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Beyond Technology: Exploring Religious Beliefs and Systems Thinking as Foundations for Renewable Energy Education

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Abstract: The global shift towards renewable energy demands an educational approach that transcends mere technical knowledge. This study posits that religious beliefs and systems thinking skills are crucial, yet often overlooked, foundations for effective renewable energy education. A cross-sectional survey was conducted among 200 Indonesian university students from diverse academic disciplines to explore this paradigm. Data were collected using a 9-item questionnaire focusing on two domains: religious beliefs (4 items) and systems thinking (5 items). The instrument's content was validated by experts in physics education and environmental science, yielding high internal consistency with Cronbach's alpha values of 092 for religious beliefs and 0.86 for systems thinking. Descriptive statistics were used to analyze the data. The results reveal that students possess a strong perceived moral alignment between religious values and environmental stewardship (M = 3.52) and a high readiness for systems thinking (M = 3.37). However, this study is limited by its reliance on self-reported data, which measures perceived readiness rather than actual performance. These findings suggest that integrating ethical drivers and analytical frameworks can foster a more holistic "Beyond Technology" pedagogical model. This study advocates for a culturally grounded approach to Education for Sustainable Development (ESD) by leveraging spiritual and cognitive assets to support the energy transition.

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INTRODUCTION

The world is currently facing the immense challenge of the climate crisis and the urgent need for energy transition, placing renewable energy at the forefront. However, conventional energy education approaches tend to focus narrowly on technological, economic, and policy aspects, often neglecting the fundamental human dimension (Aleksandrova, 2025;Liu et al., 2025; Alqallaf & Ghannam, 2024; Sun et al., 2023; Zhang et al., 2022; Senthil, 2022). This technical-centricity creates a critical gap: it produces graduates who understand the mechanics of energy but lack the moral imperative to drive change and the cognitive agility to manage the socio-technical complexities of a transition (Hume, 2023). In the Indonesian context, this gap is particularly problematic as the country aims for ambitious net-zero targets while navigating a societal landscape where decision-making is deeply rooted in cultural and spiritual values rather than purely market-driven logic.

To address this, it is essential to define the operational framework of this study. Systems thinking in energy education is defined here as the cognitive ability to identify the interconnectedness between technological components and their social, economic, and environmental impacts over time. It moves beyond linear cause-and-effect to a holistic understanding of feedback loops in energy systems (Dall-Orsoletta et al., 2022). Furthermore, the role of religion in shaping pro-environmental behavior is grounded in the Value-Belief-Norm (VBN) theory, which suggests that spiritual values shape a person's worldview,

leading to a sense of moral obligation (stewardship) to protect the environment (Batool et al., 2024; Halkos & Aslanidis, 2026).

Previous research in energy education has incorporated non-technical aspects, such as system thinking (Radtke, 2025; Pillan et al., 2023; Laimon et al., 2022), local wisdom (Fitrianawati & Noerazizah, 2025), and religion (Koehrsen, 2015). However, there has been no specific exploration of the synergy between religious beliefs as an ethical driver and system thinking as an analytical framework within the Indonesian context. In Indonesia, religion is not merely a private belief but a primary source of social norms and environmental ethics. Empirical studies show that Indonesian society often views nature through the lens of *amanah* (trust) and *khalīfah* (stewardship), where environmental degradation is seen as a moral failure (Kirin & Kariman, 2026; Bashir, 2025; Sya'roni et al., 2025). Therefore, positioning religion in energy education is critical because it provides the intrinsic "why"—the moral motivation that secular policy often fails to ignite in the local populace.

This study proposes an intentional bridge between this intrinsic motivation and analytical capability. Religious beliefs function as the ethical–motivational driver ("the why"), providing the "purpose" for sustainability. Conversely, systems thinking functions as the analytical–cognitive framework ("the how"), providing the "tools" to navigate the complexity of energy systems. Without the ethical driver, analytical tools lack direction; without systems thinking, moral aspirations lack the technical roadmap to be effective. The novelty of this research lies in its integrated effort to position religious beliefs and system thinking as foundational pillars, rather than mere complements, in renewable energy education. Based on this identified gap, this study aims to examine the readiness of the non-technical foundation for renewable energy education in Indonesia. Specifically, it explores the extent of students' positive perception towards the role of religious beliefs in energy and environmental issues, and assesses their level of system thinking capacity. The implications of these findings will then be analyzed to propose a holistic "Beyond Technology" pedagogical model.

METHOD

Research Design

This study employed a cross-sectional survey design to describe and analyze students' perceptions, system thinking capacity, and religious views at a single point in time. This design was selected for its effectiveness in collecting data from a large sample to address descriptive and exploratory research questions (Hunziker & Blankenagel, 2024). The research followed a systematic flow as illustrated in Figure 1.

Participants

The participants in this study consisted of 200 university students from various higher education institutions across Indonesia. Participant characteristics were intentionally diversified, spanning multiple disciplines, including engineering, law, natural sciences, and social sciences. Purposive sampling was utilized to ensure that the respondents represented diverse academic backgrounds, thereby providing a comprehensive overview of the student population (Hossan et al., 2023).

Instrument Development and Validation

The primary instrument used was a closed-ended questionnaire comprising 9 items. The development of the instrument was informed by established theoretical frameworks to ensure construct clarity: (1) Religious Beliefs (4 items): Developed based on the concept of Environmental Stewardship and Islamic Eco-theology (khalīfah), drawing from indicators used in previous studies regarding religion and sustainability (Nanda et al., 2023). (2) Systems Thinking (5 items): Adapted from the Systems Thinking Scale (STS) and modified for the context of energy transition, focusing on interconnections and holistic problem-solving (Dolansky et al., 2020).

To ensure the quality of the instrument, a rigorous validation process was conducted:

1. Content Validity: The instrument was reviewed by three experts in the fields of Physics Education, Environmental Science, and Islamic Studies. The validators assessed item relevance, clarity, and theoretical alignment.
2. Construct Validity: Based on expert feedback, minor adjustments were made to the wording of the

systems thinking items to ensure they were accessible to students from non-technical backgrounds.

3. Reliability: The internal consistency of each domain was measured using Cronbach's alpha. The Religious Beliefs domain yielded a coefficient of alpha= 0.92, and the Systems Thinking domain yielded a coefficient alpha = 0.86. Both values exceed the acceptable threshold of 0.70, indicating high reliability.

However, it is important to note a limitation: the systems thinking domain relies on self-report measures. While this captures students' *perceived* capacity and belief in the importance of systems, it may not reflect their actual performance in solving complex technical problems compared to objective performance-based assessments.

Data Collection

The questionnaire utilized a 4-point Likert scale (Strongly Agree/SA, Agree/A, Disagree/D, Strongly Disagree/SD) to preclude neutral responses and minimize central tendency bias. Data were collected online via a digital survey platform (Newman et al., 2021)

Data Analysis

The collected data were analyzed using descriptive statistics with the aid of the SPSS software package. The analytical approach focused on three steps:

1. Scoring: Responses were assigned numerical values (SA=4, A=3, D=2, SD=1).
2. Mean Calculation: The analysis focused on calculating the mean (M) and standard deviation (SD) for each domain to determine the overall level of agreement.
3. Interpretation: Mean scores were categorized to interpret students' readiness. Descriptive statistics were chosen as the primary model because the study's objective was to establish a baseline "map" of student perceptions in Indonesia as a foundation for pedagogical proposals, rather than testing specific causal hypotheses or correlations between variables (Ho & Yu, 2015).

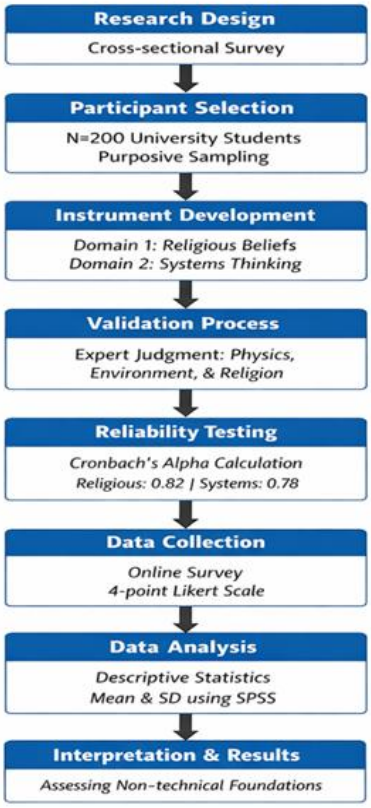

Figure 1. Research Procedure

RESULT AND DISCUSSION

Religious Beliefs as an Ethical Driver

In the context of seeking sustainable solutions to the energy and environmental crisis, the intrinsic motivation rooted in ethical values is often an overlooked determinant. The analysis of the Religious Beliefs domain, as shown in Table 1, provides a detailed breakdown of student perceptions.

Table 1. Item-Level Statistics for Religious Beliefs

No	Item Statement	Mean (M)	Standard Deviation (SD)
1	My religion instructs its followers to protect and preserve nature.	3.63	0.61
2	Damaging the environment is an act that contradicts religious values.	3.58	0.65
3	Conserving energy and other resources is a form of worship or a righteous deed. commanded by religion.	3.46	0.65
4	Religious institutions can play an active role in socializing the importance of renewable energy and environmental preservation.	3.40	0.61
	Average	3.52	0.63

Based on the data analysis, the Religious Beliefs domain yielded a mean score (M) of 3.52 with a standard deviation (SD) of 0.63. These findings reflect a strong perceived moral alignment among students, where religious values are seen as intrinsically linked to environmental stewardship. The spiritual aspect and religious beliefs, particularly within religious societies like Indonesia, are strongly suspected not only to shape individuals' moral paradigms but also to potentially act as a crucial ethical driver for pro-environmental behavior. These beliefs can provide a profound framework of meaning and responsibility that transcends mere material incentives or policy, thus establishing a solid foundation for a long-term commitment to environmental preservation and renewable energy.

For instance, regarding the statement, "My religion instructs its followers to protect and preserve nature," Figure 2 shows that 68.30% of the respondents indicated Strongly Agree (SA) and 27.70% indicated Agree (A). This result suggests that religious values, such as the concept of khalīfah (stewardship) in Islam—which emphasizes humanity's responsibility to care for the Earth—are deeply ingrained and can function as a powerful intrinsic motivator for sustainable action. However, it must be acknowledged that these results represent perceived alignment and moral predispositions rather than demonstrated behavioral commitment or actual long-term pro-environmental action.

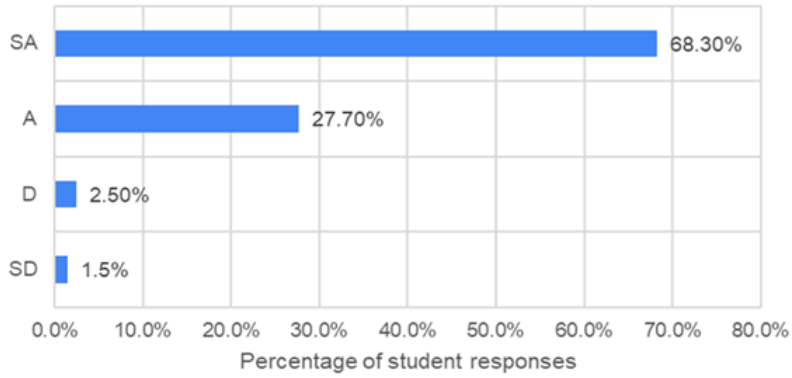

Figure 2. Student Belief regarding the Role of Religion in Environmental Issues

While the majority of participants come from an Islamic background—reflecting the concept of *khalīfah*—the findings should not be overgeneralized, as students from diverse religious backgrounds in Indonesia also navigate different theological interpretations of nature. Compared to secular approaches in Western contexts, these findings extend the work of Hajar (2024) and Setianingrum et al. (2024), suggesting that in religiously grounded educational contexts, faith-based motivation acts as a more stable foundation for environmental ethics. This creates a positive learning disposition that can be leveraged to achieve Education for Sustainable Development (ESD) goals by grounding global sustainability values in local cultural and spiritual identities.

Systems Thinking Capacity as an Analytical Framework

While ethical motivation derived from religious beliefs provides a strong foundation of values, the effectiveness of actions in addressing complex issues like the energy transition heavily relies on the analytical capacity to comprehend the system interconnections involved. Systems thinking emerges as a critical competency that enables individuals to look beyond surface symptoms, trace non-linear cause-and-effect patterns, and anticipate the long-term impacts of a policy or technological innovation. Therefore, after exploring the role of religious beliefs as an ethical driver, this section examines the extent to which students possess systems thinking capacity, which can function as the analytical framework (the how) to translate that motivation into comprehensive and sustainable solutions. Table 2 presents the item-level statistics for the Systems Thinking domain, indicating students' self-assessed readiness to handle complexity.

In the systems thinking domain, the mean score (M) obtained was 3.37 with a standard deviation (SD) of 0.60. These results indicate a high level of perceived readiness; however, literature distinguishes between systems thinking awareness (as measured here) and actual performance in complex problem-solving. To transform this awareness into measurable competence, instructional strategies such as

Problem-Based Learning (PBL) and the use of Causal Loop Diagrams (CLD) are required (Veldhuis et al., 2025; Butwong & Nuangchalerm, 2024). By contrasting these findings with studies in more technical curricula, it appears that Indonesian students have a strong innate capacity for holistic thinking, but require pedagogical scaffolding to operationalize this into technical mastery.

Table 2. Item-Level Statistics for Systems Thinking

No	Item Statement	Mean (M)	Standard Deviation (SD)
1	When analyzing a problem, I strive to look at all the involved components and their relationships.	3.32	0.58
2	I believe that a complex issue such as energy cannot be resolved by looking at only one aspect.	3.48	0.63
3	Changes in one part of an energy system will affect other parts.	3.35	0.56
4	Before making a decision, I tend to consider various possible long-term impacts.	3.36	0.60
5	I often seek the root causes of a problem rather than just its symptoms.	3.34	0.61
	Average	3.37	0.60

For instance, regarding the item, "I believe that complex issues like energy cannot be resolved by looking on only one aspect," the majority of respondents, namely 54%, indicated Strongly Agree (SA) and 40% indicated Agree (A), as shown in Figure 3. This suggests an awareness that renewable energy solutions must simultaneously consider social, economic, technological, and environmental aspects.

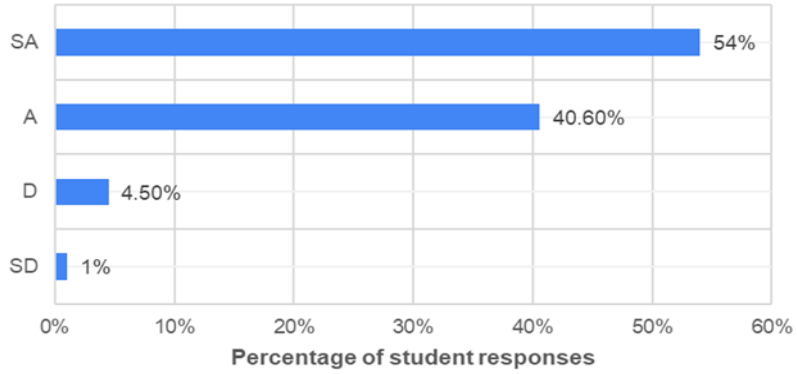

Figure 3. Student Belief regarding Systems Thinking in Energy Issues

The high positive perception towards this systems approach demonstrates students' readiness to engage in renewable energy education based on complex and holistic thinking. This capacity to see the interconnections among technological, social, economic, and environmental aspects is a vital foundation for designing sustainable and contextual renewable energy solutions (Bhambri & Bajdor, 2024; Batra, 2023). This finding reinforces the necessity of integrating a systems thinking approach into renewable energy education curricula, ensuring that students are taught not only technical solutions but also the ability to analyze systemic impacts and the interdependent relationships between various elements within the energy system (Lorenzo-Rial et al., 2025; Abdurrahman et al., 2023).

This capacity is a prerequisite for addressing the challenges of energy transition, which are inherently wicked problems. This finding supports the argument by Capra & Luisi, (2014) that a systems approach is essential for understanding the phenomena of life and sustainability. In the educational context, this initial ability represents a valuable asset that can be further developed, rather than something that must be built from scratch. Systems thinking provides "THE HOW"—the methodology for analyzing, designing, and evaluating effective and sustainable energy solutions.

Strategic Synergy: The “Beyond Technology” Framework

Based on the descriptive evidence and theoretical interpretation, we propose a "Beyond Technology" pedagogical framework (Figure 4). This framework is a conceptual proposition intended to illustrate how ethics and cognition interact to support transformative learning.

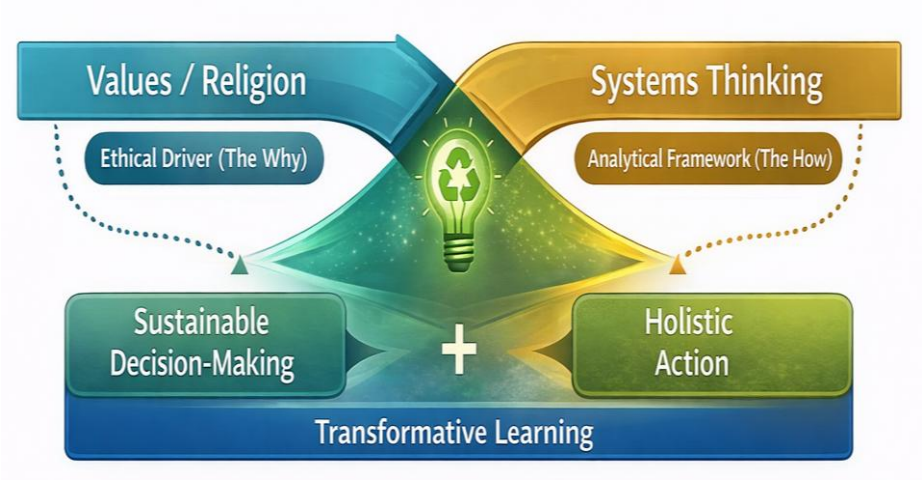

Figure 4. "Beyond Technology" pedagogical framework

The strategic opportunity for renewable energy education lies in the intentional integration between these two foundations. Religious beliefs provide the moral commitment and motivation, while systems thinking furnishes the tools necessary to translate that commitment into contextual and comprehensive solutions. Without "THE WHY," "THE HOW" risks losing direction and meaning; conversely, without "THE HOW," "THE WHY" remains a mere aspiration without concrete implementation.

In classroom practice, this synergy can be operationalized by redefining learning objectives to move beyond technical efficiency toward inclusive ethical reflection; for instance, students might analyze the systemic impact of solar farms while reflecting on the principles of social justice and stewardship. Learning activities should incorporate scenario analysis where students must weigh technological choices against religious-ethical norms and systemic environmental feedback loops, while reflection tasks encourage students to map "The Why" (moral motivation) to "The How" (systemic solution) using causal mapping in case studies. This approach advances Education for Sustainable Development (ESD) by providing a culturally grounded model for sustainability literacy.

However, this study has limitations: as a cross-sectional, self-reported survey, it cannot establish causality or capture how these perceptions are enacted in real-time classroom behavior. Consequently, future research should test the following hypotheses: H1, that integrating ethical reflection into systems thinking modules significantly increases student engagement in renewable energy units; and H2, that students trained under the "Beyond Technology" model demonstrate higher ethical-analytical consistency in solving "wicked" energy problems compared to those in technical-only tracks.

CONCLUSION

This study concludes that university students in Indonesia possess a strong non-technical readiness for renewable energy education through the synergy between religious beliefs as an ethical driver ("the why") and systems thinking as an analytical framework ("the how"). The findings reveal a high moral alignment toward environmental preservation rooted in spiritual values, coupled with a cognitive predisposition to understand the complexity of energy systems, supported by a significant positive correlation between the two domains. However, these results reflect perceived readiness and potential rather than demonstrated technical mastery or long-term behavioral commitment, due to the limitations of self-reported and cross-sectional data. Consequently, the "Beyond Technology" pedagogical framework is proposed to transform this readiness into actual competence through strategies such as problem-based learning and causal mapping, while future research should experimentally and longitudinally test this model to ensure a tangible impact on sustainability literacy.

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