EconomiX

http://economix.u-paris10.fr/

Document de Travail
Working Paper
2008-25

Bankable Pollution Permits under Uncertainty and Optimal Risk Management Rules: Theory and Empirical Evidence

Julien Chevallier
Johanna Etner
Pierre-André Jouvet

UMR 7166 CNRS

Université Paris X-Nanterre
Maison Max Weber (bâtiments K et G)
200, Avenue de la République
92001 NANTERRE CEDEX

Tél et Fax : 33.(0)1.40.97.59.07
Email : secretariat-economix@u-paris10.fr

Université Paris X Nanterre

Bankable Pollution Permits under Uncertainty and Optimal Risk Management Rules: Theory and Empirical Evidence*

Julien Chevallier†, Johanna Etner‡ and Pierre-André Jouvet§

July 6, 2008

*The authors wish to thank participants of the Environmental Economists Meeting that took place at the Catholic University of Louvain - CORE in 2006 for useful comments on an earlier version of this paper.

† *Corresponding author.* EconomiX-CNRS, University of Paris 10, Department of Economics, Office G-307a, 200 avenue de la République, 92001 Nanterre Cedex, France. Tel: +33 1 40 97 59 36; Fax: +33 1 40 97 77 84; *jchevall@u-paris10.fr*

‡Centre d'Economie de la Sorbonne, and LIRAES, University of Paris Descartes; *johanna.etner@univ-paris5.fr*

§EconomiX-CNRS, University of Paris 10; *pjouvet@u-paris10.fr*

Abstract

The well known economic advantage of tradable permits over command and control obviously vanishes if firms do not trade because of regulatory uncertainty. In fact, uncertainty about political decision changes in the permits program could make firms reluctant to participate in tradable permits markets. Based on a two-period partial equilibrium framework, our results suggest that the banking provisions may be used as a tool of policy risk control and that it is possible to define optimal risk sharing rules in order to respond to political decision changes. Finally, our empirical discussion attempts to put the theoretical results concerning firms' banking and pooling behaviors in the context of the recent development of the European Union Emisions Trading scheme (EU ETS).
Key words : Firm behavior; Tradable permits; Policy risk; EU ETS

JEL Codes : D21, D80, Q58

1 Introduction

Pollution permits are now widely considered as efficient instruments for regulating the emissions of pollutants by firms. Their numerous advantages have been extensively discussed in the literature (Bohm and Russel (1985), Pearce and Turner (1990), Cropper and Oates (1992), Koutstaal (1997), Baumol and Oates (1998)). However, pollution permits may also convey a high level of uncertainty with respect to political decisions enforced by the regulator. While in the case of a tax the political uncertainty concerns the level of the tax, in the case of a pollution permit uncertainty depends not only on its price but also on allocation rules enforced by the regulator.

Hence, the informational efficiency argument[1] in favor of pollution permits compared to other classic instruments[2] vanishes given this potential higher level of uncertainty at the firm-level linked to the risk of political decision changes[3]. To cope with these political uncertainties, a number of firms may not participate in the permits market and express their fear of an environmental regulation system dependent on such shifts in the regulatory environment (Wossink and Gardebroek (2006)).

Hahn (1989) first stressed the potential negative effects of political uncertainties of pollution permits systems. He emphasizes that the advantages of permits schemes in terms of pollution control may be undermined by political uncertainties regarding banking and trading provisions. Leston (1992), Stavins (1995) and Ben-David *et al.* (1999) have also underlined that the performance of pollution permits is critically linked to the clarity of political decisions.

[1] *i.e.* less information is needed concerning firms' depolluting costs.

[2] For instance, a tax or a lump sum.

[3] Be it concerning the global permits allocation or its repartition between firms.

In this article, we examine firms' production decisions subject to the introduction of a pollution permits market as an environmental regulation tool and to the possibility to bank permits forward in a partial equilibrium framework. At the beginning of each period, firms receive an initial permits allocation. Without uncertainty on the next period allocation, firms smooth their emissions between trading periods as already documented in the literature (Rubin (1996), Kling and Rubin (1997), Leiby and Rubin (2001)). Departing from this benchmark case, the introduction of uncertainty on future allocation provides incentives for firms to bank permits and thus to reduce their emissions of pollutants. This banking behavior also changes the temporal pattern of emissions by decreasing the concentration of emissions on early periods[4]. Since it overcomes potential negative effects, the authorization of banking therefore appears as a decisive feature for the successful implementation of permits systems[5].

The central question we address is the following: will an increase in the level of uncertainty concerning future allocation impact positively or negatively the amount of banking by firms? We aim at detailing firms' behavior following a variation in the level of uncertainty and whether it is possible to identify an optimal risk sharing rule between firms. That is why we choose to focus our analysis on the banking provisions and consider that permits trading between firms has already occurred.

Compared to previous literature, the main theoretical results of this article are threefold. First, we show that when firms face an increase in the level of risk, the variation of the amount of banked permits is linked to the third derivative of the production function with respect to emissions. This result

[4]This behavior applies especially for firms with high abatement costs.

[5]See Bosetti et al. (2008) for an empirical discussion.

is close to the notion of prudence derived by Kimball (1990). Second, if the goods used in the production function are complements (substitutes), firms increase (decrease) their inputs consumption as a response to this increase in the risk level. Third, without uncertainty on the total number of permits allocated during the second period, an agency may introduce a Pareto-optimal permits re-allocation between firms. When the regulatory uncertainty concerns the number of permits available during the second period, an optimal risk-sharing rule needs to take into account the sensitivity of firms' marginal productivity to the number of permits, as well as the elasticity of the marginal productivity with respect to the stock of pollution.

Finally, we provide empirical insights into these findings by investigating the banking behavior at the installation level and the pooling behavior at the group level in the light of the emerging European carbon market. We confirm the impact of different allocation rules and overall regulatory uncertainty on the variation of firms' banked permits, and the existence of risks-pooling by parent companies to save penalty and permits purchases costs.

The remainder of the article is organized as follows. Section 2 details the behavior of firms. Section 3 examines risk management strategies between firms and proposes an optimal risk sharing rule. Section 4 provides an empirical discussion. Section 5 concludes.

2 Behavior of Firms

We analyze in this section the behavior of firms with a two-period time-horizon for production decisions. Since we focus on the effects of uncertainty on firms' banking behavior, we thus assume that permit trading between firms has already occurred. During the first period, t, firms receive a permits allocation noted $\bar{P}_t$. This initial allocation may be used for production, but also banked for the next period. During the second period, firms receive a permits allocation noted $\bar{P}_{t+1}$.

During each period, each firm produces a good with a given production technology by using X_t input[6]and P_t pollution permits. Thus, following the introduction of pollution permits at time t, each firm uses a quantity of environment P_t additional to its input quantity X_t in order to produce a good Y_t:

$$Y_t = F(X_t, P_t) \tag{1}$$

The quantity of environment P_t simply states the number of pollution permits needed by the firm to produce and cover its pollutant emissions level. The production function is strictly concave for each of its arguments and the second non-crossed derivatives are negative ($F_{ii} < 0$).

2.1 Behavior of Firms without Uncertainty

The firm maximizes its intertemporal profit as a function of its inputs, X_t and X_{t+1}, and the choice of using pollution permits P_t and P_{t+1}. Let $\bar{P}_t$ and $\bar{P}_{t+1}$ be the permits allocated to firms and S_t the permits bank computed as the difference between the initial permits endowment and the number of permits used by the firm[7], $S_t = \bar{P}_t - P_t$. During the second period, the firm may use

[6] X_t can be a vector of inputs, *i.e.* $X_t = \{X_t^1, ..., X_t^k$ with $k \geq 1$. To ease the presentation, we consider the case where $k = 1$.

[7] In this article, we only consider the possibility to bank permits, *i.e.* at non-negative levels of S_t. If $S_t < 0$, then the firm would be allowed to borrow permits. Note that relaxing the non-negativity constraint on borrowing does not change qualitatively the results obtained.

its permits endowment plus its permits bank accumulated during the first period. Noting β the discounting factor used by the firm, the intertemporal profit may be written as:

$$\Pi_t = \pi_t + \beta\pi_{t+1}$$

with $\pi_t = F(X_t, P_t) - R_t X_t$ and $\pi_{t+1} = F(X_{t+1}, P_{t+1}) - R_{t+1}X_{t+1} + q_{t+1}(\bar{P}_{t+1} + S_t - P_{t+1})$ with R_t and R_{t+1} the inputs prices, q_t and q_{t+1} the pollution permits prices.

The optimization program of the firm is :

$$\max_{X_t, X_{t+1}, S_t \geq 0, P_t, P_{t+1}} \left\{ \begin{array}{c} F(X_t, P_t) - R_t X_t \\ +\beta \left\{ F(X_{t+1}, P_{t+1}) - R_{t+1}X_{t+1} + q_{t+1}(\bar{P}_{t+1} + S_t - P_{t+1}) \right\} \end{array} \right\}$$

With $P_t = \bar{P}_t - S_t$, the first order conditions are:

$$F_{X_t}(X_t, P_t) = R_t \quad (2)$$

$$F_{X_{t+1}}(X_{t+1}, P_{t+1}) = R_{t+1} \quad (3)$$

$$F_{P_t}(X_t, P_t) - \beta q_{t+1} \leq 0 \, ; = 0 \; if \; S_t > 0 \quad (4)$$

$$F_{P_{t+1}}(X_{t+1}, P_{t+1}) - q_{t+1} = 0 \quad (5)$$

From eq.(4), we know that the firm will bank permits if the marginal cost of banking is inferior to the anticipated permits price. Combining eq.(4) and (5), we have:

$$F_{P_t}(X_t, P_t) = \beta F_{P_{t+1}}(X_{t+1}, P_{t+1}) \quad (6)$$

From eq.(2), (3) and (6), we obtain the effects of the variation of the number of permits allocated on the firm's banking behavior during either of the two trading periods. Banking is an increasing function of the first period permits allocation, $dS_t/d\bar{P}_t > 0$, and a decreasing function of the second period permits allocation, $dS_t/d\bar{P}_{t+1} < 0$. When the number of permits allocated during the first period increases, the firm may increase both the number of permits banked and used, thereby also increasing its present and future production levels. When the number of permits allocated during the second period increases, the firm may increase its production level during both trading periods by using more permits during the second period and banking less during the first period.

In this section, we have developed the basic model underlying our analysis. In the next section, we study the effects of introducing uncertainty on the number of permits allocated during the second period.

2.2 Behavior of Firms under Uncertainty

In this section, we assume a random second period permits allocation, noted $\tilde{P}_{t+1}$ with a probability distribution $G(.)$. The randomness reflects changing permits allocation rules by the regulator impacting the second period permits allocation. Only at the beginning of the second period does the firm know its permits allocation. Thus, at time $t+1$, the firm knows its amount of permits $\hat{P}_{t+1}$ endowed and may decide on its inputs uses, production level and associated emissions of pollutants. However, at time t, this amount is not known with certainty. We assume here that the firm anticipates an average amount of permits distributed during the second period equal to $\bar{P}_{t+1}$.

Thus, when there is uncertainty on the second period allocation, the expected intertemporal profit, $E\ \Pi_t = \pi_t + \beta E\ \pi_{t+1}$ is:

$$\Pi_t = \left\{ \begin{array}{c} F(X_t, P_t) - R_t X_t \\ +\beta E\left\{F(X_{t+1}, P_{t+1}) - R_{t+1}X_{t+1} + q_{t+1}(\tilde{P}_{t+1} + S_t - P_{t+1})\right\} \end{array} \right\}$$

The choice of the firm indeed follows two steps. In a first step, the firm chooses S_t and X_t by taking into account the uncertainty over the total number of permits distributed in the future. In a second step, the firm chooses X_{t+1} and P_{t+1} with $P_{t+1} \leq \hat{P}_{t+1} + S_t$ given its choices during the first period. Let us solve this program by backward induction.

Choice of X_{t+1} ***and*** P_{t+1} ***with*** S_t ***and*** $\hat{P}_{t+1}$ ***given***

$$\max_{X_{t+1}, P_{t+1}} \left\{ \pi_{t+1} = \beta\left\{F(X_{t+1}, P_{t+1}) - R_{t+1}X_{t+1} + q_{t+1}(\hat{P}_{t+1} + S_t - P_{t+1})\right\} \right\}$$

The first order conditions are:

$$F_{X_{t+1}} - R_{t+1} = 0 \tag{7}$$

and

$$F_{P_{t+1}} - q_{t+1} = 0 \tag{8}$$

We then obtain the level of profit during the second period, $\tilde{\pi}^\star_{t+1}$ as a function of the permits allocation $\hat{P}_{t+1}$ and the bank S_t:

$$\begin{array}{c} \tilde{\pi}^\star_{t+1}(\hat{P}_{t+1}) = F(X^\star_{t+1}(\hat{P}_{t+1}, S_t), P^\star_{t+1}(\hat{P}_{t+1}, S_t)) - R_{t+1}X^\star_{t+1}(\hat{P}_{t+1}, S_t) \\ +q_{t+1}(\hat{P}_{t+1} + S_t - P^\star_{t+1}(\hat{P}_{t+1}, S_t)) \end{array}$$

Choice of X_t ***and*** S_t ***with the introduction of a random permits allocation,*** $\tilde{P}_{t+1}$

$$\max_{X_t, S_t} \left\{ \ F(X_t, \bar{P}_t - S_t) - R_t X_t + \beta E \left\{ \tilde{\pi}^{\star}_{t+1}(\tilde{P}_{t+1}) \right\} \ \right\}$$

The optimality conditions are:

$$F_{X_t} = R_t \tag{9}$$

$$F_{P_t} - \beta E[q_{t+1}] = 0 \tag{10}$$

Combining eq.(8) and (10), we obtain an expected condition similar to the case without uncertainty, *i.e.*:

$$-F_{P_t}(X_t, \bar{P}_t - S_t) + \beta E F_{P_{t+1}}(X_{t+1}, \tilde{P}_{t+1} + S_t)) = 0 \tag{11}$$

Without a variation of the level of uncertainty, the firm's behavior is simply based on the expected profit and we derive similar results to Section 2.1. Thus, it appears important to investigate the consequences of a change in the risk level associated with the second period permits allocation. To this purpose, we consider an increase in risk in the sense of Rothschild and Stiglitz (1971) and study the effects of this change in the probability distribution on the firm's banking and inputs consumption choices. The effects of the variation of the risk associated to the banking variable S lead to the following result:

Proposition 1 *For a given level of inputs, in response to an increase in risk in the sense of the mean preserving spread, the banking of pollution permits by the firm increases (decreases) if and only if the third derivative of the production function with respect to the emissions,* F_{PPP}*, is positive* *(negative).*

Proof. Considering a given level of inputs, $X_t^\star$, $X_{t+1}^\star$, from eq.(11) with the distribution of probability, $G(.)$, we obtain:

$$-F_{P_t}(X_t^\star, \bar{P}_t - S_t^G) + \beta E_G F_{P_{t+1}}(X_{t+1}^\star, \tilde{P}_{t+1} + S_t^G)) = 0 \equiv H^G(S_t^G)$$

Considering a distribution of probability $K(.)$, where $K(.)$ is a mean preserving spread of $G(.)$, eq.(11) gives:

$$-F_{P_t}(X_t^\star, \bar{P}_t - S_t^K) + \beta E_K F_{P_{t+1}}(X_{t+1}^\star, \tilde{P}_{t+1} + S_t^K)) = 0 \equiv H^K(S_t^K)$$

Using the second order condition of the optimization program, we have $S_t^K > S_t^G$ if and only if $H^K(S_t^G) > H^G(S_t^G)$.

Then, $S_t^K > S_t^G$ if and only if:

$$E^K h(S_t^G) > E^G h(S_t^G)$$

where $h(S) = F_{P_{t+1}}(X_{t+1}^\star, \tilde{P}_{t+1} + S)$. This inequality is verified if and only if $h(S)$ is convex:

$$h'(S) = F_{P_{t+1}P_{t+1}}$$

and

$$h''(S) = F_{P_{t+1}P_{t+1}P_{t+1}}$$

■

The conditions on the third derivative of the production function with respect to emissions indeed relate to the study of the concavity of this function. It is worth noting the similarity between this condition and the conditions associated with the third derivative of utility obtained by introduced by Kimball (1990)[8] when studying individuals' risk behavior while, in our framework, firms are risk-neutral.

Concerning the effects of the variation of the risk level associated with inputs choices, for a given S we have:

$$dX_t = -\frac{F_{XP}}{F_{XX}} dS_t. \tag{12}$$

Thus, the variation sense of the input quantity X_t depends on the sign of the crossed derivative of the production function (assuming that $F_{XX} < 0$). We obtain the following result:

Proposition 2 *When banking permits is an increasing function of risk, if the goods used in the production function are complements (substitutes), $F_{XP} > 0$ ($F_{XP} < 0$), then the firm increases (decreases) its inputs consumption, X, as a consequence of an increase in risk.*

In this section, we have demonstrated that the variations of firm's inputs choices and banked permits depend on its characteristic production function with respect to concavity. Firms with heterogeneous characteristics on their third derivative may adopt dramatically different behaviors in terms of banked permits. We explore in the next section whether heterogeneous firms may pool risks through the intermediation of an agency managing the permits. If such an option exists, then we investigate what may be the optimal risk sharing rule between firms.

[8] See the notion of prudence.

3 Risk Management Strategies

Let us detail first the risks pooling behavior and second the optimal risk-sharing rule between firms.

3.1 The Pooling Behavior

In order to study a risk sharing rule between firms, we assume that in partial equilibrium there exists N firms and Θ states of nature[9]. Note $\bar{P}_{t+1}^{i\theta}$ the permits allocation that firm i receives in the state of nature θ, $\underline{\theta} \leq \theta \leq \overline{\theta}$, with a realization probability μ_θ. The optimization program of firm i may be written as:

$$\max_{X_t, X_{t+1}, S_t, P_{t+1}} \left\{ \begin{array}{c} F^i(X_t^i, \bar{P}_t^i - S_t^i) - R_t X_t^i \\ +\beta \sum_{\theta=0}^{\Theta} \mu_\theta \left\{ F^i(X_{t+1}^i, P_{t+1}) - R_{t+1} X_{t+1}^i + q_{t+1}(\bar{P}_{t+1}^{i\theta} + S_t^i - P_{t+1}^i) \right\} \end{array} \right\}$$

The pooling behavior implies the introduction of a cooperation agency[10] between firms which is responsible to maximize the sum of firms' profits whatever their states of nature. This agency will thus take into account the sum of firms' permits allocations over the two periods:

$$\sum_i^N \bar{P}_t^i = \sum_i P_t^i + S_t \tag{13}$$

[9]By considering a partial equilibrium framework, we assume that the N firms constitute a sub-sample of the firms subject to the pollution permits market.

[10]This agency may either correspond to a "parent agency" with N subsidiaries or to a centralization of production decisions. This latter type of pooling corresponds to common practices for consumers' mutual insurance companies (see Gollier (2001)).

and

$$\sum_i \bar{P}^{i\theta}_{t+1} + S_t = \sum_i P^{i\theta}_{t+1},\ \forall\theta \in \Theta \tag{14}$$

Substituting S_t in eq.(13) and (14), we obtain the following constraint for the agency:

$$\sum_i [\bar{P}^i_t + \bar{P}^{i\theta}_{t+1}] = \sum_i P^i_t + \sum_i P^{i\theta}_{t+1} \equiv \bar{P}^\theta,\ \forall\theta \in \Theta \tag{15}$$

The agency's program consists in maximizing the sum of profits by choosing firms' inputs levels (X^i_t and $X^{i\theta}_{t+1}$) as well as the use of pollution permits (P^i_t and $P^{i\theta}_{t+1}$) for all states of nature . As the agency takes into account the sum of firms' profits, and given that the sum of permits sales must be equal to the sum of permits purchases, the agency's program may be written as:

$$\max_{\{X^i_t, X^{i\theta}_{t+1}, P^i_t, P^{i\theta}_{t+1}\}_{i,\theta}} \sum_i \left\{ \begin{array}{c} F^i(X^i_t, P^i_t) - R_t X^i_t \\ +\beta \sum_{\theta=0}^{\Theta} \mu_\theta \left\{ F^i(X^{i\theta}_{t+1}, P^{i\theta}_{t+1}) - R_{t+1} X^{i\theta}_{t+1} \right\} \end{array} \right\}$$

subject to the constraint in eq.(15). Noting λ_θ the Lagrange multiplier of the constraint in the state θ, we obtain the following first order conditions for all i and for all $\theta \in [0, \Theta]$:

$$F^i_{X^i_t}(X^i_t, P^i_t) = R_t \tag{16}$$

$$F^i_{X^{i\theta}_{t+1}}(X^{i\theta}_{t+1}, P^{i\theta}_{t+1}) = R_{t+1} \tag{17}$$

$$F^i_{P^i_t}(X^i_t, P^i_t) = \sum_\theta \lambda_\theta \tag{18}$$

$$\beta\mu_\theta F^i_{P^{i\theta}_{t+1}}(X^{i\theta}_{t+1}, P^{i\theta}_{t+1}) = \lambda_\theta \tag{19}$$

and

$$\lambda_\theta \left\{ \sum_i [\bar{P}_t^i + \bar{P}_{t+1}^{i\theta}] - \sum_i P_t^i - \sum_i P_{t+1}^{i\theta} \right\} = 0 \tag{20}$$

We may identify Borch's condition applied to firms and the reciprocity principle. At the optimum, the marginal rates of technical substitution of firms i and j between two states of nature, θ_1 and θ_2, are equal:

$$\frac{F^i_{P^{i\theta_1}_{t+1}}(X^{i\theta_1}_{t+1}, P^{i\theta_1}_{t+1})}{F^i_{P^{i\theta_2}_{t+1}}(X^{i\theta_2}_{t+1}, P^{i\theta_2}_{t+1})} = \frac{F^j_{P^{j\theta_1}_{t+1}}(X^{j\theta_1}_{t+1}, P^{j\theta_1}_{t+1})}{F^j_{P^{i\theta_2}_{t+1}}(X^{j\theta_2}_{t+1}, P^{j\theta_2}_{t+1})} \; \forall i, j, \theta_1, \theta_2 \tag{21}$$

This condition is similar to Borch (1962) concerning agents' marginal rates of substitutions between two states of nature.

From the set of optimality conditions (eq. (16) to (20)), we obtain an implicit function $\Gamma^{i\theta}$ between the number of permits allocated to each firm in a given state of nature and the total amounts of permits distributed for each of these states. We write the following reciprocity principle:

$$P^{i\theta}_{t+1} = \Gamma^{i\theta}(\bar{P}^1, \bar{P}^2, ..., \bar{P}^\theta, ..., \bar{P}^\Theta) \tag{22}$$

The permits distributed by the agency depend on the aggregated sum of permits available in the economy over the two periods. If a change arises in firms' permits allocation rules, and without uncertainty on the total number of permits allocated during the second period, we obtain the following result:

For any given set of decisions of the regulator concerning firms' permits allocation criteria during the second period, the re-allocation of permits by the agency is Pareto-optimal for firms.

The expected firms' profits are similar to the case without uncertainty where the agency is in charge of redistributing the total number of permits available in the economy. If the agency only knows the total number of permits allocated during each period, $\bar{\bar{P}}_t = \sum_i \bar{P}_t^i$ and $\bar{\bar{P}}_{t+1} = \sum_i \bar{P}_{t+1}^i$, it will be able to redistribute the total number of permits , $\bar{\bar{P}}_t + \bar{\bar{P}}_{t+1}$, during each period for any change in permits allocation rules enforced by the regulator. In this context, the agency is able to smooth changes in permits allocation between the two periods instead of firms. When Borch's condition is met, this allocation is also Pareto-optimal.

However, as we detail in the next section, if the uncertainty concerns the total amount of permits distributed during the second period, then the risk-sharing agency will only be able to enforce an optimal risk-sharing rule associated with permits holdings.

3.2 The Optimal Risk-Sharing Rule

For a given state of nature , θ, we may deduce from the optimality conditions the equality of permits marginal productivity between firms:

$$F^i_{P^{i\theta}_{t+1}}(X^{i\theta}_{t+1}, P^{i\theta}_{t+1}) = F^j_{P^{j\theta}_{t+1}}(X^{j\theta}_{t+1}, P^{j\theta}_{t+1}) \tag{23}$$

Based on eq.(17), the inputs X during the second period may be expressed as functions of second period permits allocations:

$$X^{i\theta}_{t+1} = \Phi^i(P^{i\theta}_{t+1}) \tag{24}$$

Plugging these functions in eq.(23), we obtain a relationship between firms' final permits allocations taken pairwise:

$$F^i_{P^{i\theta}_{t+1}}(\Phi^i(P^{i\theta}_{t+1}), P^{i\theta}_{t+1}) - F^j_{P^{j\theta}_{t+1}}(\Phi^j(P^{j\theta}_{t+1}), P^{j\theta}_{t+1}) = 0 \tag{25}$$

In order to derive the optimal risk-sharing rule, we study the variations of firms' permits allocations as a function of the variation of the second period permits bank. We consider the permits allocation constraint in eq.(15) in two different states of nature θ_1 and θ_2:

$$\sum_i [\bar{P}_t^i + \bar{P}_{t+1}^{i\theta_1}] = \sum_i P_t^i + \sum_i P_{t+1}^{i\theta_1} \tag{26}$$

and

$$\sum_i [\bar{P}_t^i + \bar{P}_{t+1}^{i\theta_2}] = \sum_i P_t^i + \sum_i P_{t+1}^{i\theta_2} \tag{27}$$

with $\bar{\bar{P}}_{t+1}^{\theta_1} = \sum_i \bar{P}_{t+1}^{i\theta_1}$ and $\bar{\bar{P}}_{t+1}^{\theta_2} = \sum_i \bar{P}_{t+1}^{i\theta_2}$, the total allocation for each state of nature, and we obtain:

$$\bar{\bar{P}}_{t+1}^{\theta_1} - \bar{\bar{P}}_{t+1}^{\theta_2} = \sum_i P_{t+1}^{i\theta_1} - \sum_i P_{t+1}^{i\theta_2} \tag{28}$$

Using eq.(25) and the implicit function theorem, we define, for each state of nature, a relationship, $g(.)$, between firms' second period permits allocations taken pairwise. For each pair of firms i and j, we have:

$$P_{t+1}^{i\theta} = g_{ij}^{\theta}(P_{t+1}^{j\theta}) \tag{29}$$

Using equation (28) and (29), we get:

$$\frac{dP_{t+1}^{j\theta}}{d\bar{\bar{P}}_{t+1}^{\theta}} = \frac{1}{\sum_i g_{ij}'^{\theta}(P_{t+1}^{j\theta})} \tag{30}$$

with

$$g_{ij}'^{\theta}(P_{t+1}^{j\theta}) = \frac{\partial F_P^j / \partial P}{\partial F_P^i / \partial P}$$

Noting σ_j^θ the elasticity of the marginal productivity of the environmental variable as a function of firm's i production with respect to the variation of the number of permits:

$$\sigma_j^\theta = P \times \frac{\partial F_P^j / \partial P}{\partial F^j / \partial P},$$

we obtain the following proposition:

Proposition 3 *If the total permits bank during the second period is random, any optimal risk-sharing rule between firms is such that:*

$$\frac{dP_{t+1}^{j\theta}}{d\bar{\bar{P}}_{t+1}^{\theta}} = \frac{\sigma_j^\theta / P_{t+1}^{j\theta}}{\sum_i \sigma_i^\theta / P_{t+1}^{i\theta}}$$

When the initial global permits allocation in the state of nature θ increases, the final second period permits allocation in this state increases proportionally to the elasticity of the marginal productivity with respect to the environmental variable (the stock of pollution). This sharing condition also takes into account the sensitivity of the firm's marginal productivity to the number of permits.

Having detailed in Section 2 the consequences of uncertainty on firms' banking behavior and in Section 3 the rationale for risk-sharing between firms, we examine in the next section whether these theoretical predictions meet firms' actual behavior on the European carbon market.

4 Empirical Evidence

This section hinges on the recent development of the EU ETS during 2005-2007 to discuss empirically the main theoretical findings. The early experience of the world's largest greenhouse gases ETS to date indeed allows us to shed some light on (i) the banking behavior at the installation level as detailed in Section 2, and (ii) the permits pooling behavior at the group level as highlighted in Section 3.

We use Reuters Carbon Market Data[11] to provide a qualitative discussion of these theoretical findings. From the 800 companies included in this database, we identify 7 companies that allow us to shed some light on the banking and pooling behaviors. Our case-studies are divided in three subsamples: firms with the highest pollution permits shortages at the group level, firms with the highest pollution permits surpluses at the group level and the highest emitter of CO_2 on the market. We focus our comments on the number of allowances banked forward at the installation level and the presumed pooling behavior at the group level as detailed respectively in Sections 2 and 3. All tables and figures may be found in the Appendix.

4.1 The Banking Behavior at the Installation Level

On the EU ETS, the political uncertainty regarding the second period permits allocation is linked to the negotiation of the second National Allocation Plans (NAPs) between Member States (MS) and the European Commission (EC). This situation fits well the theoretical framework developed in Section 2. The uncertainty concerns indeed the exact amount of permits being allocated from 2008 onwards, since the EC announced during Phase I its will to enforce stricter allocation rules for Phase II. The goal of the EC essen-

[11] Available at *http://www.carbonmarketdata.com*. To the purpose of our empirical section, we exploit from the Reuters Carbon Market Data the compilation of 2005-2007 verified emissions between subsidiaries and parent companies that was accurate as of May 2008.

tially consists in enacting stricter validation criteria for MS to create a real scarcity of pollution permits, and thus foster firms' investment in depolluting technologies and internal CO_2 emissions abatement efforts.

The variation of banked allowances between Phase I (2005-2007) and Phase II (2008-2012) corresponds to the 2008 compliance result which will be disclosed by the EC by mid-May 2009[12]. Thus, we choose to focus our comments on the variation of banked permits by firms linked to the variation of the global level of regulatory uncertainty during 2005-2007. By many aspects, Phase I may be considered as a "warm-up" period for the EU ETS since several key provisions[13] of this newly created market were characterized by abrupt decision changes. By using this approach, we intend to provide an empirical discussion of the theoretical results regarding the banking of permits that corresponds to the early development of the European carbon market.

The risk underlying permits trading on the European carbon market is linked to increasing permits prices against which installations need to form hedging strategies[14], and the firm's net short/long position that need to be carefully managed to save penalty costs (Buchner and Ellerman (2008)). An installation is defined as net short (long) if the number of verified emissions is superior (inferior) to the number of allocated allowances during the com-

[12]Moreover, due to institutional fungibility between the EU ETS and the Kyoto Protocol as of 2008, the possibility to transfer banked allowances from Phase I to Phase II has been restricted by all MS. For an extensive discussion of the inter-period ban on banking in the EU ETS, see Alberola and Chevallier (2007).

[13]Such as allocation criteria or banking provisions.

[14]See Ielpo et al. (2008) for an extensive discussion based on increasing futures prices over 2008-2012. We do not further comment this type of risk in the remainder of the article.

pliance period. An installation with a short (long) position may buy (sell) allowances in order to be in compliance (make profits). If the installation does not match its mandatory emissions target with the corresponding number of allowances during the compliance period, it needs to pay back one permits plus a penalty[15] during the next period.

On the demand side, the volume of CO_2 emissions at the installation level depends on economic activity, weather events and other energy market prices (Mansanet-Batallet et al. (2007), Alberola et al. (2008a), Alberola et al. (2008b), Newbery (2008)). On the supply side, the allocation of permits in the EU ETS during Phase I followed the grandfathering principle, which allocates permits freely based on business-as-usual emissions. If a firm encounters an uncertainty as modelled in Section 2 and goes beyond its emissions forecasts during the current allocation period, then it is basically left with two choices: either use banked permits or go on the market to buy permits.

Given the underlying assumption of our model that permits trading has already occurred between firms, we investigate the changes in banked permits at the installation level that occured in a context of regulatory uncertainty on the EU ETS during 2005-2007. Banking behaviors greatly vary between the 7 companies that belong to our case-studies. In the sub-sample of firms which record the highest permits surpluses, we remark net banking patterns for the largest installations in terms of allocation for ArcelorMittal (Figures 1 to 3, Table 1) and Dalkia (Figures 4 to 6, Tables 2-4), as well as for Eesti Energia's installation (Figures 7 to 9, Table 5). This comment applies especially for installations in the combustion sector which seem to have benefited from windfall profits during the NAPs I allocation process. In the sub-sample

[15] Equal to 40 € per unit during 2005-2007 and 100 € per unit during 2008-2012.

of firms which record the highest permits shortages, we observe asymmetric banking (borrowing) patterns for Enel (Figures 10 to 12, Table 5), E.ON (Figures 13 to 15, Tables 6-7) and Union Fenosa (Figures 19 to 21, Table 10) depending on whether those installations were characterized by a net long (short) position during 2005-2007. The same comment apply to our last sub-sample of firms for RWE, the highest emitter of CO_2 on the market (Figures 16 to 18, Tables 8-9).

Based on the visual inspection of the data, we have highlighted in this section a wide variation in the amount of banked permits at the installation level during 2005-2007. Three kinds of arguments may explain these variations between firms. First, differentiated allocation rules were enforced by the regulator between EU ETS sectors that affect firms' permits supply. Second, unforeseen economic activity events may impact firms' production levels and their permits demand. Third, these heterogeneous behaviors in terms of banked permits may come from the political uncertainty described earlier regarding banking provisions and NAPs II. The latter argument is in line with the theoretical framework regarding the effects of political decision changes on firms' banking behavior derived in Sections 2 and 3. This first step of the inspection of the data therefore brings us to a more detailed analysis analysis of the potential for permits pooling by the parent company in the next section.

4.2 The Pooling Behavior at the Group-Level

Let us detail first the rationale behind risks pooling, and second the actual behavior of the firms contained in our sample.

To our best knowledge, only Alberola et al. (2008) evoke the existence of pooling behavior in the EU ETS. In this article, we have detailed the economic intuitions behind it. Before investigating the pooling behavior empirically, it is worth emphasizing that the Community Independent Transaction Log (CITL)[16], which oversees all national registries, displays extensive information at the installation level concerning allocation and verified emissions. However, not all registries have been connected to date, and the CITL contains raw data that needs to be reorganized between subsidiaries and parent companies[17]. Hence, we do not aim at an exhaustive discussion on this topic, but rather at introducing empirical perspectives that are relevant to our theoretical results.

On the EU ETS, pooling behaviors may emerge at the group level in order to save the cost of purchasing permits. The economic logic of such an argument unfolds as follows: if there exist both types of net short and net long subsidiaries, the parent company may transfer allowances internally between them so that the net position of the parent company is globally in compliance. Thus, the exposure to the risk of permits shortage during compliance periods may be reduced by this intra re-allocation of permits. This type of behavior is close to the theoretical finding detailed in Section 3 with the role of the agency pooling risks. This logic holds only if there is an alternate of net short and net long installations at the group level, that is why we detail several cases that may apply.

Among the three firms in our sample that are in a net short position, Union Fenosa exhibits in Table 10 the largest shortage by 7.3M European

[16] Available at *http://ec.europa.eu/environment/ets/*, cited May 2008.

[17] For a detailed analysis on this compilation of emissions data at the group level, see Trotignon and McGuiness (2007) and Trotignon et al. (2008). As another preliminary remark, note it is not yet technically possible to track permits exchanges at the European level, although each permit is marked with an unique identifier, since this information will only be disclosed publicly after 5 years of permit trading in the EU ETS.

Union Allowances (EUAs)[18] in 2007. Out of 12 installations, 9 are in a short position which may only be compensated internally by 2M EUAs in surplus. Thus, the pooling of allowances by the parent company allows to reduce the risk of permits shortage by 25% for some, but not all, subsidiaries. The visual inspection of the data in Figures 19 to 21 reveals that three installations are especially short of permits over 2005-2007. Next, we turn our attention to E.ON which records in Tables 6 and 7 a net short position of 2.7M EUAs. 31 out of 89 installations encounter a permits shortage, and the potential for permits transfer at the group level amounts to 1.6M EUAs. Hence, the risk pooling strategy by the parent company may save the costs of permits purchase on the market by 60%. The distribution of subsidiaries in Figure 13 to 15 also reveals a strong dispersion in terms of size, with one installation of 1M allocated allowances being consistently short over 2005-2007. In Table 5, Enel records a net deficit of allowances by 1.5M in 2007. 5 out of 9 installations are net short, which may only be compensated by another subsidiary by 0.05M EUAs. Figures 10 to 12 confirms this analysis, with most installations being net short in 2007. From this sub-sample of firms with permits shortages, our analysis has confirmed the potential for risk-sharing and thereby the pooling behavior at the group level that constitutes one of the main finding in Section 3. Let us now examine another sub-sample of firms with permits surpluses.

Among the three firms in our sample that are in a net long position, ArcelorMittal stands out as holding the largest surplus of allowances. Indeed, as shown in Table 1, it is net long by 18.9M EUAs during the compliance year 2007. There appears to be little room for permits pooling within subsidiaries. Only 2 out of 25 installations are in a slightly short position, which may

[18] One EUA is equal to one ton of CO_2 emitted in the atmosphere.

easily be counterbalanced by permits reallocation from other installations within the group. This situation is confirmed by the visual inspection of the data in Figures 1 to 3. Overall, the parent company is a net seller on the permits market. In Table 4, Dalkia also exhibits a large surplus of 2.4M EUAs in 2007. 4 out of 125 installations are net short, which supposes similarly that their deficit may be compensated internally by the parent company, thereby covering the risk of permits shortage for its subsidiaries. From Figures 4 to 6, one may remark that the distribution of installations is very heterogeneous with two installations above 1M of allocated allowances holding substantive surpluses. On a smaller scale, Eesti Energia displays in Table 5 a net long position of 0.27M EUAs in 2007 for one installation being reported in the Reuters Carbon Market Database. Without commenting further the possibility of pooling risks, Figures 7 to 9 reveals that this permits surplus has been increasing from 2005 to 2007. This second sub-sample of firms has confirmed the liquidity of the permits market in terms of extra-allowances available for trading during each compliance period. Given this high level of heterogeneity between firms, if parent companies are still in a net short position after pooling allowances internally, they may buy allowances on the market to be globally in compliance.

Finally, we comment the case of RWE which is the largest CO_2 emitter in the current European system with 128M EUAs verified emissions in 2007. From Tables 8 and 9, we observe that RWE is in a net short position by 8.6 M EUAs. 21 out of 73 installations encounter an permits shortage, which may be compensated internally by the parent company by 2.8M EUAs, *i.e.* 33% of the total permits shortage. The distribution of installations displayed in Figures 16 to 18 reveal that RWE gathers very large installations, with 4 installations being allocated above 1.5M EUAs in 2007. One installation above 2M EUAs allocated records a net shortage of allowances in 2007. Our analysis has therefore confirmed the potential for permits pooling between subsidiaries by the parent company, which is conform to the theoretical finding on the optimal risk-sharing rule enforced by the agency derived in Section 3.

5 Conclusion

In this article, we have shown that, once permits trading between firms has occurred, the presence of uncertainty regarding political decision changes in permits allocation rules may provide incentives for firms to bank permits in order to hedge against this risk. The conditions under which risk-neutral firms hedge their risk by banking permits is linked to the third derivative of the production function. This condition is similar to the condition under which individuals adopt a prudent behavior[19]. Besides, we have characterized an optimal risk-sharing rule when the uncertainty is associated either to the repartition of permits between firms, or to the global permits allocation. This rule depends on firms' technological characteristics, and more precisely on the concavity of the production function with respect to pollution.

As for the empirical evidence, we have selected three types of firms operating on the EU ETS characterized by the highest allowances surpluses, the highest allowances shortages and the highest CO_2 emissions level on the market. Thus, we obtain a sample of 7 firms out of 800 included in the Reuters Carbon Market Database. These case studies allow us to provide some qualitative insights of the theoretical results. First, the investigation of the banking behavior has revealed asymmetric banking (borrowing) patterns

[19] *i.e.* the study of the positive third derivative of the utility function

at the installation level as a consequence of varying net long (short) positions during 2005-2007. Second, the investigation of the pooling behavior has confirmed the potential for internal permits transfers between subsidiaries at the group level. The former result is consistent with what was expected from Section 2, *i.e.* to observe a variation of the number of permits banked by firms in reaction to political uncertainty concerning Phase II of the EU ETS. The latter result illustrates the economic logic derived in Section 3, *i.e.* the parent company acts as the agency to introduce an optimal risks-sharing rule between subsidiaries.

From a regulatory viewpoint, the management of the environment through the introduction of pollution permits implies that firms have the ability to bank permits in order to hedge the risks linked to political decision changes. The banking of permits is not motivated here by adaptation concerns to environmental constraints, but by the need to counter-balance political risks attached with the introduction of pollution permits systems. Our analysis has therefore confirmed the key role played by banking provisions in order to cope with the potential political uncertainty related to the creation of pollution permits markets.

References

[1] Alberola E., Chevallier J. and Chèze B., (2008), Price Drivers and Structural Breaks in European Carbon Prices 2005-2007, *Energy Policy*, 36(2), pp. 787-797.

[2] Alberola E., Chevallier J. and Chèze B., (2008), The EU Emissions Trading Scheme: Disentangling the Effects of Industrial Production and

CO_2 Emissions on Carbon Prices, *EconomiX Working Paper Series*, # 2008-12.

[3] Alberola E. and Chevallier J., (2007), European Carbon Prices and Banking Restrictions: Evidence from Phase I (2005-2007), *EconomiX Working Paper Series*, # 2007-32.

[4] Baumol W. and Oates W. E., (1998), *The Theory of Environmental Policy*, Cambridge, Cambridge University Press.

[5] Ben-David S., Brookshire D.S., Burness S., McHee M. and Smidt C.,(1999), Heterogeneity, Irreversible Production Choice, and Efficiency in Emission Permits Markets, *Journal of Environmental Economics and Management*, 38, pp. 176-194.

[6] Bohm P. and Russel C. S.,(1985), *Comparative Analysis of Alternative Policy Instruments*, in Handbook of Natural Resources and Energy Economics, A.V. Kneese and J.L. Sweeny (eds), New-York, North-Holland, pp. 395-455.

[7] Borch K. (1962), Equilibrium in a Reinssurance Market, *Econometrica*, 30, pp 424-444.

[8] Bosetti V., Carraro C. and Massetti E.,(2008), Banking Permits: Economic Efficiency and Distributional Effects, *Working Papers Fondazione Enrico Mattei* # 2008.1.

[9] Cropper M. L. and Oates W. E.,(1992), Environmental Economics : a Survey , *Journal of Economics Literature*, 30, pp. 675-740.

[10] Ellerman A.D. and Buchner B.K., (2008), Over-Allocation or Abatement? A Preliminary Analysis of the EU ETS Based on the

2005-06 Emissions Data, *Environmental and Resource Economics*, doi:10.1007/s10640-008-9191-2.

[11] Gollier C., (2001), *The economics of risk and time*, The MIT Press, Massachusetts Institute of Technology.

[12] Hahn R.,(1989), Economics prescription for economic problems: How the patiant followed the Doctor's orders, *Jounal of Economic Perspectives*, 3, pp 252-262.

[13] Ielpo F., Chevallier J. and Mercier L., (2008), Risk Aversion and Institutional Information Disclosure on the European Carbon Market: a Case-Study of the 2006 Compliance Event, *Working Paper SSRN* # 1117184.

[14] Kimball M. S., (1990), Precautionary Savings in the Small and in the Large, *Econometrica*, **58**, 53-73.

[15] Kling C. and Rubin J., (1997), Bankable Permits for the Control of Environmental Pollution, *Journal of Public Economics*, 64, pp. 101-115.

[16] Koutstaal P., (1997), *Economic Policy and Climate Change : Tradable Permits for Reducing Carbon Emissions*, Edward Elgar.

[17] Leiby P. and Rubin J.,(2001), Intertemporal Permit Trading for the Control of Greenhouse Gas Emissions, *Environmental and Resource Economics*, 19, pp. 229-256.

[18] Leston D., (1992), Investment Decisions and Transferable Discharge Permits: an Empirical Study of Water Quality Management under Policy Uncertainty, *Environmental and Resource Economics*, 2, pp. 441-458.

[19] Mansanet-Bataller M., Pardo, A. and Valor, E., (2007), CO_2 Prices, Energy and Weather, *The Energy Journal*, 28 (3), pp. 67-86.

[20] Newbery D.M., (2008), Climate Change Policy and Its Effect on Market Power in the Gas Market, *Journal of the European Economic Association*, 6(4), pp.727-751.

[21] Pearce D.W. and Turner R.K., (1990), *Economic of Natural Resources and the Environment*, Harvester Wheatsheaf.

[22] Rothschild M. et J.E. Stiglitz (1971). Increasing Risk: I. A Definition, *Journal of Economic Theory*, 2 (3), pp. 225-243.

[23] Rubin J., (1996), A model of Intertemporal Emission Trading, Banking, and Borrowing, *Journal of Environmental Economics and Management*, 31, pp. 269-286.

[24] Stavins R.N., (1995), Transaction Costs and Tradable Permits, *Journal of Environmental Economics and Management*, 29, pp. 133-148.

[25] Trotignon, R.,McGuiness, M., 2007. Technical Memorandum on Analysis of the EU ETS Using the Community Independent Transaction Log. MIT-CEEPR Working Paper 2007-012.

[26] Trotignon, R.,McGuiness, M.,Delbosc, A., 2008. European CO_2 Market and the CITL : The Trial Period Under Scrutiny. Research Report, Mission Climat, Caisse des Dépôts, Paris, forthcoming.

[27] Wossink A. and Gardebroek C., (2006), Environmental Policy Uncertainty and Marketable Permit Systems: the Dutch Phosphate Quota Program, *American Journal of Agricultural Economics*, 88, pp 16-27.

Installation List	Country	Activity	Permit Identifier	Distributed Allowances 2005	Verified Emissions 2005	Net Short/Long Position 2005	Distributed Allowances 2006	Verified Emissions 2006	Net Short/Long Position 2006	Distributed Allowances 2007	Verified Emissions 2007	Net Short/Long Position 2007
1	France	Combustion	6301117	32067	21607	10460	32067	16732	15335	32067	18734	13333
2	Romania	Roasting	02-14-2007	0		0	0		0	10740796		10740796
3	France	Iron	6201286	264048	208249	55799	264048	236087	27961	264048	2378	261670
4	Belgium	Iron	VL201	9358697	4896453	4462244	9358697	5238916	4119781	9358697	4686947	4671750
5	Romania	Cement	05-24-2007	0		0	0		0	57844	3059	54785
6	Romania	Roasting	05-23-2007	0		0	0		0	210315	96994	113321
7	Spain	Iron	ES152805000837	60495	62372	-1877	60495	72612	-12117	60495	72619	-12124
8	France	Iron	6401052	9140902	8494864	646038	9140902	8725948	414954	9140901	7950830	1190071
9	Spain	Combustion	ES104601001147	0		0	24239	15882	8357	24239	16334	7905
10	Czech Rep	Iron	CZ-0435-07	0	0	0	0	0	0	0	7048	-7048
11	Belgium	Iron	VL202	229692	185972	43720	229692	207584	22108	229692	17634	212058
12	Germany	Combustion	14310-0819	31449	87444	-55995	31449	72779	-41330	249966	82266	167700
13	Germany	Iron	14220-0024	3416399	2582432	833967	3416399	2854331	562068	3416399	2984047	432352
14	Germany	Iron	14220-0033	96771	79619	17152	96771	100849	-4078	96771	97972	-1201
15	Germany	Cement	14240-0073	163007	136510	26497	163007	167828	-4821	163007	155281	7726
16	Germany	Iron	14225-0001		0	0		0	0			0
17	Germany	Iron	14220-0038	2101714	1501581	600133	2101714	1951193	150521	2101714	1852048	249666
18	France	Iron	7000956	12244979	11534467	710512	12244979	11578949	666030	12244978	12059456	185522
19	France	Combustion	7000955	48558	29108	19450	48558	27512	21046	48559	25334	23225
20	France	Combustion	5101363	112163	70993	41170	112163	71407	40756	112162	6783	105379
21	France	Iron	6201364	4615803	4353850	261953	4615803	4737538	-121735	4615802	4321829	293973
22	Germany	Iron	14220-0007	284157	264572	19585	289805	267586	22219	286981	272139	14842
23	Belgium	Iron	WAI133P047	61946	3376	58570	61947	22311	39636	61947	25233	36714
24	Belgium	Iron	WAI141P047	317512	186099	131413	317513	212166	105347	317513	177203	140310
25	Germany	Iron	14225-0004		0	0		0	0			0
Total				42580359	34699568	7880791	42610248	36578210	6032038	53834893	34932168	18902725

Table 1: Distributed Allowances, Verified Emissions and Net Short/Long Position for ArcelorMittal (2005-2007) from Reuters Carbon Market Data

Installation List	Country	Activity	Permit Identifier	Distributed Allowances 2005	Verified Emissions 2005	Net Short/Long Position 2005	Distributed Allowances 2006	Verified Emissions 2006	Net Short/Long Position 2006	Distributed Allowances 2007	Verified Emissions 2007	Net Short/Long Position 2007
1	Germany	Combustion	14310-0936	1408	0	1408	1408	0	1408	1408		1408
2	France	Combustion	5401474	16643	12462	4181	16643	1269	15374	16642	13037	3605
3	France	Combustion	5401291	8899	6932	1967	8899	6822	2077	8898	6236	2662
4	Poland	Combustion	PL-0119-05	92	8699	-8607	92	8672	-8580	92	6454	-6362
5	Poland	Combustion	PL-0118-05	52	5305	-5253	52	5563	-5511	52	5139	-5087
6	France	Combustion	6506250	12359	0	12359	12359	0	12359	0		0
7	France	Combustion	10100059	39363	18349	21014	39363	29305	10058	39364	30138	9226
8	France	Combustion	6804213	29774	25736	4038	29774	25544	4230	29775	26541	3234
9	France	Combustion	6506348	29086	24995	4091	29086	24727	4359	29086	2144	26942
10	France	Combustion	6507039	132299	100653	31646	132299	10219	122080	1323	104265	-102942
11	France	Combustion	6301088	13936	2917	11019	13936	2321	11615	13935	2205	11730
12	France	Combustion	10000670	37602	28772	8830	37602	28287	9315	37601	26837	10764
13	France	Combustion	7001019	15176	11016	4160	15176	8393	6783	15176	824	14352
14	France	Combustion	5701271	24004	18023	5981	24004	17909	6095	24003	16718	7285
15	France	Combustion	7001008	16529	10524	6005	16529	99	16430	16529	944	15585
16	France	Combustion	5600126	54	182	-128	54	473	-419	55	167	-112
17	France	Combustion	5600072	18173	12367	5806	18173	9996	8177	18173	8647	9526
18	France	Combustion	7000994	4655	2285	2370	4655	2258	2397	4654	2171	2483
19	France	Combustion	7001007	13821	9724	4097	13821	9209	4612	1382	7785	-6403
20	France	Combustion	7001005	25248	19230	6018	25248	20033	5215	25247	18517	6730
21	France	Combustion	10001610	20674	8928	11746	20674	8598	12076	20674	8383	12291
22	France	Combustion	6103619	3614	2144	1470	3614	2248	1366	3615	2578	1037
23	France	Combustion	7001215	9212	5488	3724	9212	5702	3510	9212	6036	3176
24	France	Combustion	7204930	25699	15622	10077	25699	19392	6307	25700	13831	11869
25	France	Combustion	5101900	23455	17960	5495	23455	17693	5762	23454	16841	6613
26	France	Combustion	6506346	9732	6451	3281	9732	6644	3088	9733	592	9141
27	France	Combustion	5104966	14428	9358	5070	14428	8409	6019	14427	825	13602
28	France	Combustion	6506331	8538	6699	1839	8538	6577	1961	8537	5426	3111
29	France	Combustion	6104721	6556	4630	1926	6556	6031	525	6555	1468	5087
30	France	Combustion	10000710	15690	12298	3392	15690	12164	3526	15690	12378	3312
31	France	Combustion	10004212	44547	29785	14762	44547	32304	12243	44546	28353	16193
32	Czech Rep	Combustion	CZ-0317-05	1536408	1272513	263895	1536408	1395596	140812	1536408	1366581	169827
33	France	Combustion	5902116	105280	77601	27679	105280	89461	15819	105280	86921	18359
34	Czech Rep	Combustion	CZ-0320-05	277	168	109	277	0	277	277	19	258
35	Czech Rep	Combustion	CZ-0236-05	121980	2453	119527	121980	1472	120508	121980	1854	120126
36	Czech Rep	Combustion	CZ-0326-05	12412	10650	1762	12412	10133	2279	12412	9864	2548
37	Czech Rep	Combustion	CZ-0323-05	1187	652	535	1187	612	575	1187	538	649
38	Czech Rep	Combustion	CZ-0324-05	9694	6	9688	9694	0	9694	9694		9694
39	France	Combustion	6506493	14174	11624	2550	14174	13052	1122	14174	8562	5612
40	France	Combustion	6506496	22855	14020	8835	22855	19605	3250	22856	17724	5132
41	France	Combustion	6506494	13637	11096	2541	13637	10781	2856	13636	9535	4101
42	France	Combustion	6506495	17019	13293	3726	17019	12866	4153	17020	11455	5565

Table 2: Distributed Allowances, Verified Emissions and Net Short/Long Position for Dalkia, Installations #1-42 (2005-2007) from Reuters Carbon Market Data

Installation List	Country	Activity	Permit Identifier	Distributed Allowances 2005	Verified Emissions 2005	Net Short/Long Position 2005	Distributed Allowances 2006	Verified Emissions 2006	Net Short/Long Position 2006	Distributed Allowances 2007	Verified Emissions 2007	Net Short/Long Position 2007
43	France	Combustion	12100006	258367	161935	96432	258367	160822	97545	258366	161574	96792
44	France	Combustion	6205585	30298	19733	10565	30298	18655	11643	30297	16661	13636
45	Czech Rep	Combustion	CZ-0322-05	25331	10436	14895	25331	12526	12805	25331	3148	22183
46	France	Combustion	6702704	45079	36378	8701	45079	3518	41561	45079	33679	11400
47	Czech Rep	Combustion	CZ-0329-05	259849	231008	28841	259849	212172	47677	259849	212777	47072
48	Czech Rep	Combustion	CZ-0330-05	145109	134628	10481	145109	128543	16566	145109	120889	24220
49	Czech Rep	Combustion	CZ-0328-05	500434	459501	40933	500434	463885	36549	500434	422977	77457
50	Czech Rep	Combustion	CZ-0327-05	83906	74250	9656	83906	78063	5843	83906	79149	4757
51	Czech Rep	Combustion	CZ-0321-05	485373	438908	46465	485373	398661	86712	485373	425107	60266
52	Czech Rep	Combustion	CZ-0325-05	530000	547298	-17298	530000	544509	-14509	530000	436681	93319
53	Czech Rep	Combustion	CZ-0318-05	198090	172429	25661	198090	160004	38086	198090	155261	42829
54	Czech Rep	Combustion	CZ-0237-05	1071343	1112121	-40778	1071343	1080780	-9437	1071343	946572	124771
55	Czech Rep	Combustion	CZ-0362-05	6872	5169	1703	6872	486	6386	0	4312	-4312
56	Czech Rep	Combustion	CZ-0319-05	47017	33895	13122	47017	34253	12764	47017	35112	11905
57	France	Combustion	5100692	18226	14319	3907	18226	13604	4622	18226	11914	6312
58	France	Combustion	5302859	16138	12453	3685	16138	12528	3610	16138	11062	5076
59	France	Combustion	6301089	27413	2851	24562	27413	933	26480	27414	764	26650
60	France	Combustion	6400007	26594	22012	4582	26594	19942	6652	26594	9308	17286
61	France	Combustion	5101812	23347	18309	5038	23347	17749	5598	23348	1708	21640
62	France	Combustion	5900460	8597	5653	2944	8597	749	7848	8597	6466	2131
63	France	Combustion	6506455	28045	21164	6881	28045	20907	7138	28046	19979	8067
64	France	Combustion	10000729	49206	21583	27623	49206	21487	27719	49206	22161	27045
65	France	Combustion	6000326	1608	1947	-339	1608	3886	-2278	1608	322	1286
66	France	Combustion	6103448	9752	8252	1500	9752	7132	2620	9752	739	9013
67	France	Combustion	5800444	58868	45017	13851	58868	45461	13407	58869	41996	16873
68	France	Combustion	5800446	16564	12478	4086	16564	12446	4118	16563	11243	5320
69	France	Combustion	5101102	28111	19981	8130	28111	17844	10267	28112	16994	11118
70	France	Combustion	5702209	20950	17017	3933	20950	15687	5263	20949	15035	5914
71	France	Combustion	6202458	10201	7994	2207	10201	7667	2534	10201	7051	3150
72	France	Combustion	7001170	41867	33151	8716	41867	32761	9106	41866	32409	9457
73	France	Combustion	5802051	11296	10635	661	11296	8914	2382	11297	4234	7063
74	France	Combustion	5800448	59079	43790	15289	59079	47574	11505	59080	41412	17668
75	France	Combustion	6505672	10670	7607	3063	10670	7533	3137	10669	6999	3670
76	France	Combustion	6505673	12676	9341	3335	12676	977	11699	12677	9116	3561
77	France	Combustion	6507535	16055	11627	4428	16055	11721	4334	16055	10796	5259
78	France	Combustion	6505669	6491	4951	1540	6491	5103	1388	6491	4455	2036
79	France	Combustion	6400260	9141	7845	1296	9141	6535	2606	914	581	333
80	France	Combustion	6501948	23865	16709	7156	23865	16052	7813	23865	12233	11632
81	France	Combustion	5701841	11568	8830	2738	11568	8409	3159	11568	8182	3386
82	France	Combustion	10004438	38511	29523	8988	38511	14414	24097	38512	3456	35056
83	France	Combustion	10004382	21041	16679	4362	21041	16443	4598	21040	16543	4497
84	France	Combustion	7001213	4091	6657	-2566	4091	16214	-12123	4090	15879	-11789

Table 3: Distributed Allowances, Verified Emissions and Net Short/Long Position for Dalkia, Installations #43-84 (2005-2007) from Reuters Carbon Market Data

Installation List	Country	Activity	Permit Identifier	Distributed Allowances 2005	Verified Emissions 2005	Net Short/Long Position 2005	Distributed Allowances 2006	Verified Emissions 2006	Net Short/Long Position 2006	Distributed Allowances 2007	Verified Emissions 2007	Net Short/Long Position 2007
85	France	Combustion	7001214	169972	107279	62693	169972	106738	63234	169972	10343	159629
86	France	Combustion	5801277	36927	29429	7498	36927	30474	6453	36927	28154	8773
87	France	Combustion	7001023	23864	6312	17552	23864	8938	14926	23863	5267	18596
88	France	Combustion	7001022	11120	8897	2223	11120	9131	1989	11121	899	10222
89	France	Combustion	7001564	12166	7187	4979	12166	8624	3542	12167	8532	3635
90	France	Combustion	7000998	8976	5693	3283	8976	5988	2988	8977	5953	3024
91	France	Combustion	5800447	17184	8190	8994	17184	8292	8892	17185	7436	9749
92	France	Combustion	6702335	22246	17541	4705	22246	16967	5279	22247	17494	4753
93	France	Combustion	10800048	40238	32892	7346	40238	28803	11435	40238	28444	11794
94	France	Combustion	6600637	69569	48950	20619	69569	38505	31064	69570	36534	33036
95	France	Combustion	10000045	59542	44876	14666	59542	41564	17978	59541	38008	21533
96	Poland	Combustion	PL-0097-05	47400	16252	31148	47400	10957	36443	47400	7430	39970
97	Poland	Combustion	PL-0098-05	1752300	1697392	54908	1752300	1622121	130179	1752300	1505584	246716
98	Poland	Combustion	PL-0104-05	649700	540263	109437	649700	538958	110742	649700	545138	104562
99	Poland	Combustion	PL-0103-05	1151200	1039988	111212	1151200	949324	201876	1151200	1105197	46003
100	Poland	Combustion	PL-0102-05	1057400	956264	101136	1057400	932665	124735	1057400	947299	110101
101	France	Combustion	6504212	100808	59494	41314	100808	5781	95027	100808	54519	46289
102	France	Combustion	6803995	59296	41493	17803	59296	40881	18415	59296	38993	20303
103	Slovak Rep	Combustion	105-027-2005	7865	7049	816	7865	6787	1078	7864	5735	2129
104	Slovak Rep	Combustion	105-024-2005	7881	7317	564	7880	6376	1504	7880	5726	2154
105	Slovak Rep	Combustion	105-019-2005	6743	4585	2158	6743	436	6307	6742	3283	3459
106	Slovak Rep	Combustion	105-020-2005	7251	6358	893	7251	5854	1397	7251	5094	2157
107	Slovak Rep	Combustion	105-033-2005	13556	12696	860	13556	12053	1503	13556	10797	2759
108	Slovak Rep	Combustion	105-034-2005	5124	890	4234	5124	380	4744	5124	193	4931
109	Slovak Rep	Combustion	105-029-2005	7165	6288	877	7165	5669	1496	7165	4927	2238
110	Slovak Rep	Combustion	105-017-2005	5744	5293	451	5744	4851	893	5744	4266	1478
111	Slovak Rep	Combustion	105-008-2005	6397	5974	423	6397	5386	1011	6396	4759	1637
112	Slovak Rep	Combustion	105-032-2005	7912	7452	460	7912	6862	1050	7911	6015	1896
113	Slovak Rep	Combustion	105-026-2005	6479	6415	64	6478	581	5897	6478	5037	1441
114	Slovak Rep	Combustion	105-025-2005	4964	4551	413	4964	426	4538	4963	3857	1106
115	Slovak Rep	Combustion	105-021-2005	4715	5219	-504	4715	4293	422	4715	3631	1084
116	Slovak Rep	Combustion	105-028-2005	7396	5968	1428	7395	5810	1585	7395	5080	2315
117	Slovak Rep	Combustion	105-016-2005	6425	5889	536	6425	5438	987	6424	4694	1730
118	Slovak Rep	Combustion	105-023-2005	5520	5372	148	5520	5001	519	5520	4457	1063
119	Slovak Rep	Combustion	105-031-2005	6781	6477	304	6780	5853	927	6780	5218	1562
120	Slovak Rep	Combustion	105-030-2005	5044	4451	593	5044	4152	892	5044	3748	1296
121	Slovak Rep	Combustion	105-022-2005	6788	6646	142	6788	6159	629	6788	5436	1352
122	Slovak Rep	Combustion	105-018-2005	4117	3499	618	4116	3132	984	4116	2854	1262
123	Romania	Combustion	03-30-2007	0		0	0		0	514797	340204	174593
124	France	Combustion	5401262	4768	3958	810	4768	3946	822	4768	3354	1414
125	Belgium	Combustion	WAI124P065	6172	6618	-446	6173	4477	1696	6173	3242	2931
Total				12207995	10525031	1682964	12207991	10106621	2101370	12551909	10118300	2433609

Table 4: Distributed Allowances, Verified Emissions and Net Short/Long Position for Dalkia, Installations #85-125 (2005-2007) from Reuters Carbon Market Data

Installation List	Country	Activity	Permit Identifier	Distributed Allowances 2005	Verified Emissions 2005	Net Short/Long Position 2005	Distributed Allowances 2006	Verified Emissions 2006	Net Short/Long Position 2006	Distributed Allowances 2007	Verified Emissions 2007	Net Short/Long Position 2007
Eesti Energia												
1	Estonia	Combustion	KL-0022	505968	373270	132698	537952	371992	165960	572064	302229	269835
Enel												
3	Spain	Combustion	ES025001000989									
4	Spain	Combustion	ES011101000060	226476	784539	-558063	88931	211016	-122085	0	6225	-6225
5	Spain	Combustion	ES011401000047	1543744	2126527	-582783	1386012	1407854	-21842	1208371	1919952	-711581
6	Spain	Combustion	ES024401000188	583889	982336	-398447	524230	947485	-423255	457041	404548	52493
7	Spain	Combustion	ES025001000187	289262	67133	222129	270088	5556	264532	0		0
8	Spain	Combustion	ES071301000402	820404	1193541	-373137	736580	562635	173945	642175	1039547	-397372
9	Spain	Combustion	ES080801000514	434947	891905	-456958	390506	1022993	-632487	340456	732426	-391970
Total				3898722	6045981	-2147259	3396347	4157539	-761192	2648043	4102698	-1454655

Table 5: Distributed Allowances, Verified Emissions and Net Short/Long Position for Eesti Energia and Enel (2005-2007) from Reuters Carbon Market Data

Installation List	Country	Activity	Permit Identifier	Distributed Allowances 2005	Verified Emissions 2005	Net Short/Long Position 2005	Distributed Allowances 2006	Verified Emissions 2006	Net Short/Long Position 2006	Distributed Allowances 2007	Verified Emissions 2007	Net Short/Long Position 2007
1	Germany	Combustion	14310-0066	5624	3341	2283	5624	0	5624	5624		5624
2	Germany	Combustion	14310-0110	3470	3323	147	3470	4948	-1478	3470	1274	2196
3	Germany	Combustion	14310-0247	16898	17098	-200	16898	15887	1011	16898	14736	2162
4	Germany	Combustion	14310-0346	12204	11243	961	12204	9607	2597	12204	6578	5626
5	Germany	Combustion	14310-0350	17154	16515	639	17154	15976	1178	17154	17607	-453
6	Germany	Combustion	14310-0384	4503	301	4202	4503	24344	-19841	4503	24848	-20345
7	Germany	Combustion	14310-0394	400918	393426	7492	400918	380311	20607	400918	3434	397484
8	Germany	Combustion	14310-0399	22125	21219	906	22125	19696	2429	22125	19648	2477
9	Germany	Combustion	14310-0693	17128	11438	5690	17128	11484	5644	17128	10419	6709
10	Germany	Combustion	14310-0788	93351	76198	17153	93351	68302	25049	93351	70276	23075
11	Germany	Combustion	14310-0855	31934	23879	8055	31934	24512	7422	31934	21746	10188
12	Germany	Combustion	14310-0862	45304	30749	14555	45304	27867	17437	45304	26899	18405
13	Germany	Combustion	14310-0903	42359	30234	12125	42359	29596	12763	42359	27947	14412
14	Germany	Combustion	14310-0955	9036	7446	1590	9036	6587	2449	9036	6289	2747
15	Germany	Combustion	14310-0957	17704	16652	1052	17704	15669	2035	17704	15172	2532
16	Germany	Combustion	14310-1036	9892	8919	973	9892	10447	-555	9892	7701	2191
17	Germany	Combustion	14310-1048	4662	5224	-562	4662	0	4662	4662		4662
18	Germany	Combustion	14310-1052	6709	790	5919	6709	0	6709	6709		6709
19	Germany	Combustion	14310-1054	642	494	148	642	438	204	642	160	482
20	Germany	Combustion	14310-1055	13929	15082	-1153	13929	14498	-569	13929	11315	2614
21	Germany	Combustion	14310-1057	17751	15129	2622	17751	15071	2680	17751	13292	4459
22	Germany	Combustion	14310-1059	6395	10233	-3838	6395	7861	-1466	6395	9746	-3351
23	Germany	Combustion	14310-1150	10061	12342	-2281	10061	11127	-1066	10061	9651	410
24	Germany	Combustion	14310-1300	7355	6799	556	7355	725	6630	7355	5841	1514
25	Germany	Combustion	14320-0006	114150	69031	45119	114150	7815	106335	114150	64876	49274
26	Germany	Combustion	14330-0024	33708	2158	31550	33708	22831	10877	33708	30888	2820
27	Germany	Combustion	14330-0025	1645	1486	159	1645	171	1474	1645	259	1386
28	Germany	Combustion	14330-0026	5277	1662	3615	5277	6681	-1404	5277		5277
29	Germany	Combustion	14330-0027	20711	38215	-17504	20711	32002	-11291	20711	25937	-5226
30	Germany	Combustion	14330-0028	31010	26805	4205	31010	50338	-19328	31010	15955	15055
31	Germany	Combustion	14330-0029	11612	14057	-2445	11612	13889	-2277	11612	651	10961
32	Germany	Combustion	14330-0031	3275	981	2294	3275	2371	904	3275	1869	1406
33	Germany	Combustion	14330-0032	169298	14698	154600	169298	178301	-9003	169298	149693	19605
34	Germany	Combustion	14310-0435	98988	101312	-2324	98988	161801	-62813	98988	162347	-63359
35	Netherlands	Combustion	200400156	135511	119	135392	135511	126196	9315	135511	54039	81472
36	Netherlands	Combustion	200400157	520204	50612	469592	520204	443254	76950	520203	339349	180854
37	Netherlands	Combustion	200400154	131404	116678	14726	131404	130933	471	131404	123972	7432
38	Netherlands	Combustion	200400153	6166456	6324962	-158506	6166456	6189119	-22663	6166456	6108992	57464
39	Netherlands	Combustion	200400155	744953	675927	69026	744953	679407	65546	744953	660029	84924
40	Germany	Combustion	14310-0506	1834	1722	112	1834	2203	-369	1834	1884	-50
41	Germany	Combustion	14310-0386	130	154	-24	130	553	-423	130	113	17
42	Germany	Combustion	14310-0425	15319	1782	13537	15319	103822	-88503	15319	236057	-220738
43	Germany	Combustion	14310-0349	63171	55822	7349	63171	53964	9207	63171	53305	9866
44	Germany	Combustion	14310-0061	922	731	191	922	105	817	922	987	-65
45	Germany	Combustion	14310-0059	1051	783	268	1051	819	232	1051	944	107

Table 6: Distributed Allowances, Verified Emissions and Net Short/Long Position for E.ON, Installations #1-45 (2005-2007) from Reuters Carbon Market Data

Installation List	Country	Activity	Permit Identifier	Distributed Allowances 2005	Verified Emissions 2005	Net Short/Long Position 2005	Distributed Allowances 2006	Verified Emissions 2006	Net Short/Long Position 2006	Distributed Allowances 2007	Verified Emissions 2007	Net Short/Long Position 2007
46	Germany	Combustion	14310-0429	522	1523	-1001	522	2656	-2134	522	906	-384
47	Germany	Combustion	14310-0656	1162	1945	-783	1162	3139	-1977	1162	3322	-2160
48	Germany	Combustion	14310-0428	24	20	4	24	127	-103	24	19	5
49	Germany	Combustion	14310-0388	2915	703	2212	2915	556	2359	2915	333	2582
50	Germany	Combustion	14310-0833	44700	2286	42414	44700	2411	42289	44700	5084	39616
51	Germany	Combustion	14310-0328	23642	18782	4860	23642	19086	4556	23642	16338	7304
52	Germany	Combustion	14310-0333	44734	38933	5801	44734	33482	11252	44734	30213	14521
53	Germany	Combustion	14310-1053	15436	12784	2652	15436	10723	4713	15436	7937	7499
54	Germany	Combustion	14310-0065	1766	1739	27	1766	3353	-1587	1766	1380	386
55	Germany	Combustion	14310-0062	921	547	374	921	1182	-261	921	992	-71
56	Germany	Combustion	14310-0060	2296	2584	-288	2296	768	1528	2296	1846	450
57	Germany	Combustion	14310-0832	1618182	1926043	-307861	1618182	1692312	-74130	1618182	1703588	-85406
58	Germany	Combustion	14310-0424	1413422	1650808	-237386	1413422	1725278	-311856	1413422	1491266	-77844
59	Germany	Combustion	14310-0420	2379	5074	-2695	2379	282	2097	2379	1184	1195
60	Germany	Combustion	14310-0906	440237	499563	-59326	440237	282381	157856	440237	461949	-21712
61	Germany	Combustion	14310-0742	3552957	2610998	941959	3552957	4100667	-547710	3552957	3678763	-125806
62	Germany	Combustion	14310-0907	827962	858731	-30769	827962	683068	144894	827962	944942	-116980
63	Germany	Combustion	14310-0651	144603	143919	684	144603	90875	53728	144603	133392	11211
64	Germany	Combustion	14310-0550	12181	8258	3923	12181	1347	10834	12181	17522	-5341
65	Germany	Combustion	14310-0438	215714	260204	-44490	215714	209632	6082	215714	242358	-26644
66	Germany	Combustion	14310-0741	1430124	1477324	-47200	1430124	1569001	-138877	1430124	1607553	-177429
67	Germany	Combustion	14310-0647	1364	962	402	1364	804	560	1364	660	704
68	Germany	Combustion	14310-1345	2315	2858	-543	2315	2898	-583	2315	264	2051
69	Germany	Combustion	14310-0909	419121	286684	132437	419121	323555	95566	419121	442209	-23088
70	Germany	Combustion	14310-0831	4949048	6125032	-1175984	4949048	6274756	-1325708	4949048	5513703	-564655
71	Germany	Combustion	14310-0649	8679778	9815880	-1136102	8679778	10671936	-1992158	10929778	12646858	-1717080
72	Germany	Combustion	14310-0836	626969	694416	-67447	626969	722379	-95410	626969	839379	-212410
73	Germany	Combustion	14310-0888	854487	1071534	-217047	854487	1043304	-188817	854487	1033278	-178791
74	Germany	Combustion	14310-1346	1076222	1174175	-97953	1076222	1025640	50582	1076222	1172046	-95824
75	Germany	Combustion	14310-0834	270688	427882	-157194	270688	357688	-87000	270688	439941	-169253
76	Germany	Combustion	14310-1347	2758879	2032467	726412	2758879	2053648	705231	2758879	2758584	295
77	Germany	Combustion	14310-1392		0	0		0	0			0
78	Germany	Combustion	14310-1348	1546	3628	-2082	1546	3665	-2119	1546	2296	-750
79	Germany	Combustion	14310-0390	3505642	3424354	81288	3505642	3553304	-47662	3505642	3139510	366132
80	Germany	Combustion	14310-0383	1669361	1972741	-303380	1669361	1798761	-129400	1669361	2019747	-350386
81	Germany	Combustion	14310-0708	163	825	-662	163	1154	-991	163	1786	-1623
82	Germany	Combustion	14330-0073			0			0			0
83	Germany	Combustion	14310-0745	164	776	-612	164	770	-606	164	939	-775
84	Germany	Combustion	14320-0002	33243	23896	9347	33243	30271	2972	33243	24361	8882
85	Germany	Combustion	14330-0030	32250	34936	-2686	32250	43857	-11607	32250	33547	-1297
86	Germany	Combustion	14310-0526	15903	3849	12054	22921	3066	19855	19412	4786	14626
87	Germany	Combustion	14330-0038	62217	27623	34594	62217	2696	59521	62217	315	61902
88	Germany	Combustion	14330-0039	2616	2269	347	2616	188	2428	2616	1844	772
89	Germany	Combustion	14330-0072			0			0			0
Total				43845592	44887326	-1041734	43852610	47268194	-3415584	46099100	48783665	-2684565

Table 7: Distributed Allowances, Verified Emissions and Net Short/Long Position for E.ON, Installations #46-89 (2005-2007) from Reuters Carbon Market Data

Installation List	Country	Activity	Permit Identifier	Distributed Allowances 2005	Verified Emissions 2005	Net Short/Long Position 2005	Distributed Allowances 2006	Verified Emissions 2006	Net Short/Long Position 2006	Distributed Allowances 2007	Verified Emissions 2007	Net Short/Long Position 2007
1	Germany	Ceramics	14260-0013	3482	2396	1086	3482	0	3482	3482		3482
2	Germany	Ceramics	14260-0057	3118	2953	165	3118	2881	237	3118	2826	292
3	Germany	Ceramics	14260-0096	5020	3314	1706	5020	3412	1608	5020	3856	1164
4	Germany	Ceramics	14260-0111	1581	1319	262	1581	1632	-51	1581	1231	350
5	Germany	Ceramics	14260-0112	1941	1933	8	1941	1742	199	1941	1819	122
6	Germany	Ceramics	14260-0115	54196	40715	13481	54196	45701	8495	28060	57008	-28948
7	Germany	Ceramics	14260-0116	539	493	46	539	431	108	539	429	110
8	Germany	Ceramics	14260-0118	1346	1175	171	1346	1153	193	1346	1194	152
9	Germany	Ceramics	14260-0121	13029	9814	3215	13029	7524	5505	13029	6954	6075
10	Germany	Ceramics	14260-0129	3195	2158	1037	3195	2006	1189	3195		3195
11	Germany	Ceramics	14260-0153	336	322	14	336	395	-59	336	306	30
12	Germany	Ceramics	14260-0155	3863	4071	-208	3863	4611	-748	3863	4329	-466
13	Germany	Ceramics	14260-0169	12280	12188	92	12280	11562	718	12280	9255	3025
14	Germany	Ceramics	14260-0181	5281	3987	1294	5281	3925	1356	5281	3415	1866
15	Germany	Ceramics	14260-0221	14301	14789	-488	14301	9953	4348	14301	1235	13066
16	Germany	Ceramics	14260-0222	9682	10138	-456	9682	1253	8429	9682	7295	2387
17	Germany	Ceramics	14260-0223	7103	0	7103	7103	0	7103	7103		7103
18	Germany	Ceramics	14260-0224	6420	6672	-252	6420	5609	811	6420	6818	-398
19	Germany	Paper	14280-0098	65369	55797	9572	65369	56556	8813	65369	51289	14080
20	Germany	Paper	14280-0106	7901	4611	3290	7901	4799	3102	7901	4645	3256
21	Germany	Combustion	14310-0055	7	0	7	7	0	7	7		7
22	Germany	Combustion	14310-0637	33196	13747	19449	33196	14776	18420	33196	7071	26125
23	Germany	Combustion	14310-0680	21505	2125	19380	21505	2034	19471	21505	22291	-786
24	Germany	Combustion	14310-0856	3240622	3388560	-147938	3240622	4351049	-1110427	3240622	4112952	-872330
25	Germany	Combustion	14310-0931		3274376	-3274376		3601708	-3601708		3061616	-3061616
26	Germany	Combustion	14310-0950	2118174	1738304	379870	2118174	1569243	548931	2118174	1652194	465980
27	Germany	Combustion	14310-0952	4276832	4127851	148981	4276832	3668069	608763	4276832	4239735	37097
28	Germany	Combustion	14310-1088	1690717	1394768	295949	1690717	1664380	26337	1690717	1492609	198108
29	Germany	Combustion	14310-1089	1529980	1060298	469682	1529980	977009	552971	1047862	1033304	14558
30	Germany	Combustion	14310-1090	1669388	1634028	35360	1669388	1613914	55474	1648071	1719506	-71435
31	Germany	Combustion	14310-1091	987205	1016733	-29528	987205	1020873	-33668	978093	1105032	-126939
32	Germany	Combustion	14310-1092	20318296	17573788	2744508	20318296	19317451	1000845	20318296	19599684	718612
33	Germany	Combustion	14310-1093	16903648	17980947	-1077299	16903648	17917668	-1014020	16903648	16795941	107707
34	Germany	Combustion	14310-1094	18989348	20612731	-1623383	18989348	18823349	165999	18979965	19683995	-704030
35	Germany	Combustion	14310-1153	28667044	29734760	-1067716	28667044	27386683	1280361	28667044	31252670	-2585626
36	Germany	Combustion	14310-1212	11630	11731	-101	11630	0	11630	11630		11630
37	Germany	Combustion	14310-1228	17108	19168	-2060	17108	19139	-2031	17108	19189	-2081

Table 8: Distributed Allowances, Verified Emissions and Net Short/Long Position for RWE, Installations #1-37 (2005-2007) from Reuters Carbon Market Data

Installation List	Country	Activity	Permit Identifier	Distributed Allowances 2005	Verified Emissions 2005	Net Short/Long Position 2005	Distributed Allowances 2006	Verified Emissions 2006	Net Short/Long Position 2006	Distributed Allowances 2007	Verified Emissions 2007	Net Short/Long Position 2007
38	Germany	Combustion	14310-1385		0	0		0	0			0
39	Germany	Combustion	14330-0001	1063	82	981	1063	569	494	1063	308	755
40	UK	Combustion	EA-ETCO2-0160	605912	795147	-189235	605912	828739	-222827	605912	824638	-218726
41	Germany	Combustion	14310-0054	1270	1991	-721	1270	1843	-573	1270	2761	-1491
42	Germany	Combustion	14310-0817	13790	8857	4933	13790	3614	10176	13790		13790
43	Germany	Glass	14250-0093		0	0		48735	-48735		126621	-126621
44	Germany	Combustion	14310-0328	23642	18782	4860	23642	19086	4556	23642	16338	7304
45	Germany	Combustion	14310-0333	44734	38933	5801	44734	33482	11252	44734	30213	14521
46	Germany	Combustion	14310-0655	36540	44518	-7978	36540	27954	8586	36540	6771	29769
47	Germany	Combustion	14310-0446	37613	33104	4509	37613	26702	10911	37613	16015	21598
48	Germany	Combustion	14310-0060	2296	2584	-288	2296	768	1528	2296	1846	450
49	Germany	Ceramics	14260-0124	7869	5222	2647	7869	5159	2710	7869	4967	2902
50	Germany	Ceramics	14260-0125	3812	4877	-1065	3812	5204	-1392	3812	5704	-1892
51	Germany	Combustion	14310-0748	93963	72251	21712	93963	72554	21409	93963	69354	24609
52	Germany	Combustion	14310-0947	154208	107036	47172	154208	110841	43367	154208	105236	48972
53	Germany	Combustion	14310-0946	122999	85932	37067	122999	84859	38140	122999	79983	43016
54	Germany	Combustion	14310-0938	3172057	3406579	-234522	3172057	3174824	-2767	3172057	3378852	-206795
55	Germany	Combustion	14310-0944	3607248	3596816	10432	3607248	4324981	-717733	3607248	4775857	-1168609
56	Germany	Combustion	14310-0943	664401	728470	-64069	664401	726747	-62346	664401	679374	-14973
57	Germany	Combustion	14310-0941	3151994	2921763	230231	3151994	3779996	-628002	3151994	3671289	-519295
58	Germany	Combustion	14310-0945	1141834	847467	294367	1141834	725634	416200	1141834	830154	311680
59	Germany	Combustion	14310-0770	5264108	5017098	247010	5264108	7289168	-2025060	5264108	6925790	-1661682
60	Netherlands	Combustion	200400091	1349869	1106063	243806	1349869	960725	389144	1349869	1076294	273575
61	Austria	Combustion	EMV233	0	0	0	0	0	0	0		0
62	Austria	Combustion	ILE164	13942	721	13221	13942	681	13261	13942	665	13277
63	Czech Rep	Combustion	CZ-0055-05	2540	2198	342	2540	2772	-232	2540	1524	1016
64	Germany	Combustion	14330-0013	6765	25116	-18351	6765	20014	-13249	6765	11221	-4456
65	Germany	Combustion	14310-0165	702	212	490	702	436	266	702	218	484
66	Czech Rep	Combustion	CZ-0059-05	200000	85476	114524	200000	7378	192622	200000	76788	123212
67	Czech Rep	Combustion	CZ-0060-05	106270	46196	60074	106270	35047	71223	106270	18405	87865
68	Czech Rep	Combustion	CZ-0057-05	27013	1590	25423	27013	10496	16517	27013	2826	24187
69	Czech Rep	Combustion	CZ-0056-05	22277	1570	20707	22277	9374	12903	22277	1750	20527
70	Czech Rep	Combustion	CZ-0058-05	35410	23141	12269	35410	22456	12954	35410	6851	28559
71	Czech Rep	Combustion	CZ-0061-05	65150	17636	47514	65150	274	64876	65150	8168	56982
72	Austria	Combustion	IVA235	0	0	0	0	0	0	0		0
73	Germany	Ceramics	14260-0172	7856	6937	919	7856	74	7782	7856	6728	1128
Total				120683830	122817125	-2133295	120683830	124473676	-3789846	120135764	128725202	-8589438

Table 9: Distributed Allowances, Verified Emissions and Net Short/Long Position for RWE, Installations #38-73 (2005-2007) from Reuters Carbon Market Data

Installation List	Country	Activity	Permit Identifier	Distributed Allowances 2005	Verified Emissions 2005	Net Short/Long Position 2005	Distributed Allowances 2006	Verified Emissions 2006	Net Short/Long Position 2006	Distributed Allowances 2007	Verified Emissions 2007	Net Short/Long Position 2007
1	Spain	Combustion	ES012101000055	1871029	1692327	178702	2077491	2536246	-458755	2128158	2423841	-295683
2	Spain	Combustion	ES033301000222	190493	3103188	-2912695	171950	2677815	-2505865	150230	3440880	-3290650
3	Spain	Combustion	ES033301000223	637005	0	637005	571919	0	571919	498618		498618
4	Spain	Combustion	ES033301000224	1915851	0	1915851	1720099	0	1720099	1499640		1499640
5	Spain	Combustion	ES062401000351	3312940	4196260	-883320	2974440	3554304	-579864	2593217	3428296	-835079
6	Spain	Combustion	ES074501000404	0	0	0	0	401075	-401075	0	936432	-936432
7	Spain	Combustion	ES074501000405	106446	412660	-306214	41798	387122	-345324	0	110778	-110778
8	Spain	Combustion	ES074501000406	85290	266228	-180938	33492	296481	-262989	0	66894	-66894
9	Spain	Combustion	ES104601000666	0	0	0	0	0	0	0	741233	-741233
10	Spain	Combustion	ES121501000747	2786379	4221684	-1435305	2553409	3847539	-1294130	2280522	5132091	-2851569
11	Spain	Combustion	ES121501000748	0	0	0	0	0	0	0		0
12	Spain	Combustion	ES121501000749	140221	530469	-390248	55061	310591	-255530	0	139806	-139806
Total				11045654	14422816	-3377162	10199659	14011173	-3811514	9150385	16420251	-7269866

Table 10: Distributed Allowances, Verified Emissions and Net Short/Long Position for Union Fenosa (2005-2007) from Reuters Carbon Market Data

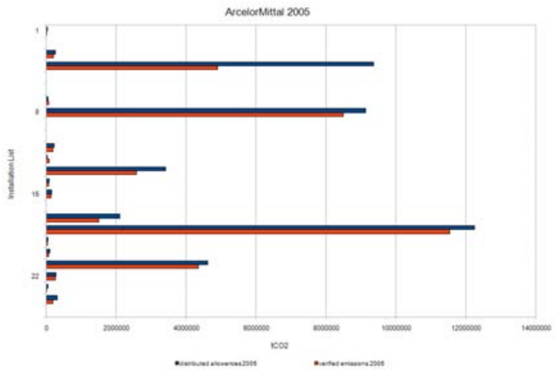

Figure 1: Distributed Allowances and Verified Emissions for ArcelorMittal in 2005 from Reuters Carbon Market Data

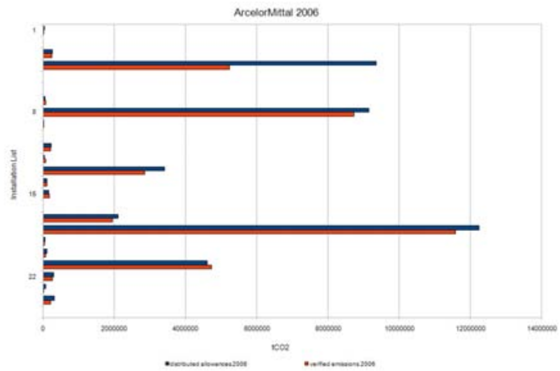

Figure 2: Distributed Allowances and Verified Emissions for ArcelorMittal in 2006 from Reuters Carbon Market Data

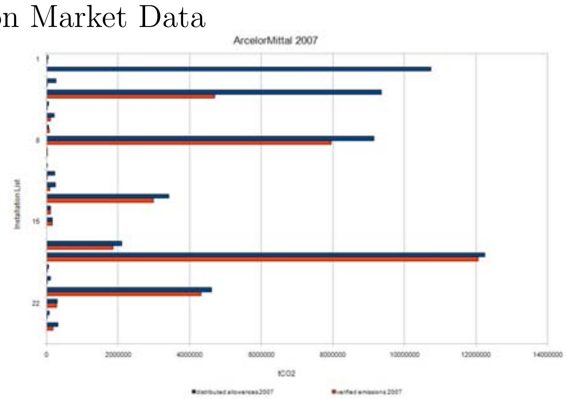

Figure 3: Distributed Allowances and Verified Emissions for ArcelorMittal in 2007 from Reuters Carbon Market Data

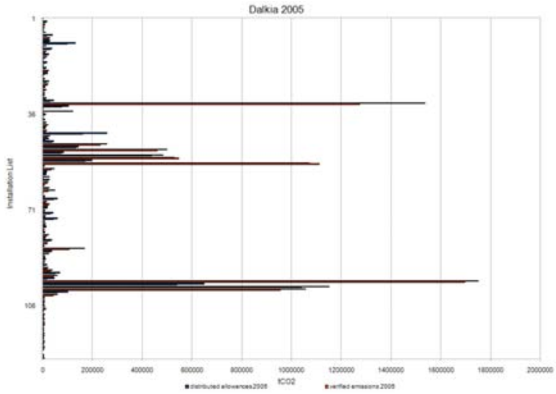

Figure 4: Distributed Allowances and Verified Emissions for Dalkia in 2005 from Reuters Carbon Market Data

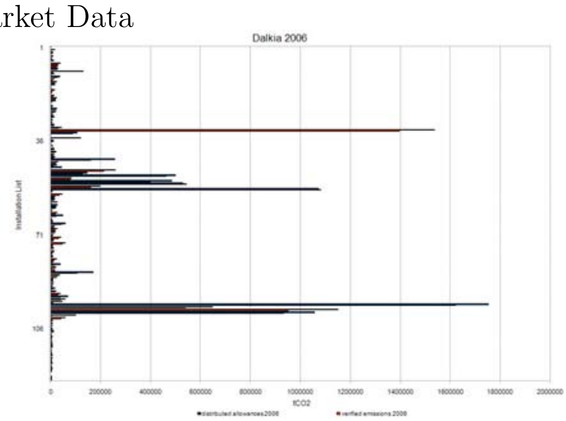

Figure 5: Distributed Allowances and Verified Emissions for Dalkia in 2006 from Reuters Carbon Market Data

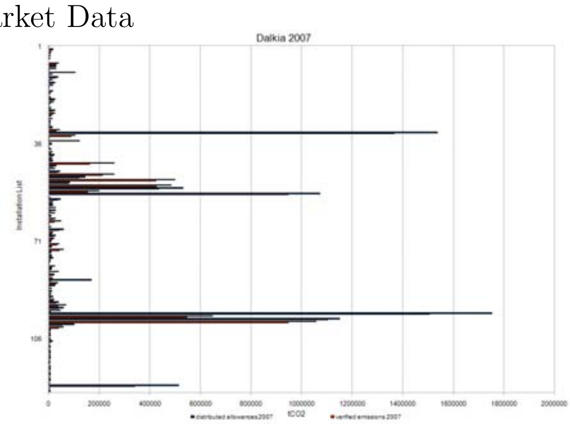

Figure 6: Distributed Allowances and Verified Emissions for Dalkia in 2007 from Reuters Carbon Market Data

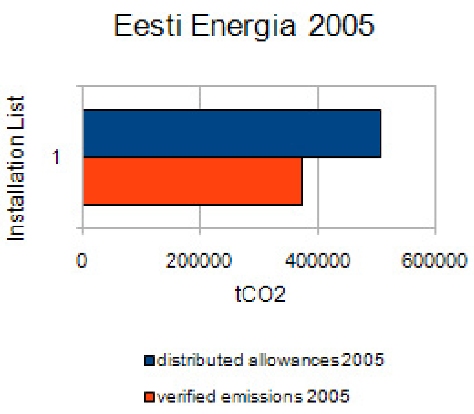

Figure 7: Distributed Allowances and Verified Emissions for Eesti Energia in 2005 from Reuters Carbon Market Data

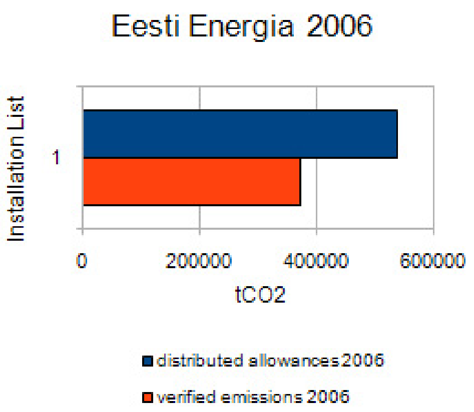

Figure 8: Distributed Allowances and Verified Emissions for Eesti Energia in 2006 from Reuters Carbon Market Data

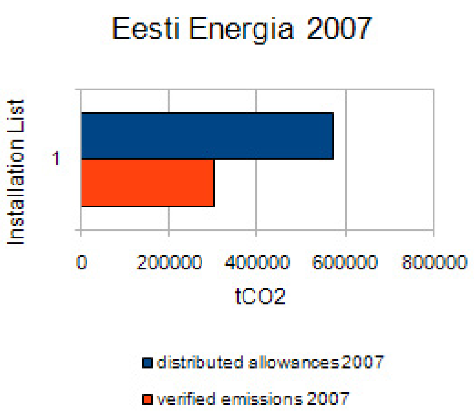

Figure 9: Distributed Allowances and Verified Emissions for Eesti Energia in 2007 from Reuters Carbon Market Data

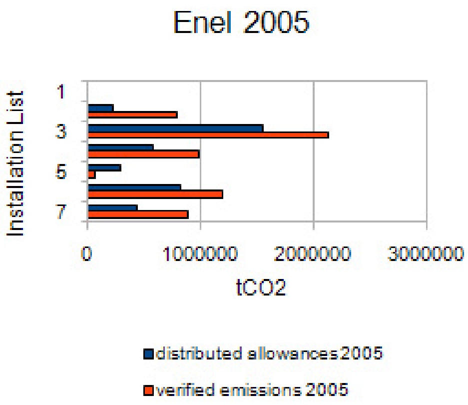

Figure 10: Distributed Allowances and Verified Emissions for Enel in 2005 from Reuters Carbon Market Data

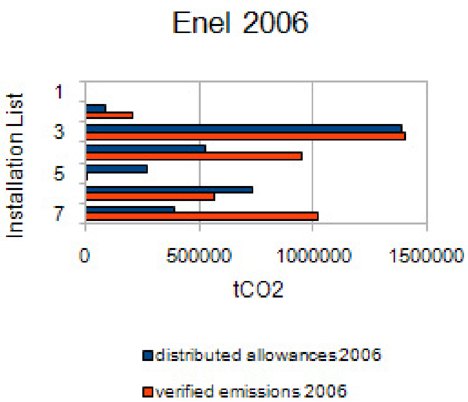

Figure 11: Distributed Allowances and Verified Emissions for Enel in 2006 from Reuters Carbon Market Data

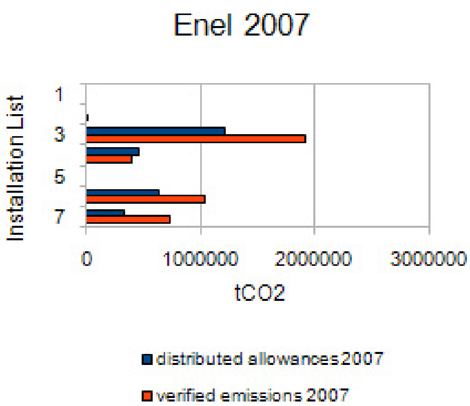

Figure 12: Distributed Allowances and Verified Emissions for Enel in 2007 from Reuters Carbon Market Data

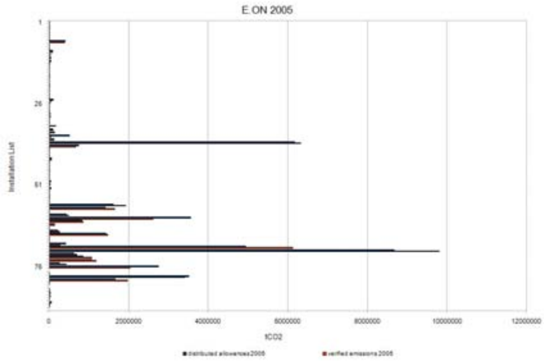

Figure 13: Distributed Allowances and Verified Emissions for Eon in 2005 from Reuters Carbon Market Data

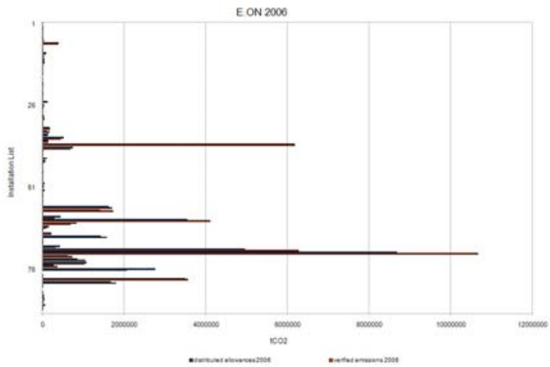

Figure 14: Distributed Allowances and Verified Emissions for Eon in 2006 from Reuters Carbon Market Data

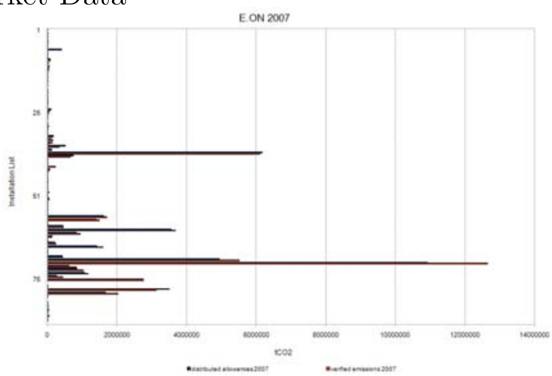

Figure 15: Distributed Allowances and Verified Emissions for Eon in 2007 from Reuters Carbon Market Data

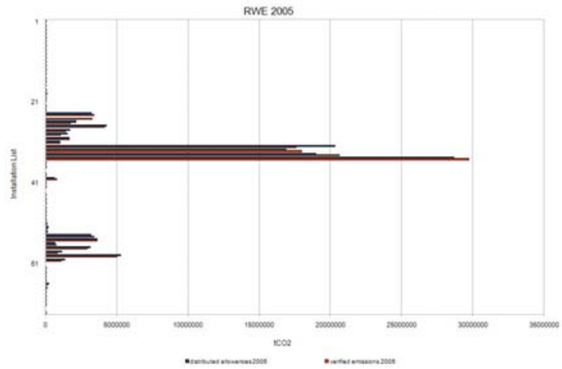

Figure 16: Distributed Allowances and Verified Emissions for RWE in 2005 from Reuters Carbon Market Data

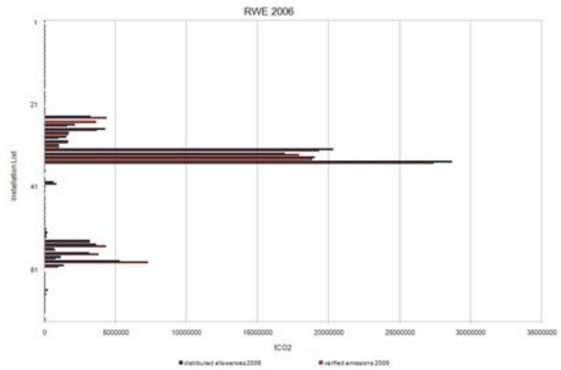

Figure 17: Distributed Allowances and Verified Emissions for RWE in 2006 from Reuters Carbon Market Data

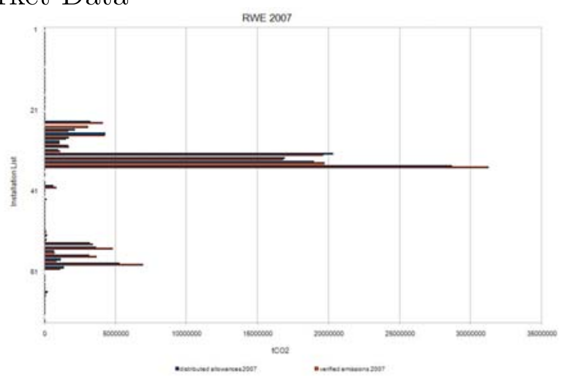

Figure 18: Distributed Allowances and Verified Emissions for RWE in 2007 from Reuters Carbon Market Data

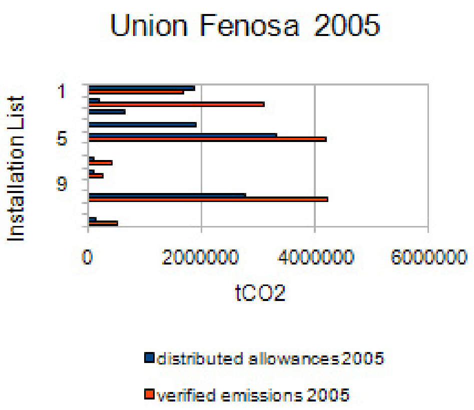

Figure 19: Distributed Allowances and Verified Emissions for Union Fenosa in 2005 from Reuters Carbon Market Data

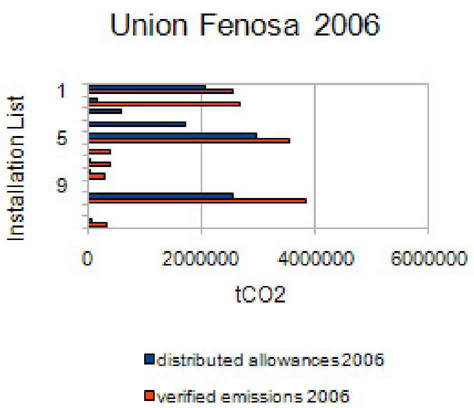

Figure 20: Distributed Allowances and Verified Emissions for Union Fenosa in 2006 from Reuters Carbon Market Data

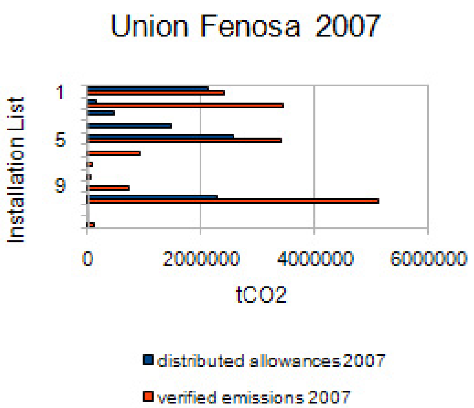

Figure 21: Distributed Allowances and Verified Emissions for Union Fenosa in 2007 from Reuters Carbon Market Data