The Southern California RECLAIM Market: Outpacing The Possibilities
The Southern California RECLAIM Market: Outpacing The Possibilities

TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CONTENT</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUMMARY</td>
<td>1</td>
</tr>
<tr>
<td>PRICES, ALLOWANCES, AND EMISSIONS</td>
<td>2</td>
</tr>
<tr>
<td>SOURCES OF NOX AND COVERAGE OF THE RECLAIM PROGRAM</td>
<td>3</td>
</tr>
<tr>
<td>POWER GENERATION SINCE 1998</td>
<td>3</td>
</tr>
<tr>
<td>EMISSIONS TRENDS AMONG LARGE EMITTERS THROUGH 1998</td>
<td>5</td>
</tr>
<tr>
<td>LATEST PERFORMANCE INDICATORS FOR THE LARGE POWER GENERATORS</td>
<td>6</td>
</tr>
<tr>
<td>PROSPECTS FOR FURTHER REDUCTIONS IN EMISSIONS RATES</td>
<td>6</td>
</tr>
<tr>
<td>COSTS OF INSTALLING SCR TECHNOLOGY</td>
<td>7</td>
</tr>
<tr>
<td>RECLAIM PRICES, THE ELECTRICITY MARKET AND GAS SUPPLIES</td>
<td>9</td>
</tr>
</tbody>
</table>
The Southern California RECLAIM Market: Outpacing The Possibilities

SUMMARY

This year, prices of NOx allowances in the SCAQMD (South Coast Air Quality Management District) RECLAIM market soared to unprecedented levels, reaching a summer peak of over $90,000/ton. Currently there is limited trading. Indications are that current prices are still running nearly 20 times year-ago levels. This report examines what has happened to provoke this extreme escalation in prices and prospects for the future.

The RECLAIM program was begun in 1994 as an attempt to replace direct regulation of emissions from stationary sources with a market-based system of tradable allowances in which initially about 400 stationary source NOx emitters would participate. Total annual allocations were to be reduced year-by-year through 2003 as a means of promoting steady reductions in emissions over time. No banking of surplus allowances was provided. In its early years, emissions were consistently well below allowances and on a declining trend. Prices were roughly stable. But since 1998, the situation has changed drastically. In particular, the region has been forced to rely on substantial increases in locally generated electric power from fossil fuel to meet its needs after years of growing reliance on imports.

During compliance year 1999 (CY1999) which expired June 30, 2000, RTC credit supply exceeded demand by only 2% or 500 tons, a substantial narrowing from the prior year when supply exceeded demand by 16% or 4,000 tons. Although the fossil fuel plants in the region are already much cleaner than elsewhere in the country, the recent escalation in NOx prices means even more must be done, and at high cost. Nonetheless, the costs of reducing emissions further are well below the extraordinary peak prices for RTC credits prevailing this year. Figure 1 shows SCAQMD's own estimates of the possible reductions from installing hard controls (e.g., selective catalytic reduction) by market segment, and their cost in ascending order. The largest source of reduction, and among the most expensive, is utility boilers. SCAQMD estimates a potential reduction of nearly 4,000 tons/year at a cost of nearly $4,000/ton. As discussed in this report, this cost estimate is consistent with extension of SCR controls to units operating at well below base-load utilization rates. Baseload utility boilers are the ones most likely to have SCR already installed. The SCAQMD estimates offer no time-frame for installation of new SCR controls.

---

1 Facilities are generally subject to RECLAIM if they had NOx (or SOx) emissions of at least 4 tons in 1990 or any subsequent year. The number of facilities participating had fallen from its original total of 394 to 326 as of mid-1998.
The process of descending to price levels based on compliance costs will take time. For CY2000, credits allocations dropped by some 4,000 tons versus CY 1999. Based upon preliminary estimates, PIRA expects emissions from utility boilers to be up by some 1,500 tons, leaving a gap of 5,500 tons to fill through hard controls, conservation, production curtailments—or some form of political intervention. Despite announced plans to install hard controls in CY2000-01 by power generators, it does not seem likely that emissions cuts will be deep enough or occur soon enough to permit these markets to balance during CY2000. Unless the SCAQMD Board or Chief Prosecutor ease the penalties for non-compliance, or somehow add to the supply of near-term credits, RTC prices will likely remain at extreme levels through perhaps the end of Cycle 1 during CY2001 (i.e., December 2001). SCAQMD staff is currently preparing a number of policy options for the SCAQMD Board to consider at their January 2001 meeting. While the SCAQMD has resisted supplying new credits, we continue to believe that a settlement may be struck that trades relief from short-term violations for long-term over-compliance (CY2003 and beyond). Until that relief comes, the value of a RTC could approach the value of a short-term electricity curtailment whenever a unit in SCAQMD is on the margin of the western power market.

**PRICES, ALLOWANCES, AND EMISSIONS**

For the first few years of the RECLAIM program, NOx prices were roughly stable while emissions were comfortably below allowances. Trends in prices allowances and emissions are summarized in the chart on the right. The left panel shows prices based on Cantor-Fitzgerald estimates beginning in May 1996 for current year allowances in $/ton. Through the end of 1997, prices appeared relatively flat at just under $2,000/ton. Prices doubled between the end of 1997 and the end of 1998, remained at about the $4,000/ton level through 1999, but this year went through the roof, reaching a peak of over $90,000/ton at the end of August before falling back to a still extreme level of $74,000/ton at the end of October on limited trading volume.

As shown in the right panel, in the early years of the program, emissions from sources in the program were well below allowances although the gap has been narrowing. In 1998, emissions were 84% of allowances, up from 61% in 1994. In 1999, preliminary data indicate the gap had nearly vanished as emissions rose to 98% of allowances. Under the RECLAIM program, total allowances for this year are lower still by nearly 20%, or about 4,000 tons less than in 1999. While emissions data for this compliance year are not available, it's clear from price developments that there is no current margin of safety for the program. Moreover, allowances are scheduled to

---

2 Based on the Cantor-Fitzgerald current year RTC Market Price Index for the months published.
3 For a power generator with an emissions rate of 0.1 pounds of NOx/MMBTU of fuel input—about the average for gas units in SCAQMD without SCR—and a 33% power generation efficiency, a price of $100,000/ton translates into a cost of $5/MMBTU or $50/MWH.
The Southern California RECLAIM Market

December 2000

EMISSIONS MARKET INTELLIGENCE SERVICES

decline further in compliance years 2001-2003 at a rate of about 1,500 tons/year before stabilizing at about 12,400 tons, or 27% below the level for the current compliance year. Without some form of political intervention to increase the supply of credits, or to reduce penalties for emissions achieving market balance will involve extreme conservation measures and outright curtailments of production by emitting units. The next section considers the developments that led to the current situation and then future prospects.

SOURCES OF NOX AND COVERAGE OF THE RECLAIM PROGRAM

The RECLAIM program covers a relatively minor share of total NOx emissions in the California South Coast Air Basin. In large part this is because stationary sources, from which the RECLAIM universe is drawn, are far less important than for the US as a whole. The chart below summarizes the shares of total NOx emissions by major source for the South Coast Air Basin and the comparable figures for the nation.

In the Basin, over 60% of emissions come from on-road vehicles while all mobile sources account for 88% of the total. These figures are well above the national share of 32% for on-road sources and 54% for all mobile sources. Stationary sources, from which the RECLAIM universe is drawn, account for only about 9% of emissions in the Basin as opposed to nearly 40% nationally. The contribution from power generation appears particularly low, accounting for only 1.4% of total emissions as opposed to a national share of 25%. Refineries accounted for the largest single share of emissions (1.4% of the 7.2%) from the other stationary sources in the Basin.

POWER GENERATION SINCE 1998

While emissions from power generation account for only one-sixth of the 9% share of NOx emissions from all stationary sources, this sector is nonetheless primarily responsible for the recent sharp escalation in RECLAIM prices. In the early years of the program, the region was able to rely on power from hydro, geothermal and other renewable sources as well as imported electricity to satisfy demands. But recently, prolonged drought and rising demand has led to sharp increases in locally produced power from natural gas. The next chart shows the trends in gas-generated power in the Southern-California Nevada region from the beginning of 1998 through August of this

---

4 As is discussed, the need for relief does not necessarily require a permanent increase in allowances. But there is a need for relief to allow time for a new round of SCR technology to be installed. Allowances could be expanded in the near-term and reduced later when the new technology is in place and current stresses to the system eased.

5 The California South Coast Air Basin includes Orange County, most of Los Angeles County (including all of the coastal area) and adjacent, western sections of San Bernardino and Riverside Counties. The RECLAIM universe of emitters is within this area.

6 The national figure for power generation understates its true contribution since only emissions by electric utilities are included. Emissions from independent power generators are included in industrial emissions by the EPA and in the Other Stationary Sources category in the chart. The figures for the California South Coast Air Basin power generators include both utilities and nonutilities.
The focus is on gas since while coal and some oil is used in the region, within southern California, gas is virtually the exclusive fossil fuel used in power generation.

In 1998, power generation from gas was 36% below its level in 1994. But in 1999, gas-fired power generation was up 31% versus 1998. For the first 8 months of this year, power generation was up 85% versus the comparable months of 1999. The data for Southern California-Nevada encompass more facilities than are in the RECLAIM universe and as such do not give a precise measure of what has happened within the more limited group of facilities covered by the program. Larger generating units, those with at least 25 MW of capacity submit monthly fuel consumption and power generation data to the Federal Energy Regulatory Commission (FERC) and it is possible, using this data, to focus on recent developments for some of the specific facilities in the RECLAIM program.

The next chart shows FERC power generation data for 19 sample power generators identified as RECLAIM participants for January 1999 through August of this year. So far this year, fossil fuel power generation from the sample facilities in every month has exceeded comparable figures for 1999 with gains especially strong beginning in May. For the eight months as a whole, power generation is running 52% ahead of year-earlier levels.

For the January-August 2000 period, the total GWH of the sample group amounted to about 45% of the total gas-based GWH generated by the Southern California-Nevada group of the previous chart.

It is clear that fossil fuel power generation is up sharply since 1998 and, other things equal, this development alone would cause a significant increase in RECLAIM universe emissions. But another factor must be considered, namely, changes in emissions rates. Declining emissions rates by power generators and/or others would moderate, even conceivably offset, the effects of sharp increases in fossil fuel power generation. On the other hand, it is also possible that to produce the higher levels of electricity, units with higher emissions rates had to be brought online, or at least used more intensively, adding further to overall emissions. The next sections consider these issues.
EMISSIONS TRENDS AMONG LARGE EMITTERS THROUGH 1998

Emissions inventory data for individual facilities are available only through 1998 but they nevertheless offer some insights into emissions trends among the most significant emitters in the RECLAIM universe. The next chart focuses on emissions trends for 1990 through 1998 for 4 large refineries and 4 large power generation facilities that together accounted for 47% of total emissions from RECLAIM facilities in 1993, the year preceding the beginning of the program.

As shown in the left panel, the 4 refineries alone accounted for 31% of RECLAIM emissions in 1993 and 30% in 1998. The pattern over the years was irregular, with emissions in 1996 higher than in 1993 and then down significantly in 1998. Emissions in 1998 were down by about 1,600 tons or 20% versus 1993, or about in line with overall emissions trends in the RECLAIM universe. The 4 large power generation facilities show a much steeper decline in emissions, with the 1998 level 55% below 1993. The steep decline reduced their share of total RECLAIM emissions from 16% in 1993 to 8% in 1998. However, emissions in 1998 were up slightly, by about 90 tons or 5%, from their 1996 level, suggesting more or less a leveling off of emissions rates after dramatic declines in the first half of the decade.

These figures by themselves don’t indicate just how well these two groups of emitters are doing. One way of judging their performance is by comparison with others. The table below presents some comparisons that suggest they are both operating at far lower emissions rates than elsewhere in the country. Comparisons for refineries are difficult because operational aspects of individual refineries tend to be proprietary information. However, certain measures such as crude capacity are made public and can be used to produce an admittedly rough indicator of comparative emissions rates. The top half of the table shows emissions rates in terms of tons of NOX per year/thousand barrels a day of crude capacity for the 4 large SCAQMD refineries and for comparative purposes, the 4 largest refineries in Texas and all Texas refineries (as identified by SIC code). The 4 SCAQMD refineries had an average emissions rate by this measure of 8.5 tons/MB/D of crude capacity in 1998. This is far below the figure of 39 for the 4 largest refineries in Texas (according to 1997 Texas emissions inventory statistics) and less than half the figure of 19 for all Texas facilities with the refining SIC code. However imperfect, the measure indicates that the 4 SCAQMD refineries operate with substantially lower emissions rates than found in the country’s largest refining center.
The lower half of the table shows emissions rates for power generation in terms of pounds of NOx per MMBTU of heat input for 1999 as published by the U.S. Environmental Protection Agency. The 4 large SCAQMD generators had an average emissions rate of 0.05 pounds of NOx/MMBTU, about one-quarter the 0.21 pounds/MMBTU national average for all units reporting gas as their prime fuel.

LATEST PERFORMANCE INDICATORS FOR THE LARGE POWER GENERATORS

The latest available emissions data indicate that the large power producers continue to make progress in reducing their emissions rates but that the gains have been more than offset by higher levels of fuel use for power generation. The chart below compares 1st half 2000 fuel use and NOx emissions of the same four large SCAQMD power generating facilities with figures for the 1st half of 1999.7

As shown in the left panel, fuel inputs, measured in TBTU, were up by 53% in the 1st half of 2000 versus the 1st half of 1999, a result consistent with the trend in fossil fuel power generation for 1999 through August 2000 shown earlier. NOx emissions, shown in the middle panel, were up as well, by about 160 tons. But this amounts to an increase of 18%, far less proportionately than the 53% increase in fuel consumption. The average emissions rate for the four facilities, shown in the right panel fell from 0.059 pounds of NOx/MMBTU in the 1st half of 1999 to 0.045 in 2000, a reduction of 23%.

When all is said and done, emissions were up significantly at a time when the overall allocations of RECLAIM allowances were still declining.8 Without further substantial declines in emissions rates, or modifications to the RECLAIM program, ongoing high levels of fossil fuel use for power generation means continuing, severe, upward pressure on RECLAIM credit prices.

PROSPECTS FOR FURTHER REDUCTIONS IN EMISSIONS RATES

Although power generation emissions rates are extremely low compared to the rest of the country, this doesn’t mean there isn’t room for further reductions. Among the four sample facilities, not all generating units have installed Selective Catalytic Reduction (SCR) technology, generally considered the best available for the purpose. Those that have SCR have substantially lower emission rates than those that don’t. Presumably, installation of

---

7 From EPA preliminary quarterly CEMS (Continuous Emissions Monitoring System) data for the first two quarters of 1999 and 2000.
8 The Southern California Air Basin inventory data show estimated emissions from all power generators this year running at virtually the same level as in 1996. However, emissions from other Basin stationary sources were down by 9,000 tons—and RECLAIM allowances (between compliance years 1996 and 2000) were down 16,000 tons.
SCR on the other units could bring down emission rates to SCR unit levels. The table below summarizes emissions rates for SCR and non-SCR units as reported for 1999.

| 1999 NOx Emission Rates — 4 Large SCAQMD Power Plants From The 1999 EPA Scorecard |
|---------------------------------|-------------------------------|-----------------|-----------------|-----------------|
|                                 | Average Emissions Rate        | Tons Emitted    | % Of Fuel Inputs | % Emissions     |
| Units with SCR                  | 0.018 Lb/MMBTU                | 542             | 57%             | 21%             |
| Units without SCR               | 0.093                         | 2,084           | 43%             | 79%             |
| All Units                       | 0.051                         | 2,626           |                 |                 |
| Note: 1998 EPA Scorecard Results|                               |                 |
| All Units                       | 0.044                         | 1,786           |                 |                 |
| % Change in fossil fuel inputs (MMBTUs) 1998-1999 | +28% |

Units with SCR had an average emissions rate of 0.018 pounds of NOx/MMBTU, about 80% below the 0.093 rate for units operating without SCR. The difference about in line with expected removal rates for gas-fired units with SCR. The units with SCR accounted for 57% of the fossil fuel inputs to the 4 facilities and 21% of emissions from them. If units without SCR installed this technology and operated at the same performance level as those already with SCR, their 1999 emissions would be cut by nearly 1,700 tons, or to about 35% of their actual emissions for the year. The cut would amount to about 8% of all RECLAIM universe allowances issued for the current year.

The table also shows emission rates and emissions for all units of the 4 facilities in 1998. Emissions were much higher in 1999, in large part because fossil fuel inputs were up 28% versus 1998. However, the average emission rate was up as well—from 0.044 to 0.051. The higher emissions rate in 1999 is not surprising. Presumably, the much higher requirement for fossil fuel power meant that somewhat lower-performance units had to be brought on line, or used more extensively. But so far this year, the pattern is different. As indicated in the previous section, the average emissions rate in the 1st half of this year was 0.045, well below the 1st half 1999 average and about in line with 1998. Unlike 1999, so far this year the 4 facilities collectively appear able to run their units still more intensively and achieve improved emissions rates.

**COSTS OF INSTALLING SCR TECHNOLOGY**

While installing SCR technology in units currently without it would achieve substantial reductions in overall emissions, the economics of doing so depends on its costs relative to NOx allowance prices. Given the current extreme levels of these prices, it would appear economic to install SCR technology even on units with relatively low utilization rates.

---

9 EPA CEMS data record emissions from “stacks” not facilities where stacks are usually associated with individual boilers or turbines. There can also be multiple boilers associated with a given “stack” and an individual boiler can emit through more than one “stack.” The four facilities discussed here have a combined total of 21 individual CEMS reporting units.

10 The latest quarterly report from the EPA indicates no significant changes in emission control technology in place in the 4 facilities. The credit would appear due to improved operations of existing controls.
The chart below summarizes estimated costs of installing SCR on gas-fired power generation units for utilization rates ranging from 10% to 70% of capacity. Costs are presented in terms of $/ton of NOx removed, and cents/kWh.\(^1\)

The lowest cost estimates shown, about $2,000/ton of NOx removed, or 0.1 cents/kWh, are for a gas-fired unit with a 70% utilization rate, representing a year-round base-load operation. Because of such relatively low costs, base-load units would presumably have been the first, earliest candidates for SCR. Indeed, the cost of SCR for such units is about in line with RECLAIM NOx prices through the end of 1997.

In the current environment, the issue would be the extent to which SCR is or would be installed on units with lower utilization rates. As indicated in earlier charts, there are strong seasonal swings in gas-fired power generation in the region so that much of the capacity in the SCAQMD is used at well below base-load rates.\(^2\) At a 50% utilization rate, costs move up to about $2,700/ton of NOx removed and at a 20% utilization rate, $6,300—about in line with the RECLAIM price in March of this year. Of course recent NOx prices are well above even the $12,400/ton cost of SCR for a unit with a 10% utilization rate.

Even apart from the extraordinary price levels reached this past summer, incentives have been created to expand the installation of SCR technology well beyond base-load or near base-load units and thereby set the stage for future significant reductions in emissions, at least within the power sector. However, at the very least, this process is going to take some time. Demand for SCR technology is already very high thanks to orders from power generators in the Eastern part of the U.S. under pressure to meet current and pending ozone transport regulatory requirements. As a result there are substantial order backlogs, and also upward pressure on equipment prices.

At some point, the cost of installing SCR on low-utilization units should set a ceiling on credit prices well below recent extreme levels, however, the ceiling will be high by any historic standard. Ongoing high demand for electricity and limited prospects for immediate relief from sources outside the region will prolong the process of descending to the ceiling.

\(^1\) Levelized costs are calculated assuming a capital cost of $30/KW, a 15 year amortization and a 10% discount rate. Fixed operating and maintenance costs are assumed to be $0.87/KW per year and variable costs 0.1 mills/kWH. Costs are based on EPA estimates for oil and gas steam boilers and combined cycle units. An 80% NOx removal rate for SCR and a heat rate of 10,355 BTU/KWH (33% efficiency) are assumed.

\(^2\) In 1999, peak month generation was nearly double the monthly average for the year and about 4 times the lowest month.
RECLAIM PRICES, THE ELECTRICITY MARKET AND GAS SUPPLIES

The extreme levels of RECLAIM prices have been accompanied by exceptionally high prices for electricity as well and the question arises to what extent the high price of one is contributing to the high price of the other.

In normal market conditions, costs of production would determine the price of electricity. Certainly the high cost of natural gas to power generators would be a contributing factor, as would the costs of compliance with clean air regulations. However, these are not normal market conditions. Rising demand for electricity and loss of supply from hydro-electric sources has meant intensified competition for available supply from local fossil-fuel generators and sharply higher prices to clear the market. With intense competition for supply setting the electricity price, generators have had room to bid up prices for additional RECLAIM allowances to far above historic levels and also to pay the exceptionally high prices for gas. In effect, at least until recently, overheated electricity market conditions have supported the extreme RECLAIM prices rather than the other way around.

Price prospects for the immediate future depend on the interplay between gas supplies, hydropower availability, demand for electricity, and possible political intervention. Right now, there is no sign of early improvement in availability of hydropower, indicating this source of upward pressure on local fossil fuel power requirements, and therefore on RECLAIM prices, will continue. On the other hand, near-term gas supply prospects for the power sector are limited given very low levels of storage and high West Coast seasonal heating requirements. Should limits on gas supply availability translate into reduced local power generation capability, the need for RECLAIM credits would be moderated. Such a development would keep upward pressure on electricity prices but not RECLAIM credit prices.

Under the RECLAIM program as it now stands, allocations are scheduled to decline in the next year (beginning July 1, 2001) by about another 10%. If fossil fuel power production remains high, without an improbably large, immediate decline in emissions rates, competition for the reduced supply of credits would intensify, raising prospects of extreme prices as high, or even higher, than seen this year. The question then becomes what political actions might be taken to ease this situation, especially since in this case, scarcity of available credits would be a highly visible limitation on electricity supplies and contributor to higher electricity prices. RECLAIM prices have already soared far beyond the $15,000/ton level at which regulators are supposed to consider the possibility of intervention. The authorities could, for example, consider allowing some form of “borrowing” of future credits to be paid back with some penalty after enough time has elapsed to permit installation of new rounds of SCR technology. The same effect could be achieved if additional RECLAIM allowances were offered to the market with provision for a buy-back in the future. Such an approach would be similar to the actions of a central bank providing temporary liquidity to stabilize a troubled financial market.

Ultimately, the growing likelihood of some form of political action to avoid constraining local power production should keep near-term RECLAIM prices below the extreme levels reached this summer, although well above even very high long-term costs of compliance.