ELSEVIER

Energy Policy 36 (2008) 388–397

ENERGY POLICY

www.elsevier.com/locate/enpol

Environmental and economic benefits resulting from citizens' participation in CO_2 emissions trading: An efficient alternative solution to the voluntary compensation of CO_2 emissions

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Received 19 July 2007; accepted 20 September 2007
Available online 29 October 2007

Abstract

Over the last few months in the emerging and lucrative carbon project market, a growing number of organizations have proposed to offset citizens' greenhouse gas emissions. The target of these carbon-offset initiatives is to satisfy the increasing demand of individuals wishing to take part in the fight against climate change. In this paper, we review and criticize these carbon-offsetting programs in general terms. We then propose an alternative that, in our opinion, should prove to be a better solution for citizens who are willing to pay for protecting the environment. This alternative is to organize citizens' participation in carbon emissions trading on a large scale in order to purchase and retire (destroy) CO_2 permits. To do so, a benevolent Regulator or non-governmental organization must correct certain CO_2 emissions market failures; this particularly concerns the high transaction costs, which represent an entry barrier and prevent citizens from purchasing and withholding permits. Based on theoretical findings, we demonstrate that implementing citizens' participation in emissions trading is an economically efficient and a morally preferable option.

Keywords: CO_2 emissions trading; Citizens' participation; Carbon offsetting

1. Introduction

Due to the increasing number of information campaigns about the causes, current impacts and future risks of climate change, the percentage of natural and artificial persons with a real energy and environmental awareness has strongly increased over the last few years. Due to personal and economic issues, more and more people are learning about and adopting good environmental behaviors. Amongst these people, some are convinced, whether rightly or wrongly, that they are already doing their maximum for reducing their impact on the environment. These people may wish to do more for the planet and are willing to pay for this purpose. As a result, today, a real demand for pollution control can be identified and the major priority is to satisfy it in a cost-efficient manner. Although various solutions already exist, they are unsatisfactory from an efficiency and ethical point of view.

The purpose of this paper is to describe a cost-efficient solution for satisfying the pollution control demand from natural and artificial persons, who are willing to pay for reducing the overall level of greenhouse gas emissions. This solution may be summarized as a pollution control service provided by the government or a non-governmental organization (NGO) consisting in buying and then withholding CO_2 emission quotas. In other words, we propose to facilitate the access of pollution victims to CO_2 emissions trading. This type of system firstly involves gathering purchase demands for a small amount of emission permits, then trading by bilateral agreement or on a carbon exchange, and finally withholding these permits from the market.

Before describing this solution, we will present and criticize the recent carbon-offset programs, which have emerged over the last few months from an economic point

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doi:10.1016/j.enpol.2007.09.019

of view. This description will facilitate the understanding of our alternative solution and its advantages.

2. Carbon-offset initiatives and their drawbacks

Over the last few months, the number of carbon-offsetting organizations has increased significantly. These initiatives started in the United States and are now being carried out in Europe. The aim is to gather a certain capital in the form of donations and to develop emission reduction projects. Potential donators, who possibly have already adopted good environmental behaviors, are informed by carbon-offsetting funds that carbon compensation may represent an additional way of fighting against climate change. This could be done by reducing carbon emissions in countries where abatement costs are lower. From a marketing point of view, carbon offsetting enables donators to become climate neutral or carbon neutral.

2.1. Definition of carbon offsetting

At this time, we do not know how many offsets have been sold for carbon neutrality purposes but it is clear that the retail offset market is growing rapidly. Today, about 30 carbon-offset organizations[1] exist in the following industrialized countries: Germany, Australia, Canada, the United States, France, Ireland, the Netherlands, the United Kingdom, Sweden and Switzerland. Detailing each of these initiatives would be too long. Consequently, we have decided to firstly describe the main steps leading to donations, then to give an overview of the various carbon-offset programs and finally to provide a critical analysis thereof.

In the first place, the donation process consists in informing the customer about the climate change issue[2] and suggesting ecological actions enabling to reduce consequences for the climate, such as energy savings, using alternative transportation solutions, waste reduction, etc. In the second place, carbon offsetting is presented as a solution for becoming carbon neutral. Thus, the customer is able to calculate his own CO_2 emission rate using a carbon calculator, which takes into account various pollution sources (cars, airplanes, heating, etc.). At the end of the calculation process, the customer can pay a certain amount of money for the compensation of his emissions and then receive a carbon-offset certificate.

Based on this main operating principle, practices may vary from one initiative to another. Donor prospecting (donors include individuals, firms, public organizations) is mainly carried out via Internet, and sometimes via information campaigns in the press, on television and also through partnerships with, for example, car manufacturers, traveling agencies, tour operators, etc. As regards the legal status of these entities, they may either be NGOs (associations and foundations) or for-profit organizations (firms), the percentage of non-profit organizations being equal to two-thirds of the total number of organizations. The amount of CO_2 emissions to be offset is calculated based on road transport, air transportation, domestic heating and even on the entire climate footprint of the relevant natural or artificial person. Thus, ''car packages'', ''airplane packages'', ''housing packages'' and even ''event packages'' can be identified. For instance, the FIFA World Cup or even the Oscars Ceremony have chosen to offset their CO_2 emissions. Among current organizations, about one-third is specialized in offsetting emissions from a single type of source, for example, cars. Other structures propose to offset all types of emissions. Moreover, there are also differences according to the type and geographical location of the projects being funded. The projects that are financed include, for example, renewable energies (wind, solar, biomass and hydro), energy efficiency, forestries (reforestation) and waste management. Most initiatives have a diversified portfolio of projects. Most of the time, the donor cannot choose the project that he wishes to finance but some programs propose this possibility. Regarding the geographical localization of the projects, American and Australian organizations seem to favor domestic projects whereas European structures are more interested in implementing emission offsetting projects in developing countries. Lastly, some organizations develop other activities such as consulting services,[3] emissions trading, climate friendly products sales and even advertising campaigns for their partners (energy suppliers, cars, banks, etc.).

2.2. Negative aspects of emission offsetting

Considering the great number of practices and initiatives, the following discussion and critics do not concern a specific project. The aim of this note is to provide a general overview and not condemn a particular structure, as this would require carefully reading the general sales terms of each initiative. Based on a general point of view, our criticism shows that certain initiatives could be economically inefficient and involve ethic and moral issues.

Firstly, some donors are unfortunately not familiar with Kyoto mechanisms and carbon finance, and, consequently, they are not aware that carbon-offset sales concern avoided

[1]Action Carbone, Atmosfair, Carbon Clear, Carbon Credit Solutions LLC, Carbon Footprint, Carbon Planet, CarbonAided, Carbonfund, Cleanairpass, Climat Mundi, Climate Balance (EDF Energy), Climate Care, Climate Friendly, CO2 Solidaire, D. Suzuki Foundation's Carbon Neutral Program, DriveNeutral, DrivingGreen, EcoNeutral, Green Tags, Greenfleet, GreenSeat, Growaforest, Klimatneutral, My Climate, Native Energy, Offsetters, The Carbon Neutral Company, The Climate Trust, Pembina Institute for Appropriate Development, Sustainable Travel International, Targetneutral (BP), TerraPass.

[2]For example, presentation of the greenhouse effect phenomenon, existing scientific reports, risks and forecasts of ecological and socio-economic impacts.

[3]Consulting services proposed to firms or public entities by emissions offset organizations include training and presentations, greenhouse gas emissions accounting and reporting, feasibility studies of emission reduction projects, marketing and environmental communication.

pollution rather than real abated pollution. The avoided pollution notion refers to the project additionality issue as well as the organization in charge of additionality verification. Are financed projects really additional or only "business as usual" type projects? Do these projects satisfy Clean Development Mechanism (CDM) criteria, as defined by the United Nations Framework Convention on Climate Change, or are they managed in a more informal way? Greiner and Michaelowa (2003) have studied the concept of additionality and have shown that the additionality assessment of an investment is a complex task. From a general point of view, we can say that a project is additional if it is not "business as usual", i.e. this project enables certain emission reductions, which would have been impossible without its implementation. In the context of the CDM, additional projects generate "certified" emission reductions (CER) that can be sold, for example, on the EU ETS. If these CER are sold, there is no carbon offsetting as it enables developed countries to increase their emissions. This is the reason why emission reductions generated by carbon-offset organizations should not be certified but only "verified" as verified emission reductions are not tradable on the carbon market. Unfortunately, this information concerning the certification or verification of emission reductions is not always available on carbon-offset initiative websites and there is no clear quality standard for carbon offsets. In practice, some projects apply formal CDM criteria while others are subject to simplified and more or less strict control systems. Furthermore, there is no necessary correlation between the price and quality of retail offsets. One can develop offsets that are quite inexpensive but credible (Clean Air-Cool Planet, 2006). It should be noted that the Gold Standard Foundation (initiated in 2003 by WWF, SSN and Helio International) has proposed since 2006 a quality label for voluntary carbon-offset projects based on criteria such as additionality, durability, environmental efficiency (except for reforestation projects), transparency, monitoring quality and project verification.

Secondly, implementing carbon-offset projects in developing countries seems to mean that it would be impossible to reduce emissions at a lower cost in developed countries. Principles characterizing most carbon-offsetting initiatives seem to show that it is preferable to finance emission reduction projects at a lower cost in developing countries rather than to make expensive investments in developed countries. In other words, according to these organizations, the cost per ton of CO_2 avoided in developing countries is lower than the cost per ton of CO_2 reduced in developed countries. However, it should be noted that the prices of a ton of CO_2 avoided are not expressly indicated as they have to be recalculated; moreover, these prices vary greatly according to the initiatives, and they are generally higher than the price of a ton traded at the same time on the European Union greenhouse gas Emissions Trading Scheme (EU ETS) (see Table 1). The observed price of a 2007 vintage permit varied between €15.5 in June 2006 and less than €1 in April 2007.[4] It should also be noted that for the same theoretical route, the amount of carbon to offset varies depending on the type of emission calculator being used. These differences may be due to emission calculation hypotheses, which only consider CO_2 emissions, or which consider all greenhouse gas emissions expressed in CO_2 equivalent units.

Table 1
Examples of carbon-offsetting calculations for a Paris–New York return trip (*Source*: ADEME (2006)) according to emission calculators available on Internet in October 2006

Name of the provider (country of origin)	CO_2 emission (ton)	Offsetting cost (€)	Price per ton (€)
Terrapass (USA)	1.28	8	6.25
Climate care (UK)	1.63	18	11
Climate care/British Airways	1.32	15	11
Action Carbone (France)	2.57	38	15
Green Seat (The Netherlands)	2.57	41	16
Climat Mundi (France)	2.56	51	20
Pembina (Canada)	2.33	56	24
My Climate (Switzerland)	2.25	54	24
CO2 Solidaire (France)	2.94	71	24
Atmosfair (Germany)	3.98	80	20

Thirdly, "carbon neutral" and "climate neutral" concepts are not relevant and are a source of error for the customer. The climate change issue requires a drastic change of our living habits and carbon-offsetting programs are just a way to ease our conscience by paying someone else to undo the damage we are generating. Reducing emissions in one developing country does not enable one to achieve a carbon neutral or climate neutral status. If an individual uses his car or watches television, he generates pollution and has an impact on the climate whether he gives money to an offset program or not. With this possibility to become carbon neutral, consumers do not need to ask themselves if it is really necessary to use their car, watch television or take a holiday on the other side of the world. Moreover, except for the development aid issue, which is not considered as the main purpose of the donation process, the question that should be asked is whether it is fair to reduce emissions growth of an African who generates far less CO_2 by year than a European?

Fourthly, considering the time factor is problematic due to the lag phase from when the pollution is generated by the donor until when the project is implemented, i.e. organizations often forward sell their offsets (e.g. forestries). Consequently, pollution abatement is not immediate. Furthermore, the donor may wrongly believe that it will not be necessary to offset his emissions the following year as his donation will have been used to build a wind generator or a waste-treatment system, which will operate

[4]In mid-April 2007, the forward price of a 2007 vintage permit (delivery in December 2007) was about 0.50 € and the forward price of a 2008 vintage permit (delivery in December 2008) was about 17.50 €.

for many years and thus offset his emissions over several years.

Fifthly, it should be wondered whether collecting funds and developing projects is fair when donors have no property rights over the projects. All these organizations provide information about the environmental benefits related to their actions; this seems to prove that their initiative is non-profit making. Whatever the legal status of these organizations (profit making or not), overall, there is a lack of detailed information concerning the distribution of collected funds, i.e. the percentage of the donation which is used for funding the project itself[5] and that which is allocated to the general operation of the organization.[6] Despite the existence of audits, this lack of information increases the probability of personal enrichment (high salaries, benefits in kind), or of costs transfers, for example between consulting and offsetting activities. Moreover, operating an organization and executing a project require purchasing goods and services and, consequently, providers have to make choices, which may, for example, favor close relations or even lead to corruption, which is more frequent in developing countries. Lastly, some projects may provide paying services (e.g. the electricity generated by a wind farm can be sold) and consequently the following questions may be asked: who receives the benefits from the sale of project services and how are these profits used? In all cases, donors are not consulted insofar as they have no property rights over the project.

Finally, few carbon-offsetting programs, such as CO_2 Solidaire or Action Carbone, offer tax deductions to donors, and we should ask ourselves whether it is worthwhile for emission offsetting to enable tax deduction. Offering a tax deduction on this type of donation reduces the already restricted educative aspect of these initiatives because the price for offsetting negative greenhouse gas externality is not entirely paid by consumers.

By way of summary, it should be noted that, in the best case, these initiatives reduce the overall pollution level; in the worst case, they do not satisfy the consumer's pollution control service, and are a good solution for "rich" donors wishing to ease their conscience in developed countries and allow firms to develop their activity by means of donations. As a result, it seems important that public authorities should carry out and publish comparative analyses (benchmarks) relative to these carbon-offsetting initiatives. The aim is to protect consumers from bad practices by increasing competition between programs (in terms of price and quality). Furthermore, in addition to these carbon-offsetting initiatives, it is interesting to implement another solution aiming to reduce the global pollution level: active citizens' participation in emissions trading based on purchasing and withholding permits. In the following sections, we will examine this alternative as an economically and morally preferable option.

3. An alternative solution: citizen's participation in CO_2 emissions trading

Today, it is obvious that there is a demand for greenhouse gas emission reduction from citizens. The number of carbon-offsetting initiatives is strongly increasing; this clearly proves that there is a significant demand for CO_2 pollution control solutions. In this context, our aim is to satisfy this pollution control demand using a more efficient approach than CO_2 offsetting programs by carrying out direct actions on the greenhouse gas market. As opposed to tax and command-and-control regulations, emissions trading represents a true opportunity for "environmentalists" (natural and artificial persons) to directly express their demand for emissions abatement, and, at the same time, to ensure an efficient protection of the environment. If access to this market is not only restricted to polluting firms, anyone can reduce the overall pollution level by purchasing and withholding permits until they are no longer valid. Although this recommendation of including pollution victims in the permit trading market was developed by Dales (1968) and despite the general authorization enabling citizens to take part in emissions trading, this idea has not received much attention.

Once we have demonstrated that citizen participation in tradable emissions markets is beneficial from a theoretical point of view, we will explain why citizens do not actively participate in pollution permit trading. We then propose to provide a solution for this problem and describe its advantages relative to carbon-offsetting initiatives.

3.1. Theoretical aspects showing the relevance of citizens' participation in emission permits market

The theoretical aspects showing the relevance of citizens' participation in pollution permit markets are described in the "prices versus quantities" debate relative to the choice of the policy instrument under imperfect information and uncertainty. This debate is a refinement of the theoretical works concerning the determination of a second-best optimum à la Baumol (1972).[7] The idea is to determine the conditions under which a price-based environmental regulation (emission tax) or a quantity-based environmental regulation (command-and-control or tradable quotas) is the preferred policy. The theoretical analysis of this choice

[5]The development of a project requires various expensive stages such as an investment opportunity research, a preliminary study, administrative agreements, construction, monitoring and verification of the project.

[6]The running costs of an offset organization include among others communication expenses, salaries, office rents, travelling expenses and even audit costs.

[7]Due to information, statistical and technical difficulties for determining the optimal level of pollution, Baumol (1972) proposes to limit the analysis to the choice of the policy instrument achieving the environmental target at the lowest cost. In other words, the level of pollution is an exogenous parameter set by the Regulator, and the Paretian optimality condition is replaced by a more modest condition: the minimization of pollution abatement costs.

Box 1

Graphical representation of the ''prices versus quantities'' debate and the relevance of citizens' participation in pollution permit trading

Similarly to Baumol and Oates (1988), we consider a static analysis and partial equilibrium context, a marginal pollution abatement cost curve (MAC) representing the reaction of polluting firms to the chosen economic instrument (tax or tradable quotas), and a marginal pollution damage curve (MPD) representing the collective willingness to pay for reaching a given pollution level. In order to simplify the graphical representation, we assume linear functions with a negative slope for the marginal pollution abatement cost, and a positive slope for the marginal pollution damage.

We consider three cases including two sub-cases; the results (which are expressed in terms of social welfare) and the choices made by the relevant Regulator are summarized in Tables 2 and 3.

Case 1 (see Fig. 1): MAC is known by the Regulator and uncertainty concerns MPD.
Case 1A: The realized position of MPD (MPD_h) is higher than its expected position (MPD_e).
Case 1B: The realized position of MPD (MPD_l) is lower than its expected position (MPD_e).
Case 2 (see Fig. 2): MPD is known by the Regulator and is steeper than MAC, which is unknown.
Case 2A: The realized position of MAC (MAC_l) is lower than its expected position (MAC_e).
Case 2B: The realized position of MAC (MAC_h) is higher than its expected position (MAC_e).
Case 3 (see Fig. 3): MPD is known by the Regulator and is less steep than MAC, which is unknown.
Case 3A: The realized position of MAC (MAC_l) is lower than its expected position (MAC_e).
Case 3B: The realized position of MAC (MAC_h) is higher than its expected position (MAC_e).

has been developed for the first time by Weitzman (1974).[8] In his seminal paper, Weitzman proposes a theorem establishing the conditions under which price and quantity regulations regarding the internalization of external costs[9] are not equivalent. The main point in Weitzman's discussion is that expected welfare gains generated by both instruments depend on the relative slopes of the aggregate functions of marginal pollution abatement cost and marginal pollution damage.

Under imperfect information and uncertainty, any environmental policy aims to maximize expected welfare. When the marginal abatement cost and the marginal pollution damage are unknown, the Regulator must select an environmental policy while knowing that he will make errors. This clearly means that the Regulator has to assess the relative significance of the consequences of his errors and adopt a price-based approach in order to avoid very high abatement costs, or adopt a quantity-based approach in order to avoid excessive pollution damage. More precisely, when the marginal pollution damage curve is steep, i.e. if there are environmental thresholds above which a small increase of emissions can generate highly significant impacts on the environment, it is very important to strictly control quantities in order to ensure that emissions do not exceed the critical level. If the marginal pollution damage curve is steeper than the marginal pollution abatement cost curve, this means that marginal damages will become increasingly high with respect to the costs, which would have been generated to prevent the emission of each additional pollution unit. In other words, it is preferable to determine quantities before the marginal pollution damage becomes too high or before exceeding the environmental threshold (saturation). Furthermore, if the slope of the marginal pollution control cost is higher than the slope of the marginal pollution damage, this means that marginal costs will become increasingly high with respect to the damage that is being prevented. In these conditions, a price-based regulation is to be favored compared with a quantity-based regulation because if an excessively strict ceiling is determined for quantities, this may generate excessively high constraints for regulated firms (see Box 1, Figs. 1–3 and Table 2).

Shrestha (1998) refined this ''prices versus quantities'' debate by including citizens in the tradable permit system. In this context, the consequences due to the Regulator's assessment errors when determining the overall pollution quota can be limited by revealing the preferences of pollution victims. Theoretically, when the marginal pollution damage exceeds the marginal pollution abatement cost, citizens will participate in emissions trading, i.e. they will purchase and withhold (i.e. destroy) emission permits from polluting firms until the optimal pollution level is reached. In other words, citizens' participation in pollution permit market enables reaching the optimal level of pollution if the ''optimal'' level of pollution defined by the Regulator under uncertainty exceeds the ''true'' optimal level of pollution. Therefore, it seems that a tradable emission permit system is to be the preferred instrument except when the marginal pollution abatement

[8]Authors contributing to this debate are Adar and Griffin (1976), who have proposed, for the first time, a graphical representation of this problem, Roberts and Spence (1976), Baumol and Oates (1988), Stavins (1996) or even Shrestha (1998).

[9]Weitzman's theorem applies to negative externalities (e.g. pollution abatement with the implementation of a tradable permit system) and to positive externalities (e.g. promotion of electricity generated from renewable energy sources with the implementation of a tradable green certificate market).

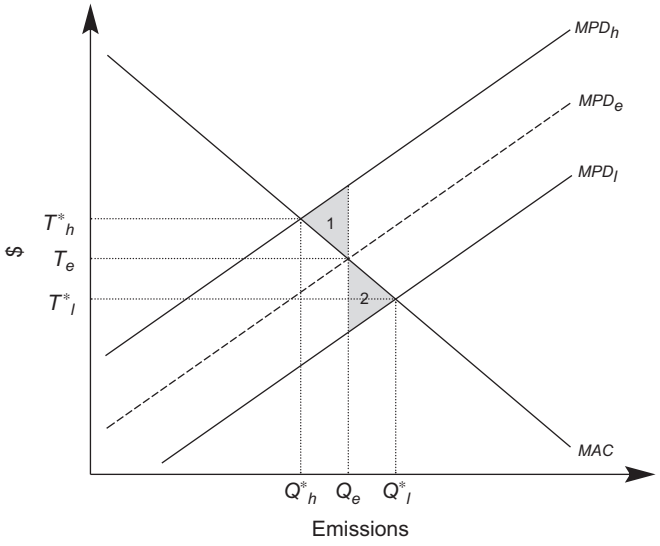

Fig. 1. .

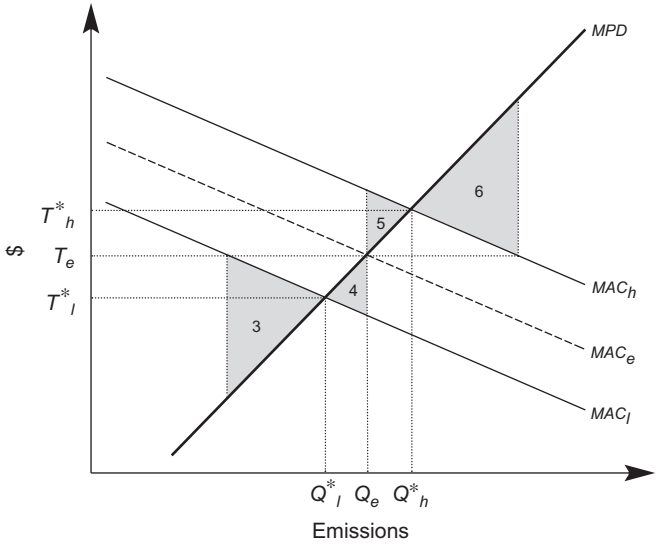

Fig. 2. .

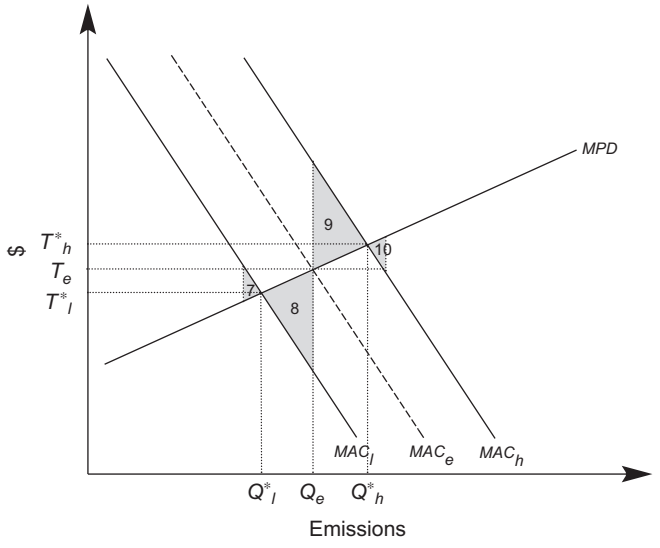

Fig. 3. .

cost curve is steeper than the marginal pollution damage curve and when its realized position is higher than its expected position (see Box 1 and Table 3).

In the literature about the role of citizens in an emission permit market, Ahlmein and Schneider (2002) propose a system in which all of the permits are allocated free of charge to citizens. They have particularly shown that these markets are as economically efficient as the markets only including polluting firms, but in addition, they benefit from an increased ecological accuracy. Nevertheless, these results are reduced as soon as we assume that certain victims of pollution do not entirely reveal the marginal pollution damage. Firstly, agent's preferences can be biased by means of *impurely altruistic* behaviors. This concept was introduced in the economic literature by Andreoni (1989, 1990). In our case, this means that individuals could withhold permits in order to feel better by acting as conscientious citizens. Secondly, in order to enable an efficient allocation of emissions, there must be no situation that Hardin (1968) has called "*Tragedy of the commons*"; i.e. victims of pollution are not to be discouraged by the assumed insignificance of their individual actions aiming to reduce the pollution level. Lastly, agents may act as free riders by letting others control pollution in their place. From a general point of view, it is clear that certain victims of pollution do not entirely reveal the marginal pollution damage, but it should also be noted that impurely altruistic behaviors can compensate the problem of the commons and free riding. The "free rider" behavior is studied in detail by Smith and Yates (2003); they have shown that, in a dynamic context, the Regulator can allocate a deliberately high number of permits (compared with a static context) during the first period in order to increase the probability of citizen participation in emissions trading and gather information regarding their preferences. Thus, during the second period, the Regulator can use this information to improve the level of welfare by selecting a cap that is closer to the optimal pollution level. From a general point of view, these papers show that the participation of pollution victims should always be considered; when non-polluting actors purchase and withhold permits, this means that the overall quota is not efficient. Furthermore, the increasing number of players in the tradable permit market improves competition, as strategic behaviors from citizens seem improbable.[10]

In practical conditions, American environmental groups and student associations have already purchased and retired SO_2 emission permits (Acid Rain Program) and NO_x (RECLAIM program) emission permits. From a quantitative point of view, this participation in emissions trading was very low compared with the number of existing permits (Schwarze and Zapfel, 2000; Kruger and Dean, 1997; Israel, 2007). Two reasons can be proposed for explaining this low participation rate. The first possibility is

[10]Dales (1968) admits that speculation in emissions trading has certain benefits.

Table 2
"Prices versus quantities" debate without citizens' participation in pollution permit market

		Equilibrium with tax	Equilibrium with tradable quotas	Prices or quantities?
Case 1	1A	Sub-optimal WL = area 1	Sub-optimal WL = area 1	Prices = Quantities[a]
	1B	Sub-optimal WL = area 2	Sub-optimal WL = area 2	
Case 2	2A	Sub-optimal WL = area 3	Sub-optimal WL = area 4	Quantities
	2B	Sub-optimal WL = area 6	Sub-optimal WL = area 5	
Case 3	3A	Sub-optimal WL = area 7	Sub-optimal WL = area 8	Prices
	3B	Sub-optimal WL = area 10	Sub-optimal WL = area 9	

WL = welfare loss.
[a]When marginal pollution abatement costs are known and citizens do not participate in pollution permit trading, both instruments are equivalent.

Table 3
"Prices versus quantities" debate with citizens' participation in pollution permit market

		Equilibrium with tax	Equilibrium with tradable quotas	Prices or quantities?
Case 1	1A	Sub-optimal WL = area 1	Optimal level of pollution Q_h*	Quantities
	1B	Sub-optimal WL = area 2	Sub-optimal WL = area 2	
Case 2	2A	Sub-optimal WL = area 3	Sub-optimal WL = area 4	Quantities
	2B	Sub-optimal WL = area 6	Optimal level of pollution Q_l*	
Case 3	3A	Sub-optimal WL = area 7	Optimal level of pollution Q_l*	Quantities or prices[a]
	3B	Sub-optimal WL = area 10	Sub-optimal WL = area 9	

WL = welfare loss.
[a]In this case, we should note that the Regulator has a 50% chance to reach the optimal level of pollution if he chooses to implement a tradable quota system.

that the Regulator has set an overall pollution quotathat is very close to the optimal level, thus rendering citizen participation irrelevant. The second possibility, which is more probable, is the existence of high transaction costs and a lack of organization among market participants, which makes participation very expensive. In the following sections, we describe the difficulties encountered by citizens regarding their participation in emissions trading and the means for solving this problem.

3.2. Why do citizens not actively participate in the EU ETS?

As in first American experiences, access to the EU ETS by any artificial or natural person is legally allowed. However, in practical conditions, access to this market is difficult because emissions markets are insiders' markets. On these specific markets, emissions are not as easy to trade as, for example, quoted shares on equity markets. Emissions markets require using the services of specialized brokers and the average trade size is large. To illustrate this point, Point Carbon provides a daily reference carbon price index for the EU ETS, which is based on forward trades for at least 5000 tons of CO_2 reported by the 10 active brokers in the EU ETS. In these conditions, purchasing a small amount of permits is difficult. It is always possible to conclude a bilateral agreement with a company wishing to sell a small amount of permits (around a few hundred tons of CO_2); but, for an individual who does not know the market and potential sellers, transaction costs for a very small amount of permits (less than 10 tons of CO_2, for instance) are very high.[11] Furthermore, in addition to brokerage fees, there are costs for opening an account with the national greenhouse gas emission allowance registry, as well as administrative management costs. For instance, in the case of an account with the French registry known as SERINGAS,[12] account opening fees, which have been determined by Minister's decree, amount to €150 and annual administrative management fees to €75. Thus, minimum knowledge of the system, high transaction costs and time are elementsthat represent barriers for the access of citizens to the EU ETS. Unfortunately, studies dealing with the design of emission permits market do not take into account that citizens' access to emissions permit markets should be easy (see EPA, 2003; Svendsen and Vesterdal, 2003; Tietenberg et al., 1999).

[11]In the Acid Rain Program, environmental groups have favored auctions rather bilateral trading, which generate higher transaction costs due to the need for a specialized broker. Joskow et al. (1998) indicate that environmental groups, which have participated in EPA's auctions have purchased SO_2 allowances at a higher price than the market price. These authors argue that environmental groups give a higher value to a ton of SO_2 but it also reflects their lack of information concerning the SO_2 market.

[12]The SERINGAS registry belongs to the CDC (Caisse des Dépôts et Consignations, i.e. translated into English, the savings deposits and retirement savings funds). CDC is a state-owned financial institution that performs public-interest missions on behalf of France's central, regional and local governments.

A simple solution to this problem encountered by pollution victims (who are also polluters) regarding access to the emissions permit market is to create an organization that will be responsible for grouping demands for pollution reductions by opening an account with the SERINGAS registry, purchasing and then voluntarily cancelling quotas. In other words, we propose to organize citizens' participation to CO_2 emission trading on a large scale. This has never been implemented although the general terms of use of the SERINGAS registry already include a "voluntary quota cancellation" clause for all account holders (operators and non-operators). From a practical point of view, based on the carbon-offsetting initiative model, we can imagine a website enabling citizens to purchase and cancel emission permits. We can also imagine other purchasing solutions such as CO_2 reduction tickets, which would be available in post offices or newsagents. It is obvious that the purchasing price should always reflect the current market price in order to provide a real carbon price signal for consumers. The idea is not to tell people what they should pay in aim of becoming "carbon neutral", but to determine their willingness to pay in order to reduce the overall level of greenhouse gas emissions.

3.3. Advantages regarding carbon offsetting

Purchasing and retiring emission permits is economically and ethically preferable for the following reasons:

- *Advantage no. 1*: Buying and withholding emission permits is a definite and immediate solution for reducing pollution and reaching the optimal pollution level. This solution does not involve any additionality problems (is the project "business as usual" or not?) or time lag problems (i.e. the fact that the donation does not involve an immediate reductions of the pollution). Furthermore, emission permits have a single price, a single quality and can be sold only once, whereas carbon-offsets price and quality vary and can be sold multiple times as they are not electronically tracked.
- *Advantage no. 2*: The permit holder remains entirely responsible of his own emissions and polluting activities as opposed to the carbon-offsetting situation.
- *Advantage no. 3*: This solution enables pollution abatement at least cost. This system involves organization and transaction costs, which are lower than carbon-offsetting costs. This is partly the reason why, on average, current prices for a ton of CO_2 are lower on the European market than the prices proposed by carbon-offsetting initiatives. Furthermore, this system is entirely transparent and non-lucrative if it is proposed by a public institution or NGO.
- *Advantage no. 4*: Purchasing and withholding emission permits contributes to controlling pollution in developed countries with the highest yearly CO_2 emission rates and GDP per inhabitant. However, project mechanisms will not be abandoned because when the pollution quota decreases in developed countries, CDM projects will become profitable and will be implemented by firms.
- *Advantage no. 5*: An organization in charge of purchasing and retiring permits can provide a carbon price signal for citizens; this enables them to adjust their consumption choices in the best possible manner, but also to improve their understanding and trust in this market mechanism. It should be noted that a research initiated by the English parliament has studied the possibility of allocating an emission quota to each individual from an economical and technical point of view (see Starkey and Anderson, 2005). In this perspective, the early participation of citizens in emissions trading could familiarize them with this economic instrument and thus play an important part in the political acceptability of this ambitious policy.
- *Advantage no. 6*: Purchasing and withholding CO_2 emission permits enables public authorities to assess citizens' environmental demand. For environmental groups, it reinforces their credibility when undertaking a lobbying action to ask institutions for (in addition to the emission reduction percentage, which is already expected for the following exchange period) a global quota reduction equal to the number of quotas retired by citizens during the previous period.[13] From a political point of view, it appears obvious that purchasing and destroying permits is a much more significant action than signing a petition (free action) for environmental protection. This clearly shows that citizens are ready to bear a higher carbon cost.

In the highly improbable case in which citizens purchase a massive amount of emission permits, there is a risk that CO_2 prices will increase rapidly, therefore leading to an increase in the prices of goods contributing to global warming as well as a reduction in the competitiveness of European industries. However, this effect can be compensated by operating a major change of consumption behaviors, by stimulating innovation and by reducing citizens' "permit purchase and cancellation campaign". Furthermore, if participation to emissions trading is organized by a "benevolent" Regulator, we can imagine that permits purchased by citizens will not be cancelled immediately but only bank until they are no longer valid. In these conditions, the "benevolent" Regulator could contribute to preventing the occurrence of extreme situations such as the Californian energy crisis in which the high prices of NO_x emission permits played a major role (see

[13] Malueg and Yates (2006) study the choice faced by citizens between participating in emissions trading and/or investing in lobbying activities with the aim of obtaining a lower overall pollution quota. However, this is only a single-period analysis; the possibility that citizens may initially participate in emissions trading and then take part in lobbying actions is still to be investigated.

Kolstad and Wolak, 2003). The "benevolent" Regulator could use this permit stock to sell permits when prices are too high and purchase them back when prices decrease. In other words, similarly to when a central bank sustains the value of its currency, he could proactively exchange permits on the market in order to prevent major price fluctuations and ensure the conditions required for investments and exchanges. This idea is far from new and has never been put into practice; it was initially developed by Dales (1968) and is an interesting alternative to the "safety valve" proposed by Jacoby and Ellerman (2004). Lastly, purchasing and withholding Kyoto permits will be preferable to ensure that all countries involved in the international emissions trading scheme will support the additional pollution control effort due to citizens' participation.

4. Conclusions

In a context where citizens' environmental demand is increasing, this note underlines two important ideas. Firstly, there is a need for regularly assessing carbon-offsetting initiatives (benchmarks) in order to increase competition in this sector and enhance control procedures by public authorities to protect consumers from bad practices. Secondly, organizing the purchase and withholding of greenhouse gas emission permits is a more efficient solution from an economical and environmental point of view compared with carbon-offsetting programs. This solution is also more transparent and should therefore be implemented rapidly.

Lastly, it should be noted that this approach can be adapted to other quota-trading markets. Among these markets, purchasing and retiring quotas may seem interesting in the case of a green certificate trading system as it offers the possibility for citizens to modify the energy mix regarding electricity production. In the countries that have decided to implement green certificate trading (Italy, The Netherlands, Belgium, etc.) rather than a feed-in tariff (France, Germany, etc.), purchasing and withholding green certificates is a predominating solution for consumers who want more green electricity rather than signing a contract for the supply of green electricity. The additional premium is paid for purchasing green electricity is only acceptable if the supplier guarantees that the green certificates, which have been obtained, are not sold on the market. If the additional premium is not sufficient for retiring green certificates from the market, then the captive customer will pay more for a level of green electricity production, which will be reached whatever the outcome as it has been determined by the Regulator.

Acknowledgments

I wish to thank Jacques Percebois, François Mirabel and Benoît Sévi for their helpful comments and suggestions. Any errors or omissions are my own responsibility.

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