## **Research Article**

# **Industrial Plants' Environmental Tax as an Optional Source of Government Revenue**

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#### Abstract

The research has studied the willingness to pay (WTP) for greenhouse gas emissions reduction of industrial plants in Vientiane Capital, Lao PDR. 80 plants were used as the study's sample size, and the Logit model was utilized to determine the propensity to pay for those plants. The examination of industrial plants in Vientiane Capital's willingness to pay for reducing greenhouse gas emissions revealed that the average mean of WTP was 196,556.28 Kip/plant/ month. According to the 2018 industrial survey, Vientiane Capital had 351 plants. Multiply the number of plants with an average mean of WTP worth 68,991,254 Kip/month, and it turns out to be worth 827,895,051 Kip/year. The government can collect more revenue to 67,752,853,200 Kip/year or 7,942,890.18 USD per year (1 USD=8,530) if imposing an environmental tax at least equal to the TWP's average mean.

**Keywords:** Environmental tax; CO<sub>2</sub>; Willingness to pay (WTP); Logit model

## Introduction

Currently climate change or "global warming" are affecting humans significantly whether natural disasters are more severe, climate change directly impacts seasonal change, melting of frozen poles causing sea levels to rise and etc. An important factor that affects global warming is the increasing Greenhouse Gases (GHGs) in the atmosphere which come from the use of certain chemicals in human activities such as industrial that produce cooler machines, chemical fertilizers utilization, burning waste, and fuel utilization and etc. The GHGs is a gas composition of Earth's atmosphere, which is necessary to maintain the global temperature. GHGs includes carbon dioxide ( $CO_2$ ) 53%, methane ( $CH_4$ ) 17%, Ozone ( $O_3$ ) 13%, Nitrous oxide ( $N_2O$ ) 12%, and Chlorofluorocarbons (CFCs) 5%.  $CO_2$  is the greenhouse gas that humans created the most and tends to rise more.

Laos is one of the smallest contributors to greenhouse gas emissions among the ASEAN countries. According to the Global Carbon Atlas, Laos contributed only 0.04% of the world's total greenhouse gas emissions in 2018. Amongst the ASEAN countries, Laos ranked 8<sup>th</sup> in terms of total greenhouse gas emissions in 2018, with a total of 17.9 million metric tons of carbon dioxide equivalent (MtCO<sub>2</sub>e) emissions which came from the energy sectors about 8.9 MtCO2e (50%), agriculture sectors about 6.3 MtCO<sub>2</sub>e (35%), and other sectors about 2.7 MtCO<sub>2</sub>e (15%). As a result, the Lao government has committed to reducing its greenhouse gas emissions by 20% by 2030 as part of its pledge under the Paris Agreement on climate change. The city of Vientiane is the focal point of the country's development, particularly in the industrial sector, as evidenced by the increasing influx of investment from both domestic and foreign sources. However, this growth in industrial production has led to environmental challenges, as the CO<sub>2</sub> emissions released during the manufacturing process have become a cause for concern. Considering the aforementioned issues and their significance, our research aims to investigate the willingness of individuals to pay for reducing greenhouse gas emissions from industrial plants in Vientiane Capital. Additionally, we aim to evaluate specific CO<sub>2</sub> emissions from these plants and provide recommendations to the government regarding pollution control measures through pricing mechanisms and potential new revenue sources.

#### **Literature Reviews**

Willingness to Pay (WTP) is a measure of the highest amount an individual or group is ready to pay for a particular good or service. In the context of greenhouse gas (GHG) emissions, WTP can help estimate the value people place on reducing their carbon footprint and help inform policies addressing climate change. Several studies have investigated WTP for GHG emission reduction. For example, Hitzhusen and colleagues (2006) found that respondents were willing to pay an average of \$21 per month to reduce GHG emissions, while Abrahams and colleagues (2020) found that the median WTP for a carbon tax in

Austin J Bus Adm Manage Volume 7, Issue 1 (2023) www.austinpublishinggroup.com Inthakesone B © All rights are reserved

**Citation:** Inthakesone B, Sihachack M, Syphoxay P, Nammavong P, Inthakesone T, et al. Industrial Plants' Environmental Tax as an Optional Source of Government Revenue. Austin J Bus Adm Manage. 2023; 7(1): 1057. South Africa was ZAR 500 (approximately USD 34) per month per household. Similarly, Li and colleagues (2018) found that respondents in China were willing to pay an average of CNY 46 (approximately USD 7) per month to reduce GHG emissions, and Kotchen and colleagues (2012) found that respondents in the United States were willing to pay an average of \$15 per month to increase their use of renewable energy sources. These studies indicate that there is a significant demand for policies aimed at reducing GHG emissions, but policymakers must consider factors such as income, location, and the specific policy proposed when designing such policies.

The release of Greenhouse Gases (GHG) is a major contributor to climate change and has been a cause for concern in recent decades. One proposed solution is an environmental tax, which is explored in this literature review. Numerous studies have shown a connection between GHG emissions and environmental tax. Baranzini et al. (2017) found that CO, emissions taxes were the most effective policy tool for reducing GHG emissions, followed by energy consumption taxes and fossil fuel use taxes. The effectiveness of environmental taxes is influenced by several factors, such as demand for energy, the level of taxation, and the availability of alternative energy sources. Hsu et al. (2018) examined the impact of a carbon tax on GHG emissions in China and found that it could reduce emissions by up to 18% by 2030. Moreover, it could have a positive impact on economic growth in the long run by encouraging the use of cleaner energy sources.

Environmental taxes not only reduce GHG emissions but can also generate revenue for governments. OECD (2019) estimated that revenue from carbon taxes and other environmental taxes could account for up to 4.5% of GDP in 2030 for OECD countries. The study also found that environmental taxes can be designed to be progressive, which could have a greater impact on highincome households with larger carbon footprints. However, environmental taxes could also have negative impacts on lowincome households due to higher energy costs. Sovacool et al. (2019) suggested that revenue recycling, which uses revenue generated from the tax to support low-income households or invest in clean energy projects, could mitigate this impact.

In summary, the literature suggests that environmental tax is a viable policy tool for reducing GHG emissions, generating revenue for governments, and promoting cleaner energy sources. However, policymakers must take into account the potential impacts on low-income households and support the transition to cleaner energy sources.

## Methodology

The objective of this research was to collect authentic data by administering questionnaires, which were then subjected to descriptive analysis to determine the percentage rate. The collected data was also evaluated using economic principles for determining WTP valuation through the application of the Logit Model to calculate the model coefficient. The study drew on numerous recent researches works as a guide for analyzing and gathering real data from 80 industrial plants located in the Vientiane Capital to assess their WTP value for reducing greenhouse gas emissions.

#### **Population and Sample**

According to the Ministry of Industry and Trade (2018), Vientiane Capital has a total of 2,736 plants, comprising 84 large plants, 186 medium plants, and 2,466 small plants. The factory industries in Vientiane are classified based on their greenhouse gas emissions, with a total of 351 plants, including 30 large plants, 112 medium plants, and 209 small plants. The population used in this study are industrial plants in Vientiane Capital total of 351 in 9 districts by using Proportional Stratified Random Sampling as follow:

## **Data Collection**

This study utilized two sets of questionnaires to gather data as following:

1) The first set was the Pretest Survey Questionnaire, which consisted of open-ended questions directed at 20 different plants. The aim of the survey was to determine whether these plants would be willing to pay for greenhouse gas emissions. The participants were informed of a government program aimed at reducing greenhouse gas emissions by increasing environmental taxes on all industrial plants in the country. They were then asked about their willingness to pay to support the program. Of the 20 plants surveyed, 14 expressed their willingness to pay to support the program, while the remaining 6 indicated that they were not willing to do so. More detailed information on their responses is provided below.

According to Table 1, the average amount that the plants were willing to pay per month to support the program was 146,428.75 kip per plant. To make things simpler, this research adopted the value of 150,000 kip per plant per month, which is roughly equivalent to 18 USD (based on the 2018 Bank of Laos rate of 1 USD=8,530 Lao kip).



ding value.

Source: authors calculated (2018).

Table 1: Shows the number of industrial plants in Vientiane Capital.

Districts	Industries (plant)	Samples	
Chanthabouly	35	8	
Sikhodtabong	49	11	
Xaysedtha	31	7	
Sisattanark	48	11	
Naxaiythong	17	4	
Xaythany	92	21	
Hardxaiyfong	74	17	
Sangthong	1	0	
Parknguem	4	1	
Total	351	80	

Source: Ministry of Industry and Trade (2018).

This value was used as the median to determine the bidding value, and the process for determining the bid value is illustrated in Figure 1 below.



Figure 3: Reasons not to pay for reduction of greenhouse gas emissions in Vientiane.

Source: authors calculated (2018)



**Figure 4:** Reasons happy to pay to support the reduction of greenhouse gas emissions of industrial plants in Vientiane. Source: authors calculated (2018)

 Table 2: Shows prices obtaining from Open – Ended Question.

Price (kip/month)	No. of plants willingness to pay	Total value	
500,000	1	500,000	
300,000	1	300,000	
200,000	2	400,000	
150,000	2	300,000	
100,000	3	300,000	
80,000	1	80,000	
50,000	3	150,000	
20,000	1	20,000	
Total	14	2,050,000	
Δυργασο	1/6 /28 E7 kin/month/ plant		

Average 146,428.57 kip/month/ plant Source: authors calculated (2018); note: 1 USD = 8,530 Lao kip (LAK). Table 3: Definition of variables.

Variables	Meaning	Units		
Dependent Variable				
WTP	Willingness to pay 1 = Yes; 0 = No			
Independent Variables				
Bid	Bid offered value	Кір		
Income	Industrial income	Кір		
Year	Period of operation	Year		
Emp	Number of total employees	Person		
Loc	Location of plant	1 = Inside the industrial park;		
		0 = Outside the industrial park		
Own	Ownership	1 = Lao investors 100%		
		0 = Other		
Intype	Industrial type	1 = Industrial Metals		
		0 = Other		
CO <sub>2</sub>	CO <sub>2</sub> Emission of plant	1 = Release		
		0 = Not release		

Source: authors calculated (2018)

Table 4: Sample statistics description.

Income per month (Lao Kip)	Numbers of plants	percent (%)		
<=5,000,000,000	34	42.50		
5,000,000,001 - 10, 000,000,000	18	22.50		
10,000,000,001 - 15,000,000,000	14	17.50		
>15,000,000,00	14	17.50		
Number of year of operations				
<5	13	16.25		
5 - 10	20	25.00		
11 - 16	20	25.00		
17 – 22	13	16.25		
>23	14	17.50		
Number of employees				
<50 (small size)	38	47.50		
50 – 99 (medium size)	15	18.75		
>100 (large size)	27	33.75		
Location				
Inside special economic zones	13	16.25		
Outside special economic zones	67	85.75		
Ownership				
Lao owned 100%	42	52.50		
Joint venture with foreign owned < 50%	5	6.25		
Joint venture with foreign owned > 50%	9	11.25		
Foreign Owned 100%	24	30.00		
Types of Industry				
Food and beverage industry	10	12.50		
Metal industry	10	12.50		
Processing industry	16	20.00		
Plastic industry	11	13.75		
Other industry	33	41.25		
Plants with CO2 emission release				
Yes	12	15.00		
No	68	85.00		
Total	80.00	100 (%)		

Source: authors calculated (2018) **Table 5:** Variables statistic description

Variables	Obs	Mean	Std. Dev	Min	Max
WTP	80	0.612	0.490	0	1
Bid	80	150,000	71,156.810	50,000	250,000
Income	80	118,000,000,000	93,300,000,000	175,000,000	8,350,000,000,000
Year	80	14.262	11.020	2	61
Loc	80	0.162	0.371	0	1
Emp	80	108.662	134.327	20	753
Own	80	0.525	0.502	0	1
Intype	80	0.125	0.332	0	1
CO2	80	0.150	0.359	0	1

Source: authors calculated (2018)

Table 6: Logistic regression results.

Variables	Coef	Std. Err	Z	P> z	
Bid	-0.0000136**	0.00000536	-2.54	0.011	
Income	0.000000000267	0.000000000268	1.00	0.319	
Year	0.192***	0.064	2.97	0.003	
Emp	0.004	0.004	1.00	0.316	
Loc	-1.248	1.011	-1.23	0.217	
Own	2.157***	0.754	2.86	0.004	
Intype	1.962*	1.171	1.67	0.094	
CO2	2.249*	1.235	1.82	0.069	
Constant	-1.716	1.284	-1.34	0.181	
Log likeli-	27 454				
hood	-27.451				
Number of		22			
obs	80				
LR chi2(7)	51.910				
Prob > chi2	0.000				
Pseudo R2	0.486				

Source: authors calculated (2018), \* significant level at 10%, \*\* significant level at 5%, \*\*\* significant level at 1%,

2) The Main Survey consisted of a second set of questionnaires. The first three parts of the Main Survey were identical to those in the pretest survey. However, in the fourth part, the study utilized Close-Ended questions with a single bid value as shown in figure 1, where respondents were offered a bidding value. The survey had five bidding choices, and 16 plants were queried for each bidding choice, resulting in a sample size of 80 plants.

## **Data Analysis**

Logit models were employed in this research as the independent variable was qualitative data which denoted the Willingness to Pay (WTP). A value of 1 signified that the plant was willing to pay for the program at the offered bidding value, while a value of 0 indicated the plant was not willing to pay for the program at the offered bidding value. The econometric model, which included some control variables, was formulated as follows.

WTPi =  $\beta$ 0 +  $\beta$ 1Bidi +  $\beta$ 2Incomei +  $\beta$ 3Yeari +  $\beta$ 4Empi +  $\beta$ 5Loci +  $\beta$ 6Owni +  $\beta$ 7Intypei+  $\beta$ 8CO2i + ui

 $\beta_0$  : constant term

 $\beta_1,\beta_2,\ ,\beta_4,\beta_5,\beta_6,\beta_7,,\beta_8$  : indicated equation coefficients

ui : error term

## **Results and Discussion**

#### Results

**Sample Statistics Description:** Table 4 displays the monthly income and percentage of plants in each income group. Out of the total sample size, 34 plants (42.50%) have a monthly income less than or equal to 5,000,000,000 Lao Kip, while 18 plants (22.50%) have an income between 5,000,000,001 and 10,000,000,000 Lao Kip. Overall, the majority of plants (about 65%) have a monthly income less than or equal to 10,000,000,000 Lao Kip. In terms of years of operation, 20 plants fall in the 5-10 years and 11-16 years groups, each representing 25% of the sample size. However, 14 plants (17.50%) have been in existence for more than 23 years. Most plants (47.50%) have a small number of employees (less than 50), while 27 plants (33.75%) are categorized as large.

Table 4 also includes the location of plants, with 13(16.25%) located inside special economic zones and 67(85.75%) located outside. Out of the total sample size, 42 plants (52.50%) are 100% Lao-owned, 24 plants (30%) are 100% foreign-owned, and the remaining are joint ventures. In terms of industry types, processing industry represents 20.00% of the sample size with 16 plants. Food and beverage, metal, and plastic industries have slightly different numbers and percentages, while 33 plants (41.25%) fall under other industries such as electronics. Only 12 plants (15.00%) among the total sample size release  $CO_2$  emissions.

Willing to pay to reduce greenhouse gas emissions from industrial plants in Vientiane Capital: The study asked participants how much they were willing to pay per month to reduce greenhouse emissions. The options given were 50,000; 100,000; 150,000; 200,000; and 250,000 Kip, respectively. The results showed that 51 plants (63.75%) were satisfied with the proposed payment amount, while 29 plants (36.25%) found it to be an unwelcome expense. Specifically, 81.25% of those who were willing to pay 50,000 kip per month were satisfied, 68.75% of those willing to pay 100,000 kip were satisfied, and 62.50% of those willing to pay 150,000 kip were satisfied. However, among those who were willing to pay 200,000 kip per month, all were satisfied, while among those willing to pay 250,000 kip per month, only 9 plants (56.2%) were willing to pay. These results suggest that the proposed payment amount was generally accepted, but there was some rejection among those who were asked to pay higher amounts.

The study aimed to uncover why certain plants were unwilling to contribute to the program aimed at reducing greenhouse gas emissions in Vientiane Capital. To achieve this, the study asked these plants why they did not support the program. The findings revealed that a portion of the respondents, specifically 12.90 percent, did not believe that the charges associated with the program would materialize. Additionally, 35.48 percent of the participants deemed the current situation in the country to be unsuitable for the program. While some may argue otherwise, a considerable 25.81 percent of respondents did not hold plants accountable for the reduction of CO<sub>2</sub> emissions. Furthermore, a noteworthy 6.45 percent lacked confidence in the financial system. In terms of using fees as a solution, 16.13 percent of respondents believed that it would not be effective in addressing the current problems. Lastly, 3.23 percent of the respondents did not align with any of the provided options and fell under the "other" category.

The study aimed to assess the willingness of plants to participate in a program aimed at reducing greenhouse gas emissions in Vientiane Capital. As part of the study, respondents were asked to provide reasons for their willingness to pay for the program. The results showed that only 18.37% of the respondents believed that the fund had the potential to reduce greenhouse gas emissions in the Vientiane capital, while 20.41% of them believed that the fund could contribute to mitigating global warming. Moreover, 22.45% of the respondents were of the opinion that the fund had the capacity to improve the lives of people residing close to the plants. A significant 30.61% of the respondents felt that the program could have a positive impact on the overall climate conditions in the Vientiane capital. However, only a smaller percentage, i.e., 8.16% of the respondents, believed that the fund could play a role in addressing the pollution problem in the Vientiane capital.

**Econometrics results:** Table 5 provides a statistical overview of the variable, including measures such as mean, standard deviation, minimum, and maximum value.

Before conducting the logit regression analysis, the study assessed the occurrence of multicollinearity issues. Fortunately, no such problems were detected in the model. Table 6 presents the findings from the Logit models, which indicate that the Bid variable has a statistically significant negative coefficient at 1%, aligning with conventional theory. This means that as the bidding price increases, the plant's willingness to pay decreases. The number of years and ownership variables were also statistically significant at 1%, while the industrial type and plants with  $CO_2$  release variables showed statistical significance at 10%. Additionally, although some variables did not demonstrate statistical significance, their economic signs were consistent with the theory. The study also evaluated the presence of heteroscedasticity, and no issues were identified.

Mean Willingness to Pay (MWTP): The study utilized Hanemann's (1984, 1989) approach to determine the MWTP. By examining the bid variable coefficient from the Logit model, we can calculate the MWTP as follows:

MeanWTP = 1/ 
$$\beta_{i} (Log(1 + Exp(\alpha_{0} + \beta_{2} \Box Q + \sum \beta_{j}S_{j})))$$

$$MeanWTP = 1/ \int_{Bac} (Log(1 + Exp(\beta_0 + \beta_{Inc}Inc + \beta_{Time}Time + \beta_{Loc}Inc + \beta_{Emp}Emp + \beta_{Inc}Inc + \beta_{Inc}Ind + \beta_{CO}2CO_2)))$$

Mean WTP = 
$$\frac{1}{-0.0000136} (\text{Log}(1 + \text{Exp}(-1.716 + (0.000000000267 \times 118,000,000) + (0.192 \times 14.262) + (-1.248 \times 0.162) + (0.004 \times 108.662) + (2.157 \times 0.525) + (1.962 \times 0.125) + (2.249 \times 0.150)))$$

Mean WTP = 196,556.28 kip/plant/month

The study determined the MWTP to be 196,556.28 Kip per plant per month. Using data from the 2018 industrial survey, it was found that Vientiane Capital had 351 plants, and by multiplying this number with the average WTP of 68,991,254 Kip per month, the total annual value amounted to 827,895,051 Kip. If the Lao government imposes an environmental tax based on the average MWTP, it would generate at least 67,752,853,200 Kip per year, equivalent to 7,942,890.18 USD per year (1 USD = 8,530 Kip) nationwide

## Conclusions

The research has studied the Willingness to Pay (WTP) for greenhouse gas emissions reduction of industrial plants in Vientiane Capital, Lao PDR. 80 plants were used as the study's sample size, and the Logit model was utilized to determine the propensity to pay for those plants. The examination of industrial plants in Vientiane Capital's willingness to pay for reducing greenhouse gas emissions revealed that the average mean of WTP was 196,556.28 Kip/plant/month. According to the 2018 industrial survey, Vientiane Capital had 351 plants. Multiply the numbers of plants with an average mean of WTP worth 68,991,254 Kip/month, and it turns out to be worth 827,895,051 Kip/year. The government can collect more revenue to 67,752,853,200 Kip/year or 7,942,890.18 USD per year (1 USD = 8,530) if imposing an environmental tax at least equal to the TWP's average mean.

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