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Youth perspectives on induction stoves: advancing sustainable energy transitions in Indonesian cities

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Cooking significantly contributes to global energy demand and carbon dioxide emissions. In Indonesia, the largest consumer of liquefied petroleum gas (LPG), much of this demand, is met through imports. Transitioning to more sustainable energy sources, such as induction stoves and solar cookers, has become a priority. However, the shift to induction stoves poses challenges due to concerns about electricity availability and the cost of new installations. Engaging Indonesia's young generation is critical to ensuring the success of this transition. This study explores user behavior and adoption of induction stoves in Indonesia from the perspective of the younger generation. It employs a methodological framework combining elements of the value-based adoption model and the unified theory of acceptance and use of technology, focusing on Performance Expectancy, Perceived Alternative Value, and Conversion Cost in relation to Conversion Intention. Surveys were conducted with 192 individuals aged 12–42 years who currently use LPG as a cooking fuel. Data were analyzed using partial least squares structural equation modeling, incorporating reflective, formative, and structural measurement models. The findings revealed that performance expectancy significantly influences conversion intention, and perceived alternative value has a direct impact on conversion intention and mediates the relationship between performance expectancy and conversion intention, while conversion cost does not have a significant effect. These results highlight a strong inclination among younger individuals toward sustainability and their readiness to adopt new technologies despite potential financial challenges. The insights gained from this study can inform policymakers in designing targeted programs that align with the values and preferences of the younger demographic, facilitating a smoother transition to sustainable cooking energy solutions.

KEYWORDS

cooking, energy transition, youth perspective, induction stove, Indonesia

1 Introduction

Cooking represents a substantial energy demand globally, contributing significantly to CO2 emissions (Adria and Bethge, 2013). South and Southeast Asia predominantly rely on liquefied petroleum gas (LPG) for cooking, with Indonesia being the largest consumer, showing a persistent increase in demand, 13.72 million tons in the next 7 years (Asian Development Bank, 2020). However, a significant portion of Indonesia's LPG consumption is met through imports, posing economic challenges exacerbated by geopolitical conflicts (Reuters Staff, 2021; Wicaksana et al., 2022). Amidst these challenges, Indonesia aims to transition toward greener energy sources to reduce reliance on fossil fuels and meet

international commitments (Ministry of Energy and Mineral Resources, 2023). This transition involves exploring alternatives such as solar cookers, dimethyl ether (DME) production from coal gasification, and induction stoves. While solar cookers and DME production show potential, induction stoves emerge as a cost-effective and environmentally favorable option compared to LPG stoves (IRENA, 2017). However, the adoption of induction stoves hinges on user acceptance and aligning policies with environmental and economic goals as Indonesian citizen dominated by low middle-income people.

Indonesia's commitment to reducing carbon emissions aligns with its objectives outlined in the Sustainable Development Goals (SDGs), Paris Agreement, and Nationally Determined Contributions (NDC). Transitioning toward net-zero emissions, particularly in daily activities such as cooking, is imperative to meet these targets. To facilitate this transition, the government has set forth dual objectives: diminishing the budget allocated for LPG imports and fostering the adoption of greener energy sources (Asian Development Bank, 2020). User intention mainly from the young generation as the target of the policy in 2030, the study of shifting toward induction stoves emerges as a pivotal factor in realizing this agenda, analogous to the significance attributed to the geothermal project, as renewable electricity sources. Notably, the government has earmarked substantial financial resources, 550 million USD for augmenting geothermal capacity (Thinkgeoenergy, 2023).

Existing scholarly investigations have underscored the role of performance expectancy as a determinant influencing users' choice of cooking fuels. This study endeavors to delve into the impact of performance expectancy on perceived alternative value and conversion intention. Furthermore, performance expectancy is anticipated to exert a significant influence on perceived alternative value and conversion intention concerning induction stoves. This study aims to investigate user perspectives on energy fuel choices for cooking, induction stoves, to inform government strategies in reducing LPG subsidies and promoting sustainable energy use.

User acceptance is crucial for evaluating readiness for new technologies, especially through regional surveys. Studies have investigated user preferences and needs for stove technologies in Rural Mexico and Bangladesh (Pine et al., 2011; Ruiz-Mercado et al., 2013; Troncoso et al., 2019). The acceptance relies on the health problem, fuel efficiency, and durability. In Indonesia, the shift from LPG to induction stoves is being considered for its convenience across all age groups in urban areas (Noverita et al., 2020). However, there is a lack of segmentation in research, especially for youth as future generation. This research aims to pioneer the study of user acceptance and technology adoption of induction stoves in Indonesia, focusing on youth (Millennials and Gen Z) as target demographics for upcoming policies.

This research conducts a thorough investigation of induction stove user acceptance and technology uptake among Indonesian adolescents. Section 2 offers a comprehensive materials and methods, while Section 3 discusses the research methodology that employs the UTAUT and VAM theory frameworks. Section 4 analyzes questionnaire data using SMARTPLS, including reflective, formative, and structural measures. Finally, Section 5 summarizes major findings and provides recommendations.

2 Literature review

2.1 Previous user perspective study of stove worldwide

There are prior studies about the stove adoption in every country. Table 1 presents a comprehensive overview of global research on user acceptance and stove adoption, categorized by geographic region, objective variables, target user demographics, and stove type. Studies were conducted in Asia, America, Africa, and Europe. Asia includes Indonesia, Bangladesh, Jordan, and India. America consists of Mexico, Peru, and Mayan regions. Africa includes Ghana, Ethiopia, and Tanzania, while Europe includes Norway. Regarding stove types, research has examined the transition from traditional cookers to LPG stoves (Billah et al., 2020; Troncoso et al., 2019; Martínez-Gómez et al., 2016; Rosenbaum et al., 2015; Jeuland et al., 2015; Dickinson et al., 2019). The result shows that the attitude depends on many factors, including cost, health problem, convenience, policy, and post-service stove. In addition, in some developing countries, there is research on the transition from LPG to induction stoves, focusing on user perspectives (Noverita et al., 2020; Shuhaiber and Mashal, 2019). Urban convenience, trust, enjoyment, and perceived hazard contribute in adopting new technologies or features.

2.2 Cooking fuels and young generation in Indonesia

The growth of households has increased energy demand for transportation and cooking. Traditional fuels include firewood, plants, and animal waste, while modern options include LPG, electricity, biogas, and solar power (Rishanty et al., 2022; Suharsono and Lontoh, 2022). However, clean cooking access has reduced traditional fuel usage from 60% in 2010 to less than 18% in 2021, leaving nearly 50 million Indonesians without access (Pangaribowo and Iskandar, 2023). The Asian Development Bank found that 61.85% of households use a 3 kg LPG canister for cooking, while 72.53% rely on gas. Indonesia's LPG consumption has increased since 2007 due to the kerosene-to-LPG conversion program, requiring 75% of 2020's demand to be imported (Asian Development Bank, 2020). The government subsidizes this amount, resulting in 6.4 million tons in 2020. LPG has the highest emissions from building, causing 28 MtCO2-eq (Christian and Suryadi, 2021).

Diversification of cooking energy is needed to reduce import dependency. The government aims to convert 8.3 million families to electric stoves by 2022, but this target has not been achieved. The reduction of LPG is a target, but only 0.76% of households use induction stoves, which are unattractive for both wealthier and poorer societies due to cost, infrastructure, and convenience (BPS, 2020; Hakam et al., 2022). Indonesia still uses over 50% of coal for electricity supply (Anggraini, 2022). Induction stoves in Ecuador have lower CO2 emissions than LPG, and switching to induction stoves can save energy up to $5.17 per month (Martínez-Gómez et al., 2016). Induction stoves also offer better cooking time, energy consumption, CO2 emissions, acceptable food, less vitamin A loss, and high food safety compared to LPG in food processing (Martínez-Gómez et al., 2016).

TABLE 1 Previous relevant research.

Country	Number of respondent	Methods	Software	Dependent variable	Result	Source
Bangladesh	299	Structured questionnaire	–	Health problem	Women who used LPG cooking were more likely to believe LPG helped them breathe easier	Billah et al. (2020)
Bangladesh	105	Assessment after trial	–	Purchase intention	People prefer to buy improved cookstoves (ICS) when there is evidence for lowering fuels	Rosenbaum et al. (2015)
Indonesia	194	Questionnaire	SMARTPLS	Conversion Intention	Urban convenience and PAV have a considerable impact on conversion intention, whereas cost has no effect	Noverita et al. (2020)
Indonesia	197	Questionnaire	WarpPLS	Intention to use	Attitudes toward success have a strong favorable impact on attitudes toward using an induction electric cooker	Kurniawan (2023)
Indonesia	194	Questionnaire	SMARTPLS	Conversion Intention	PAV primarily influences cooking energy conversion and partly mediates the relationship between urban convenience and COIN	Hilmiyati-Mas'adah et al. (2023)
Jordan	258	Questionnaire	SEMPLS	Attitude	Trust, awareness, enjoyment, and perceived hazards, usefulness and ease of use, all have a substantial influence on behavior toward smart homes	Shuhaiber and Mashal (2019)
India	295	Cultural consensus	UCINET 6	Fuelwood use	Fuelwood consumption is influenced as an availability, scarcity of alternatives, and lack of infrastructure	Jagadish and Dwivedi (2018)
India	91	Survey	FireFinder	Cookstoves adoption	Cookstove adoption remained unaltered following the trial study, but it was observed that cookstoves save fuel, cook faster, and emit less smoke	Hing and Gadgil (2023)
Mexico	259	Questionnaire	SPSS	Purchase intention	Importance of evaluating the success of stove programs based on long-term usage rather than just the number of stoves distributed	Jeuland et al. (2015)
Mexico	190	Survey	ATLAS.ti	Perception of LPG	Using LPG for cooking and are aware of the health risks linked to firewood usage but it is costly	Troncoso et al. (2019)
Peru	699	Survey	–	Post-service willingness	High desire for better access to post-acquisition services, which affected by kitchen performance sets	Gould et al. (2018)
Peru	48	Group discussion	Stata	LPG use	Obstacles hindering LPG adoption included expenses related to purchase, challenges in multitasking with other daily tasks during cooking, technologies not aligning with local cooking requirements, the necessity to save time, and the belief that LPG alters the taste of food	Martínez-Gómez et al. (2016)
Mayan	80	Survey	Stata	Less emission stove choice	Half of the sample indicated ongoing utilization of open-cookfires, underscoring the crucial necessity to confirm the decline in open-fire practices through stove distributions	Ruiz-Mercado et al. (2013)
Ghana	200	Survey	Stata	Stove performance user perception	Users' impressions of stove performance varied, with typical benefits of ICS including fuel savings, reduced smoke, and faster times	Dickinson et al. (2019)
Kenya	3,665	Survey	–	Stove balancing behavior	Performance and effort anticipation, hedonic incentive, price value, facilitation conditions, habit structures, and moderating factors all influence home stove balancing behavior	Osiolo (2021)

(Continued)

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TABLE 1 (Continued)

Country	Number of respondent	Methods	Software	Dependent variable	Result	Source
Ethiopia	1,800	Survey	BIOGEME, SPSS	Consumers' preference	Consumer desire for high-quality fuels and stoves rises with affluence	Takama et al. (2012)
Ghana	7,400	Survey	Stata	Primary cookers choice	Primary cooks in households with greater education, smaller size, affluence, and urban location are more likely to utilize LPG	Owusu-Amankwah et al. (2023)
Tanzania	271	Survey	PROGESA	Purchase intention	Households with multiple types of ICS, including charcoal and firewood, largely adopted it, with 80% purchasing it, increasing the total uptake to 48%	Kulindwa et al. (2018)
Norway	808	Questionnaire	–	New stove loyalty	Various factors to loyalty are economic benefits, heating performance, perceived effort, environmental effects, and subjective norms	Nyrud et al. (2008)

The next target policies for energy transition are younger generation, including Generation Z and millennials (Yamane and Kaneko, 2021). They are crucial in developing motivational, compensation, work environment, and human resource policies (Hakam et al., 2024). By 2030, they will be the predominant working force, driving sustainability efforts and contributing to the achievement of the Sustainable Development Goals (Eurobarometer, Special, 2009; Jürkenbeck et al., 2021). Young people are more concerned about climate change and environmental issues than older citizens, with a higher sensitivity (67% compared to 56%). Millennials are known for their social consciousness and strong support for the SDGs (Cheng, 2019; Klimkiewicz and Oltra, 2017).

3 Research methodology

The present study employs a methodological framework integrating elements of the value-based adoption model (VAM) and the unified theory of acceptance and use of technology (UTAUT) to investigate user perspectives. UTAUT is a research methodology based on psychology and sociology that identifies four key factors influencing technology acceptance: performance expectancy, effort expectancy, social influence, and facilitating condition (Puspitasari et al., 2019). Performance expectancy refers to an individual's belief that using a system will improve job performance (Lescevica et al., 2013). The VAM model, an alternative to the TAM, incorporates exogenous variables and enjoyment and perceived fee into the cost–benefit perspective, explaining technology usage behavior by focusing on benefits and sacrifices, aiding in understanding initial adoption intention and post-adoption behavior (Kim et al., 2007; Lin et al., 2012; Kim et al., 2017). Behavioral economics and socio-cultural factors play a crucial role in energy transition. Habit persistence, status quo bias, and loss aversion can hinder the adoption of induction stoves, as individuals tend to stick with familiar routines, resist change, and perceive the potential losses of switching—such as costs or learning curves—as outweighing the benefits, even when the new technology offers greater safety and sustainability. The integration of the value-based adoption model (VAM) and the unified theory of acceptance and use of technology (UTAUT) offers a comprehensive framework to examine induction stove adoption. UTAUT captures key external and social influences such as performance expectancy and facilitating conditions, while VAM adds depth by addressing intrinsic motivations such as perceived value and enjoyment. Their combination allows for a more holistic and predictive understanding of user behavior, balancing rational decision-making with emotional and value-based factors—critical for designing effective policies to support energy transitions. Conversion intention (COIN) covers the primary or secondary cooking device and the desire to switch from LPG to induction stove (Noverita et al., 2020). PAV includes functional, social, emotional, and conditional value (Hakam et al., 2020, 2022).

In Bangladesh, citizens prefer traditional cooking stoves over improved ones, but the taste is shifting due to performance after 3 weeks (Rosenbaum et al., 2015). PAV influences consumption decisions for induction kitchen appliances, affecting conversion intention partially on certain segments. Conversion intention in induction stoves, focusing on a person's tendency to change behavior from initial to new conditions (Noverita et al., 2020). The study found

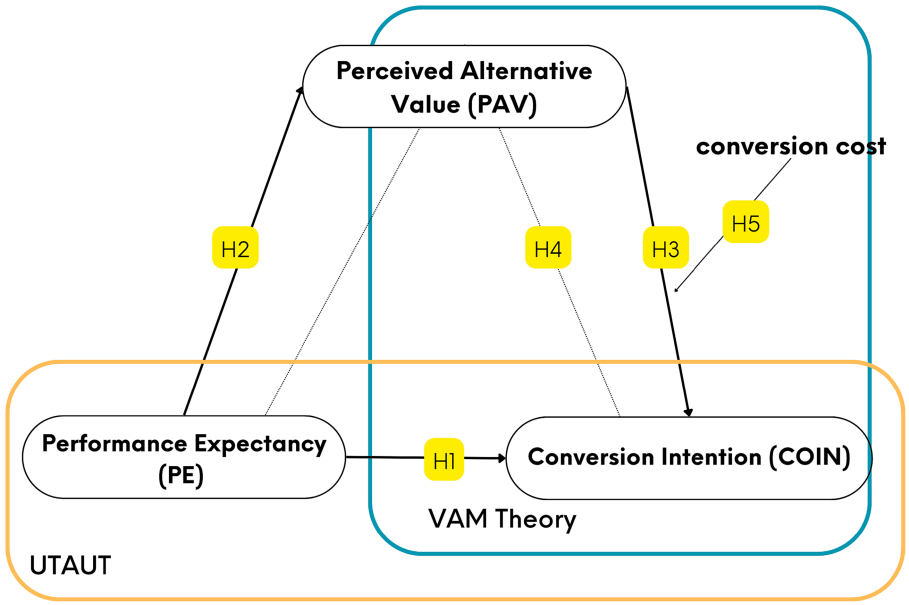

FIGURE 1
Research framework.

that usage intention is the most significant predictor of use behavior, with sample size and culture significantly influencing the relationship (Baabdullah et al., 2019; Yu et al., 2019). In addition, attitudes toward learning to use an induction electric stove positively influence adoption (Kurniawan, 2023).

This research explores the scope of conversion intention, leveraging UTAUT and VAM theory (Osiolo, 2021; Noverita et al., 2020). Key factors such as perceived alternative value (PAV) significantly influence intention and adoption rates (Shuhaiber and Mashal, 2019). Surveys examined the relationship between performance expectancy (PE), perceived alternative value (PAV), and conversion intention (COIN), with conversion cost (CC) as a mediating factor. Data were collected through questionnaires of 192 young generations (12–42 years old) who used LPG as the cooking fuels in Indonesia, asking about their expectancy in cooking plan using induction stove which is going to be government policy in 2030. The result analyzed using partial least squares structural equation modeling (PLS-SEM) via the SMARTPLS software. The analysis includes reflective measurement model assessment (outer loadings, internal consistency reliability, convergent validity (AVE), and discriminant validity using HTMT), formative measurement model assessment (convergent validity, collinearity, and the significance and relevance of the indicators), and structural measurement model assessment (t-statistic and *p*-value). The findings were interpreted considering the hypothesized relationships. The hypotheses are shown in Figure 1.

> *H1*: Performance expectancy (PE) has a significant impact on conversion intention (COIN).
>
> *H2*: Performance expectancy (PE) has a significant impact on perceived alternative value (PAV).
>
> *H3*: Perceived alternative value (PAV) has a significant impact on conversion intention (COIN).
>
> *H4*: Perceived alternative value (PAV) mediates the relationship between performance expectancy (PE) and conversion intention (COIN) to convert LPG to induction stove as cooking energy.
>
> *H5*: Conversion cost (CC) has a significant impact on conversion intention (COIN).

The survey was conducted on LPG stove users, specifically targeting Millennial and Gen Z, who make up 69.3% of the population. The survey was conducted using a Likert Scale (LS) to measure participants' agreement with statements of interest (1–5). Table 2 represents the question list of survey. The study used questionnaire data and SMART-PLS software for structural equation modeling (SEM), a widely used statistical technique. It performed well with small sample sizes and distributions, attempting to understand the connection between latent constructs reflected by different metrics.

The survey was collected by gathering the information from the questionnaire. Table 2 shows a questionnaire list items, related to the PE, PAV, CC, and COIN. PAV consists of functional, social, emotional, and conditional value. CC includes risk, set-up, and learning cost. The data were processed using the software SMART-PLS using structural equation modeling (SEM). PLS-SEM was chosen for its suitability with smaller sample sizes, such as the 192 respondents in this study, and its capacity to handle complex models with multiple constructs. Its predictive focus and flexibility with data distribution make it ideal for exploratory research on conversion intentions (Noverita et al., 2020).

4 Statistical analysis of induction user perception

Data were gathered from 192 Indonesian youth. Gender perspective revealed a balanced population, with women primarily involved in cooking activities. The number of respondents was 65.26%

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TABLE 2 Questionnaire list.

Latent variable	Indicators	Definition	Items
Performance expectancy (PE)	Independent variable	Beliefs employing technology will increase stove performance	I would use the time during which a conditionally induction stove for cooking
			I expect that a conditionally induction stove would be useful in my cooking needs
			Using a conditionally induction stove would help me cooking more safely
			Using a conditionally induction stove would help me cooking more comfortably
			I assume that a conditionally induction stove would be useful in my daily life
Conversion intention (COIN)	Dependent variable	Desire to stove transition	I tend to consider induction as my primary source of cooking energy
			I'm considering increasing my induction consumption for cooking energy
			I'm considering reducing my LPG utilization as a cooking fuel source
			I am eager to switch to induction stove
			The likelihood of me converting to an induction stove is strong
Perceived alternative value (PAV)	Intervening variable	Influence factors to COIN	Foods made with an induction stove will have constant quality
			The induction stove is durable
			The usage of an induction stove would save my cooking costs
			Using the induction stove would improve how I am seen
			Using an induction stove will make a positive impression on others
			Using an induction stove instead of an LPG burner seems like the morally just thing to do
			Using induction stove instead of LPG stove will make me feel like a better person
			If there was a subsidy for electricity, I would use an induction stove rather than an LPG stove
			I would use induction instead of an LPG stove if electricity was always available
Conversion cost (CC)	Moderating variable	initial costs and non-monetary expenses associated with stove transitioning	I'm worried that induction will not work as well as intended
			Switching to induction as cooking energy incurs monetary costs
			Learning to use the features given by induction stoves, as well as operating my LPG-fueled kitchen equipment, would take some time
			When switching to induction for cooking energy, there are several official steps for kitchen installation
			Switching to an induction stove takes time

TABLE 3 Reflective measurement analysis.

Variable	Item	Outer loading	Cronbach alpha	rho_A	rho_C	AVE
Performance expectancy	EPI 1	0.851	0.899	0.899	0.925	0.712
	EPI 2	0.842				
	EPI 3	0.809				
	EPI 4	0.846				
	EPI 5	0.868				
Conversion intention	COINI 1	0.841	0.921	0.926	0.941	0.76
	COINI 2	0.906				
	COINI 3	0.797				
	COINI 4	0.906				
	COINI 5	0.905				

belong to Generation Z, with over half having bachelor's degrees. Most users reported income levels meeting or exceeding the minimum regional wage ($244.1–367) and engage in cooking activities 2–5 times a week. In addition, 84% of respondents demonstrated familiarity with induction stoves.

Statistical SMART-PLS analysis use to evaluate reflectively measured constructs encompassed several crucial dimensions: (1) assessment of outer loadings, (2) internal consistency reliability, (3) convergent validity (AVE), and (4) discriminant validity (using HTMT). Table 3 indicates that the variables met the satisfactory standard of 0.708, in alignment with the criteria set forth (Sarstedt et al., 2022). Particularly noteworthy are the robust outer loadings observed for items COIN 2 and COIN 4, each registering at 0.906, thereby surpassing the prescribed threshold. This adherence to the outer loading criterion bolsters the validity of the data (Cheah et al., 2023). Moreover, the internal consistency reliability, as assessed through Cronbach's alpha coefficients, yielded values of 0.899 and 0.921 for the constructs PE and COIN, respectively. These coefficients fall within the recommended range of 0.70–0.95, affirming the reliability of the measurement instruments. The correlation-based reliability measures, namely, ρA and ρC, also corroborate the high reliability of the constructs within this range. These reliability indicators significantly contribute to the determination of AVE, encompassing both positive and negative aspects of the variables. Convergent validity is defined as AVE with the minimum amount of 0.5 which is categorized as valid (Ringle et al., 2012). Notably, all variables surpassed this threshold, with AVE values ranging from 0.712 to 0.76, thereby affirming the convergent validity of the measurement model. Furthermore, HTMT using Fornell-Larcker results in 0.874 which is less than the threshold of 0.9. HTMT indicates the average indicator correlation across the numerator smaller than the average indicator within the denominator (Benitez et al., 2020; Guenther et al., 2023).

The inclusion of formative assessment in the research is imperative due to its status as a higher-order construct aimed at ameliorating the pervasive inadequacies in reporting standards delineated within the scholarly literature, while concurrently ensuring the establishment of robust measurement frameworks (Becker et al., 2012; Ringle et al., 2012). Differing from reflective indicators that manifest latent variables, formatively measured indicators yield latent variables. Given the distinct nature of these indicators, there exists no interchangeability concern, thereby obviating the need for reliability testing, internal consistency assessments, or scrutiny of discriminant validity. The formative measurement calculates (1) convergent validity, (2) collinearity, and (3) the significance and relevance of the indicators. Convergent validity serves as a gage of internal consistency, aimed at verifying that the items purported to measure each latent variable indeed do so, without inadvertently capturing another latent variable.

TABLE 4 Redundancy analysis.

	Path coefficients (β)	T statistics	*P*-value
PAVI → Overall PAVI	0.822	32.577	0.000
CCI → Overall CCI	0.682	16.713	0.000

Table 4 represents the validation of overall PAV and CC. The items include the assessment of individual item reliability, Cronbach's alpha coefficient, composite reliability (CR), and average variance extracted (AVE). The result shows that path coefficient of PAV (PAV → Overall PAV) is 0.682 and the CCI (CCI → overall CCI) is 0.822. The path coefficients linking latent variables are required to meet specific criteria: They should be no less than 0.1, exhibit the appropriate algebraic sign (in this investigation, positive), and achieve statistical significance, typically at a level of at least 0.05. The number indicates VIF in the range of 2.051–2.880 in PAV and 1.472–2.300 in CC. The standard of VIF is valid below 10 and meeting the standard of SMART-PLS application. A collinearity problem may be present if the VIF is five or above (Hair et al., 2021).

Table 5 depicts the collinearity, significance, and relevance testing of PAV and CC. Indicator weight represents relative contribution to construct, while absolute contribution is represented by indicator loading (Shela et al., 2023). The analysis was conducted using bootstrapping for 10,000 times tested in two-tailed at 5% significant test. The contribution to construct of PAV and CC is mostly significant, except CCI 2 (t = 1.463), CCI 3 (t = 1.581), CCI 4 (t = 0.524), and CCI 5 (t = 1.555). The indicators that are insignificant passed the test from the weight to loading; thus, the items are retained to analyze. The result of t-statistic shows significant above 1.960 as the minimum of acceptance, meaning the items should be accepted (Chiwaridzo, 2024;

TABLE 5 Collinearity, significance, and relevance testing of PAV and CC.

Construct	Item	Variance inflation factor (VIF)	t-statistic	*p*-value (weight)	Loading	t-statistic	*p*-value (loading)
Perceived alternative value (PAV)	PAVI 1	2.161	14.118	0.000	0.776	26.953	0.000
	PAVI 2	2.266	15.979	0.000	0.769	26.770	0.000
	PAVI 3	2.051	15.197	0.000	0.767	21.811	0.000
	PAVI 4	2.418	11.727	0.000	0.741	19.054	0.000
	PAVI 5	2.880	12.477	0.000	0.779	23.553	0.000
	PAVI 6	2.085	12.462	0.000	0.753	20.027	0.000
	PAVI 7	2.571	13.431	0.000	0.790	27.117	0.000
	PAVI 8	2.182	11.618	0.000	0.730	19.334	0.000
	PAVI 9	2.205	13.225	0.000	0.737	19.773	0.000
Conversion cost	CCI 1	1.527	1.991	0.047	0.162	4.858	0.000
	CCI 2	1.472	1.463	0.144	0.168	4.365	0.000
	CCI 3	1.549	1.581	0.114	0.18	4.007	0.000
	CCI 4	2.300	0.524	0.601	0.219	3.414	0.001
	CCI 5	2.033	1.555	0.120	0.203	3.693	0.000

TABLE 6 Collinearity testing structural model.

Path	Inner VIF
Performance Expectancy (PE) → Conversion Intention (COIN)	2.227
Perceived Alternative Value (PAV) → Conversion Intention (COIN)	2.175
Conversion Cost (CC) → Conversion Intention (COIN)	1.030

Yudatama et al., 2019). All the number of indicators both in PAV and CC makes a relative and absolute contribution to their construct.

Structural measurement for SMART-PLS consists of collinearity testing, significance and relevance testing, and explanatory power testing using R2 and f2. Collinearity testing among indicators constitutes a latent variable using the variance inflation factor (VIF). Elevated levels of multicollinearity can lead to non-significant estimates and unexpected signs of coefficients. Traditionally, VIF values surpassing 5 are indicative of problematic multicollinearity (Benitez et al., 2020). When the VIF value is 5 or above, it indicates a potential issue with collinearity problem (Hair et al., 2021). Table 6 presents data extracted from the questionnaire pertaining to the performance expectancy (PE), perceived alternative value (PAV), and conversion cost paths, revealing VIF values of 2.227, 2.175, and 1.030, respectively. The values meet standard criteria, indicating no collinearity issues along the paths. Subsequent analysis can proceed to assess t-statistics and *p*-values to determine whether hypotheses can be rejected or accepted.

Table 7 shows structural model which estimates the designed path through path coefficient, t-statistic, and *p*-value. After the bootstrapping ran for 10,000 times at the 5% confident level, the path coefficients show the number in the range of −1 to +1. Stronger relationships are indicated by values closer to +1 or −1, while weaker or negligible relationships are indicated by values closer to 0. The highest path coefficient is the relationship between PE and PAV resulting in 0.737, while the weakest with the number closer to zero ($p = 0.050$) is CC that moderates PAV to COIN. The number affecting the t-statistic, as mentioned before the standard significance is 1.960 (Chiwaridzo, 2024; Yudatama et al., 2019). Aligned with theory, t-statistic is achieved from the first hypothesis to fourth hypothesis with the range of 5.907–23.886 (p-value = 0.000). It is convinced that the PE and PAV significantly influence young generations to switch from LPG to induction stove. CC moderates PAV insignificantly affecting the COIN with the t-statistic under 1.960 (p-value = 0.160), resulting in the rejection of the hypothesis. It means that the conversion cost does not affect the intention people to switch from the LPG to induction stove.

The data validity is assessed through explanatory power testing, including regression and effect size analyses. Table 8 defines the explanatory power testing of PAV and COIN. A high R2 value indicates overly conformity to the data. PAV significantly contributes to the data, accounting for 53.20% of variance without and 53.00% with moderating effects. Conversion intention moderately conforms to the data, with R2 = 68.40. Effect size values (f2) are crucial for comparing path coefficients and establishing consistency in ranking orders. In the specified path model, moderation has a 17.20% effect size. Effect sizes as minor (2–15%), moderate (15–35%), and high (>35%) determine the strength and importance of correlations between latent components and facilitate comparisons across models or studies (Sarstedt et al., 2020).

The inferential analysis, conducted through structural equation modeling (SEM), reveals that performance expectancy and perceived alternative value have statistically significant positive effects on conversion intention, with standardized path coefficients of 0.52 and 0.41, respectively ($p < 0.05$). These results indicate that users' expectations of improved safety, efficiency, and overall utility from induction stoves which substantially drive their willingness to convert. Meanwhile, the effect of conversion cost is statistically insignificant ($p > 0.05$), suggesting that for younger generations, financial or setup barriers are less influential compared to perceived benefits. This highlights a clear behavioral trend where values related to

TABLE 7 Structural model estimates.

Path	Path coefficient	t-statistic	Result
Performance Expectancy (PE) → Conversion Intention (COIN)	0.499	7.589	H1 accepted
Performance Expectancy (PE) → Perceived Alternative Value (PAV)	0.737	23.886	H2 accepted
Perceived Alternative Value (PAV) → Conversion Intention (COIN)	0.401	6.111	H3 accepted
Performance Expectancy (PE) → Perceived Alternative Value (PAV) → Conversion Intention (COIN)	0.296	5.907	H4 accepted
Conversion Cost (CC) × Perceived Alternative Value (PAV) → Conversion Intention	0.050	1.445	H5 rejected

TABLE 8 Explanatory power testing.

Construct	R2 excluding moderating effect	R2 including moderating effect	Effect size (f2)
Perceived alternative value (PAV)	72.30%	71.80%	
Conversion intention (COIN)	53.90%	53.70%	27.10%

sustainability and performance outweigh cost concerns in technology adoption decisions.

5 Indonesian induction stove perception insight and policy recommendation

This study focuses on a quantitative analysis of the relationship between predictor variables—performance expectancy, perceived alternative value, and conversion cost—and conversion intention, as viewed through the perspectives of Generation Z and millennials. The research is grounded in the unified theory of acceptance and use of technology (UTAUT) and the value-based adoption model (VAM), offering both explanatory insights and predictive outcomes that enhance understanding of user behavior and technology adoption.

The intention to switch from LPG to induction stoves is significantly influenced by users' performance expectancy (PE). Evidence from the results indicates that the majority of respondents believe induction stoves should be practical for daily cooking. They expect induction stoves to offer safety and convenience comparable to, or exceeding, that of LPG stoves. Similar to previous research confirming the significant contributions of users, teachers perceive the use of mobile Internet in teaching as both useful and valuable (Nikolopoulou et al., 2021). Another study demonstrated that colleagues believe positive user experiences, high satisfaction levels, and enjoyment could enhance their connection with information technologies and likely motivate them to continue using these technologies in the future (Camilleri, 2024). However, public concerns persist regarding the safety and convenience of induction stoves, despite the distribution of 2,000 units in two cities in Indonesia (Nurbaiti, 2022).

The role of PAV is important in significantly affecting the conversion intention, both direct and indirectly. PAV which consists of functional, social, emotional, and conditional value elements influences the young generations to convert their stove from LPG to induction stove. Previous research in Indonesia has demonstrated that time-oriented convenience significantly influences the perceived consumption value of induction stoves (Hilmiyati-Mas'adah et al., 2023). Consequently, perception plays a crucial role in enhancing the intention to convert from LPG-fueled stoves to electric-powered cooking energy. The functional aspect plays a significant role in decision-making, with many people believing that electric stoves cannot deliver the best cooking results due to the minimum energy required. The optimal heat that an electric stove should have is 1,800 watts for the efficiency (Hakam et al., 2022), but most households in Indonesia can only support 900 watts or R1-900 (Directorate General of Electricity, 2022). This factor can be a deliberation of government switching fuel planning based on the energy ladder. Access to electricity must play a wide range of critical direct and indirect roles in achieving the United Nations Millennium Development Goals (UN MDGs); moreover, in developing countries, poverty and human development become critical aspects in the lack of electricity (Shyu, 2014).

Social and emotional values elevate the public's perception of using this type of stove. From previous research mentioned, improved cooked stove strongly influences consumers' choice (Gill-Wiehl et al., 2021; Nyrud et al., 2008). Younger generation's view is using induction stoves as a means of supporting clean, green energy, reflecting their awareness of sustainability (Ogiemwonyi, 2022; Oinonen and Paloniemi, 2023). The argument supported by fact that induction stove, microwaves, and electric stove has lowest level of CO2 emissions (zero emission) (Hilmiyati-Mas'adah et al., 2024; Hakam et al., 2022). Meanwhile, conditional values highlight the importance of subsidies and availability. Since these factors depend on government regulation, policies should support the transition from LPG to induction stoves to make this shift a reality. In a similar case in Ecuador, government pushed to use clean energy (both LPG and induction stove), influenced by availability, convenience, and subsidy (Gould et al., 2018; Valarezo et al., 2023). Indonesia's roadmap for developing renewable energy, such as geothermal energy, should also be considered regarding availability and subsidies, which are managed by the state-owned enterprise PLN. Mirroring from energy switch kerosene to LPG in 2007, PAV plays a critical factor for the program key success (Hilmiyati-Mas'adah et al., 2024).

Typically, cost is an important factor in decision-making; however, surveys indicate that young generations do not consider switching costs significantly when transitioning to new technologies. Gen Z and Millennials demonstrate quick adaptation to new technology, including electric stoves, showing minimal concern for economic risk costs, moreover when they are satisfied with the tools (Pichler et al., 2021; Quintal et al., 2016). In terms of learning costs, these generations quickly adapt to new technology, facilitating their transition to

induction stoves (Pichler et al., 2021). Furthermore, setup costs do not significantly impact their intention to shift from LPG to induction stoves. These generations are willing to incur additional expenses if the technology provides environmental benefits (Ogiemwonyi, 2022; Oinonen and Paloniemi, 2023). The findings are aligned with previous research, which PE and PAV (both direct and indirect) affecting COIN. However, CC is not a significant variable in COIN important factors.

The 2023 policy aims to shift cooking fuels from LPG to alternatives to reduce oil imports, meet domestic demand using natural resources, and achieve net-zero emissions by 2060. Performance expectancy, perceived alternative value, and conversion cost are key factors influencing youth's conversion intention toward induction stoves. A study of 192 users revealed that 84% were aware of induction stoves. Performance expectancy, which includes aspects such as safety and convenience, significantly affects the youth's intention to switch from LPG to induction stoves. Perceived alternative value (PAV) positively affects the intention to switch from LPG to induction stoves, indirectly contributing to the purchasing intention of induction stoves from LPG. Conversion cost (CC) does not significantly affect the conversion to induction stoves as many young generations prioritize sustainability and are willing to pay higher costs if it benefits the environment. Induction stoves fulfill safety and convenience needs, offering a morally correct choice in people's perspectives. Although conversion cost was not found to significantly influence adoption intention, this may be due to the presence or expectation of subsidies that lower financial barriers. Mandatory policies can also create social momentum and a FOMO effect, encouraging broader adoption regardless of cost. These behavioral dynamics can enhance perceived alternative value (PAV), especially when supported by incentives and awareness campaigns. Thus, policy can play a key role in accelerating adoption and shaping long-term behavioral trends. The acceptance of shifting from LPG to induction stoves remains consistent, with the higher t-statistic indicating that the younger generation finds the functional, social, emotional, and conditional value elements of induction stoves to meet their standards.

The transition from LPG stoves to renewable energy sources, such as induction stoves, is a gradual process aimed at reducing import expenses, achieving net-zero emissions by 2060, and enhancing user safety and convenience. Performance expectancy significantly influences conversion intentions, with users needing assurance about safety, fulfilling their needs, and convenience. Induction stoves pose a challenge as many people still worry about safety and electrocution. Perceived alternative value, including social, economic, and conditional factors, significantly impacts conversion intentions. Young people derive pride from using induction stoves due to their lower emissions compared to LPG stove, aligning with environmental friendliness. However, the availability of electricity presents a challenge as not all households can afford sufficient electricity. Conversion cost is a significant factor, but the initial cost of installing induction tools should be considered. Induction stoves' low carbon emissions and potential savings make them an attractive option for young generations.

In conclusion, this study highlights that performance expectancy and perceived alternative value significantly influence the intention of Gen Z and Millennials in Indonesia to switch from LPG to induction stoves, while conversion cost is less impactful. These findings suggest that young consumers are more driven by functionality, environmental concerns, and perceived benefits than by economic constraints. Based on this, policy efforts should focus on increasing public awareness, improving access to electricity, and offering support through subsidies or incentives to ease the transition. However, the study is limited by its urban sampling and cross-sectional design, which may not fully represent broader population behavior. Future research should consider rural contexts, longitudinal data, and additional influencing factors such as social norms, trust in policy, and perceived risks to enrich the understanding of clean cooking technology.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

DH: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. NN: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Visualization, Writing – original draft, Writing – review & editing. AA: Supervision, Validation, Visualization, Writing – review & editing. AU: Funding acquisition, Supervision, Validation, Visualization, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

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