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CHOOSING TO PAY MORE FOR ELECTRICITY: AN EXPERIMENT ON THE LEVEL OF RESIDENTIAL CONSUMER COOPERATION

NOÉMIE **MARTIN**
PIERRE-OLIVIER **PINEAU**

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Choosing to Pay More for Electricity: an experiment on the level of residential consumer cooperation

Noémie Martin [*] *and Pierre-Olivier Pineau* [†]

Abstract/Résumé

Reducing energy consumption and carbon emissions are two cornerstones of the fight against climate change. Signaling negative externalities of individual consumption on the environment is at the heart of public policies, and usually materializes through an increase in the price of polluting good and services. However, social resistance typically arises when such policies are implemented. In this experiment, we are interested in testing the context in which individuals would be willing to pay more for electricity. We use the situation of Québec (Canada), where low-cost hydropower sold below market value, akin to a consumption subsidy, leads to high residential consumption. Increasing regulated prices closer to their market value would result in a direct welfare gain and free some green energy, reducing greenhouse gases (GHG) in other sectors. The choice to pay more is a prisoner's dilemma, and we find in this framework that giving clear and transparent information on the consequences of the price increase induces a majority of people to choose to pay more. In addition to the economic benefit of the public good, the presence of the environmental benefit increases contributions. Participants with a more severe budget constraint tend to contribute less. These results are encouraging for the development of efficient energy policies reducing GHG emissions.

La réduction de la consommation d'énergie et des émissions de carbone sont deux pierres angulaires de la lutte contre le changement climatique. Signaler les externalités négatives de la consommation individuelle sur l'environnement est au cœur des politiques publiques, et se matérialise généralement par une augmentation du prix des biens et services polluants. Cependant, la résistance sociale se manifeste généralement lorsque de telles politiques sont mises en œuvre. Dans cette expérience, nous souhaitons tester le contexte dans lequel les individus seraient prêts à payer plus cher pour l'électricité. Nous utilisons la situation du Québec (Canada), où l'hydroélectricité à faible coût vendue en dessous de la valeur du marché, ce qui s'apparente à une subvention à la consommation, entraîne une forte consommation résidentielle. Une augmentation des prix réglementés plus proches de leur valeur de marché entraînerait un gain de bien-être direct et libérerait une partie de l'énergie verte, réduisant ainsi les gaz à effet de serre (GES) dans d'autres secteurs. Le choix de payer plus est un dilemme du prisonnier, et nous trouvons dans ce cadre que donner des informations claires et transparentes sur les conséquences de l'augmentation des prix incite une majorité de personnes à choisir de payer plus. En plus de l'avantage économique du bien public, la présence de l'avantage environnemental augmente les contributions. Les participants ayant une contrainte budgétaire plus sévère ont tendance à moins contribuer.

[*]CIRANO. 1130, Sherbrooke Ouest, suite 1400, Montréal, Québec (Canada) H3A 2M8. noemie.c.martin@gmail.com

[†] HEC Montréal, Department of Decision Sciences. 3000, chemin de la Côte-Sainte-Catherine, Montréal (Québec), H3T 2A7 Canada. (+1) 514 340-6922, pierre-olivier.pineau@hec.ca.

Ces résultats sont encourageants pour le développement de politiques énergétiques efficaces réduisant les émissions de GES.

Keywords/Mots-clés: Public good, Voluntary environmental action, Green electricity / Bien public, action environnementale volontaire, électricité verte

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1 Introduction

Reducing CO2 emissions in the energy sector is essential if countries are to meet their climate targets in the coming decade. Improving energy efficiency and promoting energy sobriety are two solutions to reduce energy consumption and ease decarbonization efforts. Unfortunately, there exists no silver bullet that will achieve this ambitious goal without impacting the lives of individuals. An advocated policy for decades is to increase the price of energy by the value of its potential environmental damages. Consumers should optimally interpret this price signal and take adequate actions reducing their energy demand and its noxious impacts. However, in reality, price increases are rarely well accepted and sometimes induce social resistance, as it was the case for the "gilets jaunes" crisis in France in 2019. To prevent such dire circumstances, governments are often willing to keep energy prices artificially low to prevent public opposition. In North America, several regions keep the residential electricity prices under the market price, and hence subsidize residential consumption. This is particularly the case in hydro-rich regions, such as the stats of Washington, Oregon, Tennessee, Alabama, New York (U.S. Energy Information Administration, 2022) in the United States, where hydropower is sold at cost-based energy rates (U.S. Department of Energy, 2021). In Canada, this is true in many provinces (Ontario, British Columbia, Manitoba) but especially in Québec, which has both the highest hydropower production and the lowest electricity rates (International Energy Agency, 2022). These low prices encourage high electricity consumption (Statistics Canada, 2021), and create a "rebound effect", a situation where the cost reduction of a given good or service (here a price reduction) leads to an increase in the overall consumption of that good or service. In the context of Québec, this creates a distortion in the market and a welfare loss for society due to the unnecessary subsidization of "green" electricity, and prevents the progress of energy sobriety.

Our prime interest is thus to investigate whether there exists a context in which people would be willing to pay more for renewable electricity. Verifying this assumption would help to design more efficient and socially acceptable energy policies. We are interested in testing the level of residential consumers cooperation in the presence of two benefits resulting from the contribution to a public good: an economic benefit (stemming from the reduction of the subsidy, leading to higher profits made by the hydro-power firm and redistributed to all participants) and an environmental benefit (GHG reductions resulting from the decrease in electricity consumption, allowing other sectors to substitute low-emission hydropower to more GHG-intense

energy sources). We conducted public good games experiments in 2009 and in 2022, where climate change awareness has risen, and analyze how these two benefits affect individuals propensity to pay a higher price.

The classic literature on public goods shows that players do contribute more than what self-interest rationality predicts. Our results corroborate with this observation, as we find that a majority of participants are willing to pay a higher price, and that this share tends to increase in time (between 2009 and 2022). The presence of the environmental benefit in addition to the economic benefit seems to reinforce cooperation when the game is repeated. Initial endowment in terms of electricity consumption affects contributions: more financially constrained households are less inclined to choose the higher price. We observe that there exists multiple cooperation behaviours when the game is repeated, but we notice an overall tendency towards cooperation stability. We thus demonstrate that people are willing to increase the price they are already paying for renewable electricity, in order to eliminate a welfare loss due to an unnecessary subsidy on electricity. Other studies focus on the willingness-to-pay (WTP) to adopt renewable electricity, whereas this experiment tests in the laboratory if people are willing to pay more to foster energy sobriety and reduce GHG emissions.

Section 2 presents the literature on public good games and provides the context for this study. Section 3 presents the experimental design and results are provided in section 4. A discussion follows in Section 5.

2 Literature review

2.1 Public Good Games in the literature

Many theoretical settings investigate the role of social preferences and beliefs in voluntary contributions to a public good. Croson (2007) demonstrates that contributions can be explained by reciprocity, commitment or altruism: in particular, she finds evidence of a positive correlation between an individual's contribution and her beliefs about others' contributions. Voluntary contributions are also partly explained by preferences heterogeneity. Different types of contributors have been defined: free-riders who never contribute and act as rational self-interest maximising agents, and conditional cooperators who contribute only if others contribute (Fischbacher and

Gächter, 2008).

Further observations showed that repeated public good games tend to decrease contributions over time (Croson, 1996; Andreoni, 1988). Even in the absence of free-riders, cooperation decreases as conditional cooperators update their beliefs and consider that others do not contribute enough (Fischbarer and Gächter, 2010). Heterogeneity in returns seems to slightly decrease cooperation, and adding uncertainty does not seem to affect unconditional contributions (Fischbacher et al., 2014). However, the impact of group formation, in particular the effect of reputation, has an ambiguous impact on the level of contribution. Andreoni (1988) and Palfrey and Prisbrey (1996) find that individuals contribute more with strangers than with partners, Croson (1996) finds that more contributions are made when players are grouped with partners, while Weimann (1994) finds no significance difference. So far, the literature on multiple public goods games focuses on contribution behaviors when individuals face multiple competing public goods, with identical or different returns, and have to choose what amount to contribute for each good. Cherry and Dickinson (2008) show that contributions increase in a multiple goods context, compared to the classic single public good game. In the case of multiple charities, framing plays a central role in the level of donations (Maciel Cardoso et al., 2021). However, the literature has not covered how players react to a single public good with multiple benefits, i.e. when they make a single contribution to a public good that has several distinct outcomes, such for example a financial gain and a reduction in GHG emissions. This paper investigates how contributions evolve when individuals have to make one contribution for a public good with two benefits: a social economic one, and an environmental one. This framework could also be considered as an public good game with an increasing non-financial return when the environmental benefit is introduced.

2.2 An experiment with a real context

In most articles cited above, and in the public good game literature in general, the focus is on abstract experimental settings, with only one public good. However, in the real life context, many choices must be made on policies involving public goods. Although for some of them, there is no debate over their financing by the government (i.e. local and national security, primary education, judicial system), in other cases this process is less obvious, and particularly for environmental protection. Despite numerous reports on climate emergency and the various threats faced

by humans (see IPCC report, 2022), there remain controversies on how to enforce policies against climate change. Even so, there exists a substantial literature on empirical measures of the WTP for green products, and in particular for renewable electricity. A majority of estimates are derived from contingent valuation methods using responses to surveys. The controversies around this method have been extensively discussed by Oerlemans et al. (2016), one of them being the presence of hypothtical bias: people tend to state higher amounts from what they would actually do in reality. In that case, confirming the "true" WTP for green electricity with a laboratory experiment is of prime interest.

Public goods sometimes provide simultaneously multiple benefits: environmental goods can have additional health and/or economic benefits. For instance switching from cars to cycling lowers pollution from transportation. It also has additional health benefits since it is a more active type of transportation (Sallis et al., 2004), and health can be considered as a public good. To some extent, there may be an additional economic benefit from the reduced public resources dedicated to automobile-based transportation (road construction and maintenance, subsidies to car manufacturers, productivity losses in congestion). These co-benefits that were not primarily intended by public policies are defined as ancillary benefits, and gained particular attention from researchers in the 1990s because of their potential substantial size (see Buchholz et al. (2020) for more details on ancillary benefits of climate policies). Schwirplies and Ziegler (2016) even consider warm-glow and social norms associated to the consumption of green products as ancillary benefits. In this experiment however, we consider the environmental benefit as a direct primary effect.

Many studies focus on experiments in electricity markets, and mostly focus on three features: bidding schemes and market structures, psychological determinants of consumer decisions and optimal green tariffs contribution mechanisms. Rassenti and Smith (2008) use experiments to study optimal bidding processes and market designs, while Kiesling (2005) argues that experiments are needed to determine optimal policies for electricity markets. Some experimental studies concentrate on the elements of the psychological environment of individuals that would influence their propensity to purchase green electricity. Pichert and Katsikopoulos (2008) explain that more consumers tend to choose a green tariff when it is the default option than when "gray" electricity is the default. Framing also plays a major role: when the attributes of green electricity are positively presented, people tend to select renewable energy more frequently, independently of their initial attitude towards climate and the environment (Verhagen et al., 2012). The features of the chosen contribution mechanism also influence how much people are willing to pay for green

electricity: Mitra and Moore (2018) find that a voluntary contribution mechanism (VCM) generates significantly more revenue than a green tariff scheme. They also find that warm-glow preferences play a central role in contribution behavior in the case of a all-or-nothing contribution mechanism. On the other hand, Ma and Burton (2016) find that in the context of green electricity products, consumers tend to choose the minimum level of commitment (lowest possible contribution), explained by warm-glow preferences. This result corroborates with a study by Kotchen and Moore (2007) that finds that participation increases with environmental concern and altruistic behaviors. Moreover, Mitra and Moore (2018) recommend to implement an all-or-nothing green tariff in regions where the population exhibits high level of warm-glow altruism to maximise generated revenues. All these results confirm Schwirplies and Ziegler (2016) results mentioned above: altruism and warm-glow are intrinsically related to contribution behaviours.

This paper investigates how the propensity of residential consumers to choose to pay more for electricity is influenced by an all-or-nothing contribution mechanism to a public good with multiple benefits, where consumers have heterogeneous consumption levels and face various uncertainty levels over the environmental benefit, and total contributions are equally benefiting all. Due to the presence of an environmental benefit that does not generate economic returns for consumers, we expect potentially important warm-glow effects that may lead to different results than those from the classic public good games literature. A comparison of two experiments made at thirteen years time interval (2009 and 2022) also allows for a temporal comparison of contribution behaviours. Participants in 2022 played several rounds, which allows the analysis of groups dynamics. This study is thus at the crossroad of different literature trends. We are interested in how an experiment with realistic price setting can help answer the following research questions: Are residential consumers willing to pay more for their electricity ? How does their initial consumption affect their willingness to pay more? Does an additional environmental public good (GHG reduction) increase their propensity to contribute? Does it help sustaining cooperation over time?

3 A Public good game with multiple benefits

In this experiment, participants are asked to choose between two prices for electricity. The Basic Price option reflects the situation in Québec (Canada), where electricity prices are low, while the Alternative Price option better reflects the price level in

North America, where the price for electricity is much higher.

3.1 The two public goods

Electricity prices in Québec are among the lowest among North America regions. For instance, in 2021 a 1,000 kWh bill was 74 CAD in Montréal (Québec), while it cost 134 CAD in Toronto (Ontario) and 318 CAD in Boston (Massachusetts) (HydroQuébec, 2021). This is partly due to the fact that 93.6% of electricity in Québec was produced from hydro power in 2020 (Environment and Climate Change Canada, 2022), whose low production costs allow a low tariff based on average-cost principle. Electricity consumption in Québec is also the highest in Canada: in 2020, residential electricity consumption was 8,266 kWh per capita in Québec compared to a national average of 4,909 kWh (Statistic Candada, 2021). Low prices attract many energy-intensive industries, and do not give incentives to local residential consumers to be energy efficient, and are hardly compatible with energy sobriety. On the other hand, neighboring regions charge higher prices for electricity, and it comes from more polluting sources: nearly 60% of electricity is produced with natural gas in New England (U.S. Energy Information Administration, 2022).

When choosing the Alternative Price option, consumers have a higher electricity bill compared to the Basic Price. We assume that they consequently decrease their consumption, which liberates electricity to be exported in neighboring regions where a higher price is charged. The publicly owned hydro-power firm, Hydro-Québec, thus makes higher profits from both sales. These profits are then redistributed among all local citizens, even those who chose not to contribute (those choosing the Basic Price option).

In addition to this economic benefit, higher electricity prices would also create an environmental benefit. Exporting the hydro-power based, and thus low emission, electricity replaces natural gas-generated electricity in neighboring regions, as the latter is more expensive. This would lower overall GHG emissions, which constitutes a global public good.

3.2 Experimental design

This experiment was first carried out at in 2009, and was then re-conducted in 2022 with some additional features. In order to allow inter-temporal comparison, all sessions were made as identical as possible. As we are interested in how people contribute to a public good with two benefits under heterogeneous endowment, two treatments were applied to participants. The first one is the assignment to a type of household with a given initial level of electricity consumption. To control for the environmental public benefit, the second treatment is the uncertainty regarding the presence of this benefit, and for some participants the absence of benefit. Electricity consumption mostly depends on home size, and whether electric heating is used or not, especially for regions enduring cold winters such as Québec, where the experiment took place. We defined four types of households:

- **Type A**, living in a single detached home and using electric heating. Annual consumption: **35,472 kWh** (2009), **32,054 kWh** (2022).
- **Type B**, living in a single detached home and not using electric heating. Annual consumption: **11,440 kWh** (2009), **10,338 kWh** (2022).
- **Type C**, living in an apartment and using electric heating. Annual consumption: **17,806 kWh** (2009), **16,090 kWh** (2022).
- **Type D**, living in an apartment and not using electric heating. Annual consumption: **7,775 kWh** (2009), **7,026 kWh** (2022).

These consumption levels were estimated first in 2009 from the Comprehensive Energy Use Database of Natural Resources Canada (2009). The consumption level of type A households was calculated identically for 2022 (Natural Resources Canada, 2022), and the same rate of change from 2009 to 2022 was applied for the other household types. As participants were initially given the same budget (300 CAD), these consumption levels constitute heterogeneous initial endowments: participants with a higher initial electricity consumption are more affected by a change in electricity prices, which would decrease their disposable income more severely. It is thus expected that participants with a higher initial electricity consumption (types A and C) will be less likely to choose the Alternative Price option.

To study the influence of the environmental benefit, participants were facing various levels of uncertainty regarding the realization of GHG emission reductions when

choosing the Alternative Price option. Three (four in 2022) levels of uncertainty were introduced:

- **Certainty**: Choosing the Alternative Price option would lead to the specified GHG emission reductions with a probability of 1.
- **Risk**: Choosing the Alternative Price option would lead to the specified GHG emission reductions with a probability of 0.5.
- **Ambiguity**: Choosing the Alternative Price option would lead to the specified GHG emission reductions with an unknown probability.
- **No environmental benefit**: Choosing the Alternative Price option would not lead to GHG emission reductions (only for the 2022 experiment sessions): no mention of the environmental benefit was made to the participants in this group.

The fourth certainty level was introduced only in 2022, and would be comparable to a classic public good game, with only one economic benefit. Table 1 summarizes the experimental design.

Table 1: Experimental design

		Uncertainty level on the environmental benefit			
		Certainty	Risk	Ambiguity	No benefit (2022 only)
Initial endowment	A	$\text{Group}_{A-Certain}$	Group_{A-Risk}	Group_{A-Amb}	Group_{A-NB}
	B	$\text{Group}_{B-Certain}$	Group_{B-Risk}	Group_{B-Amb}	Group_{B-NB}
	C	$\text{Group}_{C-Certain}$	Group_{C-Risk}	Group_{C-Amb}	Group_{C-NB}
	D	$\text{Group}_{D-Certain}$	Group_{D-Risk}	Group_{D-Amb}	Group_{D-NB}

3.3 The experiment

The experiment was held twice, thirteen years apart. Both times, the sessions were held in the CIRANO's Experimental Economics Laboratory in Montréal (Quebec, Canada). The sessions in 2022 repeated the 2009 sessions, but additional questions

were asked in 2022. The experiment involved 200 participants in 2009, and 164 participants in 2022, where sessions in English and in French were held.

First, participants were assigned to a household type: they were asked to randomly select a card with a seat number between 1 and 20, without knowing what household type had been pre-assigned to the seat number. Each participant received an initial budget of 300 CAD for each price decision they had to make, in experimental money (which value was set 10 times higher than real Canadian money in 2009, and 20 times higher in 2022). In both sessions, they had to choose which price to pay for electricity from two distinct options: the Basic Price option, and the Alternative Price option. Depending on their choice, they had to pay the corresponding bill from their initial budget.

In 2009, participants faced the price options[3] presented in Table 10 in Appendix 1. The Basic Price option (called the "Current" Price option at the time) represented the current residential pricing rules in place in Québec. It includes a fixed charge of $12.36, independent from consumption, a first block of 912 kWh, where each kWh was charged at $0.0545, and all additional kWh were charged at $0.0746. The Alternative Price option kept the same price structure as the Basic Price option, but the price per kWh increased by $0.03, both in the first block and for additional kWh. This price better reflects the higher market price in neighboring regions (Ontario, New England, New York, New Brunswick), and the production costs of recent generation projects in Québec. It is also assumed that consumers decrease their electricity by 10% when choosing the Alternative Price option.

In 2022, participants faced the same two options. The price of the Basic Price option was fixed to the actual price charged by Hydro-Québec at the time of the experiment. The fixed charge increased to $12.52, the first block increased to 1,217 kWh and $0.0616 per kWh, additional kWh were priced at $0.095. Overall, the consumption levels of all types decreased while the prices slightly increased: the resulting bills were equivalent in 2009 and 2022. The change of price between the Basic option and the Alternative option was maintained at $0.03 in 2022, in order to have comparable results with the 2009 experiment and because it still reflected the market price difference. The two options are presented in Table 11 in Appendix 2.

Participants had one choice to make: deciding the price, and hence the total to pay between the two offered options, corresponding to the amount in the "Total"

3. As presented in the provided instructions

columns in Tables 10 and 11 (in Appendix 1 and 2), depending on their type of household. As explained before, paying the higher price leads to a 10% consumption reduction, as it can be seen in the tables. The power firm makes additional profits when consumers decide to pay more, since it sells 90% of the Basic electricity consumption \$0.03 higher than before, and the remaining 10% on external markets, also at a \$0.03 higher price. Participants were randomly placed in subgroups of four participants, with one participant of each type. The additional profits resulting from the four members' decision were shared between them, and corresponds to the social economic benefit of the public good. The final payments that each participant received corresponds to the initial budget (300 CAD), minus the total cost resulting from the chosen electricity price, plus the economic benefit resulting from the group members' decisions. All payments were rounded up to 5\$, without prior mention to the participants to prevent any effect on decisions. Table 2 shows the average profits made by the participants in round 1, depending on their household type and the price option they chose. Note that these profits also depend on the decision of the other members of their group.

Table 2: Average profits (experimental money) and standard deviations for round 1 (2022), by household type and choice of price option

Choice of price option in round 1	Household type			
	A	B	C	D
Basic Price option	85.81	252.61	214.60	271.05
	(1.42)	(2.91)	(2.95)	(3.28)
Alternative Price option	58.44	240.68	202.42	262.69
	(1.59)	(2.24)	(2.10)	(2.43)

To provide a real environmental outcome induced by participants' decisions, real carbon offsets were purchased at the end of the experiment, in front of participants. The amount of offsets was equivalent to the avoided emissions resulting from the electricity consumption reductions obtained by paying the higher price. The commercial website http://planetair.ca was used to buy Gold Standard carbon offsets. The corresponding carbon offsets purchased, when a participant of a certain type of household chooses the Alternative Price option, are shown in Table 3[4].

4. As presented in the provided instructions

Table 3: GHG emission reduction and corresponding carbon offsets value for each type of participant

About 0.5 ton of GHG reduction per 1,000 kWh saved			
2009	Monthly electricity saved (kWh)	GHG reduction (ton of CO2)	Dollar value of carbon offsets
A	296	0.148	$5.92
B	95	0.048	$1.88
C	149	0.074	$2.96
D	62	0.033	$1.32

About 0.25 ton of GHG reduction per 1,000 kWh saved			
2022	Monthly electricity saved (kWh)	GHG reduction (ton of CO2)	Dollar value of carbon offsets
A	267	0.067	$2.54
B	86	0.022	$0.82
C	134	0.034	$1.27
D	59	0.015	$0.56

The utility function of participants can be specified as follow:

$$U_i = 300 - x_i - a_i(y_i - x_i) + S + a_i\beta_i(y_i - x_i) + \lambda_i \sum_i a_i(y_i - x_i)$$

$$\text{where } a_i = \begin{cases} 0 & \text{if } i \text{ chooses the Basic price} \\ 1 & \text{if } i \text{ chooses the Alternative price} \end{cases}$$

Individual i pays the bill x_i with the Basic Price option. The additional cost of contributing $(y_i - x_i)$, is paid when choosing the Alternative Price option. S represents the economic benefit each participant received from overall contributions. This share corresponds to this calculation:

$$S = \frac{\text{Sum of Basic consumption of participants choosing the Alternative Price} * \$0.03}{\text{Number of participants in their subgroup } (=4)}$$

Additional terms affect the utility function: β_i (≥ 0) corresponds to the warm-

glow effect (or satisfaction) of the individual's own contribution, i.e. the difference between the bill with the Alternative Price and the bill with the Basic Price, and λ_i (≥ 0) represents the individual sensibility to the environment and altruistic preferences, i.e. the satisfaction an individual perceives from total contributions, independent of her own contribution. In the case where $\mathbb{E}[|x_i - y_i|] < \mathbb{E}[S + a_i\beta_i(y_i - x_i) + \lambda_i \sum_i a_i(y_i - x_i)]$, i.e. in the case where the savings from not cooperating are smaller than the expected total satisfaction from cooperating, we expect that a rational player would act as an unconditional contributor, and as a free-rider otherwise.

After entering the laboratory, participants were randomly given a seat number and received a set of instructions (see Appendix 4 and Appendix 5). Instructions were read out loud and questions were answered. In the 2009 experiment, participants had only one choice to make. They took between 5 and 15 minutes to choose one Price option, and wrote their answer on a sheet of paper. A short exit questionnaire was distributed, carbon offsets were purchased and payments were made.

The 2022 experiment replicated the 2009 experiment, with the exception that it was held on the Z-tree software (Fischbacher, 2007) and additional questions were asked. After learning about their type and being randomly placed in a group of four participants, they were asked questions on their conditional contribution preferences, depending on how many members in their group chose the Alternative price option.[5] They did not receive any payments based on these questions. After that, they were asked to choose one price option, as in the 2009 experiment. The number of participants in the group of four who chose the Alternative Price option in this round was disclosed to each participant, as well as the resulting economic and environmental benefits. For the second round, they remained in the same group of four participants, received another 300 CAD and were asked to chose between the two options, knowing how many participants chose to contribute in the previous round. Again, resulting economic and environmental benefits were disclosed, along with the number of participants in their group who chose to contribute. In the third round, groups were randomly shuffled and each participant was placed in a new group of four participants. They had a new (and third) 300 CAD budget, had to

5. Questions were asked as follow: Which option do you choose in the following situation ?

- Three participants in your group choose the Basic price option.
- Two participants choose the Basic Price option, and one participant chooses the Alternative price option.

And so on for all possible combination of contributing and not contributing members.

chose between the two options, and results were displayed. They received a payment for their answers in these three rounds. Finally, they had to fill in exit questionnaires measuring their altruistic behaviours, their sensibility to the environment, and their level of confidence in the institutions. These questionnaires were conceived after Kotchen and Moore (2007) and after the Eurobarometer and Latinobarometer, and were not included in participants' payments. The questionnaire on the sensibility to the environment followed the statements developed in the New Ecological Paradigm (Dunlap et al., 2000), while the one on altruistic preferences adopts statements established by Schwartz (1970, 1977). The questions asked can be found in Table 4[6], as well internal consistency for each scale, measured by Cronbach's alpha.

In both 2009 and 2022, the various uncertainty groups received slightly distinct instructions on the environmental benefit realization.

- Risk group: "There may be an environmental benefit from choosing the Alternative option. To determine whether there is an environmental benefit, we will place 10 balls in a bag, 5 blue, and 5 yellow. At the end of the experiment, one participant will choose the color that represents the benefit, and another participant will pull a ball out of the bag without looking into the bag. If the ball is the color representing the benefit, then there is a benefit. If the ball is not the color representing the benefit, then there is no benefit."
- Ambiguity group: "There may be an environmental benefit from choosing the Alternative option. To determine whether there is an environmental benefit, we will place 10 balls in a bag, an unknown number of blue, and the rest yellow. At the end of the experiment, one participant will choose the color that represents the benefit, and another participant will pull a ball out of the bag without looking into the bag. If the ball is the color representing the benefit, then there is a benefit. If the ball is not the color representing the benefit, then there is no benefit."

For the certainty group, they were told that the environmental benefits shown in Table 3 would happen as a consequence of all participants decision. In 2022, no mention of an environmental benefit was made to the no benefit group.

6. Altruism and sensibility to the environment are measured with a five-point scale, ranging from "strongly agree" to "strongly disagree", whereas the trust in institutions scale ranges from "very high" to "not high at all". Answers are then re-coded from 1 to 5 to translate preferences, where high numbers represent a high sensibility to the environment, strong altruistic preferences and high levels of confidence in the institutions.

Table 4: Questions in the exit questionnaires

	Questions	Mean	Standard deviation
	Altruism scale		
	Five-points scale, from "strongly disagree" (1) to "strongly agree" (5)		
1.	Contributions to community organizations rarely improve the lives of others.	3.74	0.10
2.	The individual alone is responsible for his or her well-being in life.	2.95	0.10
3.	It is my duty to help other people when they are unable to help themselves.	3.59	0.08
4.	My responsibility is to provide only for my family and myself.	3.52	0.09
5.	My personal actions can greatly improve the well-being of people I don't know.	4.23	0.07
	Final score	18.02	0.30
	Cronbach's alpha	0.6824	
	NEP scale		
	Five-points scale, from "strongly disagree" (1) to "strongly agree" (5)		
1.	Plants and animals have as much right as humans to exist.	4.42	0.07
2.	The so-called "ecological crisis" facing humankind has been greatly exaggerated.	4.35	0.07
3.	Human ingenuity will insure that we do not make the earth unlivable.	3.20	0.09
4.	The earth is like a spaceship with very limited room and resources.	4.04	0.09
5.	The balance of nature is strong enough to cope with the impacts of modern industrial nations.	4.08	0.09
	Final score	20.09	0.23
	Cronbach's alpha	0.4652	
	Institutional Trust		
	Five-points scale, from "not high at all" (1) to "very high" (5)		
1.	Provincial government.	2.68	0.08
2.	Federal government.	3.07	0.08
3.	Public administration.	2.81	0.07
4.	Social benefit system.	3.07	0.08
5.	Hydro-Québec.	3.01	0.09
	Final score	14.64	0.29
	Cronbach's alpha	0.7867	

We expected that more participants would choose the Alternative Price option in 2022, compared to the 2009 sessions, as the environment, climate change and energy

issues are more more discussed and this should encourage participants to contribute. Considering what was found in the classic experimental literature, participants with a low endowment (a high initial electricity consumption: types A and C) and/or facing uncertainty in the environmental benefit should be contributing less than other participants. We also expect that the number of participants choosing the Alternative Price option will decrease when the choice is repeated. We might observe a lower decrease than what the classic theory predicts, as we could expect more unconditional contributors due to the presence of the environmental benefit.

4 Results

In the following section, we define a cooperator as a participant who chooses the Alternative Price option, or equivalently who chooses to contribute. Figure 1 summarizes unconditional contributions in the 2009 experiment and in the 2022 experiment (the single question in 2009, and the three rounds in 2022), by type of household and by certainty level on the environmental benefit. Overall, a majority of participants are willing to pay a higher price for electricity. Contributions increase substantially between 2009 (52%) and 2022 (59.15%), especially if we consider the certainty, risk and ambiguity groups only (62.93%): the share of cooperators in the first round increases by nearly 11 percentage points between 2009 and 2022. We test whether this difference is significant using a one-sample t-test and we find that the group facing an environmental benefit in 2022 contributed significantly more in the first round in 2022 than in 2009 (the p-value is 0.0084). This can be explained by the growing social concerns for the environment in the general population over the last decade. All the tests performed in this section are summarized in Appendix 3.

Figure 1: Results of the experiments: proportion of participants choosing to contribute

Year	Round	Type				Certainty level				**Total**
		A	B	C	D	certainty	risk	ambiguity	no benefit	
2009	1	44.00%	54.00%	56.00%	54.00%	56.25%	57.35%	42.65%	-	**52.00%**
2022	1	47.83%	59.52%	67.50%	63.89%	55.26%	64.44%	69.70%	50.00%	**59.15%**
							62.93%			
	2	36.96%	59.52%	62.50%	63.89%	57.89%	62.22%	66.67%	37.5%	**54.88%**
	3	41.30%	50.00%	55.00%	61.11%	57.89%	57.78%	57.56%	35.42%	**51.22%**

It can be expected that contributions vary among households types, since it is

more costly for participants endowed with a higher initial electricity consumption (namely types A and C) to choose the Alternative Price option. Some χ^2 tests are performed at a confidence level $\alpha = 5\%$, and the hypothesis of independence between all types of household and contribution can only be rejected for the second round in 2022 (p-values are respectively: 0.62 for 2009; 0.269, 0.038 and 0.324 for the three rounds in 2022). However, if we take households of type A, consuming much more electricity than other types, there is a significant result in 2022. We compare the share of type A participants who choose the Alternative option and the share of participants that are not a type A of household and choose the Alternative option in all rounds, and test the difference at a confidence level $\alpha = 5\%$. In 2009, it cannot be concluded that a lower proportion of type A participants chose to pay more compared to other types (the p-value is 0.126), but the nil hypothesis is rejected in 2022 for all rounds at a 10% confidence level (the p-values are 0.0331, 0.0019 and 0.0571 respectively for the three rounds), meaning that a lower share of type A participants contribute compared to other types of household.

Concerning the environmental benefit, results are as expected, but slightly different in 2009 and 2022. Ambiguity did reduce cooperation in 2009, but not in 2022. However, the absence of the environmental benefit significantly reduced cooperation in 2022. Certainty did not play the same role in 2022 than in 2009, and we have no definitive explanation for this. Maybe the understanding of the probabilities played a role.

In concrete terms, it cannot be concluded that the certainty level and contributions are independent in the second round of the 2022 experiment only, at a 5% confidence level (the p-values are 0.16, 0.268, 0.032, 0.079 respectively). However, participants in the ambiguity group contributed significantly less in 2009 than participants in the two other groups (p-value is 0.04). A different test is performed for 2022: we compare the share of cooperators in the groups that faced an environmental benefit (namely the certainty, risk and ambiguity groups combined) and the share of cooperators in the group with no environmental benefit. There is no significant difference in the scores for the altruism scale, the NEP scale and the institutional trust scale between these two groups (p-values are respectively 0.9293, 0.6665 and 0.2404). The groups with an environmental benefit contribute proportionally more in all rounds, at a 10% confidence level (p-values of 0.0634, 0.0019 and 0.0045 respectively). It also seems that the presence of the environmental benefit helps to sustain cooperation over time. See Figure 1: cooperation drops by 15 percentage points in the third round among participants who did not face the environmental benefit, compared to less than 5 percentage points when the environmental benefit

is mentioned. To test whether the presence of the environmental benefit does help to maintain a stable number of contributors over time, we test if the difference in the share of cooperators between rounds 1 and 3 in the no-benefit group is greater than in the groups facing the environmental benefit. We find that the presence of the environmental benefit does not significantly help to sustain cooperation over time (the p-value is 0.1406). However, we find that cooperation in the group facing the environment benefit *with certainty* tends to be more stable than in all other groups (p-value is 0.0719). Guaranteeing that paying a higher price for electricity will lead to GHG emission reductions thus allows to maintain the number of contributors when repeating the game.

The 2022 experiment includes additional questions on conditional contributions, where participants had to decide what price option to pay depending on the number of members in their group who chose the Alternative price option (see section 3.3 for more details). This allows to define three types of contributors:

- **The free-riders**: they never choose the Alternative price option, for any number of participants in their group choosing the Alternative Price option.
- **The unconditional contributors**: they choose the Alternative Price option, for any number of participants in their group choosing the Alternative Price option.
- **The conditional contributors**: They cooperate only if other members of their group cooperate (the minimum required number of cooperators varies across participants).
- Contribution behaviours that do not exhibit a logic that falls into the types defined above are considered as "Others".

Table 5 summarizes the proportion of participants choosing the Alternative Price option in the preliminary questions, depending on the presence of the environmental benefit. As it can be expected, the number of cooperators increases with the number of participants contributing in the group. Also, there are more cooperators in the groups with an environmental benefit than without, but this difference is not significant for most questions (p-values are 0.2244, 0.0119, 0.7274 and 0.1609 respectively). Table 6 shows the types of contributors by type of households. There are significantly more free-riders in proportion among the type A households (p-value is 0.0012), as well as significantly less unconditional contributors (p-value is 0.0162). This confirms the hypothesis that the more financially constrained participants are,

Table 5: Share of contributors in conditional contribution questions

	Environmental benefit		
	With	Without	Total
if 0 contributor	35.34%	29.17%	33.54%
if 1 contributor	56.90%	37.5%	51.21%
if 2 contributors	59.48%	64.58%	60.98%
if 3 contributors	72.41%	64.58%	70.12%
N	116	48	164

the less likely they are to contribute. Also, note that among all the participants, there is proportionally more unconditional contributors than free-riders.

The contributions to the following rounds show that some contributors are irrational, i.e. they do not follow the contribution behaviour that is associated to their type. For instance, some participants that were defined as free-riders from their answers in the preliminary questions (they never contribute, whatever the number of other cooperators), choose the Alternative price option in one of the three unconditional contribution rounds. Table 7 summarizes irrational behaviours (the number of times a participant defined as a free-rider contributed and a participant defined as an unconditional contributor did not contribute) and irrational contributors (some participants were irrational in several rounds, meaning that there are less irrational participants than irrational behaviours). No real tendency can be determined in the reasons behind these changes of behaviours.

As several rounds were played in 2022, the dynamics of contributions can be analyzed. Between the first and second rounds, most participants do not change their behaviour: they keep choosing the Alternative option or they keep choosing Basic option. Table 8 shows contribution behaviour changes between the first and the second rounds, depending on the number of participants that chose the Alternative Price option in the first round.

We expect that some participants will change their behaviour in the second round depending on what the other members in their group did in the first round, especially since the group composition does not change between these two rounds. Overall, participants who start contributing in the second round are in groups with not many members contributing in the first round, while participants who stop contributing in the second round are in groups with a majority of members contributing in the

Table 6: Type of contributor, by type of household

	Sum	Share
Type A	46	28.05%
Unconditional Contributors	5	10.87%
Free-riders	14	30.43%
Conditional Contributors	21	45.65%
Others	6	13.04%
Type B	42	25.61 %
Unconditional Contributors	10	23.81%
Free-riders	5	11.90%
Conditional Contributors	14	33.33%
Others	13	30.95%
Type C	40	24.39%
Unconditional Contributors	11	27.5%
Free-riders	2	5%
Conditional Contributors	20	50%
Others	7	17.5%
Type D	36	21.95%
Unconditional Contributors	10	27.78%
Free-riders	6	16.67%
Conditional Contributors	12	33.33%
Others	8	22.22%
Total		
Unconditional Contributors	36	21.95%
Free-riders	27	16.46%
Conditional Contributors	67	40.85%
Others	34	20.73%
N	164	

Table 7: Irrational behaviors

Rounds	Irrational unconditional contributors	Irrational free-riders	Total	Total
Round 1	1	0	1	0.61%
Round 2	5	5	10	6.10%
Round 3	9	4	13	7.93%
Irrational behaviours	15	9	24	4.88%
Irrational participants	10	6	16	9.76%

Table 8: Change in contributions between Round 1 & Round 2, by number of contributors in the group in Round 1

Contributions in Round 2	Number of contributors in Round 1					
	0	1	2	3	4	Total
Started contributing	3	2	10	5	0	20
Share among those starting	15%	10%	50%	25%	0%	12.20%
Stopped contributing	0	6	12	5	4	27
Share among those stopping	0%	22.22%	44.44%	18.52%	14.81%	16.46%
Continued contributing	0	3	24	31	12	70
Share among those continuing	0%	4.29%	34.29%	44.29%	17.14%	42.98%
Continued not contributing	6	13	23	5	0	47
Share among those not continuing	12.77%	27.66%	48.94%	10.64%	0%	28.66%
Total	9	24	69	46	16	164
	5.49%	14.63%	42.07%	28.05%	9.76%	

first round. These behaviours can be interpreted as a desire for stability in the total level of contributions (that can be defined as a behaviour of triangle contributor). Incidentally, contributions slightly decrease between the first and second rounds.

The same observation is made for changes in behaviour between the first round and the third round. The groups are randomly shuffled between the second and third rounds, meaning that participants have no prior knowledge on the contribution behaviours of the new group members, but they may have expectations depending on what happened in their group in the first two rounds. For instance, a decreasing number of participants between the first and the second round might have induced deception, and thus encourages a participant who contributed in the first round to stop contributing in the third round, although no knowledge on the new members'

propensity to contribute is available. The vast majority of participants do not change their behaviour in the third round compared to the first round. Table 9 summarizes the changes in behaviours between the first and the third rounds. Again, participants

Table 9: Change in contributions between Round 3 & Round 1, by the difference in the number of contributors between Round 1 & Round 2

Contributions in Round 3	Difference in the number of contributors				
	-1	0	1	2	Total
Started contributing	6	9	0	0	15
Share among those starting	40.00%	60.00%	0%	0%	9.15%
Stopped contributing	2	9	10	7	28
Share among those stopping	7.14%	32.14%	35.71%	25.00%	17.07%
Continued contributing	17	37	14	1	69
Share among those continuing	24.64%	53.62%	20.29%	1.45%	42.07%
Continued not contributing	14	28	8	4	52
Share among those not continuing	26.92%	53.85%	15.38%	7.69%	31.71%
Total	39	83	32	12	164
	23.78%	50.61%	19.51%	7.32%	

who start contributing are in groups where cooperation declines or remains constant between the first and second round, while the majority of participants who stop contributing are in groups where cooperation generally increases between the first two rounds.

The 2022 experiment included questionnaire to evaluate the participants' altruistic preferences, their sensibility to the environment and their confidence in the institutions. All these factors can potentially affect the propensity to choose to pay more for electricity. The independence of the score for environmental sensibility and contributions, and the score for institutional trust and contributions in all rounds cannot be rejected, at a 5% confidence level. It seems that contributions are not determined by the score a participant gets in these questionnaires. However, the hypothesis of independence between altruism and contributions can be rejected in rounds and 3. It seems that altruistic preferences play a role to sustain cooperation.

It can be concluded that households with a higher electricity consumption (type A), or put another way, households with a more severe budget constraint, tend to choose to pay more in a lower proportion that the other type of consumers for who it is less costly to chose the higher price. This conclusion holds for all years of the

experiment. Besides, the environmental benefit plays a role in the choice of paying more: in 2009, participants facing a higher degree of uncertainty on the realization of the benefit tend to contribute less. This observation does not hold in 2022, but participants for which the environmental benefit was not mentioned chose the Alternative Price proportionally less than participants who faced a potential (certain or not) environmental benefit. Furthermore, it seems that the environmental benefit helps to sustain cooperation over time as the share of cooperators decreases more rapidly in the no-benefit group. Certainty over the realization of the environmental benefit seems to be a better vector of persistent cooperation. The dynamics in the 2022 experiment reveal that a variety of individual behaviours exist. Depending on the expectations that are formed in the first round, once participants have knowledge of their fellow group members' cooperation behaviours, some participants adapt their decision, even in the third round when they are joined with new unknown group members. If overall contributions steadily decline through the rounds, there seems to be a desire for cooperation stability, as a significant number of participants still start to contribute in later rounds.

Finally, participants had the possibility to leave comments and feedback at the end of the experiment. Appendix 6 comprises all the comments that were left, in English and in French. Around 55% of participants left a comment. Overall, participants gave positive feedback: they wrote that despite the appearing complexity of the instructions, they found the experiment interesting.

5 Discussion

The experiment allowed to answer the initial research questions: a majority of participants are willing to pay more for electricity in Québec. This is encouraged by the two benefits of the public good: the economic benefit, where total contributions are equally shared among all participants, even those who did not contribute, and the environmental benefit resulting from the export of the saved green electricity to neighboring regions where electricity comes from more polluting sources. On one hand, the initial conditions of people matter: participants with a higher electricity consumption cooperate significantly less than participants with a less severe budget constraint. On the other hand, the environmental benefit plays a notable role in the choice to pay more. First, contributions significantly increased between 2009 and 2022. As the financial incentives were kept equal, we assume that the difference might be explained by the growing environmental concern in a thirteen years

time. Also, participants in groups facing a higher certainty over the realization of the environmental benefit contributed more than others in 2009, and participants facing any strictly positive probability of realization over the benefit contributed more than participants facing no environmental benefit at all.

These results confirm that there exists conditions in which people are willing to pay a higher price for their consumption of energy. In the case of Québec, consumers already consume "green" electricity, but at a price kept artificially low, which induced high electricity consumption that is hardly relevant for the necessary energy sobriety. This allows governments to seize the opportunity to increase the price for goods and services which reduced consumption would benefit society. However, this situation relies on specific conditions: it is essential to give clear and transparent information on the exact consequences of the price increase, especially on the environment.

This experiment depicts precise assumptions. Here, all participants are financially able to pay the higher price: we did not account for households that do not have the means to pay more. We also chose a very basic framework for the distribution of total contributions, where all participants receive an equal share of total contributions. Other approaches could be imagined: for instance, contributions could be transferred to a fund for low-income households, or to a fund only for consumers who choose the higher price to support them in their energy transition. Such policies might increase cooperation even more. We also assumed that all participants would decrease their consumption by 10%, although in reality, the reduction of consumption in response to a higher electricity price depends on many factors: whether the consumer owns or rents her dwelling, the quantity that is already consumed, etc.

Some elements of this experiment might overestimate the final results. First, as participants voluntarily took part in this experiment, there might be a self-selection bias. They might have been initially more curious about energy consumption. Also, in general, a significant share of participants are students, and are thus more educated than the average. Since we did not control for the level of education, gender, socio-cultural background, we cannot determine whether these factors might affect the results, and in what direction. Also, the decision to pay more is not based on a long term commitment: it concerns a limited engagement, with no lasting significance. It could be expected that answers in this experiment tend to overestimate the number of consumers who would actually choose to pay more if their decision were to commit them for a long-term contract.

6 Conclusion

The literature on public good has so far focused on experimental settings with one public good, while in the electricity sector, studies focus on market design. Some experiments focused on green electricity programs and how contribution mechanisms and warm-glow affect the choice of paying more. This paper explores multiple aspects of electricity consumption: when and how are consumers willing to pay more, especially when they already consume renewable yet heavily subsidized electricity and when an environmental benefit is introduced, and how the initial endowment of consumers affect cooperation. The results reported are very encouraging for future policy designs: voluntary decision to pay more for electricity is observed when economic and environmental returns are presented in a clear and transparent manner to participants. In particular, we find that the presence of the environmental benefit significantly encourages cooperation. Future research could focus on what features of the program design could increase cooperation even more: the redistribution of total contributions, what information from participants decisions is publicly revealed, and so on. This could help designing efficient energy policies to decrease GHG emissions and meet climate goals.

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9 Appendix

Appendix 1

Table 10: Price options in 2009

	Basic Price Option specification				
	Monthly consumption (kWh)	Fixed charge	Price of first 912 kWh	Price of additional kWh	Total
		$12.36	$0.0545	$0.0746	
A	2,956	$12.36	$49.73	$152.45	$214.54
B	953	$12.36	$49.73	$3.05	$65.14
C	1,484	$12.36	$49.73	$42.62	$104.71
D	645	$12.36	$35.31	$0.00	$35.31

	Alternative Price Option specification				
	Monthly consumption (kWh)	Fixed charge	Price of first 912 kWh	Price of additional kWh	Total
		$12.36	$0.0845	$0.1046	
A	2,660	$12.36	$77.11	$182.83	$272.30
B	858	$12.36	$72.50	$0.00	$84.86
C	1,335	$12.36	$77.11	$44.24	$133.71
D	583	$12.36	$49.27	$0.00	$61.64

Appendix 2

Table 11: Price options in 2022

	Basic Price Option specification				
	Monthly consumption (kWh)	Fixed charge	Price of first 1217 kWh	Price of additional kWh	Total
		$12.52	$0.0616	$0.095	
A	2,671	$12.52	$74.93	$138.21	$225.66
B	861	$12.52	$53.06	$0.00	$65.58
C	1,341	$12.52	$74.93	$11.80	$99.26
D	585	$12.52	$36.06	$0.00	$48.58

	Alternative Price Option specification				
	Monthly consumption (kWh)	Fixed charge	Price of first 1217 kWh	Price of additional kWh	Total
		$12.52	$0.0916	$0.125	
A	2,404	$12.52	$111.43	$148.45	$272.40
B	775	$12.52	$71.01	$0.00	$83.53
C	1,207	$12.52	$110.53	$0.00	$123.05
D	527	$12.52	$48.26	$0.00	$60.78

Appendix 3

Table 12: Tests

Chi-square tests

Test variables	Chi-square	p-value	Rejected/Not rejected
Contribution R1 & Type	3.9323	0.269	Not rejected
Contribution R2 & Type	8.4515	0.038	**Rejected**
Contribution R3 & Type	3.4736	0.324	Not rejected
Contribution R1 & Altruism	15.3008	0.503	Not rejected
Contribution R1 & NEP	12.3595	0.577	Not rejected
Contribution R1 & Confidence	23.7730	0.163	Not rejected
Contribution R2 & Altruism	25.1833	0.067	**Rejected**
Contribution R2 & NEP	10.4653	0.727	Not rejected
Contribution R2 & Confidence	23.9496	0.157	Not rejected
Contribution R3 & Altruism	31.7958	0.011	**Rejected**
Contribution R3 & NEP	13.6837	0.474	Not rejected
Contribution R3 & Confidence	16.5595	0.554	Not rejected

T-tests

Hypothesis	t-stat	p-value	Rejected/Not rejected
H_0: $\Pi_{EB-2022} = 0.52$ vs H_a: $\Pi_{EB-2022} > 0.52$	1.8561	0.0326	**Rejected**
Contribution R1: H_0: $\Pi_A = \Pi_{\overline{A}}$ vs H_a: $\Pi_A < \Pi_{\overline{A}}$	1.8493	0.0331	**Rejected**
Contribution R2: H_0: $\Pi_A = \Pi_{\overline{A}}$ vs H_a: $\Pi_A < \Pi_{\overline{A}}$	2.9373	0.0019	**Rejected**
Contribution R3: H_0: $\Pi_A = \Pi_{\overline{A}}$ vs H_a: $\Pi_A < \Pi_{\overline{A}}$	1.5886	0.0571	**Rejected**
Altruism: H_0: $\Pi_{EB} = \Pi_{\overline{EB}}$ vs H_a: $\Pi_{EB} \neq \Pi_{\overline{EB}}$	0.0823	0.9345	Not rejected
NEP: H_0: $\Pi_{EB} = \Pi_{\overline{EB}}$ vs H_a: $\Pi_{EB} \neq \Pi_{\overline{EB}}$	-0.1767	0.8600	Not rejected
Confidence: H_0: $\Pi_{EB} = \Pi_{\overline{EB}}$ vs H_a: $\Pi_{EB} \neq \Pi_{\overline{EB}}$	-1.1305	0.2599	Not rejected
Contribution R1: H_0: $\Pi_{EB} = \Pi_{\overline{EB}}$ vs H_a: $\Pi_{EB} > \Pi_{\overline{EB}}$	-1.5344	0.0634	**Rejected**
Contribution R2: H_0: $\Pi_{EB} = \Pi_{\overline{EB}}$ vs H_a: $\Pi_{EB} > \Pi_{\overline{EB}}$	-2.9343	0.0019	**Rejected**
Contribution R3: H_0: $\Pi_{EB} = \Pi_{\overline{EB}}$ vs H_a: $\Pi_{EB} > \Pi_{\overline{EB}}$	-2.6437	0.0045	**Rejected**
Difference in contributions between R1 & R3 H_0: $\Pi_{EB} = \Pi_{\overline{EB}}$ vs H_a: $\Pi_{EB} < \Pi_{\overline{EB}}$	-1.0812	0.1406	Not rejected
Free-riders: H_0: $\Pi_A = \Pi_{\overline{A}}$ vs H_a: $\Pi_A > \Pi_{\overline{A}}$	-3.0803	0.0012	**Rejected**
Uncond. contributors: H_0: $\Pi_A = \Pi_{\overline{A}}$ vs H_a: $\Pi_A < \Pi_{\overline{A}}$	2.1580	0.0162	**Rejected**

Appendix 4

Instructions

Welcome. Thank you for participating in this study. We will now read the instructions together. Please raise your hand if you have any questions at any time.

What you will be doing

You will make decisions on electricity price, in relation to consumption. To get started, we will review a few facts about home energy consumption.

The total electricity consumption of a household mostly depends on two things:

- Home size,
- Whether electric heating is used or not.

In case of home size, single detached homes consume considerably more electricity than apartments. Similarly, and obviously, homes that use electric heating consume more electricity than those without electric heating.

For this study, we will define four types of households, living either in a single detached house or an apartment, with or without electric heating. The table shows the electricity consumption per year, estimated from actual data in Quebec, of each of the four types.

Yearly Electricity Consumption per Household (kWh)		
	w*ith* electric heating	*without* electric heating
Single Detached	35,472 **A**	11,440 **B**
Apartment	17,806 **C**	7,775 **D**

In this session, you will be randomly assigned to an electricity consumption equivalent to one of the four types, A, B, C, or D, of households. You will be randomly placed in a group of four participants. One of the four participants will be a type A, one will be a type B, one will be a type C, and one will be a type D.

The Choice You Make

All participants will be given an initial cash amount of $30, which has a value in the experiment of $300. All participants have a single choice to make: you choose the price you pay for electricity. To do this, you choose between the "**Current price**", which is relatively close to the real life price, and the "**Alternative Price**", where the electricity price increases by 3¢/kWh, better reflecting the market value of electricity in North America.

The two options

Current Price Option

The Current Price Option is presented in the table below. The total amount you pay for electricity consists of three components. The first component is a fixed charge of $12.36, which does not depend on your consumption. You always pay this no matter how much electricity you consume. The second component consists of the first 912 kWh of electricity that you consume each month, which is charged at 5.45¢/kWh. Finally, any electricity you consume exceeding 912kWh is charged at a higher price of 7.46¢/kWh. The breakdown of these charges is presented in the table for each type of participant.

Current Price Option

	Monthly Consumption (kWH)	Fixed Charge: $12.36	Price of first 912 kWH: $0.0545	Price of Additional kWH: $0.0746	Total
A	**2,956**	**$12.36**	**$49.73**	**$152.45**	**$214.54**
B	**953**	**$12.36**	**$49.73**	**$3.05**	**$65.14**
C	**1,484**	**$12.36**	**$49.73**	**$42.62**	**$104.71**
D	**645**	**$12.36**	**$35.31**	**$0.00**	**$35.31**

Alternative Price Option

In the case of the Alternative price option, you are charged a higher price. Given this higher price, it is assumed that you decrease your consumption slightly. However, the total amount you pay with this option is higher than with the Current option, because the reduction in consumption does not completely offset the increase in price. The Alternative option also has a public economic benefit and an environmental benefit.

Price

The Alternative Price Option has the three components of the Current price option and the fixed charge is exactly the same. However, the price of each kWh you consume increases by 3¢/kWh, both for the first block of 912kWh and for any extra consumption above that. If you select this option, it is assumed that you will make some consumption adjustments. For instance, you will increase your energy efficiency (by using electronic thermostat, sealing windows and doors, using efficient light bulbs, etc.) and/or change your consumption behavior (by using the dryer less often, switching off electric equipments when you don't use them, etc.). As a result, your monthly consumption will decrease by 10%. As a whole, despite this lower consumption, the total monthly bill still increases.

The table below shows the Alternative price option for each type of participant.

Alternative Price Option

	Monthly Consumption (kWH)	Fixed Charge: $12.36	Price of first 912 kWH: $0.0845	Price of Additional kWH: $0.1046	Total
A	**2,660**	**$12.36**	**$77.11**	**$182.83**	**$272.30**
B	**858**	**$12.36**	**$72.50**	**$0.00**	**$84.86**
C	**1,335**	**$12.36**	**$77.11**	**$44.24**	**$133.71**
D	**583**	**$12.36**	**$49.27**	**$0.00**	**$61.64**

As you can see, for each type, consumption is 10% less than under the Current price option. Notice that the fixed charge remains the same at $12.36. As mentioned before, the price of the first 912kWh increases to $0.0845 ($0.0545 + $0.03). Similarly, the price of any further consumption increases to $0.1046 ($0.0746 + $0.03). As a result, the monthly total amount paid for electricity increases for all types.

Economic benefit

All participants choosing the Alternative Price Option will pay more for the electricity they use and will reduce their consumption by 10%. The reduction in consumption releases electricity, not used by local consumers, to be exported at market price. As a result, all the electricity previously sold to participants choosing the Alternative Price Option generates additional profits for the publicly-owned electricity company.

If you choose the Alternative Price Option, your previous monthly consumption will be sold at a higher price. 90% of that previous consumption will be sold to you and the remaining 10% to the export market, both at a price 3¢/kWh higher. This new price will represent additional profit for the electricity company. When the electricity company is publicly-owned, as we assume in this experiment, this money will flow to the government's budget and will benefit all members of the society, even participants that have chosen to keep the Current Option.

The outcome when participants choose the Alternative Price Option is therefore to contribute to a general fund that is shared by all. Whatever option you choose ("Current Price" or "Alternative Price") you will receive an amount ***S*** corresponding to the following computation:

$$S = \frac{(\text{sum of initial consumption of participants choosing the other price}) \times 3¢}{4}$$

For instance, if all 4 participants choose the Alternative Price Option, then everyone will get their $45.31 back.

The table below shows the economic benefit when each type of participants chooses the Alternative option. The first column shows the total amount each participant contributes to the general fund when they choose the Alternative option. The second shows what every participants receives when each of the types choose the Alternative option.

Economic Benefit		
	Total	Per Person
A	$88.80	$22.20
B	$28.80	$7.20
C	$44.40	$10.10
D	$19.60	$4.90

Environmental Benefit

All participants choosing the Alternative Price Option make some consumption savings. This saves electricity, and therefore avoids the emission of greenhouse gases (GHG). Reducing consumption, consequently, results in an environmental benefit. This benefit either happens directly (if producing the electricity was directly causing some emissions) or indirectly if the saved electricity is "clean" (like hydropower or nuclear) and is exported to other jurisdictions.

To represent this benefit, if you choose the Alternative Price Option in this experiment, we will buy "Gold Standard" carbon offsets for an amount equivalent to the monthly reduction of GHG. A "carbon offset" is an emission reduction credit from another organization's project that results in less carbon dioxide or other greenhouse gases in the atmosphere than would otherwise occur. We will buy these from the website http://planetair.ca. One ton of Gold Standard carbon offset costs about $40 and they are the highest quality carbon offsets (see http://www.cdmgoldstandard.org).

The table shows the environmental gain when each type chooses the Alternative price option and the dollar value of the corresponding Carbon offsets, based on a price of $40 per ton. If all four participants choose the Alternative Price Option, this would result in 0.303 less tons of GHG per month. Therefore, we would buy 0.303 tons of carbon offsets for about $12.

Environmental Gain Resulting from the Alternative Price Option **About 0.5 ton of GHG reduction per 1,000 kWh of electricity saved**			
	Electricity Saved, monthly (kWh)	GHG Reduction (ton of CO_2)	Dollar Value of Carbon Offsets
A	296	0.148	$5.92
B	95	0.048	$1.88
C	149	0.074	$2.96
D	62	0.033	$1.32

The table below summarizes, for each type, the cost of choosing the Alternative Price option along with its economic and environmental benefits.

	Individual Cost	Per Person Economic Benefit	Total Economic Benefit	Dollar Value of Environmental Benefit
A	$57.76	$22.20	$88.80	$5.92
B	$19.72	$7.20	$28.80	$1.88
C	$29.00	$11.10	$44.40	$2.96
D	$26.33	$4.90	$19.60	$1.32

Finally, each of the four tables below show the total payoff that a type gets in the experiment with the Current and the Alternative options given what the other participants chose. The tables allow you to see the consequences of both your decisions, and the decisions of the other participants.

Summary

You have been randomly assigned to groups of four participants, where there is one participant of each type, A, B, C, and D. Your task is to choose either the current or alternative price for electricity. **Notice that you will make only one decision in this experiment**. After all participants make their choices, the experimenter will collect the decision sheets and determine your pay. The experimenter will then buy the carbon offset credits, and the purchase will be revealed on the overhead projector. You will then be paid in cash for your participation.

Are there any questions?

Type A:

	Current					Alternative				
Types choosing Alternative	**Payoff before Economic Benefit**	**Economic Benefit**	**Type A Total Payoff**	**Sum of Group Payoffs**	**Benefit to Environment**	**Payoff before Economic Benefit**	**Economic Benefit**	**Type A Total Payoff**	**Sum of Group Payoffs**	**Benefit to Environment**
B+C+D	85.5	23.1	**108.6**	**797.7**	6.16	27.7	45.3	**73**	**828.8**	12.08
B+C	85.5	18.3	**103.8**	**792.4**	4.84	27.7	40.5	**68.2**	**823**	10.76
B+D	85.5	12	**97.5**	**782.3**	3.2	27.7	34.2	**61.9**	**813.3**	9.12
C+D	85.5	16	**101.5**	**789.1**	4.28	27.7	38.2	**65.9**	**820.1**	10.2
B	85.5	7.2	**92.7**	**777**	1.88	27.7	29.4	**57.1**	**807.6**	7.8
C	85.5	11.1	**96.6**	**783.4**	2.96	27.7	33.3	**61**	**814.4**	8.88
D	85.5	4.9	**90.4**	**773.7**	1.32	27.7	27.1	**54.8**	**804.3**	7.24
None	85.5	0	**85.5**	**768**	0	27.7	22.2	**49.9**	**799**	5.92

Type B:

	Current					Alternative				
Types choosing Alternative	**Payoff before Economic Benefit**	**Economic Benefit**	**Type B Total Payoff**	**Sum of Group Payoffs**	**Benefit to Environment**	**Payoff before Economic Benefit**	**Economic Benefit**	**Type B Total Payoff**	**Sum of Group Payoffs**	**Benefit to Environment**
A+C+D	234.9	38.2	**273.1**	**820.1**	10.2	215.1	45.4	**260.5**	**828.7**	12.08
A+C	234.9	33.3	**268.2**	**814.4**	8.88	215.1	40.5	**255.6**	**823**	10.76
A+D	234.9	27	**261.9**	**804.3**	7.24	215.1	34.2	**249.3**	**813.3**	9.12
C+D	234.9	16	**250.9**	**789.1**	4.28	215.1	23.2	**238.3**	**797.7**	6.16
A	234.9	22.2	**257.1**	**799**	5.92	215.1	29.4	**244.5**	**807.6**	7.8
C	234.9	11.1	**246**	**783.4**	2.96	215.1	18.3	**233.4**	**792.4**	4.84
D	234.9	4.9	**239.8**	**773.7**	1.32	215.1	12.1	**227.2**	**782.3**	3.2
None	234.9	0	**234.9**	**768**	0	215.1	7.2	**222.3**	**777**	1.88

Type C:

			Current					Alternative		
Types choosing Alternative	**Payoff before Economic Benefit**	**Economic Benefit**	**Type C Total Payoff**	**Sum of Group Payoffs**	**Benefit to Environment**	**Payoff before Economic Benefit**	**Economic Benefit**	**Type C Total Payoff**	**Sum of Group Payoffs**	**Benefit to Environment**
A+B+D	195.3	34.2	**229.5**	**813.3**	9.12	166.3	45.3	**211.6**	**828.7**	12.08
A+B	195.3	29.3	**224.6**	**807.6**	7.8	166.3	40.4	**206.7**	**823**	10.76
A+D	195.3	27	**222.3**	**804.3**	7.24	166.3	38.1	**204.4**	**820.1**	10.2
B+D	195.3	12	**207.3**	**782.3**	3.2	166.3	23.1	**189.4**	**797.7**	6.16
A	195.3	22.2	**217.5**	**799**	5.92	166.3	33.3	**199.6**	**814.4**	8.88
B	195.3	7.2	**202.5**	**777**	1.88	166.3	18.3	**184.6**	**792.4**	4.84
D	195.3	4.9	**200.2**	**773.7**	1.32	166.3	16	**182.3**	**789.1**	4.28
None	195.3	0	**195.3**	**768**	0	166.3	11.1	**177.4**	**783.4**	2.96

Type D:

			Current					Alternative		
Types choosing Alternative	**Payoff before Economic Benefit**	**Economic Benefit**	**Type D Total Payoff**	**Sum of Group Payoffs**	**Benefit to Environment**	**Payoff before Economic Benefit**	**Economic Benefit**	**Type D Total Payoff**	**Sum of Group Payoffs**	**Benefit to Environment**
A+B+C	252.3	40.4	**292.7**	**823**	10.76	238.4	45.3	**283.7**	**828.7**	12.08
A+B	252.3	29.3	**281.6**	**807.6**	7.8	238.4	34.2	**272.6**	**813.3**	9.12
A+C	252.3	33.3	**285.6**	**814.4**	8.88	238.4	38.2	**276.6**	**820.1**	10.2
B+C	252.3	18.3	**270.6**	**792.4**	4.84	238.4	23.2	**261.6**	**797.7**	6.16
A	252.3	22.2	**274.5**	**799**	5.92	238.4	27.1	**265.5**	**804.3**	7.24
B	252.3	7.2	**259.5**	**777**	1.88	238.4	12.1	**250.5**	**782.3**	3.2
C	252.3	11.1	**263.4**	**783.4**	2.96	238.4	16	**254.4**	**789.1**	4.28
None	252.3	0	**252.3**	**768**	0	238.4	4.9	**243.3**	**773.7**	1.32

It is now time for you to choose between the two options. Please answer on the *Answer Sheet.* You will receive the full payoff corresponding to your option.

Answer Sheet

@	OPTIONS		Type	Payoff before S	S	Total Payoff
	CURRENT	ALTERNATIVE				
	☐	☐				

Exit questions

If you chose the Current Price Option, what is the minimum guaranteed amount ***S*** (the economic benefit) you would need to receive on a monthly basis (irrespective of your actual electricity consumption), to accept the Alternative Price Option?

_____

If you chose the Current Price Option, what motivated your choice? (select all appropriate answers)

- ☐ I did not want to pay more (and therefore decrease my payoff).
- ☐ I did not want to take the risk of reducing my payoff.
- ☐ All electricity consumers deserve low prices.
- ☐ Cheap electricity belongs to consumers when the electricity company is publicly owned.
- ☐ I wanted to protect low prices for the benefit of low-income consumers.
- ☐ (Other reason, please specify)_____

_____

_____

_____

_____

Please add any comment you may have on this experiment and on its topic.

_____

_____

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_____

Appendix 5

Instructions

Welcome. Thank you for participating in this study. We will now read the instructions together. Please raise your hand if you have any questions at any time.

What you will be doing

You will make decisions on electricity price, in relation to consumption. First, we will review a few facts about home energy consumption.

The total electricity consumption of a household mostly depends on two things:

- Home size,
- Whether electric heating is used or not.

In case of home size, single detached homes consume considerably more electricity than apartments. Similarly, and obviously, homes that use electric heating consume more electricity than those without electric heating.

For this study, we will define four types of households, living either in a single detached house or an apartment, with or without electric heating. The table shows the electricity consumption per year, estimated from actual data in Quebec, of each of the four types.

Yearly Electricity Consumption per Household (kWh)		
	w*ith* electric heating	*without* electric heating
Single Detached	32,054 **A**	10,338 **B**
Apartment	16,090 **C**	7,026 **D**

In this session, you will be randomly assigned to an electricity consumption equivalent to one of the four types, A, B, C, or D, of households. **You will keep this electric consumption throughout the whole experiment**: your type will not change. You will be randomly placed in a group of four participants. One of the four participants will be a type A, one will be a type B, one will be a type C, and one will be a type D.

The Choice You Make

All participants will be given an initial budget of $300. The experiment consists of three separate parts.

In the first part, you will be asked a set of preliminary questions. After that, all participants have a single choice to make: you choose the price you pay for electricity. To do this, you choose between the "**Basic price**", which is relatively close to

the real-life price, and the "**Alternative Price**", where the electricity price increases by 3¢/kWh, better reflecting the market value of electricity in North America.

In the second part of the experiment, you will have to answer two additional questions.

In the third and final part, you will have to fill an exit questionnaire.

The two options

Basic Price Option

The Basic Price Option is presented in the table below. The total amount you pay for electricity consists of three components. The first component is a fixed charge of $12.52, which does not depend on your consumption. You always pay this no matter how much electricity you consume. The second component consists of the first 1217 kWh of electricity that you consume each month, which is charged at 6.16¢/kWh. Finally, any electricity you consume exceeding 1217 kWh is charged at a higher price of 9.5¢/kWh. The breakdown of these charges is presented in the table for each type of participant.

Basic Price Option

	Monthly Consumption (kWH)	Fixed Charge: $12.52	Price of first 1217 kWH: $0.0616	Price of Additional kWH: $0.095	Total
A	**2,671**	**$12.52**	**$74.93**	**$138.21**	**$225.66**
B	**861**	**$12.52**	**$53.06**	**$0.00**	**$65.58**
C	**1,341**	**$12.52**	**$74.93**	**$11.80**	**$99.26**
D	**585**	**$12.52**	**$36.06**	**$0.00**	**$48.58**

Alternative Price Option

In the case of the Alternative price option, you are charged a higher price. Given this higher price, it is assumed that you decrease your consumption slightly. However, the total amount you pay with this option is higher than with the Basic option, because the reduction in consumption does not completely offset the increase in price. The Alternative option also has a public economic benefit and an environmental benefit.

Price

The Alternative Price Option has the same three components of the Basic price option, and the fixed charge is exactly the same. However, the price of each kWh you consume increases by 3¢/kWh, both for the first block of 1217 kWh and for any extra consumption above that. If you select this option, it is assumed that you will make some consumption adjustments. For instance, you will increase your energy efficiency (by using electronic thermostat, sealing windows and doors, using efficient light bulbs, etc.) and/or change your consumption behavior (by using the dryer less often, switching off electric equipment when you don't use them, etc.). As a result, your monthly consumption will decrease by 10%. As a whole, despite this lower consumption, the total monthly bill still increases.

The table below shows the Alternative price option for each type of participant.

Alternative Price Option

	Monthly Consumption (kWH)	Fixed Charge: $12.52	Price of first 1217 kWH: $0.0916	Price of Additional kWH: $0.125	Total
A	**2,404**	**$12.52**	**$111.43**	**$148.45**	**$272.40**
B	**775**	**$12.52**	**$71.01**	**$0.00**	**$83.53**
C	**1,207**	**$12.52**	**$110.53**	**$0.00**	**$123.05**
D	**527**	**$12.52**	**$48.26**	**$0.00**	**$60.78**

As you can see, for each type, consumption is 10% less than under the Basic price option. Notice that the fixed charge remains the same at $12.52. As mentioned before, the price of the first 1217 kWh increases to $0.0916 ($0.0616 + $0.03). Similarly, the price of any further consumption increases to $1.125 ($0.095 + $0.03). As a result, the monthly total amount paid for electricity increases for all types.

Economic benefit

All participants choosing the Alternative Price Option will pay more for the electricity they use and will reduce their consumption by 10%. The reduction in consumption releases electricity, not used by local consumers, to be exported at market price. As a result, all the electricity previously sold to participants choosing the Alternative Price Option generates additional profits for the publicly owned electricity company.

If you choose the Alternative Price Option, your previous monthly consumption will be sold at a higher price. 90% of that previous consumption will be sold to you and the remaining 10% to the export market, both at a price 3¢/kWh higher. This new price will represent additional profit for the electricity company. When the electricity company is publicly owned, as we assume in this experiment, this money will flow to the government's budget and will benefit all members of the society, even participants that have chosen to keep the Basic Option.

The outcome when participants choose the Alternative Price Option is therefore to contribute to a general fund that is shared by all participants in the group. Whatever option you choose ("Basic Price" or "Alternative Price") you will receive an amount ***S*** corresponding to the following computation:

$$\boldsymbol{S} = \frac{(\text{sum of initial consumption of participants choosing the Alternative Price}) \times 3¢}{4}$$

For instance, if all 4 participants in the group choose the Alternative Price Option, then everyone will get $40.94.

The table below shows the economic benefit of individual contributions by each type of participant. The first column shows the amount each type of participant contributes when they choose the Alternative option. The second column shows the amount each participant in the group receives as a result of this individual contribution.

	Economic Benefit	
	Total	Per Person
A	$80.14	$20.04
B	$25.84	$6.46
C	$40.23	$10.06
D	$17.56	$4.39

Environmental Benefit

All participants choosing the Alternative Price Option make some consumption savings. This saves electricity, and therefore avoids the emission of greenhouse gases (GHG). Reducing consumption, consequently, results in an environmental benefit. This benefit either happens directly (if producing the electricity was directly causing some emissions) or indirectly if the saved electricity is "clean" (like hydropower or nuclear) and is exported to other jurisdictions.

To represent this benefit, if you choose the Alternative Price Option in this experiment, we will buy "Gold Standard" carbon offsets for an amount equivalent to the monthly reduction of GHG. A "carbon offset" is an emission reduction credit from another organization's project that results in less carbon dioxide or other greenhouse gases in the atmosphere than would otherwise occur. We will buy these from the website http://planetair.ca. One ton of Gold Standard carbon offset costs about $38 and they are the highest quality carbon offsets (see http://www.cdmgoldstandard.org).

The table shows the environmental gain when each type chooses the Alternative price option and the dollar value of the corresponding Carbon offsets, based on a price of $38 per ton. If all four participants choose the Alternative Price Option, this would result in 0.136 less tons of GHG per month. Therefore, we would buy 0.136 tons of carbon offsets for about $5.19.

	Environmental Gain Resulting from the Alternative Price Option **About 0.25 ton of GHG reduction per 1,000 kWh of electricity saved**		
	Electricity Saved, monthly (kWh)	GHG Reduction (ton of CO_2)	Dollar Value of Carbon Offsets
A	267	0.067	$2.54
B	86	0.022	$0.82
C	134	0.034	$1.27
D	59	0.015	$0.56

The table below summarizes, for each type, the cost of choosing the Alternative Price option (i.e., the difference between the Basic Price and the Alternative Price options) along with its economic and environmental benefits.

	Individual Cost	Per Person Economic Benefit	Total Economic Benefit	Dollar Value of Environmental Benefit
A	\$46.74	\$20.04	\$80.14	\$2.54
B	\$17.95	\$6.46	\$25.84	\$0.82
C	\$23.79	\$10.06	\$40.23	\$1.27
D	\$12.20	\$4.39	\$17.56	\$0.56

Finally, each of the four tables below show the total payoff that a type gets in the experiment with the Basic and the Alternative options given what the other participants chose. The tables allow you to see the consequences of both your decisions, and the decisions of the other participants. The payoff is defined as follow:

$$Payoff \ = \ Initial\ budget\ (= 300) \ - \ Price\ of\ the\ chosen\ option \ + \ Individual\ economic\ benefit\ (= \boldsymbol{S})$$

The stages of the experiment

Preliminary questions

You will be asked to choose either the Basic or Alternative price for electricity, depending on how many participants in your group of four participants chose the Alternative price option, independent from their type:

- If no participant chooses the Alternative price
- If one participant chooses the Alternative price
- If two participants choose the Alternative price
- If three participants choose the Alternative price

The experimenter will not disclose the choices that were made by the participants, and **you will not receive payment for your choices.**

First round

In the first round, you will be randomly placed in a group of four participants, with one participant of each type. You will be asked to choose either the Basic or Alternative price for electricity. After all participants make their choices, the experimenter will determine your pay and the environmental benefit for the round.

Second part

In the second part of the experiment, you will have to answer two questions.

Third part

You will have to fill an exit questionnaire.

You will then be paid in cash for your participation, corresponding to the total of your gains. You will be paid 5¢ for each dollar you earned in the experiment (for instance, if your final benefit is $300, you will receive $15 in cash).

Summary

You have been randomly assigned to groups of four participants, where there is one participant of each type, A, B, C, and D. In the preliminary questions, you will be asked to choose either the Basic or Alternative price for electricity, depending on the choices of the other participants in your group. In the first round, your task is to choose either the basic or alternative price for electricity. You will have to answer two additional questions in the second part of the experiment. In the third part of the experiment, you will have to fill out an exit questionnaire.

Are there any questions?

Type A:

Type A choosing Basic						Type A choosing Alternative				
Types choosing Alternative*	Payoff before Economic Benefit	Economic Benefit	Type A Total Payoff	Sum of Group Payoffs	Benefit to Environment	Payoff before Economic Benefit	Economic Benefit	Type A Total Payoff	Sum of Group Payoffs	Benefit to Environment
B+C+D	74.3	20.9	**95.2**	**850.6**	2.65	27.6	40.9	**68.5**	**823.9**	5.19
B+C	74.3	16.5	**90.8**	**805.3**	2.09	27.6	36.6	**64.1**	**818.9**	4.63
B+D	74.3	10.9	**85.2**	**774.3**	1.38	27.6	30.9	**58.5**	**807.6**	3.92
C+D	74.3	14.4	**88.7**	**789.1**	1.83	27.6	34.5	**62.1**	**816.2**	4.37
B	74.3	6.5	**80.8**	**768.9**	0.82	27.6	26.5	**54.1**	**802.2**	3.36
C	74.3	10.1	**84.4**	**777.5**	1.27	27.6	30.1	**57.7**	**810.8**	3.81
D	74.3	4.4	**78.7**	**766.2**	0.56	27.6	24.4	**52.0**	**799.5**	3.10
None	74.3	0	**74.3**	**768.0**	0.00	27.6	20.0	**47.6**	**794.2**	2.54

*The other types choose the Basic option

Type B:

Type B choosing Basic						Type B choosing Alternative				
Types choosing Alternative*	Payoff before Economic Benefit	Economic Benefit	Type B Total Payoff	Sum of Group Payoffs	Benefit to Environment	Payoff before Economic Benefit	Economic Benefit	Type B Total Payoff	Sum of Group Payoffs	Benefit to Environment
A+C+D	234.4	34.5	**268.9**	**816.2**	4.37	216.5	40.9	**257.4**	**823.9**	5.19
A+C	234.4	30.1	**264.5**	**810.8**	3.81	216.5	36.6	**253.0**	**818.9**	4.63
A+D	234.4	24.4	**258.8**	**799.5**	3.10	216.5	30.9	**247.4**	**807.6**	3.92
C+D	234.4	14.4	**248.9**	**789.1**	1.83	216.5	20.9	**237.4**	**850.6**	2.65
A	234.4	20.0	**254.5**	**794.2**	2.54	216.5	26.5	**243.0**	**802.2**	3.36
C	234.4	10.1	**244.5**	**777.5**	1.27	216.5	36.6	**253.1**	**805.3**	2.09
D	234.4	4.4	**238.8**	**766.2**	0.56	216.5	10.9	**227.3**	**774.3**	1.38
None	234.4	0	**234.4**	**768.0**	0.00	216.5	6.5	**222.9**	**768.9**	0.82

*The other types choose the Basic option

Type C:

Type C choosing Basic						Type C choosing Alternative				
Types choosing Alternative*	**Payoff before Economic Benefit**	**Economic Benefit**	**Type C Total Payoff**	**Sum of Group Payoffs**	**Benefit to Environment**	**Payoff before Economic Benefit**	**Economic Benefit**	**Type C Total Payoff**	**Sum of Group Payoffs**	**Benefit to Environment**
A+B+D	200.7	30.9	**231.6**	**807.6**	3.92	177	40.9	**217.9**	**823.9**	5.19
A+B	200.7	26.5	**227.2**	**802.2**	3.36	177	36.6	**213.5**	**818.9**	4.63
A+D	200.7	24.4	**225.2**	**799.5**	3.10	177	34.5	**211.4**	**807.6**	4.37
B+D	200.7	10.9	**211.6**	**774.3**	1.38	177	20.9	**197.9**	**850.6**	2.65
A	200.7	20.0	**220.8**	**794.2**	2.54	177	30.1	**207.0**	**810.8**	3.81
B	200.7	6.5	**207.2**	**768.9**	0.82	177	16.5	**193.5**	**805.3**	2.09
D	200.7	4.4	**205.1**	**766.2**	0.56	177	14.4	**191.4**	**789.1**	1.83
None	200.7	0	**200.7**	**768.0**	0.00	177	10.1	**187.1**	**777.5**	1.27

*The other types choose the Basic option

Type D:

Type D choosing Basic						Type D choosing Alternative				
Types choosing Alternative	**Payoff before Economic Benefit**	**Economic Benefit**	**Type D Total Payoff**	**Sum of Group Payoffs**	**Benefit to Environment**	**Payoff before Economic Benefit**	**Economic Benefit**	**Type D Total Payoff**	**Sum of Group Payoffs**	**Benefit to Environment**
A+B+C	251.4	36.6	**288**	**818.9**	4.63	239.2	40.9	**280.1**	**823.9**	5.19
A+B	251.4	26.5	**277.9**	**802.2**	3.36	239.2	30.9	**270.1**	**807.6**	3.92
A+C	251.4	30.1	**281.5**	**810.8**	3.81	239.2	34.5	**273.7**	**807.6**	4.37
B+C	251.4	16.5	**267.9**	**805.3**	2.09	239.2	20.9	**260.1**	**850.6**	2.65
A	251.4	20.0	**271.5**	**794.2**	2.54	239.2	24.4	**263.6**	**799.5**	3.10
B	251.4	6.5	**257.9**	**768.9**	0.82	239.2	10.9	**250.1**	**774.3**	1.38
C	251.4	10.1	**261.5**	**777.5**	1.27	239.2	14.4	**253.7**	**789.1**	1.83
None	251.4	0	**251.4**	**768.0**	0.00	239.2	4.4	**243.6**	**766.2**	0.56

*The other types choose the Basic option

Appendix 5

Participant's comments

It is still unclear to me if the individual is making efforts to reduce electricity consumption, his or bill is still high. Please ask the experimenter not to talk while people are typing their comments. Thank you.

This experiment is quit fun and do reflex quite well the reality but at the same time is not everyone that can afford to pay the hight amount of bill every month.

very interesting and enlighting

It's rate to think about our electricity consumption. Something that people should do sometimes.

Given the type I got, I think it is always better for me to choose basic. Even there is one person at my group chosse alternative, I will be better off. I focus more on the economics side, but not much on the environmental side.

very elaborate and well though. Thistested not only the ability to think for ones electric consumtiion and bills but also their moral about general society. If we were all to choose to pay more , that would mean we would have greater results in longer terms in association with the enviroment.

In the case of choosing between environmental wellness and financial wellness, it is not always easy, even though each person's value is different. I believe that sometimes, it should not be a choice but imposed to have a better environment. Thank you for the experimenti!

Not applicable

Too many instructions/details which can easily confuse participants.

I think that this experiment is based on the Hydro reality in Quebec and it makes me realize how we ought to use electricity more carefully and not waste resources. Perhaps this experiment is a wake-up remnder.

it was interesting to see how our decisions can change a community.

For better life, everyone has responsibility to do what they can do. We are in the same boat.

Interesting subject regarding Hydro Quebec. It will improve our well-being if it is implemented.

Very interesting and fun experiment, thank you very much!

tables on page 7 and 8 were a bit confusing. Would prefer if the first colum did was listed as 'types choosing baisc' instead of alternative

les gens qui sont au governement ont la premiere responasbilitee de guider la societe a faire le bonnes choix en donnat exemple de la bonne gouvernance

dans les questionnaire mettre des echelles de choix avec un nombre de case pair. le case du milieu sert de reponse par defaut. dans la simulation il s'agit de participer un jeu communautaire, en reel l individualisme prime.

il faudrait a mon avis plus des mesures plus specifiques pour loption alternative. l imposer par exemple aux maisons dune certaine superficie qui profitent de leau gratuite durant lete par exemple. offrir egalement loption hybride avec une consommations des deux types pour les appartements. sinon le nombre le personnes qui prendraient des decisions par conscience environementale seraient tres peu et insignifiants (sur lensemble des consommateurs). une autre solution serait degalement de construire davantage de blocs dappartements de plus de 8 etages(minimum)

C'était très intéressant, merci!

It was a fun experimentation. The given context was complex but pretty clearly described.

Experience interessante dans le rapport avec les autres et l'influence de mes choix sur l'environnement. Le sujet de l'anticipation d'un éventuel décalage entre la réponse d'autres personnes et mes réponses est un véritable cas de conscience.

Very interesting experiment as it tests out personal choice over population benefits. I know this is fictif, however in my opinion, the model that would work would probably be benefiting the people using less energy as they would see it as a win win situation. Use less electricity and pay less and invest that electricity for export

In paper is kind of confusing, but it is much easier when doing it

no comments really, classic collective action experiment where everoyone has incentive to freeride. don‘t really understand the environmental benefit part but I guess it‘s because we havent gotten that far. So i don‘t gain monetarily from the environmental benefit in

any way? And theres only a 50% chance of such benefit being realized? I feel as though maybe the participants could gain from the environmental benefit in some way apart from altruism.

no comments thank you

If I had option A, I would have chosen to choose the alternative option because I would have been paying more and contributing more for other people. With Option d, I felt like I would have to pay for electric heating on top of what I'm alredy paying and the contriibution that I would make to others wouldn't be sufficient. I feel like taking care of others is important if you can take care of yoursel ffirst but I'm not going to give the little that I have to help others if I can hardly make ends meet. If I have more, than I can give more, and do so comfortably.

very interesting and sometimes unexplainable.

The experiment is interesting. If there is a choice of the alternative price option by all participants, this choice will contribute to a fund that is shared by all participants. It is good option when we think about the economic and the environmental benefit.

Interesting experience in the sens that it makes me think about my contribution to the community and even the fact that this contribution may require some kind of sacrifice or effort for the well being of the others. I think we would all have to contribute in some way to the community in order to share general benefits and help climate change.

i found it interesting the questions regarding environment and asking my opinions, it gave me an insight into how i believe and how i decide, i enjoyed answering these impt questions

It was very intresting to see how a group influences each other when making a decision. Having access to this much information and numbers (when reading the instructions) made a simple experiment seem more complicated than it was. Also, before knowing what the experiment would be, the energy in the room was very mysterious.

We should all be mindful of our actions as it has great impact on people we don't know. But at the same time, we should not sit around and wait for a saviour to come and save us.

Intéressantmme expérience

Merci

Excellente expérience base d'un point de vu plus environnementale que financier.

Auccunes commentaires

Expérience intéressante sur le plan des valeurs humaines et sur la perception de l'empreinte écologique de même que la consommation d'énergie

experience trop courte, elle aurait pu etre plus interactive.

Very interesting experiment. I don't think paying more is a motivation for people to be more aware of the earth's limitations and problems. To become more environmetally aware I think the contribution should be done by the company in an altruistic way not on the citizens. I think it's a way for Hydro Quebec to promote the company as environemtal but putting the pressure on the end user. Companies have more ways to help the planet but first help citizens. Basically becoming more aware of the way we use limited resources should be through education, not paying more for something that is necessary for everyone in Canada.

The experiment was well run. I think, in general people will be more drawn to the basic optiom because it will maximize then payout even if the environment benefits are lower

I don't necessarily trust that paying more on the individual level would really have much benefit feel regardless of how much local consumers are wiling to pay, hydro quebec, as a corporation should be doing all it can to help the environment. Personally, I live as a Type B, AND I do my best to limit my consumption depite the rate I pay. I felt very lucky to have been assigned type D for this experiment. I likely would have stuck to the basic option in any group, but I felt much more comfortable with my decision because paying more in my case didn't feel like it would make much difference to the group or environment anyway.

The experiment would have been better if it included the "Effet rebond" of the people mindset when talking about alternative option with the new technologies. Based only on statistics maybe someone will see some savings which my be in long term associated with one more consumption in another product, making the overall impact displaced in anohter perspective. Making this questionnaire would impose that the answer of one affect the overall decision and savings, maybe ones action would only affect its personal emission and saving. Then the money gained should only be based on one decision not based on everyone.

I look forward to seing the outcome of the experiment. Thank you for your research!

Round 2: Je ne me souviens plus s'il etait clairement dit ou non que les autres participants de ce groupe pouvaient egalement modifier leur choix. J'y ai pense apres avoir repondu. Je pense que c'est une information qui pourrait modifier la reponse. Round 4: je me demande si frame les questions precisant que c'est mes aspirations altruistes que l'on questionne n'oriente pas un peu mes reponses. Round 5: pour certains enonces il n'est pas aise de repondre, exemple: enough room and ressources: je pense que oui il y a assez de place et de ressources, dans l'absolu, mais non je ne pense pas qu'il y a assez de place et de ressources suivant la maniere dont l'humanite les utilise/exploite actuellement.

l'Experience etait tres interessant. Je suis conscient des problemes environnementaux que nous subissons. Et je suis pret a faire ma part. sauf que j'ai constate que Hydro quebec ne joue pas franc-jeu avec ces clients. Nous avons subi des hauuses des prix et des surfacturations pendant plusieurs annees. Le gouverement Legault avait promis de nous rembourser mais helas, nous attendons toujours ces remboursements qui devaient refleter sur nos factures. Le gournement et Hydro-quebec doivent revoir lurs gestions.

Merci :)

C'est une première expérience pour moi et je me sens comme bizarre, ais je bien repondu alors que je ne pense pas quil y ait de bonnes ou mauvaises réponses mais qu'il fallait répondre en fonction de ses convictions. peut être que je fais erreur. En tout cas merci pour cette pause réflexive.

c'est une bonne experience et j'espere que notre contribution pourra vous aider dans vos recherches

Merci pout votre experience, cela a était rapide finalement

It was good, although not necessarily easy to quickly understand for someone who has no background in math or economics

Very well organized and engaging. However I found the environmental benefit part of it a little confusing and a little disconected from the rest.

It was a good experiment. It pushs you to take fast desitions. Was a good exercise for life.

That was very interesting. Thanks.

Well done experiment, nothing to add.

I think this experiement is very useful.

Easy experiment to be on! I had a great time. I would 100% be willing to pay the alternative price for electricity if it meant all these benefits. The harder thing to do now is to educate the whole population on theses benefits and show that collective well-being is the way to go! Wish it had more questions, so that you guys can really get in my head. Thank you.

Thank you.

Thought provoking - will one continue to pay the higher price for the good of the environment, and the economic benefit of the public company? Can one trust that the money is being put to good use? And is it fair that some folks do not make this comittment, and yet reap the benefits? I suppose it‘s a lot like volunteering/charity work... so if I have the means, then I‘ll continue to do my part for the greater good. Thanks for the opportunity!

If we want to save the environment, everybody is going to have to do their part for the community. A single good action alone is not enough, good actions from everyone are necessary. I think that taking the time to read the text of the case at the beginning is very useful.

It was very interesting. Moreover, the research Team was very friendly and professional.

It was a bit confusing at first, perhaps adding a trial round would help.

Groups without the environmental benefit

There was any questons to answer. It way very straigh foward which made it is eaiser. All the information we needed was given so it help in a way guide us to help with the expirement.

it is important to contribute as much as we can for the all benifit of the community, but still the government has the bigest responsability to ensure all parts of the community got what the minimun required

it is important to contribute as much as we can for the all benifit of the community, but still the government has the bigest responsability to ensure all parts of the community got what the minimun required

It was more amusant than what I initially thought.it will be more fun if we can talk to other participants.

Les prix de l electricite sont trop bas. et notre consommation au quebec et au canada (par habitant), contrairement a l europe et beaucoup TROP elevee! Ce n est pas une mauvaise idee d augmente les prix. Par contre il faudrait donner les redevances aux consomateurs qui fond un effort pour economiser au lieu de les donner en profit a une societe d etat. Aussi le point de gestion de la consomation en fonction des habitudes et du "peak power" permet de faire de bonne economie sans couts additionnels.Le plus important c est peut etre les valeurs personnelles et l education au lieu des faibles gain monetaires.

experience clair, le sujet est interessant au vu des problematiques notamment liee a notre consommation d energie qui sepuise. la question de payer un peut plus pour ensuite arriver a satisfaire tout le monde en terrme de consommation me parait interessante.

les aspects morales et altruistique de cette experience sont tres importantes, merci de les poser pour que les participants comme membres de la societe soit oblige‘s a‘prendre leurs decisions a‘ces propos.

The table is very useful

I have voluntarily paid a higher electricity bill in the past to support green energy development (from wind) - I think whether a lot of people do this depends on how it‘s framed and how they feel the funds are being used.

experience tres interessante pour les participants

expérience tres intéressante, bien construite et bien expliquée

ceci etait une expérience fort intéréssante. Personnellement je suis restée campé sur mes positions du début Ã la fin en espérant que les autres changent leurs habitudes de consommations!

Experience bien detaillee et claire.Cependqnt, il serait plus interessant de mettre les quatre tableaux avec les options en premiere page car pour la premiere question on ne pense pas forcement a bien analyser les tableaux avant de repondre.

I choose the basic type all the time in three sections. Because for my type(C) and A, it‘s so costly to choose Alternative. The elctronic price is much higher the the basic price. So I assume that Type A will choose the Basci price system. Under this assumption, the payoff for Alternative is lower than the basic even everyone in

my group choose the basic. This experiment is so costly for the households which consume more electronic.

I found the experiment very interesting and is related with my environment of studies right now. However, I would make it a little bit more interactive for the people participating in it.

You gave clear instructions. It would be interesting to know what is the goal of this study and the impact of our answers.

Alternative electricity is interesting on a large scale depending on the consumption and people's beliefs about it. Interesting experience. Maybe it should have a longer 2nd part, for more accurate results ?

I believe thathis experiment helps us understand more about our living situations and how our personal actions could potentially benefit our serroundings or a society as a whole. We should therefore be not only mindful of ourselves but others as well.

I think its great to improve the Standars of living in terms of health with the help of these experiments, and surely the community will accomanies, when they see the final results.

The instructions were quite long and this could mean losing some people along th way. Maybe two or three exercices questions would have been useful to test the participant's understanding. Other than that, it was an interesting experiment.

1.the parameter of which country governmet we are thinking about is very impoertant. if I think about my country (Iran) or other dictatorist governmets in which the profits of using alternative option will not been used for all people (althought it is written that it is a public organization) I would just think about my own and current budget.2. in the last part, when you are asking about the participants'feelings about the government, you should mention which government you mean (my country or canada)3. ask participants about their originality and residency, it shows our attitude which come from our pasr experiences.

Quite hard to understand the rational behind the experiement, which in turn maybe makes people choose randomly? I hope it helps you still.

Experiment was good, though being able to communicate with the random group assigned could have been interseting, and thus affect our choices more.

its great and i know more about this situation:)

instead of reading the instructions to us, it would have been better to have us read for ourselves and then ask questions or atleast give us some time to read the instructions ourselves. Otherwise well thought out and very eye opening for me as an individual in regards to how altruistic I am.

I believe that taking care of environment is the responsibilityy of every individual and in real-life scenarios I would be more inclined to take more environment friendly and socially responsible actions. Normally I would take decisions with this in mind in real-life; however, in this experiment I was more inclined to take decisions for my personal gain and taking into account that others would also be self-interested. The experiment was a bit vague at first and would help to have more clairty on it.

I think it shows people how much impact can a person make to the society. If everyone was contributing to the society, by chosing the alternative option in this experiment, everyone would‘ve benefit in the present and in the future. But as someone who was the only person who chose the alternative option of my group, it was very discouraging and made me care less about the society. The thought of ‘If everyone is being selfish, there is no point of me being selfless‘ came into my mind.

I THINK IT WOULD BE BETTER TO GIBE MORE TIME TO PARTICIPANTS TO ENSURE THE INSTRUCTION MUCH MORE CAREFULLY INORDER TO PREVENT FROM RANDOM ANSWERS.