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Just Energy Transition: Problems of Consumer Protection of Rooftop Solar Photovoltaic in Indonesia

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Abstract

Indonesia's rooftop solar photovoltaic (PLTS Atap) expansion supports the ene transition, yet sectoral regulations, particularly Minister of Energy and Mineral Resou Regulation Number 2 of 2024, inadequately address transaction-specific consu protection as lex specialis. Gaps persist in contractual transparency, warranty standa and technical dispute resolution. This study examines these issues through ecolog justice and just energy transition perspectives. It employs normative juridical resea using statutory and conceptual approaches, supplemented by a multi-stakeholder Fo Group Discussion (FGD). Stakeholder-reported concerns contextualize the norma subsumption of identified issues under the Consumer Protection Law (UUPK); F findings are not treated as representative consumer evidence. The analysis identifies f principal challenges: regulatory uncertainty, limited market transparency, inadequ after-sales standards, and restricted financing access. Drawing on Heffron and McCaul energy justice framework and Mochtar Kusumaatmadja's legal development theory, study proposes five dimensions: regulatory certainty, market transparency, ser standardization, financing access, and consumer literacy. An integrated One Stop S (OSS) would support these dimensions by providing verified pricing and ser information, consumer education, and technical complaint assistance. The findi prioritize revising sectoral regulations and strengthening existing complaint mechani to advance a just energy transition.

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Contents

Abstract 1390
Introduction 1391
Research Methods 1392
Results and Discussion 1393
Conclusion 1400
Bibliography 1401

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Introduction

Climate change and an increasingly alarming environmental crisis are prompting the global community to accelerate the transition to a cleaner, more sustainable energy system (Rasyidin, 2025). This commitment is realized through international agreements such as the Paris Agreement, which targets *net-zero emissions* progressively, with new and renewable energy (NRE) as the main instrument (Manopo & Alfalahsea, 2026). Among NRE sources, solar energy has grown the fastest globally, driven by falling photovoltaic costs and abundant resources, particularly in the tropics (Aryadi, Setyobudi, Safarati, Marbun, & Anindita, 2025). However, the energy transition is not merely a technological and environmental issue; *a just energy transition* emphasizes that the energy system must transform inclusively and equitably for all stakeholders. Indonesia has responded to the global agenda by setting a target of 23% NRE by 2025 and committing to reduce carbon emissions by 29-41% by 2030, as outlined in its *Nationally Determined Contribution* (NDC) (Wahyuni, Sujatmoko, & Harris, 2023). In the electricity sector, rising national electricity consumption underscores the urgency of diversifying energy sources toward a more sustainable system.

Indonesia also identifies solar energy as a key instrument in its national energy transition strategy (Rimbawati, Ambarita, Sitorus, Irwanto, & Nur, 2025). The Electricity Supply Business Plan (RUPTL) projects solar power plant development to reach around 100 GW in the long term to meet the net-zero emissions target. However, rooftop solar development remains well below the government's target. National rooftop solar PV capacity, previously targeted at 2 GW, is currently only around 0.86 GW (Ariwibowo & Nugraha, 2026). These conditions show a significant gap between policy ambition and on-the-ground implementation, and that accelerating the energy transition requires stronger regulatory support, market governance, and consumer protection. Empirical evidence also reveals important challenges on the consumer side of rooftop solar PV adoption. According to the Institute for Essential Services Reform, the number of rooftop solar PV customers in Indonesia increased from 609 in 2018 to 9,324 in 2024. However, an earlier IESR market survey in Greater Jakarta found that about seven out of ten respondents considered rooftop solar PV attractive, while online, 8% found it relevant to their needs. Limited information on products, installation costs, and economic benefits was among the identified barriers.

The regulatory framework for rooftop solar PV has changed significantly, particularly after the replacement of Minister of Energy and Mineral Resources Regulation Number 26 of 2021 with Ministerial Regulation Number 2 of 2024, which introduced a quota-based development mechanism, discontinued electricity export-import credits for new installations, and provided transitional protection for certain existing customers. As regulations and public awareness grow, the rooftop solar ecosystem is expanding rapidly, involving a variety of business actors, from installation vendors and solar panel distributors to financing providers and IoT-based monitoring service providers (Jahrizal, 2026). This value chain's complexity creates layered legal relationships between consumers and business actors, requiring an adequate legal protection framework.

Unfortunately, the growth of the rooftop solar ecosystem is not matched by proportionate consumer protection. Consumers are in a weak bargaining position because of limited technical literacy and are vulnerable to *misleading advertising about* panel efficiency claims, estimated savings, service life, and product warranties. This problem is exacerbated by the unilateral use of standard clauses, poor installation quality, limited after-sales service, and unstable regulatory dynamics, from repeated changes to the electricity export-import mechanism to reduced *export rates,* creating legal uncertainty for consumers who have invested. On the other hand, Law Number 8 of 1999 concerning Consumer

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Protection (UUPK), which is general in nature, has not been able to accommodate the specificity of renewable energy transactions, so there are *fundamental normative lacunas* regarding service standards, business actors' responsibilities, and technical dispute resolution mechanisms in this sector. These concerns were also identified during a multi-stakeholder Focus Group Discussion (FGD) organized by the Indonesian Consumers Foundation (YLKI) on 15 April 2026. The discussion highlighted regulatory uncertainty, limited price transparency, unclear warranty provisions, inadequate after-sales services, and shortcomings in complaint-handling mechanisms. Although this study did not have disaggregated statistics on rooftop solar PV consumer complaints, these stakeholder-identified concerns provide contextual evidence of potential consumer protection risks that warrant further normative legal examination.

The normative lacuna issue, when viewed through the legal principle of *lex specialis derogat legi generali*, actually shows that the specificity of rooftop solar PV transactions should be regulated by sectoral regulations (Regulation of the Minister of Energy and Mineral Resources) as *a lex specialis* that complements, not replaces, the UUPK as *a lex generalis*. The problem is that existing sectoral regulations (Minister of Energy and Mineral Resources Regulation Number 49 of 2018 to Minister of Energy and Mineral Resources Number 2 of 2024) substantively focus on the technical-administrative aspects of network connectivity and quota mechanisms, while providing limited sector-specific elaboration of consumer protection requirements, particularly minimum warranty standards, cost transparency obligations, and technical procedures for resolving contractual disputes between consumers and rooftop solar PV service providers. Thus, the void that arises is not just a problem of "regulations that do not yet exist", but the failure of *the lex specialis* function to fill the specificity that should be its responsibility, while the UUPK, as *a lex generalis*, in terms of the formulation of its norms, is also not formulated for long-term technical transactions (7-15 years) such as rooftop solar power plants.

This condition shows that consumer protection is a structural prerequisite for the success of the energy transition, not a secondary variable. The principle *of a just energy transition* requires that rooftop solar consumers be positioned as legal subjects entitled to certainty, transparency, and accountability from business actors, not merely as market objects (Subagio, 2026). Although this urgency is increasingly evident, legal studies that integratively analyze the relationship between energy regulations, consumer protection laws, and the concept of a just energy transition remain very limited in Indonesia's academic literature. This research is here to fill the *research gap* by formulating a subsumptive analysis of the UUPK norms on the practice of rooftop solar PV, as well as formulating an adaptive and sectoral legal protection model for rooftop solar consumers, accompanied by a prescription of the form of legal instruments, as a concrete recommendation for strengthening sustainable energy policies in Indonesia. Against this background, this study focuses on two main questions: the practice of adopting Rooftop Solar Power Plants in Indonesia through the lens of consumer protection and ecological justice, and a model to strengthen consumer protection for Rooftop Solar users to realize a just energy transition in Indonesia.

Research Methods

This study uses a normative juridical method with two complementary approaches, namely the statute *approach* and the conceptual *approach*. The legislative approach is used to review and analyze regulations related to the research objects in a hierarchical and systematic manner, including Law Number 8 of 1999 concerning Consumer Protection, Law Number 30 of 2007 concerning Energy, as well as the Minister of Energy and Mineral Resources Regulations governing rooftop solar PV systems,

including Regulation Number 49 of 2018, Regulation Number 26 of 2021, and Regulation Number 2 of 2024, which revoked and replaced the previous regulatory framework. Conceptual approaches build an analytical framework based on relevant legal doctrines and theories, particularly the theory of legal protection, the principle of legal certainty (*rechtszekerheid*), the principle *of lex specialis derogat legi generali*, and the principle *of just energy transition*.

Operationally, grammatical, systematic, and teleological interpretation techniques are applied to six groups of UUPK norms which are the main units of analysis: (1) Article 4 concerning consumer rights, especially the right to true, clear and honest information as well as the right to comfort and security; (2) Article 7 concerning the obligations of business actors, especially the obligation to act in good faith and provide correct information; (3) Article 8 concerning acts that are prohibited for business actors; (4) Article 18 concerning the inclusion of standard clauses; (5) Articles 19-28 concerning the responsibility of business actors, including the provisions for compensation; and (6) Articles 45-58 concerning consumer dispute resolution mechanism, including the authority and institutional framework of the Consumer Dispute Settlement Agency (BPSK). The legal materials used include primary legal materials in the form of laws, regulations, and official policy documents, as well as secondary legal materials in the form of scientific literature, research institution reports, and expert doctrines. In addition, this study incorporates qualitative insights from a multi-stakeholder Focus Group Discussion (FGD) organized by the Indonesia Consumers Foundation (YLKI) in Jakarta on 15 April 2026. The participating stakeholders represented institutions with regulatory responsibilities, professional expertise, or institutional interests relevant to rooftop solar PV development and consumer protection. They included government and regulatory bodies, PT PLN (Persero), rooftop solar PV business actors and industry associations, academics, consumer protection institutions, and civil society organizations.

The institutional composition of the participants reflected their respective roles in energy regulation, electricity provision, solar PV installation, financing, consumer advocacy, and policy research. Although individual rooftop solar PV consumers did not participate directly, YLKI and the National Consumer Protection Agency (BPKN) represented consumer protection perspectives institutionally. We acknowledge this limitation when interpreting the FGD findings. The discussions identified and contextualized stakeholder-reported consumer protection issues, which we then examined through normative subsumption under the relevant provisions of the UUPK. Accordingly, we treated the FGD findings as supplementary qualitative material rather than statistically representative evidence or a basis for generalizing consumer experiences. The analysis is carried out through grammatical, systematic, and teleological legal interpretation techniques, which are directed to produce a prescriptive legal construction in the form of an adaptive rooftop solar consumer protection model along with the form of recommended legal instruments (revisions of laws, ministerial regulations, or institutional regulations), as recommendations for regulatory updates.

Results and Discussion

1. Rooftop Solar Photovoltaic Development Practices in the Perspective of Consumer Protection and Ecological Justice

The energy transition to new and renewable energy (NRE) is a strategic agenda for the Indonesian government to address the climate crisis, strengthen national energy security, and meet global commitments to reduce carbon emissions (Wijanarka & Dewi, 2024). One key instrument in this agenda is developing Rooftop Solar Power Plants (PLTS), which can accelerate energy decentralization while expanding community participation in clean energy production. In this context, rooftop solar is

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not only seen as an energy technology innovation, but also closely related to consumers' rights to clean, affordable, safe, and sustainable energy (Kusumastuti, et al., 2025).

The Government of Indonesia has set a *target of Net Zero Emissions* (NZE) by 2060 or sooner, with a new and renewable energy mix of 23% by 2025 (Bhakti, Majid, & Hidayat, 2025). However, until 2024, Indonesia's renewable energy mix will remain at 13-14%, leaving a considerable gap relative to the national target. This shows that Indonesia's renewable energy development pace remains relatively slow compared with the need for national decarbonization (Sholahuddin, Sesotyo, & Ahmad, 2026). In the National Electricity General Plan (RUKN), the government targets the clean energy mix to reach around 73.6% by 2060, while the revision of the National Energy Policy (KEN) also directs a gradual increase in the mix of new and renewable energy to reach more than 60% in the same period.

The development of rooftop solar power plants in Indonesia cannot be separated from rapidly changing regulations. Significant policy shifts, from eliminating *net metering schemes* to implementing a quota system, have created uncertainty that directly affects public confidence and investment interest. This dynamic is evident in the issuance of the Minister of Energy and Mineral Resources Regulation Number 2 of 2024, which replaces the Minister of Energy and Mineral Resources Regulation Number 26 of 2021. This new regulation introduces a quota mechanism for developing rooftop solar power plants and abolishes the electricity export-import scheme (*net metering*), which was previously the main economic incentive for consumers.

From a consumer protection perspective, replacing net metering raises important questions about regulatory predictability and protecting consumers' legitimate expectations. Nevertheless, Article 47 of the Minister of Energy and Mineral Resources Regulation Number 2 of 2024 provides transitional protection for eligible existing rooftop solar PV customers by maintaining the previous electricity export-import calculation mechanism for ten years from the date of approval. Accordingly, the principal legal concern is not the complete absence of transitional provisions, but whether these arrangements adequately protect consumer interests and ensure regulatory certainty amid future policy changes. Beyond regulatory issues, the main challenge in developing rooftop solar power plants in Indonesia is the high initial investment cost. In 2017, the cost of installing rooftop solar power plants was still around IDR 24 million per kilowatt peak (kWp), while in 2022-2025 it decreased to around IDR 10-17 million per kWp. However, this figure remains out of reach for most lower-middle-class people, so rooftop solar adoption is still more common among urban community groups and the upper-middle economic class.

The latest comparative study in the ASEAN region shows a significant gap in solar energy development between countries. Vietnam is recorded to have developed more than 16 GW of solar power capacity in 2023 through the support of *feed-in tariff policies* that are able to attract private investment aggressively (Le, Le, & Le, 2026). Meanwhile, Thailand, Malaysia, and the Philippines have also expanded capacity to over 1 GW through a combination of *renewable portfolio standards*, *auction systems*, and *net metering policies*. In contrast, Indonesia remains in the early stages of development, with capacity of around 0.21 GW, despite its huge technical potential for solar energy. The study found that regulatory complexity and overcapacity in PLN's electricity system are the main factors hindering the acceleration of solar energy development in Indonesia.

From a comparative legal point of view, these differences in achievement also reflect the difference in regulatory approaches to consumer protection: *feed-in tariffs* in Vietnam and *net metering* in Thailand, Malaysia, and the Philippines essentially function as instruments that provide *long-term regulatory certainty* to consumers and investors, making the legal risks of policy changes more measurable. Revoking *net metering* in Indonesia without an equivalent substitute instrument that

provides comparable legal certainty puts Indonesia in a regulatory position that is comparatively less protective of consumers than in other ASEAN countries.

The FGD results with stakeholders (associations, academics, PLN, NGOs, and consumer protection institutions) confirm that these dynamic policy changes, including the unclear direction of the New and Renewable Energy Bill (NRE Bill), have not provided adequate certainty for consumers and market participants. The distribution of solar PV installation quotas is an obstacle because business actors and consumers must compete for quotas at the beginning of each year. Licensing involving multi-stakeholders across institutions and local governments remains an obstacle, so installation quotas are not guaranteed if relevant agencies' licensing requirements are not met.

In practice, the Rooftop Solar ecosystem faces structural problems that systematically weaken consumers' position. The FGD revealed significant price variations between service providers without a clear reference standard, making it difficult for consumers to compare offers objectively. The lack of transparency on cost components, including panels, inverters, and installation services, creates space for overpricing and for product quality to be mismatched with the price offered. Furthermore, electricity infrastructure readiness remains a real obstacle, as limited network capacity in several regions leads to installation restrictions that are not openly communicated to consumers.

Analysis of consumer protection aspects shows that the applicable legal framework has not addressed the specific needs of the rooftop solar sector. There are at least four interrelated dimensions of weakness: (1) Unclear product and service warranty that causes consumers to have no certainty of the right to repair or replacement in the event of a system failure; (2) Lack of binding after-sales service standards; (3) Limited access to parts that extends the system recovery time in the event of a breakdown; and (4) Complaint and dispute resolution mechanism that is not optimal. Low consumer literacy about how the system works, its long-term economic benefits, and return-on-*investment* (ROI) calculations also exacerbates this condition because it creates the perception that rooftop solar investment is high-risk and unaffordable. In fact, regulatory certainty is crucial to protect consumers from long-term solar investments, which generally have a capital return period of 7-15 years. To examine these issues normatively, the following matrix maps stakeholder-identified consumer protection concerns and relevant technical risks documented in secondary studies to the applicable provisions of the UUPK.

Table 1. Normative Mapping of Consumer Protection Issues and Technical Evidence to UUPK Provisions

Facts of FGD Results	Relevant UUPK Norms	Analysis	Provisional Conclusion
Claims of panel efficiency, estimated savings, and misleading *lifespan (misleading advertising)*	Article 4 letter c (right to true, clear and honest information) *jo.* Article 7 letter b (obligation of business actors to provide true, clear and honest information) *jo.* Article 8 (prohibition of	Technical studies conducted under the IEA Photovoltaic Power Systems Programme (IEA PVPS) Task 13 have documented various mechanisms of photovoltaic module degradation and failure, demonstrating the importance of reliable	Norms are available in general (UUPK), but there are no sectoral technical instruments to prove/standardize claims for the performance of rooftop solar PV products. This gap lies in implementation/enforcement, not the absence of norms.

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	trading goods/services that are not in accordance with the information/claims listed).	performance assessment and verifiable technical information (IEA PVPS, 2017). These findings provide secondary technical evidence supporting the need for independent verification of rooftop solar PV performance claims. However, they do not establish that Indonesian vendors have engaged in misleading advertising. A definitive determination under Article 8 of the UUPK would require examination of specific advertising claims, contractual representations, and comparable technical performance data. Thus, the normative analysis identifies a potential enforcement problem concerning the verification of product performance claims rather than establishing a proven violation by individual business actors.	
Use of unilateral standard clauses in installation contracts	Article 18 of the UUPK (prohibition of the inclusion of standard clauses that are detrimental to consumers, including clauses that transfer the responsibility of	If the rooftop PV vendor clause contains provisions that exempt the vendor from liability for installation failures, or complicate warranty claims, such provisions could potentially fall into the category of	The norms are quite adequate textually (Article 18 is general and applies across sectors), but there is no mechanism for proactive supervision *(ex-ante review)* of the standard clauses specific to the renewable energy sector. This gap lies in

	business actors or complicate the consumer's right to claim compensation).	standard clauses prohibited under Article 18. Definitive proof requires a review of the actual contract documents used by the vendor, which has not been done directly in this study.	surveillance, not substantive norms.
There are no binding warranty/warranty standards for panels, inverters, and installation services	Article 7 letter e (obligation to provide guarantee/guarantee for goods traded) *jo.* Articles 19–28 (responsibility of business actors, including the obligation to compensate for losses due to the use of goods/services).	The UUPK requires warranties in general but does not set a minimum duration or standard of warranty for certain product categories. As a result, the duration of the solar/inverter panel's warranty is entirely dependent on the respective vendor's policy. This is a more obvious norm gap than the previous two points, because the UUPK is structurally not designed to set technical standards per product category.	The *most concrete normative point of the lacuna*: the obligation to have a warranty (UUPK) does not automatically mean the obligation of the minimum standard of warranty (it should be regulated by the Regulation of the Minister of Energy and Mineral Resources/SNI as *lex specialis*), and the current sectoral regulation of rooftop solar does not regulate this.
The complaint and dispute resolution mechanism is not optimal	Articles 45–48 (the right of consumers to sue through BPSK or the general court) *jo.* Articles 49–58 (authority and working mechanism of the Consumer Dispute Resolution Agency/BPSK).	Normatively, a consumer dispute resolution forum (BPSK) is available and is authorized to handle consumer disputes across sectors, including rooftop solar PV. However, Rooftop Solar PV disputes are basically technical (installation quality, system performance, network compatibility), while BPSK is institutionally not designed to have the	Legal forums are formally available, but there is a deficit of institutional technical capacity for sectoral disputes. This is not a void of forum norms, but a void of capacity/technical expertise in the existing forum.

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	capacity to have electrical/photovoltaic technical inspection capacity.	

The above subsumption shows that the problem of consumer protection of rooftop solar power plants does not entirely stem from the vacuum of UUPK norms, but from the absence of sectoral minimum technical standards that should be filled by *the lex specialis* (Minister of Energy and Mineral Resources/SNI), as well as the deficit of enforcement and institutional capacity, in the form of supervision of standard clauses and technical capacity in dispute resolution. To understand this problem more comprehensively, this analysis builds on the three pillars of *the energy justice* framework developed by Heffron and McCauley. First, *distributional justice* concerns who enjoys the benefits and who bears the risks of rooftop solar PV development. In fact, middle- and upper-income groups still dominate adoption of this technology, while vulnerable groups and people in areas with limited infrastructure bear the risk of network instability without receiving comparable benefits (Rouhana, Bagtzoglou, & Zhu, 2025). Second, *procedural justice*, which requires meaningful participation from all stakeholders in the policy formulation process. Repeated regulatory changes without adequate public consultation, along with non-transparent licensing mechanisms, create a real procedural deficit (Ikhsan, Hajad, Saputra, Hasan, & Rezky, 2026). Third, *recognition justice* emphasizes the importance of recognizing consumers' positions and rights equally in legal relations with business actors. Weak protection of guarantees, lack of information transparency, and the absence of minimum service standards show that the applicable regulatory framework has not proportionately recognized consumer rights (Hurwitz & Dickinson, 2026).

The three pillars *of energy justice* can be mapped directly to the findings of subsumption in the matrix above: *distributional justice* correlates with the absence of warranty standards that cause the burden of risk of system failure to fall disproportionately on individual consumers (not business actors); *procedural justice* correlates with the deficit *of ex-ante* supervision of standard clauses, where consumers have no negotiation space or objection mechanism before the contract is signed; and *recognition justice* correlates with BPSK's technical capacity deficit, which practically means that consumers' right to be "heard" (Article 4 letter d of the UUPK) is not supported by a forum capable of assessing the substance of their technical complaints. This mapping shows that *the energy justice* framework is not just a theoretical lens but can be operationalized directly against the structure of the positive legal norms analyzed. Linked to the sustainable development agenda, these problems show that achieving SDG 7 (clean and affordable energy) and SDG 13 (climate action) cannot be realized optimally without fundamental improvements in consumer protection and ecological justice. Thus, sectoral regulatory reforms, greater market transparency, stronger consumer protection mechanisms, and expanded access to inclusive financing are prerequisites for the success of Indonesia's just energy transition agenda.

2. Model of Strengthening Consumer Protection for a Just Energy Transition

Based on the analysis of the problems described earlier, this section offers a model for strengthening consumer protection for rooftop solar power plants, built on Mochtar Kusumaatmadja's legal theory of development. In this view, law is not solely an instrument of control but a means of social *engineering* that actively encourages social transformation toward greater justice (Hartono, Fahruddin, & Supangat, 2026). In the context of the energy transition, this theoretical framework is relevant to

position the law as a catalyst that drives changes in the rooftop solar ecosystem towards a more inclusive, transparent, and protective system for consumers, in line with Indonesia's commitment to the sustainable development agenda, especially SDG 7 and SDG 13.

First, strengthening regulatory certainty and simplifying licensing. The FGD findings confirm that policy instability, including changes in *net metering schemes* and the implementation of the quota system, are the main factors eroding consumer confidence in rooftop solar investment. Therefore, legislative commitment is needed to provide a stable rooftop solar PV policy in the medium to long term, including by explicitly integrating consumer protection norms into the New and Renewable Energy Bill (NRE Bill). The government also needs to evaluate the quota restriction policy and consider the return of *a more equitable* net metering scheme, including the inclusion of a transition clause *(grandfathering clause)* for existing consumers, considering that the Minister of Energy and Mineral Resources Regulation Number 2 of 2024 has removed the electricity export-import mechanism, which was previously the main incentive for the community.

Second, market reform through price transparency and service standardization. High price variations and the absence of a standard reference in the rooftop solar PV ecosystem create asymmetrical market conditions that harm consumers. To address this, the government should develop an indicative price reference based on capacity and components, require all service providers to be transparent about cost details, and strengthen implementation of Indonesian National Standards (SNI) for installation products and processes. The government should also systematically encourage the standardization of after-sales services, so consumers are protected not only at the time of the initial transaction, but throughout the rooftop solar system's use cycle.

Third, strengthening consumer protection mechanisms. The existing legal protection framework needs strengthening by establishing binding minimum standards for after-sales service, ensuring the availability of spare parts and technical services, and strengthening complaint and dispute resolution mechanisms that reflect the sector's technical characteristics. The government should establish sector-specific requirements governing the transparency, enforceability, and minimum contractual protection of photovoltaic product warranties. International industry practices provide a relevant technical reference. The International Technology Roadmap for Photovoltaics (ITRPV, 2024) identifies performance warranties of approximately 25 years for crystalline silicon PV modules, while distinguishing these from shorter product warranties. Similarly, the IEA PVPS (2017) documents the use of 20–25-year performance warranties in photovoltaic project assumptions. These practices provide a basis for comparison to develop appropriate warranty protection in Indonesia, although further technical and regulatory assessment should determine the precise mandatory duration. Sectoral requirements should distinguish module performance warranties, product warranties, inverter warranties, and installation workmanship guarantees, while ensuring transparent claims procedures and accessible remedies for consumers. This strengthening reflects *recognition justice by* recognizing consumer rights proportionately within the energy regulation framework. Given the technical specialization of rooftop solar PV disputes, additional institutional arrangements may be needed to support effective technical assessment within existing consumer dispute resolution mechanisms. Two possible institutional approaches are (1) the establishment of an electrical-photovoltaic technical expert unit/panel as part of BPSK for disputes in the renewable energy sector, or (2) the delegation of technical disputes on rooftop solar power plants to a new sectoral forum jointly supervised by the Ministry of Energy and Mineral Resources and BPKN.

Fourth, expanding access to financing and increasing consumer literacy. The high initial installation cost is a structural obstacle that limits adoption of rooftop solar power plants in certain

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segments of society. From a legal perspective, a regulatory basis is needed that requires or incentivizes financial institutions to provide financing schemes for rooftop solar PV consumers (for example, through provisions in OJK Regulations or fiscal incentives regulated by the Ministry of Finance), accompanied by the obligation to provide transparent financing information to consumers as a manifestation of the right to information according to Article 4 of the UUPK. At the same time, increasing consumer literacy needs to be carried out systematically, including a technical understanding of how the system works, long-term economic benefits, calculation of *return on investment* (ROI), as well as risks and obligations as users, in line with consumers' rights to receive consumer guidance and education according to Article 4 letter f of the UUPK.

Fifth, instrument innovation through the One Stop Shop (OSS) mechanism. As an institutional innovation that integrates all of the above dimensions, this study recommends the establishment of *a One Stop Shop* (OSS) mechanism for rooftop solar power plants as an integrated platform that carries out three main functions: (a) A centralized source of information that provides price data, product specifications, and a list of certified service providers; (b) consumer empowerment tools that facilitate objective comparison of offers and self-education; and (c) Complaints and advocacy channels that allow consumers to report problems and obtain effective solutions. The OSS mechanism integrates the three pillars of *energy justice*, *distributional justice*, meaningful consumer participation, and recognition *of consumer rights in* one operational institutional instrument. Overall, the model of strengthening consumer protection formulated in this study is a normative response to the regulatory gaps identified through subsummation, as well as an academic contribution to Indonesia's just energy transition agenda. By treating law as a means of social reform, as Mochtar Kusumaatmadja's theory suggests, this model aims not only to meet national energy-mix targets but also to realize an inclusive, fair, and sustainable rooftop solar ecosystem.

Conclusion

This study shows that Indonesia's adoption of rooftop solar power plants has not fully reflected the principles of consumer protection and ecological justice within a sustainable energy transition framework. More specifically, the normative subsumption analysis shows that this weakness does not entirely stem from the vacuum of the norms of the UUPK as *a lex generalis*, but primarily from the insufficient coverage of sector-specific consumer protection standards within existing energy regulations (lex specialis), particularly concerning minimum warranty requirements, oversight of standard contractual clauses, and technically informed dispute resolution mechanisms. Unstable regulatory dynamics, weak market transparency, suboptimal after-sales service standards, and limited access to financing and consumer literacy show that consumers remain vulnerable in the rooftop solar ecosystem. This condition prevents the benefits of the energy transition from being distributed fairly and inclusively across all levels of society. Consumer protection issues in the rooftop solar sector relate not only to contractual relations between business actors and consumers but also to energy justice and sustainable development. Unequal access to technology, limited public participation in policymaking, and inadequate recognition of consumer rights show that Indonesia's energy transition agenda still faces structural challenges in realizing ecological justice and achieving the SDGs, especially SDG 7 and SDG 13.

In response, this study proposes a five-dimensional model to strengthen rooftop solar PV consumer protection, covering regulatory certainty, market transparency, service standardization, access to financing, and consumer literacy, supported by an integrated One Stop Shop (OSS) mechanism. The most urgent legal instrument is the amendment of Minister of Energy and Mineral Resources

Regulation Number 2 of 2024, particularly through the introduction of specific provisions requiring transparent disclosure of installation costs, projected electricity savings, technical specifications, contractual terms, and warranty coverage, as well as minimum standards for installation quality and after-sales services. Article 35 should also be strengthened by establishing clearer procedures for handling consumer complaints, facilitating independent technical assessments, and coordinating referrals to competent consumer dispute resolution institutions. Furthermore, the Bill should clarify and strengthen the transitional protections under Article 47 to ensure regulatory predictability and safeguard the legitimate expectations of eligible existing consumers. At the legislative level, the Bill on New and Renewable Energy (RUU EBET) should include explicit provisions on consumer rights, equitable access to renewable energy technologies, consumer information and education, and the authority to set sector-specific consumer protection standards. The relevant financial-sector regulatory framework should develop complementary financing measures, while the proposed OSS should integrate consumer education, access to verified service information, and complaint assistance with existing institutional mechanisms. These legal and institutional priorities translate the proposed model into actionable regulatory measures. Consistent with Mochtar Kusumaatmadja's development legal theory, law should serve as an instrument of societal renewal, directing Indonesia's energy transition toward a more just, inclusive, and sustainable system.

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