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Schwarze, Reimund and Zapfel, Peter

Technical University of Berlin, European Commission

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Sulfur Allowance Trading and the Regional Clean Air Incentives Market: How Similar Are the Programs Really?

Reimund Schwarze[1] and Peter Zapfel[2]

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[1] Reimund Schwarze, Technical University of Berlin, Uhlandstrasse 4, D-10623 Berlin, Germany, R.Schwarze@ww.tu-berlin.de
[2] Peter Zapfel, Sternwartestrasse 12/34, A-1180 Vienna, Austria, Peter_Zapfel@alumni.ksg.harvard.edu

Zusammenfassung: Der Aufsatz untersucht im Detail die Designparameter der beiden bekanntesten amerikanischen Emissionszertifikatprogramme - dem U.S. EPA Sulfur Allowance Trading Program und dem Südkalifornischen Regional Clean Air Incentives Market (RECLAIM). Entgegen der ursprünglichen Erwartungen und der gängigen Literatur erweisen sich die betrachteten Programme in einigen wichtigen Designmerkmalen als diametral unterschiedlich. Ähnlichkeiten beschränken sich primär auf das Vorhandensein eines ambitionierten und mengenmäßig quantifizierten Umweltziels, scharfe Bestimmungen zur Emissionsüberwachung und hohe Strafen für Verstoß gegen die Bestimmungen, die Bedeutung eines kompetitiven Zertifikatmarktes, und die Notwendigkeit von Kompromissen in der Designphase zur Sicherstellung der politischen Akzeptanz.
Stichwörter: Umweltpolitik - Emissionszertifikate - RECLAIM - SAT - Politikdesign.

Abstract: This paper investigates in detail the design parameters of the two most prominent U.S. tradeable emission permit program - the U.S. EPA Sulfur Allowance Trading Program and the South Californian Regional Clean Air Incentives Market (RECLAIM). In contrast to expectations and the existing literature the two programs turn out to be rather different in several important design parameter choices. Common elements emerge primarily in the existence of an ambitious, quantified environmental target, stringent emission monitoring methods and high penalties for non-compliance, the importance of a competitive permit market, and some compromises necessary in order to gain political acceptability for the instrument and program.
Keywords: Environmental regulation - tradeable permits - policy design - Sulfur Allowance Trading - RECLAIM.

I. Introduction

The use of tradeable permits as an instrument in air quality and environmental policy has gained increasing attention in the environmental economic literature in recent years (Atkinson, 1994; Foster and Hahn, 1994; Tietenberg, 1992; Hahn and Hester, 1989). In particular since the inception of two comprehensive programs in the United States in the early nineties a broad body of literature has emerged discussing program design (Stavins, 1995; Cason, 1993; Hausker, 1992; Hahn and Noll, 1990) and performance (Ellerman et al., 1997; Kruger and Dean, 1997; Bohi and Burtraw, 1997; Bailey, 1996; Coggins and Swinton, 1996; Conrad and Kohn, 1996). This literature has been mainly concerned with the Sulfur Allowance Trading (SAT) program based on the US Clean Air Act Amendments of 1990 (Title IV). However, there is also a small but growing literature on the Southern Californian Regional Clean Air Incentives Market (RECLAIM) program (Harrison, 1998; Fromm and Hansjürgens, 1997; Johnson and Pekelney, 1996; Margolis, 1990).

What has been lacking in the literature so far is a thorough comparison of design parameters of the two programs. The primary objective of this paper is to close this gap and carry out such a detailed comparison. The analysis is aimed at identifying the common and distinguishing features of SAT and RECLAIM. For this purpose we introduce in part II a special scheme of design parameters for policy analysis of tradeable permits. Applying the scheme we find that SAT and RECLAIM are two rather distinctive programs. However, we also identify a set of common core design elements that may be interpreted as preliminary evidence of a general feature of applied tradeable permit programs. These elements may serve as a guideline for future design of tradeable permit programs in related air quality problems.[3] Concluding remarks in part III summarize general lessons learned from our design comparison as well as present major similarities and differences, and indicate the most important interdependencies among parameter choices.

II. Design Comparison of SAT and RECLAIM

[3] They can, however, not be extended to the emerging issue of international greenhouse gas trading (Schwarze, 1997). However, some lessons can be learned and may be transferable from Sulfur Allowance Trading to a potential allowance trading program for greenhouse gases on the domestic level (Swift, 1997).

In this part we compare SAT and RECLAIM pursuing two main objectives. Firstly, our analysis demonstrates that only a limited number out of the wealth of theoretically discussed design alternatives have been applied in practice. Secondly, it indicates common and distinguishing elements of these programs and points towards some general design features of applied tradeable permits.

Based upon a scheme used by the OECD (OECD, 1992) for the comparison of economic instruments in environmental policy we have developed an extended and refined version of design parameters adapted to the particular requirements of analyzing tradeable permit programs for air quality policy (see table 1).

Table 1: Scheme to compare tradeable permit programs

1. Purpose and framework
    a. Policy goals
    b. Political-economic framework
    c. Overlapping regulation
2. Field of operation
    a. Geographical scope
    b. Covered pollutants
    c. Affected sources
    d. Market structure
3. Mode of operation
    a. Initial allocation
    b. Special Reserves
    c. Baseline
    d. Trading rules
    e. Monitoring and enforcement
    f. Market initialization
4. Policy design
    a. Public participation
    b. Administrative requirements
    c. Implementation schedule

The following analysis will be pursued along the lines of this scheme.

1. Purpose and framework

The overarching *policy goals* of the two programs are of a rather different nature. While SAT (as the main part of the Acid Rain Program) aims to avoid and reduce natural damages from long-range transport of sulfur dioxide emissions, RECLAIM is part of a

program to bring the Los Angeles air-shed into compliance with ambient standards for ozone and particulate matter after several other policies failed to achieve this goal over two decades. Hence SAT deals with a new[4] and previously unregulated ecological problem, while RECLAIM aims at solving a clear-cut non-attainment problem by introducing a rigorous emission reduction scheme. This difference is reflected in the high attention that has been given to environmental issues (NAPAP[5]) in the political debate on acid rain legislation as compared to RECLAIM where primarily socio-economic impacts (growth and employment) have been discussed. It is also reflected in the ten year period of political debate on acid rain legislation in U.S. Congress, which compares to less than five years of debate on RECLAIM.[6]

Both programs however share one element, i.e. demanding environmental targets that would result in excessively high cost to the national or regional economy if not implemented in a least-cost fashion. Minimizing the cost for the achievement of politically agreed and quantified environmental targets has been the shared motive for both programs to find majority votes in the legislative authorities. Both applications also demonstrate the importance of what may be called the "target-instrument interdependency" of environmental policy. This is clearly visible in SAT: The ten year congressional blockade on acid rain legislation has been finally overcome in the late eighties by a compromise reached mainly between Republican presidential candidate, George Bush, and the Environmental Defense Fund (EDF). In the following all stakeholders agreed upon more stringent environmental goals at the price of accepting a market based policy.

Another shared element of both SAT and RECLAIM is the existence of distributional conflicts with regard to the primary allocation of permits. In the case of SAT it took the form of a political conflict between regional interests[7] with the Mid-West political representatives arguing for a grandfathering approach (i.e. permits distributed free of charge) and political actors in the West insisting on possibilities for further economic growth unhindered by a restrictive permit market and open access for new independent power producers (IPP's). In the case of RECLAIM distributional conflicts arose in the form of the classical "economic growth vs. environment protection" conflict, further intensified by the recession experienced in

[4] Long-range transport of acidic pollutants was low on the environmental agenda at the start of the political debate in the early eighties.

[5] The National Acid Precipitation Assessment Program (NAPAP) was a ten year effort (1980-1990) to study the causes and effects of acid deposition conducted by a team of researchers drawn from twelve federal agencies. It has been labeled "the largest assessment effort in environmental policy ever" at that time (Rubin, 1991).

[6] The first draft of the Californian Air Quality Management Plan (AQMP) was publicized in October 1989, whereas the enactment of RECLAIM has been in October 1993 and the start of implementation in January 1994.

[7] A widely popular saying in the political debate preceding SAT goes as follows: "Tell me where you stand on acid rain and I'll know where you live within fifty miles." (Ferrall, 1991).

California and other parts of the United States in the early nineties. As an outcome distributional considerations had a significant effect on design choices in both programs and led to the creation of various special reserves of allowances for SAT, or an overly generous calculation of the allowance baseline for RECLAIM (see above).

These necessary distributional concessions have had a negative impact on the volume of trading and economic efficiency of both programs: On the one hand, the preceding "political market" did reduce the need to trade in the actual permit market. On the other hand, it did allocate the permits according to political rather than economic needs. Given transaction cost of trading, this "political allocation" of permits could not be fully corrected by market forces.[8] In addition to a "target-instrument interdependency“ we find a "political acceptability vs. efficiency“ conflict in the two applied permit programs.

The two programs have not been introduced into a policy vacuum although long-range acid deposition was previously unregulated. *Overlapping regulation* exist both in areas of environmental and economic policy. In the realm of environmental policy, SAT is added on top of the national ambient air quality standard (NAAQS) for sulfur dioxide. This standard has served as a backstop provision to protect against dangerous local or seasonal concentration of pollutants that can not be fully controlled by an emissions trading policy.[9] SAT has also been affected by state legislation and - at least in practice - by technology-based new source performance standards (NSPS).

State legislation on acid rain preceded Title IV in the states of Wisconsin[10] Massachusetts, Minnesota, New York and New Hampshire, where emission reduction requirements have been stricter than in the early phase (1995 to 1999) of the nationwide SAT program. The same will hold true for RECLAIM electric utilities when they join the SAT program as of 2000.

Best available control technology requirements for new sources have been imposed as a general practice of environmental regulators, despite the fact that New Source Performance Standards (NSPS) for sulfur dioxide, especially the "percentage removal" provision (RNSPS[11]), have been formally repealed by SAT legislation.[12] This practice has generally

[8] A general proof of this result can be found in Stavins (1995).

[9] In a certain sense it is justified to call acid rain regulation not a market-based program but in effect it is a policy mix of market-based and command-and-control elements.

[10] In the case of Wisconsin each major utility has been required from 1993 on to emit on average no more than 1,2 lbs. SO_2/mmbtu, a requirement that comes into force only as of the year 2000 in the national SAT program (Wisconsin statute 144.388 (2)(b)).

[11] The 1978 revision of the NSPS (so-called RNSPS or NSPS-Subpart Da) imposes the need for new sources to use flue gas desulfurisation (scrubbers) with a minimum removal capacity of 90 %.

been justified by the regulators to protect against jointly produced other pollutants, e.g. particulate matter. In fact, there is a clear technical interdependency between sulfur dioxide and particulate emissions from exhaust gases. Thus, New Source Review (NSR) provisions effectively limit the demand of new sources for sulfur allowances.

Relevant areas of overlapping environmental legislation for RECLAIM are health based ozone and particulate matter standards and concentration targets.

Economic decisions of electric utilities (the sole industry affected by SAT and one among others in RECLAIM) are subject to regulation exercised by public utility commissions (PUC) both on the federal and state level. This encompasses supervision and approval of decisions in areas such as wholesale and retail pricing, power station construction, and fuel choice, which are strictly related to decisions on compliance with SAT. The influence of PUC regulation on SAT has been either direct by the mandated use of some compliance options, e.g. burning of local, high-sulfur coal or installation of appropriate scrubbers[13], or indirect by distortion of the incentive to trade allowances, e.g. by treating the capital cost of scrubber installation more favorable in terms of rate making than the operational cost of buying or holding allowances (Bohi and Burtraw, 1991). Indirect influence also stems from the implied uncertainty of regulatory ruling (Winebrake, Farrell and Bernstein, 1995) and increased expected transaction cost. Whether these and other influences have promoted or discouraged trading is still disputed in the literature (Bailey, 1996). However, PUC regulation has obviously played a significant role for SAT's performance, while it has hardly affected RECLAIM's universe of rather small and mixed industrial sources.

Following the electric utility restructuring movement of the late eighties there has also been a strong political and regulatory concern for emerging competition in the electricity industry. Unrestricted market entry for new so-called independent power producers[14] (IPP's) has been an important issue in the legislative process for SAT and had a significant effect on program design visible in the creation of a fixed price reserve of allowances for IPP's and annual auctions as described below. This impact has not been experienced to such an extent in RECLAIM.

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[12] As an official from Arizona's Public Service Company has put it: "It is unlikely that any new source will be permitted in the West with control levels lower than 90 %. This is primarily because of concerns for visibility protection and the existing regulatory programs for NSR, PSD, NSPS, and the EPA's "top down" policy for determining the best available control technology (Mathai, 1993).

[13] Four states with high-sulfur coal-mining industries have passed laws that mandate or offer preferential treatment (in cost recovery rules) for the use of scrubbers in regulatory decision making. However, these attempts have been struck down by federal courts in 1996.

[14] IPP's are a small but dynamically developing segment in the electricity industry after the enactment of PURPA. These are mainly small-scale power producers that do not own any transmission lines or distribution interests.

2. Field of operation

The *geographical scope* of the programs is determined by the addressed environmental problems. SAT is geared towards solving the problem of long-range acid deposition and has therefore been set up as a nationwide program covering 48 U.S. states (except Alaska and Hawaii). RECLAIM deals with a localized environmental problem and the scope is therefore limited to a comparatively small geographic area of about 13,350 square miles (the jurisdiction of the South Coast Air Quality Management District[15] - SCAQMD).

A major character of long-range transport of pollutants is the almost uniform mixing of emissions from different sources at different times. Thus SAT regulates a problem that can be approached as an emission problem.[16] As a consequence it could be treated satisfactorily with emission permits.[17] RECLAIM is concerned with ambient concentrations of pollutants, hence with a spatially and temporally sensitive environmental problem. These features did distinctively affect the design of the programs. While SAT is free of trading restrictions, RECLAIM trading is rather restricted in time by dated permits (no banking) and somewhat in space by means of the establishment of two trading zones.

SAT regulates and caps only one *pollutant*, i.e. sulfur dioxide, while RECLAIM comprises both sulfur and nitrogen oxides. Although RECLAIM deals with two pollutants the trading of one pollutant against the other - so-called „inter-pollutant trading“ - is not permitted.

Environmental regulators rarely succeed to control the total *universe* of a pollutant’s emissions with one program or instrument. This is also the case in SAT and RECLAIM. SAT covers about 70 % of US sulfur dioxide emissions at the start of the program. The corresponding figures for RECLAIM are much lower: 10 % for nitrogen oxides and 20 % for sulfur oxides. The huge gap between SAT and RECLAIM lies in the fact that most US sulfur emissions stem from large stationary sources while in the Los Angeles area most emissions are caused by smaller stationary and mobile sources as discussed below.

[15] SCAQMD is the regulatory agency responsible for the Los Angeles air-shed and the design and administration of RECLAIM.

[16] Geography does have an impact on acid deposition. However, based on economic analysis of who would make emissions reductions under permit trading it was possible to design a program without trading restrictions and still achieve emissions reductions in the ecologically desired regions, i.e. the Midwest (Kruger, 1997).

[17] Tradeable permits can also be designed for ambient environmental problems, however, they prove to be rather cumbersome and expensive to administrate in this setting (Tietenberg, 1995).

The overall reduction of the regulated universe teaches us a lesson about the applicability of tradeable permits. Both programs call for substantial reductions of about 50 % in the case of SAT as well as 75 % for nitrogen and 60 % for sulfur oxides in RECLAIM. The more ambitious the reduction target is chosen the more favorable seem to be the conditions for choosing tradeable permits as the policy instrument.

With regard to *affected sources* SAT and RECLAIM do differ substantially, too. SAT provisions affect mainly large stationary sources. Every electric power plant with a generating capacity of at least 25 MW will be in the program as of 2000. The smallest participant in 1995 had emissions of 63 tons of sulfur, the average participant had unregulated emissions of approx. 20.000 tons. The total cap of emissions amounts to 8,75 million tons per year, and the average annual reduction requirement for a utility is almost 9.000 tons.

The RECLAIM data are very different: The provisions cover a wide range of small, medium-sized, and a few large stationary sources. The minimum annual emissions value that triggers an automatic participation requirement amounts to four tons. The average participant had 96 tons of nitrogen oxides and 227 tons of sulfur oxides. The total caps will be 23.425 tons of nitrogen oxides and 6.435 tons of sulfur oxides per year in 2003. On an average the individual RECLAIM facility has to cut nitrogen by 72 tons and sulfur emissions by 139 tons.[18]

The *market structure* is different in one important respect. While SAT is a one industry program (electric utilities), RECLAIM is a multi-industry program with participating facilities operating in industries as diverse as ceramics, food, furniture, glass, and tiles. The number of market participants at the beginning of the programs were 263 in SAT as compared to 390 RECLAIM nitrogen and 41 sulfur emitting facilities.

The *competitiveness* of the two permit markets has been analyzed with concentration ratios (market share of largest participant, market share of five largest participants, and the Herfindahl-Hirshman Index[19] - HHI). SAT figures indicate a market share of 14,4 % for the largest participant and 46,1 % for the five largest facilities, the corresponding HHI is 0,058. In the nitrogen oxides segment of RECLAIM the largest participant has a share of 7,5 % and the

[18] RECLAIM facilities do have the choice to convert both Emission Reduction Credits (ERCs) earned in earlier attempts to clean up the Los Angeles air-shed and reductions constituted by scrapping old, highly polluting vehicles (as mobile source credits) into RECLAIM permits.

[19] The HHI presents the sum of the squared market shares of all participants in a market. An HHI of 1 is a monopoly-like market structure with one participant. The smaller the number, the less concentrated a market. An HHI of 0.25 indicates that the market is equivalent to a structure with four participants averaging a market share of 25 %. The HHI has been calculated on the basis of figures taken from the below discussed initial allocation of permits.

five-firm concentration ratio is 28,5 %, the HHI amounts to 0,028. These figures indicate that permit markets created in both programs are of a competitive nature.

Considering only the field of operation we find that tradeable permits can be applied over a wide range of initial conditions: small or large geographical scope, one or more pollutants, uniformly and (to a certain extent) non-uniformly mixed pollutants, small and large stationary sources, and single or multi-industry. The only general prerequisite for applied tradeable permit programs seems to be the existence of competitiveness in the created permit market.

3. Mode of operation

Fundamental design parameters for tradeable permit programs are the selection of the *initial allocation* method and the *baseline* choice. SAT and RECLAIM resemble each other in general but some important differences emerge from a closer look.

Both programs use the so-called grandfathering approach, i.e. historical emitters are allocated permits free of charge, for initial allocation of permits. The alternative allocation method, i.e. auctioning of the initial permit allocation, which is in general favored by economists was given up in order to gain acceptance by the affected industries.[20] Carrying this bias towards existing sources, both programs provide special access provisions for newcomers. SAT provisions encompass access for newcomers to a small pool of permits at a fixed price as a last resort and mandatory auctions of about three percent of the annual allocation. RECLAIM does offer similar options for newcomers. On an institutional base we find a special reserve for job creating, clean companies (the so-called „high employment / low emission“ reserve) and the non-mandatory, privately organized RECLAIM auctions are de facto also an opportunity for access to permits.

In terms of baseline choice both SAT and RECLAIM are of the same basic character. They are emissions-based[21] programs with an absolute[22] and historical baseline. One crucial

[20] Not even a combination of grandfathering and auctioning has been seriously considered in any of the programs. And auctioning of permits with revenue recycling to the bidders (the so-called „Zero-Revenue-Auction“ developed by Hahn and Noll, 1982) has not gained any practical importance either, although one may consider the EPA auction as described below as a test application of “Hahn/Noll” auctions.

[21] Alternatively, programs can be based on production input, ambient concentration, exposure or risk permits. Although both programs are emissions-based economic output of the regulated entities did play a role for the determination of the initial allocation. This feature to take economic output and not just absolute emissions into account prevent the undesirable effect of “rewarding the laggards”.

[22] In contrast, the relative baseline approach is applied in so-called credit-based programs with no initial allocation of permits but certification of emissions reductions on a project-base. The most prominent example of

difference emerges from a closer look. SAT uses average annual emissions standardized to economic output (by means of a standard emissions rate per unit of electricity generated) over a three-year historic period as the baseline, while RECLAIM allocations are based on the maximum annual emissions figure for each participant over a four-year historic period. RECLAIM's maximum emission method has been politically justified by reference to the economic recession prevalent in the baseline period (1989 to 1992). It has been argued that an average emission method would jeopardize actual economic output and future growth opportunities. The consequence of selecting maximum emissions over a historic baseline period of four years has been an over-allocation of permits in the initial years.

A peculiar feature of SAT's initial allocation procedure is the use of a set of special reserves of allowances. These so-called "bonus allowances" are granted for reasons as diverse as switching to renewable energy sources, use of advanced clean coal technologies, expected high production growth, early emission reduction efforts, and uncertainties in baseline inventories. These reserves have been very popular in phase I (1995 to 1999) as indicated by the following figure: In 1995 almost 20 % (or 1,6 million) of the 8,7 million allowances in circulation have been allocated as bonus allowances, most of them in the form of Phase I extension allowances for utilities that had made a prior commitment to install and operate some form of advanced emission reduction technology (U.S. EPA, 1996). Most of these special reserves must be judged as concessions to secure necessary political support for SAT. Their existence demonstrates the distributional flexibility inherent in tradeable permit programs (Tietenberg, 1991). However, they have had a negative impact on the volume of permit trading and the efficiency of these programs as explained above.

Two forms of "political trading" of permits surface in RECLAIM. Both of them are related with initial allocation and baseline choice. Firstly, as described above, the use of the annual maximum emissions figures for baseline choice and the resulting over-allocation have to be regarded as a „political price" to convince industry to accept the program. Secondly, companies with the peak of annual emissions in the two years prior or the year after the four-year historic baseline period, could even use one of these annual emissions figures in order to receive an additional allocation of non-tradeable permits in the years of 1994 to 1996.

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such a model is joint implementation as discussed and considered in the international climate negotiations and the U.N. Framework Convention on Climate Change of 1992.

Two set of *trading rules* merit special consideration - spatial[23] and inter-temporal[24]. SAT puts no restrictions on spatial trading flexibility, while RECLAIM rules define two trading zones with limitations in which directions permits may be bought and sold. SAT allows for banking, while RECLAIM does not provide for inter-temporal trading. The main reason for this fundamental difference is embedded in the nature of the environmental problem as explained above.

In fact, banking has played a major role in SAT. It has accounted for 35 to 40 % of the total allowances allocated in 1995 and 1996. Over the entire phase I an allowance bank of an estimated 25 to 30 % (i.e. 11 to 13 million tons) may be built up (Kruger and Dean, 1997).

Monitoring and enforcement provisions are crucial to guarantee compliance with any environmental regulation and to build up confidence in the value of permits among the regulated companies and other stakeholders (e.g. environmental groups). They have therefore earned a lot of attention in both programs.

Monitoring cost constitute a major share of fixed administrative cost for the regulatory authority and also of fixed compliance cost for the participating companies, thus one faces a trade-off between accuracy and cost of monitoring methods and technologies. In this respect SAT mandates the most accurate and expensive system, i.e. the installation and operation of continuous emissions monitoring systems (CEMS) for the whole universe of affected sources. RECLAIM mandates this technology for only about two thirds of participating facilities and allows for less accurate and costly technologies to be used by the remaining sources. This share of CEMS is nevertheless quite high in perspective of the size of the average RECLAIM facility (in terms of emissions per year) being only a fraction of a typical SAT utility.

Both programs apply sophisticated information technology for reporting and record-keeping of actual emissions and the tracking of permit ownership.

The enforcement provisions in both programs are strict but to a somewhat different degree. The emission of a ton of sulfur dioxide uncovered with a corresponding permit (sulfur allowance) triggers an automatically enforceable penalty (no lawsuit necessary) of $ 2,000 per ton (inflation adjusted). In RECLAIM, the SCAQMD has to initiate legal procedures against each single violator and financial penalties are less stringent. In addition, it is not known in advance whether financial sanctions will be imposed at all and if so, to what amount. These

[23] Spatial trading refers to the trading of emission permits and actual emissions shifts among sources and geographic areas in the same time period.

[24] Inter-temporal trading refers to trading of emissions permits and actual emissions shifts in time. The literature uses in general the term banking for saving of early emissions reductions (and unused permits) for later compliance periods.

differences render expected SAT sanctions higher than RECLAIM's. However, both programs are equivalently stringent in the sense that uncovered emissions have to be made up by an equivalent reduction in the next compliance period. Finally, the programs are identical in the progressive estimate of emissions for time periods during which CEMS are not operated.[25]

For the purpose of *market initialization* supplementary permit auctions have been used in both programs, however, the parameters of the auctions are different in several points. SAT auctions are held based upon a legal mandate in which EPA authorizes the Chicago Board of Trade to hold an allowance auction once a year in March. RECLAIM auctions are organized by the private sector (market intermediaries like Dames & Moore and Cantor Fitzgerald) on their own initiative and take place semiannually. In SAT auctions bidders can acquire current year and two vintages of forward allowances (six and seven year forwards) out of a special pool of allowances held back by EPA from the annual allocation. A share of 2.8 % of a utilities' annual allowance allocation are reserved for this purpose. Utilities are reimbursed on a proportional basis from the proceeds of the auction. Other sellers may offer allowances, too, but pool allowances are treated preferably in satisfying auction demand. RECLAIM auctions are purely dependent on the secondary market, i.e. offers submitted by RTC owners. Typically in a RECLAIM auction both current year and forward RTC's for several vintage years are traded. So while the quantities changing hands in SAT auctions are almost fixed according to a predetermined schedule[26], quantities exchanged in RECLAIM auctions vary according to actual market conditions. A further important difference is the applied auction type. While RECLAIM auctions are of a non-discriminatory style, i.e. all RTC's are traded at an identical market clearing price, SAT auctions are discriminatory, i.e. each successful bidder pays the bidding price with the highest bid matched to the lowest offer and so on.

Whether these auctions have succeeded in jump-starting the market has been doubted in the literature (Rico, 1993; Joskow et al., 1996; Stavins, 1997). Others (Ellerman et al., 1997) have pointed out that the earliest indication of the prevailing low prices came from SAT auction results in 1993.

A common feature of both auctions and the permit market in general is their openness to anyone (brokers, fuel suppliers, environmental organizations, foundations, individual people etc.). In fact, only 14% of the SAT allowances exchanged between March 1994 and March 1997 have been traded among electric utilities, whereas 86% have been exchanged

[25] The substitute values for EPA's Emission Tracking System (ETS) depend on predetermined formulae taking into account actual emissions before CEMS went offline and the length of the period of missing data.

between utilities and brokers, among brokers and with other private parties (Kruger and Dean, 1997). The 14% of direct utility to utility trade does even overstate the true percentage of direct trading because most these trades actually did involve brokers as intermediates who did not take title to the allowances (Kruger, 1997). Similar features of active market intermediation (by brokers) can be witnessed in RECLAIM. This has induced the development of credible and transparent permit markets.

In view of the mode of operation of SAT and RECLAIM we find that tradeable permit programs may be flexibly adjusted to distributional needs of all sort as well as to environmental concerns. The permit market need not be particularly initialized and it may be done in different ways. The only common operative features emerging are grandfathered allocation, special reserves, advanced and strict monitoring and enforcement provisions, as well as a market open to anyone.

4. Policy Design

The importance of *public participation in program design and implementation* has been disregarded by the literature so far. Both programs prove the involvement of representatives of various stakeholder groups in the design stage essential to assure political acceptability of a permit program. Misconceptions of the novel instrument can be overcome by involving many actors and educating them in the process of program development and implementation.

In SAT, the Acid Rain Advisory Committee (ARAC) participated intensively in the design of the regulation. The ARAC comprised representatives of the utility, coal and natural gas industries, environmental organizations, consumer groups, regulatory commissions, and the academia. RECLAIM was also developed with the assistance of advisory committees (e.g. the Regulatory Flexibility Group). Members of these committees represented public agencies, the business community (both individual companies and industry groups), trade unions, environmental organizations, and financial institutions.

Participation in the programs took the form of permit purchases at auctions. This has predominantly been pursued by environmental and student groups, some of them exclusively devoted themselves to the goal of "allowance retirement" (e.g., the National Healthy Air

[26] The number of permits sold in each auction varies from 150,000 to 250,000 in the years 1993 to1999, but is fixed at 200,000 in the years thereafter.

License Exchange - INHALE).[27] The acquired volume of these environmental market activists amounts to about $ 94,000 for a total of 934 allowances in the period of 1994 to 1997. This is of course minor compared to the total number of allowances and proceeds of the auctions ($ 121,5 million for approx. one million allowances) but it is large as a charitable expense and has important symbolic value. In view of this "retirement movement" some observers speak of an emerging "new way to democratize pollution control by empowering people to buy a better environment" (U.S. EPA, 1996), reviving the Coasian idea of organizing the receptor side of pollution rights markets (Howe and Lee, 1983). Taking a more pragmatic point of view, we conclude that this public involvement in the permit market has greatly increased the political acceptability of allowance trading and generally increased public awareness for clean air issues.

Similar activity of non-profit organizations and individuals has taken place in RECLAIM. The environmentally motivated purchase of RTC's reached a peak in the first year of RECLAIM operation. It amounted to 1925 tons of pollution (i.e., about 4 % of the annual allocation and even 98% of the auctioned volume) in 1994, which was however purchased at the very low price of $ 192,50 (Zapfel, 1996). At a closer look this quite remarkable success of „environmental market activism" does not look that impressive. The above explained over-allocation of RTC's in the initial years of program operation and the absence of banking possibilities implies that any RTC not used to cover emissions in the designated period of time is rendered valueless after the expiration date. The sale of a number of these worthless because excessive RTC's for $ 0.10 per piece thus only meant a „symbolic success" and an experience gained by environmental market activists.

Another important point are the *administrative requirements* necessary for operation the two programs. Obviously the programs have high up-front costs in terms of human resources, investment in information technology for data collection and processing, etc. These start-up costs are even higher if a change is made from traditional command-and-control to market-based regulation in a previously regulated problem. But once the program is running the administrative needs are actually quite low. In 1997 about 100 EPA employees in the Acid Rain Division and several state offices were administering the SAT program (Kruger,

[27] Allowance retirements have also occurred from charitable donations of utilities to concerned environmental or other non-profit organizations (e.g., the utility Niagara Mohawk Power has donated allowances for 10,000 tons of sulfur dioxide to the American Lung Association in 1994).

1997).[28] Similarly, about 30 to 100 people (but only seven full-time employees) work on RECLAIM in the SCAQMD (Zerlauth, 1998).

Finally, an important feature of the *implementation schedule* uniquely to SAT is the two-phased approach. In phase I (1995 to 1999) less than 15% (110 out of 700 utilities) are mandated to participate in the program. Only in phase II (as of 2000) almost all utilities are included.[29]

This schedule has been chosen for two political reasons: Firstly, to allow for preferable treatment of the Mid-West utilities who face the highest cost of compliance[30] (e.g. with 2 for 1 allowances for early reductions[31]), and secondly, to protect against hot spots by requiring reductions from the dirtiest utilities first. The second aim has proven to be illusionary since the law allows to substitute emissions reduction at affected phase I units with non-affected phase II units according to the so-called substitution rule (42 U.S.C. § 7651c(b)). This opportunity has been used to a large extent as reflected in the increase of the number of units from originally designated 263 to 445 units at the end of 1995, the difference made up of 175 "substitution units" and seven "compensating units".[32]

An initially overlooked problem of a two phase approach is highlighted by the concept of "compensating units". It is a general practice of utilities to buy and sell electricity from competitors and to dispatch their electricity production among its plants according to day-to-day operational needs. There have been widespread concerns that shifts in electricity production of this sort could create emission rights without real emission reductions, so-called „paper trades“. EPA has reacted to these concerns in two ways. Firstly, by forcing the outside units into the program as compensating units and**,** secondly, by deducting any allowances from phase I units to the extent that the combined emissions from the plants (Table I and the compensating unit) have increased.

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[28] The human resources need for the SAT is lower than 100 because the Acid Rain Program regulates also NOx emissions. The bulk of the Acid Rain Division’s staff - about 75 % - is allocated to emissions measurement (incl. NOx, CO_2 and opacity data). Only 5 people are required to operate the trading system (allowance tracking system, entering trades into the system, annual reconciliation of allowances and emissions).

[29] The Clean Air Act mandates every single plant with an annual capacity of 25 MW and above to participate in the program.

[30] According to ICF projections Mid-West utilities have the lowest *marginal* cost of sulfur abatement. Yet they are expected to bear more than 90% of the *total* cost of phase I emission reductions and almost 80% of the *total* cost of phase II due to their large total emission (ICF, 1989).

[31] According to the „two for one“-bonus program a phase I utility which reduces its emission below the phase II restrictions during the period 1997 to 1999 receives not only one allowance to sell for each ton of reduction below the phase I allocation but an additional allowance for each ton of reduction below the phase II limit (42 U.S.C. § 7651c (d)(6)). This provision was added to Title IV after Congress denied a proposed cost-sharing program for direct aid to Mid-West utilities (Ferrall, 1991).

[32] These 182 units account for 1,3 million tons (15,2 %) of the annual allowance allocation (U.S. EPA, 1996).

These fears seem to have been exaggerated. The seven compensating units participating in 1995 only account for 109.000 tons or 1,2 % of allowable emission (U.S. EPA, 1996) and "underutilization deductions" represented just 3426 tons or less than 0,4 % of the initial allocation in 1995. This small number of underutilization deductions may however be regarded as an outcome of EPA's strict rule against paper trades rather than a qualification of its necessity (Kruger, 1997).

As a general result from substitution and compensation the regional pattern of allowance distribution has to some extent departed from the predicted one (McLean, 1996; Nentjes and Klaassen, 1996; Rico, 1995).

Our discussion on design issues is summed up and visualized in the following table 2:

Table 2: Comparison of SAT and RECLAIM in review

	SAT	*RECLAIM*	
1. Purpose and Framework			
a. Policy Goals	acidification 50% reduction of acidifying substances	attainment of standards 70% reduction of ozone precursors	? ¦
b. Politico-economic Framework	high cost uncertain benefits	high cost pervasive non-attainment	¦ ?
	regional distributional conflicts	growth vs. environment conflict	?
c. Overlapping Regulation	ambient standards (NAAQS) and state limits on SO_2	NAAQS and state limits on PM10 and ozone	¦
	New Source Review (de facto)	NSR (de facto)	¦
	public utility regulation		?
2. Field of Operation			
a. Geographical Scope	national	regional	?
b. Covered Pollutants	sulfur dioxide, almost uniformly mixed	nitrogen and sulfur oxide, non-uniformly mixed	?
c. Affected Sources	large stationary	various stationary, partly mobile sources	?
d. Market Structure			
Affected industries	one	several	?
Competitiveness	HHI: 0,058	HHI: 0,028	¦
3: Mode of Operation			
a. Initial Allocation	grandfathering	grandfathering	¦
b. Special Reserves	diverse bonus allowance funds fixed price reserve for newcomers	one form of bonus permits special reserve for newcomers	¦ ¦
c. Baseline	average emissions over historic baseline period	maximum emissions over historic baseline period	?

3: Mode of Operation (ctd.)

d. Trading Rules

Inter-temporal trading	banking allowed	no banking	?
Spatial trading	unrestricted	two trading zones	?

e. Monitoring and Enforcement

Allowed monitoring method(s)	Continuous emissions monitoring (CEMS) all sources	CEMS (67 % of sources) others less strict	¦
Reporting requirements:			
Emissions	mandatory and electronic	mandatory and electronic non-CEMS less strict	¦
Permit transfers	non-mandatory	non-mandatory	¦
Record-keeping	annual emissions inventories	annual emissions inventories	¦
Financial Penalties:			
Amount	$ 2,000 per ton	up to $ 500 per violation	?
Validity	automatic	non-automatic	?
Emission estimates for non-monitored periods	double progressive and deduction in next period	double progressive and deduction in next period	¦

f. Market Initialization

Auctions	yes	yes	¦
Origin	legally mandated	voluntary and private	?
Schedule	annual	semi-annual	?
Volume	2,8% annually (fixed)	private offers (variable)	?
Type	discriminatory	non-discriminatory	?
Participation	open to anyone	open to anyone	¦

4. Policy Design

a. Public Participation

Stakeholder participation in design	very active	very active	¦
Participation of general public	detailed information on WWW and active trading	limited information on WWW and some trading	¦

b. Administrative Requirements

Staff requirements in regulatory agency	100 employees	30 to 100 employees	¦
Administrative cost	$ 12 million annually		
c. Implementation Schedule	two-phase approach	immediate full program	?

III. Concluding Lessons from Comparative Analysis

Looking at the full picture of our comparison in table 2 we find a rather mixed result of similarities (indicated by black dots) and differences (white dots). This stands in contrast to our initial expectations of a high degree of overlap between the programs.

SAT and RECLAIM differ entirely in the nature of the political problem (solution to acidification vs. attainment of NAAQS) and almost entirely in the field of operation (national vs. regional program, uniformly vs. non-uniformly mixed pollutants, large stationary sources operating in one single industry vs. various rather small sources in several industries). Accordingly, they are rather distinct in the mode of operation (regarding spatial and inter-temporal trading restrictions). Several peculiarities in SAT arise from the highly regulated target group (electric utilities). The only common condition in the field of operation seems to be a competitive permit market.

Both programs resemble each other strongly with respect to the weight that has been given towards securing political acceptability, and in the way this aim has been achieved. The design of SAT and RECLAIM reflect distributional and political concessions of various types - grandfathered allowances, special reserves for particular needs, a recession adjusted baseline etc. - necessary in order to gain acceptance by the affected industries. Some design choices indicate attention paid to the acceptance of the instrument by environmental organizations. In response to this concern markets are organized open and accessible to anyone, the responsible regulatory agencies undertook intensive public relation and information efforts and assured active participation of environmental organizations in the design phase. The advanced strict monitoring and enforcement in both programs may also be seen as a vehicle to increase confidence in the program among major stakeholders (industry and environmentalists).

A core overlapping element is a demanding and quantified environmental target combined with the expectation of high cost of compliance to reach the ambitious target. Minimizing abatement costs has been the shared philosophy in SAT and RECLAIM. Thus we identify from the comparative analysis a general „target-instrument interdependency“: Market-based instruments are more likely to be accepted and implemented if environmental targets are broadly agreed and expensive to achieve.

The programs also share a „dual approach“ and created a regulatory environment characterized by a policy mix of marked-based and command-and-control instruments. However, from the experience gained in the initial years of program implementation we learn

that the overlapping air quality standards (and other command-and-control regulation) have been rather ineffective except for influencing the behavior of new sources.

The primary interdependencies of design parameters we found are the following:
(1) trading rules adjusted to the particular character of the covered pollutants,
(2) and high administrative costs (primarily for industrial monitoring devices) coupled with a high-tech approach to monitoring and enforcement.

As a final observation we find that the initialization of the permit market in both programs has been accomplished with auctions, however, the particular design parameters of these auctions are rather different (voluntary vs. mandatory, discriminatory vs. non-discriminatory, etc.). From this feature we conclude that auctions are useful for initializing allowance markets but they need not be established by regulation and they may take diverse forms.

This general picture induces us to conclude that SAT and RECLAIM are two rather distinctive programs of tradeable permits with a few common crucial design elements. It is rather daring in view of the very small sample we observed to generalize from this comparison to any common feature of tradeable permits given also our mixed results. However, we would like to do so on a preliminary basis. The general feature that emerges is that tradeable permits are rather flexible as applied instruments of environmental policy. They are adjustable to ecological and political needs and may be fitted into differing pre-existing regulatory environments. There are only few observed interdependencies of design parameters. However, further analysis (e.g. in the field of VOC and NOx) is needed to confirm this result and the market development of both programs should be closely followed.

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