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Air quality management systems in urban regions: The case of the emission trading programme reclaim in Los Angeles and its transferability to Vienna

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Innovative regional environmental policy: an analysis of the RECLAIM-emission trading policy in Los Angeles ¹

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1. INTRODUCTION/ABSTRACT

The discussion of how to manage air-quality in a heavy-polluted area like Los Angeles (L.A.), California, in an era of shrinking public budgets and a trend towards deregulation has led to the introduction of a new environmental policy tool: A tradable emission permit approach (the so called RECLAIM-program) to reduce SO_x-and NO_x-emissions from stationary sources was introduced in 1994. This paper is an attempt to analyze and evaluate the first 3 years of the program, based on the official 3 year program audit (SCAQMD 1998) and on a written company survey and personal interviews with **experts** as well as **administrators** active in air quality management in Los Angeles (conducted by the authors between May 1996 and May 1998).²

¹ Part of this research was sponsored by the "Umweltanwaltschaft Wien" (the environmental "ombudsman" of the City of Vienna/Austria).

² The authors owe special thanks to T. Keating, UNC, without whose assistance the L.A. survey could not have been conducted successfully, as well as the patient interviewees on both sides of the Atlantic.

2. TRADABLE POLLUTION CREDITS - THE CASE OF RECLAIM IN CALIFORNIA

2.1 THE BASIC CONCEPTS UNDERPINNING A SYSTEM OF EMISSION TRADING³

The environmental economics literature describes this policy in its basic outlines as follows: The ecological target of environmental policy is the attainment of given standards of environmental quality. Such a standard of ambient quality is fixed by **a political decision**.⁴ Given this standard a compatible volume of total emissions has to be computed. The total volume of thus predetermined emissions per year defines the maximum number of pollution credits that can be used in a given year ("emission cap").

The polluters are allocated a share of these credits for a year according to a pre-determined key which entitles them to emit residuals at most equal to the acquired volume of pollution rights. If the maximum number of emissions is not attained the licensee is entitled to sell the surplus in a market of pollution rights, in the opposite case, additional credits must be purchased. Each polluter can thus choose the most cost-effective abatement strategy, the system thus provides an incentive to lower emissions in order to be able to sell superfluous credits in the market. On the macro level, total abatement costs, the sum of all individual expenses, tend to be minimal.

The system thus combines elements of **public decision making** (standards and institutional framework) and **private decentralized decisions** coordinated via a market of pollution rights. It hence makes use of the capability of markets to co-ordinate decisions, achieve efficient solutions in the long run (cost-effectiveness⁵), and set in motion innovation processes to lower costs of achieving better environmental quality. Compared to the classical "Command-and-Control" system prevalent in environmental policy so far there is a lack of very detailed regulation and its concomitant problems of control: the public only needs to set emission standards for the entire area in which the system is applied and monitor the emissions as compared to the credits (for more details see e.g. Tietenberg 1992, Kemper 1989, Michaelis 1996).

³ Also: Marketable credits, allowance trading, emission credits.

⁴ This political decision is the most important part of an emission trading program: It enables the society to set **ecologically necessary limits to our economy**.

⁵ A (perfect) market will lead to a cost-effective situation where the marginal costs of emission reduction will be same for each participating polluter.

2.2 THE SOUTH COAST AIR BASIN - SOME BASIC FACTS AND FIGURES

The region surrounding the City of Los Angeles, California, the so called South Coast Air Basin ("Basin") has had to combat its image as a "smog city" since a considerable period of time. It is the single worst air quality region in all US agglomerations. In other more technical terms, it is the number one non-attainment area in which the federal EPA quality standards are violated most, exceeding federal and national standards for ozone and particulate matters by far (NAAQS as specified in the Clean Air Act of 1970 and its amendments). Several factors characterize the specific situation of the South Coast Air Basin:

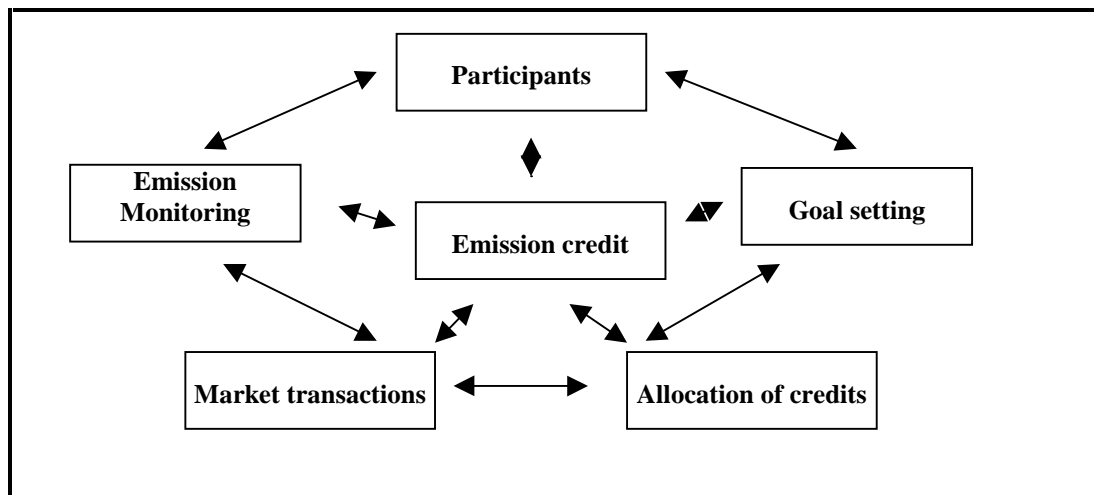
- **An unfavorable geographic situation:** The Los Angeles region constitutes a rather large plain open to the Pacific in the west and surrounded by a very high chain of mountains (the Santa Monica, San Gabriel, San Bernadino and San Jacinto mountains). This feature is responsible for the frequent temperature inversion situations during the summer, the area being exposed to high doses of UV-radiation and very low air turbulence. The mild climate and lack of wind during the winter season strongly reduce the diffusion of residuals.
- **Demographic and economic features:** The population in this region is 14 million inhabitants and approx. 9 million automobiles. In addition 35.000 enterprises produce one of the highest per capita GNPs in the world. The structure of the economy in this 12th largest agglomeration in the world is very diverse. The most important sectors are: apparel, biotechnology, the movie industry and tourism as well as machine construction, plastic industry, chemical industry, refineries and petro-chemical industry, as well as numerous large printing establishments. Till recently the economy was dominated by the aerospace and electronics industry which have shrunk dramatically since the drastic cuts in the US defense budget. Economic growth is expected to continue at an annual growth grate of about 2%, an increasing share of the regional product will accrue in the tertiary sector in the future, accompanied by a further decline of the secondary sector.
- **A very stringent environmental policy:** California as a whole and Los Angeles in particular have the strictest environmental regulation within the entire USA. This has led to an improvement in air quality, but the federal standards for ozone have not been attained since decades. Enterprises active in the Los Angeles area have to bear very high environmental compliance costs due to the stringent environmental policy: the average abatement cost for one US-ton NO_x emitted by power plants in Los Angeles were aprox. \$25.000 in 1990, as compared to the average costs of \$5.000 in the US.⁶
To combat some of the problems associated with the very strict environmental regulations the so called Emission Trading Policy (with the elements "bubble", "offset", "banking" and "netting") was introduced in 1977 to allow companies to trade so called Emission Reduction Credits . This "1. Generation concept" of an emission trading policy was the basis and starting point for the introduction of a "2.Generation concept" like RECLAIM.

⁶ The authority responsible for air quality management (SCAQMD) used to employ 30 persons staff whose main task it was to assess the state-of-the-art technology (BAT) and to determine the concomitant emission limits.

2.3 RECLAIM - REGIONAL CLEAN AIR INCENTIVE MARKET - AN OVERVIEW

The following chapter tries to give a brief overview of the concept of RECLAIM. To reach that aim, some rather technical or juridical details of the program have been omitted, even though some of them might be important for future more detailed analyses. An emission trading program has to address the following basic elements:

Figure 1: The basic elements of an emission trading program



Goal setting:

By the year 2003 the federal ambient air quality standards (NAAQS) for 7 air-borne residuals are to be attained in the entire US. In the state of California, the California Air Resource Board (CARB, a section of the California EPA) is responsible for the compliance with these standards. In areas which are not in compliance with these standards ('non-attainment area') for each group of polluters (mobile as well as stationary sources) a plan needs to be developed, specifying **how** the standards will be attained (State Implementation Plan - SIP). For the South Coast Air Basin a special management authority was created the **South Coast Air Quality Management District** (SCAQMD, only referred to as the **District** in the sequel) which is responsible for managing air quality in the Basin.⁷ The District is responsible for determining maximum annual emissions for all groups of polluters compatible with the federal standards and implement measures accordingly. Goals and measures are specified and updated in a so called Air Quality Management Plan - AQMP⁸. The AQMP of 1991 specified new, very tough emission standards to comply with federal standards till 2003. As industry and their representatives (e.g. the Regulatory Flexibility Group) heavily opposed these even tighter standards, alternative ways to reach the goal were considered.

⁷ The District is responsible for air pollution within the whole Basin. He is able to set standards for stationary sources (while standards for mobile sources are set up by CARB). The geographical borders of the Basin correspond to an "air shed", which means, that the District is responsible for various political counties (City of Los Angeles, Orange County, Riverside County and the non-desert part of San Bernardino County).

⁸ The AQMP defines reduction goals for the following groups of polluters: "off-road mobile", "mobile", "other stationary" and "RECLAIM". The original allocation of RECLAIM-credits was based on AQMP 1991. In 1994 and 1997 new AQMPs (with changed reduction goals) were issued.

After more than 3 years of discussion among the governmental agencies, industry and environmental group, such an alternative was found: For **all stationary sources of emissions** in the Basin emitting more than 4 US-tons SO_x and NO_x per year the **tradable emission credits program RECLAIM** (Regional Clean Air Incentive Market) was introduced. Initially the RECLAIM-universe consisted of 394 facilities.

RECLAIM constitutes a system of tradable pollution credits for NO_x and SO_x. These residuals were chosen for this specific program because of their special importance, NO_x particularly, as an ozone-generating substance, but also their comparatively easy measurability and monitoring characteristics were decisive.⁹

Allocation of credits:

At the macro-scale the total volume of credits was comparatively easy to compute (according to the NAAQS). Allocating shares to the participants in the program proved to be a lot more difficult¹⁰. Whereas the typical Command-and-Control approach regulates emission concentrations from each and every emission source, an emission trading program introduces one emission cap for a whole facility.

It was finally decided to use a "**modified grandfathering**" method based on historical emission volumes, issuing credits free of charge.¹¹ An allocation of credits was calculated for 3 years:

- **Determination of the initial allocation for the year 1994:** In order to ascertain a fair distribution of credits the basis of the first allocation were not the actual emissions by a company, but the historical fuel consumption (fossil fuels are inputs and NO_x and SO_x are outputs) were multiplied by an emission coefficient based on existing regulation (implemented till December 1993) and "Reasonable Available Control Technology - RACT" rules. Companies were allowed to choose their highest input years between 1989 and 1992. This procedure was to guarantee that polluters who have not introduced any abatement measures are not actually rewarded by receiving a higher initial allocation of credits ("fair initial allocation").¹²
- **Determination of the allocation for the year 2000:** Following the same principle a target for each stationary source in the program was computed for the year 2000: For each source a technologically feasible abatement volume was calculated (maximum input from the most recent

⁹ The basic aim of the AQMP is a reduction of ozone in the Basin. Therefore the aim originally was to reduce the precursors oxides of nitrogen (NO_x) and volatile organic compounds (VOC). Due to various reasons (critics of environmental groups, problems with measurement, etc.) the VOC-program was canceled. SO_x was chosen as a contributor to PM₁₀ (fine particulate matter). Most of the rules are identical for NO_x and SO_x markets. No inter-pollutant trade is possible.

All RECLAIM facilities together emit most of the stationary NO_x and SO_x emissions - but due to the very high emissions from mobile sources RECLAIM addresses **only 10% of all NO_x and 25% of SO_x emissions**.

¹⁰ The following description only gives the basic ideas of the allocation procedure. In practice, this allocation involved several rounds of computing, visits to companies, etc. Furthermore special features like "Non-tradable Emission Rights" or details on the conversion of already existing ERCs are not mentioned in the following.

¹¹ Two basic allocation mechanisms are discussed in theory (see e.g. Tietenberg 1992, Endres 1994): In an *auction* credits are sold to the highest bidder. Although this method has some clear advantages, it will hardly ever be realized in practice: it neglects historic emission rights of polluters. The second method is the so called *grandfathering*, distributing credits for free to all polluters according to a predetermined key based on historical emission data.

¹² As each polluter was allowed to chose the year with the highest annual production level (and therefore with the highest level of emissions) between 1989 and 1992 the grandfathering-scheme led to a significant overallocation.

6 years multiplied by more stringent emission coefficient) and a corresponding number of credits was allocated. It became obvious rather quickly, upon aggregation of the individual volume of credits that the computed sum significantly exceeded the maximum volume of emissions compatible with NAAQS. Therefore in a third step,

- **the final allocation for the year 2003** was determined by reducing each company allocation by 28% for NO_x and 35% for SO_x (for the remaining period after the year 2003 a constant total volume of credits was assumed¹³).

Connecting these 3 allocation years by a straight line, a hypothetical individual time path of abatement for each company was derived: The volume of credits theoretically available for each company is reduced each year by a certain percentage, computed in such a way that the target for 2003 will be attained. In the aggregate, the **total volume of SO_x credits will be reduced by 60%**, the volume of **NO_x credits by 75%**, resulting in the fact that some companies face very tough abatement requirements, others are exposed to much less of a challenge.

Each credit unit (the so called RECLAIM Trading Credit - RTC) is only valid for one year, and credits the emission of 1 US-pound of SO_x or NO_x respectively. Credits can not be banked. Each company received already in 1994 all the credits for all the years up to the year 2010 and is thus in a position to develop long run strategies. In order to avoid a rush of market transactions at the end of the accounting period, participating companies were randomly attributed to two cycles, the validity of credits of one cycle corresponds to one calendar year, while the other lasts from June 1 to May 31 of the following year; trades can take place between all participants, regardless of the cycle they are in.¹⁴

Market transactions:

A company that does not emit residuals up to the volume permitted, is entitled to trade the surplus in the market (via **brokers, auctions, or direct sales** to other RECLAIM-participants)¹⁵, in the reverse case additional emission credits must be purchased. This possibility opens up additional discretionary latitude and allows the choice of the most cost-effective abatement strategy. The financial rewards offered by the system for reducing emissions provides an additional incentive for further activities. The District does not have to pre-approve each single trade (as it was the case with the ERC-system), but registers each trade after the transaction is completed.

Traders in the sense of the RECLAIM-system are not only the participating companies, but every organization and/or individual choosing to participate. In principle trades are permitted within the total Basin without limitations. The Basin is, however, divided into 2 regions ("coastal" and "inland"; distinguished by sensitivity of the area) and trades between parties in the 2 different regions are restricted. The District is entitled to intervene if necessary and modifications of the regulation can be effected by the District whenever necessary.

Monitoring, record keeping, reporting:

¹³ RECLAIM was originally designed to cover the period 1994 to 2010. In 1996 the District prolonged the program to an unspecified time period (2010 onwards).

¹⁴ The establishment of 2 cycles not only enables companies to use credits of the respective other cycle as a sort of insurance, it also reduces the peak of trades at the end of one period and reduces the administrative burden for the District (as not all reports have to be submitted at the same time).

¹⁵ Due to the very good experiences with the private ERC-market, the District didn't try to impose any formal market structure but relied on the ability of the private market once again.

Monitoring turns out to be a crucial issue in an emissions trading program: A completely new approach to track and enforce emissions is necessary: Command-and-Control sets maximum emission concentrations for each emission source. It is comparatively easy for an inspector to determine compliance by randomly measuring emissions. RECLAIM introduces facility wide caps for a whole year – random inspections are pointless. Therefore "real" emissions have to be tracked, if possible automated and continuously.¹⁶ Within RECLAIM the precision of emission measurement required varies according to the total volume in question: **Large polluters** are obliged to measure emissions continuously and directly (so called CEMS-systems), on the other hand for **smaller polluters** it suffices to estimate the emissions by means of a formula in which the volume of input (fossil fuel) is multiplied by technologically determined emission coefficients. The measured or computed emissions are compared to the number of RTCs and are deducted from the total account for a given year by the District on a quarterly basis.¹⁷

At the end of the cycle (within a reconciliation period of 2 months), each company has to send a **report to the District** in which the total volume of emissions as well as their coverage by available credits have to be documented. This report is checked by the District for consistency and plausibility. In case the required emission data are missing, a special ("missing data"-) clause becomes effective: The District assumes a worst case scenario and computes the maximum volume of emissions in the period of the missing data.¹⁸ The company has to dispose over sufficient credits to cover these estimated emissions. In case the feasible volume of emissions covered by the credits is exceeded, severe **monetary fines** can be imposed and the amount of credits in excess of the available credits is deducted from the violators remaining credits for the next years.

¹⁶ Additionally, the incentive to cheat is much higher in an emission trading framework, as cheating corresponds with financial savings (i.e. not being required to buy credits) or financial gains (i.e. profits from selling "unneeded" credits).

¹⁷ The monitoring requirements place a heavy burden on the polluters. As of December 1996 86 facilities had installed a total of 431 Continuous Emission Monitoring System (CEMS). According to the interviewed companies, costs of installment per CEMS vary from \$50.000 to \$600.000, cost of operation lie between \$10.000 and \$150.000 per year.

¹⁸ This is true only for companies without any approved CEMS-system. In all other cases the missing data procedure applies emission estimates according to the period of missing data: The longer the period, the higher the estimates. Thus companies have an incentive to properly maintain their CEMS-system.

2.3 THE DEVELOPMENT OF RECLAIM FROM 1994 - 1997

Universe of sources:

The number of participating facilities/companies changed considerably during the first 3 years of the program: From 392 at the start of the program to currently 329 (see table 1):¹⁹

Table 1: Universe of Sources for RECLAIM Program (Lents 1998, p.6)

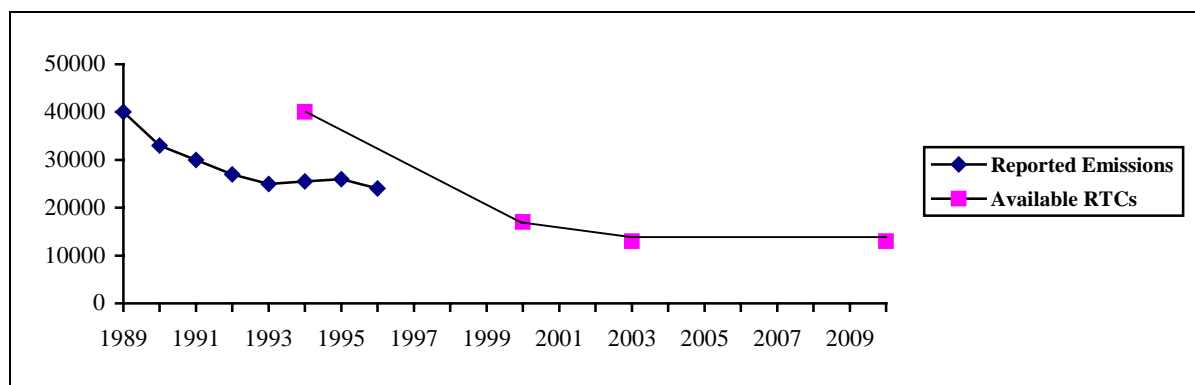
Sources	At Start	1994	1995	1996	Total
Added	---	14	2	0	16
Excluded	---	55	6	0	61
Shut Down	---	5	9	6	20
Net Participants	392	346	335	329	

Most of the companies excluded didn't apply for RECLAIM: their emission volume was not big enough. The number of shut downs has to be considered "normal". A little more attention should be paid to those companies added: **Only 4 of them opted in voluntarily** – obviously it is not very tempting for companies to opt for RECLAIM.

Overallocation:

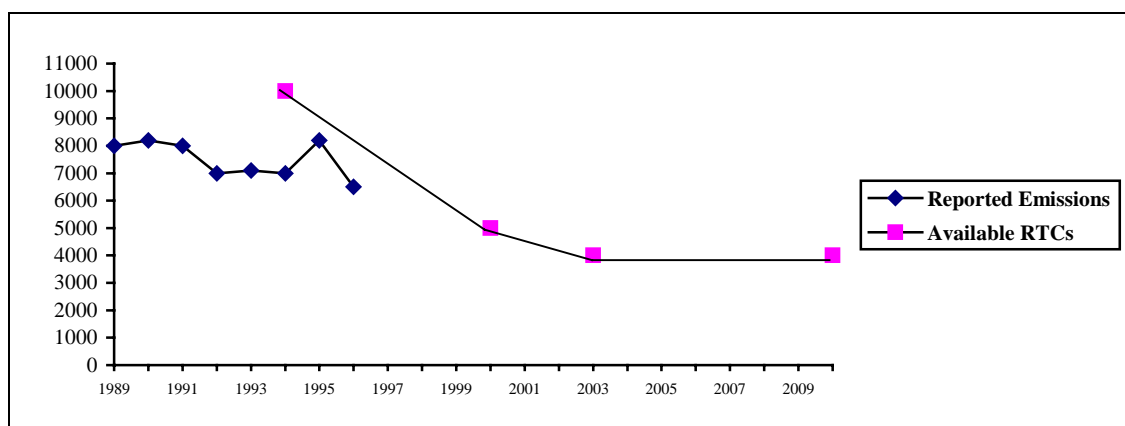
An obvious feature of the development of RECLAIM is the **significant overallocation of credits**. The following graph shows the history of emissions and credits from 1989 to the present time and the target period of the year 2010 - the overallocation with credits in both markets becomes obvious.

Figure 2: NO_x-Emissions (in US-Tons) and available RTCs (SCAQMD 1998)



¹⁹ All 329 facilities are within the NO_x-market, whereas only 40 facilities form the SO_x-universe.

Figure 3: SOx-Emissions (in US-Tons) and available RTCs (SCAQMD 1998)



At the end of 1997 a clear surplus of credits over emissions can be seen in the figures above in the NOx as well SOx area. At the beginning of the program it was anticipated, that the so called "cross-over" (the extrapolated 'emission line' crosses the 'allocation line') will be reached by 1996/97. This turned out to be too optimistic: The District now expects the overallocation to diminish in 1999 in the NOx-market and 2001 in the SOx-market.²⁰

The trade of credits

From the beginning of RECLAIM in 1994 to the end of 1997 a total volume of credits of more than **\$42 million** was traded ("RTC Traded with Price"). The majority of all these transactions can, however, be characterized as intra-facility transactions, transfers of credits from facilities to brokers, etc. involving no direct flows of money ("RTCs traded with \$0 Price"). At the end of 1996 the price of a ton of NOx was between \$154 and \$1.729, the interval for SOx lies between \$142 and \$2.117.²¹

Figure 4: Market volume 1994 - 1997

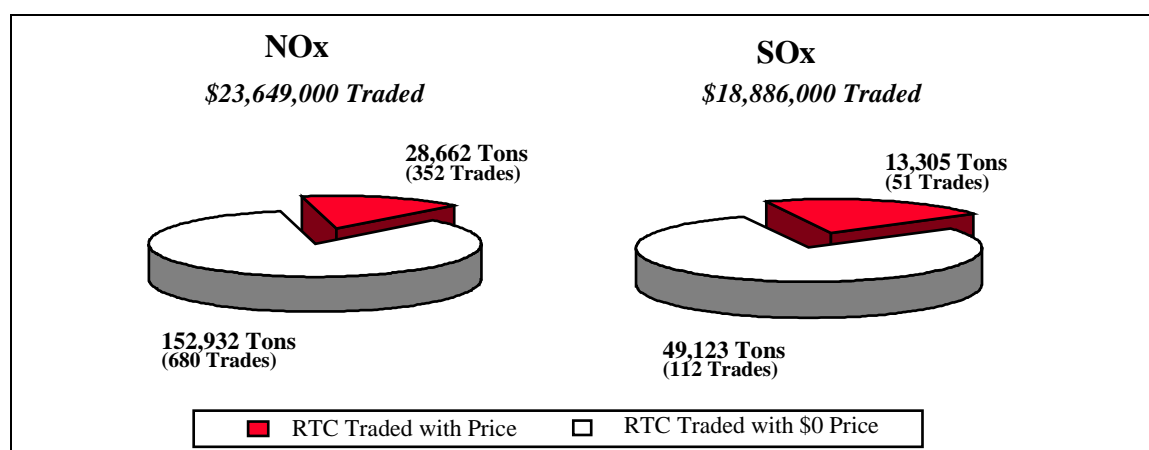


Figure 5: NOx-transactions with price and with \$0 price (SCAQMD 1998)

²⁰ As quite a few reports are still based on estimates (or "missing data" estimates) the reported emission volume still is substantially higher than the actual volume of residuals emitted.

²¹ These prices are far below the initially predicted prices (a model of the District predicted prices between \$577 and \$11.257 for NOx and SOx). In principle credits with a lower remaining duration of validity tend to be cheaper than RTCs for years to come. The reduction of credits available leads to price hikes due to the more pressing scarcity.

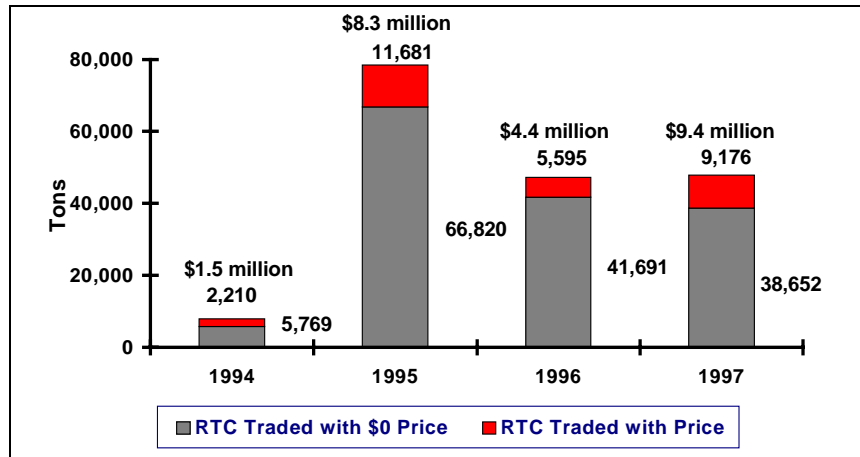
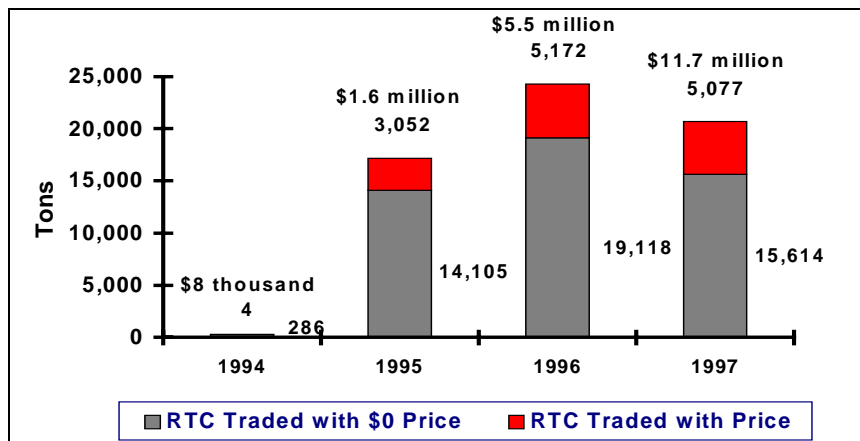


Figure 5: SOx-transactions with price and with \$0 price (SCAQMD 1998)



It is interesting to note that the much smaller SOx-market (in terms of participants and credits issued) resulted in only a fraction of the NOx trades involving almost the same amount of money - indicating that the SOx market involves more credit purchases for future years.

The first signs of demand pressure were becoming evident in 1997, accompanied by price increases. It is expected that the situation will become even tenser when the "cross-over point" has been reached (in the 1999 - 2001 timeframe).

Measures taken by companies:

The most prominent response indicated by the companies in the survey was the installation of **measuring and monitoring equipment** as well as **electronic reporting technologies**. The very low prices of credits obviously provided **no real incentive to further reduce emissions**, although some companies made use of these low prices and systematically acquired RTCs in order to be able to avoid future reductions in emissions. The interviews conducted showed that the majority of the companies expect a major restructuring in this process after 1998, the anticipated price rises of credits will provide incentives for investment in abatement technology.

Changes in regulation:

The experimental character of RECLAIM is clearly demonstrated by the number of changes in the regulations since the introduction of the program. The underlying "Regulation XX" has been amended 8 times till the end of 1997, these changes were mostly made to soften the rather rigid control and measurement rules. Additionally however, some basic changes became necessary: A fee which was collected by the District proportional to the credits retained above the actual emissions, designed to prevent the hoarding of credits, proved to be ineffective and had to be removed shortly after the beginning of RECLAIM: At the end of the cycle all credits not used up were immediately offered for sale in the market, thus leading to very strong price fluctuations at those points in time.²²

Alterations of the total emission targets and the volume of RTCs:

Particularly striking and seemingly counterproductive is the significant increase in the volume of total emissions permitted for stationary sources in the year 2003. The AQMP in 1991 conceded a maximum NOx emission volume of all RECLAIM-participants of a total of 26 tons per day (10 tons per day for SOx). In 1997 the AQMP increased this standard to 31,8 tons per day for NOx and 11,4 tons per day for SOx.²³ This change amounts to an increase of 20% for NOx and more than 10% for SOx! (The volume of RTCs was increased obviously by the same percentages).

Table 2: Adjusted NOx Allocations (Tons/Day) (Numerical Values) (SCAQMD 1998)

Year	1991 AQMP Target	Original Allocations*	1994 AQMP Target	1997 AQMP Target	Adjusted Allocations**	
					Without ERC Conversions	With ERC Conversions
1994	106	103	102.5	N/A	104.9	109.6
2000	35	35	37.5	43.4	38.8	43.6
2003	26	26	28.2	31.8	28.4	31.8

* Original allocations developed in 1993, did not include ERC conversions to RTCs at RECLAIM facilities.

** Includes adjustments to individual facility allocations, universe inclusions and exclusions, and results of Rule 2015 technology reviews.

²² RECLAIM participants are still obliged to pay an "emission fee" as this represents the basis for financing the District.

²³ The District justifies this increase in allowable emission with "new scientific insight": New data and better models lead to the new emission limits. The 1997 AQMP is heavily criticized – most members of the Scientific Advisory Committee opposed to it and left the Committee when it was introduced –and not yet approved by the EPA.

Table 3: Adjusted SO_x Allocations (Tons/Day) (Numerical Values) (SCAQMD 1998)

Year	1991 AQMP Target	Original Allocations*	1994 AQMP Target	1997 AQMP Target	Adjusted Allocations**	
					Without ERC Conversions	With ERC Conversions
1994	24	25	26.9	N/A	25.7	28.2
2000	14	14	14.5	16.3	13.8	16.3
2003	10	10	11.5	11.4	9.7	11.3

* Original allocations developed in 1993, did not include ERC conversions to RTCs at RECLAIM facilities.

** Includes adjustments to individual facility allocations and universe inclusions and exclusions. SO_x allocations were not affected by Rule 2015 technology reviews.

One reason for this increase is probably due to the complicated formula for setting the standard. Despite the fact that there is a clear overall target given in of the NAAQS there is some discretionary latitude as to the allocation of the emissions between **stationary** and **mobile sources**. The allocation of the shares was based on estimates of "**technological possibilities**" for reduction, these could of course differ between the 2 sources in question. (As an apropos, the technological feasibility assumption in the given formula led to some litigation by some companies claiming that the reduction rates used were in fact not technologically feasible - 5 companies received an increased allocation due to a technological review). A further reason for this increase can be identified by some trades between reductions made within the Emission Trading Program before the introduction of RECLAIM for which the companies received credits (ERCs) which could be converted to RTCs. Some companies made use of that possibility, thus leading to increases. Furthermore the possibility for each RECLAIM-participant exists **to trade stationary emissions** for emissions form the **mobile sector** (e.g. scrapping of old vehicles, car pooling) - so far only 5 trades of this kind have been carried out. It has to be critically noted that for mobile sources no emission cap has so far been determined. This fact can obviously lead to a situation where reductions for mobile sources are carried out, an internal trade vis á vis the stationary source emissions takes place, leading to increases in this emission source segment. Given that no overall cap for mobile sources exists, overall emissions in this sector can rise as well.

The program for Volatile Organic Compounds (VOC):

The most ardent problem of air pollution in the Los Angeles region, i.e. the ozone problem, led to the development of the RECLAIM environmental policy system. From the outset on it was clear that VOCs, as the other basic substances in the ozone cocktail, had to be reduced together with NO_x. After quite a bit of work and serious efforts to introduce a tradable permit system for this group of pollutants as well, no reforms away from the present Command-and-Control system were undertaken, yet. Reasons for this fact are partly technical problems of measurement (very small quantities at many small sources), as well as a perceived resistance against more "social experiments" before the SO_x and NO_x programs have not proven their worth. No step in the direction of an introduction of an analogous VOC system are anticipated for the near future.

3. STRENGTHS AND WEAKNESSES OF RECLAIM

To assess the strengths and weaknesses of the RECLAIM system a survey was conducted, based on partly written questionnaires, partly on interviews with experts, officials and representatives of companies participating in the program. The following issues were raised:

3.1 ENVIRONMENTAL ASPECTS

Ecologically motivated standards:

The most important argument in favor of an introduction of a tradable credits program is the introduction of a **quantitatively pinned down emission cap** for a given air shed. It is only this **limit set in absolute terms** which will safeguard against environmental deterioration in times of economic or population growth. Assuming that cheating is not possible, the standard set will not be violated (with the exception of possible short-run problems).

As already mentioned, it was precisely this argument which led to the introduction of the RECLAIM system. Despite all efforts made in Southern California by imposing the strictest regulation in all of the U.S., the ambient environmental quality standards set by the EPA could not be attained, growth processes routinely offset all the progress made on the individual level by introducing new abatement technologies.

There is one consideration, which does not speak in favor of any system working with absolute emission limits for a given area ("bubble systems"). The sources of emission can distribute themselves over space and time freely as long as the aggregate emissions do not increase. This possibility can lead to "clusters" of sources called "**hot spots**" (in space and time), which can run the range from local nuisances to serious health and localized ecological damage effects. Such hot spots are hence a serious political obstacle to the development and acceptance for environmental policy systems of this type, often seen as potentially violating equity principles – the topic of "**environmental justice**" is now heavily discussed in the US and in Los Angeles²⁴. Despite the fact that these drawbacks can be avoided by limiting trade between certain subregions or in particularly sensitive times of the year, this criticism remains indirectly valid, as the system becomes more complicated and rigid contrary to the intention of its inventors. In the RECLAIM case the whole region was subdivided into 2 zones as already mentioned, but trading restrictions are minor. The SCAQMD, however, if it sees the necessity to intervene to avoid hot spots, can do so without further notice.

Standard setting:

It was already argued above that the determination of the total volume of feasible emissions represents a key element in a successful environmental policy program. It is often assumed that natural sciences can define such emission caps, which need no further discussion. In practice this is, however, not often the case, as new research results frequently postulate new values of the standards. The clash of interests advocating lower (or higher) standards is not facilitating the tasks of political decision makers already worried about the basic scientific uncertainty about the

²⁴ The District is currently facing a law-suit led by Communities for a Better Environment, claiming that part of the Districts mobile source program violates "environmental justice".

"ecologically correct" emission values, which makes any suggestion vulnerable. In the case of the Southern California Air Basin a target given by the federal ambient environmental quality standards took a lot of heat out of the discussion (and not many advocates for stricter local standards, which the law allows in principle, were found). The allocation of permitted emissions (compatible with the quality standard) to different sources did lead to some controversies, which were resolved, not least by the possibility of internal trades between stationary and mobile sources, as sketched above.

The delineation of an air shed, in which by definition the lion's share of emissions are "produced" and "consumed", thus making any imported pollutants negligible in quantity, proved to be comparatively easy in the L.A. case, due to the geographic features of the region. Companies located in this region found it hence easier to agree to a system in which they had to bear the costs of their own emissions rather than bearing the burden of somebody else's .

This **agreement of the majority of the companies** in the region to introduce a system that presents them with more choice and flexibility on the one hand, but more responsibility on the other, is a very important strength of RECLAIM. Company executives realize that hard times will come soon, as the crossover-point is imminent and prices of RTCs will inexorably rise presenting new challenges and new costs to the enterprises. Protests are expected, but the cohesion of the L.A. business community is assumed to persist.

Changes in the volume of RTCs

The first four years of RECLAIM since its introduction clearly demonstrate the political **difficulties of maintaining the targeted total volume** of permitted emissions, definitely an Achilles tendon of the system and the prize to pay for the high flexibility and ease of adjustments in the standards possible. Between 1993 and 1997 several such changes were made to ascertain the consent of the companies supporting this air quality management scheme. Another weakness of RECLAIM is the already mentioned orientation of the standard to the technological possibilities in existence, this not only endangers the ecological motive and raison d'être of the policy approach but also deprives it of its incentive to create new technologies (ecologically oriented R&D) and innovation. In the RECLAIM case this drawback was partially mitigated by introducing the concept of "theoretical technological options" available in the future and basing the targets for the years 2000 and 2003 on these possibilities thus declaring the standards for those years as "technologically feasible" (as already mentioned, this concept is not universally accepted and law suits against it are already pending). The possibility to adjust standards during a transition period (in the RECLAIM case till 2003) rather easily must also be considered an advantage of such a system, this even more so as it forces the policy makers to make their plans transparent for a longer period, thus greatly facilitating corporate planning over longer time horizons by reducing uncertainty, which is crucial in such an innovation process.²⁵

²⁵ According to the District all changes in allocation so far were agreed on at the beginning of the program (technological reviews, changing ERCs to RTCs, etc.), and no further changes are planned in the future - it remains to be seen, whether this is true or not.

3.2 ADMINISTRATIVE ASPECTS

The public monitoring authority- SCAQMD ("District")

Creating a "bubble" over the entire L.A. agglomeration and assigning clear responsibilities to a regional authority is generally considered a major bonus of the RECLAIM system. This bubble enhances the identification of local business with its home turf, in which hard earned improvements in air quality can be savored by residents and the authority itself becomes an important member of an air quality management network in which the cooperative aspect becomes more dominating in the public view rather than the character of a public institution of control and punishment. This feeling is also enhanced by the fact that the participating companies fully finance the SCAQMD via fees computed on the basis of the volume of emissions, thus emphasizing the service function of this organization.

On the other hand this approach to financing the monitoring authority does not remain uncontested! The idea of having "to pay twice" (for the credits and the fees) are not palatable for all participants - thus new ideas are warranted. It is also claimed by some company representatives that the SCAQMD has not yet fully grown into its service role, particularly the information and knowledge diffusion role important for the long-run innovation process involved is allegedly not pursued proactively enough (this is of course generally more of a social need for smaller companies than for large entities being able to afford their own "think-tanks").

Audits to evaluate the program:

It is considered a particular strength of the RECLAIM system that the SCAQMD has to make and publish an **internal review** of the program annually. Every 3 years the system has to be audited by **external** consultants (the first such audit is due in 1998). This procedure opens up a possibility for all participants to air their complaints as well as to make suggestions for improvement and to be informed about the working of the program as a whole.

Reduction of red-tape and bureaucracy:

This objective was one of the primary movers and promoters of the RECLAIM approach. The participants interviewed were not unanimous in their evaluation of the system in this respect. It was generally agreed that the expected flexibility for companies to make their own decisions and not to be dependent on detailed individualized rules made by the authority (itself a very cost-intensive procedure), was more or less achieved with respect to NO_x and SO_x, but that all other areas of emission control were still subject to the Command-and-Control system, making **parallel organizational** provisions necessary to cope with the various requests. This proves to be very cost intensive, so that at present the net-effect is not strongly positive, partly also due to the transition effect of the system change for NO_x and SO_x and the obvious organizational investment costs accompanying such changes.

The brunt of the expenditures, company representatives claim, arises with respect to the cost of continuously measuring and reporting the actual volumes of emissions necessary in the new system. The costs of inspecting and periodically checking the proper functioning of the technical equipment and its compliance with the emission limits imposed, were considerably lower. The introduction phase of all these measuring and reporting technology was particularly expensive and accident prone, as some of the technology used was still rather in its infancy or had to be developed from

scratch. It is considered a disadvantage generally that a lot of R&D efforts and expenditures had to be made for measuring and reporting rather than on the development of new technologies to curb emissions. This transition cost effect seems to be particularly pronounced for the costs of running the District organization. The cost of development of the system and the political suasion work that had to be borne particularly in the introduction phase were considerably higher than the preceding Command-and-Control running costs. Some reductions in these administrative costs are expected by the SCAQMD experts interviewed, but it is not foreseen that these will eventually be lower than before the introduction of the program.

3 years into the program it becomes obvious that RECLAIM helped companies to save a lot of money (simply because the overallocation with RTCs made no real emission reductions necessary), whereas the administrative costs of implementing and running the program are much higher than anticipated.

3.3 CREDITS AND TRADING

Markets for credits:

When the new system was introduced, no recommendations were given by the authorities as to which institutions or communication possibilities would be preferable to make trades possible. It was left to the participants to find ways and means to organize these (among the options available now are auctions, bilateral transactions, etc.). Within a short time two major trading organizations developed spontaneously (an electronic auction program, ACE, and the brokers Cantor&Fitzgerald), by now these handle the lion's share of permit transactions. These trades seem to work smoothly and no major problems are foreseen in the future.

Market transactions of credits are seen as an advantage of RECLAIM, good use is made of a **well-functioning market system** for stocks and bonds, etc., making an important contribution to increasing efficiency and lowering the social cost of air quality management. The actual transaction costs are generally seen as marginal, while smaller companies complain about the costs of internal reorganization, by having to hire a specialist in charge of the transactions, who has to cooperate with other staff dealing with the technological side of pollution abatement and other persons dealing with the subject in the company. A new type of professional skill has become demanded opening up a niche in the L.A. labor market (a fact emphasized as a particular advantage by some interviewees).

Period of validity of the credits:

Credits expire after one year, which is accepted by most participants in the program, but some problems do typically arise. To hedge against unforeseen events (such as measuring and reporting equipment failure) a surplus of credits is usually held. They do, however, expire at the end of the year and cannot be transferred to the account of the following period. To prevent this hardship, the suggestion was made to create a short overlap between two consecutive RECLAIM years, during this period the surplus can be used either for the current year or be transferred to the next (therefore 2 cycles were introduced). The question was often raised whether it would not make the system more attractive to allow transfers of the RTCs held by a company to any of the following years ('banking'). The counter argument is the possibility of "temporal" hot spots if companies should follow such a strategy in a systematic way (e.g. anticipating growth with an expected upswing of a business cycle, etc.), so finally no banking was permitted.

3.4 COMPANIES AS ACTORS IN AND EVALUATORS OF THE PROGRAM

The most important items raised in the conducted surveys were:

Tradable permit and parallel command and control systems:

As already mentioned one of the most frequent criticisms raised by business executives is the existence of different systems, which is costly and presents major organizational challenges (e.g. different monitoring and reporting requirements, etc.). Another major drawback is seen in the fact that the old system for SO_x and NO_x control is technically speaking still valid. It decrees in particular that new production facilities emitting these residuals have to install the "best available control technology" (BACT). **thus reducing RECLAIM to a system to cope with old production facilities only**

Monitoring and measurement of emissions:

One of the prizes to be paid for the higher flexibility of the new system is the shift of responsibility and cost of measuring emissions, it is now up to the companies to cope with this requirement. Costs are further raised by the fact that measurement now has to be continuous and in the interest of the company has to be as precise as technologically feasible (otherwise the volume of RTCs to be held is higher than necessary and the District may apply the "worst scenario" rule, i.e. estimating the emissions). These **costs are seen by all companies in the survey to be too high and reforms seem mandatory** to overcome this weakness.²⁶ Certainly the fact that some of this measuring and reporting equipment had to be developed and improved is now a sunk investment increasing total expenditure, in the future these sunk costs will play less of a role (especially for late adapters of such a tradable credits system, for which a mature technology for measuring and reporting will be available).

Uncertainty about the future of RECLAIM:

Despite the fact that the program runs to 2010 and has a fair chance of being extended after this date, some participants are still worried about the **uncertainty** their long-run planning is fraught with. Particularly the possible changes in the program are a reason for concern. Should credits for future periods (after 2005) be purchased now under these circumstances? Should R&D activities be promoted to cope with bottlenecks expected for the years past the crossover-point?, Will the District give way to complaints raised by companies and increase the number of credits?, etc.

The numerous changes made in the short history of the program hint that there is a certain justification for the fears and doubts expressed. It must be mentioned, however, that no revolutionary amendments were made so far.

Flexibility and reduction of red-tape:

All interviewed participants agreed that these are the major achievements effected by the new approach. This is exemplified by the statement of a representative of a company with several production facilities in the area, who in the old system had to observe five different emission

²⁶ While in the beginning of the program the biggest problem turned out to be the actual emission monitoring via CEMS (the software to handle the measured data was not available), companies face now the problem of not being able to electronically transmit their data: at the end of 1996 only about two thirds of the big emitters reported their data properly, while only 20% (!) of the small emitters were able to comply with the electronic reporting requirements - an alarmingly low rate (see Lents 1998, p.8).

standards with each of its 13 stationary sources of emissions - now there is only one: the total volume of RTCs to be held by the company. Despite the fact that some criticisms as to the complexity of RECLAIM regulation and procedures were raised, the tenor was still positive, compared to the old system significant steps towards simplification were indeed taken.

Another positive example was given by a representative of another multi-plant company: Installing SCR-equipment as decreed under the old regime in an already existing facility made expenditures of \$20 million necessary, the new system allowing long-run planning and integrating the same equipment in a new facility already in the planning stage, resulted in costs of only \$2 million. It is generally agreed that the potentials for saving investment and running-costs are one of the real strengths of RECLAIM.

Equity:

A clear distinction was made between the introductory phase, particularly characterized by the "**modified grandfathering**" approach applied (see above, section 2), which was judged as equitable. The real crunch in this respect, however, is seen to occur in the later phases, when new businesses entering the L.A. area, emitting SO_x and NO_x in volumes to qualify them for participation in the program, have to purchase credits to be able to start production. The logical way out of this conundrum is either to auction off the first round of credits or to endow new firms with credits free of charge. The first suggestion presents a considerable political conflict potential, as companies are more likely to welcome the new system if at least part of their "old pollution rights" can be taken into the new regime free of charge. The second suggestion poses the problem of where to take the extra credits from if the emission cap is already fully utilized.

New market entries also may mean another drawback of this system. Especially in an oligopolistic market structure, hoarding credits may be a way to prevent new entries (particularly of competitors), as the companies cannot acquire sufficient credits to be able to start operations, in a more competitive situation this problem is less likely to arise.

Another issue raised were the difficulties of smaller firms to cope with the system and to make use of its potentials. Limited knowledge and capital resources are made responsible for this claim. Among other examples, one seems particularly worth considering, i.e. the financial weakness makes it very difficult for these companies to stock themselves with costly credits for several years, one of the applauded features allowing long-run considerations and planning.

The relation between the SCAQMD and the businesses participating in RECLAIM:

The cooperation between companies and the authorities is generally judged to work rather well. Both sides admit that they had to go through quite a learning process to be able to develop a new style of interaction initially, but that great progress was made.

Technological development :

As already briefly discussed above, quasi market solutions such as the tradable permit systems are seen as an excellent opportunity to develop R&D and innovation schemes from "below", the prices providing strong incentives to invest in such ventures (see e.g. Wallace 1995). This potential strength could, however, not be verified in the RECLAIM case. This is simply due to the fact that the overallocation still keeping permit prices low, has not yet provided the incentives hoped for. The first glimpses at a possibly new regime are becoming possible now that the crossover-point between emissions and RTCs is rapidly approaching. R&D institutions (private as well as university based) are starting a marketing drive for newly developed technologies allowing further cuts in emissions, the interest of the companies seems to be very limited still, but is expected to pick up steam in 1998, while at present most companies still rely on their ability to acquire credits in the market at still bearable prices.

There were some voices forecasting considerable problems after the crossover- point, as it is feared that the technological possibilities were already exhausted before RECLAIM ever started and that major breakthroughs would be necessary. Advocates of this claim expect, that the most likely strategies to be adopted by many companies will be relocation in another area altogether.

To summarize, the following key points were made in the overall evaluation of the program:

Despite the intensive theoretical discussion the concept of tradable pollution credits has hardly ever be implemented at this scale, this fact is also demonstrated by the statement, that RECLAIM even after 3 years running is still referred to as a "**major experiment**". It poses completely new questions and tasks to the involved authority as well as the participating companies. The program is usually seen as a success, but a large number of participants still is hesitant to pass a final judgment.

The whole program is influenced by one fact: In order to reach maximum consensus, the initial endowment of credits was consciously set at a very high level above actual emissions, *even 3 years after the introduction of the program, the actual emissions are still considerably below the aggregated volume of credits*. For the evaluation of RECLAIM the time after a hypothetical cross-over point will be of particular interest. It is from this point in time on that companies will be forced to seriously consider measures to avoid further emissions.

The main conclusions to be drawn from the interviews:

- RECLAIM opens up **new possibilities and chances** to introduce an efficient environmental policy approach.
- The system is, however, **not universally applicable** and for some policy areas Command-and-Control systems are still the only available alternative.
- Any kind of **euphoria should be avoided**, there are still some flaws, some of them being intrinsic to the system, others can be, at least partly, corrected.
- The criterion of economic efficiency, at the end of the day, is only secondary, the attainment of **environmental aims** counts (RECLAIM has no justification in itself, if emission targets cannot be met this way, amendments or even an abandonment of the system are warranted, just the same logic as with other systems, including Command-and-Control).
- An important quote at the end: "**RECLAIM created a market and an industry that was not there- everyone had to learn how to do it**".

4. SUMMARY AND CONCLUSIONS

The concept of tradable credits constitutes an **attractive system for air quality management**, in theory and in practice. This is true especially, if emission targets are ecologically feasible permitting some volume of residuals (even if very small) to occur. On the political side, the belief in a market system to steer allocation processes towards socially desirable aims is crucial. Even in traditional market economies this allocation system is not advocated universally when environmental problems are to be solved.

The RECLAIM example clearly demonstrates that **the tradable credits system can be implemented in practice**. It becomes clear, however, that deviations from the text-book specifications and pragmatic compromises are necessary and a more realistic view is necessary: tradable credits are no panacea – like any other policy instruments they have certain advantages and some very distinct disadvantages. Above all a new game has to be learned by all participants and modifications and amendments are a necessary part of "social experiments". It is very important to see, that RECLAIM relies heavily on already existing experience with the ERC-Emission Trading – the introduction of a similar concept in countries without any experience of that kind needs even more awareness of the advantages and disadvantages, possibilities and drawbacks of such a policy tool.

Concerning the transferability of the RECLAIM experience to other countries a few key points can be tentatively outlined:

- The permit system must be seen by a majority of stakeholders to be a reasonable alternative to the traditional environmental policy approaches - **early involvement** in the initiation process is vital!
- Introducing the system warrants a **long-run perspective** and the **definite political will** to seriously believe in its necessity in the future, as well as to realize that alternatives to a system based on emission caps cannot cope with the challenges of growth process in the economy.
- Even the **initiation phase** has to be carefully prepared! Research is needed to establish the obstacles to be expected - alternatives for details need to be considered and open concepts need to be available to start a public discussion.

This paper is meant to make a small contribution to open up the discussion.

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