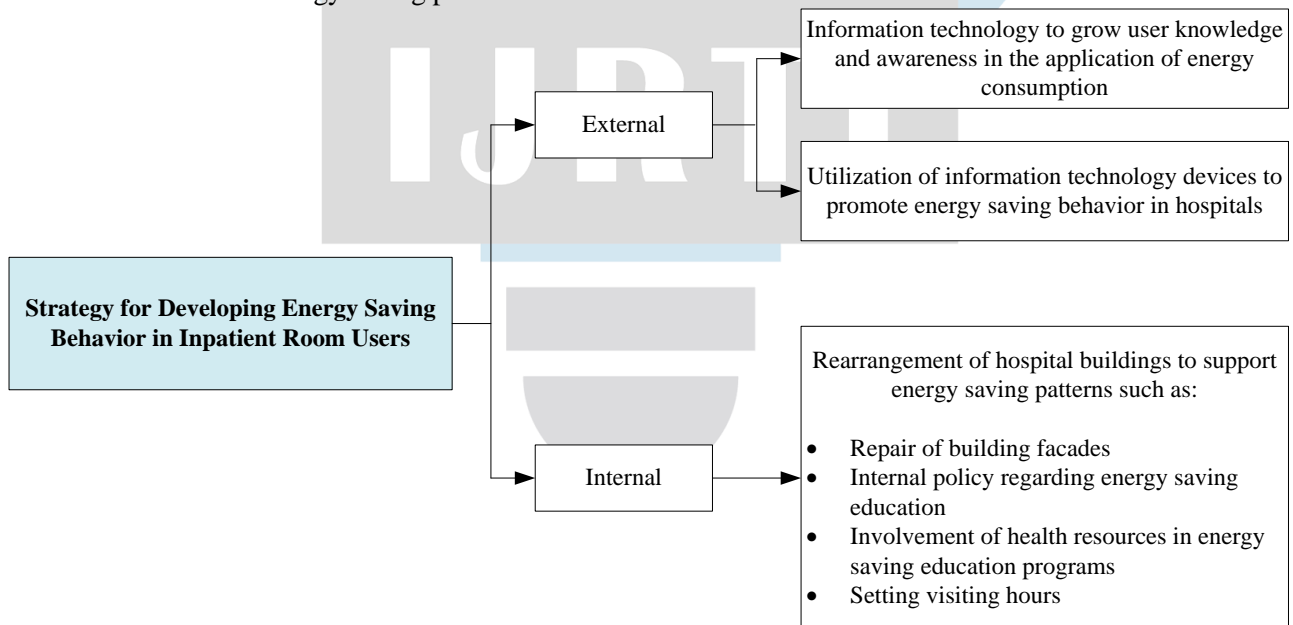


Figure 2. Energy Saving Strategy

Regarding the use of environmentally friendly equipment, hospital management should pay attention to lighting, ventilation and water use systems. These three systems are supported by electronic equipment such as AC and pumps which require large amounts of energy. The use of these electronic devices without maintenance will have an impact on electrical energy efficiency. Therefore, hospital management must carry out regular maintenance.

This finding is supported by Nouridine [11] that the intensity of energy consumption in hospitals is generally in the wasteful category. Energy conservation efforts must be carried out through operational arrangements for electronic equipment and maintenance. Furthermore, [12] explained that energy saving systems in hospitals must take into account room lighting and user comfort. Therefore, the system must consider construction systems such as the area of air ventilation and other openings.

Energy saving strategies in hospitals are one form of achieving a green hospital. The principles of green hospitals outlined includes six components, namely 1) Hospital location that supports the surrounding socio-economic and ecological environment. 2) Efficient use of water and efforts to conserve water resources. 3) Wise use of electrical energy and supporting the reduction of carbon emissions. 4) Use of environmentally friendly building materials. 5) Indoor air quality guarantees the comfort and health of room users. 6) There is innovation and creativity to achieve optimal energy use. [13]. Apart from that, energy conservation in hospitals aims to find energy saving patterns while still considering optimizing the function of health equipment [14].

Hospital management related to energy management includes six elements, namely: 1) the existence of integrated policies and systems in all hospital buildings; 2) the formation of an organization responsible for energy conservation in all hospital buildings; 3) communication and motivation of all hospital employees regarding the energy conservation program; 4) Energy utilization information system that presents the level of electrical energy utilization in all buildings; 5) promotions aimed at involving hospital space users in energy conservation and 6) Availability of hospital investment that supports the availability of energy conservation facilities ( ).

Furthermore, educational studies for inpatient room users are still limited because they are considered not to contribute to energy efficiency. [15] explain that energy saving patterns in hospitals involve the community in three actions, namely 1) Turn off machines; 2) Lights out when not needed; and 3) Close doors when possible. These three actions are considered to contribute to reducing energy use. This researcher shows that environmental campaigns as an energy reduction intervention can support energy saving patterns in hospitals.

Furthermore, [16] outline two forms of intervention in management to achieve efficiency in public buildings. Engineering interventions are characterized by the use of energy-saving lamps and the use of HVAC systems to regulate air circulation in the building. In addition, technical interventions also advocate integrating various energy sources. The second intervention is operational intervention such as scheduling equipment maintenance and controlling equipment use and the third is behavioral intervention which focuses on the habit of space users consuming excessive energy. Effective interventions that shape this behavior are education or energy awareness campaigns, intensive programs and competition between departments in energy saving efforts. With a description of the research results and several previous references, the strategy found is possible to implement as long as it has support from hospital management and the participation of its human resources. From the hammer test results, it can be concluded that although most of the concrete structures show adequate strength, several points show indications of lower strength. This can be caused by various factors, including material quality, casting method, or environmental conditions that affect the concrete. Based on these findings, it is recommended to carry out repairs or strengthening at points that show low strength. Regular monitoring and additional testing can help ensure that the structure remains safe and in good condition. Implementing preventive maintenance and repair actions can extend a structure's life and ensure building users' safety.

#### IV. CONCLUSION

The resulting model strategy shows that Labuang Baji hospital management must make strategic changes to create energy-saving behavior for inpatient room users and hospital management needs to use energy-saving technology, regularly maintain equipment and involve health workers in energy-saving education programs.

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