
The Effect of the Expected Time-to-Purchase on the Acceptable Price Premium for Green Buildings

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Abstract: Green buildings help to mitigate the impacts of construction on the environment by reducing the use of natural resources and limiting the emission of air pollutants associated with building construction and maintenance. Homebuyers who understand the life-cycle benefits of green buildings (such as lower operating costs, better indoor environment and reduced environmental impacts) are often willing to pay an additional price premium for such buildings. Although several studies examined the factors affecting the acceptable size of green building price premium, how the expected time to home purchase might affect the acceptable size of such premium remains unexplored. Here, we attempt to answer this question by using data from a countrywide survey carried out in Israel, in which responses from 390 potential homebuyers were collected and analyzed. We find that the willingness to pay a price premium for green buildings changes significantly with time to purchase and is the lowest for respondents who state that they do not plan to buy a home anytime in the near future. We explain this rather unexpected result by arguing that people who have no immediate home buying intention, might have only limited knowledge about contemporary housing market trends and thus do not consider green building as a viable alternative to traditional construction.

Keywords: Green Buildings, Price Premium, Time-to-Purchase, Israel, Survey

1. Introduction

The adoption of green building practices in the construction industry can contribute to a decrease in greenhouse gas emissions and reduced dependence on fossil fuels [1]. Consumers worldwide are increasingly attentive to environmental considerations, such as energy consumption, which has led to a remarkable growth in demand for environment-friendly products and services [2]. The demand for green buildings, however, strongly depends on knowledge about their benefits and cooperation between different housing market stakeholders [3], considering that the overall construction costs of such buildings tend to be higher than those of conventional ones [4, 5]. These additional costs are attributed to more expensive materials, import fees, embedded R&D investment, more expensive production, and special regulation costs, including commissioning, documentation, and compliance tests [6].

Recent literature provides evidence that factors affecting the consumer's decision to purchase a green apartment or building include reduced maintenance costs, energy savings, and the expected future rise in real estate values [3, 7, 8]. In addition, familiarity with the green building concept increases consumers' willingness to pay (WTP) a green building price premium, thereby stimulating green building demand [6].

As well established in the literature, consumers may be willing to pay a price premium if the perceived benefits from renting or buying a green property are higher than those conventional buildings can offer [6]. Previous studies in this field focused on general factors that influence the consumers' WTP a green price premium, including energy efficiency [9-11], initial investment costs and maintenance benefits [12, 13, 6]; environmental attitudes and social norms [14-16], and green building labeling [17]. However, to the best of our knowledge, no research has been conducted to date on the *effect of the expected time before home purchase on the acceptable size of green building price premium.*

Yet, this effect may be important, especially for *ex ante* studies, aiming at eliciting respondents' stated preferences and behavioral intentions, since an *open timeframe* in a WTP scenario may obscure or blur the budget constraints. Several studies point out that increasing the realism and immediacy of a stated WTP scenario can reduce a hypothetical bias in responses [18]. Such a bias may be especially relevant to questionnaire-based surveys, in which different time frames may fit different settings, but only explicitly determining the *time dimension* of the payment may ensure that the respondents answer the WTP question in a consistent way [18]. This can be arguably particularly important in studies concerning actions that occur with low frequency (such as purchasing an apartment) and where ensuring temporal contiguity between stated intention and behavior may result in models with little practical value [19].

2. Background Studies and Research Hypothesis

2.1. Underlying Motivations for Green Consumerism

Environmental awareness is widely considered to be the main motivator of green consumption [20, 21]. As well established in the literature, consumers who are more knowledgeable about environmental issues, tend to have a more positive attitude towards the purchase of environmentally friendly products [22, 23]. As also well established, environmental information guides consumers by pointing out environmental advantages, among other benefits, thus encouraging them to behave in a more environmentally friendly way [24].

The lack of environmental information available to consumers often results in an attitude-to-behavior gap between environmental concerns and actual buying behavior [25]. However, green consumption studies often explain *green purchase intentions* only, assuming that these intentions fully mediate the impact of social attitude and subjective norm on behavior, thus acting as a good predictor for behavior [24, 26]. As also well established, ecological values, environmental knowledge and environmental attitudes positively influence consumers' intentions to select green products over conventional ones [27, 28].

Although intention is generally accepted as a predictor for behavior [29], several studies point out at an action gap between intentions and behavior in general, observing that the predictive power of intentions on real behavior is actually low [30, 31]. The most common explanations for this action gap are the lack of full confidence in green products and often high prices of such products.

Empirical studies also reveal that *social pressure* from peers encourages consumers to purchase green products, which affectively drives sustainable consumption [22]. As a result, *pro-environmental social norms* positively influence behavioral intention towards purchasing green products [32]. However, subjective norms are not found to be significantly related to purchase intention [20]. Moreover, social values do

not necessarily have a significant impact on choice behavior, mainly because consumers did not always feel that "going green" increases their social approval rating or makes a good impression on others [21].

2.2. Acceptable Size of a Green Building Price Premium

Several studies examined the acceptable size of a green building price premium acceptable for consumers. Thus, in a recent study, Ofek *et al.* [3] observe that the maximum price premium that potential homebuyers in Israel are willing to pay for green buildings ranges between 5.28% and 6.96%, depending on the level of familiarity with green building benefits. This finding is aligned with the results reported by Kim *et al.* [11], who estimate that consumers' green premium in the U.S.A. ranges between 5 and 10%.

According to the results of another study by Mandel and Wilhelmsson [33], households in Stockholm, Sweden are willing to pay 2-4% more for energy-efficient systems and 5-8% more for technologies reducing water consumption. Similarly, Banfi *et al.* [34] put the acceptable size of green building premium for consumers in Switzerland in the range of 3-13%, depending on the implemented energy-saving measures.

Yet, Chau *et al.* [35] put the acceptable size of a green building price premium for consumers in Hong Kong at much smaller values of 3.72% for energy efficiency and energy conservation, and 3.32-3.47% for improved indoor air quality, noise level reduction, expansion of the landscape area and water savings.

2.3. The Effect of Time-to-Purchase on the WTP a Price Premium

When eliciting stated voluntary contributions through questionnaires, such as the WTP for a green apartment or building, the time constraint for implementing the declared intentions is often unspecified (see, for instance, Morri, and Soffietti, 2013 [5]). However, leaving the required period to implementation open makes the budgetary context ambiguous. In contrast, some arbitrarily short time-to-purchase (TtP) could amplify the constraints set by the current budget, thus presumably having a negative effect on WTP in compared to long-term commitments [36]. As Loomis *et al.* (1996) [37] point out, an explicit TtP constraints may limit uncertainty, thus reducing a hypothetical upward bias. As a result, different TtP periods may be appropriate for different settings. Yet, only *stating of the time dimension explicitly* can ensure that individuals are responding to the same scenario.

2.4. Research Goal and Hypothesis

This study aims to explore how the expected *time duration between the WTP statement and the home purchase affects the maximum acceptable price premium that consumers are willing to pay for green accommodations*. Our assumption is that *different time frames would result in different sizes of the acceptable green building price premium*. To verify this assumption, the following operational hypothesis is posited

for empirical testing:

H₀: Different TtP periods are unrelated to the acceptable size of a green building price premium that potential homebuyers are willing to pay for green accommodations.

H₁: there are significant differences between the acceptable size of a green building price premium that potential homebuyers are willing to pay for green accommodations in different TtP periods.

3. Research Method

The study is based on a nationwide survey of 390 potential homebuyers in Israel that was carried out by the "Dialog," Organizational Consulting, Research and Training Ltd, in 2016. The survey was conducted as an internet panel survey, with a sample error of $\pm 4.5\%$, and was funded by the Israel Ministry of Environmental Protection. The main goal of the survey was to explore the acceptable size of the green building price premium that potential homebuyers in Israel are willing to pay for green buildings, in comparison to conventional homes, and identify the main factors that affect it. The survey's results were previously discussed in Portnov et al. (2018), who focused on *stakeholders' attitudes* towards green buildings and *public policy tools* aimed at facilitating green construction. In a separate study, the results of the survey in question were used to reveal the *maximum size of green building price premium* acceptable to different groups of stakeholders, such as consumers, architects and developers (Ofek et al., 2018). Concurrently, in the present study, we look into the *effect of the TtP period on the price premium that consumers are willing to pay for green accommodations*, an important aspect that the previous studies largely overlooked.

3.1. Research Questionnaire

The questionnaire used in the study is reported in Appendix 1 and consists of four parts. The first part includes items focusing on the definition of green building and perceived green building benefits. The second part includes items focusing on policy *stimuli* that might influence potential homebuyers' willingness to buy a green apartment or building. In particular, the

respondents were asked to rate their knowledge about green buildings and their benefits on a 10-point bipolar Likert scale, from 1 (strongly disagree) to 10 (strongly agree). The third section of the questionnaire includes questions on the estimates of additional costs associated with green buildings, and the survey participants' WTP a price premium for a green accommodation. A set of socio-demographic questions about age, gender, education, and income bracket concludes the questionnaire. This section of the questionnaire also includes question on the immediacy of home purchase intention.

3.2. Statistical Analysis

The analysis of the survey's results was carried out in two stages. First, we used descriptive statistics and *t*-tests to compare the acceptable size of green building price premium (%) across different groups of respondents, stratified by their stated TtP intention. The ANOVA test was used next to investigate whether there is an overall difference between the survey groups in terms of their WTP. As ANOVA showed statistically significant one-way interactions, after rejecting ANOVA's null hypothesis of no significant differences, we used Tukey's Honestly Significant Difference (HSD) test as a post-hoc test to determine which specific groups differed. Next, we examined the effect of different factors, such as expected maintenance savings (%), TtP, apartment ownership and demographic characteristics of the respondents (education, age, monthly income, district of residence), on the acceptable size of green building price premium using multiple regression analysis.

4. Results

Table 1 reports the demographic attributes of the study population, referenced to the total population in the country. As the table shows, the sample is close to the general population in terms of education, average monthly income, and the district of residence. In addition, Figure 1A features the proportional shares of the study population sub-groups that differ by their TtP periods. At this figure shows, the majority of the survey respondents (about 89%) intend to purchase a home, while 11% of the respondents do not have such an intention.

Table 1. Descriptive characteristics of the study cohort (N=390) and its comparison with the general population of the country.

Variable	Survey participants		General population of the country
	Mean (%)	Sd ^a	Mean (%)
Number of years of schooling	14.72	2.48	16.00 ^c
Age	31.00	9.53	39.8 ^d
Monthly income (NIS)			
up to 12000	(87.7)		-
12,000-18,000	(9.8)		-
18,000-24,000	(1.8)		-
24,000 and more	(0.6)		-
Average income (NIS)	10,618 ^e	-	11,219 ^f
District of residence:			
Haifa and North	(36.5)	-	(27.9)
Tel Aviv and Center	(51.0)	-	(41.1)
Jerusalem	(12.5)	-	(31.0)

^a Standard deviation; ^b General population of Israel, as of 2016 (Source: ICBS, 2017); ^c Source: UNDP (2016); ^d Calculated using data for the 20–63 age group; ^e Authors' estimate; ^f Average net income of a male employee (Source: ICBS, 2017).

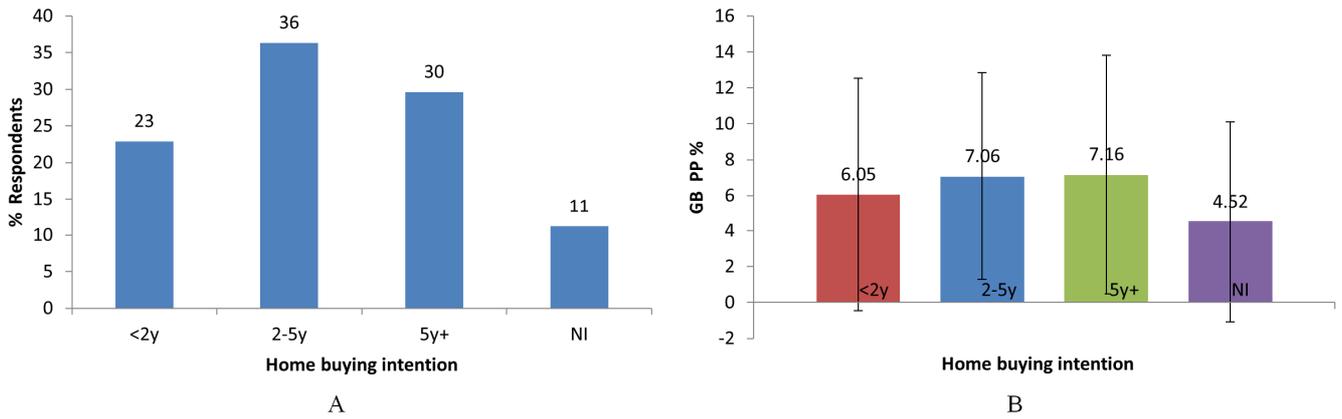


Figure 1. Immediacy of home buying intention among the survey respondents, % (A) and the acceptable size of GB PP (%) across different respondents' groups classified by immediacy of home-buying intention (B).

Notes: <2y =intention to buy an apartment within the next 2 years; 2-5y =intention to buy an apartment in the next 2-5 years; 5y+=intention to buy an apartment in the next 5 years or more; NI=no buying intention.

As Figure 1B further shows, the longer the planned time to buy an apartment, the higher price premium potential homebuyers seem to be willing to pay for green accommodations. Thus, people, who *do not* plan to purchase an apartment or house within next five years or more, state the smallest price premium (i.e., 4.52%±5.60), compared to

6.05%±6.50 for respondents who intend to buy an apartment within the next two years, and 7.16%±6.67, for respondents who intend to buy an apartment in the next five years or more. However, whether the observed differences are statistically significant is not immediately clear, which necessitates a more advanced analysis.

Table 2. GB PP (%) acceptable to consumers, characterized by different immediacy of stated home purchase intention (Method – ANOVA).

Purchase intention group	N	%	GB PP, % (mean)	Std. Dev.	F
Intention to buy an apartment in the next 2 years	88	23	6.05	6.50	2.47*
Intention to buy an apartment in the next 2-5 years	142	30	7.06	5.77	
Intention to buy an apartment in the next 5 years or more	116	36	7.16	6.67	
No buying intention	44	11	4.52	5.60	
Total:	390	100	6.58	6.23	

*Indicate a 0.05 significance level (two tailed).

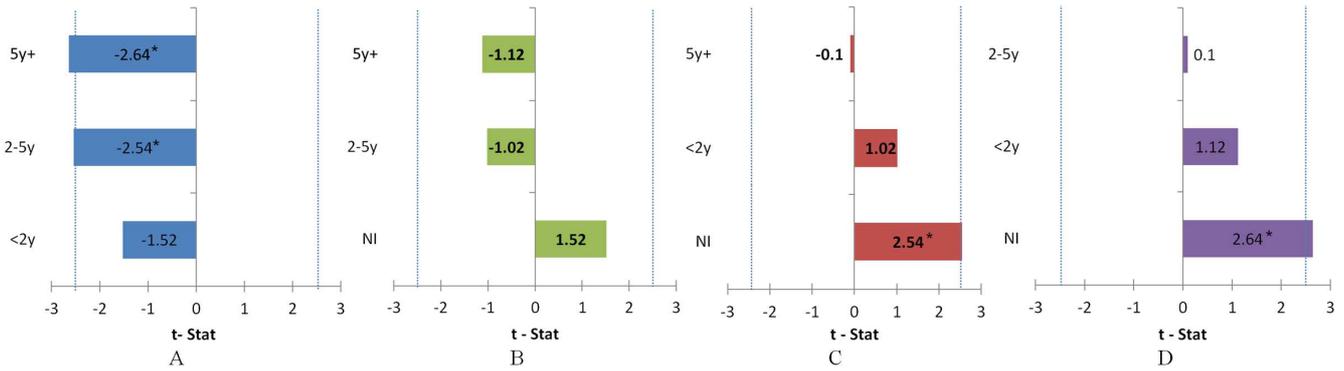
As Table 2 further shows, these differences in the acceptable size of green building price premium are statistically significant *overall* (F= 2.64; P<0.05). Tukey's HSD tests (see Figure 2 and Table 3) further reveals significant differences in the acceptable size of green

building price premium between consumers stratified by the time of purchase ranges from two to five years (t=2.54%; P<0.05), and time of purchase from five years or more (t=2.64%; P<0.05) in compare to those who do not plan to buy an apartment at all.

Table 3. Differences in acceptable GB PP (%) across different respondent groups (ANOVA- Post Hoc Tests LSD).

Respondent group (I)	vs. Respondent group (J)	Mean	Mean difference (I-J) and its significance level	95% confidence interval	
				Lower Bound	Upper Bound
Intention to buy an apartment within next 2 years (mean=6.05)	No buying intention	4.52	1.52	-0.73	3.77
	Intention to buy an apartment in the next 2-5 years	7.06	-1.02	-2.67	0.64
	Intention to buy an apartment in the next 5 years or more	7.16	-1.12	-2.84	0.60
Intention to buy an apartment in the next 2-5 years (mean=7.06)	No buying intention	4.52	2.54*	0.44	4.64
	Intention to buy an apartment within next 2 years	6.05	1.02	-0.64	2.67
	Intention to buy an apartment in the next 5 years or more	7.16	-0.10	-1.63	1.42
Intention to buy an apartment in the next 5 years or more (mean=7.16)	No buying intention	4.52	2.64*	0.48	4.80
	Intention to buy an apartment within next 2 years	6.05	1.12	-0.60	2.84
	Intention to buy an apartment in the next 2-5 years	7.06	0.10	-1.42	1.63
No buying intention (mean=4.52)	Intention to buy an apartment within next 2 years	6.05	-1.52	-3.77	0.73
	Intention to buy an apartment in the next 2-5 years	7.06	-2.54*	-4.64	-0.44
	Intention to buy an apartment in the next 5 years or more	7.16	-2.64*	-4.80	-0.48

*Indicates a 0.05 significance level.



Note: see comments to Figure 1.

Figure 2. Differences in the acceptable size of GB PP (%) between different respondent groups stratified by the immediacy of home purchase intent (Method: ANOVA - Post Hoc HSD test, estimating the significance of difference between a given group of consumers and other consumer groups under analysis).

Table 4 reports the results of multiple regression analysis linking the acceptable size of green premium (%) with factors affecting consumers' WTP green building price premium. As Table 4 shows, the factors that have a positive and significant effect on the acceptable size of green premium are expected maintenance savings ($t=6.00$; $p<0.01$); intention to purchase an apartment in the next two years or in the next five years or more ($b=1.06$; $t=2.08$; $p<0.05$ and $b=0.64$; $t=1.89$; $p<0.05$, respectively), and the age of the respondent ($t=3.24$; $p<0.01$).

Expectedly, consumers' income also has a positive effect on the acceptable size of the green building price premium, with low-income homebuyers (income up to NIS12,000 per household monthly (i.e., ~US\$3,400) generally willing to pay less than wealthier consumers ($t=-1.84$ $p<0.05$; see Table 4). Other socio-demographic data, such as education, apartment ownership, and region of residence, are found to have no significant effect on the acceptable green premium among consumers ($p>0.05$).

Table 4. Factors affecting consumers' WTP GB PP (dependent variable. WTP GB PP (%), method – multiple linear regression).

Variable	Model 1		Model 2	
	B ^a	t ^b	B ^a	t ^b
(Constant)	1.34	2.07*	1.54	1.24
Expected maintenance savings (%)	0.39	6.00**	0.37	5.74**
Intention to buy an apartment (reference=No buying intent)				
Intention to buy an apartment in the next 2 years	1.06	2.13*	1.05	2.08*
Intention to buy an apartment in the next 2-5 years	0.45	0.98	0.57	1.20
Intention to buy an apartment in the next 5 years or more	0.64	1.36	0.92	1.89*
Education (reference= High school)				
Academic	-	-	0.06	0.22
Professional	-	-	0.32	0.87
Apartment ownership (reference=not owning an apartment)				
Single apartment owner	-	-	-0.39	-1.20
Owning more than one apartment	-	-	0.06	0.10
Monthly household income (NIS) (reference=NIS24,000+)				
up to NIS12,000	-	-	-1.88	-1.84*
NIS12,000 to NIS24,000	-	-	-1.91	-1.83*
Age (years)	-	-	0.04	3.24**
District of residence (reference=South)				
Haifa and North	-	-	0.31	0.68
Jerusalem	-	-	0.67	1.23
Tel Aviv and Center	-	-	-0.17	-0.41
No of obs.	390		390	
F	10.44**		4.91**	
R ²	0.10		0.15	

Model 1: Intention to buy an apartment; Model 2: Intention to buy an apartment and sociodemographic attributes added. ** Indicate a 0.01 significance level; *Indicate a 0.05 significance level (two tailed).

5. Discussion

The present study explores how the expected length of time until purchase might affect the size of a green building price premium acceptable to consumers. We find that

consumers' WTP a green price premium changes significantly with TtP ($p<0.05$). In particular, as our multiple regression analysis shows, in comparison to people who have no immediate purchase intention, consumers who plan to purchase an apartment or house in the next two years are willing to add, *ceteris paribus*, 1.06% for the green features

Part II

3. On a scale of 1 (will not affect at all) to 10 (will strongly affect), please rate the extent to which the following measures may affect your willingness to purchase a house or an apartment rated as a green building, instead of purchasing a similar conventional house or apartment:

Table A2. Incentives for green building.

	Will not affect at all ←————→ Will strongly affect much										Don't know	
	1	2	3	4	5	6	7	8	9	10		
1 Providing the public with more and better information about green building benefits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2 Organizing guided tours to green building sites and houses	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 Providing courses and workshops on green building	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4 Subsidizing loans and grants for purchasing certified green building house/apartment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 Labeling new and existing buildings according to their compliance with green building standard	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6 Granting tax reducing to green building homebuyers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7 Advertising and educating about green building advantages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4. In the table below, please choose your estimation of the cost premium (to the developer) for constructing a new house or apartment rated as a green building, in comparison with constructing a similar conventional house or apartment:

Table A3. Green Cost Premium Estimation.

0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%
22%	23%	24%	25%	26%	27%	28%	29%	30% and more		

Part III

5. In the table below, please choose the maximum price premium that you will be willing to pay for purchasing a new house or apartment rated as a green building, in comparison with purchasing a similar conventional house or apartment:

Table A4. Willingness to pay a green premium.

0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%
22%	23%	24%	25%	26%	27%	28%	29%	30% and more		

6. In the table below, please choose your estimation of the maximum percentage of expected saving in annual maintenance expenses in a new house or apartment rated as a green building, in comparison with a similar conventional house or apartment:

Table A5. Estimating the annual savings of a green house.

0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%
22%	23%	24%	25%	26%	27%	28%	29%	30% and more		

7. In the table below, please choose your estimation of the payback period required for recovering the cost premium of a green building house or apartment through maintenance savings:

Table A6. Estimating the payback period required for recovering the cost premium of a green building house.

months to year	1 year	2 years	3 years	4 years	5 years
6 years	7 years	8 years	9 years	10 years	11 years
12 years	13 years	14 years	15 years	16 years	17 years
18 years	19 years	20 years and more	Will never return the cost premium		

Part IV

8. Please answer the following demographic questions:

Table A7. Demographic Questionnaire.

What is your region of residents?	North	South	Center	Other
What is your gender?	Male		Female	
What is your age range?	20-29	30-39	40-49	50-59 60-69 70 and above
What is your education?	Elementary	High school	Proportional, Practice degree	Academic degree
How many years of schooling do you have?				
What is your marital status?	Single	Married	Divorcee	Widower

Do you have children?	Yes, no. of children:		No		
What is your ethnic identity?	Jewish	Arab		Other	
What is your degree of religiosity?	Not religious- secular	Not religious- observes	Religious tradition		Very religious
When do you intend to buy a home or an apartment?	I do not intend to buy	During the next two years	Within two to five years		In more than five years
Will you have to take a mortgage for purchasing a house or an apartment?	Yes		No		
Do you currently own a house or an apartment?	Yes, only one		Yes, more than one	No	
What is your net monthly income (in NIS)?	Up to 6,000	6,000-12,000	12,000-18,000	18,000-24,000	Over 24,000

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