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Keywords: expectation-confirmation, continuance usage, Natural Gas

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The adoption of natural gas increased notably last years, and there is some recognition that it improves the quality of life of inhabitants. While initial acceptance is an essential first step, the continued use is relevant to the long-term success of any technology. However, the literature on energy has focused on adoption and has devoted less attention to models that explain continuance usage. Accordingly, this study developed a model to explain continuance usage, grounded in Expectation-Confirmation Model (ECM). Unlike adoption models, confirmation of previous expectations and satisfaction with the experience of use have a relevant role in this phenomenon. Data was gathered through a questionnaire to 435 users of the service in a Latin American metropolis, and structural equations model was used for analysis. The results show that constructs of the ECM (perceived usefulness, disconfirmation, and satisfaction) influences on continuance intention. While the price impacts as expected, it is surprising that environmental consciousness strongly impacts the intention. These results may be useful for public agents to foster more comprehensive policies (beyond traditional: price and access), which include environmental and safety issues to consolidate the use of this energy source. Energy companies should develop strategies to manage consumer expectations and loyalty programs based on a high level of satisfaction.

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Article

Understanding Continuance Usage of Natural Gas: A Theoretical Model and Empirical Evaluation

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Abstract: The adoption of natural gas increased notably last years, and there is some recognition that it improves the quality of life of inhabitants. While initial acceptance is an essential first step, the continued use is relevant to the long-term success of any technology. However, the literature on energy has focused on adoption and has devoted less attention to models that explain continuance usage. Accordingly, this study developed a model to explain continuance usage, grounded in Expectation-Confirmation Model (ECM). Unlike adoption models, confirmation of previous expectations and satisfaction with the experience of use have a relevant role in this phenomenon. Data was gathered through a questionnaire to 435 users of the service in a Latin American metropolis, and structural equations model was used for analysis. The results show that constructs of the ECM (perceived usefulness, disconfirmation, and satisfaction) influences on continuance intention. While the price impacts as expected, it is surprising that environmental consciousness strongly impacts the intention. These results may be useful for public agents to foster more comprehensive policies (beyond traditional: price and access), which include environmental and safety issues to consolidate the use of this energy source. Energy companies should develop strategies to manage consumer expectations and loyalty programs based on a high level of satisfaction.

Keywords: natural gas; continuance usage; expectation-confirmation

1. Introduction

One finding, which the ten Working Groups of the United Nations Millennium Project identified in common, is the urgent need to improve access to energy services as a fundamental contribution to achieving the Millennium Development Goals (MDGs). The MDGs are goals that are quantified and subject to time limits, established by the international community to respond to the issue of extreme poverty in its many facets. Some authors believe that without greater investment in the energy sector, it will not be possible to achieve the MDGs in poorer countries [1].

Natural gas could be a good alternative to contribute to this goal. Firstly, by fuel, natural gas accounted for the largest increment in energy consumption, followed by renewables and then oil [2]. Secondly, natural gas has been recognized as a comparatively low carbon and an environmentally friendly energy option to mitigate emissions [3,4]. Although fostering the consumption of this resource is relevant, the scant of research on phases of consumption suggest the need for a greater understanding of this phenomena.

The last decade has seen substantial growth in research on adopting different energy technologies. Some examples of this are works on renewable energies [5,6], photovoltaic systems [7–9], solar water heaters [10], and solar energy [11]. These studies, based on the Diffusion of Innovations Theory [12], the Technological Acceptance Model—TAM [13] and the Theory of Planned Behavior—TPB [14], have examined variables that motivate individuals to accept a new energy technology and the way in which they do so. While initial acceptance of a technology is an important first step towards the success of a technology, its long-term viability and eventual success depend on continued use rather than first-time use [15].

However, the phenomenon of adoption of technology is temporally and conceptually different from the phenomenon of continuance of use. Temporally, while in adoption, the individual makes a decision before experiencing the technology; in continuance the individual has experienced the technology and on that basis decided whether or not to continue using it [16]. Conceptually, while in adoption, perceptions are based on expectations of use; in continuance, these perceptions are also based on concrete experience of the technology. These phenomena can be so different that an individual who initially accepts a technology may subsequently discontinue its use [15]. Recently, in the energy arena, Jürisoo, Lambe [17] suggest shifting of the field's focus beyond better understanding of what motivates people to adopt technologies, to what makes households continue using them over time.

In short, to our knowledge, there is no study that explains continuance of use in the field of energy, and specifically, in natural gas. Thus, the objective of the study is to develop and empirically assess a model that shows the determining factors in the continuance of use of natural gas from the perspective of households.

The theoretical proposal is based on the expectation-confirmation model from the field of information technology, ECM-IT [15,18]. The notion of continuance of use is not limited to the field of energy, but rather is found in many fields. Models have been developed in the area of information technology that explain why individuals maintain their use of a technology after the initial decision to adopt it e.g., [16,19]. These models have been subject to extensive empirical evaluation and have been applied to various technologies [20,21].

Similarities in the notion of continuance of use, the degree of progress of the models in the field of information and communication technologies (ICTs), and a broad concept of technology (that can cover both ICTs and energy technologies) lead us to base our proposal on the theory developed in the ICT field.

The use of theory developed in the ICT field is not new in the energy arena. A number of studies [5,22–25] have been based on well-known models in the ICT arena like TAM or The Unified Theory of Acceptance and Use of Technology -UTAUT- [26]. Our proposal follows a similar line.

The article sets out a twofold contribution. On the one hand, it draws together literature from different streams—both within and outside the energy arena—and extends the nucleus to propose a model of continuance of use in the context of the consumption of natural gas in households. On the other hand, the factors that have been shown to be significant for continuance of use in households are made known to management in the gas service business and to public policy makers. This will provide them with more criteria to outline business and public policy strategies. It is worth noting that governments and companies can invest large sums of money in implementing new energy technologies, but these investments will only generate improvements in the quality of life of citizens or provide a return on investment to the extent that the technologies continue to be used.

Although our study has been developed in a single country, we estimate that our model can be applied in a broader domain. Our theoretical grounds (expectation-confirmation theory) and scales of measurement are applicable to multiple countries and eventually to other types of energy technologies.

The article is structured in six sections. The first one presents the theoretical development, which is made up of the background (ECM-IT) and the proposed research model. The latter is compounded by the adaptation of the ECM-IT to the energy context and the extension of the ECM-IT model, including new variables such as price and environmental consciousness. The third section explains the method. The results of the study are then shown. The article ends with discussion and conclusions.

2. Theoretical Development

2.1. Expectation-Confirmation Model in the ICT Field (ECM-IT)

Continuance refers to long-term or sustained use of a technology by an individual over a period of time [16]. An intention indicates the subjective probability that an individual will carry out a given behavior [27]. Thus, the intention of continued use can be understood as the probability that an individual will continue to use a given technology.

A series of cognitive and affective processes are deployed when we are faced with the decision of whether or not to continue using a product or service. In that line, the base ECM-IT proposed by Bhattacherjee [15] and the extension suggested by Hong, Thong [18] illustrate the mechanism that underlies a user's behavior when they decide to continue using a given technology.

According to this model (Figure 1), the intention to continue using a technology is linked to the satisfaction of using said technology and to the perception of how useful the adopted technology is. Both variables are influenced in turn by the validation or confirmation that the user makes between the expectations of the use of the technology and the experience once it is used. The perception of usefulness, for its part, influences a user's satisfaction level.

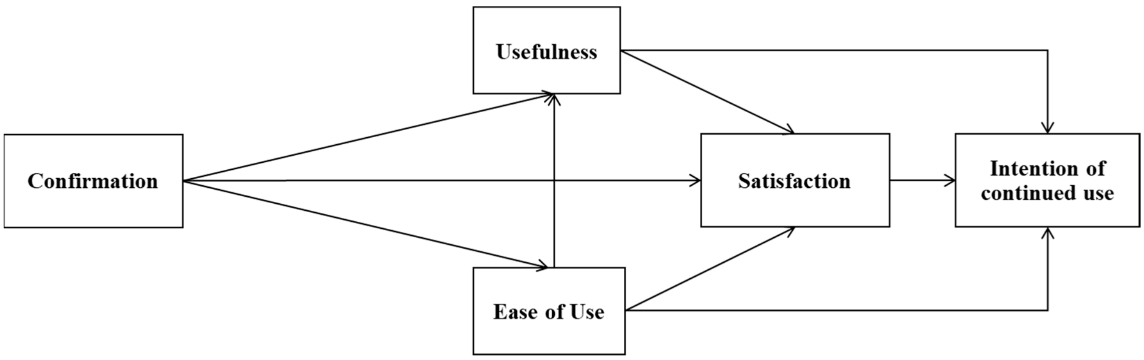

Figure 1. ECM-IT Model—[15,18].

Subsequently, Thong, Hong [28] incorporated ease of use to the model proposed by Bhattacherjee [15]. For these authors, technology, depending on its nature, is in constant evolution, which leads to users being exposed to a constant learning process, adapting continually to the use of technology. The perception of ease of use is then seen as the user's appraisal having experienced the process of adapting to and learning a given technology. This perception then influences the user's level of satisfaction and thus, the intention to continue using the technology. The perceived usefulness of a technology is apparently also influenced by the perceived ease of use. That is, if the user perceives that the technology they are using is easy to use, they will also perceive that the technology is useful. As users make use of the technology, they perceive the ease of use and the usefulness of it, thus confirming their expectations through experience. This affects their level of satisfaction, as is stated in ECM-IT.

The ECM-IT model has been applied in multiple technological contexts and geographical areas. Hossain and Quaddus [20], in a review of the progressive application of ECT-IT in the ICT context, find that empirical research on the model has been validated to a greater extent at an individual level, specifically to explain the intention of continuing to use an IT. Table 1 sets out the studies that have used the ECM-IT model as the nucleus of their proposal with different technologies.

Table 1. Empirical studies that evaluate the ECM-IT model.

N°	Link	Authors	Technology
1	Satisfaction → Intention	Hong, Thong [18] Lee [29] Lee and Kwon [30]	Mobile Internet E-learning Online shopping service
2	Usefulness → Intention	Lin, Wu [31] Hong, Thong [18] Oghuma, Libaque-Saenz [32]	Website Mobile Internet Mobile instant messaging
3	Ease of use → Intention	Hong, Thong [18] Thong, Hong [28] Choi, Kim [33]	Mobile Internet Mobile Internet Mobile data service
4	Usefulness → Satisfaction	Kim [34] Lee and Kwon [30] Halilovic and Cicic [35]	Mobile data service Online shopping service Business software
5	Ease of use → Satisfaction	Roca, Chiu [36] Liao, Chen [37] Sørebø and Eikebrokk [38]	E-learning Online services Cash Transaction system
6	Ease of use → Usefulness	Thong, Hong [28] Sørebø and Eikebrokk [38] Lee [29]	Mobile Internet Cash Transaction system E-learning
7	Confirmation → Satisfaction	Liao, Chen [37] Hung, Chang [39] Zhou [40]	Online services E-learning Mobile services
8	Confirmation → Usefulness	Hong, Thong [18] Zhou [40] Hung, Chang [39]	Mobile Internet Mobile services E-learning
9	Confirmation → Ease of use	Thong, Hong [28] Sørebø and Eikebrokk [38] Chong [41]	Internet mobile Cash Transaction system M-commerce

2.2. Research Model

Although the theoretical proposal is based on the ECM-IT model, there are two modifications necessary for its use in the field of energy. Firstly, the definitions and relationships of the constructs of the ECM-IT model must be adapted to the context of energy technologies. For example, a relevant variable in ECM-IT is perceived usefulness, which in the context of information technology is defined as the degree to which the individual assesses that the use of the technology improves his or her performance (efficiency and/or effectiveness of the individual) [42]. However, this definition is not appropriate in the energy context, given that a user of gas is not seeking to improve performance in the home. Secondly, it is possible that factors other than those contemplated in ECM-IT may be relevant in the context of energy technologies. A number of authors suggest that, for example, safety or price may influence individuals in deciding to use energy technology. Figure 2 presents as solid lines the hypotheses derived from ECM and as dotted lines the hypotheses that the energy literature suggests.

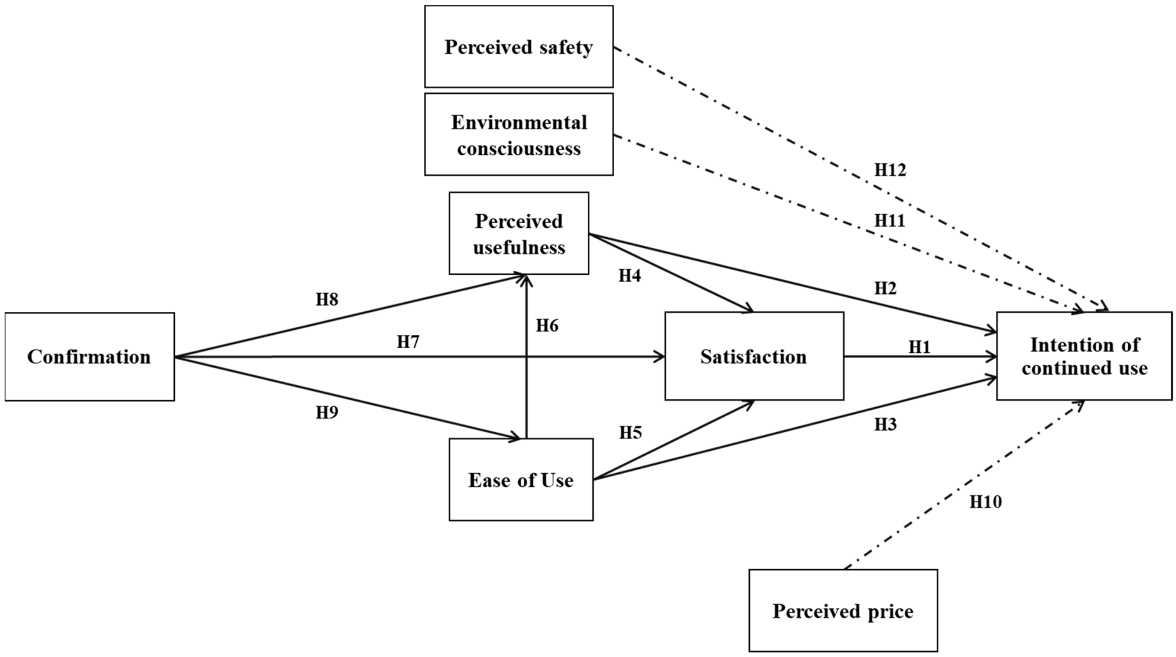

Figure 2. Research model (ECM-Gas).

2.2.1. ECM-IT in the Context of Energy Technologies

Satisfaction is a net affective response (positive, negative or indifferent) that results from the benefits that a person hopes to receive from interaction with the technology [43]. Satisfaction is derived from prior technology usage experiences, and can therefore be viewed as an experiential response to technology usage [16].

Conceptually, the expectation-confirmation literature suggests that consumers/users who have positive feelings relating to the purchase/use experience will be more willing to repurchase a product or continue to use a technology; the opposite will lead to cessation in use [15]. Empirically, a number of studies in the ICT field support this link (see Table 1). In the energy literature, the study by Nyrud, Roos [44] on loyalty in the use of residential biomass heating finds support for this relationship. This is the basis for the following hypothesis:

Hypothesis H1. *Satisfaction has a positive impact on continuance intention.*

For ECM-IT, usefulness is defined as the degree to which the individual assesses that the technology has improved his performance. An increase in performance implies greater efficiency or effectiveness of the individual [42].

This definition, conceived in the organizational context, needs to be adapted to the context of energy technology in households. Usefulness was originally seen as an extrinsic motivator through which an individual perceives that following a given behavior (e.g., adopting or using a technology) will be advantageous to them (e.g., they will be more efficient) [45]. In the context of energy, the literature suggests that usefulness can be seen as the degree to which the individual assesses that the use of an energy technology can improve aspects of his or her daily life, such as saving time, quality of life, ease of carrying out tasks, and so on [22,46,47].

Following the line of ECM-IT, individuals form intentions of certain behaviors (e.g., continuance of use) that they consider will lead them to obtain some benefit (e.g., saving time), beyond positive or negative feelings (e.g., satisfaction) that the behavior may give rise to. This occurs due to the fact that individuals tend to seek rewards or benefits independently of the moment or stage when the behavior is carried out (e.g., adoption or continuance of use) [15]. Empirically, a number of studies in the ICT field support this relationship (see Table 1). In the energy literature, the studies by Kardooni, Yusoff [22], Chen, Xu [48] and Alam, Hashim [5] on adoption of renewable energy find indirect support for this link. This leads to the following hypothesis:

Hypothesis H2. *Perceived usefulness has a positive impact on continuance intention.*

Ease of use of the technology is to be understood as the degree to which the technology is perceived as relatively simple to understand and use [5,28]. Theoretically, a technology that is perceived to be user-friendly and family-friendly will facilitate technology usage more than a technology with low ease of use [5,28]. Several empirical studies have found support for this link in the context of ICT (see Table 1). In addition, Park, Kim [23] in relation to smart grid, Alam, Hashim [5] and Kardooni, Yusoff [22] in adoption of renewable energy found indirect support for this relationship. This is the basis for the following hypothesis:

Hypothesis H3. *Ease of use has a positive effect on the continuance intention.*

As mentioned above, satisfaction is the net feeling that results from benefits that a person expects to receive. Each user has a set of expected benefits for the technology. The user is more or less satisfied if the technology meets or fails to meet each of these expectations. At a minimum, technology is expected to be useful. Beyond that, the more useful the tool, the more likely the user is to be satisfied with it [43]. Empirically, a set of studies in the ICT field found support for this relationship (see Table 1). In energy literature, the study by Nyrud, Roos [44] about residential biomass heating found indirect support for a similar relationship between perceived heating benefits and satisfaction from use. This is the basis for the following hypothesis:

Hypothesis H4. *Perceived usefulness has a positive effect on satisfaction.*

Previous empirical evidence has shown that perceived ease of use is one of the major cognitive beliefs in determining users' affect (attitude) towards technology adoption. Given that user satisfaction is a type of affect, perceived ease of use is expected to have a positive influence on a user's level of satisfaction [28]. Studies with different ICT contexts support this link (see Table 1). In the energy field, the study by Toft, Schuitema [24] about adoption of smart grid technology found indirect support for this relationship. On these grounds, we may establish:

Hypothesis H5. *Ease of use has a positive effect on satisfaction.*

Conceptually, and following the line of reasoning of Davis, Bagozzi [13], a technology that is easy to use can increase the perception of usefulness, given that the time and effort saved due to improved ease of use may be redeployed, enabling a person to accomplish more activities for the same effort or to carry out other activities. The empirical evidence supports this relationship in the ICT context (see Table 1). In addition, Park, Kim [23], in the context of adoption of smart grid found indirect support of this relationship. For that reason, we may establish:

Hypothesis H6. *Ease of use has a positive effect on perceived usefulness.*

Confirmation is to be understood as the degree to which the performance of the technology exceeds previous expectations on usefulness or ease of use. The individual evaluates the perceived performance of the technology based on his/her previous expectations and settles the extent to which his/her expectations are confirmed. If the technology performs better than expected, a positive confirmation is expected to occur. Conversely, if the user's appraisal of the technology falls below the expectation, a negative confirmation occurs [20].

Following ECM-IT, satisfaction arises when people compare their previous expectations with technology performance during actual usage. Confirmation is related to satisfaction because positive confirmation implies realization of the expected benefits of technology use, while disconfirmation denotes failure to achieve such benefits [15,16]. This relationship has been widely supported in the technology context (see Table 1). For example, Zhou [40] found that confirmation of mobile service expectations has a positive impact on satisfaction. Likewise, Hung, Chang [39] found that satisfaction with and web-based learning systems is influenced by the confirmation of expectations. Therefore:

Hypothesis H7. *Confirmation has a positive effect on satisfaction.*

An individual's expectations (e.g., about usefulness or ease of use) may be modified over time as the user learns about the technology from his/her first-hand experience. Although low initial expectation is easily confirmed, such expectations may be adjusted higher as a result of the confirmation experience, when users realize that their initial expectations were unrealistically low. Conversely, if their initial expectation is negatively confirmed, they may tone down their future expectations [15,16]. Hence, the perceived usefulness or perceived ease of use of a technology are influenced by the confirmation of expectations. Empirically, these relationships have been studied in the technology context (see Table 1). For example, Hong, Thong [18] found that confirmation impacts significantly the perceived usefulness of mobile internet. Furthermore, Chong [41] found that confirmation of expectations about m-commerce influences its perceived ease of use. Consequently, we postulate that:

Hypothesis H8. *Confirmation has a positive effect on perceived usefulness.*

Hypothesis H9. *Confirmation has a positive effect on ease of use.*

2.2.2. Extension of the ECM-IT Model in the Context of Energy Technologies

As will be argued later, ECM-IT needs to be extended to reflect the specific context of energy technologies by incorporating three constructs: perceived price, environmental consciousness and perceived safety.

Both the literature on ICTs e.g., [49,50] and on energy e.g., [5,51,52] suggest the importance of perception of price on understanding intention of use.

The price level used in most research is not an objective term; rather, it is subjective in that it refers to the perceived level of value paid for a service.

The relationship between price and behavioral intention is supported from several perspectives. For example, the psychological perspective finds that the presence of restrictions (e.g., price) may potentially inhibit behavioral intention [53,54]. Similarly, from the marketing perspective, price is an important factor in consumer decisions and thus in intent of consumption [55,56]. From the technological perspective, Liao and Cheung [49] found that price has a significant impact on developing the initial desire in internet purchases. Similarly, Venkatesh and Brown [57] found that price is relevant in adopting a PC for the home. We therefore propose the following:

Hypothesis H10. *The perception of price level has a negative impact on continuance intention of natural gas.*

Over the last three decades, consumers have had a growing concern about caring for the environment [58]. In the energy literature, a number of authors e.g., [59–63] suggests its relevance in the context of energy technologies.

Psychology mentions that this environmental concern occurs in the context of the individual's environmental consciousness. This factor is defined as the tendency to become involved in pro-environmental behaviors that are based on beliefs, values and attitudes [64–66]. Thus, an individual with a high level of environmental consciousness will be intrinsically motivated to behave in ways that benefit the environment [67]. From the perspective of marketing, the level of environmental consciousness appears to condition the way individuals consume or purchase certain products and services. If they have a high level of environmental consciousness, their consumption will be such that they do not damage the environment. If, on the other hand, they have a low level of environmental consciousness, consumers will be less influenced by environmental issues [67].

In the context of energy, Peters, van der Werff [52] have found empirical correlation between environmental motivation and sustainable use. In addition, "green marketing" holds that certain levels of environmental consciousness influence the adoption of behaviors relating to consumption of environmentally friendly products ("green buying actions") p.e., [64,68].

In the context of natural gas, which is perceived to be a cleaner technology than more traditional supply (e.g., liquefied petroleum gas—LPG—wood or coal), it may be expected that higher levels of environmental consciousness would lead to an intention to continue using this technology. Based on the above, we propose the following hypothesis:

Hypothesis H11. *Environmental consciousness has a positive impact on continuance intention.*

Access to modern energy systems (e.g., natural gas) influences human wellbeing through reduction in health and safety risks associated with the use of traditional energy (e.g., LPG. coal or wood) [69–72].

A related concept, perceived security, has been widely studied in the marketing literature in subjects relating to the use of technologies for online transactions p.e., [73–75]. In this context, security is defined as the degree to which the individual believes that the technological platform to be used is secure for carrying out an activity or transaction, and for protecting the consumer's sensitive information [73,75]. For the purposes of our research, the perception of safety will be defined as the degree to which the individual considers that gas systems are safe in relation to their use.

The marketing and ICT literature has linked perception of security with intention of use or adopting a service e.g., [74,75]. Conceptually, when an individual concludes that a service or technology platform is secure, in protecting personal information, preventing risks of fraud or theft, or any other negative consequence in general, there will be a greater likelihood that they will use the service or technology.

Although we have not found evidence to support the link between these variables in the energy systems literature, broad empirical support has been found from the technological context p.e., [76–78]. Salisbury, Pearson [75] find that the perception of security is an important variable in internet purchases. Kim, Tao [79], for their part, find that the intention of use of electronic payment media benefits more from the beliefs held about the security of the system. We therefore propose the following hypothesis:

Hypothesis H12. *Perceived safety positively affects continuance intention.*

3. Materials and Methods

To test the hypotheses, we conducted a field study, using a questionnaire as the data collection instrument and the structural equations model for the analysis.

To establish the model's degree of generalization, we considered the next domain in which this study will be conducted. The respondent should live permanently in a household that has used natural gas at least for six months. The respondent should be the ones who make frequent use of this type of energy. The respondent could be both male or female, of any age over 18 years and of any education level.

The questionnaire is mainly based on previously-used scales, which are adapted to the study context in accordance with the abovementioned domain. The scales of continued usage intention, confirmation, perceived usefulness and satisfaction were based on previous studies by Bhattacherjee [15] and Hong, Thong [18]. The perceived ease of use was measured by adapting the scale used in Bravo, Santana [80]. The measurement of environmental consciousness was based on a scale developed by Alsmadi [68]. Likewise, the scale developed by Cho [81] was used to measure perceived safety. Finally, the perceived price level was based on a scale developed by Brown and Venkatesh [46].

Given that we worked with a Spanish-speaking population, we used the back-translation technique [82] to ensure a reliable translation. Several studies have used the same technique e.g., [83].

To minimize biases, among other safeguards, the questionnaire emphasized confidentiality, stated that there are no right or wrong answers, requested honest answers, and separated dependent and independent variables.

The final design of the questionnaire asks participants to state: (1) The activities for which they use natural gas; (2) their degree of agreement or disagreement with aspects of the natural gas usage; and (3) demographic data. We used seven-point Likert scales, ranging from '1', totally disagree, to '7', totally agree.

The scales were subject to preliminary tests to assure their validity. In a pre-test, we interviewed a group of individuals to detect potential comprehension problems. Then, a pilot test was conducted, under the same conditions and with the same type of participants as the final questionnaire. The result of each one of these activities led to minor improvements to the questionnaire. The items used in the final study are listed in Appendix A.

To obtain the degree of generalization for the previously specified domain, it was decided that the sample would be randomly selected from the database of the gas service company in two districts of a Latin America metropolis where natural gas has been implemented. The questionnaires were handed out in person and participants were told that completion was voluntary. After discarding questionnaires that were blank or incomplete, there were 435 usable questionnaires.

The most common age ranges of participants were 36–45 years old (29.4%) and 46–55 years old (23.7%). In terms of gender, 53% of respondents were men and 47% were women.

4. Results

Table 2 shows the average and standard deviation for the constructs. These were calculated by previously averaging out the responses on the items for each scale.

Table 2. Descriptive Statistics.

Construct	Mean	Standard Deviation
Continuance intention (INT)	6.75	0.53
Satisfaction (SAT)	6.38	0.73
Perceived price (PPR)	1.64	1.14
Environmental consciousness (ECO)	6.71	0.56
Perceived safety (PSE)	6.27	0.82
Perceived usefulness (PUS)	6.54	0.62
Ease of use (EOU)	6.57	0.65
Confirmation (CON)	6.30	0.93

To analyze the data, this research uses structural equations that allow modelling relationships among multiple independent and dependent constructs simultaneously, as well as analyzing relations among latent variables with multiple indicators. We used IBM's SPSS AMOS 22 software. Data was analyzed in two stages. First, we developed and assessed the measurement model and second, we assessed the structural model. Given that some variables present skewness and kurtosis that are distant from the assumption of normality [84], the analysis will use the bootstrapping technique to evaluate the robustness of the results.

4.1. Measurement Model

We ran a Confirmatory Factor Analysis (CFA). The measurement model was estimated with the maximum likelihood method and the covariance matrix. Table 3 presents the correlations, variance extracted and reliability, all calculated based on the data and AMOS estimations.

Table 3. Correlations, reliability and average variance extracted (AVE).

Construct	Correlations and Square Root of AVE (*)								Cronbach's α	AVE
	INT	SAT	PPR	ECO	PSE	PUS	EOU	CON		
INT	0.87								0.89	0.76
SAT	0.54	0.92							0.95	0.85
PPR	−0.52	−0.51	0.97						0.97	0.95
ECO	0.57	0.37	−0.28	0.86					0.92	0.75
PSE	0.39	0.57	−0.33	0.23	0.93				0.94	0.86
PUS	0.56	0.49	−0.36	0.46	0.47	0.86			0.93	0.74
EOU	0.49	0.47	−0.39	0.42	0.48	0.67	0.95		0.96	0.89
CON	0.45	0.6	−0.30	0.36	0.49	0.55	0.60	0.94	0.95	0.88

Note (*): Diagonal numbers are the square root of AVE for each construct and off-diagonal numbers are the correlations between constructs.

Reliability assessed through Cronbach-α shows acceptable values over 0.7. Convergent validity is verified since all the standardized factor loadings are significant and higher than or equal to 0.7. Discriminant validity is verified since the correlation between a pair of latent variables is less than the square root of variance extracted of the variable (see Table 4).

Table 4. Fit indicators for the measurement model.

Indicator	Recommended Values	CFA Model Values
χ^2 ratio	<3	2.354
CFI	>0.95	0.969
TLI	>0.95	0.964
RMSEA	<0.08	0.056
AGFI	>0.8	0.857

Afterwards, the measurement fit of the model was assessed, resulting in the indicators shown in Table 4. The values are acceptable and in line with the values recommended in the literature [85,86].

4.2. Structural Model

In view of the satisfactory findings reached in the CFA analysis, in the second stage we assessed the structural model. First of all, the model's fit assessment yielded an acceptable adjustment for all indicators (Table 5).

Table 5. Fit indicators for the structural model.

Indicator	Recommended Values	Structural Model Values
χ^2 ratio	<3	2.846
CFI	>0.95	0.957
TLI	>0.95	0.951
RMSEA	<0.08	0.065
AGFI	>0.8	0.836

Figure 3 shows the standardized coefficient and the significance of the links, as well as the variance explained from latent variables. The links are significant to the 0.001 level, except for the links EOU

→ SAT; EOU → INT and PSE → INT, which were not found to be significant. Furthermore, 50% of intention variance is explained. Likewise, the factors explain 41% of satisfaction variance and 50% of usefulness variance.

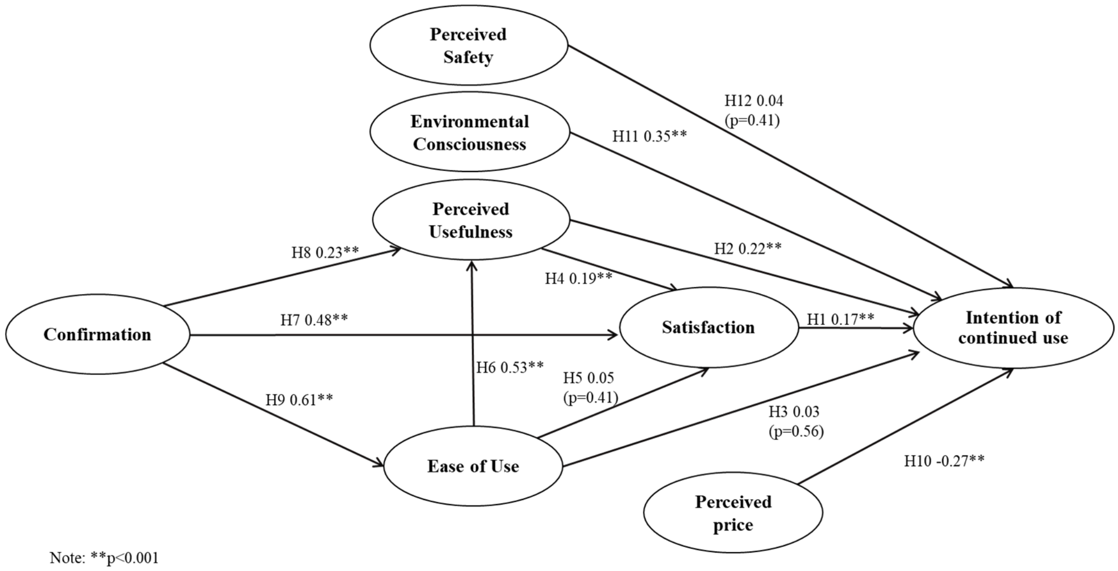

Figure 3. Results.

Considering that the variables deviate from accepted ranges for the assumption of normality, we follow the recommendation of Blunch [87], carrying out a bootstrapping analysis. The results are similar to those in the previous paragraph, with links significant to the 0.001 level, except for the link SAT → INT, which is significant at a level of 0.016. Likewise, the links EOU → SAT; EOU → INT and PSE → INT were not found to be significant.

5. Discussion

The results show that the extended expectation-confirmation model applied to the use of natural gas (ECM-Gas) explains a significant part of the continuance intention of this service in households.

On the one hand, the findings are coherent with the ECM-IT model, except for the effect of ease of use over other variables. The results suggest that if users are satisfied with the experience of the use of natural gas, then they will consider its future use positively (H1). Similarly, if users consider that it is useful compared to the alternatives, there will be a higher intention to continue using this technology (H2). However, in contrast to the ECM-IT proposal, our study does not find empirical support for the relationship between ease of use and intention, and between ease of use and satisfaction (H3 and H5, respectively). A plausible explanation for this may be that over time, users of gas gain experience with the new technology to the point that concerns over whether the technology is easy to use or not appear to have been solved, and other concerns may be more instrumental (for example, whether or not the technology is useful to them) [88]. It should be recalled that Thong, Hong [28] argued these relationships on the assumption that technologies evolve and that the individual is in a continual learning process. The results show that this assumption does not seem plausible in the context of gas.

The other links proposed in ECM-IT are also reflected in the context of gas. In that sense, the perception that the technology is useful will increase satisfaction levels among consumers of gas (H4). Similarly, if technology is seen as easy to use, the perception of usefulness will increase (H6). Finally, the cognitive evaluation of prior expectations being met appears to strengthen the assessment of usefulness, ease of use and satisfaction with the technology of gas (H7, H8 and H9).

As a whole, the hypotheses derived from ECM-IT are accepted, and this fact is coherent with studies on similar services. For example, Kim [34] finds support for these hypotheses in mobile data services. Kim, Gupta [89] report similar findings with regard to internet services.

The findings also show that the hypotheses that are specific to the context of natural gas are upheld, except for the relationship between safety and intention. In the case of price, this plays a significant part in forming intention (H10), which coincides with other contexts, such as technology and marketing. Gas technology is perceived as more environmentally friendly than the alternatives, and consumers thus attribute significance to it in forming their intention (H11). Finally, perceived safety appears not to affect intention in the context of natural gas (H12). This may be due to a phenomenon similar to ease of use. That is, with continued use, the individual learns to handle the technology and thus reduces concern about safety, which ceases to be relevant in the consumer establishing intention of continuance of use. It may also be that if the individual has been informed that the risks of use are much lower than other energy alternatives, the concerns about this new technology may from the outset be less significant in terms of decisions about adoption or continuance of use.

Our study contributes to the literature in several aspects:

- Previous literature has focused on explaining the adoption of energy technologies. However, the phenomenon of adoption is different from continued use (post-adoption). In the latter, the experience of use can be crucial. To this extent, the proposed model reflects this post-adoption behavior more faithfully, by including expectations and user satisfaction.
- Prior research that has used ECM in the field of technology or marketing has been circumscribed to a greater or lesser degree to the core constructs of the model (satisfaction, confirmation, and usefulness). However, the model must be adapted to comprehend the particularities of the natural gas context. Therefore, based on the energy literature, the core constructs (e.g., usefulness) are adapted, as well as new constructs are added (e.g., price and environmental awareness).
- Preceding studies in psychology and marketing have suggested that individuals are increasingly concerned about the environment and that this awareness can have an impact on conservation-oriented behavior. However, in the energy literature, concern for the environment has received scant attention and less yet has been linked to the continuance of use. Surprisingly, our model finds a substantial incidence of this variable on intention. This result suggests that perceived greener technologies may favor their continuous use.

The study also suggests implications for different actors in the energy context:

- Managers of natural gas companies, on carefully reading our results, could develop more effective commercial strategies to establish long-term relationships with their clients. They could invest in service quality to improve perceived usefulness and satisfaction.
- Policymakers can use other qualitative instruments, beyond the classic control price, which could facilitate extension of natural gas usage. For example, they could develop communicational and educational strategies to manage expectations, perceptions, and attitudes on natural gas. Realistic expectations could diminish post-purchase regret, avoiding dissatisfaction with natural gas usage.

6. Conclusions

This study adapts the expectation-confirmation model to explain the continuance of natural gas use. The empirical evaluation shows that the adapted model satisfactorily explains the intention of continuity.

Beyond the price, attitudes (such as intention) and beliefs (such as usefulness or environmental consciousness) explain the intention. Additionally, the confirmation of expectations is a relevant antecedent to formation of beliefs and satisfaction.

As a whole, this study is small, but the first step towards comprehension of the post-adoption stage, a relevant phase in the success of a technology, but less studied by the energy literature.

From a practical point of view, this study introduces new variables that can be employed by both policy makers and managers of gas companies to encourage the continued use of natural gas and improve inhabitants' quality of life in developing countries.

Future studies could evaluate the external validity of the model by examining its consistency with other energy technologies or in other geographical contexts.

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Appendix A

Table A1. Items and sources of scales.

Construct	Items
Satisfaction	Your overall experience of the use of natural gas: • Very Dissatisfied to Very Satisfied • Very Unhappy to Very Happy • Very Frustrated to Very Contented • Deeply Disappointed to Absolutely Delighted
Perceived usefulness	• I think natural gas is very useful for my life in general. • Using natural gas makes my life easier. • Natural gas is useful in my life.
Perceived ease of use	• It is easy to learn to use natural gas. • The way to use natural gas is clear and comprehensible. • I find it easy to use natural gas.
Confirmation	• My experience with the use of natural gas was better than I expected. • The service offered by natural gas was better than I expected. • In general, most of my expectations about the use of natural gas were confirmed.
Price level	• I think that the use of natural gas is generally expensive. • I think that the price of natural gas is a burden to me. • I think that natural gas is relatively expensive.
Environmental consciousness	• I always advise others to keep the environment clean. • It annoys me when someone contaminates the environment. • I respect every effort to maintain and preserve the environment. • I appreciate living in a healthy and clean environment.
Perceived safety	• I think natural gas is safe. • Natural gas looks safe when used (e.g., for cooking). • I feel safe when using natural gas (e.g., when cooking).
Continuance intention	• I plan to continue to use natural gas in the future. • I intend to keep on using natural gas rather than to stop using it. • My intentions are to keep on using natural gas rather than using any of the alternatives.

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