



## Original Article

# Analysis of values-beliefs-norms of decommissioned nuclear power plant reestablishment acceptance in developing countries: a perspective from the Philippines

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## ABSTRACT

Amid the ongoing discourse on clean energy solutions, the reopening of decommissioned plants, such as the Bataan Nuclear Power Plant (BNPP) in the Philippines has become a focal point in the country. This study delved into the complex web of factors influencing public acceptance of BNPP, employing the values-beliefs-norms theory. By utilizing partial-least square structural equation modeling, the research unravelled the intricate relationships among biospheric values, altruistic values, egoistic values, ecological worldview, awareness of consequences, personal norm, social norm, and the broader acceptance of BNPP establishment. With 434 respondents participating in a self-administered online survey, the study identified key correlations. Emphasizing the collaborative impact on decision-making processes by social and personal norms, the study also highlighted the role of ecological values in shaping awareness. The foundational impact of values on ecological worldviews was explored, shedding light on public attitudes toward nuclear energy. This research offers actionable insights for policymakers, advocating for targeted communication strategies and public engagement initiatives to navigate barriers and promote informed decision-making in the dynamic landscape of nuclear energy development. The study contributes to the global conversation on sustainable energy strategies, emphasizing the pivotal role of public perception in shaping the trajectory of nuclear power.

## 1. Introduction

Decommissioning nuclear power plants has become a global trend due to concerns about safety, environmental impact, and economic feasibility [1]. However, some countries have opted to commission them, or consider its reestablishment instead of dismantling them [2]. For instance, Japan restarted five of its nuclear reactors after the Fukushima disaster in 2011; while the United States extended the operating licenses of some of its nuclear power plants. These commissioning efforts have mixed results, with some plants experiencing technical difficulties and others achieving successful operations. Despite the challenges, commissioning decommissioned nuclear power plants remains a viable option for countries seeking to meet their energy needs, as well as with the aim for a more sustainable energy and green technology.

Nuclear power plants (NPP) have been recognized for their sustainability advantages, such as emitting virtually no air pollutants during

operation and providing reliable, large-scale, low-carbon energy that can directly replace fossil fuel plants [3]. Additionally, nuclear energy is considered a clean energy source, as it does not emit pollutants or contribute to air pollution [4]; though debateable [2]. Nuclear energy also provides a reliable and constant source of electricity, making it an attractive option for meeting energy demands [5]. The World Nuclear Association [6] estimated that approximately 30% of the world's low-carbon electricity comes from nuclear energy. To which, nuclear reactor performance has significantly improved over time, and some countries now rely heavily on nuclear energy for their electrical needs. For example, 95.8 GW are supplied to USA, making 18.2% of the country's electricity. In France, 61.4 GW are supplied, constituting 62.5% of the country's electricity. Coherently, an early study by Brook et al. [7] emphasized that nuclear energy is sustainable and satisfies the requirements for sustainable energy sources. Thus, countries have monitored and are practicing sustainability – especially among energy consumptions. In accordance, there are concerns about the safety,

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environmental impact, and economic feasibility of NPPs, which have led to a debate on their sustainability and public acceptance [7].

As part of its commitment to reducing reliance on nuclear power and addressing climate change, the Philippines is actively exploring alternative energy options [8]. While proponents argued that nuclear power can contribute to a reliable and continuous energy source, supporting the country's efforts towards a more sustainable future [9], concerns about safety, environmental risks, and the management of radioactive waste associated with nuclear power plants remain prominent issues [10].

Given these concerns, the decision on BNPP's reopening requires extensive public engagement, stakeholder involvement, and comprehensive risk assessments to ensure a balanced and informed choice [9]. As the Philippines continues to strive for sustainable energy practices, it is crucial to evaluate the environmental impact, carbon footprint, and long-term sustainability of nuclear power compared to other renewable energy sources [11,12]. This holistic approach aligns with the country's commitment to fostering sustainable practices, ensuring that the decision-making process incorporates not only energy reliability but also environmental considerations and public engagement for a more resilient and sustainable energy future.

The Philippines for example, has made significant strides in promoting sustainability and reducing energy consumption, but its ability to consider nuclear power plants remains a topic of debate. The Philippines has been exploring NPP uses to meet its growing energy demands. However, worries about the effects on the environment, safety, and viability from an economic standpoint have impeded this field's advancement [13]. Additionally, the country has been focusing on developing renewable energy sources, such as solar, wind, and hydropower, to transition to a more sustainable energy mix [14,15]. The need for a more stable and sustainable power source for larger consumption is still being studied. In addition, the promotion of NPPs in the Philippines like that in Bataan has recently been talked about in news for its planned establishment [16]. Mangaluz [17] even explained that South Korea is still interested with the development and plan of action on the reestablishment of Bataan NPP. However, the potential benefits and drawbacks of NPPs in the Philippine context require further investigation, particularly regarding their impact on the environment, public health, and national security [18]. With the challenges brought by sustainability behavior, consumption, and acceptance, the promotion of renewable energy has been seen; and the promotion of which may be difficult if the values, beliefs, and norms of people are not known.

To further add, a recent study has shown that Filipino consumers are increasingly embracing sustainable practices, despite facing challenges like inconvenience and higher costs [19]. This emerging trend indicates a growing awareness and commitment to environmental responsibility, with a significant number expressing a desire for more information on sustainability. This highlights a willingness to make eco-conscious choices if provided with accessible options. Another study emphasizes the role of individual actions in contributing to positive environmental outcomes and cultivating a culture of sustainability within Filipino society [20]. Key factors such as awareness of consequences, perceived marketplace influence, and internal ethics emerge as significant influencers of sustainable consumption behavior among Filipino consumers. Understanding these factors is crucial for designing targeted interventions and campaigns that encourage and facilitate sustainable choices, aligning products and initiatives with consumer values to foster a collective commitment to sustainable practices.

Furthermore, nuclear power is becoming increasingly essential in achieving Sustainable Development Goals (SDGs) by providing access to affordable, reliable, and clean energy. It has a crucial role in mitigating climate change and protecting ecosystems, emitting low quantities of greenhouse gases per unit of electricity on a life cycle basis. The notable sustainability benefits of nuclear energy, including low land requirements, minimal impact on ecosystems, and relatively low carbon emissions compared to other technologies, highlight its potential [3].

However, traditional barriers to growth must be overcome through innovation, improved government policies, and addressing public perceptions. Incorporating uranium resources into frameworks like the UNFC for example emphasized nuclear energy's significant role in sustainable development at various levels.

Sustainability advantages encompass resource adequacy, preservation, and opportunity cost, along with resource efficiency and material throughput compared to other energy sources [21]. The rapid improvement in the cost-effectiveness of extracting uranium from seawater provides a commercially viable alternative to traditional mining practices. Advanced nuclear reactors that maximize fuel usage alongside seawater extraction of uranium, offer a long-term, sustainable, and renewable energy solution that aligns with global needs while minimizing environmental impacts [22].

To date, limited studies were found in the context of Bataan NPPs. With the perceived near start of reestablishment [17,18], consideration for consumers should be dealt with so proper action and promotion could be done by the government. Only Ong et al. [2] provided valuable insights into the factors influencing public acceptance or rejection of the Bataan NPP reopening, emphasizing the need for further research in this area to inform policy decisions and promote sustainable development.

The comprehensive examination of public perceptions regarding the Bataan Nuclear Power Plant (BNPP) revealed that nuclear power knowledge plays a pivotal role in acceptance. Ong et al. [2] conducted studies that highlighted the impact of knowledge on perceived behavioral control and attitudes, acting as mediators in the acceptance of BNPP's reopening, incorporating elements from the theory of protection motivation and planned behavior. The research on Generation Z [23] highlighted the importance of knowledge in shaping risk and benefit perceptions, influencing subjective norms and behavioral intentions. Machine learning algorithms [2] effectively predicted factors affecting BNPP acceptance, with perceived benefits, such as job opportunities and economic growth, outweighing perceived risks. The potential recovery of uranium from phosphate rock imports [24] indicated the prospect of meeting a significant portion of BNPP's uranium requirements. Additionally, studies on the social dimensions of barriers [13] emphasized diverse imaginaries related to coal and nuclear energy, revealing conflicting priorities and values. Delina's study [25] also added to our understanding of the complex links between energy systems, the environment, human rights, sustainability, and climate. For holistic acceptance in the sustainability context, which has not been covered especially in the Philippines, should be considered. One of the holistic measurements of people's values, belief, and norms on sustainability context could be using the VBN theory.

The VBN theory, introduced by Stern et al. [26], suggests that the likelihood of green behaviors increases when a sequential set of variables, including values, beliefs, and norms, is in place. Numerous studies have employed this theory to evaluate sustainability behaviors, endorse environmental policies, and gauge the acceptability of energy policies [27]. According to the theory, evidence suggests that engaging in environmentally friendly behaviors is more likely when certain factors are present, such as personal values, beliefs, and norms [28]. Personal values can influence the extent to which we conserve energy in homes, while pro-environmental beliefs can help us understand the impact of our actions. As a result, people may feel a sense of responsibility to conserve energy at home and in their workplace. The VBN theory has even been extended to incorporate social norms and energy conservation behaviors, providing a comprehensive understanding of the factors influencing green behaviors and sustainability [29].

In addition, a study by Zhang et al. [30] aimed to validate the effectiveness of the VBN model in predicting energy conservation behaviors among a Chinese population. The results demonstrated the importance of biospheric values in shaping individuals' sense of responsibility, awareness of consequences, and development of pro-environmental beliefs. Additionally, the research highlighted the crucial role of pro-environmental beliefs in understanding the

consequences of energy conservation and determining responsibility in a workplace environment. This research provides valuable insights into the development of personal norms and the relationship between pro-environmental attitudes, awareness, and responsibility. Furthermore, a study by Ghazali et al. [31] explored the impact of religious values and practices on consumer behavior towards green products. The research found that religious values and habits significantly influenced green purchase behavior, supporting the relevance of personal values in shaping pro-environmental behaviors. This study provides further evidence of the significance of personal values, a key component of the VBN theory, in influencing environmental behaviors. Based on searchers, no studies have currently evaluated the Philippines' decommissioned power plant reopening or reestablishment in the sustainability context of consumer behaviors' values, beliefs, and norms. Especially since the plan of the current government officials to establish this again, the need to examine the current stand should be considered.

This study examined the public's perception of the BNPP reestablishment using the VBN theory. The study incorporated factors such as biospheric, altruistic, and egoistic values, ecological worldview, awareness of consequences, personal and social norms, and acceptance of nuclear power plant establishment. As evident in other international research on nuclear power plants, the current study seeks to provide information crucial for government decision-making, particularly concerning the upcoming reopening of the BNPP. The anticipated outcomes are deemed crucial for the growth and sustainability of the BNPP or even other NPPs in the future of the Philippines. Moreover, the model constructed in this study could be beneficial for academicians, governments, and the private sector globally, offering a robust framework for examining the reopening of closed and idle nuclear power plants. This framework could aid in expanding public perception and support the development of sustainable strategies for nuclear energy development.

## 2. Conceptual framework

Encompassing all related studies, the current framework (Fig. 1) has been developed. A total of 8 hypotheses from 8 constructs were considered. Establishing the extended VBN, the proposed framework aims to assess comprehensively the acceptance of the BNPP reestablishment. Following the figure are related studies to support the hypotheses build up. According to Stern et al. [26], VBN provides the holistic examination of sustainable behavior leading to acceptance on the cognitive and belief aspects – influencing overall behavior among individuals. To which, studies such as that of Choi et al. [28], Mahpour et al. [27], and Whitley et al. [29] have considered the sole assessment of sustainable behavior, beliefs, and overall consumer sustainable behavior with the model without extension. Since there has been no studies

evaluating this model's use on nuclear or sustainable energy, the current model was considered for holistic evaluation of sustainable values, beliefs, and norms on the acceptance of nuclear energy and its reopening.

Biospheric values, in the context of green technology and sustainability, refer to the intrinsic appreciation and prioritization of the protection and preservation of the environment, reflecting an individual's ethical standards towards non-human objects. These values correspond to the *trans*-situational belief that environmental protection is an essential goal in life. According to a study by Mamun et al. [32], the VBN theory plays a crucial role in predicting solid waste management. The study found that biospheric values precede intention and behavior, which, in turn, significantly and positively influence the ecological worldview. This supports the hypothesis that biospheric values significantly affect ecological worldview, as individuals who appreciate the values of the biosphere intrinsically value the ecosystem and view environmental action as a moral obligation. Another study by Tiwari [33] supports this, highlighting that biospheric values can predict preferences for environmentally friendly products, intentions, and attitudes toward sustainable behaviors. Furthermore, the study of Ghazali et al. [31] emphasizes the importance of biospheric values in cultivating an ecological perspective. Their research revealed that biospheric values are crucial in encouraging individuals to adopt an ecological worldview. The study identified two key factors - awareness of consequences and attribution of responsibility - that guide pro-environmental behavior. Therefore, it was hypothesized that

**H1.** Biospheric values had a significant effect on ecological worldview.

On the other hand, altruistic values refer to the selfless concern for the well-being of others and the environment. A study by Wu and Zhu [34] explored the mediating role of connectedness to nature in the relationship between altruistic values and ecological behavior. The research found that connectedness to nature, which is associated with altruistic values, mediated the relationship between awe and ecological behavior. This supports the notion that personal values and beliefs play a significant role in shaping pro-environmental behaviors. This study supports the VBN theory's emphasis on personal values and beliefs, including altruistic values, in predicting sustainability behaviors. Additionally, a recent study by Mahpour et al. [27] assessed its predictive power regarding support for car use reduction policies in Russia. The findings revealed a compelling association between a strong endorsement of biospheric values, inherently tied to altruistic principles, and heightened environmental concern. This heightened environmental concern, in turn, was linked to increased support for policies aimed at reducing car usage. The study reinforced the hypothesis that altruistic values are pivotal in shaping the ecological worldview, underscoring their significance in garnering support for initiatives promoting green

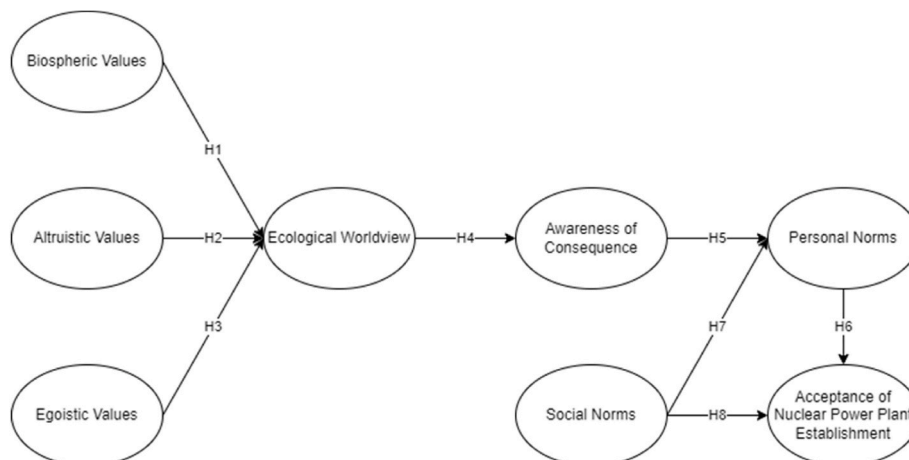


Fig. 1. Conceptual framework.

technology and sustainability. Thus, it was hypothesized that.

## H2. Altruistic values had a significant effect on ecological worldview.

Egoistic values may lead individuals to prioritize their interests over the environment, making them less inclined to act pro-environmentally. A study conducted by De Groot and Steg [35] aimed to evaluate the relationship between egoistic, altruistic, and biospheric value orientations and their impact on environmentally significant behavior. In a distinct investigation, Bouman et al. [36] found a negative correlation between egoistic values and pro-environmental beliefs and actions. These studies provide evidence of the relevance of personal values in shaping pro-environmental behavior and support the notion that egoistic values significantly affect ecological worldviews. However, it is essential to note that egoistic values may positively relate to pro-environmental behaviors when such behaviors have egoistic benefits, such as saving money or positive economic impact.

Moreover, in a recent study by Zhang et al. [37], the importance of the VBN theory in predicting intentions and actions related to the effective management of waste was demonstrated. The findings emphasized the critical role of altruistic and biospheric values in promoting an ecological worldview among individuals. The framework of VBN suggests that an ecological worldview leads to greater awareness of consequences, allowing responsibility to be attributed to taking corrective actions regarding the climate. The study also revealed the positive and notable impact on the ecological worldview by biospheric values while highlighting the noteworthy influence of altruistic values in promoting this perspective. Additionally, Steg and Van Der Werff [38] discovered that those who strongly endorsed egoistic ideals were also more conscious of the adverse environmental effects of their behavior. This, in turn, shapes their opinions and decisions, which may affect how supportive they are of laws and programs about renewable energy. The study's conclusions support the VBN paradigm by highlighting how people's views and behaviors toward environmental issues, particularly renewable energy, are shaped by their values and beliefs. Thus, this study hypothesized that.

## H3. Egoistic values had a significant effect on ecological worldview.

Ecological worldview refers to an individual's perception of the relationship between humans and the natural environment. A study by Hansla et al. [39] examined the relationship between values, beliefs, and norms and their impact on pro-environmental behavior among college students. According to the study, an ecological perspective greatly impacted knowledge of the effects of one's actions. A follow-up study by Liobikienė and Poškus [40] examined the connection between children's ecological behavior and nature-based environmental education. The research found that environmental knowledge and connectedness to nature were positively related to ecological behavior, supporting the idea that personal values and beliefs play a significant role in shaping pro-environmental behaviors. These studies demonstrate the importance of an ecological worldview in influencing people's attitudes and actions toward consequence awareness. Therefore, it could be hypothesized that.

## H4. Ecological worldview significantly influences awareness of consequences.

The concept of awareness of consequences is crucial in understanding an individual's recognition of the potential impacts of their actions on the environment, society, and economy. This awareness is a key component of the VBN theory, indicating that environmentally conscious behaviors have a higher propensity when values, beliefs, and norms are present. In this framework, awareness of consequences is closely linked to the development of personal norms, which are internalized standards that shape behavior. Additionally, a study by Hansla et al. [39], the VBN model was extended and empirically tested to predict energy conservation behavior. The results indicated that awareness of consequences and pro-environmental beliefs are crucial

factors in assuming responsibility for workplace energy preservation, ultimately contributing to establishing personal norms. Similarly, Arundati et al. [41] observed the environment in Vietnam to research consumer awareness of the surrounding environment, indicating that personal norms influence pro-environment behavior (conservation behavior). These findings support the significance of awareness of consequences in shaping personal norms and, by extension, influencing ecological worldview and pro-environmental behavior. To which, it was hypothesized that.

## H5. Awareness of consequence had a significant effect towards personal norms.

Individuals have a responsibility to engage in pro-environmental behaviors, which can include advocating for environmental policies and supporting renewable energy initiatives. According to a study conducted by De Groot and Steg [42], personal norms, encompassing a sense of moral obligation regarding actions related to nuclear energy, play a significant role in predicting individuals' willingness to engage in morally oriented actions towards nuclear energy. The study highlights the importance of personal norms in shaping individuals' reactions to environmental issues, suggesting that established personal norms can influence support or opposition towards specific energy technologies, such as nuclear power.

Furthermore, a study by Arundati et al. [41] delved deeper into the VBN model, utilizing it to forecast energy conservation behavior among a group of Chinese individuals. The results highlight the importance of personal norms, influenced by biospheric values, in influencing a person's sense of responsibility, level of awareness regarding consequences, and formation of pro-environmental beliefs. This shaped individuals' behavior towards energy conservation. This research provides evidence of the significant role of personal norms, influenced by values and beliefs, in driving pro-environmental behaviors, supporting the relevance of personal norms in green technology and sustainability. Expanding on this concept, De Groot and Steg [42] found that personal norms play a crucial role in predicting individuals' willingness to take ethical actions regarding nuclear energy, whether in support or opposition. This study highlighted the importance of personal norms in shaping people's attitudes towards environmental concerns, suggesting that firmly established personal norms can influence one's stance on specific energy technologies, such as nuclear power. Building on the promising findings of related research, we hypothesize that.

## H6. Personal norms had a significant effect towards acceptance.

Social norms refer to the commonly accepted beliefs and behaviors within a particular social group or community, including those related to environmental conservation and pro-environmental actions. In a study conducted by Niu et al. [43], it was found that social norms shape personal norms, which mediate pro-environmental behavior. This suggests that an individual's personal norms may be influenced by social norms, which in turn impacts their willingness to participate in pro-environmental actions. Another study by Kim and Seock [44], using the extended VBN theory was a practical approach to comprehending consumers' choices regarding eco-friendly lodging. The research indicated that the VBN theory accurately forecasted consumers' inclination to stay at green hotels, where personal norms played a key role in mediating the impact of social norms on pro-environmental conduct. This highlights the importance of both social and personal norms in shaping consumers' attitudes towards environmentally friendly products and services. To which, it was hypothesized that.

## H7. Social norms had a significant effect towards personal norms.

Further, social norms can influence the acceptance of NPP's establishment and the adoption of renewable energy sources. Yang et al. [45] examined the relationship between China's nuclear power growth and social acceptance. The study discovered a positive correlation between the development of nuclear power plants and social acceptance. Another



study by Kácha and Van Der Linden [46] investigated how a nuclear power plant accident influences the acceptance of nuclear power. The disaster had a detrimental effect on acceptance, according to the research, underscoring the significance of societal norms in influencing perceptions of nuclear power. In addition to nuclear power, social norms can influence the acceptance of renewable energy sources. A study by Chan et al. [47] investigated the social acceptance of renewable energy in Europe. The results indicated that social norms play a significant role in shaping attitudes towards renewable energy, as positive social norms can be a powerful motivator for pro-environmental behaviors. Similarly, Perry et al. [48] explored the relationship between social norms and environmental behavior, finding that social norms can effectively encourage pro-environmental actions by appealing to individuals' desire for recognition and tendency to conform and sanction others. Relating to the positive results of related studies, it was hypothesized that.

**H8.** Social norms had a significant effect towards acceptance.

### 3. Methodology

#### 3.1. Participants

This study evaluated public acceptance for reopening the BNPP. The survey was conducted online through Google Forms, with 434 valid participants using a convenience sampling method. Collected from November 2023 to January 2024, the study offered timely insights into public sentiment. Data was collected through social media platforms such as Facebook, X, Instagram, and Viber; as well as face-to-face questionnaire dissemination to gather valid respondents.

Table 1 provides an overview of response demographics with 50.69% being male and 49.31% female. The predominant age group is 26–35 years old, comprising 43.55% of the participants. Within the 18–25 age bracket, 11.06% participated, while 11.52% are in the 36–45 range. Respondents aged 46–55 constituted 16.82%, and those above 55 years old represented 17.05%.

Among the respondents, the majority are graduates (45.85%), followed closely by those with undergraduate (44.24%), while 8.53% are in senior high school, and 1.58% are in junior high school. Regarding salary/allowances, the most significant portion of respondents receives allowances or salaries around 20,001–30,000 PhP (32.26%), with the remainder receiving higher incomes. Geographically, a significant percentage of participants reside in NCR (30.65%), with 12.67% and 12.21% hailing from Region IV-A and Region VI, respectively, and the remainder from other regions. In terms of occupation, the top three categories are within education (41.71%), followed by professionals in information technology (6.91%), and then students (6.68%), among others.

#### 3.2. Questionnaire

The survey was based on a conceptual framework and divided into nine sections. These sections included Demographics, which covered variables like age, sex, education, location, occupation, monthly salary/allowance, and preferred energy source. Biospheric, Altruistic, and Egoistic Values each had four constructs, while Ecological Worldview had four constructs as well. Personal and Social Norms, Awareness of Consequence, and Acceptance of NPP Establishment each consisted of five or six constructs. To evaluate the constructs, a 5-point Likert scale was utilized, adapted from relevant studies. Prior to analysis, the common method bias using Harman's Single Factor test was considered. Following the suggestion of Podsakoff et al. [49], output should not exceed 50% for it to provide no bias output. This study presented a total variance of only 26.132%, thus presenting no common method bias. Moreover, the normality test using Shapiro-Wilk Test presented normal output among responses [50] – presented in Table 2 (within ±1.96 skewness and kurtosis quotient).

**Table 1**  
Respondents' descriptive characteristics (n = 434).

Respondent's Profile	Category	N	%
<b>Sex</b>	Male	220	50.69
	Female	214	49.31
<b>Age</b>	18–25 years old	48	11.06
	26–35 years old	189	43.55
	36–45 years old	50	11.52
	46–55 years old	73	16.82
	Above 55 years old	74	17.05
<b>Education Attainment</b>	Junior high school	6	1.38
	Senior high school	37	8.53
	Undergraduate	192	44.24
	Graduate	199	45.85
<b>Monthly Salary/Allowance</b>	Less than 10,000 PHP	40	9.22
	10,001–20,000 PHP	46	10.60
	20,001–30,000 PHP	140	32.26
	30,001–40,000 PHP	75	17.28
	40,001–50,000 PHP	71	16.36
	50,001 PHP and above	62	14.29
	<b>Location</b>	Region I	7
Region II		4	0.92
Region III		33	7.60
Region IV-A		55	12.67
Region IV-B		18	4.15
Region V		19	4.38
CAR		1	0.23
NCR		133	30.65
Region VI		53	12.21
Region VII		14	3.23
Region VIII		27	6.22
Region IX		18	4.15
Region X		14	3.23
Region XI	14	3.23	
Region XII	9	2.07	
Region XIII	9	2.07	
BARMM	6	1.38	
<b>What is your current or previous occupation?</b>	Unemployed	7	1.61
	Student	29	6.68
	Energy Sector	12	2.76
	Healthcare	24	5.53
	Education	181	41.71
	Manufacturing	21	4.84
	Information Technology	30	6.91
	Finance	22	5.07
	Retail	23	5.30
	Government/Public Service	26	5.99
	Arts/Entertainment	21	4.84
	Construction	14	3.23
	Agriculture	13	3.00
	Others	11	2.53

#### 3.3. Structural equation modeling

The reopening of BNPP was analyzed for its acceptance using Structural Equation Modeling (SEM). SEM, which integrates factor analysis and multiple regression analysis, emerged as a fitting choice for investigating intricate relationships and interactions among these variables [51]. Utilizing this multivariate tool allowed for the simultaneous exploration of various factors and their interconnections, enhancing our understanding of the factors influencing public acceptance of the BNPP reopening [2]. Furthermore, SEM facilitated the examination of theoretical hypotheses through path analysis, aligning seamlessly with the VBN theory [52]. This approach determines the compatibility of emerging results and measures investigation towards accepting the reopening of the BNPP. Following the suggestion of Dash and Paul [53], the use of partial least square SEM (PLS-SEM) would be best suited for analysis of newly constructed frameworks, testing of new analysis, or provide more sensitive output compared to covariance-based SEM. Therefore, this study employed PLS-SEM using SMART-PLS v3.0.

**Table 2**  
Normality test.

Variable	Items	Kurtosis	Skewness	Threshold ±1.96
Biospheric Values	BV1	-1.047	-0.493	0.471
	BV2	-1.144	-0.267	0.233
	BV3	-1.165	-0.317	0.272
	BV4	-1.114	-0.279	0.250
Altruistic Values	AV1	-0.985	-0.385	0.391
	AV2	-1.081	-0.259	0.240
	AV3	-0.922	-0.433	0.470
	AV4	-0.430	-0.759	1.765
Egoistic Values	EV1	-0.323	-0.327	1.012
	EV2	-0.364	-0.405	1.113
	EV3	-0.515	-0.667	1.295
	EV4	-0.314	-0.429	1.366
Ecological Worldview	EW1	-1.173	-0.338	0.288
	EW2	-0.781	-0.430	0.551
	EW3	-0.760	-0.536	0.705
	EW4	-0.954	-0.378	0.396
Awareness of Consequences	AC1	-1.464	0.066	-0.045
	AC2	-1.356	0.057	-0.042
	AC3	-1.314	-0.034	0.026
	AC4	-1.339	-0.029	0.022
	AC5	-1.354	-0.061	0.045
Personal Norms	PN1	-0.877	-0.502	0.572
	PN2	-0.741	-0.566	0.764
	PN3	-0.774	-0.549	0.709
	PN4	-0.411	-0.753	1.832
	PN5	-0.896	-0.507	0.566
Social Norms	SN1	-1.289	-0.214	0.166
	SN2	-0.996	-0.415	0.417
	SN3	-1.002	-0.395	0.394
	SN4	-1.075	-0.296	0.275
	SN5	-0.871	-0.431	0.495
Acceptance of Nuclear Power Plant Establishment	A1	-0.968	-0.420	0.434
	A2	-1.111	-0.337	0.303
	A3	-1.056	-0.299	0.283
	A4	-0.654	-0.578	0.884
	A5	-0.612	-0.544	0.889
	A6	-0.841	-0.533	0.634

**4. Results**

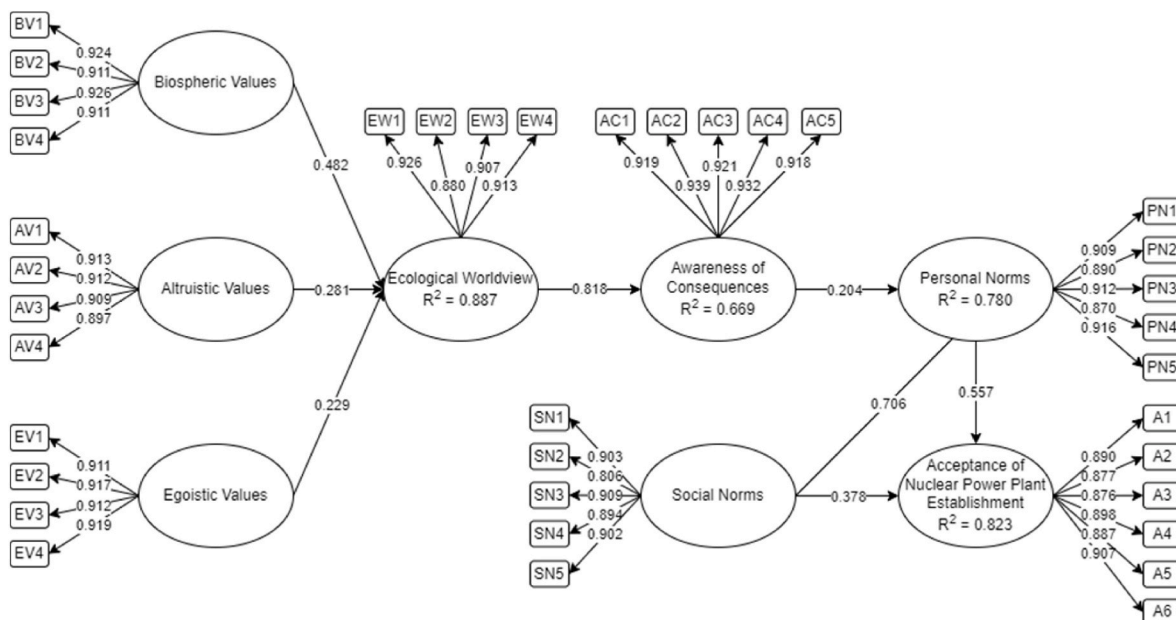
Fig. 2 shows the factors that have significantly influenced the acceptance of establishing NPP, including biospheric, altruistic, and

egoistic values, ecological worldview, awareness of consequences, personal norms, social norms, and acceptance of NPP establishment. The final model indicated that all the relationships and variables from the framework are significant with p-values below 0.05 [50]. It could also be seen that the measure items are within the 0.70 threshold, presenting the final structural equation model for this study [53]. Furthermore, R2 values were determined to evaluate the hypothesized model, presenting all to be within the >20% threshold.

Table 3 presents the factor loadings (FL), as well as the convergent reliability and validity of the measurements. All latent variables have Cronbach’s alpha (α) values that exceed the recommended threshold of 0.7. The minimum Cronbach’s alpha value is 0.928, indicating a high level of internal consistency and reliability among the indicators, as noted by Hair et al. [50]. Moreover, Leguina [54] highlights the robust construct reliability with composite reliability (CR) values that exceed the threshold of 0.70 by a significant margin, with the lowest CR value recorded at 0.947. The average variance extracted (AVE) values for all latent variables exceed the recommended threshold of 0.5, with the lowest AVE value recorded at 0.781, demonstrating high convergent validity [55]. These findings suggest that the measurement model is both reliable and valid.

The Heterotrait-Monotrait method correlations (HTMT) offer insights by considering the average correlations between different constructs about the average correlations within the same construct. According to Henseler et al. [56], it is advised to interpret Heterotrait-Monotrait (HTMT) scores as the ratio between the mean correlations among variables representing different constructs and the mean of the average correlations among items measuring the same construct. The suggested benchmark for an HTMT score is less than 0.85 or 0.90. This implies that if the HTMT value is higher than a certain threshold (Table 4), it suggests a potential issue with discriminant validity between two latent variables. To further support this, the Fornell-Larcker Criterion was obtained (Table 5). The results in Table 4 provide additional support for assessing discriminant validity by showing the square root of the AVE for each construct on the diagonal area and the correlations between constructs off the diagonal. Collectively, these results contribute to the assessment of discriminant validity in the study, deemed as acceptable.

Moreover, Table 6 presents the model fit results for the SEM in the study. Table 6 displays the outcomes of model fit for the SEM in this



**Fig. 2.** Structural equation modeling output.

**Table 3**  
Indicators statistical analysis.

Variable	Item	Mean	Std	FL	$\alpha$	CR	AVE
Biospheric Values (BV)	BV1	3.410	1.392	0.924	0.938	0.956	0.843
	BV2	3.336	1.328	0.911			
	BV3	3.313	1.379	0.926			
	BV4	3.293	1.351	0.911			
Altruistic Values (AV)	AV1	3.385	1.306	0.913	0.929	0.949	0.824
	AV2	3.221	1.336	0.912			
	AV3	3.484	1.290	0.909			
	AV4	3.696	1.257	0.897			
Egoistic Values (EV)	EV1	3.751	1.245	0.911	0.935	0.953	0.836
	EV2	3.659	1.260	0.917			
	EV3	3.634	1.238	0.912			
	EV4	3.804	1.203	0.919			
Ecological Worldview (EW)	EW1	3.304	1.411	0.926	0.928	0.949	0.823
	EW2	3.470	1.201	0.880			
	EW3	3.532	1.255	0.907			
	EW4	3.339	1.326	0.913			
Awareness of Consequence (AC)	AC1	2.935	1.514	0.919	0.958	0.968	0.857
	AC2	2.952	1.429	0.939			
	AC3	3.090	1.399	0.921			
	AC4	3.048	1.434	0.932			
	AC5	3.085	1.438	0.918			
Personal Norm (PN)	PN1	3.419	1.314	0.909	0.941	0.955	0.809
	PN2	3.514	1.283	0.890			
	PN3	3.597	1.248	0.912			
	PN4	3.691	1.232	0.870			
	PN5	3.514	1.322	0.916			
Social Norm (SN)	SN1	3.228	1.398	0.903	0.929	0.947	0.781
	SN2	3.419	1.298	0.806			
	SN3	3.493	1.283	0.909			
	SN4	3.323	1.348	0.894			
	SN5	3.424	1.275	0.902			
Acceptance of NPP Establishment (A)	A1	3.385	1.317	0.890	0.947	0.958	0.791
	A2	3.313	1.335	0.877			
	A3	3.327	1.307	0.876			
	A4	3.509	1.263	0.898			
	A5	3.516	1.209	0.887			
	A6	3.477	1.317	0.907			

**Table 4**  
Heterotrait-Monotrait (HTMT) ratio.

	AC	AV	A	BV	EV	EW	PN	SN
AC								
AV	0.815							
A	0.824	0.843						
BV	0.809	0.755	0.795					
EV	0.683	0.817	0.775	0.831				
EW	0.865	0.776	0.715	0.775	0.808			
PN	0.834	0.757	0.794	0.828	0.818	0.846		
SN	0.835	0.826	0.822	0.797	0.845	0.802	0.835	

study. The presented fit measures indicate that all parameter estimates have met or exceeded the threshold requirement for all measures, following recommendations from different studies.

**Table 5**  
Fornell-Lacker criterion result.

	AC	AV	A	BV	EV	EW	PN	SN
AC	0.926							
AV	0.818	0.908						
A	0.785	0.871	0.889					
BV	0.853	0.892	0.844	0.918				
EV	0.649	0.856	0.826	0.718	0.915			
EW	0.818	0.902	0.857	0.901	0.845	0.907		
PN	0.795	0.896	0.829	0.873	0.861	0.885	0.899	
SN	0.837	0.862	0.866	0.839	0.788	0.840	0.876	0.884

### 5. Discussion

The research employed the VBN theory to gauge Filipinos' perception of the sustainability of reopening the BNPP. Research, such as the study by Del Carmen Aguilar-Luzón et al. [60], has shown that the VBN theory outperforms other models in predicting environmental behaviors. This indicates its effectiveness in capturing the complexities of human behavior related to environmental concerns. Moreover, the VBN theory offers a holistic approach by considering values, beliefs, and norms as interconnected factors influencing behavior. By focusing solely on the VBN theory, researchers can analyze the intricate relationships between these variables and how they drive pro-environmental actions. This allows for a more in-depth understanding of the mechanisms through which values shape beliefs, influence norms, and ultimately guide behavior towards sustainability [31].

The survey consisted of 37 questions and was conducted online. The research investigated the acceptance of BNPP reopening by examining various latent variables, including biospheric values (BV), altruistic values (AV), egoistic values (EV), ecological worldview (EW), awareness of consequences (AC), personal norm (PN), social norm (SN), and acceptance of NPP establishment (A). SEM unveiled direct relationships among these variables, explored on having all hypotheses being significant. The results providing insights into the factors influencing the BNPP's acceptance by Filipinos are summarized in Table 7. The study further explored the roles of the latent variables in shaping environmental attitudes and ethical standards, offering a comprehensive understanding of the complex dynamics influencing public opinion on nuclear power in the Philippines.

The results from Table 7 indicated that the highest relationship among the latent variables is between ecological worldview and awareness of consequence ( $\beta = 0.818$ ,  $p < 0.001$ ; H4). By recognizing the potential for positive environmental impact through the reopening

**Table 6**  
Model fit result.

SEM Model Fit	Estimates for Parameters	Minimum Cutoff	Recommended by
SRMR	0.037	<0.08	Hu and Bentler [57]
Chi-Square	2.171	<5.00	Connolly et al. [58]
NFI	0.896	>0.80	Baumgartner and Homburg [59]

**Table 7**  
Respondents' hypothesis test output.

Hypothesis	Relationship	Beta	p-Value	Decision
1	BV → EW	0.482	0.002	Accept
2	AV → EW	0.281	<0.001	Accept
3	EV → EW	0.229	<0.001	Accept
4	EW → AC	0.818	<0.001	Accept
5	AC → PN	0.204	<0.001	Accept
6	PN → AC	0.557	<0.001	Accept
7	SN → PN	0.706	<0.001	Accept
8	SN → AC	0.378	<0.001	Accept

of the Bataan nuclear power plant (EW1), acknowledging its ability to influence the natural environment (EW2), anticipating advanced comprehension and management of natural processes (EW3), and asserting that the reopening of the BNPP will decrease the so-called "ecological crisis" faced by humanity (EW4), individuals are more inclined to be more conscious of the environmental consequences of their actions. This finding aligns with prior research by Ong et al. [2], emphasizing the positive influence of ecological values on environmental attitudes and behaviors. It could be posited that those who possess a strong EW tend to be more cognizant of the implications of their environmentally conscious actions, resulting in a greater sense of accountability and pro-environmental conduct. Additionally, a recent study conducted by Belmonte et al. [23] on Generation Z's attitudes toward nuclear energy as a renewable energy source in the Philippines demonstrated the constructive impact of personal beliefs and values in shaping opinions on the matter.

Similarly, in a study by Niloy et al. [61] on the acceptance of eco-friendly products, both the extended theory of planned behavior and protection motivation theory have a positive impact on gaining valuable insights into how individuals make decisions regarding environmentally significant matters. Aligning with the demographic characteristics, the respondents' educational attainment is a significant factor. The educational background provides individuals with the knowledge and awareness needed to understand the consequences of their actions on environmental issues, aligning with the observed relationship between EW and AC. Individuals with higher educational attainment (90% of the respondents of this study) may possess a more informed perspective, contributing to their acceptance or rejection of NPP establishment.

The second highest relationship was between social and personal norms ( $\beta = 0.706$ ,  $p < 0.001$ ; H7). Believing that people they know promote the use of nuclear energy (SN1), observing that those in their social circle are not concerned about nuclear energy-related issues (SN2), recognizing the importance people they know attribute to the use of nuclear energy (SN3), feeling that the community views the reopening of the BNPP as significantly positive (SN4), and perceiving that important individuals would encourage the use of nuclear energy as a renewable source (SN5), individuals are more likely to exhibit heightened adherence to personal norms. This positive effect aligns with Bai and Bai's [62] study on sustainable tourism, indicating that personal norms positively relate to behavioral intentions. The congruence between social and personal norms suggests that individuals, influenced by societal expectations, internalize these expectations as personal moral obligations, shaping their decision-making processes. Moreover, Zillich and Riesmeyer [63] highlighted that personal and social norms can be congruent or conflicting, independently influencing individuals' behavior. The positive effect implies that social and personal norms are complementary rather than conflicting, reinforcing the impact of normative influences on individuals' acceptance of NPP establishment.

Kim and Seock [44] proposed that personal norms are internalized beliefs that are regarded as moral obligations and impact how decisions are made. This notion is supported by the Norm Activation Model. This suggests that individuals, guided by their internalized moral obligations, are more likely to conform to societal expectations, reinforcing the positive relationship observed in the study. De Groot et al. [64] also emphasized that personal norms, representing feelings of moral obligations to do "the right thing," significantly influence behavior. This suggests that individuals who perceive stronger social norms also feel a heightened sense of moral obligation to accept or support the establishment of NPP. Considering demographic characteristics with higher education attainment obtained among individuals, they may have a more nuanced understanding of societal expectations and a stronger sense of personal moral obligations. This has contributed to the observed positive relationship between social and personal norms. Understanding and internalizing societal values could be crucial in shaping individuals' attitudes and behaviors related to NPP establishment, which the government may capitalized on.

The third highest relationship is between personal norm and awareness of consequence ( $\beta = 0.557$ ,  $p < 0.001$ ; H6). Feeling a moral obligation to use nuclear energy when it becomes available (PN1), having an obligation to responsibly utilize nuclear energy (PN2) responsibly, deeming it important to have the power plant reopen to reduce the use of fossil fuels (PN3), recognizing the significance of nuclear energy for people like oneself (PN4), and believing that one's well-being would improve by using nuclear energy (PN5) all reflect strong personal norms. The positive effect found in the study is in line with Ghazali et al. [31] on pro-environmental behaviors and the VBN theory. This theory posits that personal norms, as part of the NAM, are empirically validated variables influencing individuals' decision-making processes and behavior. This suggests that those with strong personal norms are more attuned to the repercussions of their behavior, especially when considering the acceptance of the NPP establishment. Kim and Seock [44] further support this idea by stating that personal norms are grounded in internalized values and entail a sense of moral obligation that guides decision-making. Therefore, individuals with well-defined personal norms may feel compelled to assess the consequences of accepting or rejecting the NPP establishment as a moral imperative. This leads to a positive correlation between personal norms and heightened awareness of consequences. Additionally, Larsen [65] demonstrates that personal norms positively relate to behavioral intentions, indicating their significant role in guiding individual behavior. This implies that individuals with strong personal norms are more likely to have positive behavioral intentions regarding the acceptance of NPP establishment, driven by their internalized moral obligations.

The fourth significant relationship is between biospheric values and ecological worldview ( $\beta = 0.482$ ,  $p = 0.002$ ; H1). The belief that the reopening of the BNPP will help prevent pollution (BV1), contribute to the protection of the environment (BV2), have favorable effects on the surrounding environment (BV3), and coexist with other species (BV4) is indicative of biospheric values. The study found a positive effect that is consistent with the study by Wu and Zhu [34] on green consumer behaviors. According to their study, love for nature produces positive outcomes in high-cost and low-cost green consumer behaviors. This effect was mediated by personal norms, ecological worldview, and biospheric values, highlighting the interconnectedness of these constructs. Additionally, Martín and Czellar [66] has shown that biospheric values are linked to individuals' or organizations' fundamental and robust values for nature, self-nature connections, awareness, consciousness, concerns, and love of nature. This alignment emphasizes the depth and significance of the relationship between biospheric values and ecological worldview. Furthermore, Sarrasin et al. [67], on the VBN model, emphasized that emotional affiliation with nature is essential for fostering pro-environmental behaviors. The positive relationship between biospheric values and ecological worldview can be attributed to individuals' emotional connection toward nature, which shapes their ecological worldview. Aligning with demographic characteristics, the respondents' age is a relevant factor. Different age groups may exhibit varying levels of affinity and connection with nature, influencing the strength of the relationship between biospheric values and ecological worldview. Younger individuals (54.61% of this study) prioritize environmental values differently than older individuals (45.39% of this study), potentially impacting their ecological worldview [68].

The fifth significant relationship is observed between social norm and awareness of consequence ( $\beta = 0.378$ ,  $p = < 0.001$ ; H8). Several factors contribute to the positive effect of nuclear energy. These include people promoting the use of nuclear energy (SN1), a lack of concern among people regarding nuclear energy issues (SN2), belief in the importance of using nuclear energy (SN3), the community's positive perception of the reopening of the BNPP (SN4), and the influence of essential individuals supporting the use of nuclear energy (SN5). This finding aligns with Larsen [65] on the relative importance of social norms in sustainable tourism, indicating that social norms significantly influence individuals' sustainable behavioral intentions. Additionally,



research by Bell and Cox [69] has emphasized that social norms are often cited as explanations for pro-social family and relationship behaviors, highlighting their pervasive influence on individual and collective actions. Additionally, Ghazali et al. [31] conducted a study on pro-environmental behaviors and the VBN theory, revealing that individuals influenced by social norms are more likely to conform to the opinions or advice of significant others, including family members and close friends. This, in turn, can impact their decision-making processes and behaviors. Furthermore, respondents' location can also be a significant factor, as different regions may exhibit varying social norms and cultural values, which can affect the level of influence that social norms have on awareness of consequences [48].

The sixth significant relationship is between altruistic values and ecological worldview ( $\beta = 0.281$ ,  $p < 0.001$ ; H2). Promoting fairness and equality (AV1), contributing to a peaceful environment (AV2), contributing to the well-being of others (AV3), and considering the reopening of the BNPP as beneficial (AV4) are indicative of altruistic values. This positive effect aligns with Hong et al. [70] on the environmental VBN model, indicating that altruistic values are significantly linked to the New Ecological Paradigm. Furthermore, a recent study by Xu et al. [71] reveals a positive association between altruistic behaviors, including acts of kindness and charitable donations, and environmentally friendly actions at the individual, organizational, and policy levels. This indicates that individuals who prioritize altruistic values are more inclined to embrace an ecological perspective, guiding their inclination to participate in prosocial and environmentally conscious activities. Moreover, Wu and Zhu [34] discovered that an individual's ecological worldview is shaped by their profoundly ingrained and stable values, which include egoistic, altruistic, and biospheric values. The positive relationship between altruistic values and ecological worldview can be attributed to the foundational nature of altruistic values in shaping individuals' broader environmental perspectives. Aligning with demographic characteristics, the respondents' occupation emerges as a relevant factor. Different occupations may be associated with varying levels of exposure to and engagement with environmental issues, influenced the strength of the relationship between altruistic values and ecological worldview [72].

The seventh significant relationship is between egoistic values and ecological worldview ( $\beta = 0.229$ ,  $p < 0.001$ ; H3). Believing that overseeing or managing individuals for the effective operation of the BNPP (EV1), perceiving that the reopening contributes to economic prosperity and wealth creation (EV2), and acknowledging the potential for significant influence and improvement in the lives of others (EV3) are contributors to this positive effect. This aligns with Hong et al. [70] on the environmental VBN model, indicating that egoistic values are significantly linked to the New Ecological Paradigm. Moreover, research by Ribeiro et al. [73] has shown that egoistic values are positively associated with environmental concern and attitudes toward green behaviors, implying that individuals with egoistic values may be more inclined to develop an ecological worldview. Furthermore, a study by Schultz et al. [74] on the connection between values and environmental issues found that worldviews and environmental concerns strongly correlated with egoistic values, emphasizing the impact of egoistic values on shaping individuals' perspectives on environmental matters. Aligning with demographic characteristics, respondents' monthly salary or allowance emerges as a relevant factor. Different income levels may influence the strength of the relationship between egoistic values and ecological worldviews, as economic factors can shape individual values and priorities related to environmental concerns [68].

The last significant relationship is observed between awareness of consequence and personal norm ( $\beta = 0.204$ ,  $p < 0.001$ ; H5). Factors like the belief that the reopening of the BNPP will have no environmental consequences (AC1), the conviction that it will not cause environmental deterioration (AC2), the perception that it will not lead to pollution, climate change, and depletion of natural resources (AC3), the assurance that it will not disrupt the natural habitat of local species

(AC4), and the confidence that it will not cause concerns, disruptions, and challenges to the locals (AC5) contributed to the positive effect. The study found a positive effect consistent with Kim and Seock's [44] research on the NAM. Personal norms refer to the ethical principles that reflect one's internalized ideals and guide their decision-making process. This suggests that individuals with a heightened awareness of the consequences of their actions, particularly regarding the acceptance of the BNPP, are more likely to feel morally obliged to engage in decision-making processes aligned with their internalized values. Furthermore, Larsen [65] indicated that personal norms positively relate to behavioral intentions, highlighting their crucial role in guiding individual behavior. People who have a greater understanding of the impacts of building a nuclear power plant may be more likely to act according to their own moral standards. Furthermore, Zillich and Riesmeyer [63] emphasized the significance of personal norms. According to the study, when people are made aware of the consequences of establishing an NPP, they may adopt personal norms that align with those outcomes. When individuals comprehend the potential results of a nuclear power plant's construction, they may develop internalized guidelines that reflect those consequences.

Overall, the study thoroughly comprehends the factors that affect public acceptance of establishing the BNPP. A strong correlation exists between an individual's ecological worldview and their awareness of consequences, indicating that ecological values positively impact environmental attitudes. Social and personal norms exhibited a substantial connection, highlighting the complementary nature of societal expectations and personal moral obligations in shaping decision-making processes. The study also underscored the significant relationship between personal norms and awareness of consequences, emphasizing the role of internalized values in influencing individual behavior. Furthermore, biospheric values and ecological worldviews are interconnected, showcasing the depth of emotional affiliation with nature in shaping environmental perspectives. The positive associations between altruistic and egoistic values with ecological worldviews highlight their foundational nature in influencing broader environmental attitudes. Finally, increased awareness of consequences positively correlates with personal norms, suggesting that heightened awareness can lead to an internalized sense of moral obligation. These factors collectively contributed to shaping public perceptions and acceptance of NPP establishment, providing valuable insights for policymakers and stakeholders in the energy sector.

### 5.1. Study implications

Applying the VBN theory offers a comprehensive understanding of the factors influencing public acceptance of the BNPP reopening. The VBN theory explains the causal link between values and the acceptance of energy policies [70]. Integrating the VBN theory into the framework contributes to the existing literature on the social dimensions of energy policy acceptance, providing insights into the complex values, beliefs, and norms that shape public attitudes toward nuclear energy. Additionally, using SEM allows testing and validating theoretical hypotheses concerning complex relationships between variables [27].

The application of the VBN theory, integrated with SEM, provides a robust framework for understanding the factors influencing public receptivity to the reopening of BNPP in the Philippines. This offers valuable insights for policymakers and government agencies involved in energy policy and nuclear plant rehabilitation and contributes to the broader discourse on the social dimensions of energy policy acceptance. For instance, policymakers could consider tailoring communication strategies to align with the identified values and beliefs of the public, ensuring messages resonate with their perspectives on nuclear energy. Additionally, conducting targeted public forums or information sessions could facilitate a more informed public discussion on the benefits and risks of reopening the BNPP.

Additionally, the study's findings can inform the development of

targeted communication strategies and public engagement initiatives to address the identified barriers and promote informed decision-making regarding the potential inclusion of nuclear power in the country's energy mix. Suggestions such as, public engagement initiatives involving town hall meetings, online webinars, or interactive platforms where experts can address concerns, provide accurate information, and engage with the public could be done. Developing user-friendly informational materials, such as brochures or websites tailored to the identified values and beliefs, could enhance public understanding, and facilitate well-informed decision-making.

Furthermore, the study's insights into the complex interplay of values, beliefs, and norms in shaping public attitudes towards nuclear energy can guide the design of educational programs and advocacy efforts focused on enhancing public understanding and fostering constructive dialogue around the reopening of the BNPP. For example, educational programs could be designed to highlight the environmental benefits, safety measures, and technological advancements associated with nuclear power. Collaborative initiatives involving community leaders, educators, and environmental advocates could facilitate open discussions, address misconceptions, and promote a more nuanced understanding of nuclear energy among the public.

### 5.2. Limitation and future works

Despite the positive outcomes of this study, it is crucial to acknowledge certain limitations. Firstly, the geographical distribution of respondents may have influenced the generalizability of the findings. With a significant proportion of respondents from NCR, Region IV-A, and Region VI and a more miniature representation from Region III, the study may not fully capture perspectives from areas near the power plant, potentially limiting the applicability of the results to those specific regions. Future studies should strive for a more comprehensive and diverse representation across various geographical locations to address this. Secondly, the reliance on online questionnaires introduced a potential bias toward younger generations (18–35 years old). As most respondents are from younger age groups, mainly active on social media, the study's findings may need to fully encapsulate the perspectives of older generations who might not be as actively engaged online. Future research should employ diverse data collection methods to ensure a more inclusive representation of different age cohorts. In addition, knowledge check and assessment on nuclear power plant was not covered and considered in the current study. As perception was the only basis for assessment, future researchers may look into those who are knowledgeable with the topic at hand and assess their sustainable behavior and acceptance. Since this study opted to be a benchmark on the values, beliefs, and norms behavioral analysis on sustainable behavior in the Philippines, the focus was separated into proving the sustainable behavior and the acceptance of renewable energy from BNPP. Therefore, even extension or integration with the model could be considered by future researchers since the establishment of the model was seen. Lastly, the study's exclusive use of quantitative methods may limit the depth of understanding regarding the nuanced reasons behind respondents' attitudes toward reopening the BNPP. Qualitative approaches, such as interviews or focus group discussions, could provide richer insights into individuals' underlying motivations and concerns, adding a more comprehensive layer to the study's findings.

### 5.3. Sustainable-related implications

As the need for energy continues to increase, nuclear power is increasingly seen as a viable solution. However, ensuring that the public is aware of sustainable practices is crucial. Public acceptance is crucial in promoting responsible resource production and consumption, as it influences the choice of energy sources and strategies that minimize environmental impact. This means we must balance meeting energy needs and safeguarding the natural ecosystems on which our planet

depends.

As the Philippines works towards a more sustainable future, the insights provided by this study offer a roadmap for promoting nuclear power acceptance while ensuring responsible production and consumption practices and effective waste management strategies. The research underscores the complexity of the decision-making process, involving technical considerations and profoundly embedded societal values. The emphasis on biospheric values, altruistic values, and ecological worldviews in the current study suggests that public sentiment is intricately tied to the ethical dimensions of environmental preservation. Policymakers can leverage these insights to tailor communication strategies that resonate with the public's values, fostering a collective understanding of the need for sustainable energy sources.

Moreover, the study's focus on personal and social norms as influential factors in shaping public attitudes emphasized the importance of community engagement and collaborative decision-making. Initiatives promoting responsible energy consumption and waste management can be more effective when grounded in the shared values of the community. This aligns with the broader global movement towards sustainable development, emphasizing the role of communities in driving positive change.

## 6. Conclusion

Using the VBN theory, this research delved into the factors influencing individuals' acceptance of the BNPP reestablishment. A self-administered online survey via Google Forms garnered responses from 434 participants, employing a convenience sampling method. Structural Equation Modeling (SEM) with SMART-PLS v3.0 was utilized to concurrently examine and test indicators for biospheric values, altruistic values, egoistic values, ecological worldview, awareness of consequences, personal norms, social norms, and acceptance of NPP establishment.

The findings revealed significant influences of all variables on people's perceptions of accepting the BNPP establishment. The model allocates 88.7% of the variation in ecological worldview, 66.9% in awareness of consequences, 78.0% in personal norms, and 82.3% in acceptance of NPP establishment. These outcomes hold paramount importance for the growth and sustainability of the BNPP and potentially other NPPs in the Philippines. Furthermore, the model developed in this study presents a valuable tool for academicians, governments, and the private sector, even globally and offers a robust framework to scrutinize the reopening of decommissioned nuclear power plants. This framework can potentially enhance public perception and support the formulation of sustainable strategies for nuclear energy development.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.net.2024.03.023>.

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