The Impact of Policy Implementation on The Use of Solar Power Plants at dr.Asmir Army Hospital

Donny Yoesgiantoro, Nurbaiti

Abstract. Every aspect of human life is being impacted by the coronavirus disease 2019 (COVID-19) pandemic. The efforts to stop the virus's spread and the halt of economic activity have a big impact on the environment. The same thing also had an effect on the operational facilities of the Indonesian army, one of which was a hospital. During the pandemic, the need for electricity to serve patients, especially patients who were exposed to Covid-19 in military hospitals, increased sharply so that a large amount of energy was needed to support the operations of army hospitals. This research was conducted at dr. Asmir Army Hospital Salatiga. The research was carried out by means of literature review and direct observation to the hospital. The results of the study found that during a pandemic at the dr. Asmir army hospital, Salatiga, electricity needs were supported by new, renewable energy, namely solar power plants with the currently available capacity of 14,400 Watts. Initially the solar power plant was used for the needs of the oxygen generator, but because the available capacity was still small, the electricity grid was used to save on hospital electricity costs.

1 Introduction

Many industries have been impacted by the COVID-19 epidemic, including agriculture, manufacturing, finance, education, healthcare, sports, tourism, and food [7]. COVID-19 has demonstrated the interconnectedness of crisis response and recovery. In Africa, where so many problems stem from a lack of access to energy, gaps in fundamental infrastructure such as electricity generate major vulnerabilities. Resolving the issue of energy availability in health facilities in response to COVID-19 gets us one step closer to breaking the vicious cycle of panic and negligence in disease prevention. Indonesia is one of the Southeast Asian countries hardest hit by COVID-19. While the case load has been high since the pandemic began in 2020, the introduction of the highly infectious delta variant resulted in a major increase in cases and deaths in July and August 2021. The COVID-19 outbreak has piqued the interest of researchers, with various studies looking at how lockdown measures affect overall electricity consumption loads [1, 6, 9, 14].

Salatiga is one of the cities in Indonesia plagued with the corona virus. Salatiga is a city in the Indonesian state of Central Java that is an enclave of the Semarang Regency. Salatiga

* Corresponding author: nurbaitiii0909@gmail.com

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).
Salatiga is in the middle of the cities of Semarang, Solo and Yogyakarta. Salatiga is divided into four sub-districts and 23 sub-districts. Salatiga has a population of 193,525 people until the end of 2021. Salatiga City now has 5,934 people afflicted with the corona virus, as of Monday (10/7/2023) at 10:41:55. The dr. Asmir Army Hospital treated 1,104 Covid-19 patients out of the 5,934 cases. The dr. Asmir Army Hospital's need for oxygen has increased dramatically because of the huge number of Covid-19 patients. The peak of the covid cases at the dr. Asmir Army Hospital occurred in June-July 2021. Unfortunately, because the oxygen demands of hospitals in Central Java are prioritized in the city of Semarang, this need must be met by the hospital itself. The oxygen generator required by the dr. Asmir Army Hospital has a capacity of 200 liters per minute and requires a substantial amount of electricity (44,000 watts or 44 kWh) for one-way operations. As a result, the hospital's administrator established a policy to build a solar power plant to provide electricity support for oxygen generators in order to meet the oxygen needs of Covid-19 patients.

Reliable power is essential for effective COVID-19 and other illness responses. Currently, almost all diagnostic tests for active COVID-19 infection require electricity. Patients who require additional diagnosis (e.g., pulse oximetry) or treatment with ventilators or oxygen masks must be admitted to clinics with reliable power; even brief outages can be fatal. Furthermore, electricity drives sanitization and cleaning equipment such as autoclaves and air filters, as well as pumped clean water in some regions. These are required to prevent the transmission of infection among patients and medical personnel. Electricity is only one of many resources that allow health systems to identify, prevent, and cure infectious diseases; clean water, enough equipment, qualified personnel, and medical supplies are also required. However, the effectiveness of these resources is heavily influenced by power.

2 Method

The study was conducted through a review of the literature and firsthand observation at the hospital. The research was conducted in two stages. The data was acquired from the appropriate sources in the first step, and it was merged, sorted, organized, and processed in the second stage.

3 Result and Discussion

Electricity is required to power the most fundamental services in health-care facilities, such as lighting and communication, as well as clean water supplies. Reliable electricity is also required for the medical equipment required to safely manage delivery or to assure immunization, as well as for the majority of routine and emergency treatments. Reliable energy supply, particularly electricity, is a critical enabler of universal health coverage. Access to energy is therefore a major enabler of health care delivery and medical technology access [2]. While hospitals in rich economies struggle to offer medical resources to people under increasing strain from COVID-19, hospitals and health facilities in low- and middle-income nations are dealing with the pandemic alongside ongoing infrastructure and energy access challenges [8].

There are two major energy requirements for health care facilities: electricity for health services and medical equipment, and thermal requirements for sterilization, space and water heating, and incineration [16]. Health staff must work in near darkness without access to reliable electricity, relying on kerosene lights, candles, and cell phones. Vaccines and drugs that require refrigeration are unable to be kept, and medical equipment and instruments,
are unable to be sanitized or used at all.

Lack of electricity access complicates the provision of emergency care services and the operation of intensive care units. The ventilator has come to represent the type of critical care approach that these pandemic warants, one that requires electricity. Reliable energy availability is also required for a quick emergency response. In the event of a pandemic, the additional demands to treat patients as quickly as possible and allow communication place further strain on already stressed systems.

When basic energy services are absent, critical components of emergency response, such as nighttime care, refrigeration to store samples, sterilizing facilities, or electricity to run simple medical devices, are jeopardized.

In countries such as Uganda (where 15% of hospitals already use solar energy) and Sierra Leone (where 36% of health facilities and 46% of hospitals combine solar photovoltaics with other forms of energy), there has been a growing interest in the potential for solar photovoltaics to supplement grid access. Research has also shown that hybrid solar systems have the ability to supply reliable energy in medical settings. However, barriers such as high capital prices, limited alternative financing options, and equipment maintenance requirements hinder the development of renewable energy for health facilities.

3.1 Profile dr. Asmir Army Hospital

Figure 1. dr. Asmir Army Hospital
Source: http://rstdrasmirsalatiga.co.id/about

On April 1, 1967, Rem Hospital 0731/Salatiga, was moved to dr. Muwardi 50 street, Salatiga based on Danrem Warrant 073 No. Sprin / 106 / III / 1967. Currently, the Tk IV Hospital 04.07.03 stands on an area of 5 Ha, is a Tk IV Hospital in the ranks of the Indonesian National Armed Forces, which is under the Regional Health Data Semt (Denkesyah 04.04.03) Salatiga. Dr. Asmir Hospital operational permit Salatiga based on Salatiga Mayor's Letter Number: 503/078/102 dated 24 February 2015. Hospital dr. Asmir Salatiga is a Type C Hospital. In managing the Hospital dr. Asmir is guided by the Vision and Mission of the Army Health, namely the Vision of becoming a trusted organizer of Army Health development based on Professionalism, Discipline, Morality and Solidarity and its mission is to provide reliable health support, excellent Health Services and thorough organic functions. Dr. Asmir Army Hospital has a land area of 48,410 m$^2$ and a building area of 9,950 m$^2$.

The motto of the dr. Asmir Army Hospital is Hesti Wira Sakti (pursuit of virtue and magic for all soldiers in all ranks of the Army Health). The average patient in the hospital is 150 per day. Dr. Asmir Army Hospital is a 24-hour hospital with 95% of patients at the dr. Asmir Army Hospital are BPJS patients with middle to lower socioeconomic conditions with the most common diseases suffered by patients are hypertension, diabetes, childbirth. Dr. Asmir Army Hospital always conducts social services every month including mass circumcision.
and blood donation as well as counseling on vectors of infectious diseases. The number of patients at the dr.asmir army hospital from 2019 to 2023 is as follows.

**Graph 1.** Number of Patients at Dr.Asmir Army Hospital

*Source: Dr.Asmir Army Hospital (2023)*

3.2 Electricity Consumption

**Graph 2.** Electricity Consumption in 2022

*Source: Dr.Asmir Army Hospital (2023)*
Christmas holidays and New Year’s preparations. Total electricity consumption in 2022 is 740,265 KWh with an average electricity consumption of 61,689 KWh per month.

Graph 3. Electricity Consumption in 2023
Source: dr. Asmir Army Hospital (2023)

Meanwhile, the trend of electricity consumption in 2023 from January to June has fluctuated with a total electricity consumption of 416,469 KWh with an average electricity consumption of 69,411 KWh per month. When compared with electricity consumption data in 2022, electricity consumption at the dr. Asmir Army Hospital has increased. This was due to the increase in the number of patients and the end of the restriction policy set by the government during the pandemic. Since the end of the pandemic, the number of patients at the dr. Asmir Army Hospital has increased quite significantly.

3.3 Solar Power Plant dr. Asmir Army Hospital

Figure 2. Solar Power Plant dr. Asmir Army Hospital
Source: dr. Asmir Army Hospital (2022)

Based on observations and information obtained from the head of the dr. Asmir Army Hospital, the dr. Asmir Army Hospital was the first army hospital to use a solar power plant. The solar power plant used is a rooftop solar power plant. Construction of the solar power plant began in March 2022. Initially the use of a solar power plant to supply electricity for oxygen generators to meet the oxygen needs of Covid-19 patients requires 44,000 watts.
Unfortunately, the army hospital's budget is not sufficient to build all rooftop solar power plants with a capacity of 44,000 watts, so a solar power plant with a capacity of 14,400 watts has just been built. Because the capacity built is still very small to supply oxygen generators, the electricity generated is used to back up electricity needs in hospitals so that the electricity generated by solar power plants is grided with the aim of saving hospital electricity costs.

Based on information obtained from the head of the hospital that a solar power plant, with a full capacity of 44,000 watts can be built in the next five to six years by considering the hospital's budget and finances because the hospital budget is mostly spent on paying the salaries of hospital employees, both civil servants (428 public servants and 620 honorary employees) and 55 military personnel, and sometimes see the dynamics of changing regulations from the center regarding the budget. The electricity requirement at the dr.Asmir army hospital is 150,000 watts – 200,000 watts per day.

With a small capacity produced by a solar power plant, the impact of the construction of a solar power plant is not very significant, especially in saving electricity costs. Since the presence of the solar power plant until June 2023, it has only been able to save Rp. 9,560,000 in hospital electricity costs. However, the existence of a solar power plant makes hospital conditions a little greener with a reduction in CO₂ emissions of 5.63 T. The total value of saving on hospital costs and reducing CO₂ emissions does not include recording in August 2022 because the recording application for that month experienced an error. The following is a graph regarding the yield of energy produced by a rooftop solar power plant at the dr.Asmir army hospital and the cost savings from using a rooftop solar power plant.

Graph 4. Total Energy Generated By Rooftop Solar Power Plants From 2022 to 2023
Source: dr.Asmir Army Hospital (2023)
For solar power plants, they only experience budget constraints and the dynamics of central regulation regarding the budget. While the weather in Salatiga has never experienced extreme weather which has caused disruption to the solar power plant. Meanwhile, seeing that the waste generated by hospitals is quite large, the head of the hospital is considering processing this waste into biogas which can generate electricity to support the use of green energy besides solar power plants.

3.4 Energy Consumption Intensity (IKE) [5,10]

Energy Consumption Intensity (IKE) is a term used to express the amount of energy used per square meter of gross area (gross) of a building in a certain period of time. Determination of the value of the Intensity of Electrical Energy Consumption has been implemented in various countries (ASEAN, APEC), and is expressed in units of kWh/m²/year. To set the "target" in this case, the IKE value was used from the results of research conducted by ASEAN-USAID whose report was issued in 1992 with details as shown in table 1.

<table>
<thead>
<tr>
<th>Number</th>
<th>Classification</th>
<th>IKE (kWh/m²/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Office/Commercial</td>
<td>240</td>
</tr>
<tr>
<td>2</td>
<td>Mall/Supermarket</td>
<td>330</td>
</tr>
<tr>
<td>3</td>
<td>Hotel/Apartment</td>
<td>300</td>
</tr>
<tr>
<td>4</td>
<td>Hospital</td>
<td>380</td>
</tr>
</tbody>
</table>
In calculating the amount of electricity IKE in buildings, there are several terms used, including electricity IKE per unit total area of the building conditioned (net), namely the total area of air-conditioned rooms and IKE electricity per unit gross area of the building, namely the total area conditioned building space (AC room) plus the total area of the building space that is not conditioned (without AC). As a guideline, IKE standard values for buildings in Indonesia have been established by the Ministry of National Education of the Republic of Indonesia in 2004.

Table 2. IKE Standards Ministry of National Education of the Republic of Indonesia in 2014

<table>
<thead>
<tr>
<th>No.</th>
<th>Criteria</th>
<th>AC Room (kWh/m²/month)</th>
<th>Room Without (kWh/m²/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Very Efficient</td>
<td>4.17 - 7.92</td>
<td>0.84 - 1.67</td>
</tr>
<tr>
<td>2</td>
<td>Efficient</td>
<td>7.92 - 12.08</td>
<td>1.67 - 2.50</td>
</tr>
<tr>
<td>3</td>
<td>Enough</td>
<td>12.08 - 14.58</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Rather Extravagant</td>
<td>14.58 - 19.17</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Extravagant</td>
<td>19.17 - 23.75</td>
<td>2.50 - 3.34</td>
</tr>
<tr>
<td>6</td>
<td>Very Extravagant</td>
<td>23.75 - 37.75</td>
<td>3.34 - 4.17</td>
</tr>
</tbody>
</table>

\[
IKE = \frac{\text{Total kWh per month}}{\text{Gross Area}}
\]

3.5 Calculation of IKE for dr.asmir Army Hospital Building [12]

The method used in this study was a casuistic descriptive method by conducting an energy audit to evaluate the profile of electricity usage and electricity consumption intensity (IKE) at dr. Asmir Army Hospital. While the analysis is intended to interpret more deeply the relationships that occur in terms of wastage of electrical energy. The calculation of IKE can be done in the following way:

\[
IKE = \frac{\text{Total kWh per month}}{\text{Gross Area}}
\]

Calculation of IKE for dr.asmir Army Hospital Building

Calculation of monthly Energy Consumption Intensity (IKE) is calculated based on monthly average usage of 61,689 KWh/month in 2022 so that IKE per month in 2022 is \(\frac{61,689}{9950} = 6.19\) KWh/m²/month, this value if associated with the IKE Standard of the Ministry of National Education of the Republic of Indonesia, for an air-conditioned room in the dr.asmir Army Hospital building complex, it is included in the very efficient category.

Whereas in 2023, the IKE per month until June 2023 \(\frac{69,411}{9950} = 6.97\) KWh/m²/month, this value is categorized as very efficient. The cost of electricity in June 2023 is IDR 55 million.

The IKE value at the dr.asmir army hospital is in the very efficient category, there may be little influence from the use of solar power plants in the hospital.

4 Conclusion
limitations of the hospital's budget and changes in regulations regarding finance in the central environment. It is possible that in the next five to six years, solar power plants can achieve the desired target of 44,000 watts to supply oxygen generator electricity. For the time being, the small capacity of electricity produced by the new solar power plant is used to back up electricity for the hospital by doing the grid on the State Electricity Company's network so that it is expected to save on hospital electricity costs. Due to the small capacity generated by the solar power plant, the impact of its construction has not yet been felt. The electricity cost that has just been saved is Rp. 9,560,000. However, the existence of a solar power plant provides a reduction in CO₂ emissions in the hospital environment, although it is not significant, namely 5.63 T, making the dr.asmir army hospital environment greener.

Meanwhile, the IKE for electricity per unit total area of the building that is conditioned (air-conditioned) for the dr. Asmir Salatiga is 6.19 kWh/m²/month in 2022 and 6.97 kWh/m²/month in 2023. This value when associated with the IKE Standard of the Ministry of National Education of the Republic of Indonesia, for air-conditioned rooms is in the very efficient category. The IKE value at the dr.asmir army hospital is in the very efficient category, there may be little influence from the use of solar power plants in the hospital.

References


