



Working
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**A Mixed Bag: Assessment of Market
Performance and Firm Trading Behavior in
the Nox Reclaim Program**

Thomas H. Klier, Richard H. Mattoon and
Michael Ari Prager

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A Mixed Bag: Assessment of Market Performance and Firm Trading Behavior in the NO_x RECLAIM Program

Thomas H. Klier, Richard H. Mattoon and Michael Ari Prager*

Abstract

Tradable permit markets have become an increasingly popular tool to address environmental policy problems. This paper examines the performance of one particular emissions trading market, the Regional Clean Air Incentives Market (RECLAIM) that started operating in Southern California at the beginning of 1994. It first describes how the RECLAIM program is designed and then describes and evaluates the performance of the market by analyzing trading and price data of NO_x emission credits. We find that a considerable number of trades have occurred in the market, however, we also find that many facilities are not significantly participating in the market. We conclude by focusing on the firm's perspective in order to attempt an explanation of trading behavior observed to date.

*The views expressed herein are those of the authors and not necessarily those of

the Federal Reserve Bank of Chicago or the Federal Reserve System

I. Introduction

The Los Angeles area has the worst air quality in the nation. The region is the only place in the country classified as an “Extreme” non-attainment area for exceeding National Ambient Air Quality Standards (NAAQSs) for ozone as defined under the 1990 Amendment of the Clean Air Act. The South Coast Air Quality Management District (SCAQMD) has taken extensive steps towards cleaning up the air in the Los Angeles area, however the area still remains far from meeting national standards.

For over 30 years economists have been proposing market based environmental regulations on the grounds that they are more efficient than the traditionally used “Command and Control” regulations. While this report will not describe the details and merits of market based environmental regulations¹ in general, it will focus on the implementation and performance of one program in particular. This report will examine the emission trading program that is currently being operated by the SCAQMD in Southern California.

This report looks at the SCAQMD’s tradable emission program, The Regional Clean Air Incentives Market or RECLAIM, that was adopted in October of 1993 and has been operating since the beginning of 1994. First, we will describe the details and rules of the RECLAIM program. Next, the report will describe and evaluate the performance of the market by looking at the trading and prices of the emission credits that has occurred so far in the program. Finally, we will offer some possible explanations for the behavior of the RECLAIM trading.

Much of the literature on marketable emission programs is theoretical in nature. This is because there is little empirical evidence since there have only been a few cases in the U.S. where market based programs have been used in practice. For various reasons,² the primary market based mechanism that has been used in the U.S. has been some form of tradable allowances. The most notable of these tradable allowance programs in the U.S. include the phase out of lead in gasoline by the EPA, early air emission trading, and the acid deposition program. These and a few others are listed in Table 1.

II. Background and History of RECLAIM

In Southern California, air quality is a particular problem because of the region’s unique climate and geographic features. Sunlight interacts with high levels of NOx and volatile organic compounds (VOCs) to give the area the worst ozone rating in the nation. In 1977 the area experienced 121 Stage 1 ozone episodes and, despite being regulated for over 20 years, the region still had 14 Stage 1 episodes in 1995.³

Stage 1 episodes occur when air quality is extremely poor and considered very unhealthy. During Stage 1 episodes everyone is advised to avoid vigorous outdoor exercise. In 1995 the ozone levels exceeded federal health standards on 98 days, down from over 175 in 1988.⁴ Because of this severe problem, regulations for NOx emissions in the basin have been issued since the mid-1970s, but these regulations have not been sufficient to bring the region into compliance and have been rather costly.

Table 1
**History of Market Based Environmental Regulatory Programs;
 Major Tradable Permit Programs in the U.S.**

Year	Program	Agency	Status
Various Years: beginning in 1970's	Emission Trading Credits; Air Emissions Offsets, Banking, Netting, and Bubbles	U.S. EPA	Ongoing
1981	Water Quality in Fox River, WI	Wisconsin Department of Natural Resources	Ended 1987
1983	Lead in Gasoline Trading/Banking	U.S. EPA	Ended 1987
1983 and later years	Dillon Reservoir, Cherry Creek and Chatsfield Basin, Colorado	Colorado Water Quality Control Commission	Ongoing
1990	Acid Deposition; SO ₂ Program	U.S. EPA	Ongoing
1994	RECLAIM NOx/SOx	SCAQMD	Ongoing

RECLAIM represents an innovative approach by the South Coast Air Quality Management District (SCAQMD) to use market incentives to reduce the presence of oxides of Nitrogen (NOx) and oxides of Sulfur (SOx) in the Los Angeles basin. Its legal basis is the California state implementation plan (SIP) which is even more stringent than the Clean Air Act (CAA) requirements. The RECLAIM program is receiving national attention as a potential model for establishing other local and regional markets for trading emission credits.⁵

The main reason that RECLAIM was adopted was to “provide facilities with

added flexibility in meeting emission reduction requirements and lower the cost of compliance".⁶ RECLAIM is intended to achieve the same overall emissions reductions as a command and control regulatory scheme at a substantially lower cost. One estimate generated before RECLAIM began was that the program will save targeted sources about \$58 million annually in compliance costs compared to command and control regulations.⁷

This paper focuses on the market performance of the RECLAIM NOx trading program. NOx is a problem emission for many urban areas because its presence, when combined with sunlight and other factors, helps form damaging ozone. In order to achieve the desired overall emissions reductions it was decided that each source with NOx emissions of greater than four tons per year needed to be included in the RECLAIM program. The RECLAIM program has several specific features worth noting.

A. Facility-wide Bubbles

RECLAIM is a facility-specific program. Each facility is given an allocation of credits that cover all of the sources of NOx emissions at the facility. This replaces the approach taken under command and control where permits were generally tied to individual types of production equipment.⁸ The advantage of a facility-wide allocation of credits is that it allows each facility the flexibility to choose where and how it wants to achieve emissions reductions in order to meet the required overall reduction rather than forcing it to make changes on specific pieces of equipment which may not represent the most cost effective way of reducing emissions. Facility-wide bubbles can generate significant cost savings for RECLAIM facilities. It is important to note however, that RECLAIM facilities do not need to trade credits to take advantage of this type of intrafacility cost savings.

B. Who is in Market; the Universe of Sources

Before the NOx trading program began the proposed trading universe encompassed 390 sources, representing roughly 65% of permitted NOx emissions in the Basin.⁹ Some exemptions were made for certain industry groups such as schools, hospitals, and public transit; they are not included in the RECLAIM program. Each source was provided with specific annual rates of emissions reductions out to the year 2003. The goal of the program is to reduce overall emissions by 80 tons of NOx per day by then. The average NOx reduction required by the original 390 sources will be on the order of 75 percent of starting emission levels.¹⁰ The vast bulk of the NOx emissions are generated by roughly 38% of the facilities which reside in the following four industry groups: SIC 1300: oil and gas extraction, SIC 3200: stone,

clay and glass, SIC 2900: petroleum and coal products, and SIC 4900: electricity, gas and sanitary services. These four industry groups represent 148 facilities (38% of 390), emitting slightly over 84% of the total starting emissions in the RECLAIM NOx program.¹¹ Even by the end of the emission reduction schedule, in the year 2003, they will emit 78% of the total NOx emissions of sources in the program.¹²

By the end of 1995, the universe of facilities decreased from the original 390 to 353 facilities. The main reason that the universe of sources in the NOx trading scheme changed was that the staff of the SCAQMD reevaluated the emissions from many sources and found that many facilities had emissions lower than 4 tons per year or they met the criteria to be an exempt facility. Also some firms were included into the universe of sources. Reasons for the inclusions include: new facilities, reevaluation of emission information, and some facilities that opted in to the program.¹³

C. RTC Allocation and Adjustments

One of the most contentious issues in the RECLAIM program was the establishment of the initial emissions allocations levels for each facility.¹⁴ One particular problem for RECLAIM designers was to ensure that the emission allocations reflected typical, that is recession-neutral, production activity at each facility. California's recent recession had caused many facilities to operate at below average production levels which meant that the emission levels, at the time SCAQMD was setting the allocations for RECLAIM facilities, reflected reductions largely related to a cyclical lowering of production rather than reductions through improved technology. In order to gain individual firm acceptance of RECLAIM, designers allowed firms to set their initial baselines on the basis of actual emissions in one of the four years 1989 to 1992. This enabled firms to select a baseline year that reflected what the firm felt was a reasonable, recession-neutral production year. After the baseline was established, each firm was allocated a declining number of RECLAIM Trading Credits (RTCs) for each future compliance year based on the facility's activity level and current emission factors. The emission factors used to determine the future RTC allocation were based on the relative control that would be required of each facility under the Air Quality Management Plan (AQMP) that was in place before RECLAIM began.¹⁵ By 1993 the SCAQMD had determined a proposed allocation of RTCs for each of the original sources.

By the end of 1995 the allocations of RTCs for 145 facilities had been revised from the proposed allocation. According to the SCAQMD, the main reasons that facilities' allocations were changed included: "emission factor corrections, re-apportionment of fuel usage, changing the peak activity year, and amendment for

previously submitted emission data by facilities.”¹⁶ While the allocation for some firms changed substantially, the net change only slightly increased the total allocation of RTCs.

D. Trading Cycles, Zones, and the Reconciliation Period

One important element of the RECLAIM program is that the annual allotment of trading credits that each firm receives has been established within staggered trading cycles. Firms are assigned to one of two cycles, their annual RTC allotment being valid from either January 1st to December 31st (cycle 1) or July 1st through June 30th (cycle 2). The presence of two cycles is intended to smooth trading behavior. Simulations conducted at the Caltech Laboratory for Experimental Economics and Political Science had found that when firms were all placed on the same cycle, trading tended to occur at the very tail end of the cycle creating extreme volatility in the market.¹⁷ This was seen as a potential obstacle to the market operating efficiently and could result in serious negative environmental consequences. While around half the facilities were assigned to each cycle, the facilities were free to purchase RTCs in the other. Also, a reconciliation period has been established at the end of the firm's annual compliance deadline in which it can review its emissions performance and take measures to ensure it is meeting its compliance cap before penalties are imposed. The reconciliation period extends for 60 days after the expiration date of the RTCs.

In addition, the actual RECLAIM market has been established with 2 geographic zones—inland and coastal. Trading occurs between firms located within their designated zone; in addition, while both zones are allowed to trade with each other, the coastal zone has restrictions on using inland zone credits for compliance. In the case of the Los Angeles Basin, the more severe air problem occurs in the inland zone. Since coastal zone pollutants can cause inland zone ozone, achieving actual emissions reductions in the coastal zone is particularly critical to meeting the environmental goals of RECLAIM.

E. Monitoring and Reporting of Emissions

RECLAIM requires the submission of periodic emissions reports and certified quarterly compliance statements. The facility permit in RECLAIM is based on actual emissions and not the permitted emissions of specific types of equipment used in previous control programs.¹⁸ In exchange for the freedom to devise their own emissions reduction program, facilities in RECLAIM must provide regulators with better and more accurate information on actual emissions levels. The RECLAIM program distinguishes three tiers for emissions reporting. Major sources, for example a 400 MW boiler, are required to report emissions levels on a daily basis.

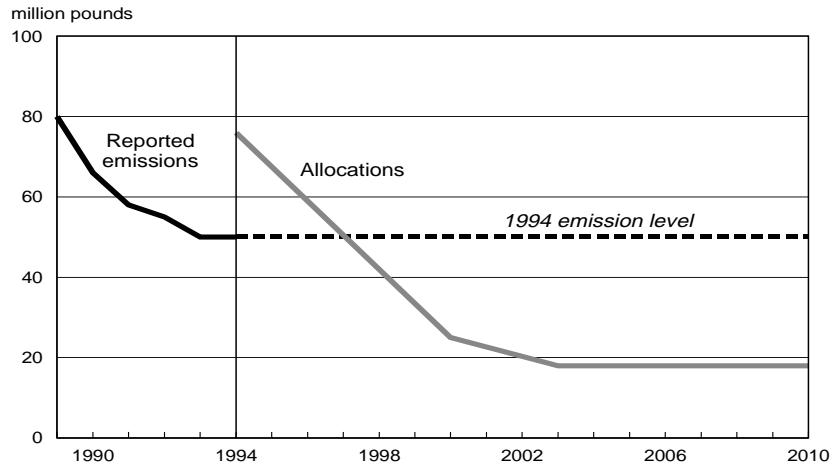
Large sources are required to report on a monthly basis and minor sources are required to report on a quarterly basis. While the initial monitoring costs for RECLAIM facilities can range from \$1,500 for minor sources to \$200,000 for large sources, much of this can be recovered through lower overall facility compliance costs.¹⁹ Much of the initial opposition from industry to RECLAIM was because of these costly monitoring requirements.²⁰

III. Expectations and the Beginning of the Market

Before RECLAIM began many felt that trading in the market would be slow at first because the initial allocation of credits provided some room for most facilities to increase their actual emissions. There was in fact some concern that the design of RECLAIM would lead to an increase of emissions in the region. Specifically, the allocation of RTCs for the first few years of the program is higher than the actual emissions for 1994. This is a result of the method used to allocate RTCs; it was based on actual emissions from four different years. Graph 1 indicates that the total allocation of RTCs in the program was set above actual emissions in 1994. The Annual Report identifies that the cross-over point for NO_x will be somewhere between 1997 and 1998. The cross-over point is when the allocated emissions will fall below the actual 1994 emissions level. While there is some concern about a rise in emissions above actual 1994 levels, it seems that significant increases will not be likely for two reasons. First is that significant numbers of RTCs were expected to be retired or not used. Secondly because RECLAIM facilities contribute only a small portion of the total NO_x emitted in the region, a small increase from RECLAIM facilities will have little change on the over all ozone problem in LA.

It is also important to keep in mind that this is a new market and that many facilities are unfamiliar with it and may be hesitant to trade at first. Many have predicted that trading may be slow at first and will pick up significantly as the total allocation of RTCs declines in future years. One prediction from the SCAQMD was that only 8.3 tons per day of NO_x and SO_x RTCs would be traded in 1994 out of the total 128 tons per day allocated.²¹ Before RECLAIM began, one estimate from SCAQMD economists was that the prices for NO_x RTCs would fall around \$577 a ton (around 29 cents a pound) in 1994 and rise to possibly \$11,000 a ton (\$5.50 a pound) by 1999.²²

Graph 1
NOx Emissions



Source: South Coast Air Quality Management District, "RECLAIM Annual Report, 1994-1995"

IV. What Have We Seen So Far in the RECLAIM Market?

Now that RECLAIM has been operating for over a year and a half we can begin assess how the program is doing and more specifically, we can look to see what type of trading is going on and how the RECLAIM facilities are participating in the market. The first element of this section will describe how trading in RECLAIM actually occurs and the sources of data we used for this analysis. Next, this section will attempt to answer three main questions about the trading in the NOx RECLAIM program; 1. How are firms trading? 2. How many trades have there been in the market and how many firms are participating in RECLAIM? and 3. Why are firms trading or not trading in the RECLAIM market?

A. How Trading Actually Happens; Auctions and Recording of Transactions

The RECLAIM program was designed so that trading could occur with minimal procedural requirements and costs. The program's designers understood that RECLAIM will be successful at saving costs only if an efficient and flexible market is created. Thus the SCAQMD placed minimal restrictions on how RTCs actually can be traded. Other than the zone restrictions discussed above, the only

important trading rule is that when RTCs are traded, the transaction must be recorded by the district. Organizations and individuals who are not RECLAIM facilities are free to participate in the market. The SCAQMD does not need to approve trades, nor does it operate a formal auction or clearing-house for RTCs. It does allow facilities to post call and put offers on its electronic bulletin board system.

Firms are free to enter into private negotiations directly with other firms. In addition, a few private parties have been acting as intermediaries in facilitating trading. Most of the brokerage trading is being conducted by two private trading systems; the Automated Environmental Credit Exchange (ACE) and the Clean Air Auction (CAA). ACE was developed and is managed by Sholtz and Associates, a consulting firm in Pasadena, California, in cooperation with the Pacific Stock Exchange. ACE is operated through the Internet and features five days of trading every quarter. The Clean Air Auction is run by Cantor Fitzgerald, a brokerage firm. Cantor Fitzgerald holds semi-annual auctions during the reconciliation period. It is important to note that SCAQMD requires both of these private trading systems to record their activities in a peculiar manner. The recording procedure is described in detail in the next section of this paper.

In addition to the trading mechanisms described above it is important to note that many of the trades in the RECLAIM market can be classified as intracompany trades. An intracompany trade results when one RECLAIM facility "gives" some of its RTCs to another RECLAIM facility that is owned by the same parent company. As discussed above, RTCs are allocated to facilities and not to companies. There are a number of large corporations that operate more than one RECLAIM facility. Southern California Gas Company for example, operates 6 of the facilities in the RECLAIM universe. If a company wants to transfer part of its RTCs from one facility to another it must record this transaction as a trade for no price.

B. Sources of Trading Data

In order to conduct this analysis, we primarily used data from the SCAQMD. The SCAQMD operates a publicly accessible computerized bulletin board system. From this bulletin board anyone can obtain various types of information, including information about any RECLAIM facility and their available RTCs as well as information on each transaction whereby RTCs changed hands. The bulletin board allows a user to download files with this information. In addition to the bulletin board, the SCAQMD published an annual report in 1996 that provides lists of trading activity and transaction price.

This data from the SCAQMD is administrative data and thus is somewhat noisy and difficult to use for our purposes. One important reason has to do with the

universe of RECLAIM facilities. Since the program began, there have been numerous occasions where RECLAIM facilities have been excluded from or included to the RECLAIM universe. The annual report lists 53 exclusions and 16 inclusion for the NOx program relative to the original 390 facilities. In addition to the exclusions and inclusions, some facilities have changed ownership, some have changed their name, for some facilities ID numbers have changed, and some facilities have ceased their operations.

A further reason that the data is rather noisy is that the initial allocations of RTCs for facilities have changed for many facilities. This makes it difficult to compare a facility's available RTCs with their initial allocation. Also, it has been difficult to analyze the trading behavior from RECLAIM facilities as many of them are involved in complex transactions. One important factor is that brokerage trades are recorded by the SCAQMD in a unique manner. Because the staff at the SCAQMD need to know at any given time who is holding RTCs, they require that when facilities want to sell RTCs through a broker, they must transfer the RTCs to the broker's account (Cantor Fitzgerald or the Pacific Stock Exchange). Then if a buyer is found, the RTCs are transferred to the buyer. The SCAQMD records this as two transactions; one from the seller to the broker (usually recorded for no price) and another from the broker to the buyer (usually recorded for a price). This administrative recording procedure results in what is in effect double counting. The broker is acting as an intermediary, and not as a speculator, in the sense that at no point does it actually purchase the RTCs.

Another somewhat confusing aspect of the recording procedure is when the broker is unable to find a buyer for the RTCs it is holding. If this is the case, the seller has the choice to take the RTCs back from the broker for no price, or they could allow the broker to hold onto the RTCs to hopefully sell them in the future. Often, the broker will give the RTCs back to the firm that was hoping to sell them. The SCAQMD records an event like that as two transactions when in fact the RTCs are simply returned to the prospective seller. For example, on August 8th, 1995 Union Oil Company traded a total of 3,200,000 NOx RTCs of various vintages to Cantor Fitzgerald with hopes to sell them in Cantor Fitzgerald's Clean Air Auction. After no buyer was found at the auction for those RTCs, on August 28th, those RTCs were traded back from Cantor Fitzgerald to Union Oil for no price. The problem is that the SCAQMD records that as two trades, from Union Oil to Cantor Fitzgerald and then another transaction from Cantor Fitzgerald to Union Oil when in fact no actual trade was commenced. In addition to double counting brokerage trades and recording brokerage trades that do not occur as two trades, another problem with the trading data is that when a facility changes ownership the facility needs to trade the RTCs to the new owners. While this did not occur frequently, it also inflates the number of trades.

A further caution in using the available data concerns the method for reporting the price paid for RTCs to SCAQMD. When RTCs are traded for a price, the SCAQMD requires the traders to report the price of the RTCs traded. The problem with this, however, is that for transactions that involve bundles of multiple vintages being sold as a package for one total price, the facility involved with the trade sometimes simply reports some average price for all vintages. This does not reflect the possibility that the purchasing firm assumes that the price of RTCs varies based on the vintage of the credit. Say a facility sold a bundle that includes a total of 25,000 RTCs, 5000 RTCs for each of the next five years, for a total price of \$2500. They may record the price of each RTC sold as \$.10. Because the total allocation of RTCs is declining, this reported price does not represent the true value of the RTCs of different vintages. In addition, the transaction information about intercompany trades does not give any information on the implicit price of the RTCs being shifted from one facility to another.

For all the reasons stated above,²³ the data presented in this paper may still contain some noise, the analysis was however conducted in good faith and every attempt was made to reconcile inconsistencies within the data and to present the most accurate portrait of the RECLAIM trading behavior. In addition, the analysis presented represents a snapshot of the market at one point in time while the market is evolving.

C. Three Key Questions

1. How Have Facilities Been Trading?

a. Types of Trading

This section will look more closely at how trading actually occurs. Trading in the RECLAIM market can be broken down into three main categories. As indicated on Graph 2, these three categories are 1. Intercompany trades, 2. Trades involving non-RECLAIM facilities, and 3. Intracompany trades. Intercompany trades between two RECLAIM facilities owned by different companies and trades involving non-RECLAIM facilities can take place using a broker or they can be individually negotiated. A considerable amount of the RECLAIM trades have been through brokers. Of the 475 transactions that have occurred as of February 26th 1996, Table 2 indicates that 42% involved either Cantor Fitzgerald or the Pacific Stock Exchange as the seller or the buyer. In addition to the 200 transactions brokered by Cantor Fitzgerald or the Pacific Stock Exchange listed in the table, some additional transactions may have been facilitated by smaller brokers. Intercompany trading and trading that involves non-RECLAIM facilities also can be directly negotiated. Experience with emission trading before RECLAIM indicates that there are high transaction cost of individually negotiated trades.²⁴ Forty-nine of the 475 transactions are directly negotiated intercompany

trades between two RECLAIM facilities. The direct transactions costs associated with trading using Cantor Fitzgerald's auctions are fairly low²⁵ and it appears that most firms who are interested in trading their RTC's with other facilities owned by another company have chosen to negotiate through brokers.

There have also been many transactions in the NOx RECLAIM market that have been intracompany trades, trades for no price between different RECLAIM facilities that are owned by the same company. Intracompany trades are similar to internal offsets and bubbles that occur in other non-attainment areas and preceded RECLAIM in the South Coast region.²⁶ Of the total transactions that took place before February 23rd, 1996, 15% of them were intracompany trades.

In addition to RTC transactions listed in the Annual Report and the Bulletin Board, many facilities have most likely engaged in intrafacility trading where they shift emissions between sources within their facility-wide bubble. Intrafacility trading should be considered a type of intracompany trading even though the facilities do not need to record these transactions with the SCAQMD as an actual trade. There is little indication of the level of this type of intrafacility trading, however, facilities are most likely taking advantage of this flexibility and are achieving major cost savings.²⁷

Graph 2
Types of RECLAIM Trading Activity

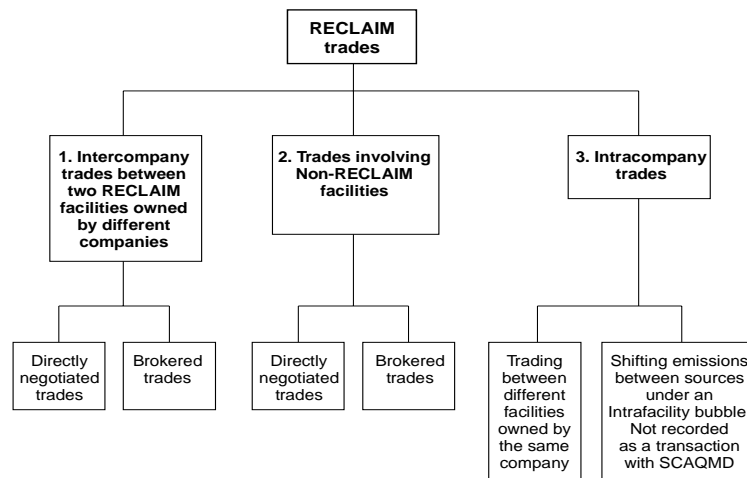


Table 2
All NOx Transaction Activity from 1-1-94 to 2-23-96; All Vintages

	Number of Transactions	Percent	Number of No-Price Transactions
Directly Negotiated Intercompany Transactions ¹	49	10.3%	16 ²
Intracompany Transactions; Trading between facilities owned by the same company ³	73 ⁴	15.3%	73
Brokered Transactions with Pacific Stock Exchange or Cantor Fitzgerald	200	42.1%	152 Broker as Seller: 47 Price/ 36 No-Price Broker as Buyer: 1 Price/ 118 No-Price
Other Transactions ⁵	153	32.2%	105
Total Transactions	475	100%	346

¹Intercompany transactions represent non-brokered trades between two RECLAIM facilities that are not owned by the same parent company.

²Some of the no-price transactions that appear to be interfacility transactions may be intracompany transactions. Some facilities may be owned by the same parent company although their names are different and if two facilities with different names traded RTCs for no price they may be owned by the same company. Also, some no-price transactions between unrelated facilities may represent cases where RTCs are given to a facility as some sort of package deal involving other environmental assets.

³Intercompany transactions are transactions for no price where the seller and buyer are two RECLAIM facilities with the same company name.

⁴There may be more than 73 intracompany transactions because as reported in the note above, this category does not include any transactions between facilities owned by the same company with different names.

⁵Other transactions represent trades with facilities that were once RECLAIM facilities but are no longer RECLAIM facilities, Non-RECLAIM facilities who converted ERCs to RTCs and participate in the market, brokered trades with brokers other than ACE and CAA, retired RTCs, changes of facility ownership, and other miscellaneous transactions.

Source: Compiled by Author from SCAQMD RECLAIM Bulletin Board.

Table 2 gives some information on the levels of different types of trading by looking at all of the transactions in the NOx RECLAIM market. The table should be interpreted with caution however, because it looks at transactions and not trades the way one would consider them in an economic sense. While it appears from Table 2 that ACE and Cantor Fitzgerald are the primary channels through which RTCs are traded, administrative reporting procedures overstate the number of successful trades brokered.

b. No- Price Trades

There has been some concern about the fact that many of the trading transactions recorded by the SCAQMD seem to be for no price. For example, a report commenting on the proposed VOC RECLAIM rules, written by the Natural Resources Defense Council, American Lung Association, and the Coalition for Clean Air wrote , “Almost half of all pounds of NOx traded have “sold” for zero dollars.”²⁸ In fact, of the 475 transactions before February 26, 1996, 346 were recorded without a price. There seems to be some confusion about why so many RTCs seem to be trading for no price. Three main factors explain the occurrence of many no-price trades. The first reason is the recording procedure for brokered trades described above. When a facility trades some RTCs to a broker no price is recorded. Similarly, if the broker gives the RTCs back to a firm when no buyer is found, that appears as a no-price trade. These no price trades involving brokers do not represent facilities actually giving away RTCs to brokers or brokers giving RTCs to facilities. Of the 346 no-price transactions, 118 are when RTCs are transferred to a broker’s account.²⁹ When brokers sell RTCs, they sometimes sell them for a price and they sometimes sell them for no-price. The no-price sales from the brokers most likely represent cases when no buyer was found and the broker returned the RTCs to the facility that originally intended to sell some of their RTCs. Thirty-six of the no-price transactions were cases when a broker “sold” RTCs for no price.

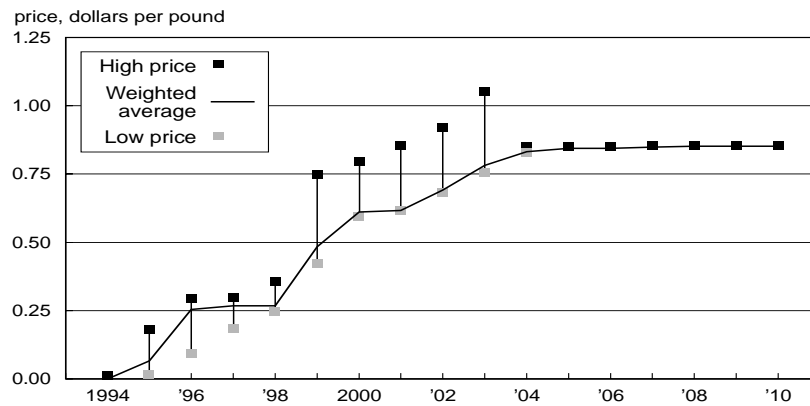
The second reason that there are many no price trades is that some of the transactions represent donations of RTCs to environmental groups and to others who do not intend to use the RTCs. For public relations or other reasons some RECLAIM facilities have given credits away for no price or a very low price to environmental groups and others who intend to retire them. The third reason that there have been so many no-price trades is that many of the trades have been intracompany trades where one company will transfer RTCs from one of its facilities to another. While there is no actual money changing hands when RTCs are traded within a company, this does not indicate that the RTCs have no value or that there is no cost savings associated with this transaction. Seventy-three of the no-price transactions were intracompany trades. As stated above, many

companies operate numerous facilities in the RECLAIM universe and have been actively conducting intracompany trading. In addition to these three main explanations for the no-price trades some no-price trades represent “dumping” of excess RTCs to non-RECLAIM facilities to avoid payment of fees for RTCs not used and some no-price trades represent changes of ownership.

c. Price Information

This section of the report will assess the price that RTCs have been selling for in the NOx RECLAIM market. There are a few different ways to obtain information on the price of RTCs traded. These include data on the auctions conducted by Cantor Fitzgerald and ACE, as well as the SCAQMD bulletin board information. Due to the reporting mechanism of priced trades with the SCAQMD, data from the auctions is likely to provide a better source of information on the true price of RTCs. Table 3 and Graph 3 indicate the price trends that have resulted from Cantor Fitzgerald’s first 4 auctions.

Graph 3
Clean Air Auction #1-4
Summary of Nox RTC Price Data



Source: Compiled by author from Cantor Fitzgerald Auction Announcement, January 11, 1996 and The Fourth Clean Air Auction, Press Release.

Table 3

**Summary of Previous Clean Air Auction NOx Price Information
after First 4 Auctions, February 1996**

Year ¹	RTCs Traded (lbs.)	Price Range (\$/RTC)		Weighted Average Price (weighted by volume traded) (\$/RTC)
		Low	High	
1994	3,318,311	\$0.0001	\$0.0010	\$0.000075
1995	354,023	\$0.0168	\$0.1670	\$0.0665
1996	76,573	\$0.0970	\$0.2870	\$0.2555
1997	62,000	\$0.1850	\$0.2880	\$0.2681
1998	228,680	\$0.2460	\$0.3500	\$0.2690
1999	702,709	\$0.4192	\$0.7400	\$0.4847
2000	957,526	\$0.5950	\$0.7900	\$0.6116
2001	738,656	\$0.6150	\$0.8500	\$0.6178
2002	643,345	\$0.6875	\$0.9150	\$0.6929
2003	530,033	\$0.7670	\$1.0450	\$0.7823
2004	392,293	\$0.8320	\$0.8450	\$0.8329
2005	392,393	\$0.8450	\$0.8450	\$0.8450
2006	392,393	\$0.8450	\$0.8450	\$0.8450
2007	392,393	\$0.8490	\$0.8530	\$0.8493
2008	392,393	\$0.8530	\$0.8530	\$0.8530
2009	392,393	\$0.8530	\$0.8530	\$0.8530
2010	392,293	\$0.8530	\$0.8530	\$0.8530
Total	9,298,873			

¹The RTC vintage year reported in Table 3 actually covers 18 months, it includes the Cycle I RTCs of that year and the Cycle II RTCs for the last six months of that year. For example 1995 includes Cycle I RTCs that run from January 1, 1995 to December 31, 1995 and Cycle II RTCs that run from July 1, 1995 to June 30, 1996.

Source: Compiled by Author from Cantor Fitzgerald Clean Air Auction Announcement, January 11, 1996 and The Fourth Clean Air Auction, Press Release.

One should note from Table 3 and Graph 3 that, while there is some range in the RTC prices, the weighted average RTC prices are increasing for each later vintage. The price for 1995 RTCs at the auction was only \$.0665 per lb of NOx and for RTCs that expire in 2010, the price per pound of NOx has increased more than five

times to \$.8530. This is what economic theory would expect because the number of RTCs allocated decreases each year. In the later years of the program RTCs are much more scarce; accordingly their price is expected to be higher than for the early years where many more RTCs are available. Table 3 also indicates that while a large number of 1994 RTCs were sold, they were sold at very low prices. This is because most of the 1994 RTCs sold were during the reconciliation period when had already expired. Also, one can see from Table 3 that the prices of RTCs are significantly lower than they were expected to be before RECLAIM began as reported in Section III of this paper.

2. How Many Trades Have There Been and How Many RECLAIM Facilities are Participating in the Market?

The annual report issued by SCAQMD states that as of November 2nd, there were over 400 RTC trades and that over 100,000 tons of pollutants have been traded in the NOx and SOx markets. It also claims that the total value of the NOx trades for that period was almost \$10 million. The report concludes, "an assessment of RTC trading activity shows that an active RTC market has developed."³⁰ This account of the trading in the annual report provides some information, however there is more to the story.

The first issue that needs to be examined is the absolute number of trades. The annual report indicates that a total of 439 transactions have occurred and that 381 transactions have occurred in the NOx market as of November 2nd, 1995.³¹ Some of these transactions were trades of only one vintage, while others were trades of bundles of RTCs of many vintages. As of February 26th 1996 the number of transactions has increased to 551 for NOx and SOx, and to 475 for only NOx RTC transactions.

While this high number of transactions may seem promising, it is misleading because of the double counting discussed above. While it appears that 475 NOx transaction overstates of the actual number of trades in the RECLAIM market, one can conclude that the RECLAIM market has been fairly active in the roughly year and a half since it began.

As described above, one of the clearest ways to assess the performance of RECLAIM is to look at the RECLAIM facilities to see if they are actively participating in the market. Each RECLAIM facility must participate in the program in that they must insure that they are holding enough RTC's to cover their annual emissions. The main innovation of RECLAIM is that it will save costs compared to command and control regulations used before RECLAIM. Under RECLAIM, facilities have the added option to compare their marginal cost of compliance with the cost of RTCs. While some of the resulting cost savings can come from reallocating emissions within a facility-wide bubble, most of it is

achieved by facilities shifting the costs of emissions controls with each other by trading RTCs. Because different facilities are likely to have different costs of reducing emissions, one would expect that if RECLAIM were successful, most firms would be either buying or selling RTCs. In fact, theory would suggest that if the market was working well the facilities who would not buy or sell RTCs would be those who had a marginal cost of emission control that was by coincidence exactly the same as the going market price of the RTCs.

In order to assess participation in RECLAIM, this section focuses on trades of Cycle 1 and Cycle 2 RTCs that expired in 1995. Since reconciliation trades of RTCs expiring in 1995 has been completed, this allows for a complete analysis of the trading behavior for two recent compliance periods where RTCs were actively traded. Table 4 summarizes the trading behavior of the RECLAIM facilities for RTCs that expired in 1995. Facilities are defined as 'No Activity' if they did neither buy nor sell 1995 RTCs. It needs to be pointed out that some of the 'No Activity' facilities in this table did participate in RECLAIM by trading vintages other than 1995 RTCs. Sellers are those facilities that sold 1995 RTCs and did not buy any 1995 RTCs. Correspondingly, Buyers are facilities that bought 1995 RTCs and did not sell any 1995 RTCs.³² Of the 351 RECLAIM facilities,³³ approximately 50% (178 facilities) did not trade 1995 RTCs in the market. Also, table 4 indicates that, 67 facilities (19.1% of all the RECLAIM facilities) were buyers and 73 facilities (20.8% of all the RECLAIM facilities) were sellers of 1995 RTCs. The remaining 33 facilities were those that did both buying and selling of 1995 RTCs.

One key feature of Table 4 is that 178 of the RECLAIM facilities have chosen not to participate in the RECLAIM market for 1995 RTCs. These presumably chose to just hold on to the RTCs they were allocated. Because banking is not allowed in RECLAIM, they presumably emitted NO_x up to the amount of RTCs they were holding. It is not clear why so many firms are not trading in the market but possible explanations will be discussed later in the paper. It is interesting to note that approximately the same number of RECLAIM facilities were buyers and sellers of RTCs that expire in 1995, however the quantity of RTCs sold by the sellers is almost three times as large as the number of RTCs bought by the buyers. It is also important to consider that 7 of the 11 facilities that have shut down since January of 1994 are included in Table 4 as either sellers or both buyers and sellers because they are still considered RECLAIM facilities. One additional notable point from Table 4 is that the 33 facilities who are both buyers and sellers of 1995 RTCs are really driving the market in that they are selling and buying most of the 1995 RTCs traded by RECLAIM facilities. In fact, those 33 facilities sold over 75% of the total 1995 RTCs sold by RECLAIM facilities and bought over 85% of the 1995 RTCs bought by RECLAIM facilities.³⁴

Table 4
Trading in RTCs that expired in 1995; All RECLAIM Facilities

	Number of Facilities	% of All Facilities	# of RTCs in lbs sold	# of RTCs in lbs bought
Sellers	73	20.8%	10,586,780	
Buyers	67	19.1%		3,634,693
Both Buyers and Sellers	33	9.4%	33,856,313 ¹	26,573,018 ¹
No Activity	178	50.7%	No RTCs bought or sold	No RTCs bought or sold
Total	351	100%	44,444,093²	30,207,711²

¹The quantity of RTCs bought and sold by the facilities who were both buyers and sellers are somewhat inflated. This is because these figures include some cases when RECLAIM facilities transferred RTCs to a broker and then the RTCs were transferred back to the facilities account after the broker could not find a buyer. This also includes a few cases when RECLAIM facilities traded RTCs with themselves in order to transfer RTCs from their certificate account to their allocation account. In an attempt to revise the total number of 1995 RTCs bought and sold by facilities, we selected all cases when a RECLAIM facility traded RTCs to a broker and then bought the same quantity of RTCs of the same vintage from the broker for no price. In addition, we selected the few cases when a RECLAIM facility traded RTCs with itself. We found that the quantities of RTCs bought and sold by the facilities who were both buyers and sellers are inflated by at least **832,451** lbs. The reason this does not adjust for all the inflation is because there were some cases when RECLAIM facilities sold RTCs to a broker and then the broker returned some RTCs to the facility, but in a smaller quantity than the amount originally sold to the broker, and these cases are not included in the inflation adjustment.

²The total bought and the total sold are not equal because this table only represents the amount of RTCs bought and sold by RECLAIM facilities and does not include RTCs that were bought or sold by any other parties. Also, the total bought and the total sold are inflated by at least 832,451 lbs as indicated above.

Source: Compiled by Author from SCAQMD RECLAIM Bulletin Board

Table 5 provides some additional information about which RECLAIM facilities are trading. It looks at the trading of facilities by broad industry categories. It distinguishes facilities in the four industries representing the major share of the initial RTC allocation. When RECLAIM began, these 4 industries groups (SIC 1300: oil and gas extraction, SIC 3200: stone, clay and glass, SIC 2900: petroleum and coal products, and SIC 4900: electricity, gas and sanitary services) emitted slightly over 84% of the total starting NOx emissions.³⁵ Around 32% (115 facilities) of the 351 facilities in the NOx market are in these four industries.

Table 5
RECLAIM Facility Trading Behavior for High Allocation Industries and Others; for RTCs that expired in 1995

	Facilities in 4 High Allocation Industries (% of Facilities in High Allocation Indus.)	Facilities not in 4 High Allocation Industries (% of Facilities not in High Allocation Indus.)	Facilities with unknown SIC code¹	All Facilities
Sellers	35 (30.4%)	24 (13.3%)	14 (25.5%)	73
Pounds of RTCs Sold	6,632,339	1,305,896	2,648,545	10,586,780
Buyers	13 (11.3%)	40 (22.1%)	14 (25.5%)	67
Pounds of RTCs Bought	2,043,526	840,037	751,130	3,634,693
Both Buyers and Sellers	24 (20.9%)	6 (3.3%)	3 (5.5%)	33
No Activity	43 (37.4%)	111 (61.3%)	25 (45.5%)	178
Total	115 (100%)	181 (100%)	55 (100%)	351

¹We were unable to obtain SIC codes for 55 of the NOx RECLAIM facilities. Our source of SIC information for RECLAIM facilities is the SCAQMD 1993 proposed rules, and many facilities were added since that report was published.

Source: Compiled by Author from SCAQMD RECLAIM Bulletin Board

This table indicates that the facilities in the 4 industries with high initial allocations of RTCs are behaving differently than the facilities that are not in the high allocation industries. First, facilities in the high allocation industries are more often sellers than buyers, while facilities not in the high allocation industries are more often buyers than sellers. Second, of the 33 facilities who were both buying and selling 1995 RTCs, 73% (24 facilities) are in the high allocation industries compared to the fact that only 32% of all facilities are in the high allocation industries. A third important fact that can be seen in Table 5 is that a significantly smaller proportion of the facilities in the high allocation industries (37.4%) did not participate in the market for 1995 RTCs compared to the facilities not in the high allocation industries (61.3%). Possible explanations for this type of trading behavior will be suggested later in the report.

3. Why are Facilities Participating in the Market; Theory and Evidence

The following section will attempt to understand the reasons various RECLAIM facilities have for participating or not participating in the RECLAIM market. This is a difficult question to answer because only the companies truly know their motivation for their trading strategy, however, there are some information sources we can use to help us understand something about firm behavior in the RECLAIM market. The SCAQMD has been collecting some limited information about the generation of RTCs sold and the use of the RTCs bought. Also, careful analysis of the trading behavior can reveal some information on the intentions of the firms involved. Furthermore, various pieces of anecdotal information are available to assist in understanding this aspect of the RECLAIM market.

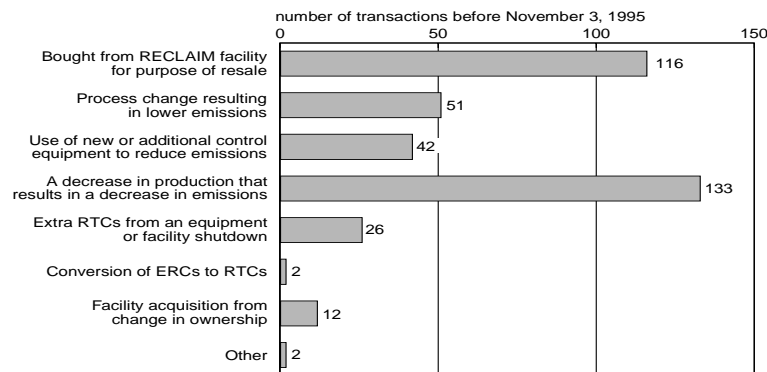
When RTCs are traded, the SCAQMD requires the traders to report how the RTCs are going to be used and how the RTCs were generated. While this information is helpful, it appears from the coding that the SCAQMD records this information to facilitate its monitoring and recording procedures, and not for evaluation of the market.³⁶ For purposes of clarity, we refined the coding system used by the SCAQMD by combining categories and by changing the titles of the categories. The Appendix explains how we altered the coding system. As discussed above, the annual report describes transactions from the beginning of the RECLAIM program, until November 3, 1995, and records a total of 381 NOx transactions.

Graph 4 lists the seven main ways that RECLAIM facilities, brokers, and other parties generate the RTCs that they sell. Graph 5 lists the five ways that RTCs are to be used when they are purchased.³⁷ Graphs 4 and 5 also indicate the number of transactions of the 381 before November 3, 1995, that can be attributed to each generation and use category listed above. These graphs do need to be interpreted with some caution however, because they continue the double counting trades

described above. Because of the recording procedure for brokered transactions, some of the transactions included in the two graphs are only one half an actual trade. Also the cases where a facility wanted to sell RTCs but could not find a buyer and the RTCs were returned to the prospective seller are included in the transaction data.

Graph 4 indicates where sellers get the RTCs they have sold. A total of 93 (24% of the transactions before November 3rd, 1995) of the transactions had sellers who generated RTCs from applying additional control equipment or changing their production process. Interestingly, in 133 (35%) of the transactions, the seller generated RTCs by reducing production levels of what ever it is that facility produces. This is noteworthy because for the most part economic theory suggests that facilities who sell credits are those firms who are able to reduce emissions by control equipment or process change; production levels are usually assumed to be fixed. It is unclear, however, if the RECLAIM program led these facilities decrease production or if the changes in output were a reaction to non-RECLAIM influences.

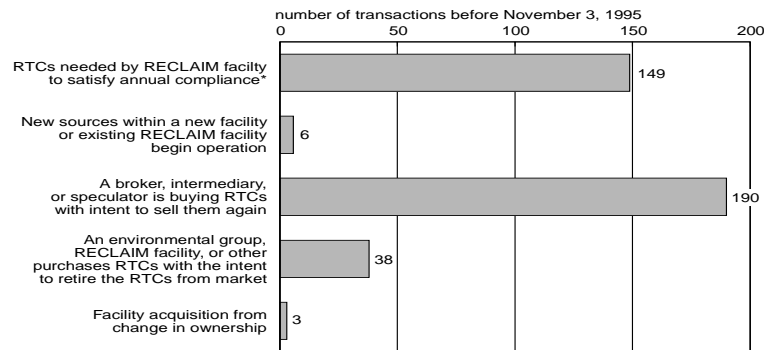
Graph 4
Generation of RTCs Sold



Source: Compiled by author from South Coast Air Quality Management District, "RECLAIM Annual Report, 1994-1995."

Graph 5 gives some information on why facilities are buying RTCs. Of note here is that there are not many (less than 2% of the transactions were used by new sources) new sources that need RTCs either within existing facilities or from new. Of all the transactions before November 3, 1995, 39% had buyers who wanted to use the RTCs to meet their annual compliance requirements. Also of interest is that in 38 of the transactions, around 10%, the buyer intended to retire the RTCs from the market.

Graph 5
Use of RTCs Purchased



*Probably because of production increase, process or equipment change, delay of installation of control equipment, or other reason.

Source: Compiled by author from South Coast Air Quality Management District, "RECLAIM Annual Report, 1994-1995."

One other way to get some more information about trading strategy is by observing the transaction information. As discussed above, some of the transactions are from shut-down facilities. This provision of the RECLAIM program has been controversial among environmental groups, since current RECLAIM rules do allow facilities that have shut down to sell their RTCs. According to the Annual Report, 11 RECLAIM facilities have ceased operation.³⁸ It is encouraging that only one of the 11 facilities claimed that RECLAIM was a contributing factor to the shut down. Of these 11 facilities, 9 have sold some or all of their RTCs in the market.³⁹ Of the 475 transactions in the NOx RECLAIM market that have occurred before February 26th, 1996, 17 were transactions

where one of these 9 shut down facilities was selling its RTCs. The reasons for this behavior seem fairly clear. Shut down facilities have RTCs that they obviously do not need and they are attempting to get as much financial return for these valuable assets.

Another interesting behavior that can be inferred from the trading data is that many firms are buying and selling credits to “balance their books”. Of the 475 transactions in the market some are bundled transactions where RTCs from more than one vintage are bought as packages. These multiple vintage transactions are assigned one registration number and two or more transaction numbers for each vintage of RTCs sold. Of the 475 transactions, only 149 (31% of the total transactions) represent multiple vintages sold together. The remaining 326 (69%) transactions are trades where only a single vintage is sold at one time. There is little significance about the fact that trading is occurring one vintage at a time. What is, however, extremely significant is that of the 326 single vintage sales, 258 transactions appear to be facilities that are increasing or decreasing their RTC account balance during the reconciliation period to satisfy annual compliance for the cycle that just finished. As indicated in Table 6, this means that 54% of all transactions in the NOx RECLAIM market to date are simply facilities balancing their books.

In considering these statistics about the transactions, it is important to remember that the total of 475 transactions includes some of the double counting discussed above that results from the peculiar recording requirements from the brokered trades. In fact many of the 258 trades that reconcile facilities balances were brokered trades from the Clean Air Auction. When a facility finds itself in during the reconciliation period short some RTCs, and it needs to cover its emissions from that compliance cycle it can choose to buy some RTCs to insure that it does not incur any penalty for non-compliance. The facility has a choice in that it may choose to buy expired RTCs from the cycle that just ended, or it could buy mid-cycle RTCs that expire something shy of 6 months from that point. Similarly, if after a cycle of RTCs has expired and a facility finds itself with a few extra RTCs, it would want to dump those RTCs to avoid a penalty⁴⁰ and to obtain any minor financial benefit if possible from the RTCs it does not need. During the reconciliation period, typically the price of RTCs that have expired is very low and the quantity of RTCs that is traded in each transaction is small.

Some anecdotal information about the behavior of firms in RECLAIM is also available. One interesting case shows the cost saving behavior that economic theory would suggest to take place in this type of emission trading scheme. In mid-1995 Union Oil Company of California bought 8.6 million NOx RTCs from Anchor Glass.⁴¹ Anchor Glass was selling its RTCs because it was one of the 11 facilities that shut down, and Union Oil claimed that it would use the RTCs over

the next 17 years instead of making costly upgrades to equipment such as heaters and burners. Another article indicates that utility companies have been able to sell significant numbers of RTCs that they don't need because many have installed new emission control equipment.⁴² Utilities contributed 75% of the NOx RTCs that were traded at the first Clean Air Auction.⁴³ An additional explanation for why utilities have been able to sell many of their allocated RTCs is that utilities have been increasing the share of electricity purchased from facilities outside of the South Coast District.

Table 6
Transaction Information on All Transactions before February 26, 1996

	Multiple Vintage Bundled Trades	Single Vintage Trades		Total
		RTC Account Balancing During Reconciliation Period ¹	Other Single Vintage Trade	
Number of Transactions	149	258	68	475
Percent of Total Transactions	31%	54%	14%	100%

¹Transactions defined as "RTC Account Balancing During Reconciliation Period" are transactions when the RTCs are being sold during the 60 day reconciliation period for a given compliance cycle, the RTCs being bought or sold are sold as a single vintage, and the vintage being traded is either for the compliance cycle that has just ended or the compliance cycle will end less than six months from that time.

Source: Compiled by Author from SCAQMD RECLAIM Bulletin Board

In addition, to the reasons described above, many environmental groups and other random individuals have purchased RTCs for the purpose of retiring them from the market. One notable example of this type of trading was when the Tides Foundation, a San Francisco based foundation with projects focusing on environmental and other issues, bought 2.9 million pounds of 1994 RTCs at the 3rd Clean Air Auction.

V. Conclusions

This final section summarizes the information described in this report and looks for possible explanations of the market behavior. It is too early to provide a thorough evaluation of RECLAIM, however this report provides a first glimpse on the actual trading behavior in this new market based regulatory system. More specifically, this report begins to shed some light on the firm's perspective on the RECLAIM market. The first important point is that there has not been very wide participation in the market. Many firms have not done anything, they have not bought or sold any RTCs. Also, of the facilities that have participated in the market, many have only traded tiny amounts of RTCs and most have only traded RTCs for the purpose of balancing their current RTC account. Few facilities have bought or sold RTCs for future years. This suggests that facilities are often unsure about their future and current emission levels and that facilities may be having trouble monitoring their emissions. The annual report describes how 46 facilities or 14% of all facilities have not complied with the rules of RECLAIM for the program's first year by emitting more RTCs than they had in their account.⁴⁴ The SCAQMD claims that the reasons for the high non-compliance were that the facilities did not understand how RECLAIM worked or they miscalculated their own emissions.⁴⁵ Considering all this, it seems that firms do not always know what their emissions will be and are unable in some cases to engage in the strategic cost sharing trading in the market that would be expected by economic theory.

Another conclusion that can be drawn from the observed market behavior to date is that the large amount of intracompany trading indicates that companies with multiple facilities in the South Coast district are benefiting from RECLAIM. An additional aspect to the story is that because the RTCs were allocated in such a way that the RTCs available in the first few years exceed actual emissions in 1994, many firms have more RTCs than they need. Also because of shut downs even more RTCs are available in the market. This could explain why the prices for early year RTCs are so low.

It is still a little too early to determine the success of the RECLAIM. There have been many transactions and it seems that the auctions have been able to facilitate low cost trading, however there are a number of problems with the RECLAIM program that cannot be overlooked. First is the significant non-compliance rate and emission monitoring problems. Facilities cannot actively participate in RECLAIM if they do not understand the program and do not even know their emissions. Another problem is that many firms are not participating in the market. It is unlikely that for all these firms the cost of emission reductions is exactly equal to the price of RTCs on the market. Because trading does not require prior approval and because the direct transactions costs associated with

brokered trades are fairly minor⁴⁶ it seems that high transactions costs are not the reason why a large number of facilities did not participate in the RECLAIM market. Margolis and Langdon have suggested that a number of start up problems specifically, uncertainty about certain elements of the RECLAIM market, such as conversion of ERCs to RTCs, clearing of titles to RTCs, and imposition of fees associated with using RTCs may have undermined the trading in the beginning of RECLAIM market.⁴⁷ Any additional obstacles that are keeping these facilities from participating in RECLAIM must be understood and overcome. Some of the possible reasons why there has not been stronger trading and participation in RECLAIM so far are listed in Table 7.

Table 7
Possible Explanations for Trading Behavior seen in RECLAIM Market

-
1. Firms don't understand/trust the program; Unclear rules and unforeseen program problems may have prevented firms from participating
 2. Non-Compliance procedures and penalties are unclear and are not precise and still evolving
 3. The baselines were set too high
 4. Shut down credits and credits from allocations that were set too high have flooded supply
 5. The benefits for participation are so minimal that emission decisions are not important; little to gain from participating
 6. Costly to monitor and predict future emissions, future production levels are uncertain.
 7. Production levels have been fairly stable; Facilities do not need to increase their emissions
 8. Many firms with multi-state facilities are able to shift production outside of SCAQMD and can sell excess credits.
-

VI. Avenues for Future Research for Evaluating the RECLAIM Program

The RECLAIM program is still evolving and environmental economists will watch the market to see how it evolves. Activity will likely pick up as RTCs become more scarce and as facilities run out of inexpensive options to cut emissions. This paper provides some preliminary assessments of the market performance; in this section we propose a few research avenues to gain a more comprehensive understanding of the performance of this new incentive-based

regulatory system.

A critical measure of success for RECLAIM will be the program's ability to generate measurable cost savings over a command and control regulatory system. This paper suggests that there already have been some significant cost savings for the facilities that have traded RTCs in the RECLAIM market and for facilities that shifted emission allocations within their facility-wide bubble. Before RECLAIM began, macroeconomic forecasting estimated that RECLAIM would save around \$58 million annually. It would be useful for research to use trading activity and RTC price data to determine the actual cost savings from RECLAIM compared to command and control regulations. Unfortunately, because a significant quantity of the trading is no-price intrafacility trading and because internal trades within facility bubbles are not recorded as transactions, it is difficult to assess all of the cost savings from the RECLAIM program based on recorded trades. Also, limited data about firm-specific abatement costs functions and technology limits our ability to assess the true cost savings. Still, developing a method for quantifying the cost savings through trading would be worth pursuing. One possible method for accomplishing this would be to estimate a marginal cost curve for compliance under command and control regulation that accounts for the costs associated with adding defined new technology and contrasting this with the marginal cost of control that is revealed through a subset of RECLAIM trades where price and volume information is available.

In addition to the static cost savings from trading described above, tradable permit systems are also designed to promote dynamic innovations in control technology. Another avenue of research could assess to what degree RECLAIM has fostered dynamic innovation within firms in the program. This can take two forms. First, RECLAIM might be technology forcing in terms of creating new, cheaper emissions control technologies. Firms may choose to purchase these technologies in an effort to over control emissions levels and sell excess credits. Similarly, in an effort to generate excess credits firms may choose to replace certain types of production equipment ahead of schedule in an effort to produce credits. This could create an incentive to accelerate the replacement of outdated capital equipment with more efficient capital equipment. Second, RECLAIM may encourage firms to innovate in terms of what type of product is produced at a specific location. In addition to producing a specific product in a more emissions friendly manner, companies can modify what the final product is they produce at a specific site. This can encourage a firm to develop a new "green" product that is more environmentally friendly to produce and to use. Examining the notion of RECLAIM as a potential spur to dynamic innovation could further illustrate the potential benefits from trading.

A third avenue for future research would involve modeling firm behavior in the RECLAIM market. In order to properly account for potential trading under RECLAIM within a given firm, three factors must be considered. First,

production levels need to be controlled for. This is important because firms can generate RECLAIM credits by simply lowering output. This method of compliance would not be the preferred option for policy makers that are interested in the short-term growth of the local economy. Second, a careful analysis of firm behavior needs to account for the range of differing marginal abatement cost curves among firms both within and across industries. Identifying these cost curves can help provide important evidence as to the success of this type of regulatory approach. Third, substitution within product lines must be controlled for. If the emissions target is met simply by shifting the NOx emitting production outside of the regulated area, the method by which attainment is met may not be what was originally attended.

Emission trading is a powerful regulatory tool and hopefully this and future research, like we have described above, will help policy makers to refine and improve upon our understanding of this tool.

Footnotes

¹For more information on the market based environmental regulations in general see Tietenberg 1990, Turner, Pearce, and Bateman 1993, and others.

²Wallace Oates, 1990 pg. 6-7, discusses that the three main reasons that tradable permits have been used instead of a fee or tax scheme are 1. "Regulators have direct control over the quantity of pollution emitted", 2. "Permits offer a way around some of the political opposition that has blocked the introduction of fees", and 3. Regulators are familiar with the permitting approach and are more comfortable with a system that allows trading, than a scheme of taxes or fees.

³SCAQMD 1995.

⁴Ibid.

⁵Similar proposals are under consideration in Massachusetts, Oklahoma, Illinois, Wisconsin, Texas, Ontario, and British Columbia (see Carlson and Sholtz 1994, p.15).

⁶SCAQMD 1996, pg. 1.

⁷Carlson and Sholtz, 1994.

⁸That could easily lead to 30 or 40 permits per facility.

⁹However, permitted stationary sources account for only 17 percent of the inventory of NO_x emissions in the Basin. The largest category contributing to NO_x emissions are mobile and off-road mobile sources (Carlson and Sholtz 1994, p.17).

¹⁰Klier and Mattoon 1995.

¹¹Ibid.

¹²Aside from these 390 identified facilities, other sources may chose to "opt-in" to RECLAIM and in doing so convert existing Emissions Reduction Credits (ERCs) to RECLAIM Trading Credits (RTCs). ERCs were created as a part of the New Source Review offset program. In addition to firms that might join the RECLAIM market because of a perceived economic opportunity, mobile sources may become a significant future source of RTCs, particularly for firms with large vehicle fleets that may wish to adopt cleaner technology for their vehicles in order to expand their supply of RECLAIM credits. Initially, credits for mobile sources will be available for firms participating in vehicle scrappage programs.

¹³SCAQMD 1996.

¹⁴Hahn and Hester (1989) point out the importance of a proper emissions baseline. "If the baseline involves a large amount of permitted emissions that are not actually produced (at a particular point in time), then the potential for an adverse environmental impact is significant; if the baseline reflects a realistic assessment of actual emissions, then the potential for environmental harm is slight." (p. 151)

¹⁵SCAQMD 1996.

¹⁶Ibid.

¹⁷Carlson, et al, 1993.

¹⁸Within the command and control framework, permits were issued with reference to a technology standard. They were based on potential emissions to be expected from that particular piece of equipment; however, the regulators often did not know what the actual emissions were.

¹⁹Ganguli, Anupom, Senior Manager SCAQMD; presentation at 2nd Regional Emissions Trading Conference, January 27-28 1994, Chicago II.

²⁰Business Wire 1993.

²¹Cone 1993.

²²Miller 1994.

²³This data is difficult to work with also due to the manner in which the bulletin board is designed. The computer menus require the user to constantly switch back and forth from different sections of the database to get each piece of information. In addition, according to the SCAQMD staff, some of the tables and files available on the bulletin board contain errors. It is also difficult to get data from the SCAQMD staff quickly. We have spoken with a number of the staff at the SCAQMD and they have indicated that their staff and budget has been cut significantly in recent years and as a result it takes significant time to obtain data via a public information request.

²⁴Hahn and Hester 1989.

²⁵Telephone interview with Robin Langdon from Cantor Fitzgerald 1996, In placing an order with Cantor Fitzgerald to buy or sell RTCs in the CAA a facility would incur a fixed fee of \$150 and a variable fee of 3½% of the total purchase price or 35\$ a ton.

²⁶Ibid.

²⁷A representative from the Regulatory Flexibility Group, a coalition of businesses in the South Coast, recently (March 1996) claimed at the Workshop on Market Based Approaches to Environmental Policy in Chicago, that RECLAIM facilities have saved significant amounts of money from shifting emissions from sources within their facility-wide bubble.

²⁸Feuer et al, 1995.

²⁹Cantor Fitzgerald staff told us that the one case where they bought RTCs for a price was due to a recording error.

³⁰SCAQMD 1996.

³¹Ibid

³²It is possible that the buyers and sellers also traded future RTCs.

³³Because of the constant changing of the RECLAIM universe from changes of ownership, inclusions, exclusions, etc. at the time of this analysis only of 351 facilities were listed on the RECLAIM bulletin board system and not the 353 facilities indicated in the annual report.

³⁴These figures include the 832,451 adjustment described in the note to Table 4.

³⁵Klier and Mattoon, 1995. Since many facilities have had adjustments to their allocation of RTCs and because there have been some inclusions and exclusions in the RECLAIM universe, the emissions from facilities in these four industries may be somewhat different than 84% of the total starting emissions.

³⁶SCAQMD 1996, Use and Generation codes are listed on pg. 10 of "RECLAIM RTC Trading Summary Report". Also, according to SCAQMD staff who we spoke with, this information is not verified by the district and the codes are not available for all transactions.

³⁷Ibid, Because the codes are used for administrative purposes, it is somewhat unclear how we could convert the coding scheme to learn about trading behavior. Specifically, it appears from the transaction data that the codes for RTC use; "Issue a Certificate" and "Increase RTC Certificate Balance. Don't issue a physical cert." are when brokers, intermediaries, or speculators purchase RTCs with intent to resell them. Also the code "Increase Allocation to satisfy annual compliance" gives no information as to why the facility needs extra RTCs to satisfy annual compliance. The main reasons are most likely that they have changed production process, increased production, or delayed installing some control equipment.

³⁸SCAQMD 1996.

³⁹In section IV.C.2 we note that 7 of the shut down facilities are sellers or buyers of RTCs that expire in 1995. Two additional shut down facilities sold their RTCs, but they did not sell RTCs that expire in 1995.

⁴⁰The SCAQMD 1996, Annual Report states on page 25, that there are fees associated with holding RTCs that have expired.

⁴¹BNA State Environment Daily, 1995.

⁴²Daily Report for Executives 1994.

⁴³Ibid.

⁴⁴SCAQMD 1996.

⁴⁵Ibid.

⁴⁶See supra note 25.

⁴⁷Margolis and Langdon 1995.

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Appendix

Use and Generation Code System Conversion

Generation Codes

Generation Codes from Annual Report	Generation Codes used in this Paper
0. Not Applicable	a. Bought from RECLAIM facility for purpose of resale
1. Process Change	b. Process change resulting in lower emissions
2. Addition of Control Equipment	c. Use of new or additional control equipment to reduce emissions
3. Production Decrease	d. A decrease in production that results in a decrease of emissions
4. Equipment or Facility Shutdown	e. Extra RTCs from an equipment or facility shutdown
5. MSERC	f. Conversion of ERCs to RTCs
6. Facility Acquisition (Change of Ownership)	g. Facility acquisition from change in ownership
7. RTCs for Future Compliance Year	Other

Appendix (continued)

Use Codes

Use Codes from Annual Report	Use Codes used in this Paper
1. Increase Allocation to satisfy annual compliance	A. RTCs needed by RECLAIM facility to satisfy annual compliance, probably because of production increase, process or equipment change, delay of installation of control equipment, or other reason
2. Use under Rule 2005-New Source Review for RECLAIM	B. New sources within a new facility or an existing RECLAIM facility begins operation
3. Increase RTC certificate balance. Don't issue a physical cert.	C. A broker, intermediary, or speculator is buying RTCs with intent to sell them again
4. Issue a certificate	C. A broker, intermediary, or speculator is buying RTCs with intent to sell them again
5. Retire RTCs from market w/o issuance of certificate	D. An environmental group, RECLAIM facility, individual, or other purchases RTCs with the intent to retire the RTCs from the market
6. Retire RTCs from market w/issuance of physical certificate	D. An environmental group, RECLAIM facility, individual, or other purchases RTCs with the intent to retire the RTCs from the market
7. Facility Acquisition (Change of Ownership)	E. Facility acquisition from change in ownership