



Decentralization Promotes Sustainable Solar Energy: Case Study in Indonesia's Remote Hamlets

Nikolaus Loy¹(✉), Iva Rachmawati¹, and Meike Lusye Karolus²

¹ Department of International Relations, Universitas Pembangunan Nasional "Veteran"
Yogyakarta, Yogyakarta, Indonesia

{nikolausloy, iva.rachmawati}@upnyk.ac.id

² Department of Communication, Universitas Pembangunan Nasional "Veteran" Yogyakarta,
Yogyakarta, Indonesia

meike.karolus@upnyk.ac.id

Abstract. This article aims to investigate the role of decentralization in promoting the sustainability of renewable energy, specifically solar power, at the local level in Indonesia. The study uses a case study approach by examining four traditional hamlets in Ngada Regency, East Nusa Tenggara, where solar power plants have been installed to provide electricity to remote communities. Data was collected through literature review, observation, and in-depth interviews with 30 respondents who were residents, village officials, and local government staff. The study concludes that broader decentralization of energy policies is necessary to ensure the sustainability of renewable energy production and consumption, which includes the transfer of authority, capacity and technical knowledge, and financial resources from the central government to the local government. The findings have implications for improving energy access for isolated communities, promoting energy security, and preventing future energy crises in Indonesia.

Keywords: Decentralization · renewable energy · solar power generation · sustainability

1 Introduction

After 2000, the Indonesian government sought to increase renewable and new energy production and consumption. To produce renewable energy, people can employ sources that can renew themselves, such as solar power, hydropower, wind power, or bioenergy. Humans can create new energy, such as gasified or liquified coal, using technologies. The threat of a future energy crisis due to a decline in oil production and an increase in imports is a fundamental reason behind the priority of using renewable energy. As of July 2021, the volume of natural gas production reached 977 thousand barrels of oil equivalent per day, while oil production was only 661 thousand barrels per day [1]. Low oil production forces the government to import crude and fuel oil. The Central Statistics Agency reported the value of oil and gas imports of US\$ 19.46 billion in the first half of

2022, an increase of 68.98% from the first half of 2021 [2]. The import value of crude oil is US\$ 4.74 billion, which will increase from US\$3.68 billion in 2021. Meanwhile, refined oil imports reached US\$ 12.01 billion from January to June 2022, an increase from US\$ 16.8 billion in the same period in 2021 [2].

Oil imports increase the number of subsidy funds. The 2022 state budget allocates IDR 152.5 trillion for subsidies and compensation funds for the more expensive fuel prices. The president then issued presidential regulation No. 98/2022 to revise the number of fuel subsidies to IDR 502.4 trillion [3]. As an impact of growing donations, the annual state budget may record a more significant deficit in the coming years. At the same time, the environmental effects of fossil energy use force Indonesia to make an energy transition. The Indonesian government targets the contribution of new and renewable energy in the national energy mix to increase to 25% in 2023 and 30% in 2050.

Moreover, Indonesia selects renewable energy because this country has excellent potential sources. The Ministry of Energy and Mineral Resources reported a renewable energy potential of 417 GW. The utilization has only reached 2.5% or 10.4 GW. The possibility includes solar energy, geothermal, hydropower, wind power, biomass, and ocean currents.

One of the renewable energy sectors that are the government's priority is solar power. Apart from its great potential, the need for expanded access to electricity makes the country prefer solar power. Since 2009, the government has built large, medium, and small-scale photovoltaic power plants in various regions of Indonesia. This policy encourages the energy transition while strengthening energy justice. For isolated areas in Eastern Indonesia, the central government is focusing on developing micro-power plants in the form of energy-efficient solar lamps.

Ngada Regency in East Nusa Tenggara is one area where the government is developing solar electricity. The regency is in Central Flores and had a population of 165,254 people in 2021. They inhabit an area of 1,620.92 Km². Ngada has dozens of well-preserved traditional hamlets. Four hamlets, Maghilewa, Watu, Jere, and Belaraghi, were the recipients of small-scale solar power projects between 2009 and 2019. There are two types of solar generators. First is the community microgrid, where one plant serves dozens of homes. Second, the type of home system, a 20 Wp power plant, stands separately in each household. The power grid of the state power company has no connection with the two types of communal solar electricity generation.

This paper is a part of research on the use of solar electricity in the four hamlets above. Sustainability is a critical issue in using solar electricity in the four hamlets. This issue is closely related to the decentralization of energy governance, where the role of local government is an essential element. The question to be discussed is how does the centralization of energy policy hinder the sustainability of solar electricity? How can decentralization help maintain the sustainability of the community's use of solar energy? The paper develops arguments in several sections. After outlining research methods and literature reviews, the report describes the impact of energy policy centralization that hinders sustainability amidst the strong motivation of hamlet dwellers to continue to maintain this energy. After that, the paper will discuss conceptually how decentralization through multilevel governance can strengthen the sustainability of renewable energy. The article closes with a brief conclusion.

2 Methodology

This paper discusses the relationship between the decentralization of energy policy and renewable energy production and sustainability. The method used is a case study of solar power plants in four indigenous hamlets in Ngada Regency, East Nusa Tenggara. The relationship between decentralization and energy sustainability is explained descriptively and qualitatively. The information collection utilizes researched literature, observation, and in-depth interviews with 30 respondents using solar power plants in four indigenous villages. Interviews with 30 of the 80 residents from four indigenous villages were conducted from March to June 2022. Respondents cover different social and economic backgrounds, such as farmers, community leaders, village government staff, local bureaucrats, and elementary school teachers. Fifteen respondents are women who are mostly housewives, farmers, and community activists.

3 Literature Review

Various studies on energy decentralization discuss how to hand over energy management to the authorities and actors closest to energy sources and consumers. This model goes from the argument that local actors know best the situation of local production, consumption, and energy needs. Decentralization of energy, especially renewable energy, can guarantee the sustainability of sources, energy installations, and their utilization in the long term. A study by [4] found that the centralization of the energy system inhibits the expansion of renewable energy from the niche, thus influencing the configuration of the national energy system. They argue that decentralization through tiered energy policies helps expand the use of renewable energy because energy promoters may easily interact with local governments rather than national ones.

[5] Uses the participatory rural appraisal to assess the development of solar electricity use in Odhisa Village, India. His study found that solar power projects were initially well-developed but declined due to technical and maintenance issues. He concluded that renewable energy sustainability requires decentralizing technological capacity to the community level. [6] Use historical analysis to look at the development of decentralized energy systems concerning electrification. They argue that using information technology, especially mobile phones and virtual financial services, in a decentralized electricity system can expand access to energy and support sustainable development.

Another study focuses on governance and accountability patterns in non-centralized electrical systems [7]. Decentralized electricity governance requires a different model of accountability. The responsibility system must be changed to ensure electrical energy's reliability, access, affordability, and the management of natural resources in the energy field, such as water sources. [8] Analyze energy decentralization, especially how the market decentralizes in the power sector. They found that the regulatory framework needed to improve the decentralization of the electrical system. Meanwhile, technologies such as the intelligent grid facilitate energy decentralization.

Several other studies have found the benefits of decentralized energy systems. In the system, the central authority transfers energy policymaking and its implementation to the lowest public authorities. Using a case study of Indonesia and Nepal, [9] argue that a

decentralized energy system has many benefits compared to large-scale and centralized energy projects. The benefits include being environmentally friendly, taking small risks, and empowering the community. They then concluded that the governance structure largely determines how much a decentralized energy system benefits.

[10] Writes about security and the energy transition in Asia Pacific. Energy safety is measured based on the accessibility, affordability, availability, and acceptability of certain types of energy. They argue that energy decentralization is the best way to ensure energy security and encourage transition. Decentralizing energy systems empowers communities, strengthens local clean technologies, and prevents dependence on the technologies of developed countries.

This paper enriches and complements previous studies on energy decentralization. At the same time, expanding by arguing that renewable energy sustainability requires decentralization in three aspects: first, the authority to determine and build types of renewable energy at the local level; second, decentralization of technical capacities relating to development and maintenance; third, financial decentralization to support the development and maintenance of renewable energy.

4 Results and Discussion

4.1 Renewable Energy in Four Hamlets in Ngada

Indigenous communities in four hamlets in Ngada recognize renewable energy through a program to expand access to electrical power. This program started during the era of the Susilo Bambang Yudhoyono administration, who became the president of Indonesia from 2004–2014. For remote areas, the central government builds types of renewable energy according to local potential. Solar power plants are one of the leading choices to accelerate the equitable distribution of electricity. In 2005, the new electrification ratio reached approximately 55–60%. Therefore, the central government targets to build 1 million units of 50-W peak solar home systems for remote areas between 2005–2025 [11]. The Ministry of Energy and Mineral Resources plans to develop as many as 0.87 GW of solar panels by 2025.

The Joko Widodo administration continued the solar panel electricity program for the outermost, underdeveloped, and isolated areas. As a legal basis, the government issued presidential regulation No. 47/2017 concerning the Provision of Energy-Saving Solar Lamps for people without access to electricity. The Ministry of Energy and Mineral Resources distributes a set of energy-saving lamps consisting of 20-W peak solar panels and four lighting-emitting diodes (LED) lights. In 2017, the government allocated RP 332.8 billion to finance the procurement of 95,729 solar electricity units [12]. Six provinces in Eastern Indonesia, including East Nusa Tenggara, are the beneficiaries of energy-efficient solar lamps.

Maghilewa, Jere, Watu, and Belaraghi, East Nusa Tenggara, received solar panel projects starting in 2009. Initially, the central government built a grid micro solar power plant serving 31 houses in the hamlets of Maghilewa and Jere. Meanwhile, Watu, located west of Maghilewa, received as many as 20 home system solar power plants in 2015. Meanwhile, 20 traditional houses in Belaraghi obtained Surya home system panels in 2017. Because the micro-grid solar plant is not functioning, Maghilewa and Jere received

energy-efficient solar electricity through the Ministry of Energy and Mineral Resources program in 2019.

4.2 Centralization and Sustainability of Renewable Energy in Four Hamlets

Two contradictory facts characterize the sustainability of solar electricity in the community of four hamlets. On the one hand, community members are strongly motivated to maintain the continuity of plant installations and solar energy electricity consumption. On the other hand, some generators and LED lights need to be fixed. Residents of indigenous communities interviewed showed a willingness to maintain the sustainability of solar electricity. They want to substitute broken elements and those lamps that have been damaged or expired. Indigenous community members are willing to allocate a portion of their income to repair the damage, purchase new components, or power-generating units.

This motivation develops from the experience of using solar energy electricity, which has a positive impact on their lives. First, photovoltaic electricity increases work productivity. Solar panel lamps allow the community member to work at night. They can process crops such as separating clove flowers, slicing betel nuts, and peeling pecans. In the evening, solar power enables community members to process pig fodder. Before the construction of solar power plants, this work should be carried out during the day because it requires sufficient lighting.

Second, solar electricity has psychological and social meaning for people in four hamlets. They view renewable electrical energy as liberation from darkness and a source of happiness. According to some hamlet dwellers, the darkness of the night made them unable to think more clearly after a day of work in the arable lands. The impact is that there is often verbal violence when returning home in dark conditions. Solar lights open the mind to a brighter one. An interviewed mother said that “*go magha kami da dara*” (our minds become bright) thanks to the presence of solar panel lights (Mama Sia, Personal Communication, March 31, 2022). They are also happy because they can meet and gather at night after being tired from work. Solar power plants make that possible.

Contrary to the motivation of residents to preserve, the long-term sustainability of solar power plants could be better. Sustainability includes the long-term preservation of electricity power plants, the availability and continuous consumption of solar electricity, and the integration of this type of energy in the life of local communities. In Maghilewa, a micro-grid photovoltaic power plant has not worked since 2016. Some of the solar panels of home systems received after 2015 also did not function correctly. In addition, several LED lamps can no longer turn on. Power storage in several homes in Watu and Belaraghi needs to be fixed.

The failure of solar electrical installations is a combination of several factors. First, The majority of community fellows need to learn how electricity works. The hamlets' dwellers only understand that sunlight can generate electricity. It is available freely and infinitely. The impact is that some households always leave the lights on during days, causing damage to the storage battery and the LED lamps. In the case of the microgrid in Maghilewa, overuse causes some parts of power generation to malfunction. Another reason is that the operator changes equipment and cable networks to the user's home.

However, the operator needs more technical knowledge. Second, the need for knowledge about solar panels is rooted in inadequate education and training for community technicians and members. An interview with the village head revealed that adequate socialization and training did not precede the construction of power plants.

Centralization of energy policy also makes renewable energy unsustainable. Centralized energy policies cause local governments to be very limited in developing local resource-based power. There needs to be a clear demarcation of authority in the energy sector between central, regional, and village governments. Centralization and vagueness of the division of power impact the absence of institutions responsible for managing renewable energy at the local level. In this case, it is photovoltaic electrical energy in Ngada District. The contractor appointed by the central government handles the entire process of building solar power plants in the four indigenous hamlets above. The county and village governments are not directly involved. In addition, there needs to be a handover of the function of maintenance and management of post-development plants to local governments or village governments. The impact is the uncertainty about who is responsible for maintaining the existing solar power plants after the completion of the project.

The damage to the solar power plant in Maghilewa is an example of how the vagueness of authority negatively affects the sustainability of renewable energy. An interview with one of the village officials revealed that when the solar power generation stopped functioning in 2016, the village reported it to the responsible agency of the local government. The agency did not dare to take corrective steps because the central government still needed to hand the installation to the local authority. An Effort to move this installation out of the middle of the traditional hamlet also showed a lack of control. The village staff reported to the Energy and Mineral Resources Office of Ngada Regency. Later, the local government reorganized the office into the Mining and Industry Office. The agency responded that it did not have the authority to allow the transfer because the energy sector is the provincial authority.

One of the difficulties in maintaining solar power plants is the need for more village authority. The installation was handed over to the village after it operated. The impact is that the village government needs to use the annual budget to fund the maintenance of the solar installation. The village government also has no authority to control the community organization that operates solar power generators. As a result, when there are conflicts and mismanagement in financial revenue, the village government cannot take the necessary actions (Bernadus, Personal Communication, Malapedho, April 1, 2022).

The legal basis for the centralization of energy policy is Law Number 32/2014 on local government. Before this law, the division of authority in the energy sector was specified in government regulation number 39/2007 on the Division of Government Affairs Between the Government, Provincial Governments, and Municipal District Governments. In this regulation, the regency and municipal government have the right to regulate the affairs of oil and natural gas, geothermal and groundwater, geology, and electric power. The government should have held the division of authority in new and renewable energy affairs before 2014.

The local government law of 2014 transferred authority in the energy sector and mineral resources to the provincial and central governments. District and municipal governments only have the power to grant geothermal energy permits for direct use, such as food drying. The centralization of authority in the energy sector is strengthened by government regulation No. 25/2021 concerning implementing the energy and mineral resources sector. The authorized areas are provinces, not districts. Article 22 of this regulation states that providing electricity for undeveloped areas and electric power for remote and rural areas is the duty of the minister and the governor.

Furthermore, article 32 of the same regulation states that regional business entities can provide electricity support services in addition to state and private enterprises. These services include, among others, consultation in the field of electrical power installation; testing; operation; maintenance, and research in the field of electricity. However, whether the second-level regional business entity has the same authority and rights as the electricity support, service business needs to be explained. The provincial government is authorized to supervise, foster, and control the provision and utilization of energy sources for power generation, network utilization, adequacy of electricity supply, environment, labor, and licensing. The district government has no authority in all such affairs.

The centralization of authority has an impact on the sustainability of renewable energy. First, the districts and cities' local governments have no responsibility for maintaining the various energy installations that have been built, including solar electricity. The Ngada regency government also needs a technical unit to assist hamlet residents in supporting the structure, providing information about the price and vendors from which they can purchase replacement components. Second, the Ngada regency government did a reorganization, making energy a marginal affair. The government dismantled the office of Energy and Mineral Resources in 2020. In exchange, the local government formed an industry service. Later, it changed the institution to the agency of Industry and Trade. The energy sector, including renewable energy, is then incorporated into the latter's official structure.

The local agency of industry and trade is a type B service with a moderate workload in the regional organizational structure. This type of organization can only have one secretariat and two fields of responsibilities; when needed, one other area can be added. In Ngada Regency, the industry and commerce agency has only two functions, as represented in the name of the office. Concerning renewable energy, the agency's authority is limited only to utilizing the energy produced, for example, street lighting. This regional apparatus has no authority to build, organize and manage renewable energy generation sources and installations. The low reference explains why the local government is not intensely involved in constructing solar power plants in the hamlets, as mentioned earlier.

Second, implementing bureaucrats need clarification about the boundaries between energy source management, production processes, and utilization. In the case of solar electricity, the local government agency only utilizes renewable energy for lighting, while the construction and installation of power plants are not the provincial government's obligation. In an interview, Adrianus Dopo, Secretary of the Ngada District Industry and Trade Service, revealed that

“... The management authority for resources was recentralized to the province, which utilized its energy in the district. So the regency is free to take care of

the components of solar power plants. We are here to only take care of energy use, for example, from steam power plants or hydropower—the steam or heat we use for drying and so on. So the takeover of authority needs to be completed, complete, and comprehensive from production to lighting handling. Then solar electricity, the handling needs to be more detailed. The county became a victim. For example, street lighting is taken care of by the Public Works agency. Still, strangely, the authority to manage electricity should be held by something other than the local public works agency. There is a little ambiguity there” (Adi, Personal Communication, Ngada, June 19, 2022).

Third, the transfer of authority negates the ability regency government to finance energy projects. The provincial government in Kupang takes energy functions and the budget to cover the costs of renewable energy installation. As an impact, the Ngada regency needs more funds to build and maintain various renewable energy installations. The regency government also cannot order staff through formal channels to repair solar panel damage in indigenous villages. According to Adrianus, this authority change is unfair to local governments and the community, considering that these changes need to be completed (Personal Communication, June 19, 2022).

Third, the continued impact is that the regions need more incentives to develop organization, governance, and technical capacity in renewable energy. Ngada Regency and several other districts in East Nusa Tenggara have not established specialized units that handle renewable energy, such as solar energy or micro hydro. They also need workshops or technicians to perform maintenance of solar panel installations. Ito, one of the staff responsible for electricity at the Ngada Regency Industry and Trade Office, explained that the local government needs more technicians, equipment, and renewable energy support systems. As a result, maintenance efforts are more sporadic and on personal initiative. In the case of the community micro-grid plant in Maghilewa, Ito has been checking and trying to repair the damage. Formal duties and functions are not the reasons for his action. It is because he has family ties to residents in Maghilewa, one of the indigenous hamlets in Ngada (Personal Communication, Bajawa, June 19, 2022).

Finally, local governments cannot build renewable energy business systems to support sustainability. The beneficiaries of renewable energy in the four hamlets said they needed help replacing components or solar lamps. The reason is that they needed to figure out where to buy and through what means. The local government still needs to develop a supportive business network to supply villagers’ needs to maintain solar power plants.

4.3 Decentralization and Sustainability of Renewable Energy

The production and consumption of renewable energy require decentralized governance. If decentralization is the principle of delegation of authority, multilevel governance is the pattern of organization and division of types of power. The multilevel governance (MLG) approach can encourage the need for energy access while supporting the sustainability of renewable energy. MLG is a governance model in which authority is divided vertically and horizontally among different levels of government –local, regional, national and supra-national, as well as across policy areas and sectors, including state and non-state

actors [13]. In renewable energy, the implementation of tiered governance allows for the vertical sharing of burdens between different administrative levels of government and horizontally between government actors, business groups, civil society organizations, and academia. The multilevel governance model also serves as a radar mechanism to capture the knowledge and expertise needed to develop and maintain the sustainability of renewable energy.

In tiered governance, each level of government has different authority and responsibility. The central and provincial governments deal with general energy policies, financing and managing large-scale renewable energy projects such as reservoir-based hydroelectric power. Central and local governments can cooperate with the large business sector in developing large-scale power plants, with epistemic communities in research and development, and with civil society in public campaigns and social empowerment.

Local governments are given greater authority in constructing renewable energy installations based on local energy resources. The priorities of renewable energy types are determined based on the sustainability of the source in the medium and long term. The construction of small-scale solar power, micro hydropower plants, bio-gas, or bio-mass energy should be handed over to local governments. For renewable energy development to create jobs for local communities, local governments need to involve small and medium-sized companies with the capacity and financial resources. Local businesses' participation is necessary to develop supply networks of products, equipment, and components. Local governments can work with academics to develop renewable energy technologies, especially the possibility of using local technology. Civil society organizations can play a role in spreading awareness, knowledge, and culture of using renewable energy and environmental protection.

Community organizations have a central role in renewable energy sustainability. Community citizens are beneficiaries of various technologies and renewable energy products. Studies in four hamlets in Ngada found that one crucial variable affecting renewable energy sustainability is the need for knowledge and maintenance capacity. The hamlets where solar panels exist have no technicians who understand how the boards work and can repair them if damage occurs. While the regulatory authority rests with local governments, maintenance capacity should be decentralized to community organizations. A higher authority-tiered governance model should help communities develop maintenance capacity. This capacity is critical to maintaining the sustainability of renewable energy.

Applying a multilevel governance model in the energy sector is based on several considerations. First, geographically the territory of Indonesia is vast. The chain of control and provision of energy needs is very long. The organizational and financial capacity of the central government is limited. At the same time, local governments and private actors at various levels of administration have resources that can be mobilized to support the use of renewable energy. Those financial resources and knowledge can be used to accelerate the energy transition, where renewable energy sustainability is a crucial variable. Second, renewable energy resources such as rivers, wind, and biomass have different capacities based on location and climate change. The development strategy requires a decentralized model so that the response can align with local needs. Concerning maintenance, decentralized systems bring technical and organizational support closer to energy

sources and user communities. Thirdly, This new type of energy demands new ways of adaptation and behavior. Beneficiary residents need education, awareness, and sustainable empowerment until the community makes this type of energy a necessity of daily life. The sign is when they take the initiative to maintain the continuity of installation, production, and consumption without being driven by outside actors. Empowerment is also related to the productive economic benefits of renewable energy. In this aspect, the lowest authority and organization should have been given greater power.

Local government is critical to successful tiered governance in supporting renewable energy sustainability. Depending on the local situation, the form can be a district, city, or sub-district government. Therefore, the central government needs to implement a broader energy system decentralization. To support the development and transition of energy, local governments need authority, financing capacity, organizational support, and technological capacity. Decentralization is becoming an integral part of increasing the capacity of local governments. There are at least three areas of energy policy that need to be transferred to local governments. First is decentralizing energy functions to local governments, especially the medium and small-scale renewable energy sector. At the local level, the handover of authority should be complete, which includes determining the priorities and types of renewable energy, locations, and beneficiaries, management of its supporting sources and environments, and construction and maintenance of plant installations.

Second, decentralization of knowledge and socio-technical capacity. To handle the provision of renewable energy, local governments must have the technical ability to plan, build and maintain both the means of production and use of renewable energy. That energy source and usage of renewable energy are in remote and isolated areas. Local authorities must recruit more staff and personnel with expertise in renewable energy development and maintenance. If it is embraced, organizational changes must also be made. The government can establish a particular technical unit that handles the construction, maintenance, and procurement of specialized components for various local renewable energy installations. In collaboration with the private sector, this unit can also build a business network to support the sustainability of solar energy, hydropower, biogas, biofuels, or wind power.

Third, decentralization of financial financing in the energy sector. Together with the handover of energy authority to the local government, the central government supports the necessary funding. With budget decentralization, regions can carry out the energy functions handed over. Financing capacity allows areas to develop various strategies to ensure the sustainability of renewable energy. The development of technical support systems for communities and component supply chains for maintenance are two efforts that local governments can make if they have financing capabilities.

5 Conclusion

Renewable energy tends to be dispersed by location and user and can be transferred over long distances without incurring expensive costs. Centralized energy systems impede the sustainability of renewable energy. The dominance of higher authorities in energy development and operations will only hinder the development and growth of renewable

energy in the long run. A better way to ensure the sustainability of renewable energy installations and uses is to involve actors, governments, or the private sector at the local level. Renewable energy sustainability requires a tiered energy governance system. The central government must delegate authority, financing, and technical capacity to local governments in this system.

References

1. ESDM, K. (2021, Agustus 26). Hingga Juli 2021, Lifting Migas Capai 1,6 Juta Barel per Hari. Retrieved October 2, 2022, from <https://www.esdm.go.id/id/media-center/arsip-berita>.
2. Kusnandar, V. B. (2022, June 22). Harga Minyak Melonjak, Impor Migas Indonesia Capai Rp292 Triliun pada Semester I 2022. Retrieved from <https://databoks.katadata.co.id/datapublish/2022/07/22>.
3. Putri, C. A. (2022, September 1). Oneng Kritik Dana Subsidi BBM Rp502 T, Ini Kata Sri Mulyani. Retrieved September 20, 2022, from <https://www.cnbcindonesia.com/news/20220901140313-4-368475>.
4. Schaubé, P., Ortiz, W., & Recalde, M. (2018). Status and future dynamics of decentralized renewable energy niche building processes in Argentina. *Energy Research and Social Science*, 35, 57–67. <https://doi.org/10.1016/j.erss.2017.10.037>
5. Mishra, C. (2021). Decentralized Renewable Energy and Rural Development: Lessons from Odisha's First Solar Village. *Journal of Land and Rural Studies*, 9(1), 178–192. <https://doi.org/10.1177/2321024920967842>
6. Alstone, P., Gershenson, D., & Kammen, D. M. (2015, March 25). Decentralized energy systems for clean electricity access. *Perspective*, 5. <https://doi.org/10.1038/NCLIMATE2512>
7. Brisbois, M. C. (2020). Decentralized energy, decentralized accountability? Lessons on how to govern decentralized electricity transitions from multilevel natural resource governance. *Global Transitions*, 2, 16–25. <https://doi.org/10.1016/j.glt.2020.01.001>
8. Leal-Arcas, R., Akondo, N., & Rios, J. A. (2019). Energy Decentralization in the European Union. The Queen Mary University of London, School of Law Legal Studies Research Paper, 32(1). Retrieved September 29, 2022, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3333694
9. Ha, Y.-H., & Kumar, S. S. (2021). Investigating decentralized renewable energy systems under different governance approaches in Nepal and Indonesia: How does governance fail? *Energy Research & Social Science*, 80, 1–10. <https://doi.org/10.1016/j.erss.2021.102214>
10. Sharma, P. (2018, January 1). A Decentralized Pathway for Energy Security and Energy Transition in Asia and the Pacific region. Retrieved Agustus 28, 2022, from Sharma, Pooja, A Decentralized Pathway for Energy Security and Energy Transit SSRN: <https://ssrn.com/abstract=3319593>
11. ESDM, K. (2012, Juni 19). Matahari untuk PLTS Indonesia. Retrieved September 23, 2022, from <https://www.esdm.go.id/id/media-center/arsip-berita>.
12. ESDM, K. (2017, April 20). Presiden Joko Widodo Terbitkan Peraturan Penyediaan LTSHE. Retrieved October 2, 2022, from <https://ebtke.esdm.go.id/post/2017/04/20/1631/>.
13. Daniell, K., & Kay, A. (2017). Multilevel Governance: An Introduction. In K. Daniell, & A. Kay, *Multilevel Governance: Conceptual challenges and case studies from Australia* (pp. 3–32). <https://doi.org/10.22459/MG.11.2017.01>

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

