The Socio-economic Determinants of Energy Technology Awareness in Latin America and the Caribbean

Infrastructure and Energy

Martín C. De Meio Reggiani
Sabina Blanco Vecchi
Cinthya Pastor
David Lopez Soto
Enrique Chueca Montuenga
Michelle Hallack

TECHNICAL NOTE Nº 2010

September 2020

The Socio-economic Determinants of Energy Technology Awareness in Latin America and the Caribbean

Martín C. De Meio Reggiani
Sabina Blanco Vecchi
Cinthya Pastor
David Lopez Soto
Enrique Chueca Montuenga
Michelle Hallack

September 2020

Inter-American Development Bank

Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library
The socio-economic determinants of energy technology awareness in Latin America and the Caribbean / Martín C. De Meio Reggiani, Sabina Blanco Vecchi, Cinthya Pastor, David López Soto, Enrique Chueca Montuenga, Michelle Hallack.
p. cm. — (IDB Technical Note ; 2010)
Includes bibliographic references.
1. Energy development-Economic aspects-Latin America. 2. Energy development-Caribbean Area. 3. Energy development-Social aspects-Latin America. 4. Energy development-Social aspects-Caribbean Area. I. De Meio Reggiani, Martín C. II. Blanco Vecchi, Sabina. III. Pastor, Cinthya. IV. López Soto, David. V. Chueca Montuenga, Enrique. VI. Hallack, Michelle, 1983- VII. Inter-American Development Bank. Infrastructure and Energy Sector. VIII. Series.
IDB-TN-2010

JEL Codes: C21, D1, N76, R2, O14, O33, Q49, Q55
Key words: Innovation, Energy, Technology Choice, Digitalization

This document is a product of the research program developed for the preparation of the Inter-American Development Bank 2020 flagship report: Infrastructure Services in Latin America. To know all the documents from the research program, see: www.iadb.org/infrastructureservices

The Socio-economic Determinants of Energy Technology Awareness in Latin America and the Caribbean

Martín C. De Meio Reggiani[a], Sabina Blanco Vecchi, Cinthya Pastor[b], David Lopez Soto[b], Enrique Chueca Montuenga[b], Michelle Hallack[b]

[a] *Instituto de Investigaciones Económicas y Sociales del Sur, CONICET-UNS, 800 San Andrés, Bahía Blanca, Argentina.*

[b] *Inter-American Development Bank, 1300 New York Ave NW, Washington D.C., United States of America.*

Abstract

The adoption of energy technologies like solar panels, LED bulbs, hybrid and electric vehicles; and energy-related mobile apps will transform an entire energy sector and give energy consumers a more central role inside energy markets. To drive the adoption of these technologies, we must first address technology awareness and examine the determining factors. This paper assesses the awareness of the five technologies aforementioned in sixteen Latin American and Caribbean countries based on information collected at the individual level. We propose a logistic model to identify the socioeconomic factors that explain the level of awareness of energy technologies in the region. The results show that an effective public policy that aims to increase the technological awareness and promote the adoption of energy-related technologies needs to consider variables such as gender, education, income level and energy-saving behavior and the use of social media.

Content

Figures and Tables

1. Introduction: adoption of new technologies starts with awareness

The global energy system experiences a transformation characterized by the so-called 3D revolution: decentralization, digitalization and decarbonization. Technological innovations are disrupting the energy sector as we know it (IRENA, 2019). Photovoltaic solar panels and energy batteries can decentralize and modify an energy sector built on passive consumers that just buy all their energy from the network, giving them a central role inside energy markets. With the help of digital platforms and electronic devices such as mobile applications, households could decide the source of energy and the services they consume, changing current forms of energy provision. **Technology development and its adoption are the two main components to set the pace towards a sustainable energy path. Simple actions like changing an incandescent light bulb for a LED or others deserving greater investment, such as buying an electric car, will contribute to reducing greenhouse gas emissions.**

Latin America and the Caribbean may benefit from the adoption of these technological innovations. While most of the region´s countries have achieved electricity access rates above 90 percent, others like Haiti and Honduras still have significant gaps with access rates of 39 and 81 percent respectively in 2018. In terms of quality of service, Latin American and the Caribbean (LAC) countries experienced an average of 16 nonprogrammed interruptions in 2018 lasting 33 minutes. Frequent and prolonged interruptions in the supply of electricity diminish the well-being of households and affect financial stability of utilities. **By enabling countries to leapfrog and prompt the adoption of energy technologies, the region can tackle the main challenges of the energy sector in terms of access, quality, and affordability without venturing in a costly expansion of generation capacity (IDB, 2020)**. **But who is adopting? Or at least, who is aware of these technologies?**

To drive up the adoption of energy-related technologies, we must first address people´s awareness and examine the determining factors. From a consumer perspective, the decision of whether a person will adopt a technology begins when they expose themselves to it and gain an understanding of how it works (Rogers, 1995, 2003). Consumers go through a process of acquiring knowledge or awareness of the products before adopting them. Therefore, technology awareness is the first step towards adoption. The smaller the information gap that a person has, the higher the acceptance and willingness to adopt (Zografakis et al., 2010; Rogers and Shoemaker, 2001).

This paper analyzes the variables that lead the consumer awareness of 5 energy technologies in 16 Latin America and the Caribbean countries. Despite a non-linear relationship between awareness and adoption, this paper considers awareness as a relevant factor and important precondition for technological adoption.

When we started to explore the technological awareness in LAC, we faced two challenges. First, there is a lack of data concerning technology adoption at household level. Second, the literature focused on the determinants of awareness is scarce. Given the rapid evolution of technology and potential consumer interest in disruptive energy technology options there are several studies that examine the technological options to be adopted. But often, those studies assume that the consumers implicitly accept the technologies, when actually behavioral, social and economic and political factors influence their use and acquisition (Hardt et. al, 2019).

To tackle the first problem, we suggested to incorporate a brand-new section on energy technologies in the 2018 Latinobarometro Survey, one of the most relevant surveys on individual perceptions of socioeconomic and political issues in the region. To our knowledge this is the first time this kind of questions have been added to the questionnaire. Consumer awareness is commonly studied with the use of perception surveys as they are the most suitable tool for this type of research. Concerning the second problem and to bridge the gap between the academic literature done regarding the determinants of technology adoption and its awareness, we propose a logistic model to identify the factors that explain the level of awareness about solar panels, LED bulbs, hybrid and electric vehicles and energy-related mobile apps.

This paper represents one of the first attempts to unveil the determinants of energy technologies awareness in LAC. This is important to improve the design and effectiveness of public policies that aim to increase technological awareness and promote adoption in the region. In terms of awareness, the results show that being young correlates with a higher probability of knowing energy innovations, also having adopted energy saving practices implies an increase in the probability. Education is another relevant factor; more years of education enhance the chances of technological awareness. The same goes for income, the higher the income level, the more likely a person is to be aware of these five technologies. It is worth noting that technology awareness among women is consistently lower than in men in all cases, conversely, concerning LED bulbs and mobile apps the female respondents are the most familiar with this kind of innovations. Finally, belonging to countries with a predominance of non-renewable energy in their generation matrix increases the probability of recognizing alternative electric devices. This is a point in favor of continuing efforts towards the decarbonization of the energy sector.

The data collected by Latinobarometro also allowed us to explore the case of adoption of LED bulbs and the willingness to adopt the rest of the technologies conditioned by respondents that were aware of them. In LAC, LED bulbs proved to be the most accessible of all five technologies due to antiquity, cost and ease of use. Higher age and increasing years of instruction seems to be correlated with a higher chance of adopt LED bulbs. On the other hand, be a regular user of social media and having energy-saving attitudes are positive correlated to willingness to adopt all technologies.

The paper is organized as follows. Section 2 contains a literature review on the determinants of energy innovation awareness. In section 3, the methodology and the data used is presented. Results are discussed in section 4. Section 5 presents the policy implications. Finally, limiting considerations and concluding remarks are presented in section 6.

2. Literature Review: what we know about awareness and new technologies adoption

Most academic studies and policy reports have aimed at identifying the underlying reasons why people adopt innovative technologies; however, the assessment of consumer awareness is usually ignored. This is startling in a context where literature has claimed that **awareness represents a prerequisite that needs to be understood before the adoption can be addressed** (Claudy et al., 2010). Thus, the lack of awareness has been identified as one of the main barriers to technology adoption (Luthra et al., 2015).In fact, the lack of research on consumer awareness of new technologies, and the growing relevance of the active consumer in the energy market, poses consumer perception as a major concern.

Several pieces in the literature have examined the behavior of individuals and families towards the knowledge of energy technology. In this regard, education and/or training in energy sector has usually played a major role. In particular, evidence shows that those who pursued energy-related careers are the most aware (Karatepe et al., 2012). Social networks have also proved to enable the observability of new technologies (Schelly, 2014).

Another key variable for awareness of new technologies relies on gender. Although gender and use of energy technologies and resources have been researched, the relationship between gender and awareness of the technologies is relatively new. Research suggests that women are more likely to be aware of efficient lighting devices (Lee et al., 2013). In fact, Kabir et al.

(2013) and Kelebe et al. (2017) found evidence that adoption decisions of clean and innovative energies in Bangladesh and Ethiopia were usually linked to female-headed households. Nonetheless, these findings are not pervasive since other authors have had opposite results. For instance, Mwirigi et al. (2014) found that decisions related to energy resources in Ugandan and Kenyan households were taken mostly by men, while Walekhwa et al. (2009) found no statistical correlation with respect to biogas. Furthermore, Deree et al. (2001) determined that in Nicaragua, women-led decisions were mostly related to household appliances and men-led ones were mostly linked to high-tech or entertainment devices.

Age may have an impact on both energy technology awareness and adoption. Based on a study on the European Union, Mills and Schleich (2012) showed that households with young children were more likely to be aware and adopt energy-efficient technologies. On the contrary, households with a high average of elderly members place more importance on financial savings and show lower levels of technology awareness and adoption.

Guerin et al. (2000) noted that not only age, but also homeownership, income, number of house occupants and house size were the most frequent predictors of energy consumption changes. Similarly, a positive effect of homeownership on the adoption of energy-efficient appliances has been widely documented (Davis, 2011; Jaffe and Stavins, 1994; Kiran et al., 2015).

Moreover, Claudy et al. (2010) found a relationship between income and energy technology awareness. Particularly, their results found the upper-middle-class showed higher levels of awareness than other groups. Furthermore, other authors, identified that the technology adopter was younger, more highly educated, had higher in income, was earlier in the family life cycle, and had a higher occupational status than the general population (Karytsas and Theodoropoulou, 2014; Labay and Kinnear, 1981). The next section presents the methodology and the data used in the awareness and adoption analysis for five different energy-related technologies.

3. Methodology and Data

The current analysis is based on the Latinobarometro Report 2018. The annual survey, which is elaborated by the Latinobarometro Corporation, aims at measuring the individual perception of socioeconomic and political issues in Latin-American countries. With respect to the countries that were included in the sample, the selected group comprises Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, and Uruguay. Surveyed individuals ranged from 1000 to 1200 in each territory, amounting to a total of 20,204 observations.

For the purpose of this study, the 2018th edition incorporated a brand-new section that collected information on energy innovative technologies. The list of devices comprises LED bulbs, solar panels, hybrid and electric vehicles; and energy-related mobile apps. Respondents were asked about their knowledge of these tools, their willingness to adopt them, and whether they already acquired them.

Based on this dataset we propose a model to understand the level of LAC citizens familiarity with modern energy technologies that are starting to be adopted, especially in developed countries such as European countries and in the United States.

a. Model

The analysis of awareness involved three stages, the first of which corresponded to the degree of familiarity with respect to the list of innovations. To this end, a series of logit models were run to correlate the awareness of different types of energy technology i ($Awareness_i$) with socio-economic variables (X) (Eq. 1).

$$p_i = P(Awareness_i = Yes/X) \quad (1)$$

Taking into account the available data, a similar approach was used in order to evaluate the determinants of the willingness to adopt innovations ($Willingness_i$). In order to achieve this, the willingness evaluation was circumscribed to those who were familiar with each one of the devices, but who had not adopted them yet (Eq. 3).

$$p_i = P(Willingness_i = Yes/X, Awareness_i = Yes, Adoption_i = No) \quad (3)$$

Additionally, technology adoption was also assessed by another logit model, when possible. Thus, while the assessment of awareness was conducted on all the technologies listed above, the adoption of LED ($Adoption_{LED}$) was the only one that could be evaluated because the other technologies exhibited an extreme imbalance between adopters and non-adopters. This analysis was limited to respondents that were already aware of LED illumination (Eq. 2).

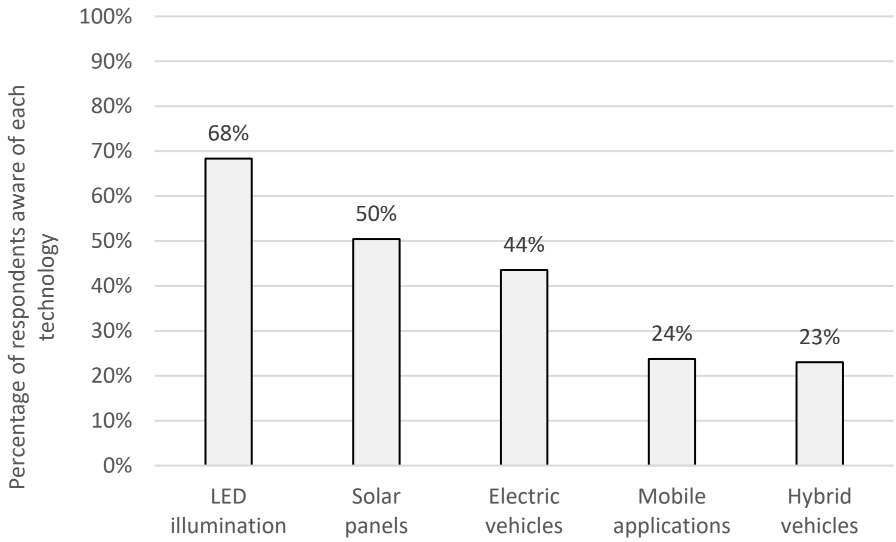
$$p_{LED} = P(Adoption_{LED} = Yes/X, Awareness_{LED} = Yes) \quad (2)$$

b. Descriptive Statistics

The survey addressed a set of intertwined questions related to energy habits. In particular, some questions asked about the technologies that respondents may have known among LED bulbs, solar panels, hybrid and electric vehicles; and energy-related mobile apps. If known, the survey asked if each of those innovations were adopted by the respondent. In the case that they were not adopted, the survey enquired whether the interviewed would eventually like to adopt them.

Figure 1 depicts the awareness of each of the evaluated energy technologies in LAC. While LED illumination is widely recognized across LAC, solar panels and electric vehicles are also in the radar of half of LAC's population. On the other hand, data suggests that LAC's population still is not aware of mobile applications for energy management and hybrid vehicles.

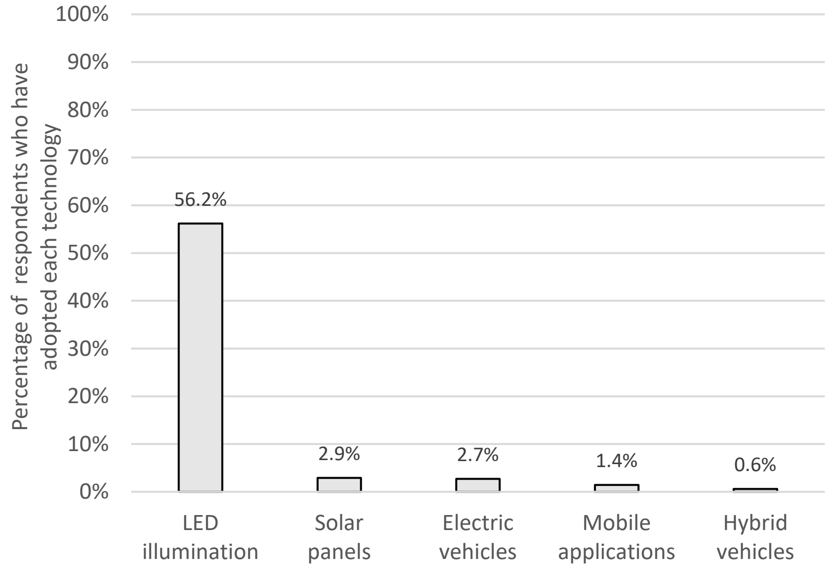
Figure 1. Awareness of energy technologies in Latin America and the Caribbean



Source: own calculations based on Latinobarometro 2018

Once respondents revealed their awareness of a specific technology, the rate of adoption drops significantly for all the technologies, with the exception of LED bulbs. **Figure 2** shows that 56% of the people surveyed claimed to use LED bulbs, which is equivalent to 82% of the respondents that were familiar with this technology.

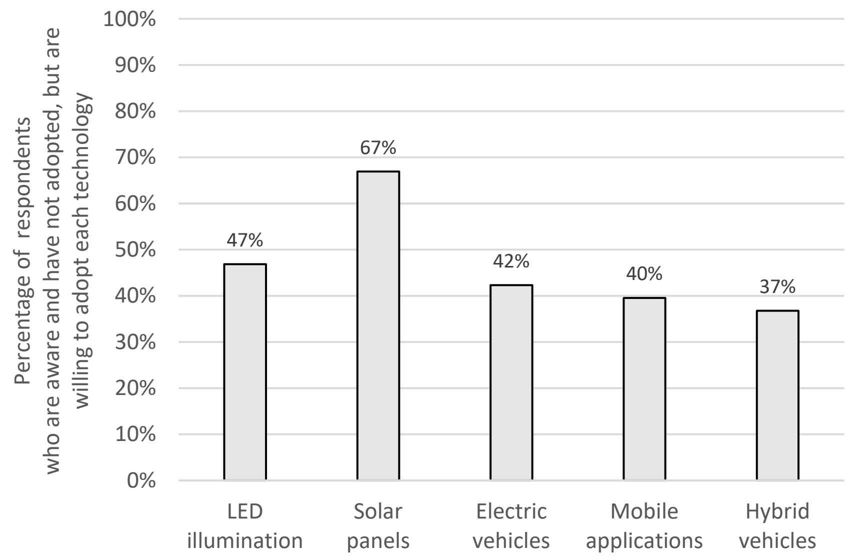
Figure 2. Technology adoption of energy technologies in Latin America and the Caribbean



Source: own calculations based on Latinobarometro 2018

For all of the other technologies (solar panels, hybrid and electric vehicles; and energy-related mobile apps), the adoption rates are below 3% of the total surveyed. Despite this low rate of adoption, results suggest a strong chance of future adoption of these technologies. Conditioning the sample on non-adopters that are aware of the technology, the rate of willingness to adopt energy technologies was between 37% and 67% depending the technology, see **Figure 3**.

Figure 3. Willingness to adopt energy technologies in Latin America and the Caribbean

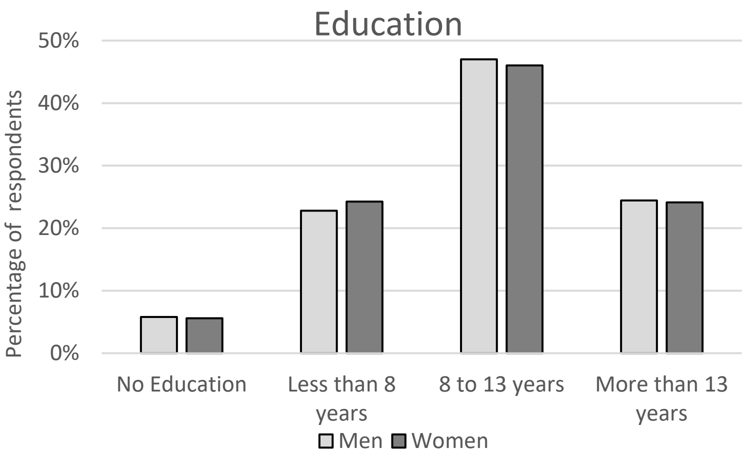


Source: own calculations based on Latinobarometro 2018

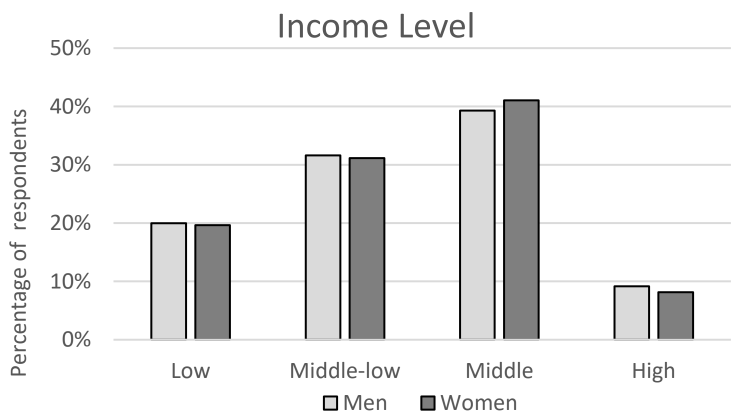
According to Schelly (2014), innovation adoption depends on demographic and behavioral factors. The current study uses a similar approach regarding innovation awareness and willingness to adopt. In this sense, socioeconomic variables were included, such as gender, age, years of education, income level, and country of residence.

An average of 1000 to 1200 individuals were surveyed, of whom 51.24% were $Women$. The age of the surveyed individuals ranged from 16 to 100 years (age mean is 40.09 $\pm$ SD 16.10). The variable $Education$ was reclassified in 4 categories as the frequency of the original series reveals a strong concentration in the lower years of education. By doing this, numerical answers were recategorized into "No education", "less than 8 years", "8 to 13 years" inclusive, and "more than 13 years" of education. Similarly, $IncomeLevel$ is a categorical variable reclassified in 4 quantiles[1], the lowest one being the base level. It is worth mentioning that the question about income was asked in terms of respondents' self-perception rather than being based on objective elements. **Figure 4** displays these two categorical variables divided by gender, showing a virtual parity in the sample composition.

Figure 4. Education and income level



Source: own calculations based on Latinobarometro 2018



Source: own calculations based on Latinobarometro 2018

[1] Middle-high and high income levels were merged into a single category to maintain an even distribution among classes.

The variable $Country$ was included to represent the policy environment and other non-observable heterogeneities of each territory. If countries were ranked according to their positive answers of awareness in all technologies, Paraguay would lie in the middle of that ranking. Therefore, Paraguay was chosen as the base level.

Behavioral variables relate to the attitude towards new technologies and energy consumption. In this regard, respondents were asked whether they could find favorable their introduction to children at an early age ($Friendliness$), obtaining 63.36% positive responses. Energy-saving behavior was also taken into account using the $Saving$ variable. Consumers revealed that 72.99% of them had carried out these types of measures at least once. Awareness may also be spread through social networks ($SocialMedia$), with 69.06% of respondents affirmed having used them.

In addition, the perception of non-renewable energy consumption could be a driver behind the awareness and adoption of alternative energy technologies (Atalay et al., 2016). The variable named $Non - Renewable$ captures to what extent respondents believed whether the energy they consumed comes primarily from non-renewable sources, including coal, oil and natural gas. Positive answers amounted to over 60.27% of the total.

Finally, as Guerin et al. (2000) have suggested, homeownership ($Ownership$) was included in the adoption and willingness to adopt equations. This variable represents the convenience of investing in long-term technology for household use. The proportion of homeowners reached 75.24%.

4. Results: technological awareness are strongly heterogenous among LAC citizens

We divided the results in two groups: first regarding the awareness of the different technologies and then, the adoption of LED bulbs, the most spread energy efficient technology in this survey.

a. Awareness

Table 1 reveals that coefficients are highly significant for almost all the variables of interest and their signs are invariably consistent with the literature and our expectations for all the technologies evaluated.[2]

[2] The corresponding fit stats and supplemental reports were included in Appendix 1.

Hereafter, marginal effects are calculated in relation to middle-class men with a high school diploma, leaving the remaining qualitative variables at the base level. In the case of the LED model, the values of marginal effects are generally lower than those of the other technologies. This could be explained by the fact that LED is probably the most accessible of all five technologies due to antiquity, cost and ease of use.

Table 1. Awareness logit regression

VARIABLES	LED	Solar	Mobile Apps	Electric Vehicles	Hybrid Vehicles
Woman	-0.372***	-0.593***	-0.533***	-0.744***	-1.020***
	(0.042)	(0.033)	(0.039)	(0.034)	(0.041)
Age	0.002	-0.003**	-0.011***	-0.010***	-0.004***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Saving	0.236***	0.388***	0.328***	0.268***	0.357***
	(0.047)	(0.038)	(0.047)	(0.040)	(0.050)
Friendliness	0.143***	0.122***	0.210***	0.046	0.222***
	(0.044)	(0.035)	(0.041)	(0.036)	(0.043)
Non-Renewable	0.080*	0.015	0.147***	0.214***	0.148***
	(0.045)	(0.036)	(0.042)	(0.037)	(0.044)
Social Media	0.525***	0.484***	0.527***	0.641***	0.742***
	(0.055)	(0.044)	(0.056)	(0.046)	(0.060)
Education	0.085	0.209***	-0.009	0.072	0.249*
less than 8 y.	(0.088)	(0.079)	(0.116)	(0.091)	(0.135)
Education	0.424***	0.465***	0.260**	0.453***	0.754***
from 8 to 12 y.	(0.089)	(0.080)	(0.114)	(0.090)	(0.132)
Education	0.929***	0.910***	0.825***	1.000***	1.462***
More than 12 y.	(0.100)	(0.086)	(0.117)	(0.095)	(0.136)
Income Level	0.334***	0.083*	0.156**	0.250***	0.240***
Middle-low	(0.060)	(0.048)	(0.062)	(0.051)	(0.065)
Income Level	0.393***	0.224***	0.426***	0.378***	0.420***
Middle	(0.060)	(0.048)	(0.060)	(0.050)	(0.064)
Income Level	0.197**	0.220***	0.804***	0.472***	0.552***
High	(0.083)	(0.068)	(0.079)	(0.071)	(0.085)
Constant	-0.149	-1.469***	-2.124***	-0.938***	-3.281***
	(0.154)	(0.131)	(0.167)	(0.139)	(0.189)
Observations	17,381	17,380	17,316	17,356	17,292
Pseudo R^2	0.331	0.100	0.0954	0.130	0.147
Likelihood	-7254	-10840	-8578	-10340	-7949

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Results show that **gender** is an important determinant of energy technologies awareness. The probability of awareness for women is consistently lower than men for all the technologies. However, the lower level of probability of awareness for women varies among technologies. LED and mobile applications are the most familiar to female respondents. For a woman, the probability of being aware reduces in average 5.7 pp for LED and 7 pp for mobile applications per country. For hybrid vehicles and solar panels, the probability reaches, on average, -8.7 and -12.3 pp, respectively. In last place, electrical vehicles are the most unfamiliar technology for women (is 17.8 pp less likely for women to be aware of this technology versus men).

Regarding **age**, youth correlates with a higher probability of knowing almost all of the energy technologies surveyed. In average, every additional year of age reduces the awareness probability in 0.01 pp for hybrid vehicles and 0.23 pp for electric cars. For solar panels and mobile mobility applications it reduces the probability on average 0.05 pp and 0.07 pp, respectively. LED awareness, however, seems to be uncorrelated with age.

Concerning **energy conservation**, having adopted energy-saving practices increases the probability of awareness between 2.3 pp. and 9.6 pp depending the technology. Nonetheless, the probability of awareness for LED based on the energy saving practices adoption is smaller, averaging 3.5 pp. Being a more widely adopted technology it covers a wider audience and is less reliant of the practices of the surveyed and regarding energy.

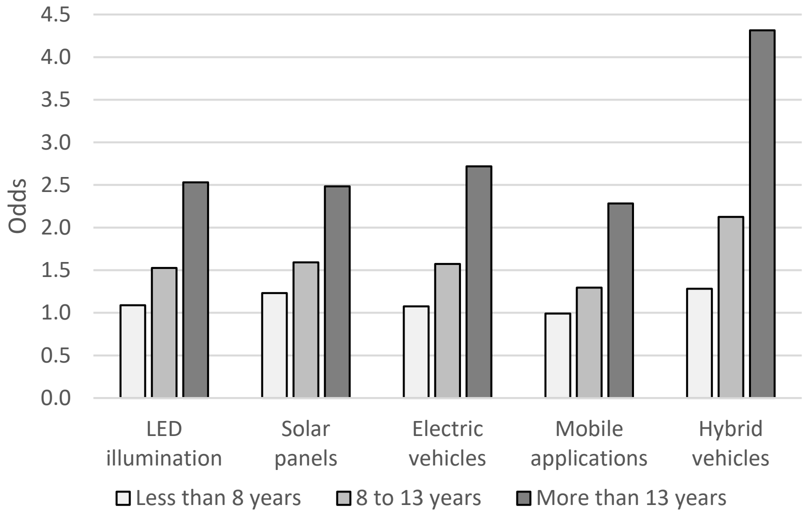
Innovation affinity increases the probability of awareness of almost all of the energy technologies evaluated. In the case of LED bulbs, the probability of awareness for people with innovation affinity ranges from 0.5 pp. to 3.5 pp. depending the country; while for solar, electric vehicles, hybrid vehicles and mobile apps it ranges between 0.7 pp. and 4.9 pp.

Belonging to countries with a predominance of **non-renewable energy** increases the probability of recognizing the energy technologies evaluated, except for solar panels. Living in such countries improves the probability of awareness of mobile applications, electric and hybrid vehicles between 0.8 pp. and 5.3 pp depending the technology. In the case of LED bulbs, belonging to a country with predominance of non-renewable energy increases the probability of awareness between 0.3 pp. and 1.9 pp. according to the country. However, at a lower significance level (10%).

The usage of **social media** increases the probability of knowing all technologies evaluated. Thus, the usage of social networks increases the probability of awareness of LED and mobile applications between 1.5 and 12.9 percentage points; whilst 8.5 points to a maximum of 11.9 for solar panels depending the country. For both types of vehicles, the probability increases by 6.2 to 17.5 pp depending the country.

More years of **education** increases the odds of awareness. **Figure 5** displays how the awareness of the energy technologies surveyed rises with the increase in years of education. For people with less than 8 years of education, the probability of awareness averages 1.7pp, while it averages 7.1 pp. for people with 8-13 years of education and 16.8 pp. for the highest education level.

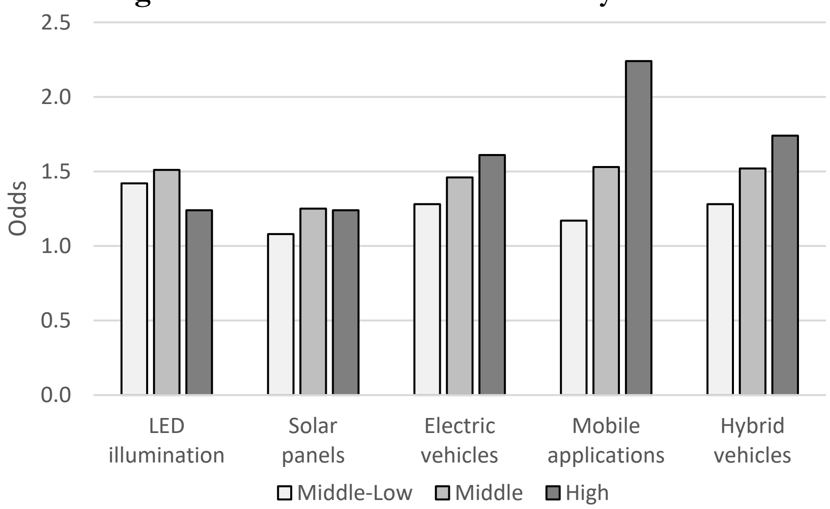
Figure 5. Odds ratios of awareness by education



Source: own calculations based on Latinobarometro 2018

Income is another determinant of technology awareness. The higher the income, the higher the probability of awareness. For both type of vehicles and mobile applications the probability increases from 0.8 pp. to 6.1 pp. for the persons from the middle-low income, from 1.8 pp. to 9.3 pp. for the middle level income, and from 2.5 pp. to 15.1 pp. for the high level income depending on the country. On the other hand, in the case of LED and solar technologies, the income trend is not increasing monotone regarding the wealth growth, see **Figure 6**.

Figure 6. Odds ratios of awareness by income



Source: own calculations based on Latinobarometro 2018

The **country** can also determine how likely it is to be aware of new technologies. **Figure 7** shows the level of awareness by country, where the darkest colors mean higher chances of awareness. Uruguay is the country whose citizens have the greatest chance to recognize these technologies; while Ecuador, Bolivia and El Salvador have the lowest probability of awareness.[3]

Figure 7. Odds ratios of innovation awareness per country

Source: own calculations based on Latinobarometro 2018

b. Adoption

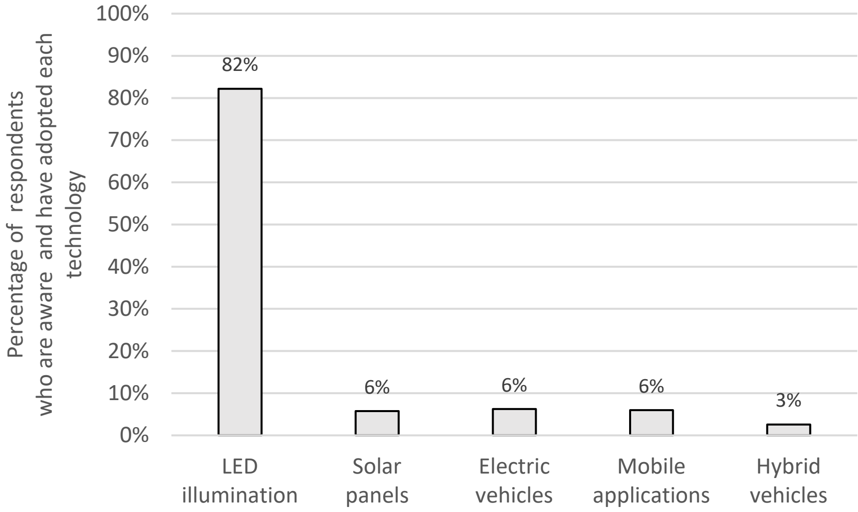
The adoption analysis is constrained to LED technology because of the extreme imbalance between positive and negative answers in the other technologies. The McFadden's pseudo R^2 revealed that the LED model had a better the goodness of fit than the other technologies' models, making the analysis of this technology more suitable for the adoption assessment. Similarly, its sensitivity and specificity rates reached 79% and 82% respectively, while rates of the other models oscillated between 63% to 70%. This fact reflects in the classification accuracy. Whereas LED could correctly classify 80.63% of cases, the other ones could only achieve an average accuracy of 66.26%.[4]

Figure 8 shows that even when the sample is conditioned to the interviewees that were aware of the different types of technology, the severe disproportion remains. Additionally,

[3] For further details on *Country* coefficients, see Appendix.
[4] The corresponding fit stats and supplemental reports were included in Appendix 1.

Ecuador and Colombia were excluded from the sample since the negative answers for the questions about adoption and willingness were almost inexistent for almost all technologies. As a result, it is unfeasible to distinguish when a "no reply" answer is actually a negative one.

Figure 8. Adoption rates among aware respondents



Source: own calculations based on Latinobarometro 2018

Limiting the sample to respondents that were familiar with LED technology, the positive answers to LED adoption reached 82%. This imbalance of the dependent variable may originate biased coefficients. In order to discard this problem, the logit model was compared against the King and Zeng correction and a Firth logistic regression. The coefficient comparison indicates that there was no evidence of a statistic difference (χ^2 statistics are 1.36 and 1.60, respectively). In contrast with the awareness model, the goodness of fit is lower (5.9%) possibly due to the massiveness in the usage of LED bulbs. This observation is also reflected in the sensibility and specificity rates, only achieving 65.48% and 58.49% respectively. Nonetheless, the overall significance of coefficients is high (χ^2 is 587.24).

Table 2 reveals that the individual significance of coefficients change compared to the awareness model[5]. **Age** becomes positively and highly significant, while $Friendliness$, $NonRenewable$, and the highest income level lose explanatory power. Once more, an increase in the income level appears to be uncorrelated with a higher LED adoption rate.

In the case of **gender**, the coefficient sign of women is positive, showing that once a person is aware of the technology, the probability of LED adoption is higher for women. The results of LED adoption in Latin America may support the view of female-headed households in

[5] The corresponding fit stats and supplemental reports were included in Appendix.

some African and Asian countries. The probability of adopting LED for a woman averages 2 pp.

The variable Age improved substantially its significance. Nevertheless, the probability of LED adoption just increases 0.03 pp. per year. On the other hand, **energy conservation** coefficient remained practically unchanged, although the probability of LED adoption increased to 4.8 pp.

The variable $SocialMedia$ for LED reduced its effect when moving from the awareness stage to the adoption phase, reducing its probability in the same proportion.

Table 2. Awareness vs Adoption logit regression

VARIABLES	LED Awareness	odds ratio	LED Adoption	odds ratio
Woman	-0.397***	0.672	0.106**	1.112
	(0.045)		(0.052)	
Age	0.001	1.001	0.015***	1.015
	(0.002)		(0.002)	
Saving	0.277***	1.319	0.237***	1.267
	(0.050)		(0.060)	
Friendliness	0.172***	1.187	0.081	1.084
	(0.047)		(0.055)	
NonRenewable	0.072	1.074	0.089	1.093
	(0.047)		(0.056)	
SocialMedia	0.491***	1.633	0.253***	1.288
	(0.058)		(0.070)	
Ownership			0.191***	1.210
			(0.061)	
Education	0.081	1.085	0.223*	1.250
Less than 8	(0.091)		(0.135)	
Education	0.390***	1.478	0.311**	1.364
From 8 to 13	(0.092)		(0.135)	
Education	0.929***	2.531	0.570***	1.769
More than 13	(0.104)		(0.144)	
IncomeLevel	0.352***	1.422	0.154**	1.167
Middle-Low	(0.063)		(0.074)	
IncomeLevel	0.386***	1.472	0.222***	1.249
Middle	(0.063)		(0.075)	
IncomeLevel	0.164*	1.178	0.181	1.198
High	(0.087)		(0.112)	
Constant	-0.084	0.919	-0.915***	0.400
	(0.161)		(0.204)	
Observations	15,160		11,622	
Pseudo R^2	0.313		0.0666	
Likelihood	-6347		-4918	

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Colombia and Ecuador not included

Although $\boldsymbol{Education}$ with less than 8 years shows signs of being significant at a level of 10%, increasing years of instruction seems to be correlated with a higher chance of adoption.

Marginal effects oscillate from 2.2 pp. to 5.2 pp. when respondents had less than 8 years of education, from 3 pp. to 7 pp. for the following category, and from 5.1 pp. to 13.3 pp. for the highest educated depending on the country.

Even though the **income level** lacks a consistent power of prediction in both stages, **homeownership** increases the probability of LED adoption. Marginal effects range from 1.8 to 4.8 percentage points depending on the country.

When it comes to LED adoption, Uruguay and Colombia remain at the top of the adoption ranking. Then, the second group is formed by Panama and Peru. The last group in terms of adoption probability is comprised of Bolivia, Honduras, Paraguay, El Salvador, and Guatemala, see **Figure 9**.[6]

Figure 9. Odds ratio of LED bulbs adoption per country

Source: own calculations based on Latinobarometro 2018

c. Willingness to adopt innovation

Once the sample was conditioned by respondents that were aware of the different innovations, but who were non-adopters, the distribution of those who would be willing to adopt these technologies in the future is balanced (**Figure 3**) and allows further analysis.

[6] Country coefficients are displayed in Appendix B.

Table 3 exhibits the logit regressions for willingness (on the conditioned sample).[7] Regarding **age**, the willingness to adopt increases with age. In the case of LED, the marginal effect is low, averaging 0.3 pp. per year. On the contrary, the willingness to adopt mobile applications and electric and hybrid vehicles is seemingly related to youth, with a probability of willingness from 0.06 pp. to 0.21 pp.

The interviewees that are **supportive of the introduction of new technologies** to children at an early age may adopt mobile applications or non-conventional vehicles in the future. In this case, the marginal effect averages 4.1 pp.

Energy-saving practices and use of social media are also positively correlated with the willingness to adopt solar panels, mobile applications and electric vehicles. The probability of people who apply energy-saving practices to be willing to adopt one of these technologies varies from 2.1 pp. up to 10.9 pp; whereas they oscillate between 2.4 and 9.1 pp. in the case of Social Media.

The other socio-economic variables present lower significance or are occasionally uncorrelated with the willingness to adopt innovation. For instance, future implementation of electric or hybrid vehicles has a negative correlation with female respondents. The variable $Ownership$ is positively significant in the sole case of electric cars, whereas respondents livening in oil-producing countries may only seem favorable to adopt this means of transport. Moreover, $Income\ Level$ and $Education$ are apparently uncorrelated to willingness, or they present an inconsistent relationship as in the case of solar panels and years of education.

[7] The corresponding fit stats and supplemental reports were included in Appendix B.

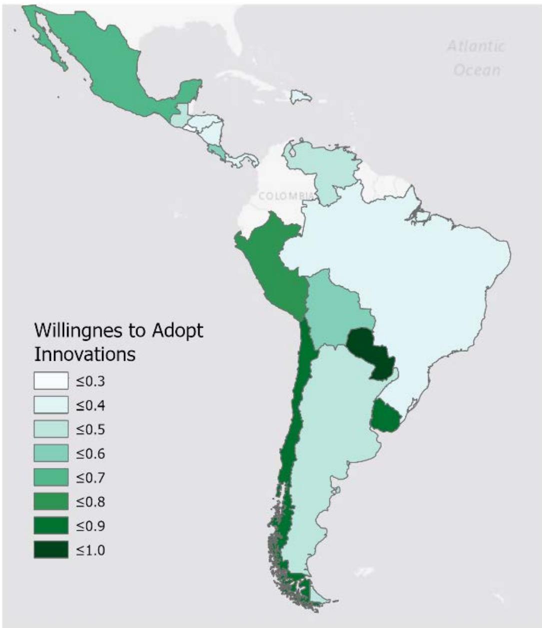
Table 3. Willingness logit regression

VARIABLES	LED	Solar	Mobile App	Electric Vehicle	Hybrid Vehicle
Woman	0.123	-0.098*	-0.099	-0.421***	-0.419***
	(0.102)	(0.054)	(0.080)	(0.057)	(0.084)
Age	0.014***	0.001	-0.009***	-0.004**	-0.006**
	(0.004)	(0.002)	(0.003)	(0.002)	(0.003)
Saving	0.220*	0.269***	0.438***	0.315***	0.237**
	(0.116)	(0.063)	(0.105)	(0.071)	(0.107)
Friendliness	-0.150	0.012	0.224**	0.199***	0.269***
	(0.109)	(0.057)	(0.089)	(0.061)	(0.088)
Non-Renewable	-0.072	0.046	0.107	0.166***	0.136
	(0.108)	(0.057)	(0.087)	(0.060)	(0.086)
Social Media	0.056	0.366***	0.297**	0.304***	0.346***
	(0.139)	(0.073)	(0.126)	(0.085)	(0.133)
Ownership	-0.011	-0.009	0.163*	-0.103	0.087
	(0.116)	(0.063)	(0.096)	(0.065)	(0.094)
Education	0.491*	-0.390***	0.006	-0.110	-0.410
Less than 8	(0.257)	(0.142)	(0.285)	(0.179)	(0.307)
Education	0.453*	-0.290**	-0.053	-0.119	-0.435
From 8 to 13	(0.257)	(0.142)	(0.280)	(0.176)	(0.301)
Education	0.358	-0.067	0.122	-0.000	-0.212
More than 13	(0.276)	(0.150)	(0.285)	(0.181)	(0.306)
Income Level	-0.081	0.201**	0.214	0.058	0.102
Middle-Low	(0.144)	(0.080)	(0.134)	(0.090)	(0.138)
Income Level	-0.150	0.087	0.057	-0.016	-0.066
Middle	(0.145)	(0.078)	(0.130)	(0.088)	(0.135)
Income Level	-0.202	-0.091	0.216	0.059	-0.072
High	(0.219)	(0.111)	(0.163)	(0.121)	(0.173)
Constant	-0.117	0.393*	0.129	0.658***	-0.015
	(0.395)	(0.229)	(0.387)	(0.255)	(0.401)
Observations	1,809	7,158	3,085	6,068	3,136
Pseudo R2	0.0729	0.0646	0.0657	0.0680	0.0534
Likelihood	-1159	-4248	-1936	-3854	-1953

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Colombia and Ecuador not included

When the odds ratios of each technology are averaged by country, a ranking for future adoption could be estimated (**Figure 10**). While Uruguay remains at the top positions of the ranking, Paraguay is the leader. After clustering the ranking in 4 groups, the first one, which is composed by countries with the highest chance to adopt innovations in the future, is completed by Chile and Peru. On the other hand, the fourth group is solely formed by El Salvador.

Figure 10. Willingness to adopt innovation by country by country



Source: own calculations based on Latinobarometro 2018

5. Why policy makers should care about the heterogeneity LAC awareness when leading the adoption of new technologies for the energy transition?

A large percentage of the population in LAC has never heard about some of the key technologies that are shaping the future. The results show that an effective policy that aims to increase the technological awareness and promote the adoption of energy-related technologies needs to consider variables such as gender, education, income level and whether the person has an energy-saving behavior and use social media.

Although each type of technology studied in this paper offers a different kind of service, some general guidelines could be drawn to improve energy consumer awareness. For instance, evidence shows that social media is nowadays the means by which people exchange daily information, which implies that people with internet access have a higher probability of awareness. Thus, promoting internet access is a first step to spread technology awareness among people.

Communication is the mainstay in any go-to-market plan, but in order to reduce the gender gap observed in adoption, policies should promote awareness among women. Likewise, encouraging and promoting the knowledge of new energy technologies during the first years of education may increase the overall probability. In addition, encouraging energy-efficiency habits could be another way to raise awareness among people. Advertising that underscores benefits and ease of use by referring to "time savings", "convenience" at anywhere any time, "low costs" and "information availability" might have some impact.

It is important to avoid, as much as possible, that awareness of new efficient technologies to be concentrated in just a part of the population. It means the technological awareness are biased according to gender, education, energy-saving practices, and the use of social media. This concentration can increase inequality in the access of energy services (also considering affordability) and be a barrier to the spread of technology adoption, that can be economically efficient. Creating or deepen a gap in the long term as a result.

Policies may have different roles in the adoption of new technologies, but there are evidences they play an important role. Most studies found a strong link between energy technology adoption and public policy instruments (Egbue and Long, op. cit.; Neij, 1997)[8].

Besides their effect on awareness, policies play a role in adoption, especially towards population which is not usually in contact with these technologies. With some adoption policies increasing awareness also. There is an intrinsic interaction since awareness impact adoption, but policies pushing adoption, such as using new technologies in schools or other places that are common to most of the population may impact on awareness and minimize gaps across potential adopters. As adoption driving policies, countries should work on financial mechanisms and incentive programs to promote adoption, particularly aimed at lower-income populations emphasizing the long term benefits that can be obtained from this technologies and reducing the upfront costs that might acts as a barrier to their acquisition.

To analyze adoption in LAC more extensively new variables should be included in future studies [9]. Among them, prices are a common requirement, while it is not the only barrier, it usually plays a key role[10]. Price distortions may represent an important additional barrier or incentives for the new technologies' adoption (explained by the studies of Caird et al., 2008

[8] Bearing on LED Bulbs, the magnitude of the marginal effects is in line with the claim that promotion policies are relevant.

[9] For example, environmental values seemed to be relevant to the adoption of energy technology (Costanzo et al., 1986; Karytsas and Theodoropoulou, 2014). The aesthetic component limited adoption as well. This applies to renewable energy such as solar and wind energy technologies (Faiers and Neame, 2006; Wüstenhagen et al., 2007). Especially, both technologies have become a subject of contested debates in several countries largely due to its visual impact on landscapes. Energy security and the reduction of the ecological footprint may be relevant factors that define consumers' behavior as well as environmental liabilities (Graham-Rowe et al., 2012).

[10] Caird et al., 2008, based on the UK suggests that adoption highly varies depending on the technology concerned.

and Sardianou and Genoudi, 2013). Gallagher and Muehlegger (2011) showed that rising gasoline prices were associated with greater hybrid vehicle sales. However, while financial incentives such as tax credits or fuel taxes were relevant, they would be insufficient if consumers were misinformed or unknowing of the technology.

6. Conclusion

This paper underlined the awareness of new energy-related technologies as an important element for an effective policy design to promote the adoption among people. Through a perception survey, respondents revealed their knowledge related to solar panels, LED bulbs, hybrid and electric vehicles, and energy-related mobile apps. Evidence suggests that the most determining factors of technological awareness are gender, education, energy-saving practices, and the use of social media. Awareness among women is found to be consistently lower than men in all cases, with the odds of men almost doubling that of women. Years of education enhance awareness, with population that have a college education retaining the highest probability of recognizing innovative technologies. Furthermore, the effects of social media usage and energy-saving practices are particularly strong in all models.

Additionally, youth and having a good predisposition to new technologies correlate to some extent with a higher probability of knowing energy innovations. Nonetheless, the correlation of income depends on the individual case. In the case of vehicles and mobile applications, the higher the income level is, the more probable the awareness becomes. In contrast, LED bulbs and solar panels reveal an inconsistent relation between awareness probability and the increase in wealth. Concerning awareness in LAC, Uruguay stands at the top of the awareness and adoption ranking. Large countries such as Argentina, Brazil and Mexico are usually above the average in terms of awareness probability, whereas low-income countries in terms of GDP per capita are frequently at the lowest awareness positions.

Acknowledgment

The authors gratefully acknowledge Dr. Valentina Viego (Universidad Nacional del Sur, Argentina) and Mtr. Marina Tortul (IIESS, Argentina) for their support and comments on this article. We also thanks Tomas Serebrisky for all the support during the work with the survey and fruitful discussion about this topic.

7. Appendix. Supplemental reports

Table A.1 – Regressions summary. Fit stats.

	Awareness					Adoption	Willingness				
	LED	Solar	Mobile APP	Electric Vehicle	Hybrid Vehicle	LED	LED	Solar	Mobile APP	Electric Vehicle	Hybrid Vehicle
N° Obs	17,381	17,380	17,316	17,356	17,292	10,631	1,809	7,158	3,085	6,048	3,136
Log likelihood	-7,254	-10,839	-8,578	-10,339	-7,948	-4,683	-1,159	-4,247	-1,935	-3,854	-1,952
Pseudo R^2	0.3313	0.1002	0.0954	0.1299	0.1473	0.0590	0.0729	0.0646	0.0657	0.0680	0.0534
LR test	7,189	2,413	1,810	3,088	2,745	587	182	587	272	562	220
Positive Ans.	68.35%	50.39%	23.71%	43.51%	22.98%	82.21%	46.88%	66.96%	39.64%	42.37%	36.80%
Sensitivity	79.87%	66.10%	66.87%	68.72%	70.68%	65.48%	67.57%	63.01%	59.53%	62.15%	62.48%
Specificity	81.37%	64.23%	63.51%	65.80%	67.80%	58.49%	57.75%	62.45%	63.16%	61.37%	59.59%
Correct class.	80.34%	65.17%	64.30%	67.07%	68.47%	64.24%	62.35%	62.82%	61.72%	61.70%	60.65%
ROC area	0.8668	0.7083	0.7113	0.7363	0.7593	0.6703	0.6771	0.6730	0.6641	0.6705	0.6531

Table A.2 – Regressions summary. Sign and significance by explanatory variable.

	Awareness					Adoption	Willingness				
	LED	Solar	Mobile APP	Electric Vehicle	Hybrid Vehicle	LED	LED	Solar	Mobile APP	Electric Vehicle	Hybrid Vehicle
Woman	Neg***	Neg***	Neg***	Neg***	Neg***	Pos**		Neg*		Neg***	Neg***
Age		Neg**	Neg***	Neg***	Neg***	Pos***	Pos***		Neg***	Neg**	Neg**
Saving	Pos***	Pos***	Pos***	Pos***	Pos***	Pos***	Pos*	Pos***	Pos***	Pos***	Pos**
Friendliness	Pos***	Pos***	Pos***		Pos***				Pos**	Pos***	Pos***
Non-Renewable	Pos*		Pos***	Pos***	Pos***					Pos***	
Social Media	Pos***	Pos***	Pos***	Pos***	Pos***	Pos***		Pos***	Pos**	Pos***	Pos***
Ownership						Pos***			Pos*		
Education Less than 8		Pos***			Pos*	Pos*	Pos*	Neg***			
Education From 8 to 13	Pos***	Pos***	Pos**	Pos***	Pos***	Pos**	Pos*	Neg**			
Education More than 13	Pos***	Pos***	Pos***	Pos***	Pos***	Pos***					
Income Level Middle-low	Pos***	Pos*	Pos**	Pos***	Pos***	Pos**		Pos**			
Income Level Middle	Pos***	Pos***	Pos***	Pos***	Pos***	Pos***					
Income Level High	Pos**	Pos***	Pos***	Pos***	Pos***						

*** p<0.01, ** p<0.05, * p<0.1

Table A.3 – Odds ratios of the Awareness logit regressions.

VARIABLES	LED	Solar	Mobile App	Electric Vehicle	Hybrid Vehicle
Woman	0.690***	0.553***	0.587***	0.475***	0.361***
Age	1.002	0.997**	0.989***	0.990***	0.996***
Saving	1.266***	1.475***	1.388***	1.307***	1.430***
Friendliness	1.154***	1.130***	1.234***	1.047	1.249***
NonRenewable	1.083*	1.015	1.158***	1.239***	1.160***
SocialMedia	1.690***	1.623***	1.694***	1.899***	2.100***
Ed. Less 8	1.089	1.232***	0.991	1.075	1.282*
Ed. 8 to 13	1.527***	1.592***	1.296**	1.573***	2.126***
Ed. More 13	2.531***	2.484***	2.283***	2.718***	4.314***
SC. Middle Low	1.397***	1.086*	1.169**	1.285***	1.271***
SC. Middle	1.482***	1.251***	1.531***	1.459***	1.521***
SC. High	1.218**	1.246***	2.234***	1.604***	1.737***
C. Argentina	4.752***	2.282***	2.020***	0.889	1.653***
C. Bolivia	0.583***	1.673***	1.027	0.392***	0.598***
C. Brazil	5.323***	1.653***	1.422***	1.681***	2.032***
C. Chile	3.381***	4.280***	1.072	1.410***	2.202***
C. Colombia	5.073***	1.099	0.677***	0.961	1.040
C. Costa Rica	0.230***	2.733***	1.391***	2.442***	4.275***
C. Dominican R.	0.109***	2.303***	0.678***	0.652***	1.728***
C. Ecuador	0.060***	0.781**	0.583***	0.639***	2.688***
C. El Salvador	0.250***	1.146	0.658***	0.774**	1.378**
C. Guatemala	0.225***	1.569***	1.065	0.882	1.877***
C. Honduras	0.165***	2.185***	0.857	0.635***	1.835***
C. Mexico	2.404***	2.493***	1.030	0.911	2.181***
C. Nicaragua	0.315***	3.239***	0.991	0.520***	0.791
C. Panama	2.640***	2.825***	1.068	0.890	2.197***
C. Peru	3.057***	1.258**	0.617***	0.381***	0.574***
C. Uruguay	11.022***	4.362***	2.256***	2.437***	2.206***
C. Venezuela	2.305***	0.513***	1.639***	0.386***	0.880
Constant	0.862	0.230***	0.120***	0.392***	0.038***
Observations	17,381	17,380	17,316	17,356	17,292

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.4 – Country coefficients of the Awareness logit regressions.

VARIABLES	LED	Solar	Mobile App	Electric Vehicle	Hybrid Vehicle
C. Argentina	1.559***	0.825***	0.703***	-0.117	0.503***
	(0.151)	(0.096)	(0.106)	(0.097)	(0.118)
C. Bolivia	-0.540***	0.514***	0.027	-0.936***	-0.514***
	(0.105)	(0.097)	(0.112)	(0.103)	(0.138)
C. Brazil	1.672***	0.503***	0.352***	0.520***	0.709***
	(0.146)	(0.094)	(0.108)	(0.096)	(0.118)
C. Chile	1.218***	1.454***	0.070	0.344***	0.789***
	(0.141)	(0.102)	(0.112)	(0.098)	(0.117)
C. Colombia	1.624***	0.095	-0.390***	-0.040	0.039
	(0.148)	(0.095)	(0.115)	(0.097)	(0.123)
C. Costa Rica	-1.470***	1.005***	0.330***	0.893***	1.453***
	(0.105)	(0.099)	(0.111)	(0.102)	(0.117)
C. Dominican R.	-2.220***	0.834***	-0.389***	-0.428***	0.547***
	(0.113)	(0.100)	(0.122)	(0.102)	(0.124)
C. Ecuador	-2.810***	-0.247**	-0.540***	-0.448***	0.989***
	(0.115)	(0.098)	(0.118)	(0.098)	(0.115)
C. El Salvador	-1.387***	0.136	-0.419***	-0.256**	0.321**
	(0.108)	(0.102)	(0.129)	(0.103)	(0.132)
C. Guatemala	-1.491***	0.450***	0.063	-0.125	0.630***
	(0.115)	(0.107)	(0.127)	(0.110)	(0.137)
C. Honduras	-1.799***	0.782***	-0.155	-0.453***	0.607***
	(0.115)	(0.103)	(0.131)	(0.110)	(0.137)
C. Mexico	0.877***	0.914***	0.030	-0.094	0.780***
	(0.121)	(0.096)	(0.112)	(0.097)	(0.118)
C. Nicaragua	-1.154***	1.175***	-0.009	-0.653***	-0.234
	(0.112)	(0.105)	(0.130)	(0.114)	(0.163)
C. Panama	0.971***	1.039***	0.066	-0.117	0.787***
	(0.131)	(0.101)	(0.117)	(0.102)	(0.124)
C. Peru	1.118***	0.229**	-0.484***	-0.964***	-0.556***
	(0.133)	(0.098)	(0.120)	(0.104)	(0.137)
C. Uruguay	2.400***	1.473***	0.814***	0.891***	0.791***
	(0.197)	(0.100)	(0.105)	(0.099)	(0.117)
C. Venezuela	0.835***	-0.668***	0.494***	-0.953***	-0.128
	(0.125)	(0.100)	(0.106)	(0.100)	(0.124)
Observations	17,381	17,380	17,316	17,356	17,292
Pseudo R^2	0.331	0.100	0.0954	0.130	0.147
Likelihood	-7254	-10840	-8578	-10340	-7949

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.5 – Country coefficients of the LED Adoption model.

VARIABLES	LED Awareness	odds ratio	LED Adoption	odds ratio
C. Argentina	1.606***	4.984	0.920***	2.508
	(0.155)		(0.127)	
C. Bolivia	-0.574***	0.563	0.135	1.145
	(0.106)		(0.125)	
C. Brazil	1.732***	5.654	0.830***	2.293
	(0.151)		(0.122)	
C. Chile	1.375***	3.954	0.574***	1.776
	(0.151)		(0.123)	
C. Costa Rica	-1.495***	0.224	0.609***	1.839
	(0.106)		(0.157)	
C. Dominican R.	-2.244***	0.106	0.548***	1.731
	(0.114)		(0.185)	
C. El Salvador	-1.405***	0.245	-0.097	0.907
	(0.109)		(0.143)	
C. Guatemala	-1.528***	0.217	-0.292*	0.746
	(0.116)		(0.158)	
C. Honduras	-1.833***	0.160	0.098	1.103
	(0.116)		(0.173)	
C. Mexico	0.846***	2.330	0.949***	2.583
	(0.122)		(0.128)	
C. Nicaragua	-1.199***	0.302	0.718***	2.051
	(0.113)		(0.169)	
C. Panama	0.942***	2.565	1.112***	3.042
	(0.132)		(0.139)	
C. Peru	1.311***	3.709	1.324***	3.760
	(0.143)		(0.141)	
C. Uruguay	2.546***	12.751	1.804***	6.073
	(0.212)		(0.156)	
C. Venezuela	0.865***	2.376	0.772***	2.163
	(0.128)		(0.126)	
Observations	15,160		10,631	
Pseudo R^2	0.313		0.0590	
Likelihood	-6347		-4683	

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Colombia and Ecuador not included

Table A.6 – Odds ratios of the Willingness logit regressions.

VARIABLES	LED	Solar	Mobile App	Electric Vehicle	Hybrid Vehicle
Woman	1.131	0.907*	0.905	0.657***	0.657***
Age	1.014***	1.001	0.991***	0.996**	0.994**
Saving	1.246*	1.309***	1.550***	1.370***	1.268**
Friendliness	0.860	1.012	1.251**	1.220***	1.308***
NonRenewable	0.930	1.047	1.113	1.181***	1.146
SocialMedia	1.058	1.442***	1.346**	1.355***	1.413***
Ownership	0.989	0.991	1.177*	0.902	1.091
Ed. Less 8	1.633*	0.677***	1.006	0.896	0.664
Ed. 8 to 13	1.572*	0.748**	0.948	0.888	0.647
Ed. More 13	1.430	0.935	1.130	1.000	0.809
SC. Middle Low	0.922	1.223**	1.239	1.059	1.107
SC. Middle	0.860	1.091	1.059	0.984	0.936
SC. High	0.817	0.913	1.241	1.061	0.931
C. Argentina	0.463***	0.889	0.190***	0.218***	0.390***
C. Bolivia	0.562**	0.702**	0.435***	0.399***	0.735
C. Brazil	0.256***	0.777*	0.181***	0.147***	0.204***
C. Chile	0.533***	2.699***	0.346***	0.224***	0.283***
C. Costa Rica	0.214***	1.289	0.230***	0.376***	0.778
C. Dominican R.	0.151***	0.474***	0.172***	0.303***	0.542***
C. El Salvador	0.158***	0.354***	0.101***	0.139***	0.309***
C. Guatemala	0.258***	0.669**	0.337***	0.307***	0.532**
C. Honduras	0.123***	0.895	0.166***	0.187***	0.404***
C. Mexico	0.362***	1.287	0.285***	0.399***	0.811
C. Nicaragua	0.396***	0.407***	0.138***	0.153***	0.579*
C. Panama	0.154***	0.909	0.218***	0.136***	0.501***
C. Peru	0.671	1.356*	0.380***	0.466***	0.879
C. Uruguay	0.484**	2.035***	0.399***	0.495***	0.642**
C. Venezuela	0.745	0.695**	0.288***	0.236***	0.438***
Constant	0.890	1.482*	1.138	1.932***	0.985
Observations	1,809	7,158	3,085	6,068	3,136

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Colombia and Ecuador not included

Table A.7 – Country coefficients of the Willingness logit regressions.

VARIABLES	LED	Solar	Mobile App	Electric Vehicle	Hybrid Vehicle
C. Argentina	-0.771***	-0.118	-1.660***	-1.522***	-0.941***
	(0.241)	(0.150)	(0.202)	(0.149)	(0.212)
C. Bolivia	-0.576**	-0.354**	-0.832***	-0.919***	-0.308
	(0.227)	(0.156)	(0.222)	(0.169)	(0.252)
C. Brazil	-1.363***	-0.253*	-1.710***	-1.918***	-1.590***
	(0.233)	(0.152)	(0.210)	(0.148)	(0.227)
C. Chile	-0.630***	0.993***	-1.063***	-1.496***	-1.263***
	(0.241)	(0.165)	(0.208)	(0.147)	(0.214)
C. Costa Rica	-1.540***	0.254	-1.471***	-0.977***	-0.251
	(0.302)	(0.156)	(0.215)	(0.141)	(0.196)
C. Dominican R.	-1.887***	-0.746***	-1.762***	-1.195***	-0.612***
	(0.375)	(0.154)	(0.252)	(0.166)	(0.227)
C. El Salvador	-1.847***	-1.038***	-2.289***	-1.973***	-1.173***
	(0.271)	(0.168)	(0.292)	(0.176)	(0.256)
C. Guatemala	-1.355***	-0.401**	-1.089***	-1.179***	-0.631**
	(0.274)	(0.180)	(0.257)	(0.176)	(0.260)
C. Honduras	-2.098***	-0.111	-1.798***	-1.679***	-0.907***
	(0.350)	(0.169)	(0.276)	(0.194)	(0.264)
C. Mexico	-1.015***	0.252	-1.255***	-0.919***	-0.209
	(0.242)	(0.156)	(0.215)	(0.150)	(0.204)
C. Nicaragua	-0.926***	-0.900***	-1.979***	-1.875***	-0.546*
	(0.304)	(0.164)	(0.292)	(0.212)	(0.324)
C. Panama	-1.874***	-0.095	-1.525***	-1.999***	-0.691***
	(0.287)	(0.157)	(0.241)	(0.176)	(0.221)
C. Peru	-0.399	0.305*	-0.968***	-0.763***	-0.129
	(0.271)	(0.169)	(0.237)	(0.168)	(0.249)
C. Uruguay	-0.727**	0.710***	-0.919***	-0.704***	-0.443**
	(0.330)	(0.156)	(0.198)	(0.141)	(0.207)
C. Venezuela	-0.294	-0.363**	-1.243***	-1.442***	-0.826***
	(0.251)	(0.173)	(0.206)	(0.165)	(0.228)
Observations	1,809	7,158	3,085	6,068	3,136
Pseudo R^2	0.0729	0.0646	0.0657	0.0680	0.0534
Likelihood	-1159	-4248	-1936	-3854	-1953

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Colombia and Ecuador not included

8. References

Atalay, Y., Biermann, F. and Kalfagianni, A. (2016). Adoption of renewable energy technologies in oil-rich countries: Explaining policy variation in the Gulf Cooperation Council states. Renewable Energy, 85, 206–214. https://doi.org/10.1016/j.renene.2015.06.045

Caird, S., Roy, R. and Herring, H. (2008). Improving the energy performance of UK households: Results from surveys of consumer adoption and use of low- and zero-carbon technologies. Energy Efficiency, 1(2), 149–166. https://doi.org/10.1007/s12053-008-9013-y

Claudy, M., Michelsen, C., O'driscoll, A., Mullen, M., Claudy, M., Michelsen, C., and Mullen, M. R. (2010). Consumer Awareness in the Adoption of Microgeneration Technologies: An Empirical Investigation in the Republic of Ireland. Renewable and Sustainable Energy Reviews, 14(7), 2154–2160. https://doi.org/10.1016/j.rser.2010.03.028

Costanzo, M., Archer, D., Aronson, E. and Pettigrew, T. (1986). Energy Conservation Behavior. The Difficult Path from Information to Action. American Psychologist, 41(5), 521–528. https://doi.org/10.1037/0003-066X.41.5.521

Davis, L. W. (2011). Evaluating the slow adoption of energy efficient investments: are renters less likely to have energy efficient appliances? The design and implementation of US climate policy (pp. 301-316). University of Chicago Press.

Egbue, O. and Long, S. (2012). Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions. Energy Policy, 48, 717–729. https://doi.org/10.1016/j.enpol.2012.06.009

Faiers, A. and Neame, C. (2006). Consumer attitudes towards domestic solar power systems. Energy Policy, 34(14), 1797–1806. https://doi.org/10.1016/j.enpol.2005.01.001

Firth, D. (1993). Bias reduction of maximum likelihood estimates. Biometrika 80:27-38.

Gallagher, K. S. and Muehlegger, E. (2011). Giving green to get green? Incentives and consumer adoption of hybrid vehicle technology. Journal of Environmental Economics and Management, 61(1), 1–15. https://doi.org/10.1016/j.jeem.2010.05.004

Graham-Rowe, E., Gardner, B., Abraham, C., Skippon, S., Dittmar, H., Hutchins, R. and Stannard, J. (2012). Mainstream consumers driving plug-in battery-electric and plug-in hybrid electric cars: A qualitative analysis of responses and evaluations. Transportation Research Part A: Policy and Practice, 46(1), 140-153.

Guerin, D. A., Yust, B. L. and Coopet, J. G. (2000). Family and Consumer Sciences Research Studies Since 1975 Found in Energy Studies Since 1975. Family and Consumer Sciences Research Journal, 29(0035304). https://doi.org/10.1177/1077727X00291003

Inter-American Development Bank (IDB). (2020) From Structures to Services: The Path to Better Infrastructure in Latin America and the Caribbean. IADB Publishing, Washington. D.C., USA

Jaffe, A. B. and Stavins, R. N. (1994). Energy-Efficiency Investments and Public Policy. In Source: The Energy Journal (Vol. 15).

Kabir, H., Yegbemey, R. N., & Bauer, S. (2013). Factors determinant of biogas adoption in Bangladesh. Renewable and Sustainable Energy Reviews, 28, 881-889.

Karatepe, Y., Neşe, S. V., Keçebaş, A. and Yumurtaci, M. (2012). The levels of awareness about the renewable energy sources of university students in Turkey. Renewable Energy, 44, 174–179. https://doi.org/10.1016/j.renene.2012.01.099

Karytsas, S. and Theodoropoulou, H. (2014). Public awareness and willingness to adopt ground source heat pumps for domestic heating and cooling. Renewable and Sustainable Energy Reviews, 34, 49–57. https://doi.org/10.1016/j.rser.2014.02.008

Kelebe, H. E., Ayimut, K. M., Berhe, G. H., & Hintsa, K. (2017). Determinants for adoption decision of small-scale biogas technology by rural households in Tigray, Ethiopia. Energy Economics, 66, 272-278.

King, G. and Zeng, L. (1999a). Logistic Regression in Rare Events Data. Department of Government, Harvard University, available from http://GKing.Harvard.Edu.

King, G. and Zeng, L. (1999b). Estimating Absolute, Relative, and Attributable Risks in Case-Control Studies," Department of Government, Harvard University, available from http://GKing.Harvard.Edu.

Kiran, C., Krishnamurthy, B. and Kriström, B. (2015). How Large is the Owner-Renter Divide in Energy Efficient Technology? Evidence from an OECD Cross-section. Source: The Energy Journal, 36(4), 85–104. https://doi.org/10.5547/01956574.36.4.ckri

Labay, D. G. and Kinnear, T. C. (1981). Exploring the Consumer Decision Process in the Adoption of Solar Energy Systems. Journal of Consumer Research, 8(3), 271. https://doi.org/10.1086/208865

Lee, E., Park, N.-K. and Han, J. H. (2013). Gender Difference in Environmental Attitude and Behaviors in Adoption of Energy-Efficient Lighting at Home. Journal of Sustainable Development, 6(9). https://doi.org/10.5539/jsd.v6n9p36

Luthra, S., Kumar, S., Garg, D. and Haleem, A. (2015). Barriers to renewable/sustainable energy technologies adoption: Indian perspective. Renewable and Sustainable Energy Reviews, 41, 762–776. https://doi.org/10.1016/j.rser.2014.08.077

Mills, B. and Schleich, J. (2012). Residential energy-efficient technology adoption, energy conservation, knowledge, and attitudes: An analysis of European countries. Energy Policy, 49, 616–628. https://doi.org/10.1016/j.enpol.2012.07.008

Mwirigi, J., Balana, B. B., Mugisha, J., Walekhwa, P., Melamu, R., Nakami, S., & Makenzi, P. (2014). Socio-economic hurdles to widespread adoption of small-scale biogas digesters in Sub-Saharan Africa: A review. Biomass and Bioenergy, 70, 17-25.

Neij, L. (1997). Use of experience curves to analyse the prospects for diffusion and adoption of renewable energy technology. Energy Policy, 25(13), 1099–1107. https://doi.org/10.1016/S0301-4215(97)00135-3

Schelly, C. (2014). Residential solar electricity adoption: What motivates, and what matters? A case study of early adopters. Energy Research and Social Science, 2, 183–191. https://doi.org/10.1016/j.erss.2014.01.001

Walekhwa, P. N., Mugisha, J., & Drake, L. (2009). Biogas energy from family-sized digesters in Uganda: Critical factors and policy implications. Energy policy, 37(7), 2754-2762.

Wüstenhagen, R., Wolsink, M. and Bürer, M. J. (2007). Social acceptance of renewable energy innovation: An introduction to the concept. Energy Policy, 35(5), 2683–2691. https://doi.org/10.1016/j.enpol.2006.12.001