ZISWAF: Jurnal Zakat dan Wakaf
E-ISSN **2654-8569**, P-ISSN **2654-8577**
Volume 11 Number 1 Year 2024
Page 40-59

Waqf as an Alternative Financing for Solar Energy in Indonesia: Opportunities and Challenges

Farokhah Muzayinatun Niswah[1*], Esa Dwiyan[2], Thufeil Ammar[3], Lisa Listiana[4]

[1] Universitas Muhammadiyah Lamongan, Waqf Center for Indonesian Development and Studies (WaCIDS)

[234] Waqf Center for Indonesian Development and Studies (WaCIDS)

[4] Universitas Indonesia, Waqf Center for Indonesian Development and Studies (WaCIDS)

Abstract: *Environmental damage is a pressing global issue that requires immediate action to ensure the survival of all life on Earth. A promising solution is the transition to renewable energy (RE), though this shift can be expensive. Waqf, a form of Islamic endowment, offers a potential alternative financing mechanism for RE projects. Among renewable energy sources, solar energy stands out due to its relatively low installation costs, ease of deployment, and suitability for tropical regions like Indonesia. While previous studies have explored energy financing concepts, none have specifically examined waqf as a funding source for solar energy. This paper seeks to assess the opportunities and challenges of using waqf to finance solar energy in Indonesia. The research is based on literature reviews and in-depth interviews with stakeholders involved in energy waqf in Indonesia. Findings indicate that the primary challenge was the lack of awareness and education about waqf and solar energy. This research provides valuable insights for policymakers, particularly the Indonesian Waqf Board (BWI), nazhir (waqf managers), and the Ministry of Energy and Mineral Resources.*

Keywords: *Productive Waqf; Green Waqf; Renewable Energy; Solar Energy; Green Economy*

***Corresponding author**: fmniswah@gmail.com

Received: February 29,2024; Accepted: March 6, 2024; Published: June 24, 2024

INTRODUCTION

Seventeen Sustainable Development Goals (SDGs) were formulated on September 25, 2015. The SDGs emphasize at least three main concerns: to alleviate poverty, secure the planet, and ensure prosperity for all (Aassouli et al., 2018). The idea is

to boost a healthy and inclusive economy while being mindful of environmental change. A year later, in conjunction with environmental change, all stakeholders represented by 178 governments adopted the Paris Agreement in 2016, including Indonesia. As part of the Paris Agreement, Indonesia committed to a serious and ambitious effort to reduce emissions by 29% in 2030 (Mahmoody et al., 2021; Reyseliani & Purwanto, 2021).

One crucial strategy for reducing emissions is shifting energy production from coal to renewable sources. Indonesia needs to lower its emissions to below 662 MtCO2e by 2030 to align with the global 1.5°C scenarios outlined by the IPCC. To achieve this, the share of renewable energy in Indonesia's energy mix must increase to at least 50% by 2030 (Climate Transparency, 2020). This target is challenging given that Indonesia's current renewable energy capacity is increasing by only 4% (PCY Data Center, 2023), leaving a 38% gap that must be addressed before the 2030 deadline.

Solar rooftops are seen as a highly viable solution to address the energy gap. They offer a relatively low installation cost compared to other renewable energy sources (Reyseliani & Purwanto, 2021), are easy to install, and can be deployed across Indonesia's archipelago (Qosim & Hariyati, 2021). Additionally, Indonesia's equatorial location provides optimal solar heat distribution, making solar rooftops an ideal choice for government development (Vakulchuk et al., 2020). In addition, the Ministry of Energy and Mineral Resources of Indonesia (ESDM) mentioned that solar rooftop has a huge potential of 32.5 GW compared to the current energy mix capacity of 8.89 GW (Iskandar & Aqbar, 2019). This fact also confirms possible undiscovered potentials from solar rooftops.

To accelerate the energy transition, there are at least two things the government needs to do, revising the regulation and financing solar energy infrastructure. As for regulation, the Ministry of Energy and Mineral Resources published Regulation No 26 to improve the percentage of solar-generated electricity from 65 percent to 100 percent. However, there is an urgent need to cover the financing part. An investment of IDR 533 trillion is needed to fulfill the country's target of installing 23% renewable energy by 2025. Nonetheless, the current annual investment set by the Ministry of Energy and Mineral Resources is only IDR 30.4 trillion (Hendriwardani et al., 2022). There is a huge gap between what has been invested and the target investment.

The government needs a financial strategy to address the investment gap, and Islamic finance could play a crucial role in advancing solar-generated electricity. Waqf, in particular, has a proven history of contributing to national development. Historical waqf projects in the Ottoman Empire funded infrastructures such as roads, schools, water supplies, hospitals, and inns. In Egypt, the Al-Azhar University project exemplifies an integrated waqf model involving rented land, a public market, and an educational institution. Similarly, in Morocco, another university was established using waqf. Additionally, agricultural waqf land established by Umar ibn Khattab and Uthman's water well continue to serve their purposes today.

Building on the historical use of waqf, there is potential to apply it to modern sustainable projects, such as solar-generated electricity. Key questions include: What are the opportunities and challenges of using waqf to finance solar infrastructure? How can waqf contribute to these projects? What waqf schemes could be implemented to support solar energy? Addressing these questions can clarify how waqf might effectively support and advance renewable energy initiatives.

An in-depth interview with stakeholders involved in waqf and solar energy can address these questions. While previous studies have explored waqf and solar energy, this research distinguishes itself by focusing on the opportunities and challenges of using waqf as an alternative financing method for solar energy in Indonesia. It examines the perspectives of users, practitioners, and regulators of solar energy waqf. Unlike previous research, which often relied on descriptive analysis of waqf's role in renewable energy funding, this study combines literature review with detailed interviews to provide a comprehensive understanding of the subject.

LITERATURE REVIEW

Renewable Energy

Renewable energy is energy derived from natural processes which do not involve consuming exhaustible resources such as fossil fuels and uranium (Hasan et al., 2012). It is undeniable that every human being needs energy resources. Every activity certainly requires resources, whether it is renewable or not. However, using non-renewable energy sources that have been massively used will one day be exhausted and produce pollution that can damage the environment and health. Therefore, countries such as Indonesia have planned to switch from dirty energy to renewable energy. Renewable energy has the virtue that it will never stop or as long as the natural cycle is still going on, is environmentally friendly, and can minimize environmental pollution. One renewable energy source that is being intensively developed in Indonesia is solar energy.

Solar Energy

Nowadays, solar energy has become more popular as an energy supply globally and is considered the most economical alternative (Noer & Ariyanti, 2012). Solar energy has advantages compared to other types of energy, such as energy sources that are easy to obtain, environmentally friendly, suitable for various geographical conditions, and easy installation, operation, and maintenance (Qosim & Hariyati, 2021; USAID & Otoritas Jasa Keuangan (OJK), 2016). Indonesia is a tropical country located on the equator line, so it has abundant potential for solar energy or power plants (Hasan et al., 2012).

There are two main types of solar power plants: photovoltaic (PV) and solar thermal. PV systems use solar panels to directly convert sunlight into electricity, while solar thermal systems collect solar heat to warm a liquid, producing steam that drives turbines to generate electricity. PV is more popular and has a larger market share compared to solar thermal. This preference is due to the technical

limitations of solar thermal, which requires specific locations with direct sunlight and is typically viable only for large-scale installations exceeding 20 MW (USAID & Otoritas Jasa Keuangan (OJK), 2016). A photovoltaic system operates to generate electricity. The solar PV system is classified into standalone or off-grid photovoltaic systems and grid-connected or on-grid photovoltaic systems (Kumar et al., 2018)

Almost all parts of Indonesia have the potential to develop solar power plants with an average power of up to 4 kWh/m^2. By region, the western region of Indonesia has a potential of around 4.5 kWh/m^2/day, and the eastern region of Indonesia has a potential of around 5.1 kWh/m^2/day. The potential of solar power nationwide reaches 4.8 kWh/m^2/day, equivalent to 207,898 MW (Ardiyansah, 2022). The data on solar potency in each region of Indonesia can be perceived in Table 1.

Table 1. The Potency of Solar Energy in Indonesia

No.	Province	Potency (MW)	No.	Province	Potency (MW)
1	West Kalimantan	20,113	18	West Sumatra	5,898
2	South Sumatra	17,233	19	North Kalimantan	4,643
3	East Kalimantan	13,479	20	Southeast Sulawesi	3,917
4	North Sumatra	11,851	21	Bengkulu	3,475
5	East Java	10,335	22	North Maluku	3,036
6	West Nusa Tenggara	9,931	23	Bangka Belitung	2,810
7	West Java	9,099	24	Banten	2,461
8	Jambi	8,847	25	Lampung	2,238
9	Central Java	8,753	26	North Sulawesi	2,113
10	Central Kalimantan	8,459	27	Papua	2,035
11	Aceh	7,881	28	Maluku	2,020
12	Riau	7,763	29	West Sulawesi	1,677
13	South Sulawesi	7,588	30	Bali	1,254
14	East Nusa Tenggara	7,272	31	Gorontalo	1,218
15	West Papua	6,307	32	Yogyakarta	996
16	Central Sulawesi	6,187	33	Riau	753
17	South Sulawesi	6,031	34	Jakarta	225
				Total	207,898

Source: Bayu, 2021

Despite the potential of solar power plants for public benefit, their development has been insufficiently supported by the Government, including the National Electricity

Company (PT Perusahaan Listrik Negara, PLN) and private Independent Power Producers (IPPs). The high investment required for solar power makes it less competitive compared to other energy sources. This lack of support results in policies that do not effectively promote the solar power sector and undermine its potential. Although PLN has committed to the Paris Agreement, it has made little progress in reducing greenhouse gas emissions. This is due to PLN's continued reliance on coal-fired power plants and its low-priority approach to developing New and Renewable Energy (NRE) sources, which contrasts sharply with their potential (Modjo, 2019).

The investment cost for shifting energy to solar panels is considered big. It includes the cost of purchasing all the components, such as a solar module and an inverter, while maintenance and operational costs are around 1-2% of the total initial investment cost (Qosim & Hariyati, 2021). The initial investment cost for on-grid solar energy with a capacity of 20 kWp with an operating period of 20 years is around IDR 225,500,000 with maintenance and operational costs of 1%, IDR 2,255,000 (Qosim & Hariyati, 2021). The high cost and the lack of an overview of solar energy make it difficult for financial institutions such as banks to finance the project (USAID & Otoritas Jasa Keuangan (OJK), 2016). Sharia finance can be one solution to the problem of the lack of availability of financing instruments following renewable energy (RE) investment (Iskandar et al., 2021; Iskandar & Aqbar, 2019).

Waqf for Solar Energy Financing

One of the financing instruments in Islam with a prospect strategic for the community is the waqf. The basic economic concept of a waqf is to invest money (and other resources) in productive assets that produce usufruct or income for the benefit of society, whether as a whole or in part, rather than using them for personal or group consumption (Tutuko et al., 2017). When appropriately distributed and managed in profitable and secure investments, the entire waqf can be a useful funding source. In society, there is a need for productive waqf which is eternal to provide services for the community for various social and economic purposes.

Waqf for solar energy financing is included in green financing supporting green economy concept, in which waqf is used to finance environmentally friendly projects with paying attention to environmental and social impacts in carrying out their operational activities (USAID & Otoritas Jasa Keuangan (OJK), 2016). An interesting thing about waqf financing for solar energy is that it contributes to sustainability because solar energy will be used continuously by the community as long as this instrument lasts. Although the implementation of waqf energy is a novelty in the world and even first applied in Indonesia, however, there are several start-ups, foundations, and mosques which implement this waqf energy such as *Berbagi Listrik* and Istiqlal Mosque.

The green economy concept seeks to promote investments in environmentally friendly sectors while also addressing poverty alleviation. The need for renewable energy and the implementation of a sharia economy aligns with global efforts to achieve Sustainable Development Goals (SDGs) (Iskandar et al., 2021). Waqf

presents a valuable option for financing solar energy projects, as it combines social and economic benefits.

Previous Research

This research aims to propose waqf as an alternative financing method for solar energy projects in Indonesia to support the Sustainable Development Goals (SDGs). The scope of this study is relatively new, as there is limited research on the connection between waqf and renewable energy, particularly solar energy. Previous studies have explored various aspects of this relationship, such as waqf energy's potential to mitigate climate change impacts (Anam & Fauzi, 2021), the urgency of renewable energy availability, and the role of sharia-compliant economic and financial systems in advancing the SDGs (Iskandar et al., 2021; Razak & Dawami, 2022). Other research has also highlighted the potential of Islamic redistributive institutions to provide alternative funding sources for socioeconomic infrastructure development (Nafar, 2019), and the use of agent-based modelling and scenario-based simulations to demonstrate the benefits of redesigning the waqf system for financing solar power plants (Ari & Koc, 2021).

Other research talks about a scheme of waqf financing to be easily accessible to many people (Nor et al., 2021) and a productive waqf scheme with environmentally friendly (Ali & Kassim, 2020), the potential for solar energy development in Indonesia (Adjikri, 2017), regulations for the concept of electricity costs if produced alone through solar panels (Yudha & Tjahjono, 2019), and the importance of synergies between waqf institutions and the government to create greater benefits for society and the environment (Hamdani et al., 2021). Previous research has not yet addressed the potential of combining solar panels with waqf financing schemes. This study differentiates itself by focusing on the opportunities and challenges of using waqf as an alternative financing method for solar energy in Indonesia. It examines these aspects from the perspectives of users, practitioners, and regulators involved in both solar energy and waqf.

RESEARCH METHODS

This research used a combination of literature research and in-depth-interviews because the field of research on the relationship between waqf and solar energy is relatively unexplored. This research employed desk research and semi-structured interviews. Desk research was conducted to obtain a detailed critical review and analysis of previous literature from reports, journals, books, and official government websites. To determine the waqf financing model for solar energy, this study also analyzed implemented waqf financing schemes. There are four objects of this research: Jogokaryan Mosque in Yogyakarta, Salman Mosque in Bandung, Istiqlal Mosque in Jakarta, and *Berbagi Listrik* in West Kalimantan. All of the objects already use solar energy by using the waqf scheme for financing. Semi-structured interviews were conducted to obtain expert and practitioner opinions on the opportunities and challenges of waqf for solar energy financing in Indonesia. The waqf scheme used by the users is also being identified to get a suitable waqf scheme for solar energy financing. The results of the interviews were mapped based on the same criteria and poured into a schematic chart of the opportunities and

challenges of waqf as financing for solar energy in Indonesia. The 6 selected respondents are experts and practitioners in the field of waqf and energy who are also solar energy waqf stakeholders in Indonesia. The respondent's list can be perceived in Table 2.

Table 2. Respondents of Research

No.	Position in Institution	Institution	Position in Research
1.	General Treasurer and Administrator	Jogokariyan Mosque, Yogyakarta	User
2.	Program Manager of Salman Waqf	Salman ITB Mosque, Bandung	User
3.	Deputy Head of *Riayah* Division	Istiqlal Mosque, Jakarta	User
4.	Communication Manager	Ministry of Energy and Mineral Resources (ESDM)	Regulator
5.	Chief Executive Officer (CEO)	*Berbagi Listrik*	Practitioner
6.	Head of Nazhir Empowerment and Management	Indonesian Waqf Board (BWI)	Regulator

Source: Author, 2022

The research process was carried out in several steps. First, a literature review was conducted to confirm that the research subject involved a solar panel user and utilized waqf funds for its operations. Next, in-depth interviews were conducted using a semi-structured questionnaire model. All interviews were held online. Below is an outline of the key questions posed to the respondents:
1. Since when has this mosque been established?
2. Was the mosque constructed using waqf funds?
3. Where did the funds for mosque operations come from?
4. What productive programs are available in this mosque?

The initial phase of the interviews involved an introduction to gather general information about the research subject and ensure that it met the desired criteria. Then, the main questions in the research were posed to the respondents as below:

1. Are solar panels used to meet the electricity needs of this institution?
2. What is the reason for choosing solar panels?
3. How much of the institution's electricity demand (capacity) is covered by solar panels?
4. Are there any challenges encountered during the installation of solar panels?

5. How is the funding for the solar panel installation obtained?
6. What methods are used to raise waqf funds?
7. How much money is required for the installation of the solar panels, and when is the Break Even Point (BEP) expected to be reached?
8. Is the use of solar panels more cost-efficient?
9. What is your perspective as an administrator on using waqf for solar panel financing?
10. How has the community responded to the implementation of solar panel waqf?

Triangulation of data with documents and also literature data sourced from journal articles, official government websites, and news. Furthermore, the results of the interviews were mapped based on the same theme or keyword. After the results are obtained, the discussion was carried out and finally, the conclusions of the study were obtained.

RESULTS AND DISCUSSION

The Practice of Waqf in Financing Solar Energy in Indonesia

The development of waqf as alternative financing for solar energy has been found in Indonesia, including Jogokariyan Mosque in Yogyakarta, Salman ITB Mosque in Bandung, Istiqlal Mosque in Jakarta, and *Berbagi Listrik*. Based on the interviews, the type of solar energy used is photovoltaic (PV) solar panels by installing solar panels on top of the building (*solar rooftop)*. All four users stated that solar panels could save electricity (Ardiyansah, 2022; Hermala, 2022; Pramtama, 2022; Rahim, 2022).

Jogokariyan Mosque is a mosque located in the area of Yogyakarta (Masjid Jogokariyan, 2022). The mosque, which was awarded as a national pilot of a large mosque, received a waqf of 9 solar modules from a *waqif* (Masjid Jogokariyan, 2022; Rahim, 2022). The solar panel has a 4,185-Watt peak (Wp) capacity and can save around IDR 30,000 per day. The solar panels that have been installed since November 2021 are used to meet the electricity needs in the mosque area during the day when there is still sunlight, while at night, the mosque uses electricity from the PLN, an Indonesian government-owned corporation for electric power distribution in Indonesia (Rahim, 2022).

Mohammad Rizki Rahim, the General Treasurer and Administrator of Jogokariyan Mosque (2022), noted that since the installation of solar panels, the mosque's monthly expenses have decreased, albeit only slightly, as the current solar panel system is relatively small. The mosque management aims to expand the capacity of the solar panels to achieve more substantial electricity savings. This larger-scale solar panel installation will be funded using a waqf scheme through community fundraising efforts.

Unlike Jogokariyan Mosque, which is relatively new to using solar panels, Salman Mosque, located at one of Indonesia's oldest universities, Institut Teknologi Bandung (ITB), has been utilizing solar energy since 2016. That year, Salman

Mosque received a grant from ITB alumni, consisting of 12 solar modules capable of generating 54,691 kWh annually. This installation has resulted in an 8% reduction in electricity consumption for the mosque (Ardiansyah, 2022; Wakaf Salman, 2022). Bayu Rian Ardiansyah, Program Manager of Wakaf Salman (2022), reported that the mosque saves between 1.8 to 2.7 million IDR per month from using solar panels, which, like at Jogokariyan Mosque, are only operational during the daytime.

Like Salman ITB Mosque and Jogokariyan Mosque, Istiqlal Mosque is also a mosque using solar panels to meet its operational needs (Pramtama, 2022). The deputy Head of Istiqlal *Riayah* Division (2022) said that solar panels were installed during a major renovation of the mosque, which was completed in 2020. The Ministry of Public Works and Public Housing of the Republic of Indonesia granted 163 kWp or 504 units of solar modules, and the Agency for the Assessment and Application of Technology granted 11.4 kWp or 32 units of solar modules for the Istiqlal Mosque. There are 536 solar module units in total with a maximum capacity of 174.4 kWp with an on-grid system (Pramtama, 2022). Using solar panels during the day, mosques can save electricity consumption by 13% in real-time or monthly savings of up to 50 million rupiahs (Pramtama, 2022; Wakaf Salman, 2022). As the same as Salman Mosque and Jogokariyan Mosque, Istiqlal Mosque also plans to increase its solar panel capacity by raising waqf funds.

Other than mosque operations, waqf development on solar panels is also carried out for village lighting, such as what is performed by *Berbagi Listrik*. *Berbagi Listrik* is a socio-enterprise under *Energi Nusantara* Waqf Foundation to distribute electricity for free to Indonesia's villages that do not have electricity (Hermala, 2022). Until today, *Berbagi Listrik* has distributed free electricity to 14 locations, and one of the installations uses a waqf financing scheme (Hermala, 2022). In mid-October 2020, *Berbagi Listrik* installed solar panels in Sebongkup Hamlet, Nanga Biang Village, Kapuas District, Sanggau Regency, West Kalimantan with 144 families on the mandate of waqf from Majlis Ta'lim XL Foundation (Hermala, 2022; Indotelko.com, 2020). The electricity installed in the village can help the community to meet their daily electricity needs, especially lighting at night (Hermala, 2022; Indotelko.com, 2020). The installed solar panels have a capacity of about 6,000 MW (Hermala, 2022).

The Waqf Scheme for Solar Energy Financing

Based on the practice of the four research objects, there are two waqf schemes that can be considered for financing solar energy projects in Indonesia.

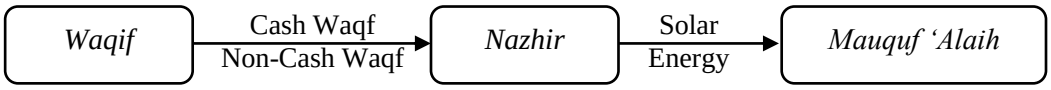

Figure 1. The 1st Waqf Scheme for Solar Energy

In the first waqf scheme, the waqf given by the *waqif* can be in the form of money (cash) or not money (non-cash), in the form of a solar panel component, to be submitted to *nazhir* as waqf manager. *Nazhir* gives the waqf to the beneficiaries for the installation of solar panels. In this scheme, waqf is the only source of financing for solar energy. This scheme is implemented by *Berbagi Listrik*, where the solar panel installation process in Sebongkup Hamlet is all funded by the waqf of XL Axiata employees (Hermala, 2022; Indotelko.com, 2020). The Istiqlal also used this first waqf financing scheme to fund the addition of solar panel capacity in the mosque. Until now, fundraising for solar panels is still being carried out under the name "*Wakaf Energi Istiqlal*" or Istiqlal Energy Waqf.

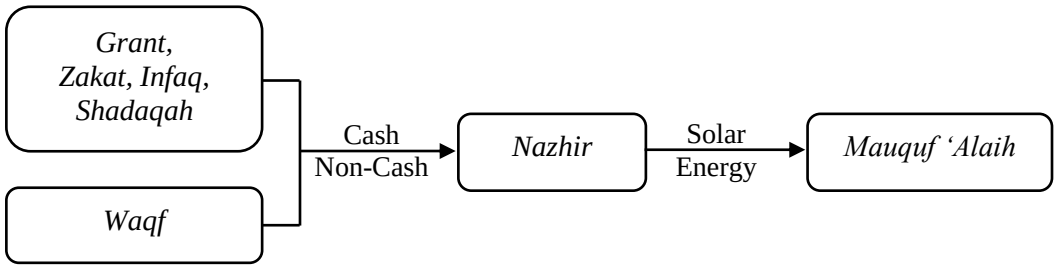

Figure 2. The 2nd Waqf Scheme for Solar Energy

In contrast to the first scheme, where waqf is the sole source of financing for solar energy, the second scheme involves collaboration with other funding sources such as Zakat, Infaq, Sadaqah (ZIS), or grants. This combined approach is perceived at Jogokariyan Mosque, where waqf contributors provided non-cash waqf in the form of solar panel components, while the installation and maintenance costs were covered by mosque operational funds sourced from ZIS (Rahim, 2022).

Similarly, Salman ITB Mosque used a collaborative financing model involving both waqf and grant. The grant was used to provide solar panel components, while cash waqf funds were allocated for the operation and maintenance of the system (Ardiansyah, 2022). Salman ITB Mosque is planning to expand its solar panel capacity, with implementation expected this year. The financing for this expansion will follow the same waqf scheme used in the first phase of solar energy installation. Currently, Wakaf Salman, the fundraising arm of Salman ITB Mosque, is actively raising waqf funds for this second phase of solar panel installation.

The Opportunities of Waqf as Alternative Financing for Solar Energy in Indonesia

Waqf is suitable for developing solar energy because it can be used for up to 20 to 25 years, is environmentally friendly, and can help meet the needs of electrical energy (Ardiyansah, 2022; Qosim & Hariyati, 2021; Tanjung, 2022). Irvan Hermala, Chief Executive Officer (CEO) of Berbagi Listrik (2022), said that waqf is suitable for financing solar energy compared to other instruments because waqf has an attractive return. In Islamic finance, waqf is quite optimal, and its utilization is also suitable for the beneficiaries, both socially and economically. Based on the

stakeholders, waqf has big opportunities to finance solar energy in Indonesia and challenges to anticipate.

Based on the data obtained from in-depth interviews with stakeholders of waqf and solar energy, the opportunities for waqf as an alternative to financing solar energy as shown in figure 3 below.

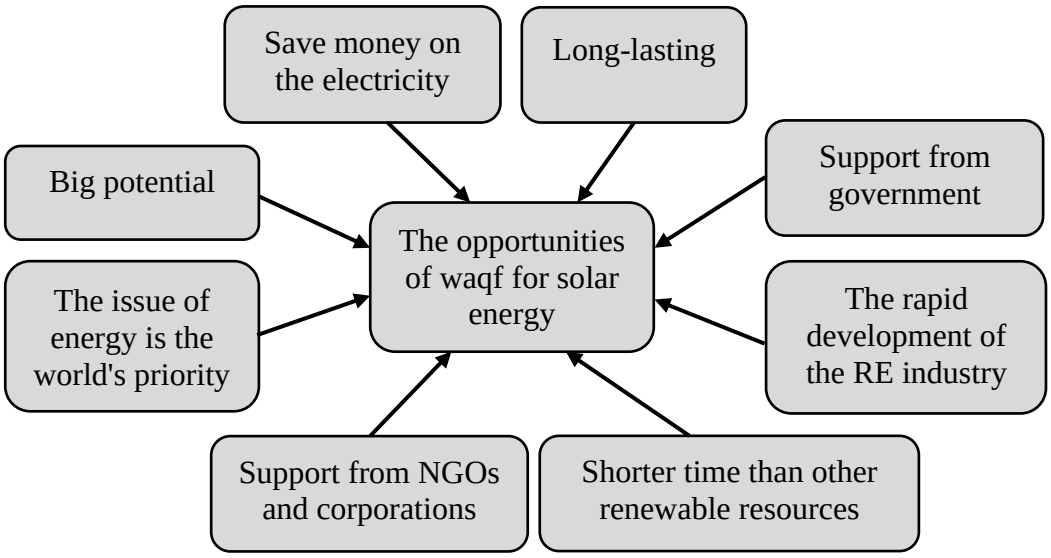

Figure 3. The opportunities of waqf for solar energy

Source: Respondents, 2022

The first opportunity for waqf in solar energy financing lies in its potential to reduce electricity costs. According to the Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia Number 26 of 2021, regarding Rooftop Solar Power Plants connected to the public electricity grid, one key goal of solar panel usage is to lower electricity bills. As demonstrated by Jogokariyan Mosque, Salman ITB Mosque, Istiqlal Mosque, and *Berbagi Listrik*, the adoption of solar energy has led to noticeable savings in electricity costs (Ardiansyah, 2022; Hermala, 2022; Pramtama, 2022; Rahim, 2022). During daylight hours, solar energy meets electricity demands, while at night, or when sunlight is insufficient, electricity is automatically sourced from the PLN, Indonesia's national power utility.

The second opportunity is the long-lasting period of solar energy. The period of use of solar panels is quite long, can be up to 25 years (Oktaviani, 2022), and it is in line with the waqf principle, where its use should not be temporary but sustainable. With the proper maintenance, solar panels will last to a maximum usage time. The potential rewards from installing solar cells with waqf funds are long-term (Rahim, 2022). Besides containing an economic value, using waqf funds to finance solar energy also contains a social value.

The third opportunity is the big potential of waqf to finance solar energy. The use of solar energy as an alternative energy source has received considerable attention from many countries in the world. Besides being sustainable, it does not cause pollution, which can damage the environment. Solar energy is one of the alternative energy suitable to implement in Indonesia. Indonesia is a country located on the equator line, and it is easy to get sunlight all year round (Hermala, 2022). The sunlight can be converted into electricity by using solar cells or photovoltaic technology. The potential of solar energy in Indonesia is very large, around 4.8 kWh/m^2 or equivalent to 112,000 GWp. Currently, the government has issued a roadmap for the use of solar energy, which targets the installed solar power plant capacity until 2025 to be 0.87 GW or around 50 MWp/year. This number illustrates the considerable market potential for developing solar energy in the future (Ministry of Energy and Mineral Resources Republic of Indonesia (ESDM), 2012).

The fourth opportunity is the great support of the government as a regulator. The development of waqf in solar energy gets full support from the government, as stated in the legislation, both waqf and solar energy (Oktaviani, 2022; Tanjung, 2022). Government support for the development of solar energy is stated in Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia Number 26 of 2021 concerning Rooftop Solar Power Plants Connected to the Electric Power Network Holders of Business Licenses to Provide Electricity for Public Interest. The regulation was made to encourage the use of environmentally friendly solar energy for electricity generation using a rooftop solar power generation system, a type of solar energy easily applied by the public. In addition, the policy of purchasing electricity by the National Electricity Company and providing incentives to users of solar power plants is also a form of government support and encouragement to increase the use of solar energy in Indonesia (Oktaviani, 2022).

Government support for the development of waqf, including as an alternative to solar energy financing, is stated in Law No. 41 of 2004. The waqf law states that waqf functions to realize the potential and economic benefits of waqf property for worship and to promote public welfare. As an alternative to solar energy financing, Waqf is a form of productive waqf where its activities produce economic value, and do not violate sharia, and many people can feel the benefits. Hendri Tanjung, Head of *Nazhir* Empowerment and Management in Indonesian Waqf Board (BWI), said, *"From regulation, everything is an opportunity (to support), the law (waqf) itself opens up the widest possible range of waqf assets, gold, silver, shares can be developed. Waqf assets are flexible, the important thing is that the benefits can be distributed."*

The fifth opportunity is the rapid development of the renewable energy industry and research. Based on the country's target of installing 23% renewable energy by 2025 (Ministry of Energy and Mineral Resources Republic of Indonesia (ESDM), 2012), the efforts in developing renewable energy need to be solved. The development of solar energy presents a significant opportunity for advancing electrical energy sources. This will drive the growth of the solar energy industry and encourage further innovation. Solar panels are already widely used globally, making them

more cost-efficient due to the expanding industrial sector, growing demand, and involvement of key stakeholders. As the market for solar energy continues to mature, it becomes easier for solar technology to reach economically viable prices, contributing to broader economic development (Hermala, 2022). In Indonesia, solar energy is a reliable and promising renewable energy source.

The sixth opportunity is a shorter time needed by solar energy to produce energy than other renewable resources. There are many renewable energy sources, but solar panel is the easiest and simplest technology in terms of installation (Oktaviani, 2022). Compared with other sources such as geothermal, water, wind, and biomass, installing solar panels only requires supporting devices and exposure to sunlight, so solar panels can already produce electricity. The maintenance of solar panels is also uncomplicated and not superfluous. Maintaining solar panels is relatively simple, requiring only periodic cleaning of the components. This involves wiping the surface of the panels with a special cleaner and ensuring that no dust accumulates. When properly maintained and cleaned, solar panels can operate at optimal efficiency. Generally, solar panels have a lifespan of several decades, often up to 25 years or more. However, without regular maintenance, their service life may be significantly reduced to less than 25 years (Energi Mitra Investama, 2021)

The seventh opportunity is Non-Government Organizations (NGOs) and corporation's support for renewable energy projects. The Efforts to support the renewable energy transition also come from Corporate Social Responsibility (CSR) companies that offer solar projects for energy needs (Oktaviani, 2022). Some CSR collaborates with the government for electrification programs in remote, frontier, and disadvantaged communities. This cooperation between the government and the private sector is needed to provide affordable energy sources. Apart from corporations, support for the renewable energy transition also comes from NGOs. One of them is the United Nations Development Program (UNDP). Indonesia collaborates with the Ministry of Energy and Mineral Resources of Indonesia to launch a Sustainable Energy Fund (SEF) grant for the incentive of solar power plants (Oktaviani, 2022). This rooftop solar panel incentive uses the allocation of SEF grant funds from the Global Environment Facility (GEF) and will be managed and distributed by the Environmental Fund Management Agency. This incentive aims to encourage people to install rooftop solar power plants, especially PLN customers in the household, small-medium-scale businesses industries (MSMEs), and social categories. This program is expected to accelerate the implementation of the rooftop solar power plant program massively and contribute to the achievement of the national renewable energy target (Directorate General of New Renewable Energy and Energy Conservation, 2022).

The final critical opportunity is that energy could become the world's top priority. The shift from fossil fuels to renewable energy is a key global issue, underscored by the Paris Agreement, which aims to combat climate change and reduce emissions. A major challenge on the path to achieving net-zero emissions is supplying electricity from low-carbon energy sources.

Nowadays, the earth's temperature is getting warmer every year. Recent studies mention global temperature's chance to temporarily reach 1.5°C thresholds in the next five years (World Meteorological Organization, 2022). This study impacts the obligation to reduce the dominance of fossil energy, especially coal, in the power plant sector, which is currently quite large because it produces a lot of emissions and is not environmentally friendly. The positive effect of the transition to renewable energy has made many stakeholders have begun to be aware of financing for renewable energy projects. One of them is philanthropy which starts focusing on green energy issues. Even Non-Governmental Organizations (NGOs) from various countries have been interconnected for energy renewal projects to increase the demand for renewable energy projects (Hermala, 2022).

The Challenges of Waqf as Alternative Financing for Solar Energy in Indonesia

Based on the result, the challenges of waqf as alternative financing for solar energy in Indonesia are shown in figure 4 below.

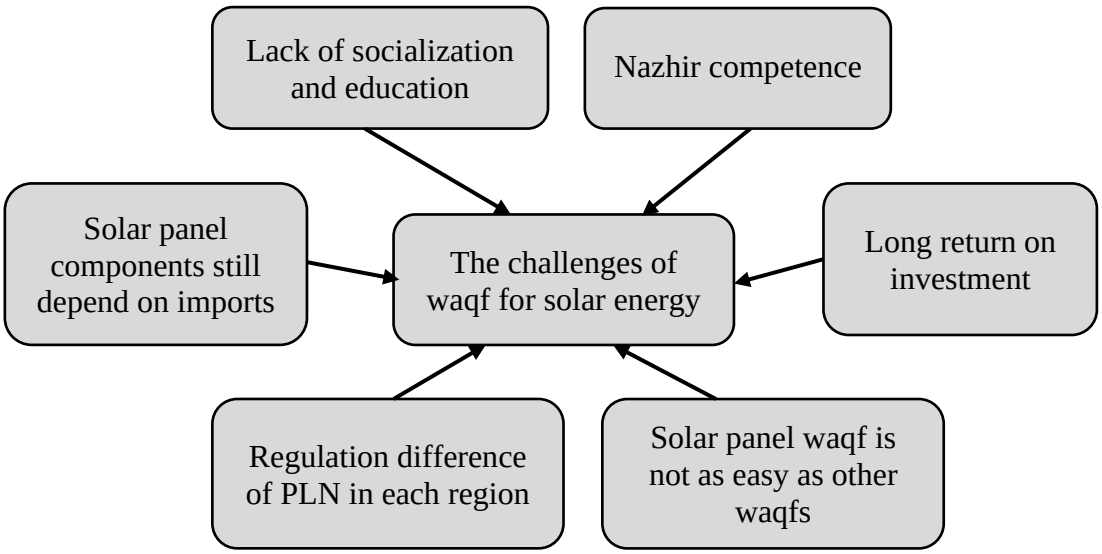

Figure 4. The challenges of waqf for solar energy

Source: Respondents, 2022

The first challenge is the lack of socialization and education about waqf and renewable energy. Knowledge and understanding of solar panels are still low (Iskandar et al., 2021). The lack of public awareness and support for renewable energy is still becoming a problem. Socialization and education related to waqf and solar energy must be carried out to the community as candidates for waqif so that they are willing to participate in solar energy waqf. Many people are still unfamiliar with renewable energy, including solar power. As electricity has long been supplied by PLN without much promotion of eco-friendly energy sources, public awareness in this area remains low. In addition to solar energy, raising awareness and

educating the public about productive waqf is equally important, as many still believe waqf is solely for building mosques, schools, and cemeteries. Many *nazhir* also do not know about the advantages of using solar energy. It is also crucial to provide education and outreach to *nazhir*, particularly concerning solar energy as a potential waqf project. For instance, at the Jogokariyan Mosque, the management lacked a comprehensive understanding of solar energy, which led to suboptimal use of the technology. Effective socialization and training can help ensure that such projects are implemented and managed more efficiently (Rahim, 2022). Raising awareness about the use and maintenance of solar panel systems is essential to ensure their optimal performance. Education on the installation, operation, and upkeep of solar panels is crucial for improving public understanding (Oktaviani, 2022). Additionally, campaigns highlighting the benefits of renewable energy over fossil fuels can help increase public awareness of renewable energy's potential in achieving energy independence (Iskandar et al., 2021).

The second challenge is the long return on investment of solar energy. Many people have realized that the use of energy solar can minimize the cost of their energy needs and then make solar panels a long-term investment. Even the use of solar panels for households has been widely applied to get a full supply of electricity from the network or as an alternative. Of course, the benefits that will be obtained from investing in solar panels are long-term, around 20 or 30 years, meaning that the benefits cannot be achieved in a short time (Chesney & Vargas, 2018). In the case of Salman Mosque, the electricity operational need of 10,000 – 14,000 kWh/month and energy generated from solar panels of 2000 kWh/month will have a return on investment within a period of 8-12 years (Ardiyansah, 2022). Solar panels have a long return on investment, but the installation of solar panels has been proven to save electricity and save CO_2 production (Rahim, 2022). Besides, the determination of the optimum operational strategy has to be done to meet electricity needs at the lowest cost (Reyseliani & Purwanto, 2021).

The third challenge is solar panel waqf practice is not as easy as other waqf projects. Waqf has more advantage compared to other financial instruments is the flexibility of its use, as long as waqf is used for projects that can generate public welfare and do not violate sharia values. The use of waqf to finance solar panel projects is a new form of waqf development. The urgency of shifting non-renewable energy to renewable energy such as solar energy is not widely understood by the public. This makes it difficult to convince waqf institutions to make solar energy as one of the prospective waqf projects because the *waqif* candidates are reluctant to participate in waqf. This happened when waqf fundraising for solar energy installations in the Salman ITB Mosque, where community participation for waqf was lower than other waqf projects, such as waqf for repairing ablution places (Ardiyansah, 2022).

The fourth challenge is the difference of PLN regulations in each region of Indonesia. There are differences in regulations from one region to another because each region has different priorities, said Khoiria Oktaviani, Communication Manager of the Ministry of Energy and Mineral Resources (2022). A key policy difference pertains to the Export-Import kWh meter, which is a static or electronic meter that measures and tracks the energy exported, imported, and netted according

to the net metering principle (Ardiyansah, 2022). At Jogokariyan Mosque, this meter has been in use since the installation of their solar panels, enabling them to sell excess energy back to PLN and reduce their electricity bills. In contrast, Salman ITB Mosque has not utilized this meter due to PLN's policies in Bandung (Oktaviani, 2022; Rahim, 2022). During the pandemic, PLN faced an oversupply of electricity because of reduced demand resulting from community activity restrictions.

The fifth challenge is the dependency of solar energy components on imports. Currently, there are more and more users of solar energy, including in Indonesia. However, it is unfortunate that Indonesia, which has a high potential for the use of solar energy, still has to depend on foreign countries for solar panel components (Hermala, 2022; Oktaviani, 2022). Currently, Indonesia relies on imports for all components needed to install solar panels, with the majority coming from China due to their lower prices compared to other sources. To boost the domestic solar industry, Indonesia could become a major producer of these components. However, this shift requires incentives for local manufacturers to encourage the production of solar panel components and promote the wider adoption of solar power throughout the country (Hermala, 2022; Oktaviani, 2022). The feed-in tariff did not trigger much interest among power producers. One of the major reasons is that renewable energy power producers have not been prioritized vis a vis fossil-fuel power producer in the regulatory framework. To improve the competitiveness of renewables, Indonesia could raise the production tax credits for renewable energy projects (Vakulchuk et al., 2020). Dependence on imports causes the price of the components needed to be expensive which causes the initial investment value for installing solar panels to be high.

The last challenge is the *nazhir* competence in managing solar energy project. The challenge of waqf as an alternative to solar energy financing lies in *nazhir. Nazhir* is the key to whether a waqf asset can develop or not. To be able to develop waqf assets to be productive, a professional *nazhir* is needed with abilities that are by to use of waqf. *Nazhir* is required to innovate to provide education to wakif to ensure that solar energy is a feasible project to be developed using waqf funds (Tanjung, 2022). Hendri Tanjung, Head of Nazhir Empowerment and Management at the Indonesian Waqf Board (BWI), emphasized that managing waqf is akin to running a business—without proper qualifications, there's a risk of failure and loss of waqf assets. This differs from zakat, where the amil (zakat administrator) is not required to develop assets; their primary responsibility is to ensure that funds are distributed effectively and accurately.

CONCLUSION

Based on the results, it can be concluded that waqf presents significant opportunities as an alternative financing source for solar energy in Indonesia. These opportunities include potential for electricity savings, long-term sustainability, substantial growth potential, government support, rapid advancements in the renewable energy sector and research, faster energy production compared to other renewable resources,

backing from NGOs and corporations, and alignment with the global priority of addressing energy issues.

Despite the significant opportunities, using waqf to finance solar energy also presents several challenges. These challenges must be addressed for waqf to be an effective option for supporting renewable energy, particularly solar power. They include: insufficient socialization and education about waqf and solar energy, long return on investment, greater complexity in managing solar panel waqf compared to other waqf projects, variations in PLN regulations across different regions, dependence on imported components for solar panels, limited expertise among *nazhir* in managing solar energy projects.

There have been numerous initiatives to support renewable energy, including the development of energy laws and regulations, yet they still did not give the best result. To attain sustainable energy, the public, non-governmental organizations, and the government should be more aggressive in promoting and using renewable energy. Also, the results of the study can be used by policymakers as a consideration in making policies and determining steps to increase the use of solar energy as one of the potential renewable energy to develop in Indonesia.

For further research, it is recommended to explore the application of solar energy waqf beyond mosques, such as in institutions, schools, and other potential sites. To support the government's goal of increasing the renewable energy mix, particularly through widespread adoption of solar panels, it is crucial to review and potentially revise policies related to rooftop solar power systems. Additionally, incentives and non-discriminatory measures should be implemented to encourage the adoption of rooftop solar power systems, ensuring the sustainability of environmentally friendly energy solutions.

REFERENCES

Aassouli, D., Asutay, M., Mohieldin, M., & Chiara Nwokike, T. (2018). *Green Sukuk, Energy Poverty, and Climate Change A Roadmap for Sub-Saharan Africa*. http://www.worldbank.org/

Adjikri, F. (2017). Strategi Pengembangan Energi Terbarukan di Indonesia. *Jurnal Online Mahasiswa (JOM) Bidang Teknik Elektro*, *1*(1), 1–13.

Ali, K. M., & Kassim, S. (2020). Waqf Forest: How Waqf Can Play a Role In Forest Preservation and SDGs Achievement? *ETIKONOMI*, *19*(2). https://doi.org/10.15408/etk.v19i2.16310

Anam, S., & Fauzi, R. A. (2021). Wakaf dan Energi Terbarukan: Analisis Potensi Wakaf Energi dalam Mengurangi Dampak Perubahan Iklim. *Al-Awqaf: Jurnal Wakaf dan Ekonomi Islam*, *14*(2), 123–138. https://jurnal.bwi.go.id/index.php/awqaf/article/view/152

Ardiyansah, B. R. (2022). *Waqf as Alternative Financing for Solar Energy in Indonesia*.

Ari, I., & Koc, M. (2021). Towards sustainable financing models: A proof-of-concept for a waqf-based alternative financing model for renewable energy

investments. *Borsa Istanbul Review*, *21*, S46–S56. https://doi.org/10.1016/j.bir.2021.03.007

Chesney, M., & Vargas, C. (2018). *What are you waiting to invest? Long-term investment in grid-connected residential solar energy in California. A real options analysis*. https://ssrn.com/abstract=3231984

Climate Transparency. (2020). *Climate Transparency Report Comparing G20 Climate Action and Responses to the Covid-19 Crisis*. www.climate-transparency.org

Directorate General of New Renewable Energy and Energy Conservation. (2022, February 10). *Luncurkan Hibah SEF, Kementeriaan ESDM Harap PLTS Atap Makin Terjangkau dan Diminati Masyarakat*. Https://Ebtke.Esdm.Go.Id.

Energi Mitra Investama. (2021). *Laporan Tahunan& Laporan Keberlanjutan 2021*. https://sunenergy.id/cfind/source/files/Annual%20Report%20Final%20071022-1_compress.pdf

Hamdani, L., Hamzah Muchtar, E., & Pasummah, B. T. (2021). WAQF BASED WASTE ENERGY MANAGEMENT: CASE STUDY ON PLTS. In *Journal of Asian and African Social Science and Humanities* (Vol. 7, Issue 4).

Hasan, M. H., Mahlia, T. M. I., & Nur, H. (2012). A review on energy scenario and sustainable energy in Indonesia. *Renewable and Sustainable Energy Reviews*, *16*(4), 2316–2328. https://doi.org/10.1016/j.rser.2011.12.007

Hendriwardani, M., Geddes, A., Sumarno, T. B., & Hohenberger, L. (2022). *Using Public Funding to Attract Private Investment in Renewable Energy in Indonesia Executive Summary*. https://www.iisd.org/projects/fossil-free-recovery.

Hermala, I. (2022). *Waqf as Alternative Financing for Solar Energy in Indonesia*.

Indotelko.com. (2020, December 28). *Karyawan XL wakafkan pembangkit listrik dan masjid*. Https://Www.Indotelko.Com.

Iskandar, A., & Aqbar, K. (2019). Green Economy Indonesia Dalam Perspektif Maqashid Syari'ah. *Al-Mashrafiyah: Jurnal Ekonomi, Keuangan, Dan Perbankan Syariah*, *3*(2), 83. https://doi.org/10.24252/al-mashrafiyah.v3i2.9576

Iskandar, A., Usman, A. H., Syarul, &, & Shaharuddin, A. (2021). *Role of Islamic economic and finance in renewable energy: some quotation from Quranic verses and Indonesia experiences [Peranan ekonomi dan kewangan Islam dalam program-program tenaga boleh diperbaharui: beberapa petikan dari ayat-ayat al-Quran dan pengalaman Indonesia]* (Vol. 6, Issue 1). https://orcid.org/0000-0002-7930-4693.

Kumar, N. M., Subathra, M. S. P., & Moses, J. E. (2018). On-grid solar photovoltaic system: components, design considerations, and case study. *2018 4th International Conference on Electrical Energy Systems (ICEES)*, 616–619.

Mahmoody, F., Sharafmal, F., Razafindrakoto, H., Dhakal, N. R., Ayuthia, I., Yuliani, F., & Widagdo, N. (2021). *A Brief Summary of Good Practices and Challenges on Renewable Energy Development In Afghanistan, Indonesia, Madagascar and Nepal*. https://www.esdm.go.id/assets/media/content/content-brief-summary-sstc-renewable-energy-1.pdf

Masjid Jogokariyan. (2022). *Manajemen Masjid*. Https://Masjidjogokariyan.Com/Materi-Manajemen-Masjid/.

Ministry of Energy and Mineral Resources Republic of Indonesia (ESDM). (2012, June 19). *Matahari Untuk PLTS di Indonesia*. Https://Www.Esdm.Go.Id.

Modjo, S. (2019). PLN vs Energi Terbarukan: Peraturan Menteri ESDM Terkait Penggunaan Sistem Pembangkit Listrik Tenaga Surya Atap. *Jurnal Hukum Lingkungan Indonesia*, *6*(1), 19–40. https://doi.org/https://doi.org/10.38011/jhli.v6i1.89

Noer, A. H., & Ariyanti, D. (2012). The potency of Solar Energy Applications in Indonesia. *International Journal of Renewable Energy Development*, *1*(2), 33–38.

Nor, F. M., Johari, F., Haron, H., Shafii, Z., Shahwan, S., Misbah, H., Ahmad, A., & Shaharuddin, A. (2021). Conceptualization Benefidonors Model in Waqf. *The International Islamic Economic System Conference – The 9th I-IECONS 2021*, 442–448.

Oktaviani, K. (2022). *Waqf as Alternative Financing for Solar Energy in Indonesia*.

PCY Data Center. (2023, January 25). *Renewable Energy Installed Capacity in Asia*.

Pramtama, H. (2022). *Waqf as Alternative Financing for Solar Energy in Indonesia*.

Qosim, M. N., & Hariyati, R. (2021). Kajian Kelayakan Finansial Fotovoltaik Terintegrasi On Grid Dengan Kapasitas 20 kWp. *KILAT*, *10*(1), 1–9. https://doi.org/10.33322/kilat.v10i1.544

Rahim, M. R. (2022). *Waqf as Alternative Financing for Solar Energy in Indonesia*.

Razak, D. A., & Dawami, Q. (2022). *Achieving Islamic Social Finance Goals through Zakat, Waqf, and Sadaqa in Selected Countries: Issues and Challenges*. 38–45. https://doi.org/10.5220/0010114500002898

Reyseliani, N., & Purwanto, W. W. (2021). Pathway towards 100% renewable energy in Indonesia power system by 2050. *Renewable Energy*, *176*, 305–321. https://doi.org/10.1016/j.renene.2021.05.118

Tanjung, H. (2022). *Waqf as Alternative Financing for Solar Energy in Indonesia*.

Tutuko, B., Hudaifah, A., & Zulfikar, A. (2017). Structuring Model for Corporate Productive Cash-Waqf in Indonesia (A Case Study of PT. Semen Indonesia). *Journal of Islamic Finance (Special Issue, Special Issue*, 163–173. https://journals.iium.edu.my/iiibf-journal/index.php/jif/article/view/264

USAID, & Otoritas Jasa Keuangan (OJK). (2016). *Pembiayaan Pembangkit Listrik Tenaga Surya Paket Pelatihan Keuangan Berkelanjutan dalam Pembiayaan Energi Bersih*. USAID.

Vakulchuk, R., Chan, H.-Y., Kresnawan, M. R., & Merdekawati, M. (2020). *Indonesia: How to Boost Investment in Renewable Energy*. https://doi.org/10.13140/RG.2.2.11060.07047

Wakaf Salman. (2022, February 6). *Masjid Ramah Lingkungan di Jakarta & Bandung*. Wakaf Salman.

World Meteorological Organization. (2022, May 9). *50:50 chance of global temperature temporarily reaching 15%*. World Meteorological Organization.

Yudha, S. W., & Tjahjono, B. (2019). Stakeholder mapping and analysis of the renewable energy industry in Indonesia. In *Energies* (Vol. 12, Issue 4). MDPI AG. https://doi.org/10.3390/en12040602